

UNITED STATES AIR FORCE
INSTALLATION RESTORATION PROGRAM

FINAL

**Second Five-Year Review Report for Area D/
American Lake Garden Tract
McChord Air Force Base, Washington**



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March 2005

Lead Agency Acceptance
Second Five-Year Review
McChord Air Force Base—Area D/ALGT NPL Site

This signature sheet documents the United States Air Force acceptance of the second Five-Year Review for the Area D/ALGT NPL Site at McChord Air Force Base.



ROWAYNE A. SCHATZ, JR., Colonel, USAF
Commander, 62d Airlift Wing

22 MAR 2005

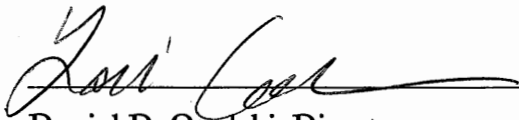
Date

Support Agency Acceptance

Second Five-Year Review

McChord Air Force Base—Area D/ALGT NPL Site

This signature sheet documents the United States Environmental Protection Agency acceptance of the second Five-Year Review for the Area D/ALGT NPL Site at McChord Air Force Base.



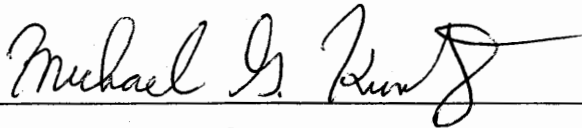
Daniel D. Opalski, Director
Environmental Cleanup Office
Region X
U.S. Environmental Protection Agency

4/7/05

Date

**Support Agency Acceptance
Second Five-Year Review
McChord Air Force Base—Area D/ALGT NPL Site**

This signature sheet documents the Washington State Department of Ecology acceptance of the second Five-Year Review for the Area D/ALGT NPL Site at McChord Air Force Base.



Michael Kuntz P.G., P.HG
Toxics Cleanup Program
Washington State Department of Ecology

4-7-05

Date

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LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
Air Force	U.S. Air Force
ALGT	American Lake Garden Tract
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ft/day	foot per day
GAC	granular activated carbon
gpm	gallons per minute
IRP	Installation Restoration Program
µg/L	micrograms per liter
MCL	Maximum Contaminant Level
MTCA	Model Toxics Control Act
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operations and Maintenance
RAO	Remedial Action Objective
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
TCE	trichloroethene
URSG	URS Greiner Woodward Clyde
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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 the Area D/American Lake Garden Tract (ALGT) National Priorities List site at McChord Air Force Base, Washington. The remedy selected by the ROD is groundwater extraction and treatment to eliminate or reduce the risks posed by the site to levels that are protective of human health and the environment. This is the second Five-Year Review for the Area D/ALGT site. The trigger for this review was the signing of the first Five-Year Review report on March 29, 2000.

The Five-Year Review Summary Form on the following pages presents the issues that were identified during the review, provides associated recommendations and follow-up actions, and includes a protectiveness statement.

The assessment of this Five-Year Review found that the pump-and-treat system has operated as designed since the first Five-Year Review and continues to accomplish static plume containment, but without measurable reduction in contaminant concentrations within the current plume boundaries. The historical known extent of the plume lies entirely within base property; therefore, remediation goals for groundwater have been attained offbase in the ALGT. Although contaminant concentrations in the current plume boundary are not diminishing, institutional controls are in-place to eliminate current risk pathways onbase.

While the remedy implemented at Area D/ALGT is protective offbase, and exposure pathways have been controlled effectively until remediation goals are achieved onbase, the absence of reduction of contaminant concentrations within the current plume boundaries suggests that the pump-and-treat system operation may not achieve the remediation goals throughout the plume within a reasonable timeframe (estimated at 50 years in the ROD). An Optimization Study should be completed to evaluate potential alternatives that address the lack of significant contaminant concentration reduction within the current plume boundary and to evaluate the need for containment of groundwater that is already below the remediation goals in the northern portion of the site, near extraction well DX-2, as well as determine the long-term protectiveness of each remedy. Recommended changes to the remedy would be presented in a Proposed Plan and followed by a ROD amendment or in an Explanation of Significant Differences (ESD) to the existing ROD.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: AMERICAN LAKE GARDEN/MCCHORD AFB		
EPA ID: WAD980833065		
Region: 10	State: WA	City/County: Tacoma, Pierce County
SITE STATUS		
NPL status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify)		
Remediation status Operating		
Multiple OUs?* No	Construction completion date: 9/29/1994	
Has site been put into reuse? Golf course remains in use; shallow aquifer use restricted		
REVIEW STATUS		
Lead agency: U.S. Air Force		
Author name: Brenda Zehr		
Author title: Restoration Chief, Environmental Management Flight	Author affiliation: McChord AFB 62 CES/CEV	
Review period:** 3/29/2000 to 3/29/2005		
Date(s) of site inspection: On-going inspections by operators		
Type of review:		
<input checked="" type="checkbox"/> Post-SARA <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> NPL State/Tribe-lead <input type="checkbox"/> Regional Discretion		
Review number: 2 (second)		
Triggering action:		
<input type="checkbox"/> Actual RA Onsite Construction at OU # _____	<input type="checkbox"/> Actual RA Start at OU# _____	
<input type="checkbox"/> Construction Completion	<input checked="" type="checkbox"/> Previous Five-Year Review Report	
<input type="checkbox"/> Other (specify)		
Triggering action date: 3/29/2000		
Due date: 3/29/2005		

* ["OU" refers to operable unit.]

Five-Year Review Summary Form, cont'd.

Issues:

Although the initial groundwater plume has been reduced in area by approximately 50 percent, significant reduction of contaminant concentrations within the current plume boundary is not being accomplished by operation of the pump-and-treat system.

Further reduction of the plume boundary since the first Five-Year Review has not occurred, potentially reducing the long-term protectiveness of the remedy.

The chemical 1,4-dioxane has recently (since the last Five-Year Review) been associated with VOC plumes; however, the presence of 1,4-dioxane at McChord Area D/ALGT is unknown.

Recommendations and Follow-up Actions:

An Optimization Study should be undertaken to evaluate potential alternatives to address the lack of significant contaminant concentration reduction within the current plume boundary and to evaluate the need for containment of the groundwater plume that is already below remediation goals in the northern portion of the site, near extraction well DX-2. The Optimization Study should re-evaluate the goals of the pump-and-treat system and recommend appropriate changes. Remedial technologies developed since completion of the Feasibility Study may be considered in the Optimization Study.

Recommended changes to the remedy should be presented in a Proposed Plan that is followed by a ROD amendment or in an ESD.

The EPA recommends that the Air Force determine if 1,4-dioxane is present in the TCE groundwater plume at Area D/ALGT.

Protectiveness Statement(s):

The remedy at Area D/ALGT is thought to be currently protective of human health and the environment because there are no complete exposure pathways within the boundaries of the TCE plume. If 1,4-dioxane was found in the groundwater offbase in ALGT at concentrations above regulatory standards (currently the MTCA cleanup level of 7.95 µg/L), then the remedy would not be currently protective. Institutional controls exist that eliminate current exposure pathways and prevent the potential for completing future exposure pathways onbase.

Long-term Protectiveness:

Long-term protectiveness of the remedial action will be verified by groundwater monitoring to confirm that the TCE plume exceeding remediation goals remains onbase and that the contaminant concentrations within the plume boundary reduce over time. Institutional controls exist to prevent the completion of potential exposure pathways onbase. An evaluation of alternatives or enhancements to the remedial action is recommended to identify whether reduction of contaminant concentrations within the plume can be accelerated and whether further reduction of the plume extent is possible with the current remedy.

Other Comments:

None.

I. Introduction

The U.S. Air Force (Air Force) prepared this Five-Year Review report for the Area D/American Lake Garden Tract (ALGT) site at McChord Air Force Base (AFB), Washington, pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). Area D/ALGT is the first of two operable units placed on the National Priorities List (NPL) at McChord AFB and currently is on the Final NPL (U.S. Environmental Protection Agency [EPA] ID# WAD980833065). A second, previously listed site at McChord AFB—the Washrack/Treatment Area—was delisted from the NPL on September 26, 1996, and is addressed in a separate Five-Year Review report. Groundwater contamination at the Area D/ALGT site is being addressed through federal actions. The Air Force is the lead agency for cleanup of Area D/ALGT, and the Washington State Department of Ecology (Ecology) is the lead regulatory agency, with the EPA as the secondary regulatory agency.

McChord AFB conducted this Five-Year Review of the remedial actions implemented at Area D/ALGT based on data collected through December 2004. The triggering action for the review was the completion date of the previous Five-Year Review, identified as March 29, 2000, in EPA's WasteLAN database. Tetra Tech FW, Inc. (formerly Foster Wheeler Environmental Corporation) supported McChord AFB in this review through their contract with the Air Force Center for Environmental Excellence (AFCEE). The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment, and includes identification of any issues with the remedy and recommendations to address them.

