FINAL

First Five-Year Review Report for Installation Restoration Program Sites at Wurtsmith Air Force Base, Township of Oscoda, Iosco County, Michigan

U.S. AIR FORCE

Prepared For

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and

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FIRST FIVE-YEAR REVIEW REPORT FOR INSTALLATION RESTORATION PROGRAM SITES AT THE FORMER WURTSMITH AIR FORCE BASE, TOWNSHIP OF OSCODA IOSCO COUNTY, MICHIGAN

September 2004

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LIST OF ACRONYMS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ACC	Air Combat Command
ACL	alternate cleanup level
ACM	asbestos containing material
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Environmental Excellence
AFRPA	Air Force Real Property Agency
AGE	aerospace ground equipment
ALCM	air launched cruise missile
ARAR	applicable or relevant and appropriate requirements
AS	air sparging
ASPTS	Arrow Street Pump and Treat System
AST	above-ground storage tank
B&RE	Brown & Root Environmental
BCT	BRAC Cleanup Team
BEC	Base Environmental Coordinator
bgs	below ground surface
BHC	benzene hexachloride
BLRA	baseline risk assessment
BNA	base neutral acids
BOA	Base Operational Apron
BPPTS	Benzene Plant Pump and Treat System
BRAC	base realignment and closure
BTEX	benzene, toluene, ethylbenzene, and xylene

LIST OF ACRONYMS (Continued)

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
COD	chemical oxygen demand
COR	contracting officer's representative
C-RAP	Consolidated Remedial Action Plan
CSC	Computer Sciences Corporation (formerly DynCorp)
CWA	Clean Water Act
DCA	dichloroethane
DCBD	dichlorobenzidine
DCE	dichloroethene
DD	decision document
DDT	dichlorodiphenoltrichloroethane
DO	dissolved oxygen
DRC	Declaration of Restrictive Covenant
DRMO	Defense Reutilization and Marketing Office
DRO	diesel range organics
EIS	Environmental Impact Statement
ERD	Environmental Response Division
FFS	focused feasibility study
FS	feasibility study
ft/day	feet per day
GAC	granular activated carbon
gpd	gallons per day
gpm	gallons per minute
GRO	gasoline range organics
GSI	groundwater/surface water interface

LIST OF ACRONYMS (Continued)

HSP	health and safety plan
HWSF	hazardous waste storage facility
IC	institutional control
ICF	ICF Kaiser/ICF Technology, Inc.
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
JP-4	grade 4 jet propulsion fuel
lbs	pounds
LEA	Legally Enforceable Agreement
LNAPL	light non-aqueous phase liquid
LTM	long-term monitoring
LUC	land use control
MCL	maximum contaminant level
MDEQ	Michigan Department of Environmental Quality
MDH	Michigan Department of Health
MDNR	Michigan Department of Natural Resources
MDPTS	Mission Drive Pump and Treat System
MERA	Michigan Environmental Response Act
mg/L	milligrams per liter
MWH	Montgomery Watson Harza
MNA	monitored natural attenuation
MOA	memorandum of agreement
MOGAS	military operational gasoline
MOU	memorandum of understanding
NCP	National Contingency Plan
NFRAP	no further remedial action planned
NPDES	National Pollutant Discharge Elimination System

LIST OF ACRONYMS (Continued)

NREPA	National Resource and Environmental Protection Act
O&M	operation and maintenance
ORC	oxygen release compound
ORP	oxidation-reduction potential
OWS	oil water separator
PAH	polynuclear aromatic hydrocarbon
PCE	tetrachloroethene
POL	petroleum, oils, and lubricants
PTS	pump and treat system
RA	remedial action
RAB	remediation advisory board
RAO	remedial action objective
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
RPO	remedial process optimization
SAC	Strategic Air Command
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SI	site investigation
SRD	substantive requirements document
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
SWQD	Surface Water Quality Division
SY	Storage Yard
TBC	To Be Considered

LIST OF ACRONYMS (Continued)

TCA	trichloroethane
TCE	trichloroethene
TDL	target detection limit
TDS	total dissolved solids
TMB	trimethylbenzene
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TVH	total volatile hydrocarbons
UCL	upper confidence limit
URS	URS Group, Inc.
URSG	URS Greiner
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
WQBVGL	water quality based venting groundwater limit
WSA	Weapons Storage Area
WWES	WW Engineering and Science
WWTP	Wastewater Treatment Plant
YMCA	Young Men's Christian Association

EXECUTIVE SUMMARY

The United States Air Force (USAF) conducted a five-year review of the remedies implemented at Installation Restoration Program (IRP) sites at the former Wurtsmith Air Force Base (AFB) located near Oscoda, Michigan. A five-year review is required because hazardous substances, pollutants, or contaminants remaining at one or more of the IRP sites are above levels that allow for unlimited use and unrestricted exposure. The purpose of the five-year review is to determine whether the action implemented at each site remains protective of human health and the environment. This is the first five-year review for Wurtsmith AFB. The land is currently being transferred on a parcel-by-parcel basis to the Township of Oscoda for development.

The triggering action for this review is the date of the first decision document between the United States Environmental Protection Agency (USEPA) and the USAF, which was for the RA start date for the Base Operational Apron (or Site SS-08) as shown in USEPA's WasteLAN database: 5/30/99. Decision documents for the remaining IRP sites are in various stages of approval and implementation and may not actually be due for five-year reviews at this time. However, to streamline and consolidate the five-year review process for the entire base, the USAF has voluntarily elected to include all 61 IRP sites in this five-year review. Therefore, all IRP sites will continue to be reviewed together during future five-year reviews.

Prior to the selection of a remedy, remedial investigations and assessments of the nature and extent of contamination were conducted. Based on the results of these investigations, remedial action objectives (RAOs) were selected for each IRP site. These objectives were then used to select the remedial actions (RAs) for the site that are detailed in site-specific decision documents. During the five-year review, the selected action is reviewed for its continued ability to achieve its goal of protection of human health and the environment, implementation, and system operation and maintenance (if applicable). For sites without approved RAOs or RAs, the progress of existing remedial actions towards general protectiveness goals was reviewed.

Current data were reviewed for exceedances of RAOs, trends in contaminant concentrations, and changes in contaminant distribution. Generally, the remedies in place are protective of human health and the environment. Where final remedies are not in place, exposure pathways that could result in unacceptable risks are being controlled through various means during the interim. Several protectiveness issues were noted during the five-year review and deserve special attention:

- Site SS-05 is currently protective; however, future protectiveness relies heavily on the enforcement of off-base well drilling restrictions. Additional public education is recommended. Potential changes to risk factors related to trichloroethene (TCE) could impact protectiveness for off-base residents near Lake Van Etten.

- The Memorandum of Understanding (MOU) between the USAF and the United States Forest Service (Andrina, 1997) needs to be expanded to areas downgradient of Sites OT-16 and OT-24 to prevent any future groundwater use. Additionally, a second MOU may be needed between the USAF and the Michigan Department of Natural Resources to prevent groundwater use in an off-site forested area around Duell Lake.

- Potential changes to risk factors related to TCE could impact protectiveness for on-base residents in Site OT-24.

- A final remedy has not been selected for Site LF-27. A protectiveness determination of the remedy at Site LF-27 cannot be made until further information is obtained. There are concerns that adjacent wetlands may be impacted by Site LF-27 contaminants.

- A final remedy has not been selected for Sites LF-30 and LF-31. The primary protectiveness concern at these sites is the enforceability of off-base institutional controls. Timely reporting of monitoring data to the Young Men's Christian Association (YMCA) (off-base landowner) is very important.

- At several sites, for the remedy to be protective in the long-term, enforceable groundwater use, industrial land use, and soil movement restrictions must be implemented when a

property is transferred. The USAF must ensure that all institutional controls are enforceable. Additional public education is recommended.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from CERCLIS)*: Wurtsmith Air Force Base

EPA ID *(from CERCLIS)*: MI5570024278

Region: 05	**State:** Michigan	**City/County:** Iosco County

SITE STATUS

NPL status: ☐ Final ☐ Deleted ☒ Other (specify) Proposed for NPL *(from CERCLIS)*

Remediation status (choose all that apply): ☒ Under Construction ☒ Operating ☒ Complete

Multiple OUs?* ☒ YES ☐ NO | **Construction completion date:** ___ / ___ / _____ Ongoing

Has site been put into reuse? ☒ YES ☐ NO

REVIEW STATUS

Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency Air Force Real Property Agency (AFRPA)

Author name: Doug Downey

Author title: Project Manager	**Author affiliation: Parsons Corporation (consultant)**

Review period:** 08/2003 to 01/2004

Date(s) of site inspection: 06/09/2003 to 06/13/2003 and 08/12/2003 to 08/14/2003

Type of review:

☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only

☒ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead

☐ Regional Discretion

Review number: ☒ 1 (first) ☐ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:

☐ Actual RA Onsite Construction at OU #____

☐ Actual RA Start at OU#____

☐ Construction Completion

☐ Previous Five-Year Review Report

☒ Other (specify): Decision document for Site SS-08

Triggering action date: 05/30/1999

Due date *(five years after triggering action date)*: 05/30/2004

* ["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:

The five year review identified the following issues that require action beyond that required in the decision document for each of the sites:

Site SS-05 is currently protective; however, future protectiveness relies heavily on the enforcement of off-base well drilling restrictions. Additional public education is recommended in the form of annual pamphlet distributions to off-base residents in plume impacted areas. Potential changes to risk factors related to trichloroethylene could impact protectiveness for off-base residents near Lake Van Etten. If MDEQ issues new promulgated standards, the USAF should reevaluate risk assessments for this site.

The Memorandum of Understanding between the United States Air Force (USAF) and the United States Forest Service needs to be expanded to areas downgradient of Sites OT-16 and OT-24 to prevent any future groundwater use. Additionally, a written agreement is needed between the USAF and the Michigan Department of Natural Resources to prevent groundwater use in an off-site forested area around Duell Lake.

Potential changes to risk factors related to trichloroethene could impact protectiveness for on-base residents in Site OT-24. If MDEQ issues new promulgated standards, the USAF should reevaluate risk assessments for this site.

A final remedy has not been selected for Site LF-27. A protectiveness determination of the remedy at Site LF-27 cannot be made until risk assessments are completed as a part of the RI/FS process and a final remedy is implemented.

A final remedy has not been selected for Sites LF-30 and LF-31. The primary protectiveness concern at these sites is the enforceability of off-base institutional controls. The USAF should provide available groundwater monitoring data to the YMCA (off-base landowner) prior to each summer camping season.

At several sites, for the remedy to be protective in the long-term, enforceable groundwater use, industrial land use, and soil movement restrictions must be implemented when property is transferred. The USAF will use the Wurtsmith AFB Land Use Control/Insitutional Control Management Plan to implement enforceable controls.

Recommendations and Follow-up Actions:

The review concluded that the approved remedy for each site as selected by the respective DDs appears to be providing sufficient protection of human health and the environment. Recommendations and follow-up actions to improve future protectiveness are highlighted in the paragraphs above.

Protectiveness Statement(s):

The approved remedies in place at the former Wurtsmith Air Force Base are protective of human health and the environment. Where approved final remedies are not currently in place, exposure pathways that could result in unacceptable risks are being controlled through interim remedies and institutional controls. One exception is Site LF-27, where a protectiveness determination can not be made until risk assessments are completed as a part of the RI/FS process and a final remedy is implemented.

Other Comments:

None.

SECTION 1

INTRODUCTION

The United States Air Force (USAF) conducted a five-year review of the remedies implemented at Installation Restoration Program (IRP) sites at the former Wurtsmith Air Force Base (AFB), located near Oscoda, Michigan (Figure 1-1). The sites were reviewed because hazardous substances, pollutants, or contaminants remaining at one or more of the sites are above levels that allow for unlimited use and unrestricted exposure. The general locations of the IRP sites are shown in Figure 1-2.

The purpose of the five-year review is to determine whether the remedy implemented at each site protects human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review Reports. In addition, Five-Year Review Reports identify performance, operational, and public perception issues found during the review, if any, and identify recommendations to address these issues.

This Five-Year Review Report is being prepared pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). 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 United States Environmental Protection Agency (USEPA) interpreted this requirement further in the NCP, Title 40 of the Code of Federal Regulations (CFR) §300.430(f)(4),(ii) which 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."

The USAF is the designated lead agency for this five-year review. Parsons was retained by the USAF to conduct a five-year review of the RAs implemented at or proposed for all IRP sites at Wurtsmith AFB under contract F41624-01-D-9009, task order 2004. This review was conducted from August, 2003 through January, 2004. This report documents the results of the review.

This is the first such five-year review for Wurtsmith AFB. The triggering action for this review is the date of the first decision document (DD) between the USEPA and the USAF, which was the remedial action (RA) start date for the Base Operational Apron (or Site SS-08) as shown in USEPA's WasteLAN database: 5/30/99.

During site assessment and site investigation (SI) activities completed from 1983 to present, 61 IRP sites were identified for further investigation (Tables 1-1a and 1-1b). These sites were investigated through records review and through sample and analysis methods to establish the presence or absence of contamination and the relative risk posed by any contamination present. Of the 61 IRP sites, 34 were identified as no further remedial action planned (NFRAP) and were closed without restriction (Table 1-1a). The remaining 27 sites were identified as requiring some form of active remediation, long-term monitoring (LTM), land use restrictions, and/or further investigation to address the reduction of contaminants, or the reduction of exposure from contaminants, to reduce human health and ecological risks associated with contaminants.

DDs (e.g., Remedial Action Plans [RAPs]) for the 34 NFRAP sites have been produced and were approved and signed by both the Air Force Base Conversion Agency (AFBCA) (later to become the Air Force Real Property Agency [AFRPA]) and the USEPA.

Of the remaining 27 IRP sites,

- RAPs have been prepared, approved, and signed by the AFRPA and the USEPA for 17 sites,
- RAPs were being prepared at the time of this report for an additional seven sites, and
- Three sites were undergoing further investigation and did not have RAPs at the time of this report.

No RAP is considered final until it has been approved and signed by both the USAF and the USEPA.

Tables 1-1a and 1-1b present summaries of the IRP sites at Wurtsmith AFB, the status of the DD for each site, and the selected remedies. As shown in Table 1-1a, 34 of the IRP sites were closed with a NFRAP designation based on future unrestricted use of the property and are not discussed further in this report. The other 27 sites (Table 1-1b) are either closed with some type of institutional control (IC) such as land-use/access restriction or are not yet closed but are undergoing active remediation. Based on the five-year review requirements, these 27 sites require periodic review, because the selected or proposed RA results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow unlimited use and unrestricted exposure. These 27 sites are designated hereafter as the Five-Year Review Sites.

A five-year review is not required for the 34 IRP sites designated as NFRAP, but the remaining 27 IRP sites at Wurtsmith AFB will be reviewed. In some instances, IRP sites have been grouped together as shown in Table 1-1b because they are being addressed with a common remedy.

This report has been organized into 12 sections, including this introduction and three appendices. Section 2 provides a chronology of the key regulatory and remedial events for each of the 27 IRP sites reviewed and listed on Table 1-1b as requiring some type of RA. Section 3 includes a general description of the former Wurtsmith AFB, followed by an individual description of each of the 27 IRP sites. Section 4 describes the RAOs and RAs selected for each site. Section 5 is reserved to discuss progress since the last five-year review. Since this is the first five-year review, this section will not be completed until 2009. Section 6 describes the five-year review process including community involvement, a list of documents reviewed, evaluation of remediation data from each of the 27 IRP sites, site inspections, and personal interviews. Section 7 provides a technical assessment of the required protectiveness factors for each of the 27 IRP sites. Section 8 identifies site-specific issues that may be impacting current or future protectiveness, while Section 9 recommends actions to address these issues. Section 10 includes a "protectiveness statement" for each of the 27 sites included in this review. The schedule for the next five-year review is presented in Section 11, and references used in the generation of this report are listed in Section 12. Appendix A contains land use maps and a reference table serving as a key to the maps. Appendix B contains an example of the site inspection checklist/form used during the site visits. Appendix C is a table listing all comments received from the USEPA and the MDEQ on the draft version of the report, as well as the AF responses to those comments.

SECTION 2

SITE CHRONOLOGY

Tables 2-1 through 2-18 present the chronology of activities for the 27 IRP sites. They provide key events and their dates for each IRP site or group of sites.

SECTION 3

BACKGROUND

This section provides a Base overview and site-specific summary of the:

- Physical characteristics,
- Historic, present, and anticipated future land and resource use,
- History of contamination, including a brief summary of the findings of the various SIs,
- USAF's initial response to contamination, and
- Basis for taking action.

3.1 GENERAL BASE AREA

3.1.1 Physical Characteristics

Wurtsmith AFB is located in Iosco County in the northern part of Michigan's Lower Peninsula (Figures 1-1 and 1-2) about one mile west of the western shore of Lake Huron. The Base is bounded to the northeast by Van Etten Lake, to the east by the community of Oscoda, to the south by the Au Sable River, and to the west by the Alpena State Forest. The Base occupies 5,221 acres and is approximately 170 miles north of Detroit, Michigan.

3.1.2 Land and Resource Use

Wurtsmith AFB began operation in 1923 under the name of Camp Skeel, as a landing field for Selfridge Army Air Field near Detroit. In 1924, the Army Air Service started using the area as a gunnery range and for winter maneuvers. From 1924 to 1945, operations consisted of pilot/technical training, bombing techniques, and aerial gunnery. The aircraft used included P-1s and P-47s. In 1942, Camp Skeel was renamed Oscoda Army Air Field. The base was closed in

1945, then reactivated in 1947 for transient activities under the Continental Air Command. With the creation of the Department of the USAF; the base was renamed Oscoda AFB in 1948, and hosted units from the Air Defense Command. In 1953, the 527th Air Defense Group was activated, and the base was renamed Wurtsmith AFB. The present runway and taxiway configuration was established in 1959. In 1960, the Strategic Air Command (SAC) assumed control of the facility, and air refueling squadrons were established flying KC-135A jet tankers. In 1977, the base mission expanded to include B-52 bombers. October 1992 marked the beginning of base closure process, and the Base was officially closed on June 30, 1993, under the Base Realignment and Closure (BRAC) Act.

3.1.3 History of Contamination

Groundwater quality at Wurtsmith AFB has been affected primarily by previous spills of trichloroethene (TCE) solvent, jet fuels, and gasoline as part of normal base operations. TCE was first detected in Base water supply wells in 1979. In response, the first groundwater RA began in 1981.

3.1.4 Initial Response

Several environmental investigations have taken place at Wurtsmith AFB since 1979. Multiple source removal and soil remediation actions have taken place and several large groundwater pump and treat systems (PTSs) have been installed to address groundwater contamination on the Base.

3.1.5 Basis for Taking Action

The USAF has taken action at Wurtsmith AFB because hazardous substances have been released on the base that do not allow for unlimited and unrestricted use of the property. Groundwater contamination has also migrated off of the former Base at levels that do not allow for the unlimited and unrestricted use of private property.

3.2 FT-02

3.2.1 Physical Characteristics

Site FT-02 is a former fire training area that was active from 1958 through 1991. The site is located near the southwest corner of the Base (see Figure 3-1) in an unpopulated area near the main flight line. A wetland tributary to the Au Sable River is located approximately 1,000 feet south-southwest of the site.

Originally, the fire training area was a built-up oval area of compacted soil covered with a layer of gravel and slightly depressed in the center. In 1982, a 115-foot diameter circular pit was constructed with 6-inch thick reinforced concrete. Polyethylene sheeting was placed beneath the concrete as an impermeable layer to contain any chemicals that may seep through the concrete.

3.2.2 Land and Resource Use

The historic land use of the site was as a runway/taxiway clear zone and as a fire training area.

Site FT-02 is zoned as industrial (I), industrial airfield (A-1), and downgradient areas as forestry (F). Access to the site is not controlled or restricted. However, there is no apparent recreational use of the site. Future land use is expected to remain industrial/airfield and recreational.

The groundwater aquifer underlying the site is currently not used as a drinking water source. The dominant groundwater flow direction is to the south-southeast.

3.2.3 History of Contamination

As part of the fire training activities that occurred at the site, waste fuels were floated on a water lens that surrounded a simulated steel airplane (removed in 1993) situated in the pit. Fuels were then ignited during fire training exercises. The fires were extinguished with Aqueous Film Forming Foam (15% butyl carbitol), Halon 1211 (bromochloromethane), and/or multipurpose dry chemical (potassium bicarbonate or sodium bicarbonate). During a typical exercise, 2,000 gallons of waste fuel were used. Prior to the Resource Conservation and Recovery Act (RCRA), smaller quantities of waste solvents were mixed with fuels for burning. Historically, exercises

were performed almost weekly, but during the last few years of operation, the site was used only about once a month. When active, the pit was connected to a 12,000-gallon waste fuel tank located approximately 550 feet to the west.

The sources of contamination at Site FT-02, the fuels, solvents, and fire retarding agents used in the fire training exercises, are no longer present at the site. However, residual concentrations of contaminants in soil continue to act as a source of groundwater contamination.

3.2.4 Initial Response

An SI initiated in 1987 was followed by the removal of the 12,000-gallon waste fuel tank in 1993. During the tank removal, all associated piping was left in-place underground, although it was purged prior to abandonment.

3.2.5 Basis for Taking Action

Although the RAP and RAOs have not been finalized by written approval from the USAF and USEPA, hazardous substances including ethylbenzene, toluene, xylenes, acenaphthene, and naphthalene, have been detected in soil exceeding Michigan Department of Environmental Quality (MDEQ) Part 201 Industrial Drinking Water Protection/Groundwater-Surface Water Interface (GSI) criteria for soil. The impacted soils are the source for the groundwater and surface water exposure pathways

Benzene, cis-1,2-dichloroethene (DCE), ethylbenzene, methylene chloride, vinyl chloride (VC), xylenes, naphthalene, 1,2,4-trimethylbenzene (TMB), chlorobenzene, mercury, and manganese have been detected in groundwater at concentrations exceeding MDEQ Part 201 Industrial Drinking Water/GSI criteria for groundwater. There are no receptors exposed to groundwater, and future groundwater ingestion is unlikely, given the future industrial/airfield land use planned for much of the site. Groundwater migration to the Au Sable River wetlands is a potential pathway because of potential groundwater discharge to surface water and sediments.

Ethylbenzene, naphthalene, VC, and xylenes have been detected in seeps at concentrations exceeding MDEQ Part 201 GSI criteria, which may pose unacceptable risk to a surface water and/or sediment receptor.

3.2.5.1 Identification of Contaminants of Concern

Soil

Based on the Remedial Investigation (RI) data collected by ICF Kaiser/ICF Technology, Inc. (ICF) in 1995, the volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) acenaphthene, ethylbenzene, toluene, xylenes, and naphthalene, exceeded MDEQ Industrial Cleanup criteria for soil. Ethylbenzene, toluene, and xylenes exceeded both MDEQ Industrial Drinking Water Protection and GSI Protection criteria in soil. Acenaphthene and naphthalene exceeded MDEQ GSI Protection criteria only. Therefore, the COCs for soil include acenaphthene, ethylbenzene, toluene, xylenes, and naphthalene.

Groundwater

The VOCs and SVOCs that exceed MDEQ Industrial criteria for groundwater include: 1,2,4-TMB, benzene, chlorobenzene, cis-1,2-DCE, ethylbenzene, methylene chloride, VC, xylenes, and naphthalene. Aluminum, lead, and iron were detected above the MDEQ Industrial Drinking Water criteria, but are below the basewide background levels calculated by ICF; therefore, these metals are considered background. Manganese concentrations exceeded MDEQ Industrial Drinking Water criteria, however; elevated manganese is likely the result of reducing conditions associated with fuel degradation. The COCs for groundwater include 1,2,4-TMB, benzene, chlorobenzene, cis-1,2-DCE, ethylbenzene, methylene chloride, VC, xylenes, naphthalene, and manganese. Mercury was an initial COC but has been eliminated based on improved detection limits.

Surface Water

Based on the 1995 analytical data, the following compounds exceeded GSI criteria: ethylbenzene, VC, xylenes, naphthalene, mercury, zinc, and silver. Zinc and silver were only detected once in the 9 samples (8 samples plus one duplicate) above GSI criteria. Zinc and silver are not considered COCs in groundwater; and therefore are not considered COCs in surface water. The following VOCs have exceeded GSI criteria in a seep which was sampled by Montgomery Watson from 1997 to 2002: ethylbenzene, VC, and naphthalene. However, there were no detections of these compounds or other VOCs based on data from the May 2002

sampling event. All metals sampled and analyzed from that seep from May 1997 to May 2002 were not detected above the method detection limit; however, the method detection limit exceeded GSI criteria for selenium, silver, lead, cadmium, mercury, arsenic, and chromium in May 1997, and silver, cadmium, and mercury in May 2002. As discussed above, these metals are not considered COCs in groundwater; therefore, these metals are not considered COCs in surface water. The COCs for surface water include ethylbenzene, VC, xylenes, and naphthalene.

Sediments

Metals concentrations in surface water and potential impacts on sediments will be addressed during the evaluation of nearby Site LF-27, and are not attributed to Site FT-02.

3.2.5.2 Summary of Risk Assessments

Surface Soil Pathways

A current or future on-site base worker could be exposed to chemicals in surface soil through direct contact and incidental ingestion. Also, receptors could be exposed via inhalation of volatilized constituents from the soils. For all scenarios associated with soil, potential noncarcinogenic hazards are less than 1, which is acceptable by both USEPA and MDEQ criteria. There were no potentially carcinogenic chemicals identified as COCs in soils.

Subsurface Soil Pathways

In current and future uses of Site FT-02, no current receptors have the potential for direct contact with chemicals in the subsurface soils. It is possible, however, for volatile chemicals to be released slowly to air. This provides a means for exposure via inhalation of these chemicals. As described above, for all scenarios associated with soil, potential noncarcinogenic hazards are less than 1, which is acceptable by both USEPA and MDEQ criteria. There were no potentially carcinogenic chemicals identified as COCs in soils.

Groundwater Pathways

Under current and future conditions, there are no receptors exposed to groundwater. However, groundwater migration to the wetlands is a potential pathway because of potential exposure to the surface water and sediments. Both potential noncarcinogenic hazards and

theoretical excess lifetime cancer risks are within the target range specified by USEPA and are below MDEQ criteria for an "average-case" exposure scenario for chemicals of potential concern in groundwater.

Surface Water and Sediment Pathways

A recreational visitor who may be hiking or fishing in the wetland area may be exposed to surface water or sediments through dermal contact while wading. Aquatic receptors in the wetlands may also be exposed to chemicals in surface water and sediments. Vertebrate terrestrial receptors in the wetlands may be exposed through ingestion of chemicals in surface water or seeps. Potential risks associated with exposure to surface water and sediments were within the target range specified by USEPA and below MDEQ criteria for all scenarios.

3.3 WP-04

3.3.1 Physical Characteristics

Site WP-04 is a former Wastewater Treatment Plant (WWTP) located in the southeast part of the Base (see Figure 3-2) that operated from 1959 to 1983. The WWTP received and treated all sanitary wastewater generated at the Base during this period. After passing through a bar screen and grit trap, wastewater was treated in the settling tank and passed through a trickling filter and sludge digesters before being discharged. Sludge was spread in layers in the sludge beds to dry, and was sometimes tilled. In 1983, the WWTP was upgraded by installing three new aeration lagoons in the southwest corner of the Base, approximately 2.5 miles from the WWTP. After the new system became operational, the sludge beds, the digesters, the trickling filters, and the clarifiers were removed and the areas were backfilled with sand to existing grade. The sludge beds and soil beneath the sludge beds were removed to a depth of 6 feet below ground surface (bgs).

During January and May of 1980, TCE was detected in monitoring wells AF15 and R25S at concentrations of 61 micrograms per liter (µg/L) and 65 µg/L, respectively. At the time of the sampling, both AF15 and R25S were downgradient of the WWTP.

3.3.2 Land and Resource Use

The historic land use of the site was as a WWTP.

Site WP-04 is zoned as light industrial/commercial, Wurtsmith Business District (WB-3). Access to the site is not controlled or restricted. However, there is no apparent recreational use of the site. Future land use is expected to remain consistent with the current zoning.

The groundwater aquifer underlying the site is currently not used as a drinking water source. The dominant groundwater flow direction is to the east.

3.3.3 History of Contamination

The WWTP received contaminated groundwater from an interim treatment plant across from Building 43, which was built to aerate TCE-contaminated groundwater pumped from the Building 43 area as a result of a spill that occurred in 1977. The interim treatment at the WWTP was in use for approximately one year while the Arrow Street treatment system was constructed. TCE concentrations received by the WWTP could have been as high as 2,800 µg/L and leaks in the treatment system and sludge disposal practices are the likely cause of limited groundwater contamination. During January and May of 1980, TCE was detected in downgradient monitoring wells at concentrations up to 65 µg/L.

3.3.4 Initial Response

In December 1981, the Arrow Street PTS (ASPTS) began operation using an activated carbon filtration system to reduce TCE concentrations, and thereafter the WWTP stopped receiving the extracted groundwater from this area.

After start up of the ASPTS, groundwater flow paths changed under the influence of the pumping. Due to the presence of TCE in the groundwater, the United States Geological Survey (USGS) conducted a soil and groundwater investigation during 1981, which included installation and sampling of several groundwater monitoring wells near the sludge drying beds. Results indicated that the deep wells had TCE concentrations up to 53 µg/L. Surface and subsurface soil samples were also collected from various locations, including the sludge drying beds, but none of

these results exceeded MDEQ criteria. The USGS collected additional groundwater samples in 1991, and TCE was detected at a maximum concentration of 21 µg/L.

3.3.5 Basis for Taking Action

Tetrachloroethene (PCE) and TCE have been detected in groundwater at concentrations exceeding MDEQ Part 201 residential drinking water criteria for groundwater. Although there is no continuing source of contamination and there are no current receptors exposed to impacted groundwater, the groundwater ingestion pathway is a potential concern for a future receptor.

In 1995, ICF performed an RI to determine the current nature and extent of the soil and groundwater contamination at Site WP-04. The RI was initiated because contaminants that could pose health risks to future receptors were detected in soil and groundwater at the site during initial investigations. Based on the results of the RI, ICF prepared a RAP/DD in 1998 (ICF, 1998e) identifying the preferred alternative as limited action/natural attenuation. Regular groundwater monitoring at the site has been ongoing since 1993.

3.4 SS-05

3.4.1 Physical Characteristics

Site SS-05 is located in the northeastern part of the base (Figure 3-3). Based on previous investigations discussed below, Site SS-05 consists of two TCE groundwater plumes which have emanated from the former Weapons Storage Area (WSA). The southern plume (Pierce's Plume) has been delineated from the eastern edge of the WSA to Van Etten Lake. The second plume is located just north of Pierce's Plume and has been partially delineated from the eastern edge of the WSA to the western edge of the SAC Alert Apron.

3.4.2 Land and Resource Use

The main purpose of the WSA was storage and maintenance of bombs (1956-1993), and air launched cruise missiles (ALCMs). Background information pertaining to the use of TCE and the land use activities at SS-05 is limited. Zoning of the site is industrial, and future use of the on-base portion of the site is expected to be industrial. Future use of the off-base land associated with this site is expected to remain residential.

Groundwater flow at the site is in an eastern direction. Historically, groundwater emanating from this site was used as the primary water supply for some residences along the western shore of Van Etten Lake. However, in 1979 when TCE was first detected in the water supply well of one of these residences, use of the residential wells for water supply was terminated, and the USAF began supplying drinking water to these residences. By the end of 1992, the USAF had finished connecting all potentially affected residences to the Oscoda municipal water supply system.

3.4.3 History of Contamination

Site history indicates the following suspected source areas within the WSA: the septic tanks and leachfields (tile fields) for Buildings 5308, 5109, and 5335. These source areas were used before the WSA was connected to the base-wide sewage system. The leachfield for Building 5308 appears to be located under Building 5306, which was constructed in 1982. It is uncertain if the leachfield for Building 5308 was removed during the construction of Building 5306 or was left in place. Because no construction took place at Buildings 5335 and 5109, it is probable that the septic tanks and leachfields were abandoned in place. Waste disposal practices for the WSA are not documented (ICF, 1996e).

The TCE plume, commonly referred to as Pierce's Plume, was identified in 1979 when Charles Pierce had a sample of water from his potable well tested and TCE was detected at a concentration of 753 μg/L. The Pierce residence is located near Van Etten Lake in a cottage more than 4,000 feet downgradient of the WSA. Between 1983 and 1987, TCE levels near the source area decreased significantly but increased downgradient, with maximum concentrations of 1,281 μg/L (in Pierce Well, 1985). From 1988 to 1992, upgradient TCE levels had fallen to 30 μg/L or less while downgradient concentrations had decreased to a maximum concentration of 410 μg/L (in Pierce Well, 1992).

Between 1979 and 1991, 58 groundwater monitoring wells were installed by the USGS between the WSA and Van Etten Lake. The wells were sampled by the Michigan Department of Natural Resources (MDNR), the USGS, and the USAF at various times. TCE was the primary contaminant detected, and PCE was less frequently detected but was detected at a peak

concentration of 420 µg/L. Other organic contaminants were detected, although rarely at concentrations exceeding 10 µg/L. Potable drinking water wells in the area were also sampled.

From 1984 until 1992, surface water samples were collected from Van Etten Lake at the apparent leading edge of the TCE plume. The highest TCE concentrations detected were in the samples collected in January 1992 from a point 3 meters from the shore near the Pierce house in the shallow (387.5 µg/L) and deep (339.5 µg/L) samples. Additional surface water samples collected in the summer of 1994 and the winter of 1995 show much lower levels of TCE in Van Etten Lake.

3.4.4 Initial Response

After identification of the plume, drinking water was provided to the affected residences by the USAF until the end of 1992, when the USAF had finished connecting potentially affected residences to the Oscoda municipal water supply system.

The septic tank and leach field in the southeast area of the WSA (closest to Building 5300) were removed during the construction of the ALCM support facilities in the 1980s. According to a former USAF employee, the two tanks and leach fields at Buildings 5109 and 5336 were previously emptied, the tops and sidewalls collapsed, and the excavation backfilled.

3.4.5 Basis for Taking Action

TCE and PCE have been detected in groundwater at concentrations exceeding MDEQ Part 201 Residential Drinking Water for groundwater. Although there are no current receptors exposed to groundwater, the groundwater ingestion pathway is a potential concern for a future receptor.

ICF performed an RI (ICF, 1996e) to determine the current nature and extent of the soil and groundwater contamination at Site SS-05. The RI was initiated because contaminants that could pose health risks to future receptors were detected in groundwater at the site during initial investigations. During the RI, a baseline risk assessment (BLRA) was performed to estimate the potential health and environmental threats, if any, that could result if contamination at Site SS-05 was not addressed. Under the baseline human health risk assessment, COCs were only identified

in groundwater. Therefore, a quantitative risk assessment was conducted for chemicals in this medium. Under current conditions, there are no complete pathways for chemicals in groundwater because receptors in areas overlying the plume now receive their drinking water from the Oscoda municipal water supply system. The risk assessment concluded that if a future off-site resident installed a groundwater well, the exposure to chemicals in the groundwater posed potentially unacceptable risks. The Michigan Department of Health (MDH) has imposed well drilling restrictions in impacted areas. The ecological risk assessment identified COCs in sediments. The conclusions of the quantitative risk assessment were that risks are acceptable for ecological receptors under current and future land use for Site SS-05.

3.5 SS-06, SS-13, ST-40, AND ST-46

This section includes a discussion of the background at Sites SS-06, SS-13, ST-40, and ST-46 (Figure 1-2 and 3-4). Because the source of the groundwater contamination at these sites is primarily from the Petroleum, Oil, and Lubricants (POL) Bulk Storage Facility, all four sites as a whole are often referred to as the POL Area. Although IRP Sites SS-06, SS-13, ST-40, and ST-46 were combined because of similarities in their geographic location and hydrogeology, they have separate sources of contamination and will be discussed individually in this section.

3.5.1 Physical Characteristics

Site SS-06 comprises the four former and/or existing above-ground storage tanks (ASTs) at the POL bulk storage. These tanks and their volumes are:

- Tank 7000, a 1.26-million gallon Grade 4 jet propulsion fuel (JP-4) AST;
- Tank 7001, a 568,000-gallon JP-4 AST;
- Tank 7039, a 210,000-gallon heating fuel AST; and
- Tank 7040, a 315,000-gallon heating fuel AST.

Site ST-13 is the site of a military operational gasoline (MOGAS) spill at the Building 394 Motor Pool.

Site ST-40 is the site of a former 2,000-gallon underground storage tank (UST) that was used as a waste heating oil recovery tank. Fuel operations to and from the UST were conducted through pumps in Building 351. Excess heating oil that remained in the pumps after fuel transfer was drained and stored in the UST at the site. The oils were then removed and disposed of appropriately.

Site ST-46 is located in the motor pool area at the center of Wurtsmith AFB. The site consists of an area that previously contained three USTs:

- A 10,000-gallon diesel fuel tank,
- A 12,000-gallon gasoline tank, and
- A 550-gallon diesel tank,

all of which were installed in 1961.

3.5.2 Land and Resource Use

The zoning for these sites is designated as industrial (I) and light industrial/commercial Wurtsmith Business District (WB-3). The proposed site-specific closure for Sites SS-06, SS-13, ST-40, and ST-46 is Site-Specific Industrial Closure with Restrictions. Future land use is expected to be consistent with the current zoning.

The groundwater aquifer underlying the site is currently not used as a drinking water source. Groundwater flow enters the area from the west. Flow leaving the area is influenced by the operation of groundwater PTSs (Benzene Plant PTS [BPPTS] and ASPTS), although natural flow away from the site is generally toward the north-northeast.

3.5.3 History of Contamination

Site SS-06

No significant fuel spills have been reported at the POL bulk storage facility; however, Tank 7000 was known to have leaked in 1983. The presence of benzene, toluene, and other organic

compounds in groundwater samples collected at the site in 1979 suggested that these fuel compounds were discharged to the soil and groundwater from Tank 7000, which contained JP-4 jet fuel. Light non-aqueous phase liquid (LNAPL) was discovered at the site in 1983.

Site ST-13

In the mid-1970s, an unknown quantity of MOGAS was spilled at the surface of Site ST-13. Water hydrants were opened to dilute the spill. The spill was not contained or removed from the ground. The contaminated soil could not be excavated due to frozen ground.

Site ST-40

The 2,000-gallon UST failed a tracer test in May 1990 and the compounds toluene, ethylbenzene, xylenes, lead, naphthalene, and 2-methylnaphthalene were detected in soil and groundwater samples collected from the site in November 1990. Free-phase LNAPL also was discovered at the site in 1990.

Site ST-46

On May 17, 1990, the 10,000-gallon diesel tank (Facility 7297) failed a tightness test. The presence of xylenes, naphthalene, and phenanthrene in soil samples collected during the removal of the tank suggested that these compounds had leaked from the diesel tank. Free-phase LNAPL also was discovered at the site in 1992.

3.5.4 TCE, PCE, and DCE Residuals

Although no source of TCE, PCE, or DCE is suspected in the POL Area, low levels of these compounds have been detected in two BPPTS pumping wells and several monitoring wells. These compounds have migrated into this area from dilute residual plumes emanating from the surrounding industrial area.

3.5.5 Initial Response

Site SS-06

Tank 7000 was removed in the summer of 1992.

Site ST-13

Aside from the efforts to dilute the spill, no additional initial response actions were taken.

Site ST-40

The tank was removed in July 1990. Approximately 0.5 cubic yards of contaminated soil was also removed for disposal as a hazardous waste. A soil sample was collected from the area that was beneath the tank at a depth of 13 feet bgs, and then the excavation was backfilled to grade (USAF, 1990).

Site ST-46

The USTs were removed in October 1990. Approximately 1,080 cubic yards of impacted soil were removed from the excavation and stockpiled. The excavation was subsequently backfilled with clean fill. The excavated soil was removed to an area in the northern portion of the base where ex-situ bioremediation was performed on the soil until applicable soil action levels were achieved.

3.5.6 Basis for Taking Action

1,2,4-TMB, 1,3,5-TMB, benzene, ethylbenzene, methylene chloride, PCE, cis-1,2-DCE, 1,2-dichloroethane (DCA), anthracene, chrysene, phenanthrene, TCE and xylenes have been detected in groundwater at concentrations exceeding MDEQ Part 201 Industrial Drinking Water criteria for groundwater. Xylenes have been detected in soil at concentrations exceeding MDEQ Part 201 Industrial Drinking Water Protection criteria. Although there are no current receptors exposed to groundwater, the groundwater ingestion pathway is a potential concern for a future receptor.

ICF performed an RI (ICF, 1996d) to determine the current nature and extent of the soil and groundwater contamination at Sites SS-06, SS-13, ST-40, and ST-46. The RI was initiated because contaminants that could pose health risks to future receptors were detected in soil and groundwater at the site during initial investigations. The RI did not include an assessment of soil exposure pathways and receptors. Possible exposure pathways include direct contact and inhalation of constituents through volatilization from soil or inhalation of airborne particulate.

The RI assumes that the BPPTS will continue operation until the VOCs and SVOCs that exceed the MDEQ Industrial Cleanup criteria are below criteria. Further, it states that currently there are no receptors that have direct contact with groundwater in this area. Groundwater use restrictions have been imposed on areas of the base where shallow groundwater contamination exists or is suspected to exist. The base water supply system was deactivated during 1996/1997, which means that there is no need (or plan) to extract groundwater from the shallow aquifer underlying or immediately downgradient from the base to meet future water supply demands. However, in the future it is possible that an on-site manufacturer could drill a well for industrial water use and future industrial workers could be exposed through ingestion of groundwater, dermal contact with groundwater during washing, and inhalation of vapors in groundwater while showering.

3.6 SS-08, ST-41, SS-42, AND SS-53

This section presents information for Sites SS-08, ST-41, SS-42, and SS-53. Site ST-41 has previously been referred to as OT-41. The sites are adjacent to each other in an area that has been designated for future industrial use; therefore, they are all addressed together. Sites ST-41, SS-42, and SS-53 do not yet have signed RAPs.

3.6.1 Physical Characteristics

The SS-08 area is located in the central part of Wurtsmith AFB (Figure 1-2 and 3-5) and includes the SAC Operational Apron, Nose Dock, and maintenance areas. Past operations at this location included aircraft parking, cleaning, maintenance, and fueling.

Sites ST-41 and SS-42 are located in the southeast corner of the SS-08 maintenance area. Site ST-41 is located at the Aerospace Ground Equipment (AGE) refueling island (Facility 5011), near Building 5009. Three 2,000-gallon USTs containing JP-4, MOGAS, and diesel fuel were previously located at the facility. Site SS-42, also located at the AGE facility near Building 5009, is the site of an AST that contained JP-4.

Site SS-53 is located on the former Air Combat Command (ACC) aircraft parking and refueling apron, and was the location of a leaking "T" flange on a jet fueling hydrant.

3.6.2 Land and Resource Use

The sites are adjacent to each other in an area that has been designated for future industrial use; therefore, they are all addressed together. Past operations at these locations included aircraft parking, cleaning, maintenance, and fueling. Current and expected future zoning and use of the area is industrial, industrial aviation support, light industrial/commercial, and recreational vehicle parking.

The groundwater aquifer underlying this area is not currently used as a drinking water source. The predominant groundwater flow direction is generally from west to east, although it is controlled locally by the BPPTS groundwater extraction system.

3.6.3 History of Contamination

Source investigations have identified the following potential sources of contamination at the subject sites:

- Leaks from aircraft parking, cleaning, maintenance, and fueling;
- Leaks from oil water separators (OWSs), sanitary sewers, and storm sewers that were used in the past for waste solvent and oil disposal;
- Possible dumping of small amounts of solvents along the southern blast fence;
- Three 2,000-gallon USTs containing JP-4, MOGAS (gasoline), and diesel fuel previously located at ST-41;

- A small, intermittent leak of unknown quantity identified near the ST-41 MOGAS tank during testing in 1995;
- A spill of JP-4 from a former AST at Site SS-42;
- A malfunctioning fuel pump at SS-42, which siphoned approximately 1,400 gallons of fuel into the ground beneath the pump in 1991;
- Approximately 100 gallons of MOGAS that may have leaked into the ground from a nearby pump at Site SS-42 in 1991; and
- A leak on a flanged "T" at hydrant 22A adjacent to Parking Spot 19 (Site SS-53) on the ACC Operational Apron identified in 1988.

3.6.4 Initial Response

Site SS-08

The Mission Drive Pump and Treat System (MDPTS) was constructed to remediate groundwater that may have originated from this site and flowed southeast into Site OT-24.

Sites ST-41

The USTs were removed and the resulting excavation was reportedly backfilled with native sand (Parsons, 1996a).

Site ST-42

The AST was removed following a spill and replaced with two new ASTs.

Site SS-53

The leaking "T" in the fuel line was replaced, and approximately 12 cubic yards of impacted soil were excavated (WW Engineering and Science [WWES], 1994).

Additionally, numerous investigations and groundwater sampling events were conducted from 1979 to the present to assess soil and groundwater impact in the vicinity of Sites SS-08, ST-41, SS-42, and SS-53. A chronology of significant events obtained from ICFs Site SS-08 RAP (ICF, 1998j) is provided in Table 2-5.

3.6.5 Basis for Taking Action

1,2,4-TMB, 1,3,5-TMB, benzene, ethylbenzene, toluene, and xylenes (BTEX), PCE, TCE and naphthalene have been detected in groundwater at concentrations exceeding MDEQ Part 201 Industrial Drinking Water for groundwater. Ethylbenzene, xylenes, 1,2,4-TMB, and 1,3,5-TMB have been detected in soil at concentrations exceeding MDEQ Part 201 Industrial Drinking Water Protection criteria at Site SS-42. Although there are no current receptors exposed to impacted soil and groundwater, the groundwater ingestion pathway and the soil direct contact pathways are potential concerns for a future receptor.

ICF performed an RI (ICF, 1996a) to determine the current nature and extent of the soil and groundwater contamination at Sites SS-08, and SS-53. The SS-08 and SS-53 RI was initiated because contaminants that could pose health risks to future receptors were detected in soil and groundwater at the site during initial investigations. A risk assessment for Sites SS-08 and SS-53 was performed as part of this RI and the results of this are summarized below.

The industrial nature of the site, which includes concrete and asphalt driveways and parking areas, small buildings, and chain link fencing to limit access, precludes the existence of suitable wildlife habitat. No resident ecological receptors were identified for which soils and/or groundwater are likely contaminant exposure media. No current or potential exposure pathways involving potential off-site receptors were identified.

While the focus of the RI for SS-08 was groundwater, the original releases may have been to surface soil. Because of the high permeability of site soils, it is likely that chemicals released to surface soils so long ago will have migrated downward away from the surface soil.

There are detectable levels of PCE, TCE, benzene, toluene, and acetone in soils at Sites SS-08 and SS-53. The only soil samples exhibiting concentrations of COCs above the cleanup criteria

were from greater than 15 feet bgs (URS, 2002b). Intrusive workers could be incidentally exposed to impacted environmental media during very deep excavation activities at and immediately downgradient from the sites. However, because no intrusive activities have been recently conducted or are planned at these sites as part of the final reuse plans, and because chemical contamination above the MDEQ Residential and Industrial Drinking Water Protection criteria are limited to environmental media at least 15 feet bgs, the potential exposure of intrusive workers should be classified as hypothetically possible but unlikely. Trespassing by potential residential or recreational receptors is not expected to be a significant concern at these sites due to access restrictions.

Groundwater use restrictions have been imposed on areas on the base where shallow groundwater contamination exists or is suspected to exist. The base water supply system was deactivated during 1996/1997, which means that there is no need (or plan) to extract groundwater from the shallow aquifer underlying or immediately downgradient from the base to meet future water supply demands. No shallow groundwater is withdrawn from areas within at least 0.5 mile from these sites to meet potable or non-potable water requirements. However, in the future it is possible that an on-site manufacturer could drill a well for industrial water use and future industrial workers could be exposed through ingestion of groundwater, dermal contact with groundwater during washing, and inhalation of vapors in groundwater while showering.

Although workers involved in collecting groundwater samples for monitoring purposes are potential receptors, their work is conducted under the guidelines of site specific health and safety plans (HSP) to minimize their risk of exposure; therefore, exposure is expected to be negligible.

No surface water or sediment pathways have been evaluated in this assessment of risk. Historically, chemicals found in groundwater adjacent to Duell Lake or in 3-Pipes Drainage Ditch may have originated from Sites SS-08, ST-41, SS-42, and SS-53; however, the portion of the groundwater plume that potentially affects the lake and ditch areas will be evaluated as a separate site, Site OT-24. These areas and associated groundwater are investigated under Site OT-24 and are not evaluated as part of the Sites SS-08, ST-41, SS-42, and SS-53 investigation.

3.7 OT-16

3.7.1 Physical Characteristics

Site OT-16 (Figure 1-2 and 3-6) is a former jet engine test cell at Building 5098 which was operated from 1972 until 1990. The engine test bay of the building was connected through a floor drain to an OWS and then to a 3-foot diameter dry well. The original OWS, located inside the test bay, was replaced with a new OWS outside the building in 1979.

3.7.2 Land and Resource Use

Historically, this site was used to test jet engines. As part of these activities, jet fuels and solvents were used. The site has been zoned industrial, industrial airfield, and downgradient areas for forestry. Future use is expected to be consistent with these zoning restrictions.

The groundwater aquifer underlying this area is not currently used as a drinking water source. The predominant groundwater flow direction is generally to the southeast toward the Au Sable River wetlands.

3.7.3 History of Contamination

Jet fuels or solvents spilled during use of the test cell were washed down the floor drain on a weekly basis. The OWS/dry well system did not function properly and overflowed when the test cell floor was washed. These overflow practices discontinued in 1987, and the OWS/dry well system was taken out of service in December 1988. The contents of the OWS and dry well were pumped into an AST, and the separator, dry well, and surrounding contaminated soils were removed. In 1990, the AST overflowed approximately 10 gallons of used fuel, synthetic oil, and solvents and was declared a site of environmental contamination by the MDEQ.

3.7.4 Initial Response

In 1985, USAF personnel observed that the OWS and dry well were not functioning properly. Soil samples confirmed the presence of residual contamination originating from the OWS overflow. The USAF's initial response was to discontinue overflow practices in 1987, and to remove the OWS and dry well from service in December 1988. In 1989, the dry well and surrounding soil were excavated, and an AST was installed to replace the OWS. In response to

the overflow of the AST in 1990, the soil surrounding the AST was reportedly excavated, although results of the soil removal are not documented. Operations at Building 5098 were discontinued after March 1990. The floor drain inside the building was plugged, and the AST was removed at a later date. Results of the AST removal are not documented (ICF, 1997e).

3.7.5 Basis for Taking Action

Acenaphthene, benzo(a)pyrene, ethylbenzene, naphthalene, methylene chloride, and xylenes have been detected in soil at concentrations exceeding MDEQ Part 201 Industrial Drinking Water and GSI Protection criteria. BTEX, 1,2,4-TMB, bis(2-ethylhexyl)phthalate, naphthalene, phenanthrene, methylphenols, methylene chloride, TCE, 2-methylnaphthalene, manganese, and iron have been detected in groundwater at concentrations exceeding MDEQ Part 201 Industrial Drinking Water and GSI criteria.

ICF performed an RI (ICF, 1997e) to determine the current nature and extent of the soil, groundwater, surface water, and sediment contamination at OT-16. The RI was initiated because contaminants that could pose health risks to future receptors were detected in soil and groundwater at the site during initial investigations.

Based on the soil sampling results from the RI, the COCs for soil include ethylbenzene, acenaphthene, naphthalene, xylenes, methylene chloride, and benzo(a)pyrene. The RI and other investigations performed at Site OT-16 show that the COCs for groundwater include benzene, ethylbenzene, toluene, xylenes, 1,2,4-TMB, bis(2-ethylhexyl)phthalate, naphthalene, phenanthrene, methylphenols, methylene chloride, TCE, 2-methylnaphthalene, manganese, and iron.

Two risk assessments were performed for Site OT-16. The baseline human health risk assessment evaluated risks associated with exposure to contamination based on current and potential future site usage. The ecological risk assessment evaluated risk to current ecological receptors.

Surface Soil Pathways

A current on-site base worker could be exposed to chemicals in surface soil through direct contact and incidental ingestion. Also, receptors could be exposed via inhalation of volatilized constituents from the soils. For all scenarios associated with soil, potential noncarcinogenic hazards are less than 1, which is acceptable by both USEPA and MDEQ criteria. There were no potentially carcinogenic chemicals identified as chemical of concern in surface soils (ICF, 1997e).

Subsurface Soil Pathways

Based on current and future uses at Site OT -16, no current receptors have the potential for direct contact with chemicals in the subsurface soils. It is possible, however, for volatile chemicals to be released slowly to the air. This provides a means for exposure via inhalation of these chemicals. As discussed above, for all scenarios associated with soil, potential noncarcinogenic hazards are less than 1, which is acceptable by both USEPA and MDEQ criteria. There were no potentially carcinogenic chemicals identified as COCs in subsurface soils (ICF, 1997e).

Groundwater Pathways

Under current and future conditions, there are no receptors exposed to groundwater. However, groundwater migration to the wetlands is a potential pathway because of potential exposure to the surface water and sediments. Both potential noncarcinogenic hazards and theoretical excess lifetime cancer risks are within the target range specified by USEPA and are below MDEQ criteria for an "average case" exposure scenario for chemicals of potential concern in groundwater.

Surface Water and Sediment Pathways

It was concluded that Site OT-16 was not contributing to contamination to the Beaver Pond surface water or sediment (ICF, 1997e).

3.8 SS-17, SS-21, AND SS-47

3.8.1 Physical Characteristics

Sites SS-17, SS-21, and SS-47 at Wurtsmith AFB are roughly bounded by Arrow Street on the south, the Operational Apron to the west and north, and the base boundary on the east (Figure 1-2 and 3-7). These sites are addressed as a group because of their proximity to one another (SS-17 and SS-21), and because they share a common remedy (the ASPTS).

Site SS-17 was created due to a spill from a former AST located on the southern side of the Civil Engineering Fuels Maintenance Shop, Building 25.

Site SS-21 is the site of a 500-gallon UST that was located north of the Jet Engine Maintenance Shop, Building 43. The tank was installed as a holding tank for waste oils and waste TCE collected in the washroom of Building 43.

Site SS-47 was created due to an assumed loss of premium unleaded gasoline from a UST located at the former Base Gas Station.

3.8.2 Land and Resource Use

Sites SS-17, SS-21, and SS-47 are zoned as industrial and light industrial/commercial. The areas were historically used for various light maintenance and support activities associated with normal base operations, including a gasoline station. Future use of the area is expected to remain consistent with the zoning restrictions currently in-place.

The groundwater aquifer underlying this area is not currently used as a drinking water source. The predominant groundwater flow direction is to the east, although locally flow is influenced by the ASPTS.

3.8.3 History of Contamination

Site SS-17: Fuel Oil Spill Near Building 25

In 1978, approximately 100 gallons of heating oil were spilled from a former AST on the southern side of the Civil Engineering Fuels Maintenance Shop, Building 25 (USGS, 1983). The

heating oil was not contained and was absorbed directly into the ground. In 1985, the USGS conducted a Phase I investigation (records search). No samples were collected because the spill was believed to have moved through the soil into the groundwater and to the existing recovery wells located east of Sites SS-17 and SS-21.

Site SS-21: TCE Spill Northeast of Building 43

In 1977, TCE was detected in several pumping wells in the vicinity of Building 43. The source of the TCE contamination was traced to the UST at Building 43 and the tank was removed.

Site SS-47: Base Gas Station

Site SS-47 was established in November 1987 when approximately 400 gallons of premium unleaded gasoline were released from a 10,000-gallon UST. Reports indicate that product was seen leaking from the UST through a valve on the top of the UST. The estimated 400 gallons comes from a 400-gallon discrepancy in the October 1987 inventory record.

3.8.4 Initial Response

Site SS-17

Because Site SS-17 was within the capture zone of the Site SS-21 recovery wells, no other investigation or remediation effort was planned. From October 1991 through July 1995, 17 soil borings were advanced in the area of Sites SS-17 and SS-21 by ICF. From these borings, both surface and subsurface soil samples were collected and analyzed for VOCs and polynuclear aromatic hydrocarbons (PAHs). None of the analytes exceeded MDEQ Industrial Cleanup criteria (ICF, 1998k).

Site SS-21

From 1979 through 1981, the USGS and USAF contractors studied the TCE plume from the UST at Building 43. The studies concluded that the TCE was migrating under the influence of groundwater gradients. These gradients were both naturally occurring and driven by the base's water supply wells. The ASPTS, which was activated in December 1981, was designed to

extract groundwater from the SS-21 (Building 43) TCE plume at a rate of 300 gallons per minute (gpm) per well. The extracted groundwater was treated to MDEQ water quality standards with a reverse-flow air stripping system and an activated carbon filtration system. The treated water was then discharged through the base storm sewer system, which discharges through a National Pollutant Discharge Elimination System (NPDES) permitted outfall on Van Etten Creek. In 1983, approximately one year after the ASPTS went into full operation, the ASPTS consisted of five pumping wells (PW1, PW2, PW3, PW4, and AF3), and the plume concentrations had decreased substantially from the 1981 conditions. The downgradient portion of the plume (beyond the vicinity of pumping well AF1) was below 5 µg/L by 1983. In 1984, to provide a more effective capture zone, pumping well AF3 was replaced with pumping well AF1.

Site SS-47

In 1990, 1991, and 1992, Tracer Research Corporation performed leak tests on the 10,000-gallon premium gasoline UST along with two other regular unleaded gasoline USTs (20,000 gallon capacity each) located at the Base Gas Station. Tracer tests indicated that the tanks were not leaking. No information was provided for the three years between the reported 400-gallon fuel spill and the leak testing. After base closure in July 1993, product was removed from the three USTs (WWES, 1995). The three tanks were removed in the spring of 1996 (ICF, 1998k).

3.8.5 Basis for Taking Action

1,2,4-TMB, benzene, ethylbenzene, xylenes (total), PCE, toluene and TCE have been detected in groundwater at concentrations exceeding MDEQ Part 201 Industrial Drinking Water for groundwater. During SS-21 tank removal, ethylbenzene and xylenes exceeded MDEQ Industrial Drinking Water criteria in only one soil sample at a depth of 16.5 feet bgs. Although there are no current receptors exposed to groundwater, the groundwater ingestion pathway is a potential concern for future receptors.