This is the second Five-Year Review conducted for the Area D/ALGT site. The first Five-Year Review, completed in March 2000, concluded that the remedy was protective of human health and the environment (U.S. Air Force 2000). Both Ecology and EPA concurred with this assessment. The review was initiated because contaminant concentrations in groundwater at the site exceed levels that would allow unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy at the site is protective of human health and the environment and whether the remedy remains the most appropriate action for the site.

II. Site Chronology

Table 1 provides a summary of events for the Area D/ALGT site.

Table 1. Chronology of Site Events for Area D/ALGT

Event	Date
Disposal activities at the site	mid-1940s to early 1970s
Department of Defense Installation Restoration Program (IRP) initiated at McChord AFB	1981
IRP Phase I—Records search	1982
IRP Phase II—Site investigation	1983
Discovery/Preliminary Assessment	1983
Proposal to EPA NPL	1983
Final listing on EPA NPL	1984
Interim remedial activities—bottled water provided to private residences	1984–1986
Residences located within 5-micrograms per liter (µg/L) contour of the trichloroethene (TCE) plume connected to the public water system	1986
Remedial Investigation/Feasibility Study (RI/FS) negotiations completed	1988
Federal Facilities Agreement between Air Force, EPA, and Ecology finalized	1989
Human Health Risk Assessment finalized	1990
Ecological Risk Assessment finalized	1991
RI/FS finalized	1991
Proposed Plan identifying EPA's preferred remedy presented to public; start of public comment period	1991
Record of Decision (ROD) selecting the remedy signed	1991
Remedial Design completed	1992
Began on-site construction of groundwater containment and treatment system	1993
Completed connection of residents in ALGT to the public water system	1993
Containment system startup	1994
Operations and Maintenance (O&M) Plan approved by EPA	1994
Completed on-site construction of groundwater containment and treatment system	1994
Extraction well DX-1 shut down due to low concentrations in aquifer	1999
First Five-Year Review completed	2000
Extraction well DX-2 shut down due to low concentrations in aquifer	2003
Extraction well DX-2 pump replaced and returned to service due to resource protection well slightly above remediation goal	2004

III. Background

Physical Characteristics

Area D/ALGT is located approximately 7 miles south of downtown Tacoma in central Pierce County, Washington. Geographical features that roughly bound the site include Interstate 5 to the northwest, Porter Hills and McChord AFB ammunition storage area to the north, Burlington Northern Railroad and "A" Street to the east, Wescott Hills and Fort Lewis Logistic Center to the south, and ALGT to the southwest (Figure 1). Area D lies in the southwestern portion of McChord AFB, where several disposal areas were operated at various times from the mid-1940s to the early 1970s. The Whispering Firs Golf Course (and driving range) now overlies several of the former Area D disposal areas. McChord AFB also contains a large residential area in the southwestern portion of Area D. Immediately southwest of Area D lies the offbase residential housing of the ALGT.

Glacial sedimentary deposits that underlie Area D/ALGT consist of permeable sand and gravel outwash materials separated by till layers and interspersed non-glacial units. The Vashon Drift is the geologic unit exposed at the surface and consists of gravel, recessional outwash, till, and advance outwash units, as well as lacustrine silt. The uppermost hydrogeologic unit within the Vashon Drift hosts the shallow, unconfined aquifer within outwash sand and gravel. The unconfined aquifer extends from approximately 20 feet below ground surface (bgs) to a depth between 80 and 160 feet bgs. Two drumlins (Wescott and Porter Hills) influence the flow of groundwater within the unconfined aquifer at Area D/ALGT; groundwater flows generally in an arc from the east to southwest or west-northwest at an approximate mean rate of 0.4 feet per day (ft/day), with seasonal variations.

Land and Resource Use

Area D, which lies in the southwestern portion of McChord AFB, was the site of several disposal areas that operated at various times from the mid-1940s to the early 1970s. A base golf course and driving range now occupy the area and overlie former landfills that were part of the Area D disposal areas. The southwestern portion of Area D also contains a large onbase residential area that was expanded in 1998 and now houses approximately 3,500 residents. Area D residential area changes scheduled to begin in 2005 include the demolition of 891 housing units with replacement by 283 units in the same location. ALGT is an offbase residential tract abutting the southwestern boundary of Area D that lies between McChord AFB, Fort Lewis Logistic Center, and Interstate 5. This tract consists of 1,183 housing units with approximately 3,400 residents.

Onbase and offbase water supplies are not threatened because groundwater is withdrawn from deeper sources located away from Area D/ALGT. McChord AFB withdraws drinking water from deeper aquifers and has no extraction wells in the shallow, unconfined aquifer. The offbase residential area had drinking water wells installed in the shallow aquifer at the time of discovery. Subsequently, the residential area was connected to the Lakewood Water District Water Supply System that derives drinking water from a source away from the site, as described below under Initial Response.

In 1998 McChord AFB expanded its southwestern boundary in the vicinity of Area D/ALGT. This adjustment added 23.15 acres to base property, as indicated by the positions of the former and current base boundaries (Figure 1). As a result of the property acquisition, the furthest documented downgradient extent of the TCE groundwater plume at 5 µg/L or greater and cis-1,2-dichloroethene (cis-1,2-DCE) groundwater plume at 70 µg/L or greater are contained entirely within the McChord AFB boundary. Figures 2 and 3 show the current base boundary and the historical and current plume extents for TCE and cis-1,2-DCE.

History of Contamination

Table 1 provides a summary of completion dates for enforcement and cleanup actions for Area D/ALGT. The Department of Defense IRP was initiated at McChord AFB in March 1981. The Phase I Records Search (CH2M HILL 1982) identified seven past and current potential waste disposal sites. The follow-up Phase II investigation reported low-level organic contamination at several of these sites within Area D and recommended further studies to confirm contaminant characteristics and distribution. In 1983, a resident living near the base boundary contacted EPA about family health problems believed to have been caused by drinking contaminated water. Concurrent with the Phase II IRP investigation, EPA and the Tacoma-Pierce County Health Department sampled nearby drinking water wells and found elevated metals concentrations and volatile organic compounds (VOCs), including TCE and cis-1,2-DCE. In 1984, EPA concluded that Area D of McChord AFB in the vicinity of former Landfill 5 was the likely source of groundwater contamination in Area D/ALGT. Seven former sites within Area D subsequently were included in the NPL listing of the Area D/ALGT site: Landfill 4, Landfill 5, Landfill 6, Landfill 7, Ordnance Disposal Area 26, Radioactive Disposal Well 35, and Old Burn Trench 39. Listing of the site initiated the CERCLA RI/FS process.

Groundwater characterization identified a low-concentration contaminant plume (TCE < 85 µg/L) in the shallow aquifer that originated in Area D. The contaminant plume as defined by detectable concentrations of VOCs has extended up to approximately 3,500 feet downgradient of an old landfill (Site LF-05) into or near the northeast corner of the former offbase ALGT boundary. In addition to the consistent presence of TCE and cis-1,2-DCE in the plume, occasional trace detections of vinyl chloride and 1,1-DCE have occurred. Hydrogeologic complexities in the shallow aquifer have created a bifurcation in downgradient groundwater flow directions, largely influenced by the presence of glacial drumlins of Wescott and Porter Hills, that appears to have formed southwestern-trending and western-trending segments of the contaminant plume (see plume shapes on Figures 2 and 3). No occupied buildings overlie the historical extent of groundwater contaminants that exceed the remediation goals.

The RI documented that concentrations of TCE and cis-1,2-DCE in groundwater diminish with distance of transport, principally due to dispersion and dilution (Ebasco 1991a). An evaluation of biodegradation by URS Greiner Woodward Clyde (URSG) and Foster Wheeler Environmental Corporation (1998a) and current review of monitoring results show that some degradation by dehalogenation occurs, albeit at slow rates. Some evidence of the slow degradation includes an increase with transport distance in the ratio of daughter product to parent product for cis-1,2-DCE and TCE and the occasional detection mid-plume of trace amounts of vinyl chloride (daughter product to cis-1,2-DCE).

Monitoring conducted between February 1989 (initiation of RI sampling) and November 1993 (last sampling event prior to system startup in February 1994) does not provide evidence that the TCE groundwater plume was migrating. Pre-remedial action concentrations for wells nearest LF-05 (DA-7b and DA-21b), wells located mid-gradient within the plume (DA-29 and DB-6), and wells at the fringe of the plume (DA-28 and EPA-W-5) are presented on Table 2. As shown, concentrations in these representative wells remained fairly consistent over the 5-year period prior to system startup, with no apparent trend toward increasing concentrations up to the point of implementation of the pump-and-treat system. In addition, mean concentrations for the wells since the first Five-Year Review do not show a marked decrease during the 11 years of system operation.