ICF performed RIs (ICF, 1996a) to determine the current nature and extent of the soil and groundwater contamination at SS-17, SS-21, and SS-47. The RI was initiated because contaminants that could pose health risks to future receptors were detected in soil and

groundwater at the site during initial investigations. This section describes the results of those RIs, the extent of soil and groundwater contamination above MDEQ criteria, and summary findings of risk assessments performed as part of the RIs.

The COCs for soil include ethylbenzene and xylenes. Eight analytes with concentrations above the MDEQ Industrial Drinking Water criteria are considered COCs in groundwater, including: cis-1,2-DCE, 1,2,4-TMB, benzene, ethylbenzene, xylene (total), PCE, toluene, and TCE.

A site-specific risk assessment was performed by ICF using 1991 groundwater data and 1995 soil data for Sites SS-21 and SS-17. WWES conducted a site-specific risk assessment using 1993 soil and groundwater data from Site SS-47 (WWES, 1995).

The risk assessment for Sites SS-17 and SS-21 concluded that there is no unacceptable risk associated with the soils (ICF 1997a). There are currently no means for receptors to contact groundwater in the vicinity of Sites SS-17 and SS-21. Chemicals from this area will not migrate off site to potential residential groundwater areas while the ASPTS is in operation. However, if the ASPTS was shut down before acceptable levels are achieved, a future worker exposed to groundwater would have a lifetime cancer risk of 2×10^{-5} and a hazard index of 0.5.

Based on the Site SS-47 soil and groundwater results from the WWES 1993 investigation of Site SS-47 (WWES, 1995), along with the fate and transport modeling performed, WWES has determined that while the ASPTS is in operation, there are no significant migration/exposure pathways for residual contaminants in soils or groundwater (WWES, 1995).

3.9 LF-23

3.9.1 Physical Characteristics

Site LF-23 is a former landfill that was active from 1951 to 1953. The site is located in the southeast area of the base (Figure 1-2). The exact boundary of the landfill has never been confirmed. An aerial photograph from November 1955 shows a cleared area approximately 170 feet by 340 feet in an area located south of the POL yard and west of the railroad tracks. This

area, believed to be the location of the former landfill, was forested on the south, west and north sides.

3.9.2 Land and Resource Use

The historic land use of the site was a landfill that was never permitted. Site LF-23 is located on land still owned by the USAF. A parking lot currently covers part of this area, and the trees to the south have been cut down. Coal was formerly present on the ground surface southwest of the parking lot, up to a depth of several inches. Future use of Site LF-23 is classified as industrial or light industrial/commercial and the site contains landfill materials.

The groundwater aquifer underlying this area is not currently used as a drinking water source. The natural groundwater flow direction is to the east, although currently flow is to the north-northeast due to influence from the ASPTS.

3.9.3 History of Contamination

Wood debris, auto parts, and small quantities of oil and unknown solvents were disposed in the landfill associated with Site LF-23 from 1951 to 1953.

3.9.4 Initial Response

In 1990, a groundwater sample from the site was analyzed for TCE, benzene, and 1,2-DCE; TCE was detected at a concentration of 1 µg/L. A subsequent groundwater sample collected in 1990 by the USGS and exhibited no detections of VOCs. The site monitoring wells are abandoned.

In 1995, ICF performed an RI to confirm the location of the landfill and identify potential soil and groundwater contamination. ICF performed additional sampling in 1996. In addition, URS Group, Inc. (URS) performed a Supplemental RI during November 2001.

3.9.5 Basis for Taking Action

No further RA is planned because the BLRA determined that risks associated with exposure to soil and groundwater are acceptable under existing conditions. ICs and other restrictions

include industrial land use restrictions, drinking water restrictions, and construction of permanent markers.

ICF performed RIs to determine the current nature and extent of the soil and groundwater contamination at LF-23. The RI process was initiated because contaminants that could pose health risks to future receptors were detected in soil and groundwater at the site during initial investigations. This section describes the results of those RIs, the extent of soil and groundwater contamination above MDEQ criteria, and summary findings of risk assessments performed as part of the RIs.

During the 1995 RI, antimony and magnesium exceeded the June 7, 2000, MDEQ Residential criteria in soil samples, but were below MDEQ Industrial criteria. Iron concentrations exceeded both the June 7, 2000, MDEQ Residential and Industrial criteria. The 95% UCL was calculated by ICF in the RI (ICF, 1997b) for antimony, magnesium, and iron. The 95% UCL of 367 micrograms per kilogram (µg/kg) for antimony is below MDEQ Residential criteria. The 95% UCL of 5,971,000 µg/kg for iron is above MDEQ Residential and Industrial criteria. The 95% UCL of 12,139,000 µg/kg for magnesium is above MDEQ Residential criteria, but below Industrial criteria (ICF, 1997b). MDEQ has requested that UCL calculations be revisited because they do not reflect current guidelines for statistical analysis, as issued by the State of Michigan.

During the 1995 RI, no groundwater contaminants exceeded MDEQ Residential and Industrial criteria except for methylene chloride, a common laboratory contaminant. During the 2001 RI, three inorganics (total aluminum, total chromium, and total lead) were detected in exceedance of 2000 MDEQ Residential cleanup criteria; however, dissolved aluminum, chromium, and lead concentrations were below MDEQ Residential and Industrial criteria. Since the groundwater samples were collected using a geoprobe, the comparison of total metals concentrations to MDEQ criteria is not applicable due to the high turbidity and total solids resulting from this method. Based on the results of the RI in 1996 and Supplemental RI in 2001, metals concentrations in soil are not leaching to groundwater at concentrations above MDEQ criteria.

A site-specific BLRA was conducted for the soils and groundwater at Site LF-23 as part of the RI. The BLRA determined that risks associated with exposure to soil and groundwater are acceptable under existing land use conditions.

3.10 OT-24

3.10.1 Physical Characteristics

Site OT-24 is roughly bounded by Perimeter Road on the north, the 3-Pipes Drainage Ditch on the west, the Au Sable River on the south, and the base boundary on the east (Figure 1-2 and 3-8).

3.10.2 Land and Resource Use

The historic land use of the site was for residential housing for military personnel stationed at Wurtsmith AFB. Military housing is now being purchased for public housing. The predominant source of groundwater contamination at the site was from aviation maintenance activities associated with operation of Wurtsmith AFB. Contaminants include chlorinated solvents, including TCE and DCE, which are believed to have been generated and introduced to the subsurface in the aircraft maintenance areas or transported south in storm sewers.

The current land use and zoning for the area is residential. Access to the 3-Pipes Drainage Ditch is partially limited in areas by fencing. However, there is no apparent recreational use of the 3-Pipes Drainage Ditch. Future land use is expected to be residential.

The groundwater aquifer underlying the site is currently not used as a drinking water source, and future groundwater use is restricted by covenant. The dominant groundwater flow direction is to the south-southeast toward the 3-Pipes Drainage Ditch.

3.10.3 History of Contamination

The 3-Pipes Drainage Ditch (part of Site OT-24) was constructed in 1959 to convey storm water from the Base maintenance area to the Au Sable River. In 1963, an OWS pond was constructed at the headwater of the ditch. Contaminant sources that may have contributed to this site are the Nose Dock Area and Operational Apron (Site SS-08), which may have been a

historical source for the Mission Drive Plume, and overflow from the OWS pond which empties into the ditch. As early as November 1977, TCE was detected in Base water supply wells (AF18A and AF19) north of Perimeter Road and west of Mission Drive. According to the USGS (1983), TCE contamination extended at least 1,900 feet south of Perimeter Road and was detected at concentrations as high as 3,200 µg/L in the area of Site OT-24. The USGS also noted that TCE concentrations increased south of Perimeter Road, indicating that TCE was continuing to migrate towards the Au Sable River and the 3-Pipes Drainage Ditch. Groundwater modeling indicated that the water supply wells were drawing contaminants southward across a local groundwater divide. Modeling also indicated that the contaminants would continue to migrate south/southwest toward the 3-Pipes Drainage Ditch if the production wells ceased operation.

An RI was completed for Site OT-24 in 1994 (ICF, 1996f). Fifteen VOCs were detected in groundwater, but only cis-1,2-DCE, methylene chloride, trichloroethane (TCA), and TCE exceeded the MDEQ GSI criteria. Two distinct groundwater contaminant plumes (Plume A and Plume B) were identified based on the RI results. Plume A was characterized by two areas of high TCE; one centered around the middle of the MDPTS extraction wells and a second located west of the extraction wells near the 3-Pipes Drainage Ditch. Additional monitoring is underway near the 3-Pipes Drainage Ditch to better define the levels of TCE near and upgradient of the ditch. Preliminary results indicate that TCE remains below MDEQ GSI criteria near the 3-Pipes Drainage Ditch (unpublished TolTest data).

Plume B was defined as an area of much lower concentrations of TCE near Duell Lake. The Final RI Report (ICF, 1996f) summarized the results of additional groundwater and soil sampling during 1988 and 1989 in the Plume B area. The principal contaminant found in groundwater was TCE at concentrations up to 77 µg/L, with lower concentrations of cis-1,2-DCE. TCE was also detected in the OWS influent, contents, and discharge and downstream of the 3-Pipes Drainage Ditch outfall but not upstream of the discharge point.

3.10.4 Initial Response

As early as November 1977, TCE was detected in base water supply wells AF18A and AF19 located north of Perimeter Road and west of Mission Drive. By November 1983, the USGS had

installed a total of 49 wells to assess the extent of the TCE contamination. The USGS estimated that TCE contamination extended at least 1,900 feet south of Perimeter Road and was detected at concentrations as high as 3,200 µg/L south of Perimeter Road. The USGS identified a potential source of the TCE contamination near Building 5008, which is part of Site SS-08. Monitoring near Building 5008 has not revealed high concentrations of TCE, and this is not a continuing source. Long-term leakage from base flightline and housing area storm sewers discharging to the 3-Pipes Drainage Ditch also were considered as possible sources for TCE.

In 1985, the USGS completed their study of this area. The MDPTS was subsequently constructed to treat the TCE-impacted groundwater and became operational in June 1987. Three groundwater extraction wells were installed along Mission Drive, south of Perimeter Road, and a fourth was installed northwest of the intersection of Mission Drive and Perimeter Road.

The data collected during the RI were incorporated into a RAP (ICF, 1996g). The RAP recommended the continued use of the MDPTS for remediation of the groundwater impacts associated with Site OT-24. Alternate cleanup levels (ACLs) approved in the RAP were the MDEQ GSI criteria for on-base wells and MDEQ Residential Drinking Water criteria for off-site wells. On-base ACLs were proposed for TCE (94 µg/L), cis-1,2-DCE (232 µg/L), and 1,1,1-TCA (120 µg/L). Additionally, monitored natural attenuation (MNA) was selected as the RA for the southern portion of the plume that is not being captured by the MDPTS.

3.10.5 Basis for Taking Action

Hazardous substances, including TCE, cis-1,2-DCE, and 1,1,1-TCA, are present in groundwater at the site. These substances could cause significant human health risk if a pathway existed for groundwater ingestion. Restrictive covenants are now in place to prevent groundwater wells in on-base areas. Based on modeling completed by Wurtsmith AFB, indoor air levels resulting from soil vapors above the groundwater do not pose a significant health risk. If contaminated groundwater continues to migrate toward the 3-Pipes Drainage Ditch, potential impacts to surface water quality was a concern of the MDEQ.

ICF performed RIs to determine the current nature and extent of the soil and groundwater contamination at OT-24. The RI process was initiated because contaminants that could pose health risks to future receptors were detected in soil and groundwater at the site during initial investigations. This section describes the results of those RIs, the extent of soil and groundwater contamination above MDEQ criteria, and summary findings of risk assessments performed as part of the RIs.

The annual monitoring data collected by Montgomery Watson and URS from 1993 to 2002 indicates that 1,1,1-TCA, cis-1,2-DCE, TCE, and 3,3-dichlorobenzidine (DCBD) have historically exceeded ACLs for on-site wells. However, TCE is the only constituent that has exceeded the ACLs for on-site wells in samples collected since 1996. Methylene chloride concentrations exceeded the ACL criteria in only one sample throughout 1994 to date, and is likely a laboratory artifact. The only constituents exceeding MDEQ Residential criteria for off-site wells are TCE and cis-1,2-DCE.

Three site-specific risk assessments were performed by ICF at Site OT-24. A baseline human health risk assessment was designed to evaluate the potential for adverse human health effects, in the absence of additional RA, under current and potential future site conditions. An ecological risk assessment was designed to evaluate the potential for adverse effects to non-domesticated plants and animals. Additionally, ICF performed a human health risk assessment to evaluate indoor air exposure pathways.

The baseline human health risk assessment was performed to provide a qualitative and quantitative analysis, in a conservative and health-protective manner, of the likelihood of adverse human health effects which may be associated with potential exposures to the contamination in environmental media at Site OT-24. The conclusions of the baseline human health risk assessment were that the only unacceptable risks were to a potential future adult or child resident. The unacceptable risk is associated with the ingestion of groundwater. TCE is the contaminant responsible for the unacceptable risks. There were no unacceptable risks for current residents because current residents are restricted from access to Site OT-24 groundwater as a drinking water source; therefore, there is no completed exposure pathway (ICF, 1996f).

The evaluation of the indoor air exposure pathway was conducted because of the concern over the potential for VOCs (specifically TCE) in the groundwater to volatilize and infiltrate the living spaces of houses constructed over the groundwater plume at Site OT-24. The conclusion of this evaluation was that there were no unacceptable risks associated with the volatilization of TCE from the groundwater plume (ICF, 1996f).

The ecological risk assessment was performed to provide a qualitative and quantitative analysis of the potential for adverse effects to non-domesticated plants and animals that may be associated with potential exposures to the contamination in environmental media at Site OT-24. The conclusions of the ecological risk assessment were that there were no unacceptable risks to flora or fauna it the Site OT-24 area due to ingestion or direct contact of surface water or sediments.

3.11 LF-26

3.11.1 Physical Characteristics

Site LF-26 is a former landfill located along Lake Shore Drive, east of the SAC apron (Figure 1-2). Adjacent land uses include a SAC operational apron to the west, Van Etten Lake to the east, a field to south, and a wooded area to the north. The area is not located within a flood plain, its terrain is flat, and the ground coverage is grass and forested areas.

The exact boundary of the landfill has never been completely delineated. The expected location of the landfill was the disturbed area identified by an aerial photograph taken November 14, 1955.

3.11.2 Land and Resource Use

Site LF-26 is zoned industrial (I). Landfill LF-26 was reported to have been used from 1949 to 1951 for the disposal of wood, coal ash, broken concrete, and automobile parts (Radian, 1985).

In October 1992, heavy equipment operators who were performing maintenance on the road between the fence and the tree line uncovered what appeared to be trash (i.e., paper, plastic, etc.). The reviewed aerial photographs (1955, 1965, 1968, and 1978) did not show disturbances close

to the fence line, nor did they show any differences in the amount of forested areas. This would suggest that the material buried here is limited to the area occupied by the road. An aerial photograph taken May 15, 1965 reveals several disturbed areas south of the identified Landfill 26. These areas range from approximately 100 to 200 feet in length, and 25 to 75 feet in width. An aerial photograph taken on May 24, 1968 shows grass growing on the disturbed areas.

Future use of the area is expected to be industrial.

The groundwater aquifer underlying the site is currently not used as a drinking water source. The dominant groundwater flow direction is to the northeast toward Van Etten Lake.

3.11.3 History of Contamination

In April 1994, an interview was conducted with an airman who had been stationed at the base from 1956 to 1958. He described dumping material into a trench on a weekly basis. The material included drums of solvents from a typewriter repair shop, drums of nuts and bolts, and material collected as part of general housekeeping at the two hangars. He estimated that one drum per week was disposed in the landfill. All items were taken to a trench described as approximately 15 feet deep and 18 to 20 feet wide. When the trench was filled to a depth of approximately 6 feet, the material was covered with the previously excavated soil and the trench was continued to the north. It is unknown when the use of the trench was discontinued. The interviewee could not identify the exact location of the trench, but thought it should be approximately 15 feet west of the dirt road that is currently inside the fence.

3.11.4 Initial Response

No compounds were detected in groundwater samples collected by the USGS in 1991 from the Korroch and Brown residential wells located downgradient of the landfill.

In 1994, ICF performed a RI (ICF, 1996e) using geophysical methods to identify potential anomalies to be investigated by test pits, surface soil samples, subsurface soil samples, and groundwater samples from existing wells and temporary multi-level wells. ICF performed additional testing in 1996.

3.11.5 Basis for Taking Action

No further RA is planned because the BLRA determined that risks associated with exposure to soil and groundwater are acceptable under existing conditions. The *in situ* leachate tests indicate that the leaching of landfilled materials (especially SVOCs) is minimal and should not result in exceedance of MDEQ Residential or Industrial Drinking Water cleanup criteria. ICs and other restrictions include industrial land use restrictions, drinking water restrictions, and construction of permanent markers are proposed for Area A only because arsenic and lead concentrations detected in Area A exceed the MDEQ residential direct contact criteria. Although the 95 percent UCL for arsenic and the mean site-wide lead concentration for soil were below the MDEQ residential direct contact criteria, ICs were implemented as a conservative approach.

The 95 percent UCL was calculated for arsenic and beryllium. The calculated 95 percent UCL for each of these constituents was below MDEQ Residential Direct Contact criteria. The detected lead concentrations in soil (which were estimated) above the MDEQ Residential and Industrial Direct Contact criteria were averaged over Area A, and the mean site-wide lead concentration for soil was calculated to be below the MDEQ Industrial and Residential Direct Contact criteria (ICF, 1998c). MDEQ has requested that UCL calculations be revisited because they do not reflect current guidelines for statistical analysis, as issued by the State of Michigan.

The only exceedance of MDEQ Residential and Industrial Drinking Water criteria for collected groundwater samples was bis(2-ethylhexyl)phthalate. Additional field work consisting of three groundwater samples from three monitoring wells near the previous location and downgradient indicated no exceedance of MDEQ Residential or Industrial Drinking Water criteria. A base-wide sampling program also indicated non-detect for bis(2-ethylhexyl)phthalate. Since this compound was not detected at the location it had been previously detected or other nearby locations, the compound does not appear site-related (ICF, 1998c).

In situ leachate tests were performed to evaluate the potential leaching of soil contaminants to groundwater under the MDEQ Residential and Industrial Drinking Water cleanup criteria. The tests indicate that the leaching of landfilled materials (especially SVOCs) is minimal, or does not

appear to be leaching to groundwater, and should not result in exceedances of MDEQ Residential or Industrial Drinking Water cleanup criteria (ICF, 1998e).

Based on these comparison methods, the detected contaminants at LF-26 are below MDEQ Residential and Industrial criteria for soil and groundwater.

During the RI, a BLRA was performed to assess the potential human health and ecological risks, if any, that could result if contamination identified at Landfill 26 was not addressed in some manner. The conclusion of the risk assessment for Site LF-26 was that the site did not pose an unacceptable risk for human health or the environment.

3.12 LF-27

3.12.1 Physical Characteristics

Site LF-27 is a 6.5-acre former landfill located adjacent to a wetland area near the southwest corner of the Base (Figure 1-2 and 3.9). Currently, the site is well vegetated with grasses, bushes, and trees. The portion of the site bordering the wetland is fairly steep, and concrete debris can be seen extruding from the soil bank in some locations. There are areas on the ground surface that are unvegetated and that are covered with a black sooty material presumed to be fly-ash. USAF personnel have reported that leachate has historically seeped from the landfill at unspecified locations.

3.12.2 Land and Resource Use

The historic land use of the site was a landfill. From 1950 to 1972, the landfill received coal ash, concrete, asphalt, and metals. The land use and zoning has been revised from recreational to industrial. Future land use is expected to be consistent with the current zoning.

The groundwater aquifer underlying the site is currently not used as a drinking water source. The dominant groundwater flow direction is to the south-southeast, where it discharges to a wetland tributary to the Au Sable River.

3.12.3 History of Contamination

In 1990, drums and metal debris were removed from the landfill surface. Surface water samples collected at that time in the adjacent wetlands identified toluene in four areas and cis-1,2-DCE in one area, with arsenic and high levels of iron. Groundwater samples identified local occurrences of 1,1,1-TCA and bromodichloromethane.

3.12.4 Initial Response

Aside from the SIs that have taken place at LF-27, no other active responses have been taken by the USAF. Additional investigations and assessment activities are currently underway for this site to address the PCE concentrations and metals migrating to the wetlands in groundwater. There are no active remedial systems or objectives in place at Site LF-27.

3.12.5 Basis for Taking Action

This site is currently under investigation and monitoring to determine if remedial activities are required to reduce the potential impacts of PCE discharging to surface water. No RAP has been signed for Site LF-27.

ICF performed an RI to determine the current nature and extent of the soil, groundwater, sediment, and surface water contamination at LF-27. The RI process was initiated because contaminants that could pose health risks to future receptors were detected at the site during initial investigations.

Groundwater

Groundwater sampling for the initial RI indicated, in general, that groundwater had not been significantly impacted at or downgradient of Site LF-27. Only manganese (522 µg/L) in one groundwater sample exceeded the MDEQ Industrial Drinking Water criterion.

Soil

Arsenic (12,800 µg/kg) detected in one soil sample from an RI test pit within the landfill exceeded the statewide default background level (5,800 µg/kg), but was less than the MDEQ

Industrial Direct Contact level (83,000 µg/kg). Arsenic (13,100 µg/kg) was also detected in one surface soil sample within the landfill area. However, no groundwater samples from the RI contained arsenic at concentrations greater than the Industrial Drinking Water criterion (11 µg/L), suggesting that the arsenic in soil is not leaching to the groundwater. The USAF has conducted additional soil sampling for arsenic to provide a statistically valid data base for evaluating arsenic levels at the site. This data is currently under review.

Surface Water

Surface water samples from the RI identified the presence of 4,4-dichlorodiphenoltrichloroethane (DDT) and alpha-benzene hexachloride (BHC) at concentrations greater than the GSI Criteria. These concentrations are attributed to the historical spraying of herbicides and pesticides at the edge of the wetlands to control vegetation and insects, and are not related to the landfill. PCE has also been detected during the RI and during annual monitoring of groundwater seeps discharging to the Au Sable River wetlands. PCE concentrations that slightly exceeded the 45 µg/L MDEQ GSI criteria were detected at two seeps in December 2002. The USAF is conducting additional groundwater sampling near and upgradient of the seeps to determine the extent of the PCE contamination. This data is currently under review.

Manganese and arsenic were detected during the initial RI in surface water exceeding the MDEQ Industrial Drinking Water criteria and/or GSI criteria. The manganese and arsenic exceedances were believed to be attributed to other upgradient contaminant sources and were due to the fact that surface water samples were not filtered and contained suspended sediments. Annual monitoring samples from 2002 indicate that only manganese is potentially leaching from the landfill at levels above MDEQ Industrial Drinking Water criteria.

Sediment Samples

Lead was detected during the RI in one sediment sample at concentrations greater than the MDEQ Industrial Direct Contract criterion at 446,000 µg/kg. This sample was not downgradient of the landfill and, therefore, not attributed to the landfill. Arsenic was detected in four sediment

samples at concentrations greater than the Statewide Default Background level (5,800 µg/kg), but less than the MDEQ Industrial Direct Contact criterion (83,000 µg/kg) at concentrations ranging from 8,100 µg/kg to 57,900 µg/kg. Arsenic in these samples was indicated to potentially be related to the landfill.

3.13 LF-30 AND LF-31

3.13.1 Physical Characteristics

LF-30 is an approximate 27-acre domestic and industrial waste landfill that operated from 1960 to 1973. LF-31 is an approximate 74-acre landfill that operated between 1973 and 1979. The sites are located in the northern portion of the base just south and east of the Defense Re-utilization and Marketing Office (DRMO) yard (Figure 1-2 and 3-10).

3.13.2 Land and Resource Use

These areas were used as landfills from 1960 through 1979. While the base was in operation, these landfills received municipal and industrial waste generated by base activities.

In 1971, two 6,000-gallon tank trailers were buried in the center of LF-30 and were used for temporary storage of JP-4, oils, solvents, thinners, and lubricants. In 1973, LF-30 was closed and capped with pervious fill material and vegetated, in accordance with regulations existing at that time.

LF-31 reportedly received municipal and industrial wastes. During its operation, the dumping of sewage, drums, solvents, oils, and metal was banned. Approximately 18 acres of the landfill were used for disposal of municipal waste. The remainder of the landfill received only demolition debris, such as concrete rubble, asphalt, lumber, and, potentially, some paint cans and metal. In October 1979, LF-31 was closed for non-compliance with the Michigan Solid Waste Management Act of 1978 due to its location in permeable sand.

The groundwater aquifer underlying the site is currently not used as a drinking water source. The dominant groundwater flow direction is to the east, where it ultimately discharges to Van Etten Lake.

Groundwater flows from these sites in an eastward direction towards Van Etten Lake and passes beneath a summer camp operated by the Young Men's Christian Association (YMCA).

3.13.3 History of Contamination

In 1979, the USGS found contaminants in the groundwater downgradient of the landfills. Additional sampling of groundwater and soil at the site revealed contamination of these media at concentrations that warranted RA at the site. An RI conducted by ICF in 1996 (ICF, 1996i) demonstrated groundwater contamination in excess of MDEQ Part 201 residential criteria, with a plume emanating from the landfills flowing in a northeast direction off-site toward Van Etten Lake. The principal groundwater contaminants for these landfills are benzene, cis-1,2-DCE, ethylbenzene, methylene chloride, TCE, VC, and xylenes. In addition, it is believed that anoxic conditions in the aquifer downgradient of the landfills have resulted in increased dissolved iron concentrations. Once the impacted groundwater discharges to the Van Etten Lake beachfront (currently owned by the YMCA), the dissolved iron is re-oxidized and precipitates, producing an orange staining on the beach sand. Though the discolored beach sand currently does not pose a human health risk, it does produce an undesirable aesthetic impact deemed unacceptable by the property owner and the MDEQ Part 201.

3.13.4 Initial Response

In 1979, the tank trailers in LF-30 were excavated and removed with no evidence of leaks was encountered.

In response to a 1980 consent decree, Wurtsmith AFB installed an engineered partial cover over the former sanitary waste disposal area at LF-31 and provided connection to the municipal water supply system to off-site properties affected by the LF-30/31 groundwater plume. A limited groundwater monitoring program has been conducted since 1979.

Additionally, an air sparging (AS)/PTS was installed along the base boundary and was activated in December 2001. The system is designed to treat groundwater contamination consisting primarily of VOCs along the Base boundary at LF-30/LF-31 to meet MDEQ Residential Drinking Water criteria. Another intended benefit of the AS component of this

system was to introduce oxygen to the subsurface with the intent of oxidizing the reduced iron in the groundwater before it discharged into the Van Etten Lake. This would presumably minimize the aesthetic impact of the iron staining along a portion of the Van Etten Lake beachfront.

3.13.5 Basis for Taking Action

The USAF, MDEQ and USEPA are currently reviewing the need for additional RAs at Site LF-30/31. No RAP has been signed for LF-30/31. The USAF is collecting data from the AS/PTS to assess the impact of the first two years of operation. Section 6.4 provides a review of remediation data collected to date.

The comprehensive risk assessment for LF-30/31 concluded that there was no current threat to human health and the environment, and the groundwater impacted by LF-30/31 is not used as a potable water supply (ICF, 1996i). However, contaminated groundwater has migrated beyond the area under USAF control. Alternate potable water supplies are in place for the YMCA camp, but long-term groundwater use restrictions are needed to maintain protectiveness. Negotiations for these measures are in progress. The MDH will no longer issue new well permits for contaminated groundwater areas near Van Etten Lake.

In addition, impacted groundwater containing high dissolved iron has had unacceptable impacts to the Van Etten Lake beach on the off-site YMCA property. No ecological risks exist at Van Etten Lake and remaining off-base TCE is at concentrations below MDEQ GSI criteria.

3.14 SS-51

3.14.1 Physical Characteristics

Site SS-51, also known as the KC-135 Crash Site, is located approximately 600 feet north of the center of the former ACC instrument runway and 8,900 feet from the north end of the runway at Wurtsmith AFB (Figure 1-2 and 3-11).

3.14.2 Land and Resource Use

Site SS-51 is zoned as industrial airfield. The proposed site-specific closure for Site SS-51 is Site-Specific Industrial Closure with Restrictions.

The groundwater aquifer underlying the site is currently not used as a drinking water source. Groundwater flow data obtained from monitoring wells by Parsons in 1994 indicate that the direction of groundwater flow at Site SS-51 is predominately to the southeast.

3.14.3 History of Contamination

In October 1988, a KC-135 crashed while attempting to land. Approximately 3,000 gallons of JP-4 were in the fuel tanks at the time of the crash. An unknown amount of fuel was consumed in the ensuing fire, and the remaining fuel percolated into the ground.