Table 2. Pre-Remedy TCE Concentrations in Representative Site Wells

Location	Well ID	RI							Post-RI/Pre-RA			Prior 5 Years
		2/89	5/89	8/89	11/89	3/90	6/90	9/90	1/92	7/93	11/93	Mean
Nearest LF-05	DA-7b	--	82	76	62	88	--	--	96	58	74	72
	DA-21b	--	--	--	57	62	80	46.5	62	56	45	40
Mid-gradient	DA-29	--	--	--	--	--	--	--	--	17	14	12
	DB-6	--	19	18	7	4.5	--	--	22	20	13	6.6
Plume fringe	DA-28	--	--	--	--	--	--	--	--	1	0.92	0.39
	EPA-W-5	0.23	0.28	1	0.59	--	--	--	0.1	0.6	0.26	0.46

Initial Response

A Memorandum of Agreement was signed in September 1985 between the Air Force, EPA, Ecology, Washington Department of Social and Health Service, and the Tacoma-Pierce County Health Department that required the installation of a permanent alternative water supply for the ALGT. The Air Force subsequently provided bottled water to residents in the ALGT affected by well contamination. By mid-1986 the residents within the 5- $\mu\text{g}/\text{L}$ contour of the TCE plume were connected to the public water system, replacing the need for bottled water. As a follow-on action in 1992, the Air Force offered free hookups to all property owners in the ALGT, and those owners that accepted the offer were connected by June 1993.

Basis for Taking Action

The RI (Ebasco 1991a) characterized the nature and extent of contamination in groundwater, soil, surface water, and sediments. The Human Health Risk Assessment and the Ecological Risk Assessment (summarized in Ebasco 1991a) evaluated potential effects of the contamination on human health and the environment. The FS (Ebasco 1991b) evaluated alternatives for remediation of the contamination.

Groundwater monitoring results reported in the RI showed that concentrations of TCE exceeding the Maximum Contaminant Level (MCL) of 5 $\mu\text{g}/\text{L}$ were present in a groundwater plume roughly 3,000 feet in length (see historical plume contour on Figure 2). A similar plume extent was identified for cis-1,2-DCE, a daughter product of TCE (Figure 3). The baseline Human Health Risk Assessment (Ebasco 1991a) determined that unacceptable risks exist for groundwater ingestion and groundwater inhalation by onbase residents and offbase residents and groundwater ingestion by long-term workers based on maximum detected contaminant concentrations. The unacceptable risks for groundwater ingestion have been mitigated by prohibiting usage of the contaminated water

as a drinking water source. Recent modeling for evaluation of inhalation risks associated with a higher concentration TCE plume at McChord AFB yielded vapor concentrations below MTCA regulatory limits. Landfill 5 in Area D was identified as the source of the groundwater contamination, although source concentrations in soil were not identified. As no unacceptable human or ecological risk was identified for soil, surface water, or sediment (Ebasco 1991a), the ROD determined a need only for a remedial action for groundwater (EPA et al. 1991). The other six sites that comprise the Area D/ALGT NPL site were determined to pose no unacceptable risk to human health or the environment.

IV. Remedial Actions

Remedy Selection

The selected remedial action alternative stated in the ROD (EPA et al. 1991) included connection of ALGT residents to a public water system and the extraction and treatment of groundwater in a long-term effort to remediate the drinking water aquifer. As determined in the ROD, only the contaminant plume associated with Landfill 5 required remedial action for Area D/ALGT. Furthermore, the ROD also determined that no remedial action was necessary for soil, surface water, or sediment. The remedial action selected by the ROD specifies restoration of groundwater to its beneficial use as a drinking water source.

The ROD opted for a pump-and-treat remedial action with installation of three groundwater extraction systems (designed and installed as one well per system) “to create a hydrologic barrier to prevent further offbase migration of contaminants above the MCLs and to treat the most contaminated groundwater beneath the Area D site,” with the expectation that the action would “remediate the contaminated plume off-site and on-site” (EPA et al. 1991). The engineered remedial action consists of three extraction wells; one well installed along the former western boundary of McChord AFB (well DX-1); one well installed in the northern portion of the contaminant plume (well DX-2); one well installed near Site LF-05 (well DX-3), a treatment plant to treat extracted groundwater, and two recharge trenches to infiltrate treated water downgradient of the TCE plume (Figure 4), as presented in the final Remedial Design (USACE 1992). Other components of the remedy include: 1) long-term monitoring to confirm system performance and plume stability or reduction, 2) connection of ALGT households to the public water supply, and 3) establishment of institutional controls that restrict the use of contaminated groundwater within Area D/ALGT to non-potable applications. The treatment plant removes dissolved VOCs by passing water through two granular activated carbon (GAC) vessels. Monitoring is conducted for groundwater wells, treatment plant influent, and treatment plant effluent. The system started operation on February 15, 1994.

The ROD specifies one Remedial Action Objective (RAO) for Area D/ALGT to “restore groundwater to its beneficial use, a drinking water source.” Remediation goals listed in Table 16 of the ROD for individual compounds in groundwater are summarized in Table 3. The standards for TCE and cis-1,2-DCE have remained the same since 1991. EPA downgraded the carcinogenicity for 1,1-DCE in 2002 which results in a higher Model Toxics Control Act (MTCA) Method B value such that the appropriate basis is now the MCL of 7 µg/L. In addition, the MTCA Method B value for vinyl chloride was updated in 2001 to 0.03 µg/L.

Table 3. Groundwater Remediation Goals in ROD for Area D/ALGT

Compound of Concern	Groundwater Remediation Goal in µg/L ¹	Basis of Remediation Goal ²
TCE	5	MCL
cis-1,2-DCE	70	MCL
1,1-DCE	0.07	MTCA Method B ³
Vinyl chloride	0.04	MTCA Method B ³

¹Treatment plant effluent must meet the groundwater remediation goals, as well as meet the pH range of 6.5 to 8.5.
²Determination of remediation goals is presented in the ROD (EPA et al. 1991).
³Ecology MTCA Method B cleanup level for groundwater in 1991.

Remedy Implementation

The Air Force provided connections to the Lakewood Water District Water Supply System for households within the plume extent by 1986 and completed additional connections by June 1993 for ALGT households that accepted the Air Force's offer of free connections. The Remedial Design of the groundwater pump-and-treat system was begun on November 18, 1991, and completed on November 13, 1992 (USACE 1992). The Air Force began construction of the system on April 14, 1993, and the extraction wells and treatment system started operation on February 15, 1994. All construction was determined to be complete on September 29, 1994. One non-potable production well completed in the shallow aquifer [Golf Course Well 3 (#889)] remains on standby and is slated to be decommissioned during CY 2005. The pump-and-treat system has been operating since 1994. Reduction in concentrations within the groundwater plume has allowed two of the three extraction wells (DX-1 and DX-2) to be placed on a standby "non-pumping status," although one (DX-2) was recently returned to service. Plume contaminant concentrations were sufficiently low in the vicinity of the furthest downgradient pumping well, DX-1, for the well to be turned off on December 14, 1999. Similarly, low contaminant concentrations for the central portion of the plume allowed the central pumping well, DX-2, to be turned off on February 18, 2003. Well DX-3—the pumping well closest to Site LF-05—remained as the sole operating extraction well during the remainder of 2003 until DX-2 was restarted on December 31, 2003, at the request of Ecology. To compensate in part for cessation of other wells, the extraction rate for DX-3 was increased first in February 2003 from 75 to 80 gallons per minute (gpm), and then again in October 2003 to 100 gpm to increase the capture zone width.

Since the start of operations in February 1994 through December 2004, the Area D/ALGT pump-and-treat system has achieved the following (Tetra Tech FW, Inc. 2005):

- Approximately 658 million gallons of groundwater withdrawn, treated by GAC, and recharged
- Approximately 26 kilograms TCE removed (equivalent to 57 pounds or 4.7 gallons) currently estimated at removal of approximately 14 percent of the total amount of TCE available
- Approximately 59 kilograms cis-1,2-DCE removed (equivalent to 130 pounds or 12.1 gallons) currently estimated at removal of approximately 40 percent of the total amount of cis-1,2-DCE available

- Approximately \$5 million spent on remedial action (see operations and maintenance [O&M] discussion below).