3.14.4 Initial Response

The USGS conducted an initial SI during March 1989 to determine the nature and extent of the contamination at Site SS-51. The soil gas survey indicated that soil and groundwater immediately adjacent to and downgradient from the crash site were contaminated with fuel hydrocarbons. LNAPL was measured in source area monitoring wells between April 1989 and June 1991. From 1989 to 1991, LNAPL thickness ranged from a thin sheen to 1.58 feet in monitoring well USGS-4, and from a thin sheen to 1.31 feet in monitoring well USGS-7. No LNAPL was measured in these wells or in new monitoring wells during subsequent SIs (USGS, 1990). An MNA study completed on this site concluded that the plume was stable of receding and that confirmation monitoring was the only action required at the site (Parsons, 1996b).

3.14.5 Basis for Taking Action

Ethylbenzene, xylenes, 1,2,4-TMB, and 1,3,5-TMB have been detected in groundwater at concentrations exceeding MDEQ Part 201 Industrial Drinking Water criteria. There are no current receptors exposed to impacted groundwater, and the location of this site between the runway and taxiway make any future groundwater ingestion pathway very unlikely.

Groundwater analytical data collected from 1992 through 1996 indicate BTEX, 1,2,4-TMB, and 1,3,5-TMB concentrations in exceedance of MDEQ Residential and Industrial criteria. Groundwater analytical data collected by Montgomery Watson from 1997 through 2001 indicates toluene, ethylbenzene, xylenes, 1,2,4-TMB, 1,3,5-TMB, iron, and manganese were

above MDEQ Residential and Industrial criteria. The main COCs for groundwater include ethylbenzene, xylenes, 1,2,4-TMB, and 1,3,5-TMB.

Dissolved groundwater contamination has not migrated in the past 10 years, and the hydrocarbon plume appears to be shrinking in size. Concentrations of TEX and the TMB isomers have exceeded the MDEQ Industrial Drinking Water cleanup criteria during sampling events in 1997 through 2002 but are limited to source area monitoring wells USGS-4 and W409S.

There does not appear to be a significant source of residual contamination at this location, based on soil samples and the absence of free product in the monitoring wells. The risk assessment (contaminant release and transport screening assessments) determined that groundwater is the only impacted environmental medium at the site that could possibly be an exposure pathway. The RI report compared measured concentrations of the BTEX compounds and naphthalene in soils and groundwater to MDEQ defined generic cleanup criteria. Based on this comparison, the RI report concluded that site-related contamination did not present a risk to human health through the air inhalation pathway or as a result of direct contact with contaminated soils. Potential adverse impacts from contaminants leaching from soils into groundwater and from groundwater migrating to and discharging into surface water bodies also were determined to be negligible (Parsons, 1996b).

3.15 SS-57

3.15.1 Physical Characteristics

Site SS-57 consists of a World War II vintage refueling hydrant system that underlies the Base Operational Apron (BOA) in the eastern central portion of the Base (Figure 1-2 and 3-12).

3.15.2 Land and Resource Use

Site SS-57, historically used as an aircraft fueling area, was taken out of service in 1972. The USTs at the site continued to be used until Base closure in June 1993. It is not known if the system was purged or the exact procedure used to abandon it in 1972. The hydrant fueling

system was decommissioned in 1995, including removal of the hydrant system piping, two 50,000-gallon and one 12,000-gallon USTs, and six apron hydrants.

The zoning for Site SS-57 is industrial, industrial aviation support, and light industrial/commercial. The proposed site-specific closure for Site SS-57 is Site-Specific Industrial Closure with Restrictions.

The groundwater aquifer underlying this site is not used as a drinking water source. Groundwater flow in the vicinity of the BOA is generally toward the east. However, groundwater flow east of the BOA is locally influenced by operation of the ASPTS. Operation of the groundwater extraction system creates a southerly flow component in the vicinity of these monitoring wells. Based on available site-specific hydrogeologic data, horizontal groundwater flow velocities in the vicinity of the BOA range from approximately 1.1 feet per day (ft/day) to 9.5 ft/day. The higher groundwater flow velocities are expected in the vicinity of the ASPTS, where steeper gradients have been induced by the operation of the system.

3.15.3 History of Contamination

In late 1983, benzene was detected in water supply well AF2. In January 1984, four monitoring wells were installed and sampled by the USGS in the immediate vicinity of AF2 in an effort to determine the source of benzene. Groundwater samples were analyzed for VOCs. Benzene was not detected in the monitoring wells.

The search for the source of benzene at AF2 was then expanded through May 1985 with the installation of additional monitoring wells in the vicinity of well AF2 and on the east and west side of the BOA. The newly installed monitoring wells were sampled by the USGS and analyzed for VOCs. BTEX and DCE were detected in groundwater samples collected from the newly installed wells. The majority of analytes detected were fuel components. The source of the elevated concentrations of fuel-related components in groundwater samples was assumed to be the former UST located hydraulically upgradient of the hydrant fueling system. Free product has been detected in several SS-57 source area wells.

3.15.4 Initial Response

The hydrant refueling system was decommissioned in 1995 by Brown & Root Environmental (B&RE). B&RE was retained by the Air Force Center for Environmental Excellence (AFCEE) to perform the following tasks at the BOA during the summer of 1995:

- Remove or abandon in-place (via cement plugs at end of abandoned sections) the hydrant system piping;
- Demolish Building 5081;
- Remove the USTs associated with the hydrant system; and
- Excavate and remove the six apron hydrants.

Generally, soil samples were collected at depths of 4 to 7 feet below grade at every 100 feet of pipeline or at each pipeline connection. Soil samples were analyzed for VOCs, PAHs, and lead. Elevated levels of toluene, ethylbenzene, xylenes, diesel range organics (DRO), gasoline range organics (GRO), and PAHs were detected at locations along the hydrant system located beneath and immediately adjacent to the BOA. Lead concentrations were detected, but were below MDEQ criteria for soil.

A combination bioventing and biosparging system was installed on the site in 2002. During system startup, there were concerns about vapor migration from areas with free product. During 2003, a decision was made to proceed with system startup using a temporary SVE system to control vapor migration.

3.15.5 Basis for Taking Action

Anthracene, benzo(a)pyrene, ethylbenzene, dibenzo(a,h)anthracene, nitrobenzene, 1,2,4-TMB, 1,3,5-TMB and xylenes have been detected in soil at concentrations exceeding MDEQ Part 201 Industrial Drinking Water Protection criteria. Benzene, bis(2-ethylhexyl)phthalate, ethylbenzene, n-propylbenzene, 1,2,4-TMB, 1,3,5-TMB, and xylenes have been detected in groundwater at concentrations exceeding MDEQ Part 201 Industrial Drinking Water criteria. Although there are no current receptors exposed to impacted soil and groundwater, the soil to

groundwater leaching and the groundwater ingestion pathway are potential concerns for a future receptor.

Soil

Ethylbenzene, 1,2,4-TMB, 1,3,5-TMB, xylenes, anthracene, and nitrobenzene exceed MDEQ Industrial Drinking Water Protection criteria. Benzo(a)pyrene and dibenzo(a,h)anthracene exceed MDEQ Industrial Direct Contact criteria. Soil COCs consist of ethylbenzene, 1,2,4-TMB, 1,3,5-TMB, xylenes, anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, and nitrobenzene.

Groundwater

Following the June 2001 sampling, only six compounds exceeded MDEQ Industrial criteria. These compounds include 1,2,4-TMB, 1,3,5-TMB, benzene, ethylbenzene, xylenes, and bis (2-ethylhexyl)phthalate. N-propylbenzene concentrations exceeded MDEQ Residential criteria, but were below MDEQ Industrial criteria. Therefore, the main COCs are 1,2,4-TMB, 1,3,5-TMB, benzene, ethylbenzene, xylenes, bis (2-ethylhexyl)phthalate, and n-propylbenzene.

Surface Water

The nearest surface water to Site SS-57 is Van Etten Lake, located 4,500 feet downgradient. The contaminant plume migration is currently within the capture zone of the ASPTS and are also biodegrading in the aerobic aquifer.

3.16 ST-68

3.16.1 Physical Characteristics

Site ST-68 is comprised of an area that formerly contained OWSs servicing buildings 5067 and 5068 within the general SS-08 area, also referred to as Nose Dock 3 (Figure 1-2). The OWS servicing Building 5067 had a 500-gallon capacity, and was constructed of concrete mostly below the ground surface at the southeast corner of the building. This OWS along with another that serviced Building 5068 was located in-line between a hangar and the sanitary sewer line.

3.16.2 Land and Resource Use

The OWSs at Site ST-68 were used from 1960 to 1993 in conjunction with aircraft maintenance while the base was operational.

The groundwater aquifer underlying this site is not used as a drinking water source. Natural groundwater flow in the vicinity is generally toward the east, although it is currently influenced by the PTSs in operation at the Base.

3.16.3 History of Contamination

In September of 1993, the OWS was cleaned and sampled. After cleaning, four soil borings were drilled adjacent to the OWS and soil samples were collected and analyzed for BTEX, lead, total petroleum hydrocarbons (TPH), and base neutral acids (BNA) extractables. One soil sample exhibited concentrations of ethylbenzene and total xylenes in exceedance of MDEQ generic residential and industrial Drinking Water Protection criteria and GSI Protection criteria. Other analyzed constituents did not exceed the applicable criteria.

3.16.4 Initial Response

The OWSs were cleaned, sampled, and subsequently removed from service by Ogden Environmental in November 1993. In May 2003, the OWSs were excavated and removed along with the soil immediately surrounding OWSs (approximately 300 cubic yards). All excavated material was disposed of off-site. Additionally, confirmatory soil samples were collected and analyzed for VOCs and SVOCs. The OWS excavations were backfilled with approximately 1,000 cubic yards of sand and 80 cubic yards of clean topsoil.

3.16.5 Basis for Taking Action

No RAP has been signed for Site ST-68. Hazardous substances including benzene, ethylbenzene, total xylenes, 1,3,5-TMB, 1,2,4-TMB, tert-butylbenzene, n-butylbenzene, sec-butylbenzene, and n-propylbenzene have been released to soil and groundwater at the site.

The pathways of concern associated with the unacceptable risk are direct contact with soil and the ingestion of groundwater. Direct soil contact is unlikely given the depth of the contamination

and water ingestion would require an industrial well to be sited directly over the site. However, without a restrictive covenant on industrial groundwater use, future ingestion is possible.

3.17 ST-69

3.17.1 Physical Characteristics

Site ST-69 is located within the DRMO facility (Figure 1-2 and 3-13). The DRMO facility is located on the northeast corner of the base and contains two facilities, the former Hazardous Waste Storage Facility (HWSF) and the Storage Yard (SY). The USAF retained B&RE in 1995 to complete the RCRA Closure of the HWSF and the SY at the DRMO complex. These two areas were previously regulated under the RCRA and Michigan's Hazardous Waste Management Act 64. Both areas were operated under interim status as HWSFs and were subject to the closure requirements of 40 CFR 265 Subpart G.

The HWSF, constructed in 1990, consists of four covered concrete storage pads with catch basins to collect any precipitation or spilled material. The SY consists of a 330 feet by 120 feet exposed storage area located on the eastern side of the DRMO facility. The western half of the SY is covered with a steel mesh and served as a driveway, parking area, and storage area. Hazardous wastes were stored in the SY until the construction of the HWSF.

3.17.2 Land and Resource Use

Historic use of the area was for storage of various materials, including hazardous waste. All storage activities at the DRMO facility ceased on October 1, 1993 (B&RE, 1997). Site ST-69 is zoned as light industrial/commercial, and future use is anticipated to be in accordance with this classification.

The groundwater aquifer underlying this site is not used as a drinking water source. Groundwater flow in the vicinity is toward the northeast.

3.17.3 History of Contamination

As part of a two phase SI in 1995 and 1996, a TCE plume in groundwater was identified that was approximately 300 feet long, 90 feet wide, and 10 feet thick. The highest concentration of

TCE detected in groundwater during that investigation was 12 μg/L. Although there has never been a spill, leak, or release reported at this facility, hazardous wastes were stored in the SY until the construction of the HWSF. According to a May 9, 2002, letter from Montgomery Watson to MDEQ Waste management Department, the source of TCE was most likely the result of an inadvertent spill on the ground in the vicinity of a 1,000-gallon UST associated with Site OT-45 located next to Building 5608 at the DRMO facility.

The UST at OT-45 that leaked may have contained heating oil. Site OT-45 was previously closed as a NFRAP site after a period of MNA. However, free product was noted in well VW-1 recently. A sample of the product was analyzed and the dissolved petro concentrations were below Federal maximum contaminant levels (MCLs).

3.17.4 Initial Response

B&RE performed investigative activities at the DRMO in two phases, Phase I and Phase II (B&RE, 1997). Phase I SI activities were performed at the DRMO in June 1995, and included field screening of soil, installation of temporary wells, collection of soil and groundwater samples, and decontamination of the HWSF concrete pads using a triple rinse procedure. Phase II SI activities conducted by B&RE in December 1995 included the collection of additional soil samples to further evaluate methylene chloride and VOCs, and the collection of additional groundwater samples for delineation and characterization of VOC concentrations.

3.17.5 Basis for Taking Action

TCE has been detected in groundwater at concentrations exceeding MDEQ Part 201 Industrial Drinking Water criteria. There are no current receptors exposed to impacted groundwater, and the groundwater ingestion pathway can be eliminated through on-base groundwater use restrictions until drinking water criteria are achieved. No RAP has been signed for Site ST-69.

The most recent sampling event conducted in May 2002 indicates that the only well with an exceedance of MDEQ Residential and Industrial criteria for TCE is well ST69-TW1 (5.8 μg/L). This well has exhibited slight variations in TCE concentrations above and below the MDEQ criteria but has exhibited a steady downward trend.

According to the Montgomery Watson letter dated May 9, 2002, at this time, there are no completed exposure pathways for the groundwater contamination at ST-69. There are currently no potable water wells in the vicinity of site ST-69, and the Base and surrounding property owners currently obtain potable water from the Township of Oscoda. Based on the analytical data collected to date, TCE is not migrating to the Base boundary at concentrations greater than the MDEQ Part 201 Residential Groundwater criteria. Therefore, off-site receptors are not at risk. In addition, an IC prohibiting the use of groundwater at the site will be maintained. This IC is currently in effect via a lease agreement between the USAF and the Township of Oscoda.

3.18 WP-70

3.18.1 Physical Characteristics

Site WP-70 (formerly known as POI-32) consists of an irregular area approximately 400 feet by 1,000 feet that is roughly bounded by Perimeter Road on the south and Mission Drive on the east (Figure 1-2). A transmitter site and Building 5000 are located just southwest and east (mid point of site area between Mission Drive and site), respectively. Based on historical aerial photographs and site maps, site topography has changed over the years.

3.18.2 Land and Resource Use

Site WP-70 was previously used to dispose of landscape waste, concrete fragments, and surplus asphalt. The area was also used as a sand-fill storage and borrow area during construction of housing on the base which occurred in 1964. During the late 1960s, trucks entered the site from the east and dumped broken concrete, asphalt, and possibly scrap metal from small projects on base. Leaves and grass clippings were also dumped on site. According to available aerial photographs, the area appears to have been used for sand borrow and possible disposal since the early 1960s.

Site WP-70 is zoned as recreational vehicle. Future use of the site is anticipated to remain recreational.

The groundwater aquifer underlying this site is not used as a drinking water source. However, groundwater flow in the vicinity is toward the southeast which is an on-base residential area.

3.18.3 History of Contamination

No soil or groundwater sampling has been performed at Site WP-70. However, a geophysical survey which involved the excavation of 11 test pits to a depth of approximately 20 feet was performed in 1996. During this survey, the only material identified which is not classified as construction and demolition debris by the MDEQ included a half-buried empty crushed drum, and some asbestos–containing material (ACM), including transite pipe and sheets. Since subsurface ACM was likely disposed prior to enactment of the solid waste management regulations, and appears to be in small quantities and not impacting the groundwater, it is recommended that it be left in place and that deed restrictions be placed on the land.

3.18.4 Initial Response

Since this site was formerly used as a disposal area for numerous materials, a geophysical survey was conducted at this site by Versar in 1996 during the SI (Versar, 2000a). The geophysical survey was used to locate and to characterize the extent and depth of fill material and presence of metal debris (e.g., drums), construction debris, geologic variations, and saturated zones to a depth of approximately 20 feet.

3.18.5 Basis for Taking Action

Soil

The non-friable ACM that was visible in surface soils was removed in October of 2003. The only potentially complete exposure pathway at Site WP-70 would involve digging in the area, uncovering buried ACM, and rendering it friable. Since a relatively small amount of transite material was identified at Site WP-70, this scenario, while possible, is not likely. Therefore, restricting access, future activities, or construction at the site should provide added protection of human health.

Groundwater

Groundwater underlying Site WP-70 is unlikely to be impacted by the small quantity of transite material located at Site WP-70 because it is non-friable and therefore unlikely to leach. However, groundwater underlying this site will be restricted to prevent drinking water

consumption due to potential groundwater contamination from Site OT-24, which is adjacent to Site WP-70.

3.19 SS-71

3.19.1 Physical Characteristics

Site SS-71 (formerly referred to as POI-20) is a septic field for the former Jet Engine Test Cell (Building 5045) located in the eastern central portion of the base (Figure 1-2 and 3-14).

3.19.2 Land and Resource Use

Site SS-71 (formerly referred to as POI-20) was used as a septic field from a test cell; operations at the site ceased in 1993. Future land use has not yet been described for this site, although it is likely that groundwater use restrictions will be put in place.

The groundwater aquifer underlying this site is not used as a drinking water source. Groundwater flow in the vicinity is toward the east-northeast.

3.19.3 History of Contamination

In a 1996 SI, lead and PCE were detected in soil samples at concentrations greater than the MDEQ criteria. Additional soil and groundwater sampling by Versar in May 1999 (Versar, 2000b) identified multiple VOCs (including PCE), but none exceeding MDEQ criteria.

Additional Geoprobe® investigations were performed at SS-71 by URS in November 2001 (URS, 2002a). PCE was identified in groundwater samples at concentrations slightly greater than the MDEQ Residential Drinking Water criterion.

3.19.4 Initial Response

Except for the SIs described above, and annual monitoring of two wells, no other responses have been taken by the USAF at this site.

3.19.5 Basis for Taking Action

In 2002, two monitoring wells (SS71-MW1 and SS71-MW2) were installed at SS-71. These wells were sampled for VOCs for the first time in July 2002 and indicated that PCE was present

at 6.17 µg/L, slightly exceeded the MDEQ Residential and Industrial Drinking Water criterion (5.0 µg/L) at SS71-MW1. No RAP has been signed for Site SS-71.

SECTION 4

REMEDIAL ACTIONS

Based on the results of the RIs and assessments of the nature and extent of contamination, RAOs were developed for most sites. The RAOs were then used to select RAs for each of the sites. In accordance with CERCLA and the NCP, the overriding goals for any RA are protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). A number of remedial alternatives were considered for each of the sites, and final selection was made based on implementability, ability to achieve RA goals, protectiveness of human health and the environment, and cost. At the time of this review, RAs and/or final DDs were at various stages of implementation and approval. For each IRP Site or group of sites, the sections below describe the remedy selection including RAOs, the status or remedy implementation, and system operation and maintenance (O&M) costs and issues.

4.1 FT-02

The RAP for Site FT-02 is being produced at the time of this report, and therefore, no final remedy has been formally selected. Therefore, final RAOs have not been approved for this site.

4.1.1 Initial Remedy Selection

Although the RAP and RAOs have not been finalized by written approval from the USAF and USEPA, the USAF has proposed and initiated the following remedial actions at the site:

- MNA,
- Soil vapor extraction (SVE),
- ICs,

- LTM,
- Apply for a mixing zone request for GSI exceedances, if necessary, based on monitoring results,
- Periodic reviews, and
- Public education.

MNA

MNA is proposed to remediate contaminated groundwater at Site FT-02. Modeling has suggested that the plume will continue to shrink to approximately 200 feet in length within 20 years and would be essentially non-existent within 30 years (ICF, 1997e). A source remediation alternative for soils should reduce the time required for plume shrinkage to occur.

SVE

The proposed alternative for remediation of subsurface soils at Site FT-02 is SVE. The SVE system was installed in May 2001 and consists of 25 SVE wells installed in a grid pattern, 100 feet apart on center. The mass of VOCs to be treated by SVE at Site FT-02 was estimated at approximately 3,000 pounds (lbs). The USAF proposes to operate the SVE system at Site FT-02 until soil gas sampling indicates that the levels of VOCs in subsurface soils have reached asymptotic levels.

ICs

The proposed site-specific closure for Site FT-02 is Site-Specific Industrial Closure with restrictions. The actual IC restrictive language that is proposed will be contained in the Declaration of Restrictive Covenant (DRC) and Legally Enforceable Agreement (LEA) currently being prepared by the USAF. However, the proposed RAP describes what those restrictions would be as summarized below.

- Restrict groundwater consumption.

- Restrict soil movement pursuant to Section 20120c of National Resource and Environmental Protection Act (NREPA).
- Require a survey to provide a legal description of the site footprint.
- Request a mixing zone for exceedances of GSI criteria if necessary based on monitoring results.
- Require a monitoring plan.
- Restrict future land use to industrial.

LTM

Groundwater samples will be collected annually for VOC analyses using USEPA Method 8260 from 15 monitoring wells and one seep area.

Well FT-1 will be resampled and the site-specific background value for manganese will be reevaluated to verify that manganese concentrations present in groundwater at Site FT-02 are naturally occurring. Mercury was resampled using a lower detection limit to verify that mercury concentrations are below GSI criteria.

Mixing Zone

Depending on the results of LTM, a mixing zone application may be submitted to address GSI exceedances if they reoccur in groundwater near the wetlands.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB.

The draft RAP proposed a contingency plan at Site FT-02 that includes activation of contingency response activities if any one or more of the following three conditions occur: monitoring data over time no longer provides evidence of ongoing degradation, VOC data over time shows an increasing trend above applicable cleanup criteria, or the plume shows signs of

expansion. The contingency response activities include data evaluation and additional sampling (i.e., increasing sampling frequency, parameters, and/or additional sample locations) or investigation (i.e., reevaluation of the source or additional delineation, etc.), depending upon the results of the data evaluation. If monitoring data indicates that contaminants are migrating toward surface water, and will likely exceed an applicable GSI criteria, the USAF will evaluate the data consistent with the requirements of Rule 716(9)(c). If, after 6 months, activation of the contingency response activities does not result in satisfactory progress or resolution in relation to the three trigger actions discussed above, a change in remedy will be required under Part 201. The USAF will create, in consultation with MDEQ and USEPA, a schedule for submission of a RAP revision to address remedy failure.

If monitoring data indicates that an acute toxicity-based criterion has been, or likely will be, exceeded at the GSI, the USAF will implement a contingency plan consistent with Rule 716(14).

Public Education

A public education program was implemented to inform workers and local residents of the potential risks associated with soil and groundwater at Site FT-02. This program includes public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. This program also includes informing the MDH and USFS about the potential hazards of installing a water supply well in the area of Site FT-02, and notifying any future residents near the affected property of the potential hazards associated with well installation. The public education programs will continue through the completion of the remedy and the 2-year, post-closure monitoring period.

4.1.2 Implementation

The SVE system was started in May 2001 and appears to be performing very well, with an average (on-line) operating record exceeding 99 percent, including short duration outages caused by freezing of condensate in the laterals during the coldest parts of the winter. The SVE unit has been operated at rated vapor-flow conditions without exceeding the MDEQ air-emission standards. Samples are collected from the SVE extraction lines on a quarterly basis and analyzed for VOCs and TPH to estimate removal rates. This monitoring will be done until the project is

completed. Annual soil gas monitoring is also being conducted until asymptotic levels of the COCs are achieved. Once this is achieved, confirmatory soil samples will be collected in the areas where the highest levels of contaminants were previously detected to verify that treatment objectives have been met. Confirmation soil samples will be collected in general accordance with MDEQ's "Verification of Soil Remediation" (MDEQ, 1994).

MNA for the site has been implemented as part of the regular LTM program at the Base. Fifteen monitoring wells are collected annually and analyzed for VOCs. Monitoring well FT02-MW3 will also be sampled for SVOCs, alkalinity, ammonia-nitrogen, arsenic, chlorides, ferrous iron, lead, manganese, mercury, nitrate, ortho-phosphate, sulfate, total dissolved solids (TDS), total iron, and total organic carbon (TOC).

Wurtsmith AFB is currently preparing a declaration of restrictive covenant and Legally Enforceable Agreement (LEA) that will prevent groundwater from being used for drinking water and will restrict future land use to industrial uses only.

Finally, a public meeting was held on October 8, 2003, to address the requirement of public participation in the remedy selection process.

4.1.3 System O&M

A summary of the cost of the various components of the proposed RA at Site FT-02 is presented in Table 4-1. Specific problems with the system O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.2 WP-04

The RAP for Site WP-04 (ICF, 1998e) was approved and signed by the USEPA and the USAF on May 8, 1998 and April 3, 2000, respectively. Additionally, in a letter dated June 8, 1998, MDEQ concurred in concept with the proposed RA for Site WP-04, with comments on the need for 1) a natural attenuation waiver, 2) contingencies in the event of shut-off of the ASPTS, and 3) a groundwater monitoring plan.

An RAO was developed in the RAP as a result of data collected during SIs to aid in the development and screening of remedial alternatives to be considered for the RAP. The RAO for Site WP-04 is:

- To achieve MDEQ Residential Cleanup criteria for the groundwater at Site WP-04.

4.2.1 Remedy Selection

The selected remedy presented in the RAP for Site WP-04 (ICF, 1998e) contained the following components, which are described in more detail below:

- ICs,
- LTM, and
- Periodic site reviews.

Supplemental components to the remedy that are not included in the RAP (ICF, 1998e) have been proposed by the USAF and/or recommended by the MDEQ. In some instances, these components have been implemented to various degrees at the site. In all instances, these supplemental proposed components enhance the selected remedy and do not reduce protectiveness in any way. However, since these components have not been formally incorporated into the RAP (ICF, 1998e) via an Explanation of Significant Difference (ESD) or other means, they are technically not reviewable components of the five-year review and are therefore not subject to the same performance metrics that are applied to the components of the selected remedy. Nonetheless, for informational value they are presented and discussed where appropriate below and throughout the rest of this document. These supplemental components include:

- Additional ICs,
- Contingency plan, and
- Public education.

ICs

The site-specific closure for Site WP-04 is Site-Specific Closure with Restrictions. The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the RAP describes what those restrictions are as summarized below.

- Restrict groundwater consumption as drinking water.

Supplemental proposed ICs include:

- Require natural attenuation/groundwater waiver.
- Require a land survey to provide a legal description of the site footprint.
- Require an O&M plan.
- Require a Monitoring Plan.

LTM

Annual groundwater monitoring will be performed at four existing and two new monitoring wells for VOCs. Groundwater monitoring will track contaminant concentrations over time. Monitoring will be conducted until groundwater meets MDEQ Residential criteria, plus two years of post-closure monitoring. Future modifications may be made to the monitoring plan to improve its effectiveness over time.

Periodic Site Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

Contingency Plan

The contingency plan at Site WP-04 includes activation of contingency response activities if any one or more of the following three conditions occur:

- Monitoring data over time no longer provides evidence of ongoing degradation,
- VOC data over time shows an increasing trend above applicable cleanup criteria, or
- The plume shows signs of expansion.

The contingency response activities include data evaluation and additional sampling (i.e., increasing sampling frequency, parameters, and/or additional sample locations) or investigation (i.e., reevaluation of the source or additional delineation, etc.), depending on the results of the data evaluation. If monitoring data indicates that contaminant levels have exceeded, or likely will exceed an applicable GSI criteria, the USAF will evaluate the data consistent with the requirements of Rule 716(9)(c). If, after 6 months, activation of the contingency response activities does not result in satisfactory progress or resolution in relation to the three trigger actions discussed above, a change in remedy will be required under Part 201. The USAF will create, in consultation with MDEQ and USEPA, a schedule for submission of a RAP revision to address remedy failure. The USAF will diligently pursue funding for RAP revision and implementation. If monitoring data indicates that an acute toxicity-based criterion has been, or likely will be, exceeded at the GSI, the USAF will implement a contingency plan consistent with Rule 716(14).

Natural Attenuation Waiver

A natural attenuation waiver was presented to the MDEQ on behalf of Wurtsmith AFB by URS on April 10, 2001. The MDEQ responded to the waiver in a July 24, 2001, letter to the USAF. The letter indicated that the waiver would be granted contingent upon the USAF determining the source and extent of the PCE contamination and demonstrating that the concentrations are decreasing at the site at a reasonable rate.

Public Education

A public education program was implemented to inform workers and local residents of the potential risks associated with groundwater at Site WP-04. These programs include public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. This program also includes informing the MDH about the potential hazards of installing a water supply well in the area of Site WP-04, and notifying residents of an affected property of the potential hazards associated with well installation. The public education program will continue through the completion of the remedy and the two-year post-closure monitoring period.

4.2.2 Implementation

Wurtsmith AFB is currently preparing a declaration of restrictive covenant or LEA that will prevent groundwater from being used for drinking water and will restrict future land use to industrial uses only.

LTM has been implemented in accordance with the RAP.

In response to MDEQ's concerns regarding the natural attenuation waiver, the 2002 Supplemental RI was conducted to further delineate the nature and extent of PCE contamination in groundwater at Site WP-04. This Supplemental RI included the installation of monitoring well WP04-MW4, which is located downgradient of existing well WP04-MW2. As discussed, this well will be used as part of the LTM plan for Site WP-04. Based on the results of this investigation, PCE concentrations in groundwater are highest in the area of well WP04-MW2 and decrease outward indicating a small plume of PCE associated with monitoring well WP04-MW2.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected remedy.