In the 11 years of pump-and-treat system operation and approximately 15 years since completion of the RI, changes have occurred in the plume configuration and extent relative to the McChord AFB boundary. The following conditions describe the current Area D/ALGT groundwater contaminant plume (as discussed in the Data Review of Section VI):

- Reduction has occurred in the length of the TCE plume as delineated by the 5- $\mu\text{g/L}$ contour. The length of the southwestern segment has decreased from roughly 3,000 feet in 1991 to roughly 1,400 feet in 2004.
- TCE and cis-1,2-DCE have maintained essentially constant concentrations over time in the resource protection wells within the current plume boundary and/or closest to Site LF-05 (wells DA-7b, DA-9b, DA-21b, DA-29, DB-6).
- With adjustment of the McChord AFB boundary to the southwest by land acquisition, the historical greatest extent of the TCE and cis-1,2-DCE plumes above MCLs (5- $\mu\text{g/L}$ contour for TCE, 70- $\mu\text{g/L}$ contour for cis-1,2-DCE) lie entirely within the base boundary (Figures 2 and 3)
- Groundwater extraction has reduced the current areal extent of the TCE plume; however, data collected between May 1989 and November 1993 (prior to system startup in February 1994) provide evidence that the groundwater plume had likely reached a steady state equilibrium, and would not migrate beyond the McChord AFB boundary in the absence of active containment.
- No current exposure pathways exist for Area D/ALGT groundwater contaminants.

These plume characteristics are consistent with findings of the RI, which concluded that the Area D/ALGT plume was stable (i.e., not expanding downgradient) as a result of a static source and natural processes that decreased concentration with transport distance. While operation of the pump-and-treat system apparently has reduced the extent of groundwater containing contaminants exceeding MCLs, the remedial action has not been necessary for preventing offbase migration of contaminants above MCLs. Furthermore, operation of the pump-and-treat system does not appear to be reducing contaminant concentrations within the current plume boundary.

Institutional controls (ICs) for Area D/ALGT are specified in the Base Comprehensive Plan (BCP) (McChord AFB, 2001 and the most current update, in progress). The existing ICs minimize the potential for completing exposure pathways and ensure human health and the environment are not threatened. ICs specific to the Area D/ALGT include:

1. Listing and plan view maps showing the Area D/ALGT as an IRP site.
2. Designated land use at the Area D/ALGT for the source area and groundwater plume is for open space/recreation (i.e., golf course).

3. Restriction of land development within the Area D/ALGT that stipulates no new development within the plume boundary until remediation is complete, whereby all proposed projects are subject to review and approval by Environmental Management Flight Staff.
4. Restriction of groundwater usage from the shallow water table aquifer at the Area D/ALGT for non-potable purposes only. All base potable water is obtained from deeper aquifers that are not within the site boundary.
5. Offbase institutional controls administered by the Pierce County Department of Health includes the Pierce County Washington Comprehensive Plan at 19A.90.070(A)(1)(4) prohibiting construction of new individual domestic wells in Urban Growth Areas when properties are within 600 feet of a public water system main. Potable water from the Lakewood Water District is available throughout the ALGT.

The Air Force also has administrative procedures that require project approval for projects requiring construction, subsurface soil disturbance, or changes in land use. Air Force Instructions and procedures require coordination with and prior approval be obtained from Environmental Management Flight if a proposed project is located on or near an IRP site.

The Air Force details Area D/ALGT site conditions and sampling results in both quarterly technical information and annual reports. These reports are submitted to Ecology and are available to the public for review and comment.

The current base contact for ICs for the Area D/ALGT is Brenda Zehr, Restoration Chief, Environmental Management Flight, 62 CES/CEV, 253-982-6202 (or her designee).

System Operations/Operations and Maintenance

The Area D/ALGT pump-and-treat system has run consistently since startup in February 1994. Operations follow the final Operation and Maintenance Plan (USACE 1994a) and final Remedial Action Work Plan (USACE 1994b), with updated procedures provided in yearly Quality Project Plans for the Groundwater Treatment Plant Monitoring and Optimization Program (latest version, Tetra Tech FW, Inc. 2004). Table 4 identifies groundwater extraction and treatment rates and cumulative extraction volumes for the 11 years of operation. Combined extraction rates for the system have varied between 105 and 136 gpm over the 10 years of operation compared to the maximum design rate of 140 gpm. This table reflects placement of wells DX-1 and DX-2 on standby in December 1999 and February 2003, respectively. A cumulative total of approximately 658 million gallons have been extracted for treatment over an 11-year period of near-continuous operation (Figures 5 and 6). Individual extraction well rates are shown on Figure 7. GAC treatment has removed contaminants effectively, as shown by concentration differences for TCE and cis-1,2-DCE treatment plant influent and effluent on Figures 5 and 6 (Figure 5 depicts method detection limits for TCE, as no detections have been reported in effluent), and six carbon changeouts have been required thus far in the 11 years of operation.

The following describes operational changes since the first Five-Year Review:

- Well DX-1 was placed on standby on December 14, 1999, because the groundwater quality of the extraction well and nearby monitoring wells met the remediation goals identified in

Table 3 in the vicinity of the well. Concentrations of TCE in well DX-1 since the first Five-Year Review have remained below remediation goals. Placement of well DX-1 on standby was accompanied by additional groundwater monitoring to confirm groundwater quality.

- Well DX-2 was placed on standby on February 18, 2003, because groundwater quality of the extraction well and nearby monitoring wells met the remediation goals identified in Table 3 in the vicinity of the well. Concentrations of TCE in well DX-2 since the first Five-Year Review have remained below remediation goals.

Table 4. Summary of Groundwater Extraction/Treatment Flow Rates

Well ID	Design Flow Rate (gpm)	Flow Rate Average ¹ Year 1 (gpm)	Flow Rate Average ¹ Year 2 (gpm)	Flow Rate Average ¹ Year 3 (gpm)	Flow Rate Average ¹ Year 4 (gpm)	Flow Rate Average ¹ Year 5 (gpm)	Flow Rate Average ¹ Year 6 (gpm)	Flow Rate Average ¹ Year 7 (gpm)	Flow Rate Average ¹ Year 8 (gpm)	Flow Rate Average ¹ Year 9 (gpm)	Flow Rate Average ¹ Year 10 (gpm)	Flow Rate Average ¹ Year 11 (gpm)	Cumulative Flow through December 31, 2004 (Mgal)
DX-1	25 ²	19	26	25	24	23	23	0	0	0	0	0	67
DX-2	40 ³	32	36 ⁴	36	37	28	26	26	34	29	1	21	135 ⁵
DX-3	75 ⁶	60	75	66	50	67	66	69	73	75	82	87	391 ⁷
Total ⁸	140	105	136	126	114	111	121	105	118	108	108	115	658

¹Average flow rates in extraction wells are calculated based on nonzero flow-rate measurements.

²DX-1 flow rate was reduced from 25 gpm to 0 gpm on December 18, 1997, and increased from 0 gpm to 25 gpm on March 10, 1998. DX-1 was placed on standby on December 14, 1999.

³DX-2 was placed on standby on February 18, 2003; re-started on December 31, 2003.

⁴The DX-2 flow meter/totalizer showed signs of malfunctioning beginning the first week in June 1995. For the remainder of 1995, DX-2 flow rates and cumulative flows were estimated based on DX-1, DX-3, and influent totalizer readings.

⁵Cumulative flow in DX-2 is based on three different totalizer readings because of equipment failure. The value presented represents the combined total of the final reading of the original totalizer on May 21, 1996; the final reading of a failed transmitter on October 22, 1996; and the December 31, 2001, reading of the currently operating totalizer transmitter.

⁶Design rate lowered from 75 gpm to 50 gpm on September 25, 1996. Design rate increased from 50 gpm to >75 gpm on December 18, 1997.

⁷Cumulative flow in DX-3 is based on two different totalizer readings because of equipment failure. The value presented represents the combined total of the final reading of the original totalizer on June 19, 2001, and the December 31, 2001, reading of the currently operating totalizer transmitter.

⁸Total flows are based on influent point totalizer readings.

- Placement of well DX-2 on standby was accompanied by additional groundwater monitoring to confirm groundwater quality. Subsequently, well DX-2 was returned to service on July 13, 2004 (after replacement of the turbine pump with a submersible pump) in response to Ecology concerns regarding groundwater concentrations of TCE in nearby resource protection well DO-2, which has consistently been between 5 and 6.5 µg/L since system startup.
- The extraction rate for Well DX-3 was increased from 75 gpm to approximately 80 gpm in February 2003 to increase the capture zone. The rate was increased again in October 2003 to approximately 100 gpm. During CY 2004, well DX-3 was set to pump at a maximum of 100 gpm, as long as the water table elevation was sustainable above the critical shutoff level. The geometric mean concentration of TCE for well DX-3 since the first Five-Year Review is approximately 12 µg/L. There is no apparent trend in increasing or decreasing concentrations in well DX-3 during the previous five years.

Costs for the Area D/ALGT remedy—including design, construction, and operation—total approximately \$5 million to date. Current operations, maintenance, and monitoring costs total roughly \$250,000 per year, and the occasional changeout of GAC every 18 months or so costs about \$20,000 each time. Estimated system costs to date are shown in Table 5.

Considering the mass removed to date, as reported above under Remedy Implementation, the system design, construction, and operation equates to \$96,000 per pound TCE or \$1,200,000 per gallon TCE, as well as \$41,000 per pound cis-1,2-DCE or \$420,000 per gallon cis-1,2-DCE, if considered separately. Conversely, approximately 658 million gallons of contaminated groundwater have been extracted, treated, and returned to the aquifer at the rough cost of 0.8 cents per gallon. Containment also has reduced the areal extent of the plume that exceeds the remediation goals, thereby further increasing potable water.

Table 5. Area D/ALGT System Design, Construction, and Operations/O&M Costs

Activity	Dates		Approximate Cost
	From	To	
Remedial Design	1991	1992	\$1,000,000
Remedial Action Construction	1993	1994	\$1,000,000
Annual Operations/O&M Costs at \$250,000 per year	1994	2004	\$2,750,000
GAC Changeouts—6 at \$20,000 each	1994	2004	\$120,000
Approximate Total Costs (through December 2004)	1991	2004	\$4,870,000

V. Progress Since the Last Five-Year Review

The first Five-Year Review (U.S. Air Force 2000) determined that the selected remedy was protective of human health and the environment. The first Five-Year Review recommended that extraction wells DX-1 and DX-2 be placed on standby because low concentrations of TCE and cis-1,2-DCE had been reported in well discharge and in adjacent portions of the groundwater plume. As described in Section IV, System Operations/Operations & Maintenance, wells DX-1 and DX-2 were placed on standby on December 14, 1999, and February 18, 2003, respectively; however, DX-2 was returned to operation in July 2004 at the request of Ecology. Follow-up actions are listed in Table 6.

In its letter of concurrence with the Five-Year Review (U.S. Air Force 2000, attachment), EPA identified that the Area D/ALGT ROD does not contain all the requirements for institutional controls at operating federal facilities, as established in EPA's "*Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities*" (1999). The Base Comprehensive Plan (U.S. Air Force 2001) was revised in May 2001 and specifies land development processes for base projects. This plan identifies Area D/ALGT and applies the permitting process to prevent inappropriate development of the site.

Table 6. Actions Taken Since the Last Five-Year Review

Recommendations from Previous Review	Party Responsible	Action Taken and Outcome	Date of Action
Place well DX-1 on standby	McChord AFB	DX-1 shut down, monitoring increased	December 1999
Place well DX-2 on standby	McChord AFB	DX-2 shut down, monitoring increased	February 2003
	McChord AFB	Increase DX-3 to 80 gpm for increased capture	February 2003
	McChord AFB	Increase DX-3 to 100 gpm for increased capture	October 2003
Well DX-2 returned to operation	McChord AFB	DX-2 restarted, monitoring decreased	July 2004
Update institutional controls	McChord AFB	The updated Base Comprehensive Plan shows Area D/ALGT as the greatest aerial extent of the contaminant plume and stipulates no development for any IRP site until remediation is completed	May 2001

VI. Five-Year Review Process

Administrative Components

The Area D/ALGT Five-Year Review team was led by Brenda Zehr, Restoration Chief, Environmental Management Flight, McChord AFB 62 CES/CEV. A kickoff teleconference to initiate the Five-Year Review was conducted by Ms. Zehr on December 19, 2003, that included representatives of McChord AFB, EPA, Ecology, and Tetra Tech FW, Inc.

Community Notification and Involvement

The public was notified by newsletter in February 2004 when more than 10,000 copies were mailed. The newsletter stated that the Air Force is re-evaluating the selected remedy of the ROD to determine if the pump-and-treat system is efficiently and effectively reducing the associated risks posed by contaminants at this site. The public will be notified via newspaper advertisement at the completion of the final Five-Year Review report, with copies made available at the public library.

Document Review

This Five-Year Review consists of a review of relevant documents including Annual Reports that contain O&M records and monitoring data (see Data Review below). Applicable groundwater cleanup standards, as listed in the 1991 ROD, were reviewed. Current values for MCLs and MTCA Method B levels listed as remediation goals on Table 3 were checked for changes since issuance of the ROD.

Data Review

The status of Area D/ALGT operations and results of groundwater monitoring are reported each year in the Annual Report (Hart Crowser 1995, 1996; URSG and Foster Wheeler Environmental Corporation 1997, 1998b, 1999, 2000; FPM Group, Ltd. and Foster Wheeler Environmental Corporation 2001; Foster Wheeler Environmental Corporation 2002b, 2003); Tetra Tech FW, Inc. (2004, 2005). Monitoring has demonstrated that groundwater contamination consists of VOCs comprised primarily of TCE and cis-1,2-DCE, as well as trace amounts of 1,1-DCE and vinyl chloride. Therefore, groundwater currently is monitored for VOCs.

Groundwater monitoring results since the last Five-Year Review (2000 through 2004) show near constant values within the current plume boundary (wells DA-7b, DA-9b, DA-21b, DA-29, DB-6) and slowly decreasing values for downgradient resource protection wells. Figures 2 and 3 illustrate the decreased extent of concentrations exceeding remediation goals (5 µg/L for TCE and 70 µg/L for cis-1,2-DCE). The length of the TCE plume with concentrations greater than 5 µg/L has decreased from roughly 3,000 feet at the time of the RI (1991) to roughly 1,400 feet at present (Figure 2, averaged for March and September 2004). Trends over time for wells along the plume centerline are shown for TCE and cis-1,2-DCE on Figures 8 and 9, in which a source location is chosen arbitrarily at 100 feet east of well DA-7b. As seen in Figures 8 and 9, the most significant reductions in concentration since the start of pump-and-treat operations in 1994 have occurred in wells more distant from the source. Of the wells portrayed in Figure 8, those that exceeded the remediation goal for TCE prior to containment (DA-7b, DA21b, and DA-29) still remain higher

than the goal. Figure 9 shows that only well DA-7b remains above the remediation goal for cis-1,2-DCE while well DA-21b has dropped below the goal.

Extraction wells DX-1, DX-2, and DX-3 have decreasing contaminant concentration trends as shown on Figures 10 and 11, which are typical for pump-and-treat systems. TCE concentrations in DX-1 dropped below the remediation goal after 1 year of operation, while TCE concentrations in DX-2 have remained less than the goal throughout the period of operation. TCE concentrations in DX-3 were reduced about 50 percent during the first 3 years of operation, but remain above the TCE remediation goal at levels between 10 and 15 $\mu\text{g/L}$. Only DX-3 began operations above the cis-1,2-DCE remediation goal, but concentrations were quickly reduced to levels well below the goal (Figure 11). Consistent discharge concentrations below the remediation goals led to shutting off well DX-1 in December 1999 and well DX-2 in February 2003. Well DO-2 adjacent to extraction well DX-2 produced monitoring results in 2003 for TCE slightly above the remediation goal of 5 $\mu\text{g/L}$. This result for TCE above the remediation goal led to the restart of well DX-2 on July 13, 2004, in accordance with prior agreement with Ecology. The extraction rate for DX-3 was increased to approximately 80 gpm in February 2003 and then to approximately 100 gpm in October 2003 to increase the capture zone upgradient of DX-2. Increased extraction at DX-3 was shown by discharge monitoring to have increased mass removal for TCE in a linear relationship with the pumping rate increase; however, insufficient time was provided prior to the restart of DX-2 to determine whether the increased capture at DX-3 would reduce concentrations in downgradient wells.

The TCE and cis-1,2-DCE plume was identified as stable in the RI, and the consistent concentrations observed at well DA-7b near the source and consistent to decreasing concentrations in downgradient wells (Figures 8 and 9) support that assessment. Data indicate that operation of the pump-and-treat system has reduced the area of the plume that exceeds the remediation goals, but has not achieved reduction of contaminant concentrations within the current plume boundary.

Site Inspection

Activities and review associated with preparation of the CY 2004 Annual Report served as the site inspection. This review indicates the following conditions:

- Extraction well DX-1 remains on standby.
- The line-shaft turbine pump in extraction well DX-2 has been replaced with a submersible pump (July 2004) capable of achieving/exceeding the initial design flow rate of 40 gpm.
- The line-shaft turbine pump in extraction well DX-3 previously experienced biofouling and was replaced with a submersible pump in May 2000. Replacement of the turbine pump with a submersible pump has resulted in improved operation and increased the maximum discharge rate from 75 gpm to approximately 100 gpm.
- The GAC treatment is operating as designed, and six changeouts in 11 years is a reasonable rate for the technology.
- Recharge trenches operate generally without incident.
- Resource protection wells remain in usable condition.

Interviews

Facts concerning the operation of the treatment plant have been obtained from Tetra Tech FW, Inc. and David T. Johnson Engineers, contractors responsible for operations and maintenance of the Area D/ALGT treatment plant system since 1995.