4.2.3 System O&M

A summary of the cost of the various components of the proposed RA at Site WP-04 is presented in Table 4-1. Specific problems with the system O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.3 SS-05

The RAP for Site SS-05 (ICF, 1998i) was approved and signed by the USEPA and the USAF on October 21, 1998, and October 10, 2000, respectively. Additionally, in a letter dated October 23, 1997, MDEQ stated that they would approve the RAP if certain provisions (such as land use restrictions, a natural attenuation waiver request, and LTM program) were implemented.

RAOs were developed in the RAP (ICF, 1998i) as a result of data collected during SIs to aid in the development and screening of remedial alternatives to be considered for the RAP. The RAOs for Site SS-05 are as follows:

- Reduce risks to human health for current and future use scenarios to 10^{-4} to 10^{-6} for cancer risks, and the non-cancer hazard quotient to less than 1.
- Restore groundwater to meet MDEQ Residential Drinking Water criteria throughout the groundwater plume.
- Meet the Water Quality Based Venting Groundwater Limit (WQBVGL) of 940 µg/L for TCE in groundwater discharging to Van Etten Lake.

4.3.1 Remedy Selection

The selected remedy for Site SS-05 contained the following components, which are described in more detail below:

- LTM,
- ICs,
- Period site reviews, and

- Public education.

Supplemental components to the remedy that are not included in the RAP (ICF, 1998i) have been proposed by the USAF and/or recommended by the MDEQ. In some instances, these components have been implemented to various degrees at the site. In all instances, these supplemental proposed components enhance the selected remedy and do not reduce protectiveness in any way. However, since these components have not been formally incorporated into the RAP (ICF, 1998i) via an Explanation of Significant Difference (ESD) or other means, they are technically not reviewable components of the five-year review and are therefore not subject to the same performance metrics that are applied to the components of the selected remedy. Nonetheless, for informational value they are presented and discussed where appropriate below and throughout the rest of this document. These supplemental components include:

- Supplemental ICs, and
- A natural attenuation waiver.

Monitoring Plan

Groundwater monitoring will be conducted annually to monitor the nature of the plume and the progress of natural attenuation processes. A total of eighteen wells were designated for LTM. A combination of these wells will be sampled on an annual basis and analyzed for VOCs. Post-closure monitoring will be continued for two years following attainment of cleanup criteria.

LTM also will include semi-annual surface water monitoring in Van Etten Lake from three locations three meters off-shore for two years. These samples will be analyzed for VOCs.

ICs

The site-specific closure for Site SS-05 is Site-Specific Residential Closure with Restrictions. For on-base areas impacted by the plume, the actual IC restrictive language that is recorded will

be contained in the DRC and LEA currently being prepared by the USAF. However, the RAP describes what those restrictions are as summarized below.

- Restrict groundwater consumption.

For off-base areas that are impacted by VOC plumes, the USAF will continue to pursue restrictive easements with landowners. The Iosco County Health Department District No. 2 has a well permitting program in place to prohibit the installation of new wells in areas impacted by Wurtsmith groundwater contamination. This includes off-base residential areas along Lake Van Etten impacted by the SS-05 plume.

Supplemental ICs include:

- Require a land survey to provide a legal description of the site footprint.
- Require a monitoring plan.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

A contingency plan will be developed, if necessary, if monitoring data does not show generally declining trends of VOCs in the groundwater over time. The contingency plan will include data evaluation and recommendations for additional investigation or remediation, if necessary.

Public Education

Public education programs will be implemented to inform workers and local residents of the potential risks associated with groundwater at Site SS-05. These programs may include public

meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. This program may also include: informing the MDH about the potential hazards of installing a water supply well in the area of Site SS-05, notifying residents of an affected property of the potential hazards associated with well installation, and press releases, where appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

Natural Attenuation Waiver

A waiver was presented to the MDEQ on behalf of Wurtsmith AFB by URS on June 7, 2001, and discusses the site history, results of previous investigations, and information supporting the waiver request. Wurtsmith AFB has requested this waiver under Section 20118(6)(d), which states that "The RAP provides for a reduction of concentration through a documented naturally occurring process and (i) there will be no adverse impact on the environment except for that part of the aquifer approved in the RAP, and (ii) the RAP includes enforceable land use restrictions or other institutional controls." The Wurtsmith AFB requested approval of this waiver based on site conditions detailed in the Consolidated RAP (C-RAP) (URS, 2002b).

4.3.2 Implementation

MDEQ submitted a response letter related to the natural attenuation waiver request stating their concern that the septic tanks might still remain in place resulting in a potential continuing source of contamination. The USAF submitted a response letter, dated June 6, 2002, stating that the septic tank and leach field in the southeast area of the WSA (closest to Building 5300) were removed during the construction of the ALCM support facilities in the 1980s. According to a former USAF employee, the two tanks and leach fields at Buildings 5109 and 5336 were previously emptied, the tops and sidewalls collapsed, and the excavation backfilled.

Long-term groundwater monitoring at Site SS-05 is being conducted annually to monitor the progress of natural attenuation processes. Thirteen wells are designated for LTM of VOCs. This monitoring will be continued for two years following attainment of cleanup criteria.

For any transfer of on-base properties, the actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. The Iosco County Health Department District No. 2 has a well permitting program in place to prohibit the installation of new wells in areas impacted by Wurtsmith groundwater contamination. The USAF has also offered to purchase restrictive easements on groundwater use from residential land owners impacted by the SS-05 plume.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected remedy.

4.3.3 System O&M

A summary of the cost of the various components of the proposed RA at Site WP-04 is presented in Table 4-1. Specific problems with the system O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.4 SS-06, SS-13, ST-40, AND ST-46

The RAP (ICF, 1998g) was signed by the USEPA on October 18, 1999, and the USAF on February 15, 2000. MDEQ approval/concurrence of the RAP for this site is expected as part of their approval/concurrence of the C-RAP (URS, 2002b).

RAOs were developed in the RAP as a result of data collected during SIs to aid in the development and screening of remedial alternatives to be considered for the RAP. The RAOs for the POL Area, are as follows:

- Removal of existing free-phase LNAPL from the subsurface as required by Act 451.
- Reduction of chemical concentration in subsurface soil to MDEQ 20X Drinking Water criteria to reduce continued migration of chemicals into the groundwater.
- Reduction of contamination in groundwater to below MDEQ Residential Drinking Water criteria and Federal MCLs.

Future use of the POL Area has been classified as industrial by the Environmental Impact Statement (EIS) (Montgomery Watson, 1993). To minimize future land use restrictions, residential groundwater criteria will be used as the final cleanup criteria so that the site can be closed without land use restrictions. Table 4-2 presents the cleanup criteria for contaminants exceeding the RAO cleanup criteria.

TABLE 4-2
CLEANUP CRITERIA FOR SOIL AND GROUNDWATER,
SITES SS-06, ST-40, SS-13, AND ST-46
CERCLA 5-YEAR REVIEW
WURTSMITH AFB, MICHIGAN

Contaminant	MDEQ Residential Drinking Water Criteria[a/] (µg/L)	MDEQ 20X Residential Drinking Water Criteria[b/] (µg/L)
Acenaphthylene	26	--
Benzene	5	100
Carbon Disulfide	--	16,000
Ethylbenzene	74	1,500
methylene chloride	5	--
Naphthalene	260	5,200
Phenanathrene	26	--
Toluene	--	16,000
TCE	5	--
Xylene, Total	280	5,600
Lead	--	21,000[c/]

a/ MDEQ ERD Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria. Value is the lowest health-based drinking water level and aesthetic drinking water level.

b/ MDEQ ERD Operations Memorandum #8, Revision 4: Generic Residential Cleanup Criteria. Value is the 20x's lowest health-based and aesthetic drinking water levels.

c/ MDEQ 20X Drinking Water criteria less than Site-Specific Background. Therefore, Site-Specific Background becomes Residential Cleanup Criteria. Site-Specific Background is greater of practical quantitation limit, the base-side background, or the state-wide background (Michigan Environmental Response Act [MERA] Operations Memorandum #15, Revision #2).

4.4.1 Remedy Selection

The selected remedial alternative for Sites SS-06, ST-40, SS-13, and ST-46 is bioventing to remediate the Sites SS-06, and ST-40 soils, biosparging to remediate the residual-phase LNAPL, and continuous operation of the BPPTS until MDEQ groundwater cleanup levels are achieved. Achievement of cleanup objectives will be evaluated through the monitoring plan and a public

education program to keep the public aware of the progress of the RA. Supplemental components to the remedy that are not included in the RAP (ICF, 1998g) have been proposed by the USAF and/or recommended by the MDEQ. In some instances, these components have been implemented to various degrees at the site. In all instances, these supplemental proposed components enhance the selected remedy and do not reduce protectiveness in any way. However, since these components have not been formally incorporated into the RAP (ICF, 1998g) via an Explanation of Significant Difference (ESD) or other means, they are technically not reviewable components of the five-year review and are therefore not subject to the same performance metrics that are applied to the components of the selected remedy. Nonetheless, for informational value they are presented and discussed where appropriate below and throughout the rest of this document. These supplemental components include an excavation restriction will be instituted within the footprint of Sites SS-06, ST-40, SS-13, and ST-46 to a depth of 15 feet due to smear zone contamination attributed to former free phase product at the site, and SVE as an additional component to the bioventing system. The RA is described in more detail as follows:

Continued Operation of the BPPTS

- The BPPTS will continue to operate until MDEQ Drinking Water criteria are met in the POL Area (Sites SS-06, ST-40, SS-13, and ST-46) groundwater.

SVE/Bioventing of the Soils at Sites SS-06, ST-40, and ST-46

- The soils at Sites SS-06, ST-40, and ST-46 are currently undergoing remediation through SVE and bioventing to remove petroleum hydrocarbons. The full-scale SVE and bioventing system was installed in November 1999. It will continue to operate until the MDEQ Drinking Water Protection criteria are met (as determined by confirmatory soil sampling). SVE was added as a component to the RA after the RAP (ICF, 1998g) was accepted/finalized.

Residual-Phase LNAPL Remediation Using Biosparging System

- Remedial activities will be conducted to decrease the groundwater contamination cleanup time through biosparging of the residual-phase LNAPL. The biosparging system began operation in November 1999.

Monitoring Plan

Groundwater monitoring will be performed to assure that the remedy is performing as intended. LTM will be performed using 13 existing wells and three proposed monitoring wells which will be installed in the vicinity of Site ST-67. These wells will be sampled annually for VOCs. Wells A66 and A67 will also be sampled annually for SVOCs. Post-closure monitoring will be continued for two years following attainment of cleanup criteria.

For the soil contamination at Sites SS-06, ST-40, and ST-46, monitoring will be performed using the following schedule:

- Annual soil gas monitoring for total volatile hydrocarbons (TVH) and respiration testing will be conducted until low soil gas TVH concentrations and low oxygen utilization rates, as compared with baseline conditions, are achieved. Once sufficient remediation has been achieved, closure soil sampling will be conducted to verify that the treatment objectives have been met. The soil sample locations will be proposed to MDEQ based on the initial areas of highest contamination. The soil samples will be analyzed for VOCs.

For the residual-phase LNAPL contamination, monitoring will be performed using the following schedule:

- Annual soil gas monitoring will be conducted until asymptotic levels of the COCs (specifically BTEX) in the soil are achieved. Vapor samples will also be collected from the SVE wells to monitor SVE system performance and subsurface contaminant levels. Soil gas samples will be analyzed for TVH and BTEX. Once asymptotic levels of the BTEX contaminants have been achieved, confirmatory soil sampling will be performed in the areas of the highest contamination to verify that the treatment objectives have been met. The soil sample locations will be proposed to MDEQ based on the anticipated area of highest contamination. The soil samples will be analyzed for BTEX compounds. Post-

closure monitoring will be continued for two years following attainment of cleanup criteria.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

A contingency plan will be developed, if necessary, if monitoring data does not show generally declining trends of VOCs and SVOCs in the groundwater over time. The contingency plan will include data evaluation and recommendations for additional investigation or remediation, if necessary.

Public Education Program

Public education programs will be implemented to inform workers and local residents of the potential risks associated with soil and groundwater at Sites SS-06, ST-40, SS-13, and ST-46. These programs may include public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. This program may also include: informing the MDH about the potential hazards of installing a water supply well in the area of Sites SS-06, ST-40, SS-13, and ST-46, notifying residents of an affected property of the potential hazards associated with well installation, and press releases, where appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

ICs

No ICs are specified in the RAP (ICF, 1998g). However, some restrictions are proposed in the C-RAP (URS, 2002b). The actual IC restrictive language that is recorded will be contained

in the DRC and LEA currently being prepared by the USAF. However, the C-RAP (URS, 2002b) describes what those restrictions are as summarized below.

- Restrict groundwater consumption.
- Restrict soil movement pursuant to Section 20120c of the NREPA.
- Restrict excavation to a depth of 15 feet.
- Require a survey to provide a legal description of the site footprint.
- Require a Monitoring Plan.
- Require an O&M plan.
- Restrict future land use to industrial.

4.4.2 Implementation

The BPPTS has been operating since 1992. It consists of six purge wells that pump groundwater to two packed-column aeration towers configured to operate in series. After exiting the towers, the treated groundwater is discharged to Van Etten Creek. Product recovery pumps are contained within purge wells four of the six purge wells to facilitate the periodic recovery of LNAPL accumulations. According to URS (2002), the free-product recovery objective is expected to be attained by November 2007.

The bioventing system was activated in September 1996. This treatment system consists of one air injection blower, eight air injection points, and thirteen air monitoring points. The system includes a control timer and alarm indicator to assist in system monitoring. The system control timer has historically been set for six-hour operation intervals (6 hours "on" and 6 hours "off"). According to URS (2002), the soil remedial objectives are expected to be attained by November 2007.

The Site SS-06 SVE/AS System was activated on October 21, 1999. The system consists of nineteen SVE points and 59 air injection points. These extraction and injection points are

divided into four operating groups. Extracted soil gas from the system was historically treated in the BPPTS catalytic oxidation unit prior to discharge to the atmosphere. Operation of the catalytic oxidation unit was discontinued in August 2001. Extracted soil gas complies with discharge limits and is currently discharged to the atmosphere. According to URS (2002), the groundwater remediation objectives are expected to be reached by November 2007.

Long-term groundwater monitoring at the POL Area is being conducted annually to monitor the progress of groundwater extraction and natural attenuation processes. Thirteen wells are designated for LTM of VOCs. This monitoring will be continued for two years following attainment of cleanup criteria.

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003 to address the requirement of the public education component of the selected remedy.

4.4.3 System O&M

A summary of the cost of the various components of the proposed RA at these sites is presented in Table 4-1. Specific problems with the system O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.5 SS-08, ST-41, SS-42, AND SS-53

The RAP for Site SS-08 (ICF, 1998j) was approved and signed by the USEPA and the USAF on October 21, 1998 and February 15, 2000, respectively. No RAP has been approved for Sites ST-41, SS-42, and SS-53, although one is being prepared at the time of this report. MDEQ provided comments on the RAP for Site SS-08 regarding a potential data gap area which they described in a letter dated March 30, 1998. These concerns are being addressed in the RAP that is being prepared for Sites ST-41, SS-42, and SS-53.

An RAO was developed as a result of data collected during SIs to aid in the development and screening of remedial alternatives to be considered for the RAP. The RAO developed for site SS-08 is:

- To reduce BTEX and 1,2,4-TMB groundwater concentrations within Plume A and Plume B to meet MDEQ residential criteria which are equal to or more stringent than MDEQ industrial criteria and Federal MCLs

4.5.1 Remedy Selection

This section presents the selected remedy for RA at Site SS-08. The selected remedy in the RAP (URS, 2002c) includes the following components, which are described in more detail below:

- AS and SVE,
- ICs,
- LTM, and
- Periodic reviews.

Additional remedies proposed by the USAF as described in the C-RAP (URS, 2002b) but not incorporated into the approved remedy include additional ICs, and continued operation of the ASPTS and BPPTS.

AS and SVE

The selected alternative involves aggressive remediation of the Plume A hot spots through an *in situ* AS and SVE system. Analyses completed in the FS (ICF, 1997c) estimated that the AS/SVE system will be able to remediate Plume A within one year. The overall treatment life of the alternative is estimated to be 15 years. Likewise, groundwater monitoring will have to be conducted for an estimated 15 years until all groundwater (Plume B) meets MDEQ Residential/Industrial criteria, plus two years for post-closure monitoring (ICF, 1998j).

ICs

Site SS-08 is zoned as Industrial (I), Industrial Aviation Support (A-2), Light Industrial/Commercial (Wurtsmith Business District) (WB-3), and Recreational Vehicle (RV). The site-specific cleanup category for Site SS-08 is Site-Specific Industrial Closure with Restrictions. The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the RAP describes the ICs as being

- Land/groundwater use restrictions to be placed in leases and/or deeds for properties affected by the groundwater contamination at Site SS-08.

Additional and/or refined ICs proposed in the C-RAP (URS, 2002b) include:

- Restrict groundwater consumption.
- Require a survey to provide a legal description of the site footprint.
- Restrict soil movement and excavation of soils at the ACC Apron.
- Require a Monitoring Plan.
- Require an O&M Plan.
- Restrict future land use to industrial.

LTM

Annual groundwater monitoring will be performed for VOCs. Fourteen monitoring wells will be sampled for LTM purposes. Groundwater monitoring will track contaminant concentrations over time.

Monitoring will be conducted until Plumes A and B meet MDEQ Industrial criteria, plus two years of post-closure monitoring. Future modifications may be made to the monitoring plan to improve its effectiveness over time, with approval from the appropriate regulatory agencies.

Semi-annual soil gas monitoring also will be performed using an estimated 16 micro-wells during air sparging activities, with one final round following completion of air sparging.

Periodic Site Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

The site reviews will assess site conditions, track progress, and make recommendations for additional investigation or modifications to the existing remedy, if necessary. The reviews will evaluate and summarize the data obtained through the monitoring program and make recommendations to improve the monitoring program based on historical results of the groundwater sampling and analyses if needed.

As part of the C-RAP (URS, 2002b), it is proposed that a contingency plan be developed if monitoring data does not show generally declining trends of VOCs in the groundwater over time. The contingency plan would include data evaluation and recommendations for additional investigation or remediation, if necessary.

Public Education Program

Public education programs were implemented to inform workers and local residents of the potential risks associated with groundwater at the sites addressed in this RAP. The public education program consists of the following:

- An initial public meeting to inform the community of the remediation to be performed at Site SS-08.

- Informing the MDH about the potential hazards of installing a water supply well in the area of Site SS-08 prior to completion of the groundwater remediation. This will allow the Department to completely assess any permit requests for such installations.

- Notification of future owners of any affected properties and the potential hazards associated with well installation prior to completion of the groundwater remediation.

- Periodic press releases to outline progress (one per year for the first five years and then one every five years).

- If requested by the public, tours of the remedial facilities could be arranged. These could also be arranged as a community service and as field trips for students at local grade schools and high schools.

At the completion of the post-closure monitoring period, another notice will be sent to the MDH informing them that potential hazards associated with groundwater have been eliminated.

4.5.2 Implementation

The AS and SVE system was installed at the site in November 1999 by Montgomery Watson and shut down in October 2001. The AS was designed to remove the hot spot VOCs from the groundwater by injecting air into the saturated zone to volatilize contaminants. This system included a blower that supplied air through a common manifold to sparge wells. The sparge wells injected the air into the saturated zone. Air and contaminants, which migrate into the vadose zone, were collected using vapor extraction wells. The vapor extraction wells were connected using underground piping to a common manifold that was connected to the intake of a blower. The blower discharged the extractant through a particulate filter and moisture separator before release to the atmosphere.

The AS system was designed to address the three hot spots within Plume A. In order to remediate these three areas, the AS system required 58 air injection (sparge) wells and 33 vapor extraction wells. Operational requirements during the life of the treatment system included bi-weekly maintenance activities and bi-weekly field screening of vapors from extraction wells to

determine if adjustments to vacuum pressures were needed. Progress was monitored using the data from the groundwater monitoring program and the bi-weekly SVE screening.

Samples from Plume A monitoring wells H86S, H87S, H89S, H90S, H95S, and H95D, collected in July/August 2000 and June 2001 indicated that MDEQ Residential criteria had been achieved in groundwater. The AS/SVE system was subsequently shutdown verification monitoring on October 5, 2001 after discussion at the August 2001 BRAC Cleanup Team (BCT) meeting held at Wurtsmith AFB. Quarterly sampling of groundwater will be conducted as a means of assessing any potential rebound affects associated with discontinued remedial system operations. Upon completion of the two-year post-closure monitoring period, the results will be evaluated by the BCT to verify the appropriateness of permanently shutting down and decommissioning the system. The groundwater in Plume B is currently being remediated by the existing PTSs, as shown by modeling completed for these groundwater plumes (URS, 2001).

Long-term groundwater monitoring of Plume B (near the POL Area) is being conducted annually with groundwater sampling and analysis for VOCs at 14 monitoring wells and quarterly groundwater sampling and analysis for VOCs at six monitoring wells. Following achievement of remedial goals, two years of post-closure monitoring will be completed. This monitoring will be continued for two years following attainment of cleanup criteria.

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected SS-08 remedy.

4.5.3 System O&M

A summary of the cost of the various components of the proposed RA at SS-08 is presented in Table 4-1. Specific problems with the system O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.6 OT-16

The RAP for OT-16 (ICF, 1998h) was signed by the USAF on February 15, 2000, and USEPA on October 21, 1998. MDEQ approval/concurrence of the RAP for this site is expected as part of their approval/concurrence of the C-RAP (URS, 2002b).

RAOs were developed in the RAP as a result of data collected during SIs to aid in the development and screening of remedial alternatives to be considered for the RAP. The following RAOs are specified for Site OT-16:

- To restore groundwater to satisfy the stricter of MDEQ Residential and GSI cleanup criteria for organic constituents (as summarized in Table 4-3), allowing for unrestricted future use;

TABLE 4-3
CLEANUP CRITERIA FOR GROUNDWATER, SITE OT-16
CERCLA 5-YEAR REVIEW
WURTSMITH AFB, MICHIGAN

Contaminant	Cleanup Criteria (µg/L)*
Benzene	5
Ethylbenzene	31
Toluene	110
TCE	5
Xylenes	59
2,4-Dimethylphenol	31
4-Methylphenol	6.2
Naphthalene	29
Phenanthrene	26

* Cleanup criterion is the lower of MDEQ Residential and GSI levels.

- To prevent further migration of groundwater contaminants above MDEQ Residential and GSI Cleanup criteria to surface water and sediment; and

- To prevent exposure to contaminated soil.

4.6.1 Remedy Selection

The selected RA is intrinsic remediation by MNA of the groundwater to achieve MDEQ Industrial Drinking Water and GSI criteria for on-site property and MDEQ Residential Drinking

Water and GSI criteria for off-site property. Under this RA, no aggressive actions will be implemented. Contaminants will biodegrade under natural processes, and the site will be monitored to assess conditions over time. Chemical levels will be monitored by conducting annual sampling and analyses of groundwater. Groundwater modeling using the USEPA BIOSCREEN model for benzene and toluene suggested that the plume will be naturally attenuated within four years. Additional modeling completed as part of the FS estimated that organic contaminants may reach MDEQ criteria within six years (i.e., in 2004). Should metals concentrations remain elevated after organic concentrations have been remediated, additional monitoring and evaluation of other remedial alternatives may be required. Higher dissolved metals concentrations are frequently associated with the reducing conditions caused by areas of higher dissolved organics.

Additional components of the proposed remedy include ICs, LTM, periodic reviews, and public education.

ICs

The site-specific closure for Site OT-16 is Site-Specific Industrial Closure with restrictions for on-site property at Wurtsmith AFB. The RAP (IC, 1998h) does not identify specific ICs, with the exception of stating that some form of land-use restrictions will be placed in the leases and/or deeds for the property to ensure that the site is only used for recreational purposes in the future. The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the C-RAP (URS, 2002b) describes what those restrictions will be as summarized below.

- Restrict groundwater consumption for the entire site footprint of Site OT-16 (includes on- and off-site property).
- Restrict soil movement pursuant to Section 20120c of NREPA, basements, and excavation of soils below 9 feet bgs in an approximate 12 acre area surrounding well OT16-MW6.

- Require an HSP to be provided by the landowner/contractor and reviewed and approved by the USAF prior to excavation or construction in the excavation restriction area described above.
- Restrict future land uses to industrial for the on-site property.
- Require a survey to provide a legal description of the site footprint.
- Require an O&M plan.
- Require a Monitoring Plan.

For off-base property, a Site-Specific Residential Closure with groundwater use restrictions is proposed for land owned by the United States Forest Service (USFS). A Memorandum of Understanding (MOU) has been signed by the USAF and USFS. The MOU describes how the USFS does not intend to install potable wells on the property downgradient of sites OT-16 and OT-24.

LTM

Groundwater samples will be collected annually for VOC analyses using USEPA Method 8260, SVOC analyses using USEPA Method 8270, and selected metals analyses (manganese and iron) from 17 monitoring wells.

The monitoring wells will be sampled annually until VOC and SVOC concentrations meet or are below MDEQ Industrial Drinking Water and GSI criteria for on-site wells (13 wells). LTM will be conducted annually until VOCs and SVOCs meet or are below MDEQ Residential Drinking Water and GSI criteria for off-site wells (four wells). Once concentrations meet MDEQ criteria, post-closure monitoring of the previously identified wells will be performed for two years to ensure that remediation is complete.

Should metals concentrations remain elevated after the organics have been remediated, a contingency will need to be added to account for additional monitoring and the possibility of evaluating remedial alternatives to address this situation.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

Although not described in the RAP (ICF, 1998h), the C-RAP (URS, 2002b) describes a contingency plan at Site OT-16 that includes activation of contingency response actions if one or more of the following three conditions occur: monitoring data over time no longer provides evidence of ongoing degradation, VOC and SVOC data over time shows an increasing trend above applicable cleanup criteria, or the plume shows signs of expansion. The contingency response activities include data evaluation and additional sampling (i.e., increasing sampling frequency, parameters, and/or additional sample locations) or investigation (i.e., reevaluation of the source or additional delineation, etc.), depending on the results of the data evaluation. If monitoring data indicates that contaminant levels have exceeded, or likely will exceed, an applicable GSI criteria, the USAF will evaluate the data consistent with the requirements of Rule 716(9)(c). If, after 6 months, activation of the contingency response activities does not result in satisfactory progress or resolution in relation to the three trigger actions discussed above, a change in remedy will be required under Part 201 of Act 451 of 1994, as amended. The USAF will create, in consultation with the MDEQ and USEPA, a schedule for submission of a RAP revision to address remedy failure.

If monitoring data indicates that an acute toxicity-based criterion has been, or likely will be, exceeded at the GSI, the USAF will implement a contingency plan consistent with Rule 716(14).

Public Education

A public education program will be implemented to inform base and USFS workers of the potential risks associated with soil and groundwater at Site OT-16. This will be accomplished

through public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. Additionally, these programs may include informing the MDH about the potential hazards of installing a water supply well in the area of Site OT-16 and notifying residents of an affected property of the potential hazards associated with well installation, when appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

4.6.2 Implementation

LTM was performed in 2001 and 2002.

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. Off-base land use is controlled under a MOU with the USFS. Not all of the downgradient area appears to be covered by the MOU.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected remedy.

4.6.3 System O&M

A summary of the cost of the various components of the proposed RA at Site OT-16 is presented in Table 4-1. Specific problems with the system O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.7 SS-17, SS-21, AND SS-47

A RAP (ICF, 1998k) was signed by the USAF on February 15, 2000, and USEPA on October 18, 1999. MDEQ approval/concurrence of the RAP for this site is expected as part of their approval/concurrence of the C-RAP (URS, 2002b).

An RAO was developed in the RAP (ICF, 1998k) as a result of data collected during SIs to aid in the development and screening of remedial alternatives to be considered for the RAP (ICF, 1998k). The RAO for Sites SS-17, SS-21, and SS-47 is:

- Reduce benzene, toluene, xylene, PCE, and TCE concentrations in groundwater to below MDEQ industrial cleanup criteria on base, and ensure that the MDEQ residential cleanup criteria are not exceeded at the base boundary.

The cleanup levels referenced are summarized in Table 4-4.

TABLE 4-4
CLEANUP CRITERIA FOR GROUNDWATER,
SITES SS-17, SS-21, AND SS-47
CERCLA 5-YEAR REVIEW
WURTSMITH AFB, MICHIGAN

Compounds	MDEQ Industrial Cleanup Criteria (µg/L)	MDEQ Residential Cleanup Criteria (µg/L)
Benzene	5	5
Ethylbenzene	74	74
PCE	5	5
Toluene	790	790
TCE	5	5
Xylene (Total)	280	280

NOTE: Compounds presented in table present those compounds detected in the 1996 investigation that exceeds the residential and industrial cleanup criteria.

4.7.1 Remedy Selection

Soils

The selected remedy for the soil at Sites SS-17 and SS-21 is no action with land use restrictions. This remedy includes a public education component. The remedy is based on an industrial future land use designation. Should the area be considered for residential land use in the future, the condition of the soils at Sites SS-17 and SS-21 should be reevaluated.