VII. Technical Assessment

The technical assessment follows EPA guidance (EPA 2001) and answers the following three questions:

- **Question A:** Is the remedy functioning as intended by the decision documents?
- **Question B:** Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?
- **Question C:** Has any other information come to light that could call into question the protectiveness of the remedy?

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

The remedy is intended to eliminate or reduce the risks posed by the site to levels that are protective of human health and the environment. Containment of the plume is being achieved, although it appears that operation of the pump-and-treat system is not needed to contain offbase migration of contaminants exceeding the MCLs. Operation of the pump-and-treat system has resulted in a reduced areal extent of the TCE plume exceeding 5 µg/L; however, no additional reductions in areal extent have been observed since the first Five-Year Review. In addition, there has been no measurable reduction in contaminant concentrations within the current plume boundaries since the first Five-Year Review.

In general, the remedial action is operating and functioning as designed. The system has operated consistently and with few periods of shutdown. Extraction wells have achieved successful containment (capture), and have experienced relatively minor biofouling (Tetra Tech FW, Inc. 2005). GAC treatment has met effluent requirements with a reasonable rate of carbon changeouts (6 in 11 years). Reinfiltration of treated water in the recharge trenches has operated successfully. Furthermore, low concentrations of contaminants in the shallow aquifer adjacent to extraction well DX-1 have allowed cessation of pumping that has been replaced by increased monitoring. DX-2 was also shut down throughout most of 2003 as a result of low VOC concentrations detected at nearby wells, but has been restarted for the interim at the request of Ecology. TCE concentrations at one monitoring well nearby to DX-2 exceeded 5 µg/L (up to 6.5 µg/L) and Ecology expressed the concern that drinking water standards must be met or controlled throughout the plume in order to maintain regulatory consistency with the ROD. The ROD states that “The goal of this remedial action is to restore groundwater to its beneficial use, which is, at this site, a potential drinking water source by attaining drinking water standards throughout the groundwater aquifer” and that the plume will be monitored “to ensure that groundwater remediation goals are achieved and maintained throughout the contaminant plume.”

The long record of monitoring demonstrates that no contaminants in the groundwater plume exceeding the MCLs have migrated beyond the base boundary. The historical and current extents of TCE and cis-1,2-DCE concentrations exceeding the MCLs are confined to McChord AFB property, even without the enhanced containment provided by the pump-and-treat system. Data presented in Table 2 provide evidence that the plume dimensions and contaminant concentrations had likely

reached a steady state equilibrium prior to system startup. Furthermore, extraction of groundwater and removal of contaminants is expensive on a mass-removal basis due to low plume concentrations (approximately \$96,000 per pound or \$1,200,000 per gallon TCE), although treated groundwater has returned approximately 658 million gallons of potable water to the aquifer at less than 0.8 cents per gallon and containment has reduced the plume area that exceeds remediation goals.

The monitoring record also demonstrates that operation of the pump-and-treat system has not reduced source concentrations to date. The record at well DA-7b during 11 years of consistent system operation shows constant concentrations of TCE and cis-1,2-DCE (Figures 8 and 9). Persistence of TCE and cis-1,2-DCE concentrations indicates that the pump-and-treat system has not significantly affected the source of the low-concentration plume. This finding is consistent with results at many sites that indicate applying only pump-and-treat remediation technology may fail to achieve groundwater restoration within a reasonable timeframe (EPA 1996). Implementation of either a supplemental or alternative remedy may be appropriate for achieving faster source reduction.

Institutional controls (control of land use and control of withdrawal of shallow groundwater) continue to effectively prevent human exposure to groundwater contamination by eliminating potential exposure pathways.

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

Groundwater standards identified as remediation goals (Table 3) were reviewed for changes since issuance of the ROD in 1991. MCLs for the two principal contaminants of the Area D groundwater plume—TCE and cis-1,2-DCE—have remained unchanged at 5 µg/L and 70 µg/L, respectively. EPA downgraded the carcinogenicity for 1,1-DCE on its Integrated Risk Information System (IRIS) in 2002, thereby increasing the calculated MTCA Method B cleanup level for 1,1-DCE above the MCL of 7 µg/L; therefore, the MCL now is the appropriate basis for the remediation goal (Table 7). Furthermore, the criterion for vinyl chloride has changed from 0.04 to 0.03 µg/L (Table 7). This review recommends changing remediation goals identified in Table 3 to values shown in Table 7. At the higher value of 7 µg/L, the groundwater monitoring record shows that the revised remediation goal for 1,1-DCE would be satisfied throughout Area D/ALGT (no detections reported above the laboratory practical quantitation limits of between 0.2 and 1.3 µg/L).

McChord AFB acquired 23.15 acres in 1998 that adjusted the base boundary in the area of Area D/ALGT, as shown on Figure 1. With this change, the historical extent of groundwater contamination above MCLs lies entirely within McChord AFB property. Therefore, groundwater contamination at unacceptable risks has not reached offbase residential areas, and groundwater quality offbase meets standards for a drinking water source. Nonetheless, McChord AFB previously offered residents in the ALGT connections to the public water supply, and those accepting the offer were connected by June 1993. Under these circumstances, no reasonable human health exposure pathway exists for offbase residents. Furthermore, no human health exposure pathway exists for onbase residents or long-term onbase workers, who receive water from the McChord AFB water system that draws from deeper aquifers protected from the Area D/ALGT plume. These changes make the remedy more protective than previously considered.

The one RAO for the Area D/ALGT specified in the ROD is to “restore groundwater to its beneficial use, a drinking water source.” Progress is being made toward meeting the RAO of returning the aquifer to meet drinking water standards. In the onbase area, the extent of the groundwater plume within Area D has been reduced, as shown in Figures 2 and 3. In the offbase area, contaminants exceeding drinking water standards have not migrated beyond the base boundary and the RAO has been met. The ROD estimates that the RAO can be met in approximately 50 years; however, current data for the remedy offer no evidence that the source is decreasing at a significant rate.

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

A newly-recognized association of the compound 1,4-dioxane, which may have been mixed with TCE at 1 to 5 percent as a solvent stabilizer, raises the possibility of its presence in groundwater at the Area D/ALGT site. No analysis for 1,4-dioxane has been performed to date, nor is it specified in the ROD for Area D/ALGT. Although EPA has not established an MCL, the MTCA Method B groundwater cleanup level for 1,4-dioxane is 7.95 µg/L. Characteristics of 1,4-dioxane result in high mobility for the compound in groundwater.

Technical Assessment Summary

The remedy implemented at Area D/ALGT is currently considered protective, if influent sampling does not indicate concentrations of 1,4-dioxane above the MTCA Method B cleanup level of 7.95 µg/L. Operation of the pump-and-treat system initially reduced the overall areal extent of the groundwater plume onbase exceeding remediation goals by approximately 50 percent; however, no noticeable further reduction of the plume has been observed since the first Five-Year Review. The absence of reduction of contaminant concentrations within the current plume boundaries also suggests that the current remedy may not achieve the remediation goals throughout the plume within a reasonable timeframe (e.g., 50 years, as stated in the ROD). Current estimates of TCE mass removal indicate that approximately 14 percent of the total amount of TCE available has been removed in 11 years of operation, which also points to a longer remedial timeframe than originally anticipated. New information, understanding, and changed site conditions subsequent to issuance of the ROD in 1991, as enumerated below, may warrant a new evaluation of the selected remedy:

- Several remedial technologies developed or improved since the ROD have gained frequent application to chlorinated VOC sites, including in situ chemical oxidation, enhanced reductive dechlorination, and monitored natural attenuation.
- Connections to municipal water supplies and institutional controls that restrict shallow aquifer use to non-potable applications have eliminated potential exposure pathways.
- The greatest known areal extent of the groundwater plume above regulatory levels is now fully contained within base property following changes to the McChord AFB property boundary.
- Absence of verifiable source reduction after 11 years of pump-and-treat operation suggests that the selected remedy may require more time or optimization to attain remediation goals than previously hoped.

- Potential of finding 1,4-dioxane above MTCA cleanup levels in groundwater beneath ALGT.

An increase in protectiveness is realized from existing institutional controls that have provided connections to municipal water supply, restricted shallow aquifer use to non-potable applications, and stipulated no new development within the site onbase until remediation is complete, thereby eliminating potential exposure pathways. RAOs and remediation goals for Area D/ALGT remain applicable. The newly-recognized association of the compound 1,4-dioxane with TCE raises the potential for it's presence in Area D/ALGT groundwater; the Air Force acknowledges EPA's concerns regarding 1,4-dioxane and will develop a response to the issue. There is no other information that calls into question the protectiveness of the remedy.

Table 7. Changes in Chemical-Specific Standards

Contaminant	Media	Remediation Goal	Standard		Citation/Year
1,1-DCE	Groundwater	7 µg/L	Previous	0.04 µg/L	MTCA 1988
			New	7 µg/L	MCL 2002
Vinyl Chloride	Groundwater	0.03 µg/L	Previous	0.04 µg/L	MTCA 1988
			New	0.03 µg/L	MTCA 2001

VIII. Issues

Issues related to the effectiveness of the site remedy are listed in Table 8.