Public Education

A public education program will be implemented to inform workers and local residents of the potential risks associated with soil and groundwater at Sites SS-17, SS-21, and SS-47. This will be accomplished through public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. Additionally, these programs may include: informing the MDH about the potential hazards of installing a water supply well in the area of these sites and notifying residents of an affected property of the potential hazards associated with well installation, when appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

Land Use Restrictions

Zoning requirements involving the restriction of the area for industrial use only are to be established.

Groundwater

The selected remedy for groundwater at Sites SS-17, SS-21, and SS-47 includes:

- Operation and maintenance of the ASPTS,
- LTM,
- ICs,
- Periodic reviews, and
- System closure.

Pump and Treat

The selected remedy for groundwater at Sites SS-17, SS-21 and SS-47 is modification of the ASPTS, with increased pumping at pumping well PW3 (ICF, 1998k).

This alternative addresses groundwater contamination at Sites SS-17, SS-21, and SS-47 through groundwater extraction using four existing extraction wells with treatment at an existing air stripper located on the base at ASPTS. Although modification of the ASPTS with increased pumping at pumping well PW3 is the preferred alternative, it is only considered as a modification to the remedy of pump and treat to improve performance if necessary. The ASPTS will only be modified by increasing the pumping rate at well PW3 as necessary to optimize the system. Additional optimization is being evaluated by the USAF as the TCE plume continues to shrink. The ASPTS is considered the final remedy for Sites SS-17, SS-21, and SS-47 and has been operating for over 20 years.

Monitoring Plan

Groundwater monitoring will be conducted annually to monitor the nature of the plume and the progress of natural attenuation processes. Thirty wells are designated for LTM and will be sampled on an annual basis and analyzed for VOCs. Post-closure monitoring will be continued for 2 years following attainment of cleanup criteria.

ICs

The site-specific closure for Sites SS-17, SS-21, and SS-47 is Site-Specific Industrial Closure with Restrictions. The RAP (ICF, 1998k) does not contain specific language describing ICs, except that they will include zoning and groundwater restrictions, and that that those restrictions are to be temporary and could be lifter upon completion of RA. The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the C-RAP (URS, 2002b) describes what those restrictions will be as summarized below.

- Restrict groundwater consumption.
- Require a monitoring plan.
- Require a land survey to provide a legal description of the site footprint.

- Require notices to easement holders.
- Require an O&M plan.
- Restrict future land use to industrial.

Public Education

A public education program will be implemented to inform workers and local residents of the potential risks associated with soil and groundwater at Sites SS-17, SS-21, and SS-47. This will be accomplished through public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. Additionally, these programs may include: informing the MDH about the potential hazards of installing a water supply well in the area of these sites and notifying residents of an affected property of the potential hazards associated with well installation, when appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

Periodic Review

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

A contingency plan will be developed, if necessary, if monitoring data does not show generally declining trends of VOCs in the groundwater over time. The contingency plan will include data evaluation and recommendations for additional investigation or remediation, if necessary.

System Closure

System closure includes removing piping and pumping equipment, abandoning pumping wells, and closing the ASPTS.

4.7.2 Implementation

Since 1981, the ASPTS has removed and treated nearly 8 billion gallons of groundwater. The approved RAP calls for increasing the pumping rate at PW3 to approximately 400,000 gallons per day (gpd) (previous pumping rate 174,000 gpd as of April 1998) (only if necessary to optimize the system), maintaining the pumping rates at wells PW1, PW2, and PW4, developing a periodic sampling plan, and developing a plan to disassemble the ASPTS upon completion of remediation. LTM has been performed since 1994.

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected remedy.

4.7.3 System O&M

A summary of the cost of the various components of the proposed RA at these sites is presented in Table 4-1. Specific problems with the system O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.8 LF-23

A RAP (ICF, 1998l) was signed by the USAF and the USEPA on October 21, 1998. MDEQ approval/concurrence of the RAP (ICF, 1998l) for this site is expected as part of their approval/concurrence of the C-RAP (URS, 2002b). No RAOs were identified in the RAP (ICF, 1998l).

4.8.1 Remedy Selection

Future use of Site LF-23 is classified as industrial or light industrial/commercial, and the site contains landfill materials, therefore the selected alternative shall be no action under an industrial closure with land use restrictions, and the remedy will include ICs.

ICs

The site-specific closure for Site LF-23 is Site-Specific Industrial Closure with Restrictions. No specific language regarding lease and/or deed restrictions was included in the RAP (ICF, 1998l). The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the C-RAP (URS, 2002b) describes what those restrictions are as summarized below.

- Restrict groundwater consumption.
- Require a land survey to provide a legal description of the site footprint.
- Require permanent markers.
- Require a HSP to be prepared by the landowner/contractor and reviewed and approved by the USAF prior to soil excavation.
- Require an O&M plan.
- Restrict future land use to industrial.

Periodic Reviews

Although not a component of the RAP (ICF, 1998l), the USAF has elected to include a periodic review component to the selected remedy as described here. In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted

within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

4.8.2 Implementation

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF.

The first five-year review is being performed within the appropriate schedule.

4.8.3 System O&M

There currently is no system or groundwater monitoring at Site LF-23. Enforcement of ICs is the only ongoing activity.

4.9 OT-24

The RAP (ICF, 1996g) for OT-24 was signed by the USAF and USEPA on May 18 and 29, 1998, respectively. RAOs were developed as a result of data collected during the RI to aid in the development and screening of remedial alternatives to be considered for the RAP (ICF, 1996g). The RAOs for OT-24 are:

- Decrease the contamination present in the groundwater at Site OT-24 to those concentrations specified in Table 4-5, and minimize potential risks to human health by eliminating potential exposure pathways to groundwater at Site OT-24 (i.e., restrict access to groundwater as a source of drinking water).

4.9.1 Remedy Selection

The selected remedy includes the following measures which are described in more detail below:

- Operation and continued optimization of the MDPTS extraction system,
- ICs prohibiting the installation of wells,

TABLE 4-5
ALTERNATE CLEANUP LEVELS, SITE OT-24
CERCLA 5-YEAR REVIEW
WURTSMITH AFB, MICHIGAN

Compound	Cleanup Criteria (µg/L)
TCE	94
cis-1,2-DCE	232*
1,1,1-TCA	120
Methylene Chloride	59

* No GSI is specified by MDEQ for cis-1,2-DCE. Therefore, the chronic freshwater ambient water quality criteria will be adopted.

- LTM, and
- Public education.

Pump and Treat

The selected RA for Site OT-24 is the continued operation of the MDPTS until VOC concentrations in Plume A are below the GSI cleanup criteria. As recommended in the RAP (ICF, 1996g), the MDPTS was redesigned in 2001 to optimize the placement of extraction wells. The four existing extraction wells were abandoned, and seven new extraction wells were installed in March, 2001. Groundwater is treated using two air-stripping towers which are operated in series. Treated water is discharged to the Au Sable River southeast of Duell Lake. Air emissions are discharged directly to the atmosphere and are consistently been below MDEQ air quality standards.

ICs

The site-specific closure for Site OT-24 is Site-Specific Residential Closure with Restrictions. No specific language regarding lease and/or deed restrictions was included in the RAP (ICF, 1996g). The RAP does state that restrictive clauses will be placed in leases and/or deeds for the properties affected by the groundwater contamination at Site OT-24 and owned (at the time of the RAP [ICF, 1996g]) by the USAF. These clauses will prohibit the installation of wells, eliminating potentially hazardous exposure to contaminants in the groundwater.

ICs include on-base groundwater use restrictions. An expanded MOU is needed to provide an off-base restrictive easement for land owned by the USFS. This MOU is required until the groundwater underlying the site is below designated cleanup criteria. Currently, there are no water supply wells on USFS properties.

Should any affected property change ownership prior to the completion of the remediation program, the USAF will notify the new owner(s) of the potential hazards related to the use of the groundwater and offer to connect any potential users of the groundwater with the municipal water supply.

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the C-RAP (URS, 2002b) describes what those restrictions/requirements are as summarized below.

- Restrict groundwater consumption.
- Require a monitoring plan.
- Require an O&M plan.
- Require a survey to provide a legal description of the site footprint.

Monitoring

Groundwater monitoring is currently being performed at over 30 wells to assure that the remedy is performing as intended. These wells are sampled annually for VOCs. Post-closure monitoring will be continued for two years following attainment of cleanup criteria.

Periodic Site Reviews

Although not included as a component of the RAP (ICF, 1996g), a periodic site review component has been proposed by the USAF in the C-RAP (URS, 2002b). In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy

will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

A contingency plan will be developed, if necessary, if monitoring data does not show generally declining trends of VOCs in the groundwater over time. The contingency plan will include data evaluation and recommendations for additional investigation or remediation, if necessary.

Public Education

Public education programs will be implemented to inform workers and local residents of the potential risks associated with groundwater at Site OT-24. These programs may include public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. This program may also include informing the MDH about the potential hazards of installing a water supply well in the area of Site OT-24, notifying residents of an affected property of the potential hazards associated with well installation, and press releases, where appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

MNA

A supplemental MNA component to the remedy that is not included in the RAP (ICF, 1996g) has been proposed by the USAF and/or recommended by the MDEQ. This component has been implemented at the site and enhances the selected remedy without reducing protectiveness in any way. However, since this component has not been formally incorporated into the RAP (ICF, 1996g) via an Explanation of Significant Difference (ESD) or other means, it is technically not a reviewable component of the five-year review and is therefore not subject to the same performance metrics that are applied to the components of the selected remedy. Nonetheless, for informational value this component is presented and discussed where appropriate below and throughout the rest of this document.

The supplemental component to the selected remedy for the groundwater in the southern portion of the site (which is located outside the capture zone of the MDPTS) is MNA. MDEQ has indicated that a waiver is required for the selected remedy of natural attenuation under Rules 705(5) and 705(6). A waiver request for Site OT-24 was submitted to MDEQ on December 6, 2001. The waiver was requested based on the following site conditions:

- Due to the relatively low concentrations of TCE in the groundwater south of the MDPTS (located outside of the MDPTS capture zone), it is not practical to install groundwater extraction wells to remediate impacted groundwater in these areas.

- According to historical data, it appears that TCE migrated to Site OT-24 from the Building 5008 area, and there is no continuing source of contamination.

- Based on existing monitoring data, it appears that there has been a general decrease in TCE concentrations near the former base boundary, based on the annual monitoring data and historical data collected by USGS, ICF, and Versar. For example, TCE concentrations in monitoring well H71D have decreased from 650 µg/L in December 1993 to 53.9 µg/L in July 2000, indicating that the TCE plume is naturally attenuating as it migrates south towards Duell Lake and the 3-Pipes Drainage Ditch.

- Wurtsmith AFB is currently preparing a DRC and LEA implementing ICs, such as on base groundwater use restrictions and an off-base restrictive easements (detailed in the Memorandum of Understanding [MOU] between Wurtsmith AFB and the USFS [Andrina, 1997]), until the groundwater underlying this site is below designated cleanup criteria. LTM will be conducted annually for VOCs to assess whether the TCE groundwater plume is naturally attenuating. Post-closure monitoring will be continued for two years following attainment of cleanup criteria. Additionally, periodic reviews will be conducted every five years to assess the results of the RA. If necessary, a contingency plan, consisting of evaluation of the existing data and modification of the RA, will be implemented.

4.9.2 Remedy Implementation

Groundwater from the OT-24 plume is being treated in a recently upgraded (came on-line in April 2001) air stripping facility that includes two towers operated in series and rated at 350 gpm capacity. The plant includes an in-line backup blower that can provide 1,200 scfm of additional air to improve treatment efficiency. The treatment plant is equipped with state-of-the-art controls, including digital readouts of pumping rates and water levels for the seven extraction wells.

MNA for the southern portion of the plume has been implemented as part of the regular monitoring program at the Base. Thirty-four monitoring wells are sampled annually for VOCs.

According to AFRPA representative, Mr. Paul Rekowski, and Oscoda Township representative, Mr. Gary Kellan, ICs have been implemented in the form of incorporating a deed restriction for groundwater use as drinking water in the DRC and LEA (currently being prepared by the USAF) for those properties that have changed ownership.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected remedy.

4.9.3 System O&M

The USAF is conducting LTM and maintenance activities according to the O&M plan and a Sampling and Analysis Plan (SAP) that were approved by USEPA. The primary activities associated with O&M include the following:

- Regular replacement of packing media in the air stripper towers;
- Inspection of the condition of groundwater monitoring wells;
- Monthly collections of influent, intermediate, and effluent samples from the treatment plant with analysis for chloroform, trans-1,2-DCE, TCE, and 1,1,1-TCA;

- Monitoring treatment plant effluent five times per week for pH and flow;
- Sampling all extraction wells quarterly for VOCs
- Sampling 32 groundwater monitoring wells at Site OT-24 annually for VOCs.

A summary of the cost of the various components of the RA at Site OT-24 is presented in Table 4-1. Based on conversations with the plant operator, Larry DeKett (TolTest), this plant requires minimal maintenance. The system has been operating since start-up with very little down-time other than for routine maintenance.

4.10 LF-26

The USAF and USEPA signed a no action declaration on May 8, 1998 as described in the Final No Action RAP/DD, Site LF-26 (ICF, 1998c). MDEQ submitted a letter, dated May 26, 1998, stating that they would approve of this remedy as long as restrictions were required for Area A. Site LF-26 Area A is closed with restrictions as described below.

4.10.1 Remedy Selection

According to the RAP (ICF, 1998c), unrestricted use of the soil and groundwater is allowable under Michigan Act 451, Part 201 guidance. Accordingly, Site LF-26 was to be removed from further consideration in the Wurtsmith AFB IRP.

As described above, under the CERCLA RAP (ICF, 1998c), no further action is required at the site. However, MDEQ has requested that some additional actions be implemented at Site LF-26 as summarized in the C-RAP (URS, 2002b) and described below. For informational purposes, these actions will be included in the five-year review report although they are not technically components of the final CERCLA remedy (no action) at the site.

ICs

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the C-RAP (URS, 2002b) describes what those restrictions are as summarized below.

- Restrict excavation and/or construction.
- Restrict groundwater consumption.
- Restrict land use to industrial.
- Require permanent markers.
- Require a land survey to provide a legal description of the site footprint.
- Require a notice to all easement holders.
- Require an O&M plan.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

4.10.2 Implementation

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF.

The first five-year review is being performed within the appropriate schedule.

4.10.3 System O&M

There currently is no system or groundwater monitoring at Site LF-26. Enforcement of ICs is the only ongoing activity.

4.11 LF-27

This site is undergoing further investigation. No RAP has been approved for this site and a five-year review could not be completed for this site. A proposed remedy was presented to a RAB meeting on October 8, 2003. Although no formal RAOs were identified during the presentation, RAs were proposed for three different concerns:

- PCE in venting groundwater (seeps),
- Arsenic in surface soil, and
- Metals in groundwater.

4.11.1 Remedy Selection

The proposed remedy for PCE in seeps involves the following components:

- Determination of the source and extent of PCE contamination,
- Calculation of site-specific cleanup criteria for PCE,
- MNA,
- LTM, and
- ICs.

The proposed remedy for arsenic in surface soil involves the following components:

- Comprehensive sampling for arsenic in the top 6 inches of soil cover following MDEQ guidance for comparison to MDEQ Residential Direct Contact criteria,
- If sample results show arsenic in surface soil below MDEQ Residential Direct Contact criteria,
  - Remove exposed metal hazards from surface,
  - Maintain existing natural soil cover, and

- Implement ICs.

- If sample results show arsenic in surface soil above MDEQ Residential Direct Contact criteria,

  - Install a cover as warranted (in hotspots only if warranted), and

  - Implement ICs.

The proposed remedy for metals in groundwater involves the following components:

- Determination of a mixing zone,
- Calculation of site-specific cleanup criteria for metals,
- MNA,
- LTM, and
- ICs.

4.11.2 Implementation

At the time of this review, the proposed remedies had not been implemented. However, various activities associated with the additional investigations taking place at LF-27 were in progress including soil, groundwater, and surface water (seep) sampling.

4.11.3 System O&M

A summary of the cost of the various components of monitoring at Site LF-27 is presented in Table 4-1. Additional investigations, monitoring, and the enforcement of ICs are underway and costs have not been assigned. Specific problems with O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.12 LF-30 AND LF-31

There is no approved RAP for LF-30 and LF-31. However, a RAP was prepared for Sites LF-30 and LF-31 in April 2001 (Montgomery Watson, 2001) which was approved by the USEPA in a letter dated August 21, 2001. Since that time, the MDEQ has identified outstanding issues with the proposed remedy in the draft RAP; therefore, these sites are undergoing further investigation and evaluation.

4.12.1 Proposed Remedy

The proposed remedy described in the draft RAP (Montgomery Watson, 2001) includes the following elements:

- Air sparging (AS) along the AFB property line to add oxygen and enhance bioremediation in the southern two-thirds of the plume.
- Pumping and treatment of groundwater along a portion of the AFB property line to hydraulically contain the TCE contamination in the northern third of the impacted groundwater plume. Discharge of treated groundwater through an infiltration trench/gallery upgradient of the AS curtain.
- Injection of oxygen release compound (ORC) along the Van Etten Lake beach in the areas previously identified as having aesthetic impacts.
- One-time injection of ORC along the AFB boundary in the footprint of the AS system to add oxygen to the southern two-thirds of the plume until the AS system is operational.
- MNA for the off-site plume.
- Periodic beach maintenance and sand replacement as needed.
- LTM and maintenance.

- ICs in the landfills area, including deed restrictions to prohibit excavation, building construction, and groundwater use and to limit land use to industrial use only as defined by the MDEQ in Part 201 of Act 451.

- Extension of municipal water supply line to the low ropes course area on the YMCA property.

The AS system has been installed along the property line to deliver oxygen to the southern and middle portions of the contaminant plume to enhance biological degradation of VC and BTEX compounds.

Hydraulic containment though extraction and treatment is used in the area of well H127S to address VOC migration in the northern portion of the plume. Extracted groundwater is treated by an air stripping or granular activated carbon (GAC) system on the AFB property. The treated groundwater from the system is discharged on the AFB property using an infiltration trench or gallery system located upgradient of the AS curtain. Treated groundwater to be infiltrated must meet MDEQ Part 22 groundwater quality standards.

MNA is proposed for remediation of the impacted groundwater off-site. Overtime, the downgradient MNA may be enhanced by the oxygen that is added by the AS system.

The proposed alternative also includes periodic beach maintenance performed on an as-needed basis. It is expected that the need for periodic beach maintenance will reduce over time and eventually be eliminated by the oxygenation provided by the upgradient AS system.

Although a final remedy has not been agreed upon for LF-30/31, the initial two-year review of the interim system has been used for the first five-year review. The two-year reviews were instituted to evaluate operation and performance of the system and to determine if additional action should be taken in the source area or if refinement to the RA should be made to optimize its effectiveness.

ICs are proposed to be implemented on-site in the landfill area. These proposed ICs include deed restrictions in the landfills area to prohibit excavation, building construction, and

groundwater use and to limit land use to industrial use only as defined by the MDEQ in Part 201 of Act 451.

The YMCA has stated that they will not agree to groundwater use restrictions on their property, but protection from exposure to impacted groundwater is provided by other means. The YMCA property is connected to the municipal drinking water supply for potable water, and the property owner is aware of the situation and has been actively involved in the decision-making process for RA. The Iosco County Health Department District No. 2 has a well permitting program in place to prohibit the installation of new wells in areas impacted by Wurtsmith groundwater contamination. Therefore, no formal groundwater use restrictions have been implemented for the off-site property. In order to address the YMCA's need for potable water in an area of their property that is not directly connected to the municipal water supply line and that overlies the groundwater plume (i.e., the low-ropes course), the USAF extended the current municipal water supply lines to this area as part of the RA.

4.12.2 Implementation

A portion of the RA, including installation of the AS wells and extraction well and the application of the ORC, was completed prior to the final Remedial Design (RD) submittal. These RA elements were performed in accordance with design documents provided by URS and with the approval of the USAF, MDEQ, USEPA, and the YMCA. Construction of the LF-30/31 AS/PTS was completed in December 2001 by MWH. Activation of the system occurred in December 2001 and annual monitoring is being completed at over 20 wells.

The USAF, USEPA, and MDEQ are currently discussing the final remedy for Site LF-30/31 and determining the final RAOs for the site.

4.12.3 System O&M

A summary of the cost of the various components of the proposed RA at Sites LF-30 and LF-31 is presented in Table 4-1. Specific problems with the system O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.13 SS-51

The RAP for Site SS-51 (Parsons, 1996b) was signed by the USEPA and the USAF on October 21, 1999, and February 15, 2000, respectively. Additionally, the MDEQ issued a letter of concurrence for MNA on November 3, 1997. The USAF has selected an RA at the KC-135 Crash Site (Site SS-51) to attain contaminant concentrations that are below generic industrial cleanup criteria, as defined by MDEQ (Parsons, 1996b). The selected RA also eventually will be sufficient to reduce site concentrations to below generic residential cleanup criteria. However, cleanup to residential standards is neither a requirement nor a goal of the RAP.

4.13.1 Remedy Selection

The selected remedy includes the following components: MNA, ICs, and LTM.

MNA and LTM

Groundwater monitoring will be conducted annually to monitor the nature of the plume and the progress of natural attenuation processes. The RAP (Parsons, 1996b) included annual groundwater sampling at eight monitoring wells for VOCs. Post-closure monitoring will be continued for two years following attainment of cleanup criteria.

ICs

The RAP (Parsons, 1996b) included requirements for restricted access to the airfield and that future lease of the land for airfield activities stipulate that groundwater will not be extracted within 1,000 feet of the plume centerline until COC concentrations have been reduced below the industrial cleanup criteria. It further required that excavation in the plume area be limited to depths of less than 8 feet bgs. Finally, it specified that lease and or deed restrictions should be implemented as part of future land transfers. The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the C-RAP (URS, 2002b) describes what those restrictions/requirements are as summarized below.

- Require a land survey to provide a legal description of the site footprint.
- Restrict groundwater consumption.

- Require a monitoring plan.

- Restrict future land use to industrial.

Supplemental components to the remedy that are not included in the RAP (Parsons, 1996b) have been proposed by the USAF and/or recommended by the MDEQ. In some instances, these components have been implemented to various degrees at the site. In all instances, these supplemental proposed components enhance the selected remedy and do not reduce protectiveness in any way. However, since these components have not been formally incorporated into the RAP (Parsons, 1996b) via an Explanation of Significant Difference (ESD) or other means, they are technically not reviewable components of the five-year review and are therefore not subject to the same performance metrics that are applied to the components of the selected remedy. Nonetheless, for informational value they are presented and discussed where appropriate below and throughout the rest of this document. These supplemental components include periodic reviews and public education.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

A contingency plan will be developed, if necessary, if monitoring data does not show generally declining trends of VOCs in the groundwater over time. The contingency plan will include data evaluation and recommendations for additional investigation or remediation, if necessary.

Public Education

Public education programs will be implemented to inform workers and local residents of the potential risks associated with groundwater at Site SS-51. These programs may include public

meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. This program may also include informing the MDH about the potential hazards of installing a water supply well in the area of Site SS-51, notifying residents of an affected property of the potential hazards associated with well installation, and press releases, where appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

4.13.2 Implementation

Groundwater remediation, through MNA, is estimated to take approximately eight years. The start date for the groundwater remediation was October 1997, and the end date is estimated to be October 2005.

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected remedy.

4.13.3 System O&M

A summary of the cost of the various components of the RA at Site SS-51 is presented in Table 4-1. Specific problems with the O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.14 SS-57

The RAP for Site SS-57 (Versar, 2002) was signed by the USEPA and the USAF on October 11, 2002 and November 8, 2002, respectively. Additionally, the MDEQ issued a letter of concurrence on April 29, 2002. RAOs were developed in the RAP (Versar, 2002) as a result of data collected during SIs to aid in the development and screening of remedial alternatives to be considered for the RAP (Versar, 2002). The RAOs for Site SS-57 are:

- To reduce VOC and SVOCs in soil within the source area and smear zone above the water table to meet MDEQ industrial criteria, and to limit further degradation of the groundwater.

- To reduce VOC and SVOCs in groundwater to meet MDEQ industrial criteria

4.14.1 Remedy Selection

The RAP (Versar, 2002) identified the preferred alternative as enhanced bioremediation of soil and hot spot groundwater with extended operation of the ASPTS, depending upon the results of a treatability study. A treatability study was subsequently performed by Montgomery Watson in October 2001. Based on the results of the treatability study, AFCEE and AFBCA agreed to select a different RA alternative. The selected alternative consists of bioventing and biosparging using vertical wells. This alternative involves *in situ* biodegradation of soil and groundwater. The soil biodegradation will occur through use of a bioventing system that provides oxygen to existing soil microbes. The hot spot groundwater contamination associated with the smear zone downgradient of the source soil contamination area is addressed through use of a biosparging system that introduces oxygen to the groundwater. After free product was discovered on the site, the USAF elected to operate a temporary SVE system to minimize the potential migration of vapors during system startup.

Groundwater contamination downgradient of the hot spots will be captured and remediated through the use of the existing ASPTS and by on-going natural bioremediation. This RA includes operation of the existing ASPTS for capture and treatment of groundwater, groundwater monitoring, ICs, periodic reviews, and public education throughout the life of the alternative.

The selected RA consists of the following:

- Approximately ten biovent wells screened from approximately 5 to 20 feet bgs to inject air (oxygen) into the subsurface to enhance the biodegradation of petroleum constituents in the vadose zone;

- Approximately 63 biosparge wells screened below the water table from approximately 27 to 30 feet bgs to inject air beneath the groundwater table to increase dissolved oxygen and promote biodegradation of petroleum constituents in the saturated zone; and,

- Continued operation of the ASPTS for capture and treatment of the downgradient plume.

Cleanup Time for Soil

The bioventing and biosparging systems will be operated in the source and hot spot areas for as long as it takes to achieve the MDEQ Industrial criteria. As presented in the Feasibility Study (FS) (ICF, 1998a), conservative estimates based on biodegradation rates have predicted approximately four years for soil and five years for groundwater hot-spot remediation, followed by two years of post-closure monitoring. The recent discovery of free product on this site could extend the time required to achieve MDEQ industrial criteria.

Remediation of Remaining Plume

Groundwater contamination downgradient of the hot spots will be captured and remediated through the existing ASPTS and by ongoing natural bioremediation. The contaminants within the groundwater restricted area will be reduced to meet MDEQ Industrial Drinking Water criteria. If the ASPTS achieves cleanup goals for TCE sooner than Site SS-57 achieves cleanup standards for BTEX and other fuel contaminants, then the USAF will determine if continued pump and treat or natural attenuation is the best solution for remaining groundwater contaminants. The USAF will need to demonstrate with a groundwater model, and additional monitoring, that groundwater above MDEQ Residential criteria will not migrate beyond the boundaries of the restricted area.

ICs

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the C-RAP (URS, 2002b) describes what those restrictions are as summarized below.

- Restrict excavation to a maximum depth of 15 feet.

- Restrict groundwater consumption.
- Require an HSP to be provided by the landowner/contractor for USAF review and approval prior to excavation.
- Restrict soil movement pursuant to Section 20120c of NREPA.
- Restrict land use to industrial only.
- Require a monitoring plan.
- Require a survey to provide a legal description of the site footprint.
- Require an O&M plan.

Monitoring Plan

There are two distinct phases of the soil and groundwater monitoring programs: the RA monitoring and the post-closure monitoring phases.

RA Monitoring:

RA monitoring will include monitoring the progress of both the soil and groundwater cleanups. A soil monitoring program will be performed at Site SS-57 during remediation to monitor the effectiveness of soil bioventing and monitor contaminants that may migrate into the vadose zone due to biosparging. Approximately 19 soil gas monitoring locations have been installed for carbon dioxide, oxygen, and total hydrocarbon sampling and analysis. Soil gas monitoring will be conducted during bioventing and biosparging activities to determine respiration rates and estimate cleanup times.

In addition to soil gas monitoring, the USAF will provide quarterly air monitoring in the source area to demonstrate that air emissions from volatilization of contaminants during bioventing and biosparging do not exceed the de minimus air emissions criteria. When the RA is deemed complete, a Soil Remediation Verification Plan will be implemented to demonstrate that the remediation achieved the MDEQ Industrial Drinking Water Protection and Direct Contact

criteria. This plan will include soil borings to collect confirmation soil samples in the vadose zone to verify that the MDEQ soil criteria have been attained. Groundwater monitoring at Site SS-57 includes both hot spot and downgradient plume monitoring using 16 wells.

The USAF is currently performing monthly monitoring of free-phase liquid at SS-57, and any product detected is being removed and reused.

Post-Closure Monitoring:

Post-closure monitoring will begin after shut down of the ASPTS. Post-closure monitoring will consist of quarterly sampling of 16 wells to demonstrate that the MDEQ Groundwater criteria have been attained.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

A contingency plan will be developed, if necessary, if monitoring data does not show generally declining trends of VOCs in the groundwater over time. The contingency plan will include data evaluation and recommendations for additional investigation or remediation, if necessary.