Table 8. Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Significant reduction of contaminant concentrations within the current plume boundary is not being accomplished by the pump-and-treat system.	N	Unknown
Further reduction of the plume boundary since the first Five-Year Review has not occurred, potentially reducing the long-term protectiveness of the remedy.	N	Unknown
It is unknown if 1,4-dioxane is present in groundwater at levels above regulatory standards.	Unknown	Unknown

IX. Recommendations and Follow-up Actions

Recommendations and follow-up actions are listed in Table 9.

Table 9. Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Significant reduction of contaminant concentrations within the current plume boundary is not being accomplished by the pump-and-treat system.	Evaluate alternatives and enhancements through an optimization study/focused feasibility study	McChord AFB	Ecology/ EPA	May 2005	N	Unknown
Further reduction of the plume boundary since the first Five-Year Review has not occurred, potentially reducing the long-term protectiveness of the remedy.	Evaluate alternatives and enhancements through an optimization study/focused feasibility study	McChord AFB	Ecology/ EPA	May 2005	N	Unknown
It is unknown if 1,4-dioxane is present in groundwater at levels above regulatory standards.	McChord AFB will collect samples to confirm or deny the presence of 1,4-dioxane in groundwater above regulatory limits (currently the MTCA Method B cleanup level of 7.95 µg/L) as requested by EPA.	McChord AFB	Ecology/ EPA	March 2005	Unknown	Unknown
	Issue Proposed Plan for any remedy updates, including any clarifications needed on the institutional controls as well as cleanup levels due to updated toxicity information.	McChord AFB	Ecology/ EPA	November 2005	N	N

X. Protectiveness Statement(s)

The remedy at Area D/ALGT is currently protective of human health and the environment in the offbase area of ALGT where groundwater meets remediation goals (drinking water criteria), while onbase in Area D, the remedy is expected to be protective of human health and the environment upon attainment of remediation goals. In the interim, institutional controls exist that eliminate current exposure pathways and prevent the potential for completing future exposure pathways. Providing public water supply connections to residents and restricting the shallow aquifer to non-potable uses have controlled current threats at the site.

In order for the remedy to be protective in the long term, the remedial action objective of restoring the aquifer to its beneficial use must be attainable in a reasonable timeframe. If the remedy cannot further reduce plume dimensions and contaminant concentrations, then alternative remedies should be explored via an optimization study. In addition, it needs to be determined if 1,4-dioxane is present in the shallow aquifer at concentrations above current regulatory limits.

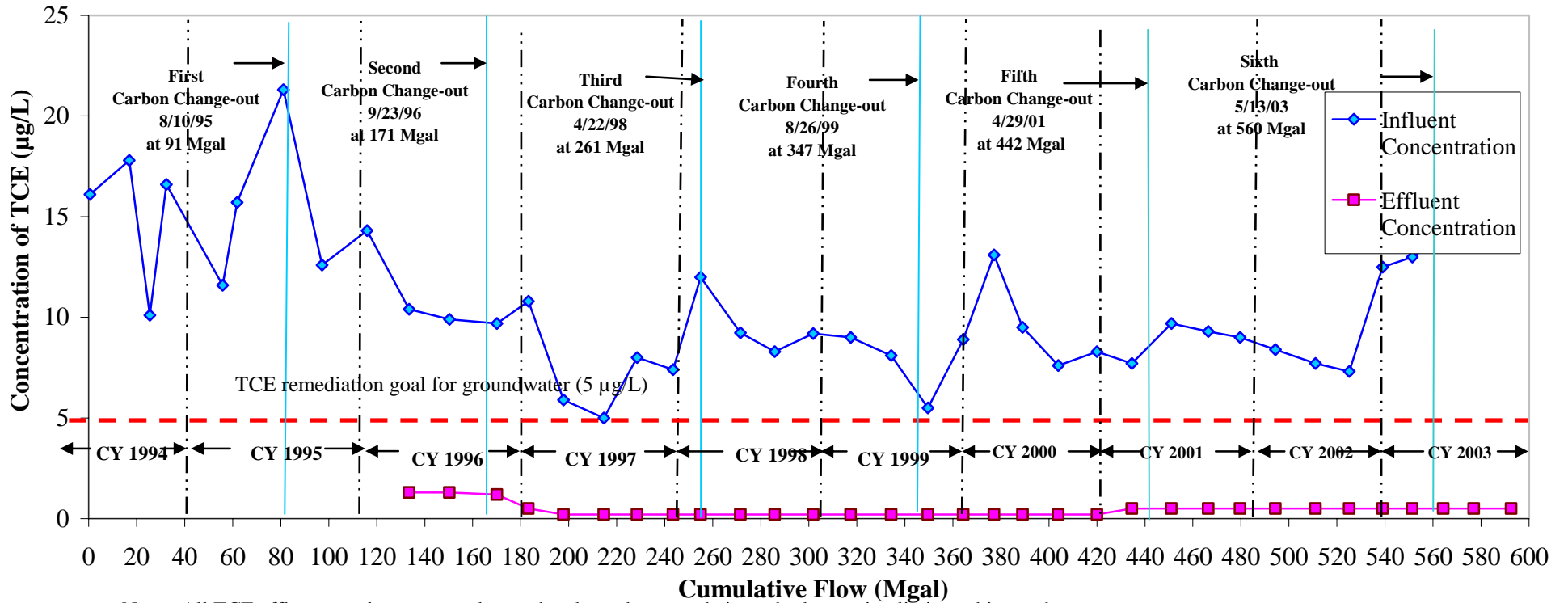
XI. Next Review

The next Five-Year Review for Area D/ALGT is required by March 2010, 5 years from the date of this review.

ATTACHMENTS

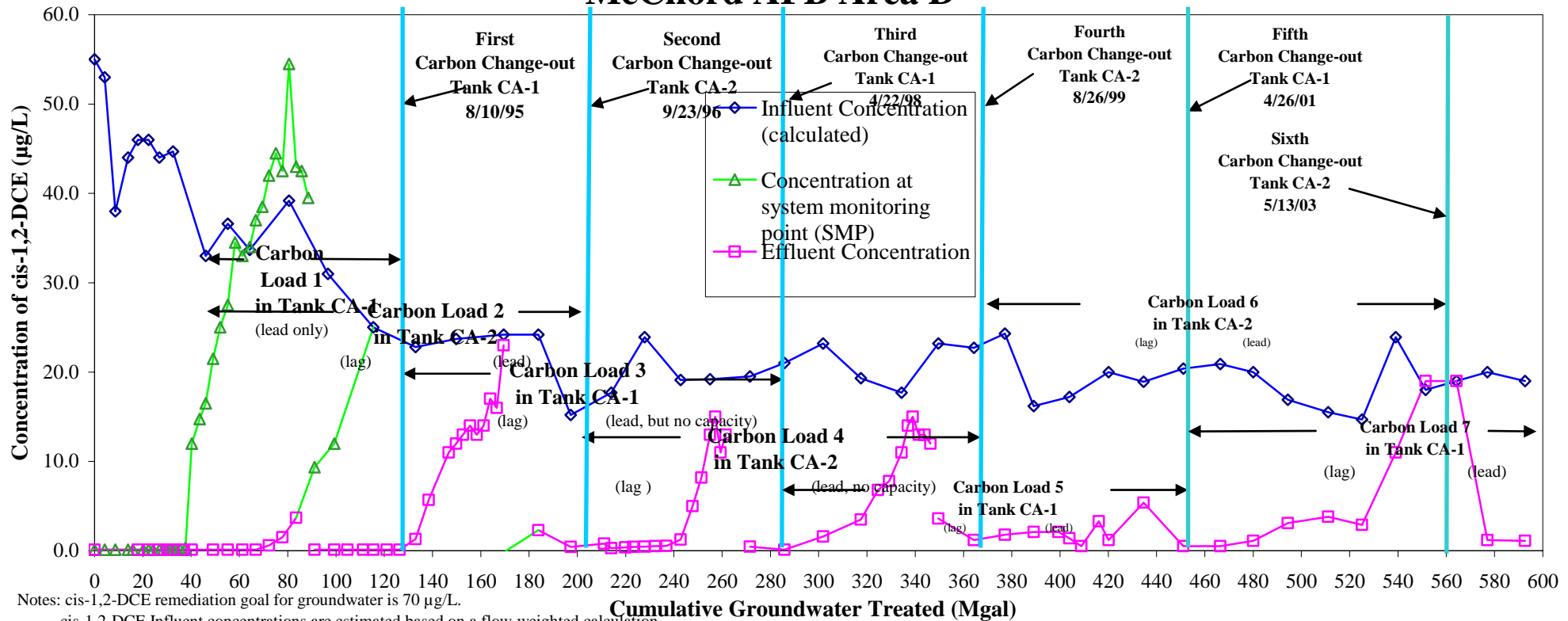
Attachment 1 Figures

Figure 5
Treatment Plant TCE Concentration vs. Cumulative Flow
McChord AFB Area D



Note: All TCE effluent results were not detected and are shown at their method reporting limit on this graph.
 TCE influent concentrations are estimated based on a flow-weighted calculation.