Public Education

Public education programs will be implemented to inform workers and local residents of the potential risks associated with soil and groundwater at Site SS-57. These programs may include public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. This program may also include: informing the MDH about the potential hazards of installing a water supply well in the area of Site SS-57,

notifying residents of an affected property of the potential hazards associated with well installation, and press releases, where appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

4.14.2 Implementation

The remedial systems were installed in 2002 and were scheduled to start in spring 2003. However, baseline sampling prior to startup indicated explosive concentrations of TVH in the soil gas, and the system was therefore not started. A temporary SVE system will be used to collect high levels of hydrocarbon vapors and prevent migration during sparging system startup. The system start up should include soil gas monitoring to detect potential vapor migration into underground utilities or buildings.

Monthly monitoring of free-phase liquid at SS-57 is currently being performed and will continue until free-phase liquid is not detected for one year. At that time, monitoring for free-phase liquid will cease unless it is detected in the future during regular monitoring.

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected remedy.

4.14.3 System O&M

A summary of the cost of the various components of the RA at Site SS-57 is presented in Table 4-1. Because the system has not been started, there have been no O&M issues.

4.15 ST-68

No approved RAP was in-place at the time of this review. However, the proposed remedy from a draft version of a RAP for this site was presented at a RAB meeting on October 8, 2003. The details of that remedy are discussed below.

4.15.1 Remedy Selection

The proposed RA alternative for soil cleanup is removal of the OWSs, natural attenuation for soils, and implementation of ICs. The preferred RA alternative for groundwater is to maintain the existing ASPTS and implement ICs at the site. The actual IC restrictive language that is proposed would be contained in a DRC and LEA. However, the proposed remedy describes what those restrictions would be as summarized below.

- Limit future land use to industrial.
- Prevent excavations below 15 feet bgs and prevent basements in the ST-68 footprint.
- Review and approval by USAF of an HSP prior to excavations of depths less than 15 feet bgs in the ST-68 footprint.
- Prevent groundwater use as drinking water.
- Groundwater monitoring for the life of the alternative.

4.15.2 Implementation

The following activities have been completed to date.

- Removal of OWSs 5067 and 5068 in May 2003. Removed approximately 115 cubic yards of clean concrete.
- Removal of approximately 300 cubic yards of contaminated non-hazardous soil immediately surrounding the OWSs in May 2003 for disposal off-site.
- Collection and analysis of confirmatory soil samples for VOCs and SVOCs.
- Restoration of the site and backfill of excavations with approximately 1,000 cubic yards of clean sand and 80 cubic yards of clean topsoil in May 2003.

4.15.3 System O&M

It is estimated that proposed RA for groundwater will take 30 years to complete.

Groundwater monitoring wells will be installed in the vicinity of the site to monitor the progress of the RA.

No costs have been assigned to Site ST-68. Because no remedial system has been started, there have been no O&M issues.

4.16 ST-69

No RAP for Site ST-69 has been approved, partially due to its relatively recent identification as a separate IRP site (it was previously included as part of Site ST-45). However, through several letters of concurrence from the USAF (September 22, 1998, and October 7, 1998), USEPA (September 22, 1998), and MDEQ (February 26, 1998, July 7, 1998, and September 25, 1998), a proposed RA was established as described below.

4.16.1 Proposed Remedy

As stated in the Montgomery Watson letter, dated May 9, 2002, the proposed remedy of MNA has been demonstrated to be appropriate for the site. The proposed remedy also includes LTM, ICs, periodic reviews, and public education.

Monitoring Plan

A total of six monitoring wells will be sampled each quarter for VOCs until TCE is measured in all monitored wells at concentrations less than the 5 μg/L criteria for TCE for four consecutive sampling events.

ICs

The actual IC restrictive language that is proposed would be contained in a DRC and LEA. However, the proposed restrictions would include industrial land use restrictions and groundwater use restrictions.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process would assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all

sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review would be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

A contingency plan would be developed, if necessary, if monitoring data does not show generally declining trends of VOCs in the groundwater over time. The contingency plan would include data evaluation and recommendations for additional investigation or remediation, if necessary.

Public Education

Public education programs would be implemented to inform workers and local residents of the potential risks associated with groundwater at Site ST-69. These programs could include public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. This program could also include: informing the MDH about the potential hazards of installing a water supply well in the area of Site ST-69, notifying residents of an affected property of the potential hazards associated with well installation, and press releases, where appropriate. The public education programs would continue through the completion of the remedy and the post-closure monitoring period.

4.16.2 Implementation

LTM has been performed since as early as 1997 and is continuing.

A RAB meeting was held on October 8, 2003, to address the requirement for public participation in the remedy selection process.

4.16.3 System O&M

A summary of the cost of the various components of the RA at Site ST-69 is presented in Table 4-1. Because no system has been started, there have been no O&M issues.

4.17 WP-70

A RAP (URS, 2001) was approved by the USEPA and the USAF on December 23, 2002 and October 28, 2002, respectively. Additionally, the MDEQ has concurred with the selected remedy in the RAP (URS, 2001), according to a letter dated September 25, 2002.

An RAO was developed in the RAP (URS, 2001) as a result of data collected during SIs to aid in the development and screening of remedial alternatives to be considered for the RAP (URS, 2001). The RAO for WP-70 (formerly POI-32) is a follows:

- Prevent uncontrolled excavation or other disturbance of the area at POI-32 where construction debris, including ACM, is located.

4.17.1 Remedy Selection

The selected remedy for Site WP-70 includes removing surficial ACM and large construction debris and placing permanent markers around the perimeter of the former landscape disposal area. A natural soil cover of 6 inches will also be maintained at the site over the ACM. The design of the permanent markers will be discussed in more detail in the declaration of restrictive covenant or LEA currently being prepared by the USAF. A HSP will be required to be provided by the landowner/contractor, and the plan must be reviewed and approved by the USAF prior to excavation at Site WP-70. As previously discussed, groundwater underlying the site will be restricted for consumption due to impacted groundwater from the adjacent site (Site OT-24).

Site WP-70 will also be surveyed to identify the area of impact. This alternative also includes deed restrictions, ICs, periodic reviews, and public education.

ICs

Site WP-70 is zoned as recreational vehicle. The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF. However, the RAP describes what those restrictions are as summarized below.

- Maintain 6 inches of natural soil cover over the ACM. Annual site inspections will be performed to evaluate the condition of the soil cover and to perform any required maintenance.

- Require an HSP to be provided by the landowner/contractor and reviewed and approved by the USAF prior to excavation or construction.

- Require a survey to provide a legal description of the site footprint.

- Restrict future land use to recreational vehicle.

- Require permanent markers.

- Require an O&M plan for inspection and maintenance of the permanent markers and natural soil cover.

Periodic Reviews

In compliance with CERCLA requirements, a five-year review process will assess the effectiveness of RAs being undertaken at Wurtsmith AFB. Five-year reviews are required for all sites where the remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The statutory review will be conducted within five years after initiation of RA to ensure that the remedy is, or will be, protective of human health and the environment.

Public Education

Public education programs will be implemented to inform workers and local residents of any potential risks related to Site WP-70. These programs may include public meetings and presentations, press releases, notification of residents of the progress of the remediation, and posting of signs where appropriate. The public education programs will continue through the completion of the remedy and the two-year post-closure monitoring period.

4.17.2 Implementation

Removal of surficial ACM and large construction debris, placement of permanent markers around the perimeter of the former landscape disposal area, and placement of a natural soil cover over the ACM was completed in November of 2003.

The actual IC restrictive language that is recorded will be contained in the DRC and LEA currently being prepared by the USAF.

The first five-year review is being performed within the appropriate schedule.

Finally, a RAB meeting was held on October 8, 2003, to address the requirement of the public education component of the selected remedy.

4.17.3 System O&M

Inspections will be performed annually to evaluate site conditions and to complete any required maintenance. An O&M plan will be prepared which will identify procedures to be followed for monitoring site conditions including maintaining permanent markers and the 6-inch natural soil cover over the landfill.

A summary of the cost of the various components of the RA at Site WP-70 is presented in Table 4-1. Specific problems with O&M noted during this review, if any, are included in Sections 6.5 and 6.6.

4.18 SS-71

No RAP has been prepared or approved for Site SS-71 to date. However, a remedy was proposed during an October 8, 2003, RAB meeting as described below.

4.18.1 Proposed Remedy

The proposed remedy for Site SS-71 is MNA for groundwater, with groundwater use restrictions and public education.

4.18.2 Implementation

In 2002, two monitoring wells were installed at SS-71. These wells were sampled for VOCs for the first time in July 2002. Analyses indicated that PCE was present at one well at 6.17 µg/L, which slightly exceeded the MDEQ residential and industrial drinking water criterion of 5.0 µg/L. A June 2003 monitoring event did not detect PCE in either well. An additional annual monitoring event was recommended to verify the continued absence of PCE.

4.18.3 System O&M

Minor monitoring costs have been incurred at Site SS-71. Since no RA has been implemented at this time, there are no concerns associated with system O&M.

SECTION 5

PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This is the first five-year review.

SECTION 6

FIVE-YEAR REVIEW PROCESS

The five-year review was completed following USEPA guidance in *Comprehensive Five-Year Review Guidance* (USEPA 540-R-01-007). This section provides a summary of the process used for the five-year review for Wurtsmith AFB.

6.1 ADMINISTRATIVE COMPONENTS

The AFCEE and AFRPA initiated the five-year review in March 2003 by awarding Delivery Order 2004 under Contract No. F41624-01-D-9009 to Parsons. The Parsons five-year review team was led by Mr. Doug Downey (project manager), Mr. John Ratz (technical director), Dr. Ed Heyse (senior engineer), Mr. John Tunks (hydrogeologist), and Dr. Fan Wang-Cahill (risk assessor). The team was assisted by Mr. Paul Rekowski, the AFRPA Wurtsmith AFB Environmental Coordinator, and members of various base consultants to the AFRPA. Mr. Charles Rice (the AFCEE contracting officer's representative [COR]) and Mr. Steve LaFrenière (AFRPA) provided oversight and technical direction. Input also was provided by base contractors, the USEPA, and MDEQ.

The review schedule was established by the review team and included the following components:

Community involvement
Document review
Data review
Site inspection
Interviews

6.2 COMMUNITY INVOLVEMENT

On 1 October 2003, a public notice was published in the local newspaper, the *Oscoda Press*, inviting the general public to a RAB meeting where they would receive an update on the Wurtsmith AFB remediation program. On 8 October 2003, the notice was again published in the *Oscoda Press* to specifically announce the initiation of a five-year review process at Wurtsmith AFB.

During the afternoon of 8 October 2003, USAF and Parsons representatives presented an overview and schedule for the five-year review process. Ten local citizens and community leaders attended the meeting. Information on ongoing site remedies was provided. The public was given a complete overview of the five-year review process and encouraged to contact Mr. Paul Rekowski at the local AFRPA office if they had questions, comments or suggestions concerning the Wurtsmith AFB remediation program.

At the conclusion of the five-year review process, the results of the review will be presented in a future RAB meeting. Copies of the final document will be made available in the public library.

6.3 DOCUMENT REVIEW

This five-year review consisted of a review of relevant documents including O&M records and manuals, HSPs, SAPs, monitoring data and monitoring reports, applicable cleanup standards, RI reports, and DDs. Specifically, the following documents were reviewed:

- Final Remedial Investigation Report, Sites FT-02, OT-16, and LF-27, Wurtsmith Air Force Base, Oscoda, Michigan (ICF, 1997e);
- Final Remedial Action Plan Decision Document, Site FT-02 (ICF, 1998d);
- Final Revised Remedial Action Plan/Decision Document for Site FT-02 (URS, 2002a);
- Final Remedial Investigation Report, Sites FT-01, WP-04, and LF-23 (ICF, 1997b);
- Final Remedial Action Plan/Decision Document, Site WP-04 (ICF, 1998e);

- Final Consolidated Remedial Action Plan (URS, 2002b);
- Final Technical Report, Supplemental Remedial Investigation, Sites WP-04, SS-05, SS-06, SS-08, LF-23, OT-24, LF-27, ST-41, SS-42, and SS-71 (URS, 2003);
- Remedial Investigation for Sites SS-05 and LF-26 (ICF, 1996e);
- Final Remedial Action Plan Decision Document, Site SS-05 (ICF, 1998i);
- Remedial Investigation, Final Report, Sites SS-06, ST-40, SS-13 and ST-46 (ICF, 1996d);
- Final Remedial Action Plan/Decision Document, Sites SS-06, ST-40, SS-13, and ST-46 (ICF, 1998g);
- Remedial Investigation, Final Report, Sites OT-41, SS-42, OT-44 and SS-48 (ICF, 1996b);
- Final Remedial Action Plan Decision Document, Site SS-08 (ICF, April 1998j);
- Final Remedial Action Plan/Decision Document, Sites SS-08, ST-41, SS-42, and SS-53 (URS, September 2002c);
- Final Remedial Action Plan/Decision Document, Site OT-16 (ICF, April 1998h);
- Final Remedial Investigation Report at the Base Gas Station Site (SS-47), Wurtsmith Air Force Base, Oscoda, Michigan (WWES, 1995);
- Final Remedial Investigation Report, Site SS-17, SS-21, and Arrow Street Pump and Treat System (ICF, 1997a);
- Final Feasibility Report, Sites SS-17, SS-21, and SS-47 (ICF, 1997d);
- Final Remedial Action Plan, Sites SS-17, SS-21, and SS-47 (ICF, 1998k);
- Current (i.e., 2003) Annual Monitoring Data (WurtsmithAFB.net, 2004);
- Final No Action Remedial Action Plan Decision Document, Site LF-23 (ICF, 1998l);

- Remedial Investigation Report, OT-24 (ICF, 1996f);
- Addendum to the Remedial Investigation Report, Site "OT-24" (ICF, 1996h);
- Remedial Action Plan, OT-24 (ICF, 1996g);
- 2002 Annual RAO Monitoring Report (MWH, 2003b);
- Monthly Technical Status Reports (WurtsmithAFB.net, 2004);
- Final No Action Remedial Action Plan/Decision Document, Site LF-26 (ICF, 1998c);
- Performance-Based Environmental Restoration Management Assessment (PERMA) for Landfills 30 and 31, (AFRPA, 2003b)
- Remedial Action Plan, Risk-Based Approach to Remediation, KC-135 Crash Site (Parsons, 1996b); and
- Final Remedial Action Plan Decision Document, Base Operational Apron, Site SS-57 (Versar, 2002).

6.4 DATA REVIEW

As part of the five-year review, data collected in support of RAs were reviewed to identify relevant trends and levels. This section summarizes the results of that review for each IRP site or group of sites.

6.4.1 FT-02

SVE System

Soil gas data were reviewed in the 2002 RAO report and monthly performance reports produced by the base O&M contractor. Samples are collected from the SVE extraction lines for Group A through Group E vent wells on a quarterly basis and analyzed for VOCs and TPH to estimate removal rates. Annual soil gas monitoring is also being conducted until asymptotic levels of the COCs are achieved. According to the proposed RAP, once this is achieved,

confirmatory soil samples will be collected in the areas where the highest levels of contaminants were previously detected to verify that treatment objectives have been met. Confirmation soil samples will be collected in general accordance with MDEQ's *Verification of Soil Remediation* (MDEQ, 1994).

The extracted vapors are discharged (no permit required) directly to the atmosphere without treatment with an air-emission restriction of 1,000 pounds of noncarcinogenic contaminants per month and 20 pounds of carcinogenic compounds per month. There is no discharge limit on TPH. These limits have never been exceeded. Quarterly samplings of vapor emissions from each of the well groups are performed to confirm compliance with the discharge restrictions and determine contaminant removal rates.

Significant cleanup of the vadose and smear zone soil occurred throughout the 19-month operating period from May 2001 through March 2003. The contaminant removal rates decreased asymptotically during the May 2001 through December 2002 period of operation (Figure 6-1). As of March 2003, the total mass removed was approximately 5,100 pounds. This exceeds the 3,000-pound design estimate.

TPH has been by far the predominant vapor constituent extracted by the SVE system. For example, during the months of June 2002 and December 2002, TPH represented approximately 98.1 percent of the contaminant mass in the FT-02 soil vapors. During this period, noncarcinogenic compounds constituted 1.7 percent, and carcinogenic compounds constituted less than 0.2 percent of the soil vapor contaminant mass.

Based on the cleanup (asymptotic) profile, it appears the soil cleanup by SVE at FT-02 is approaching completion. A soil-vapor rebound test is recommended to confirm the cleanup before confirmatory soil samples are obtained. Soil-gas samples from areas of historical soil contaminant "hot spots" within the treatment area also could be obtained for laboratory analysis to estimate the degree of soil cleanup. Alternately, a limited number of soil samples could be collected and analyzed for contaminant "hot spots," but also could be obtained to provide depth-contaminant profiles of the soil column, with special emphasis on the soil in the smear/capillary zone.

After performing these preliminary investigations successfully, the MDEQ-mandated confirmatory soil sampling protocol may be performed as prescribed. If this testing is successful, the FT-02 SVE system will be permanently shutting down.

MNA

MNA for the site has been implemented as part of the regular LTM program at the base. Fifteen monitoring wells are collected annually and analyzed for VOCs. Figure 3-1 provides a map of LTM wells and 2002 BTEX concentrations. Monitoring well FT02-MW3 also is sampled for SVOCs, alkalinity, ammonia-nitrogen, arsenic, chlorides, ferrous iron, lead, manganese, mercury, nitrate, ortho-phosphate, sulfate, TDS, total iron, and TOC.

Natural bioattenuation processes have been documented by the University of Michigan for degradation of VOCs in the groundwater at FT-02. Reductive dechlorination is supported by the continued presence of anaerobic conditions in the core of the plume and the complete degradation of TCE. The migration of cis-1,2-DCE and VC has also been curtailed by the aerobic degradation of these compounds on the leading edge of the plume. Based on modeling performed in 1999, the MNA process duration for the groundwater at this site is estimated to be about 20 years.

A review of data from the 2002 RAO report and April 2003 sampling results for FT-02 indicates the following trends.

- Groundwater contaminant concentrations generally are decreasing. Only four wells (FT2, FT4S, FT8W, and FT8S) have had contaminant concentrations for benzene, 1,2,4-TMB, ethyl benzene, cis-1,2-DCE, and VC consistently above the MDEQ criteria. A spike in concentrations occurred during the May 2002 sampling event but concentrations returned to a downward trend by August 2003. These wells are in or near the source area and have not yet established a consistent decreasing concentration trend. VOC concentrations in these wells are likely influenced by changing water levels and spatial variations in source area contamination. For example, water levels were 1 to 2 feet higher in May of 2002 than

in previous sampling events. This indicates that the capillary fringe of the site contains higher levels of contaminants and should be the focus of future soil treatment.

- Most wells outside of the source area are exhibiting decreasing concentration trends, indicating that contaminants within the downgradient plume are degrading and the plume is stable or shrinking. The MNA remedial approach is showing substantial evidence of degrading source contamination of TCE from the FT-02 source area. The presence of VC concentrations in groundwater monitoring wells within the source area (FT2, FT4S, FT8M, and FT8S) is to be expected during active reductive dechlorination. Migration of VC into more aerobic down-gradient groundwater appears to allow aerobic degradation and rapid removal of these compounds. Future MNA monitoring should be used to confirm this trend.

- Samples from the Seep 1.3 area show substantially reduced concentrations of all COCs compared to historical data for 1997, 1998, and 1999. August 2003 concentrations were comparable to the May 2002 results, which were all less than the MDEQ Part 201 criteria. Seep 1.3 is the area where the FT-02 groundwater plume discharges to the surface and mixes with the wetland waters.

- Water levels within the Site FT-02 area fluctuate and vary from well to well and from time to time. This variability may be a result of the specific operating mode of the SVE system at the time of measurements. The fluctuations for the site range up to 1.5 feet, but could be greater seasonally. These variations could be the cause of more erratic groundwater VOC concentrations in the source area wells.

- Elevated concentrations of dissolved iron and manganese are present in the source area. This is a common phenomenon caused by the reducing conditions created by fuel degradation. These dissolved metals precipitate out as oxides as the downgradient groundwater becomes more aerobic. Dissolved iron and manganese "plumes" will contract as the site becomes more aerobic.

6.4.2 WP-04

Monitoring data from the WP-04 Site were evaluated to determine if adequate source definition has been completed and to determine if the existing remedy of MNA is operating as expected. The groundwater monitoring plan for WP-04 consists of sampling for VOCs from five monitoring wells (WP04-MW1, WP04-MW2, WP04-MW3, WP04-MW4, and R76D) on a quarterly basis. Groundwater analytical results from these wells from 1994 through 2003 were evaluated as part of this review. Figure 3-2 provides a map of LTM wells and 2002 PCE concentrations.

With the exception of PCE in well WP04-MW2, no VOCs have been detected at Site WP-04 above the MDEQ residential and industrial drinking water criteria since 1995. The concentration of PCE in well WP04-MW2 has been decreasing slowly but consistently from a maximum of 17 µg/L in 1998 to 12 µg/L in August 2003.

The hydraulic gradient at the site is relatively flat due to the extraction of groundwater by the ASPTS. This reduces the potential for the PCE plume to migrate in any direction. The plume extent has been well defined to the north and south, less well to the west, and poorly to the east. However, due to the shallow hydraulic gradient, further plume extent characterization is not warranted. There does not appear to be a well downgradient in the direction of groundwater migration off-site that could be used to evaluate any potential migration off-site. This should be further evaluated.

Based on the limited detections at Site WP-04, monitoring wells MW1, MW3, and MW4 may not be required for long-term MNA. The following are additional recommendations to the RA at Site WP-04.

- Reduce frequency of sample collection from quarterly to annually.
- Remove wells WP04-MW1, MW3, MW4 and R76D from the monitoring network.

- Consider installing a well near the intersection of Perimeter Road and Skeel Avenue to define the eastern extent of the plume because this is the only direction in which the plume could migrate off base without being monitored.

6.4.3 SS-05

Monitoring data from the SS-05 Site were evaluated to determine if adequate source definition has been completed and whether the selected remedial alternative of MNA is operating as expected. Remedial objectives are MDEQ residential drinking water criteria. According to ICF (ICF, 1998i), the modeled duration of the remediation is 7 years for PCE (by April 2005) and 16 years for TCE (by April 2014). The long-term groundwater monitoring at Site SS-05 will be conducted annually to determine the progress of natural attenuation processes.

Thirteen wells are designated for LTM: SS05-MW1, SS05-MW2, SS05-MW3, SS05-MW4, SS05-MW5, SS05-MW6, SS05-MW7, R13S, R19S, R19D, R27D, R31S, and R33S. Groundwater and surface water analytical results from 1994 through 2002 were evaluated as part of this review. Figure 3-3 provides a map of LTM wells and 2002 TCE concentrations.

The annual report indicates "PCE concentrations have been decreasing at this location since 1999..." and that "TCE concentrations are generally decreasing at four locations (R19D, SS05-MW1, SS05-MW2, and SS05-MW4), increasing at two locations (SS05-MW3 and SS05-MW5), and fluctuating or indeterminate at one location (SS05-MW6)." The data analysis indicates that these conclusions are not supportable, particularly for the off-base monitoring wells. Figure 6-2 shows a consistent concentration of TCE at this site over the past six to ten years. However, the extent of the overall plume is retracting and this trend is expected to eventually be observed off site. For now, the monitoring data indicate that the off-base concentrations of contaminants in the groundwater will remain above the MCL for the foreseeable future.

The interpreted plumes as drawn in Figure 3-3 (MWH, 2003b) could also be interpreted as a continuous plume, not three separate plumes. Monitoring wells SS05-MW1, SS05-MW2, and SS05-MW4 are all located off-site. These three wells have TCE concentrations that have remained consistent for the past 3 or 4 years at approximate concentrations of 100 µg/L, 60 µg/L,

and 20 µg/L, respectively. The TCE contamination may in fact be continuous from SS05-MW4 to SS05-MW3.

The five-year review team does not recommend that additional wells be installed to the west of SS05-MW4 because definition of the interior of the plume is not necessary. Remedial decisions to ensure protectiveness can be made with the current information. However, at least one new well should be added to the east of MW4 to delineate that edge of the plume toward the houses in that direction. This may be important in evaluating the possibility of vapor intrusion into the buildings to the east. Furthermore, continued sampling of well SS05-MW2 may not be necessary due to its' proximity to well SS05-MW1 (within approximately 100 feet downgradient). The value of data collected from well SS05-MW2 relative to MNA is reduced due to the spatial redundancy of data from this area (due to continued sampling of SS05-MW1).

The concentrations of TCE do not exceed the GSI for surface water. However, the groundwater in the off-base property exceeds MDEQ residential criteria. Water supply for residential use in this area is provided by alternate sources. The final remedy will have to include an IC on those properties with groundwater contamination above the MDEQ residential criteria.

In order to improve the protectiveness of the off-base SS-05 groundwater remedy, annual public education (such as providing literature on well restrictions) should be provided to all off-base residents potentially impacted by the SS-05 VOC plume.

6.4.4 SS-06, SS-13, ST-40, and ST-46

Multiple remediation technologies operate at the POL Bulk Storage Facility to treat fuel hydrocarbons from Sites SS-06, SS-13, ST-40, and ST-46.

A groundwater extraction and treatment system known as the BPPTS was installed in 1991 to remove benzene contamination from groundwater. Twin fiberglass packed towers are used for air stripping. The system also includes six extraction wells, four of which have product recovery skimmer pumps.

An AS and SVE system was installed in portions of the site that had floating hydrocarbons. The system was intended to contain and remediate a composite plume of petroleum hydrocarbons believed to emanate from sites SS-06, SS-13, SS-40, and SS-46. The AS system was designed to enhance the removal of dissolved and free-phase hydrocarbons through biodegradation and direct volatilization. The off-gas from the SVE system complies with MDEQ discharge limits and is directly released to the atmosphere.

A bioventing system was installed within the former bulk fuels storage area (Site ST-40) to remediate petroleum contaminated soil.

6.4.4.1 Groundwater Extraction System Data Review

Four original groundwater extraction wells (PW-1 through PW-4) and two additional extraction wells (PW-5 and PW-6) constructed in 1999 operate at a combined extraction rate of approximately 150 gpm. A review of potentiometric surface maps indicate that this pumping rate is more than sufficient to capture the dissolved contaminants from the four fuel-contaminated sites. The pump and treat system is currently being evaluated for additional optimization.

A review of historical data, including the *2002 Annual RAO Monitoring Report* (MWH, 2003b) indicates that benzene concentrations have been decreased from several hundred µg/L to less than the 5 µg/L residential groundwater standard. Similar trends have been noted for ethylbenzene and xylenes. The total mass of BTEX removed via groundwater extraction to date is approximately 950 pounds. Increasing concentrations and mass removal of TCE has been noted since the start of extraction from the two new extraction wells, PW-5 and PW-6; however, the concentrations are relatively low, approximately 10 µg/l to 15 µg/L. This TCE appears to be a remnant of a historical TCE plume that may have emanated from upgradient site SS-08. Figure 3-4 provides a map of LTM wells and 2002 VOC concentrations.

6.4.4.2 Free Product Recovery Data Review

Four of the groundwater extraction wells are equipped with small recovery pumps for product skimming. Limited volumes of product are currently recovered despite substantial measured thicknesses (up to 4 feet) at well PW-4.

More than 12,000 gallons of free product have been collected. However, the annual recovery rate has dropped from 6,200 gallons in 1999 to fewer than 60 gallons in 2002. Most of the product has been recovered from PW-3 and PW-4.

Substantial maintenance is required for these wells, based on a review of the 2003 monthly RAO reports. The well screens require frequent scrubbing to remove the iron bacteria and iron scum that impair flow and pump performance. Because the free product is immobile and no longer contains enough BTEX to constitute a long-term source of groundwater or soil gas contamination, the need for continued free product removal is questionable.

6.4.4.3 AS/SVE System Data Review

In October 1999, the base initiated a combination AS and SVE system at Site SS-06 to promote BTEX removal in the most contaminated area of the site. A total of 59 AS wells and 19 SVE wells have operated over the past four years. A catalytic oxidation unit operated until extracted vapor levels fell below discharge limits in August 2001.

Based on a review of 1999 to 2002 groundwater data, Site SS-06 groundwater concentrations of BTEX compounds have dropped from more than 500 µg/L before the sparging system came on-line to fewer than 5 µg/L. These compounds are now below MDEQ industrial drinking water standards. Continued operation of the AS system is recommended to remove 1,2,4-TMB that remains slightly above MDEQ standards.

Table 6-1 illustrates the progress of the AS/SVE system in reducing soil gas levels of BTEX and TPH. Data indicate that SVE is no longer removing significant levels of BTEX or TPH, confirming that the volatile (and toxic) fraction of remaining hydrocarbons has been removed from the site. A recent site SS-06 RPO evaluation recommended that the SVE system be turned off and that the AS system be operated alone as a biosparging application (AFRPA, 2003a).

6.4.4.4 Bioventing System Data Review

Concentrations of petroleum hydrocarbons in soil vapors within the bioventing system at Site ST-40 have declined by more than an order of magnitude since the bioventing system began operation. Based on 2001 soil gas data, there are still contaminated soils that are not receiving oxygen at levels above the recommended minimum concentration of 5 percent. The base RAO contractors are currently working on a rebalancing of air injection rates to improve oxygen distribution.