Figure 6
Treatment Plant cis-1,2-DCE Concentration vs. Cumulative Flow
McChord AFB Area D



Notes: cis-1,2-DCE remediation goal for groundwater is 70 µg/L.

cis-1,2-DCE Influent concentrations are estimated based on a flow-weighted calculation.

Location of SMP is presented on Figure 3.

Figure 10
Concentration of TCE in Extraction Wells Over Time
McChord AFB Area D

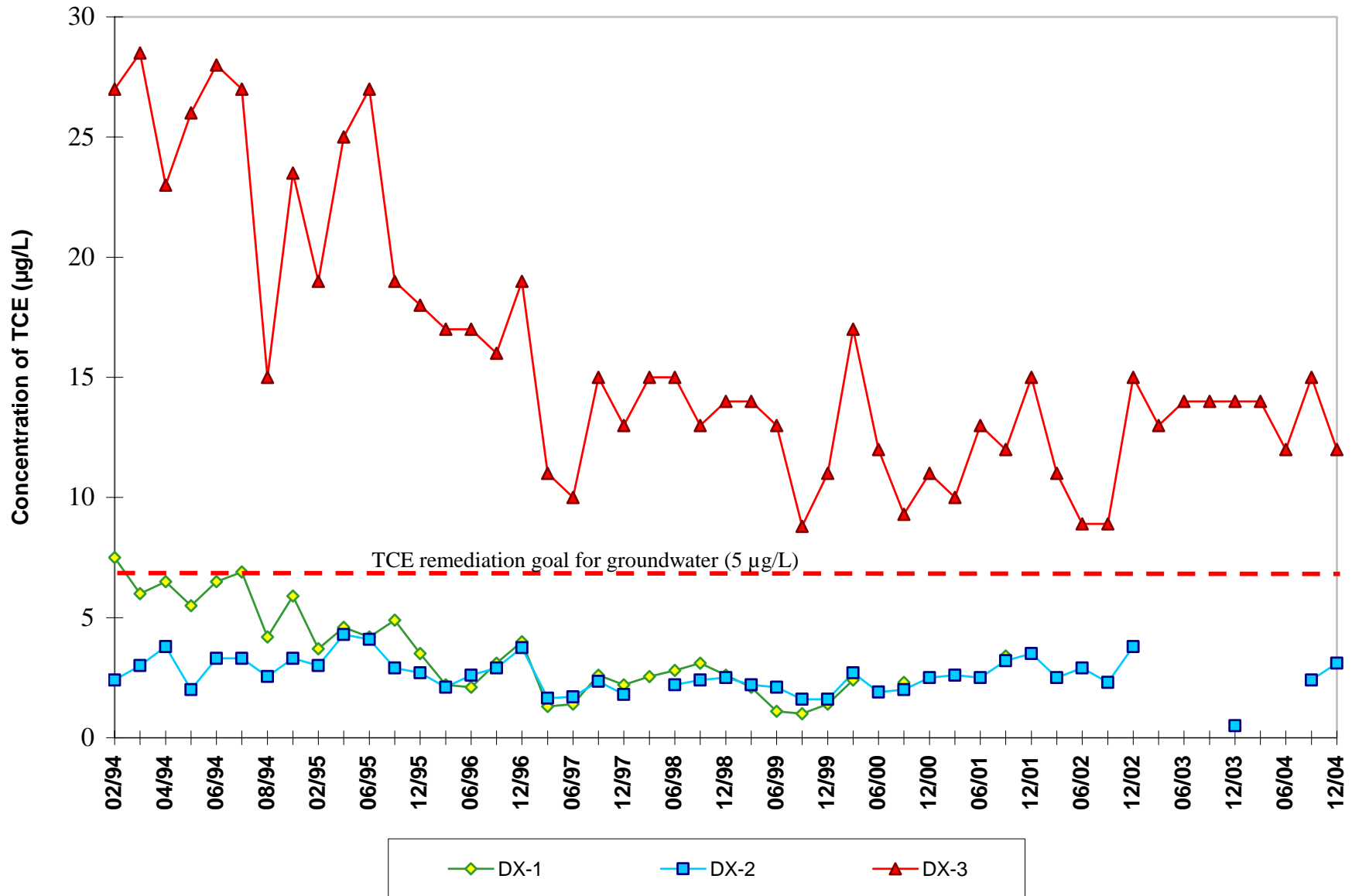
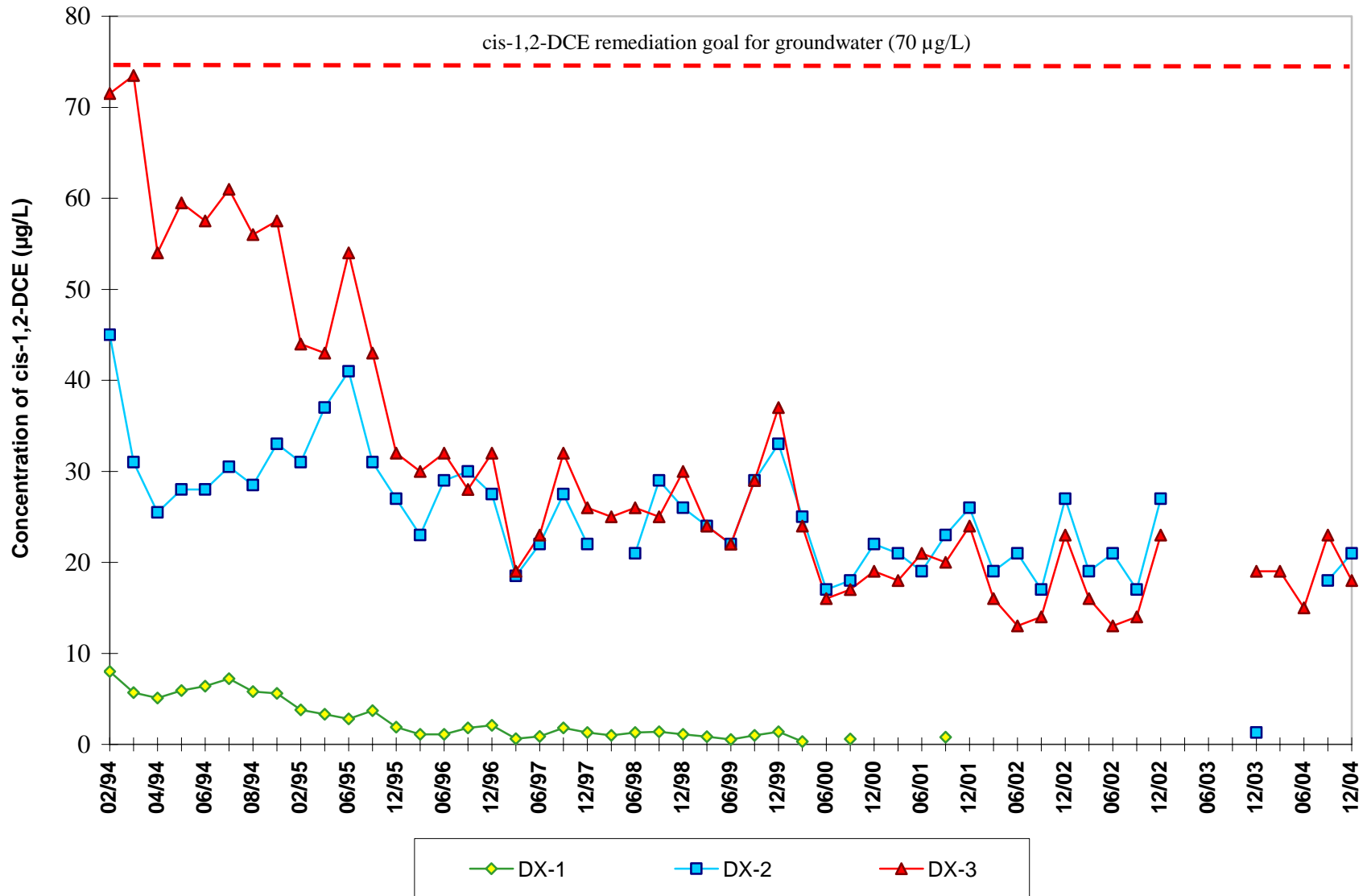


Figure 11
Concentration of cis-1,2-DCE in Extraction Wells Over Time
McChord AFB Area D



Attachment 2 References

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