6.4.5 SS-08, ST-41, SS-42, and SS-53

Monitoring data from the former ACC aircraft parking and refueling apron and maintenance "nose dock" facilities were evaluated to determine if adequate source definition has been completed and the existing AS and SVE system achieved its remedial objectives. This area includes two active remediation sites:

- Site SS-08 is a general area of jet fuel and minor chlorinated solvent contamination emanating from the former aircraft hydrant refueling area and the back of nose dock Building 5063. Figure 3-5 provides a map of LTM wells and 2002 VOC concentrations.

- Site SS-53 refers to a specific JP-4 leak at hydrant No. 22.

Two sites are also being monitored for natural attenuation in this area. Leaking USTs resulted in jet fuel and MOGAS contamination at Site ST-41 and a leaking AST spilled JP-4 at Site SS-42.

6.4.5.1 Adequacy of SS-08 Source Area Definition

Over the past 10 years, Wurtsmith AFB has completed a total of six RIs in the aircraft parking apron and nose dock areas. In addition to soil and soil-gas studies, more than 40 groundwater monitoring wells were installed in the apron and maintenance area (URS, 2002b). These wells are generally located near or downgradient of fuel pipelines and OWS facilities.

Since 1994, only four wells have had TCE or PCE concentrations exceeding 5 µg/L. All wells downgradient of Site SS-08 have been gradually decreasing from the 10 µg/L to 20 µg/L

range to the current range of 1 µg/L to 10 µg/L. The sources at Sites ST-41 and SS-42 are well defined.

Historical and current groundwater data downgradient of the aircraft maintenance area strongly suggest that no substantial sources of TCE or PCE remain. The recent soil and groundwater sampling near OWSs ST-67 and ST-68, and the discovery of a leak in the sewer line entering ST-68, confirm that limited sources of BTEX and chlorinated solvents do exist in this area (MWH, 2003a). However, the presence of small, randomly distributed source areas is not creating a need for additional downgradient remediation.

The general decreasing trends in downgradient monitoring wells indicate that these sources are attenuating and will fall below the most conservative MDEQ groundwater criteria long before the downgradient PTSs are terminated. These low concentrations and decreasing contaminant trends indicate that large chlorinated solvent or BTEX sources do not remain in the aircraft parking apron or nose dock maintenance areas. The USAF recently completed a "picket fence" of temporary monitoring wells to the south of Site SS-08 to determine if any continuing source from this site was impacting downgradient groundwater. Results presented at the December 2003 BCT meeting indicated no significant chlorinated solvent sources remain (unpublished data).

6.4.5.2 SS-08/SS-53 SVE and AS System Data Review

The SVE and AS system was turned on in September 1999. After the first few weeks of operation and sampling, it was determined that the use of activated carbon to treat extracted soil gas was no longer needed to meet MDEQ air emission limits. Two years of operation and monitoring were completed and the system was shut down in November 2001. System shutdown was based on having achieved two criteria:

- Groundwater BTEX and TMB concentrations had dropped below MDEQ industrial drinking water criteria; and
- SVE influent data showed TVH removal had decreased from initial values of 500 to 800 pounds per month to an asymptotic value of less than 20 pounds per month (MWH, 2002).

After achieving these criteria, Wurtsmith AFB began two years of quarterly groundwater monitoring at several wells within the SS-08/SS-53 plume area. Prior to venting, the groundwater concentration of benzene at well H90S was 135 µg/L. Benzene has been reduced to concentrations below the detection limits. After one year of monitoring, concentrations of 1,2,4-TMB rebounded to 183 µg/L at well H90S. After 15 months of monitoring, 1,2,4-TMB concentrations were at 86 µg/L, and after 18 months (July 2003) levels had dropped to less than 8 µg/L, substantially below the MDEQ industrial drinking water criterion of 63 µg/L. If this data trend continues for the next six months, the groundwater will have clearly achieved MDEQ cleanup criteria.

The combination AS and SVE system has been very successful at removing fuel contaminants from soils at this site. The SVE system removed an estimated 4,000 pounds of TVH from the SS-08 and SS-53 source areas. If the effects of *in situ* biodegradation are considered, the total hydrocarbon removal has likely exceeded 6,000 pounds.

A review of 2002 and 2003 groundwater data from Sites ST-41 and SS-42 indicate that MNA has reduced groundwater concentrations of BTEX and TMBs to concentrations below MDEQ industrial drinking water criteria.

6.4.6 OT-16

Monitoring data from the OT-16 Site included in the *2002 Annual RAO Monitoring Report* (MWH, 2003b) were evaluated to determine if adequate source definition has been completed and the selected remedy of MNA is operating as expected. MNA is performed using a network of 17 wells that are sampled quarterly for VOCs, SVOCs, arsenic, mercury, lead, manganese, and traditional bioremediation parameters. Cleanup criteria are to achieve MDEQ residential drinking water and GSI criteria for off-site property and MDEQ industrial drinking water and GSI criteria for onsite property. Groundwater modeling efforts completed as part of the FS (ICF, 1998b) estimated that organic contaminants may reach MDEQ criteria within six years (2004). Figure 3-6 provides a map of LTM wells and 2002 VOC concentrations.

Additional groundwater investigation activities were conducted by MWH in the summer and fall of 2001 and the spring of 2002 to further define the lateral and vertical extent of the VOC contamination at this site (MWH, 2003a). The highest concentration of TCE (41 µg/L) was detected in well OT16-MW15 in August 2002. This location is within 200 feet of the wetlands. Additional sampling at this location in 2003 has confirmed these concentrations. Although this concentrations is below MDEQ GSI criteria (200 µg/L) is does exceed the final RAO for this area of compliance with MDEQ residential drinking water criteria.

The highest concentrations of fuel compounds were detected in OT16-MW3. As of the June 2003 sampling event, only 1,2,4-TMB (65 µg/L) remains slightly above MDEQ industrial drinking water criteria. Concentrations of BTEX and naphthalene appear to be limited to wells OT16-MW3 and OT16-MW8, and appear to decrease substantially in concentration to the southeast. These compounds do not discharge to surface water and are completely attenuated within the boundary of the AFB property.

Attenuation of dissolved iron and manganese is difficult to evaluate because concentrations of these chemicals do not appear to adhere to typical plume dimensions and vary throughout the presumed groundwater flow path. However, concentrations of these metals are above MDEQ residential drinking water criteria at the point where groundwater discharges to surface water. No GSI criteria have been established for these chemicals. Concentrations of dissolved iron and manganese normally decrease as the fuel hydrocarbons are degraded and the groundwater becomes increasingly oxidized.

- After data review, the five-year review team recommends the following.

- Consider reducing the LTM network to what is necessary to demonstrate the MNA objective. Several good recommendations were made in the 2002 RAO report. They included reducing the sampling frequency to semi-annually and dropping SVOC analysis.

- Perform monitoring network optimization. Consider LTM at wells OT16-MW1, OT16-MW3, OT16-MW5, and OT16-MW9 through MW16 after assessment activities are

completed, as these locations will provide monitoring of background concentrations, source concentrations, and potential off-site migration.

- Evaluate more fully the TCE and metals that are being detected at wells located near a groundwater discharge to surface water area, for exceedances of calculated GSI criteria. This will require a determination of the hardness value for the receiving water body.

6.4.7 SS-17, SS-21, and SS-47

The ASPTS was designed in 1981 to treat contaminated groundwater from the SS-21 TCE spill. The system also captures hydrocarbon and BTEX contaminants from the SS-17 fuel oil spill and SS-47 base service station site. Based on a review of potentiometric surface maps, the capture zone of the ASPTS appears wide enough to collect upgradient groundwater from Plume B at Site SS-08 (specifically Sites ST-41, SS-42, and SS-53). The groundwater contaminants associated with Site SS-57 Old Apron Hydrant Fuel System and WP-04 Old Sewage Plant are also within the capture zone.

The ASPTS currently includes two steel air-stripping towers, four extraction wells, and associated influent and effluent piping. Treated water is discharged via pipeline to Van Etten Creek (Outfall 007A) southeast of the plant. The substantive requirements document (SRD) limits total discharge to 1,730,000 gpd (approximately 1,200 gpm) with a TCE concentration in the effluent of 1.5 µg/L or less. According to the *2002 Annual RAO Monitoring Report* (MWH, 2003b) these discharge limits have been consistently achieved.

Air from the air stripper is discharged directly to the atmosphere. The plant can emit up to 20 pounds of carcinogenic compounds to the atmosphere per month without emissions treatment. Current air emission rates are an order of magnitude below the discharge limits.

Aggressive pumping at ASPTS has removed more than 7.75 billion gallons of water from 1982 through July 2003. Current extraction rates are 500 to 600 gpm.

The original plume measured approximately 3,000 feet long by 400 feet wide by 50 feet thick. Assuming a porosity of 30 percent, at least 57 pore volumes of water have flushed through the

portion of the aquifer that was occupied by the original Arrow Street plume. The current TCE plume is less than 2,000 feet long and 300 feet wide.

Concentrations of contaminant in the influent have decreased substantially over the years, from more than 1,000 µg/L in 1982 to around 10 µg/L in 2002. MWH (2003) has estimated that approximately 7,650 pounds of TCE have been removed by extraction system since 1982. Annual removal is now less than 20 pounds of TCE.

The mass loading of TCE to the ASPTS is shown in Figure 6-4. The TCE mass loading to the ASPTS has decreased at a nearly exponential rate. However, data collected over the past five years indicate that the mass recovery curve is now "flattening" or becoming asymptotic. Individual monitoring well data indicate that two monitoring wells exhibit persistent TCE levels. Monitoring well G14S/D (the presumed source at SS-21) and well W512 (an unknown source near SS-47) both appear to be located near a TCE generating source. Figure 3-7 provides a map of LTM wells and 2002 TCE and DCE concentrations.

After more than 20 years of operation, the ASPTS is in need of pumping optimization and a replacement of the antiquated control systems. The AFRPA has funded an RPO project that is studying contaminant removal trends and is expected to recommend a total system upgrade with the relocation of some extraction wells. Source reduction methods, such as enhanced biodegradation, will also be evaluated for reducing the overall cleanup time for source areas near Sites SS-21 and SS-47.

6.4.8 LF-23

There are no active remedial systems or monitoring occurring at Site LF-23. Only ICs, which are discussed in Section 7.8, are required. Accordingly, a data review is not applicable.

6.4.9 OT-24

Data review included data present on the base website (dated from December 1979 through August 2003), and in the *2002 Annual RAO Monitoring Report* (MWH, 2003b). Groundwater sampling from 1993 to 2003 at Site OT-24 indicated the presence of 1,1,1-TCA, cis-1,2-DCE, and TCE in on-site wells at concentrations greater than the MDEQ GSI and residential drinking

water criteria and the GSI criteria listed in the RAP. However, TCE and cis-1,2-DCE are the only GSI exceedances since 1996. Figure 3-8 provides a map of LTM wells and 2002 TCE concentrations.

For off-site wells, constituents that have historically exceeded MDEQ residential drinking water criteria are TCE and cis-1,2-DCE. Based on June/July 2003 sampling, off-base TCE levels are in the 20 µg/L to 30 µg/L range and DCE is less than 2 µg/L.

The MDPTS and 2001 extraction well optimization have had a positive impact on local groundwater quality. The design of the groundwater extraction field uses three of the seven wells (PW1A through PW3A) to extract approximately 75 percent of the total treatment plant inflow. These three wells are located within the approximate center of the TCE plume designated as Plume A.

Recent concentrations of TCE in extracted groundwater from these three wells ranged from 37 µg/L to 128 µg/L. Concentrations of TCE in these wells have decreased steadily since system start-up when concentrations ranged from 136 µg/L to 206 µg/L.

Of the remaining four wells, three (PW5A, PW6A, and PW7A) are located east of the TCE Plume A (as defined by the 5 µg/L TCE concentration contour). Since system start-up, they have generally contained low concentrations of TCE that ranged from about 3 µg/L to non-detectable levels. DCE in these wells ranges from 5 µg/L to 57 µg/L, less than the ACLs. DCE concentrations have remained relatively stable in two of these wells (PW6A and PW7A) but have decreased from 132 µg/L to 46 µg/L in PW5A since system start-up. Figure 6-5 illustrates the historical mass removal of TCE achieved with the MDPTS. The spike in mass removal in 2001 was due to the start up of the optimized extraction well configuration.

The extraction system is close to achieving the cleanup criterion of 94 µg/L TCE within the capture zone of the system. TCE concentrations in the portion of the plume that appears to be downgradient (south) of the MDPTS capture zone have shown a less defined pattern. A general decrease in TCE concentrations occurred since August 2001, but TCE still remains above

cleanup criteria. In July of 2003, well H52D had a TCE concentration of 531 µg/L. Additional groundwater extraction from this area would accelerate site cleanup.

The hydraulic gradient in this area may be particularly flat due to the influence of the MDPTS, which may be slowing down the advective transport of this portion of the plume toward the Three Pipes Drainage Ditch. At the downgradient portion of the plume where Plume A intersects the Three Pipes Drainage Ditch, TCE concentrations in monitoring wells H71D and H69D have decreased from 800 µg/L to 20 µg/L from 1994 to 2003 (H71D) and from 136 µg/L to 30 µg/L from 2000 to 2003 (H69D). These trends indicate that the plume is retreating, or decreasing in magnitude, and that the selected remedy of MNA is appropriate.

The following are conclusions presented in the *2002 Annual RAO Monitoring Report* (MWH, 2003b) which are corroborated by the five-year review team.

- Most wells in Plume A have demonstrated decreasing TCE concentrations since the MDPTS was upgraded in 2001, but insufficient time has passed to verify this result for wells at the downgradient end of the plume. In Plume B, TCE concentrations in the one well that has exceeded the MDEQ residential criterion have decreased with time.

- Continue the current LTM program in Plumes A and B to evaluate impacts of the remedial programs. The five-year review team recommends the addition of one or two monitoring wells spaced equally south of extraction well PW7A and north of monitoring well H119D. This area of the site is not being monitored as part of the LTM program and presents a potential pathway for contaminant migration in groundwater.

- The GSI and cleanup criteria referred to in the C-RAP (URS, 2002b) for the constituents of interest are substantially different from those currently listed in the MDEQ Part 201 rules or in the RAP/DD (ICF, 1996g). If these were specifically calculated for the site or were based on an outdated version of the criteria tables, it may be appropriate to revise the cleanup criteria that apply to this site.

- Additional optimization of the MDPTS is recommended if TCE concentrations in monitoring wells H52D and H64D do not continue to decrease over the next two years. Since this area is likely outside the MDPTS capture zone, the addition of one or more extraction wells may be required to achieve cleanup criteria in a reasonable timeframe.

6.4.10 LF-26

There are no components to the RA or monitoring that require the collection of data at Site LF-26. Only ICs are required. These are discussed in Section 7.10. Therefore, no data review was performed for Site LF-26.

6.4.11 LF-27

No remedy has been selected for this site. Monitoring activities at Site LF-27 are intended to continue characterization of site conditions. The current monitoring program for this site is focusing on surface water and groundwater sampling and analysis for arsenic, manganese, and VOCs. Samples have been collected from monitoring wells, surface water sampling stations, and seeps that appear along the landfill face. The data presented in the *2002 Annual RAO Monitoring Report* (MWH, 2003b) were reviewed as part of this section, but a more comprehensive data collection effort is underway at the time of this report.

Samples were collected from two surface water sampling points (LF27-SW-4 and SW-5) in May 2002) and three monitoring wells (LF27MW7D, MW7S and MW8) in February and May 2002. Arsenic and manganese were detected at each location. Arsenic did not exceed the MDEQ residential/industrial drinking water criterion at any location, but manganese exceeded these criterion at all five locations. The historical data are highly variable and concentration trends for these compounds cannot be established. Figure 3-9 provides a map of initial monitoring locations at Site LF-27. Additional sampling locations are now being evaluated to determine the source of PCE in this area.

Samples were collected in December 2002 from all the seeps located at the site. The results indicated that five of the seeps had detections of PCE greater than the MDEQ residential and industrial drinking water criterion and two locations had concentrations at or slightly greater than

the GSI criterion for PCE of 45 μg/L. The source of the PCE contamination is the current focus of remedial investigation activities at the site.

Arsenic has been detected in surface soils at LF-27 at concentrations exceeding MDEQ screening criteria. Additional sampling and statistical analysis is underway to determine if arsenic poses a potential risk. The five-year review team does not have all of the information required to make a protectiveness determination at Site LF-27. Ecological impacts are of particular concern at this site and additional sampling and risk evaluations are required to determine the impact of PCE and metals contamination to the adjoining wetlands.

6.4.12 LF-30 and LF-31

Groundwater and surface water data were reviewed in the *2002 RAO Monitoring Report* (MWH, 2003b) and the recently completed Conceptual Site Model for LF-30/LF-31 (AFRPA, 2003b). The latter report incorporates data from the May 2003 sampling event.

Current remediation efforts at this site consist of an 80-well AS system for reducing VOCs and dissolved iron, a single pumping well to capture TCE and DCE at the base boundary, and the ongoing natural attenuation of all VOCs. In May of 2003, the maximum concentrations of TCE and cis-1,2-DCE at the site were 353 μg/L and 217 μg/L, respectively at on-base well H127S. The maximum benzene concentration was 200 μg/L at on-base well R14S. Figure 3-10 and Figure 6-6 provides a map of LTM wells and 2002/2003 VOC concentrations.

6.4.12.1 AS System

Data from the AS system are inconclusive. VOC removal has been difficult to judge in part because the low initial concentrations of benzene, TCE, DCE, and VC near the line of sparge wells made it difficult to calculate performance.

The lack of wells that can be monitored immediately downgradient of the sparge wall also contributes to the performance uncertainty. Data collected from wells in this area indicate the following.

Well LF30-MW4 is located approximately 400 feet downgradient of the sparge wells. Benzene concentrations in this well have decreased from 5.7 µg/L in 2001 to 0.2 µg/L in 2003. Decreases of this magnitude could also be the result of natural attenuation.

There has been a 50 percent or greater decrease in the chemical oxygen demand (COD) of groundwater measured in wells R88S, R88D, R89S, R89D, and LF30-MW4. These wells are all located downgradient of the line of sparge wells. The COD data indicate that the sparge system oxygen is being used for aerobic degradation of dissolved organics from the landfill area.

Changes in dissolved oxygen (DO) concentrations have been less apparent. Shallow wells located within 20 feet of the sparge curtain have shown increases in DO concentrations, while deeper well pairs have not shown increases. There has been no consistent increase in DO concentrations in downgradient wells as a result of the chemical/biological demand for oxygen in the landfill leachate.

While some localized oxidation of dissolved iron may be occurring near the sparge wells, there has been no decrease in downgradient dissolved iron during the first 14 months of sparge system operation.

The downgradient wells are more than 400 feet from the sparge wells. Therefore, the base is installing additional downgradient wells closer to the sparge wells to determine the impact of the sparging system on oxygen levels and dissolved iron.

6.4.12.2 Pump and Treat System

A single extraction well is removing approximately 30 gpm to 40 gpm in a narrow TCE/DCE plume that appears to be centered near well H127S/D. Historical concentrations of TCE and DCE have been erratic at these wells with a general trend downward for TCE (353 µg/L in May 2003) and a recent upward trend for cis-1,2-DCE (217 µg/L in May 2003). The decrease in TCE and increase in cis-1,2-DCE are likely the result of reductive dechlorination occurring in the upgradient source.

Well LF30-MW5 is located 250 feet downgradient of the extraction well. There has been a substantial reduction in cis-1,2-DCE at this well since pumping was initiated in March 2002.

The aboveground treatment of groundwater using granulated activated carbon has consistently removed all VOCs to levels below MDEQ discharge criteria.

6.4.12.3 Natural Attenuation

Natural attenuation processes have been responsible for historical decreases in both BTEX and chlorinated VOCs at Site LF30/LF31. Figure 6-6 was prepared by MWH and Mitretek, and illustrates the history of LF30/LF31 VOC concentrations from as early as 1979 to 2003.

The highly aerobic natural aquifer surrounding these landfills has stimulated the aerobic biodegradation of dissolved organics, including BTEX compounds, in landfill leachate. The degradation of these dissolved organics has created anaerobic zones where TCE can be degraded via reductive dechlorination. The result has been an overall decrease in both BTEX and TCE with the generation of cis-1,2-DCE and VC as byproducts. The general trend of cis-1,2-DCE and VC concentrations is also downward, particularly as these compounds enter more aerobic groundwater near Lake Van Etten.

6.4.12.4 YMCA Beach Remediation

Several short-term remediation projects have been completed to reduce iron staining and VOC concentrations at the YMCA beach. During 2001, 2002, and 2003, USAF contractors completed three sand removal and replacement actions to decrease the visible iron staining along an 800-linear-foot segment of the Van Etten Lake shore. In February and October 2001, the USAF injected an ORC into the shallow water table upgradient of the beach in an attempt to oxidize dissolved iron before it surfaced at the beach. The staining reappeared in 2002 and VOC levels were not clearly reduced by the ORC.

6.4.13 SS-51

The selected remedy requiring active data collection for Site SS-51 is MNA. Groundwater sampling results for the four wells identified for regular LTM from 1997 through 2002 presented

in the *2002 Annual RAO Monitoring Report* (MWH, 2003b) were reviewed. The lateral extent of groundwater contamination is illustrated on Figure 3-11.

Based on a review of historical groundwater data, the SS-51 jet fuel plume is both shrinking in size and decreasing in concentration. The extent of groundwater exceedances is limited to the crash site source area.

Four monitoring wells (USGS-4, W409D, W409S, and W411) were sampled in July 2002 and analyzed for VOCs. The VOCs 1,2,4-TMB, 1,3,5-TMB, and total xylenes were detected in well USGS-4 at concentrations that exceeded the MDEQ residential and industrial drinking water and GSI criteria. 1,2,4-TMB and 1,3,5-TMB concentrations have generally decreased since monitoring began (1,2,4-TMB was 930 µg/L in 1997 and 264.20 µg/L in 2002; 1,3,5-TMB was 250 µg/L in 1997 and 126.80 µg/L in 2002). However, both compounds are slightly elevated from their 2001 concentrations (46.74 µg/L for 1,2,4-TMB and 62.19 µg/L for 1,3,5-TMB). Xylene concentrations have generally decreased since monitoring began (3,800 µg/L in 1997 and 451.70 µg/L in 2002), but also show a slight increase in 2002 compared to previous years. Figure 3-11 provides a map of LTM wells and 2002 BTEX concentrations.

For constituents detected at W409S, concentrations did not exceed the MDEQ industrial drinking water criteria, but did exceed the GSI criteria. In addition, naphthalene and ethylbenzene were detected at concentrations exceeding the GSI criteria in both USGS-4 and W409S.

6.4.14 SS-57

A remedy involving soil bioventing/biosparging and free product removal has been selected for Site SS-57. However, these actions had not been implemented prior to the five-year review.

The five-year review team confirmed that groundwater from the SS-57 area is within the ASPTS capture zone. Dissolved hydrocarbons from this fuel spill are undergoing biodegradation and natural attenuation.

Several wells in the source area have exceeded MDEQ industrial drinking water criteria by more than an order of magnitude. The list of compounds with consistent exceedances includes 1,2,4-TMB, 1,3,5-TMB, ethylbenzene, xylenes, and benzene. Although downgradient well R5S has shown decreasing trends of these contaminants, the limited MNA data are inconclusive. Figure 3-12 provides a map of LTM wells and 2002 BTEX concentrations.

The remediation progress at this site will be addressed in the next five-year review cycle. However, the five-year review team made the following recommendations.

Free product contamination can be addressed through bioventing and biosparging systems assuming that soil gas monitoring shows that vapor migration does not produce safety issues with buildings or utilities. Startup on the system with low rates of air injection should lessen the risk of vapor migration. Although the ASPTS will be the default treatment system for dissolved hydrocarbons, the USAF should continue MNA monitoring to determine the contribution of biodegradation to the SS-57 plume attenuation. Monitoring should occur at key wells upgradient, within the source area, and in the downgradient plume. Eventually, the biodegradation in the plume may replace the ASPTS as the primary treatment method for preventing off-base migration.

6.4.15 ST-68

One of the components of the proposed remedy at Site ST-68 is ICs and continued groundwater extraction and treatment using the ASPTS. The data review for the ASPTS is included in Section 6.4.7 as part of the review for Sites SS-17, SS-21, and SS-47.

Low levels of VOCs in groundwater at this former OWS site are within the capture zone for the ASPTS and are expected to decrease without additional source area treatment. ICs for industrial land and groundwater use and soil removal restrictions are in place.

6.4.16 ST-69

The proposed remedy for Site ST-69 is MNA, LTM and ICs. As part of the data review process, groundwater sampling results from 1997 through 2002 that were presented in the *2002 Annual RAO Monitoring Report* (MWH, 2003b) were evaluated.

The groundwater monitoring program for Site ST-69 includes sampling wells OT45-MW2, OT45-MW11, ST69-TW1, ST69-TW4, ST69-TW11, and ST69-TW12 on a quarterly basis for VOCs. Quarterly monitoring will continue until TCE is less than 5 µg/L for four consecutive sampling events in all wells. In addition, LNAPL monitoring and removal activities are conducted at this site. Wells OT45-MW2, OT45-VW1, and OT45-East are monitored for LNAPL that is believed to be associated with a previously removed UST that was used to contain heating oil. Figure 3-13 provides a map of LTM wells and 2002 TCE plume.

During the 2002 quarterly sampling, TCE was detected in each well except ST69-TW4. TCE exceeded the MDEQ industrial drinking water criterion at OT45-MW2 (5.6 µg/L) and OT45-MW11 (5.7 µg/L) in October and at ST69-TW1 in May, August, and October (maximum concentration was 6.59 µg/L). At OT45-MW11, this represents a general increase in TCE over previous years. At OT45-MW2, this represents a slight increase in TCE concentrations over the past several years, but only a general fluctuation of concentrations since monitoring began in 1997. At ST69-TW1, this represents fluctuations around the regulatory limit since 1997. TCE was detected at concentrations that did not exceed the MDEQ drinking water criteria at ST69-TW11 and ST69-TW12. ST69-TW12 is the furthest downgradient well at this site. No other exceedances were noted.

Results of the monitoring of LNAPL at this site indicated that LNAPL thicknesses were between a few tenths of a foot to more than 18 inches. The greatest thicknesses were observed at OT45-VW1.

The five-year review team agrees with the following recommendation that was presented in the *2002 Annual RAO Monitoring Report* (MWH, 2003b).

Existing wells appear adequate to monitor long-term effects of natural attenuation progress at Site ST-69. However, if TCE detections in well ST69-TW12, the furthest downgradient well at this site, exceed objectives in the future, additional site characterization and off-site investigations may be warranted. Based on the low concentrations of TCE, this site is relatively close to achieving criteria at all points.

6.4.17 WP-70

Surficial ACM was removed from the site in October of 2003. The proposed remedy at Site WP-70 is ICs and there is no activity that involves the ongoing collection of data. Therefore, no data review is possible for Site WP-70.

6.4.18 SS-71

The proposed remedy at Site SS-71 is MNA and ICs. The objective of monitoring at Site SS-71 to date has been to supplement existing site characterization information. In 2002, two monitoring wells (SS71-MW1 and SS71-MW2) were installed at SS-71. These wells were sampled for VOCs for the first time in July 2002. Analyses indicated that PCE was present at SS71-MW1 at 6.17 µg/L, which slightly exceeded the MDEQ residential and industrial drinking water criterion of 5.0 µg/L. PCE was also detected at SS71-MW2, but at a concentration less than the criterion (3.37 µg/L). No other VOCs were detected at either well. Figure 3-14 provides a map of LTM wells and 2002 PCE concentrations. A June 2003 monitoring event did not detect PCE in either well. An additional annual monitoring event is recommended to verify the continued absence of PCE.

6.5 SITE INSPECTION

An initial site inspection and visit to active treatment systems was completed by Mr. Doug Downey of Parsons from June 9 to 13, 2003. During this inspection, Mr. Downey visited all treatment facilities with Mr. Larry DeKett (TolTest) and inspected the treatment plant controls and operations.

Mr. John Tunks and Ms. Fan Wang-Cahill of Parsons performed a site inspection from August 12 to 14, 2003. A comprehensive 14-page site inspection form, provided in the USEPA Comprehensive Five Year Review Guidance (USEPA, 2001), was used to direct the activities performed at all sites during this site inspection, and the form itself was completed for sites: FT-02, SS-06, SS-13, ST-40, ST-46, SS-17, SS-21, SS-47, OT-24, LF-30, and LF-31. A copy of the standard site inspection form is included in Appendix B. During this site inspection, the following activities were performed:

- Ms. Claudia Schiller (TolTest) and Mr. Lee Major (Computer Sciences Corporation [CSC], formerly DynCorp) were interviewed;
- On-site documents and records were verified;
- Access and ICs were inspected; and
- General site conditions were evaluated.

Generally, all sites appeared to be in good condition with regard to such features as wells, roads, and fencing. All required on-site documents were available. The AFRPA BEC, Mr. Paul Rekowski, explained that deed restrictions were in-place as property was transferred from the USAF and that the LEA and land use control (LUC) management plan were currently being prepared. Examples of the environmental covenants restricting soil disturbance and/or groundwater use were reviewed as they were recorded in deeds for commercial/industrial property and residential lots. The covenant language clearly restricted all groundwater use and required that deep excavation work be approved by the USAF and follow an approved health and safety plan. An interview with the Oscoda Township Economic Development Coordinator, Mr. Gary Kellan, indicated that these deed restrictions were an integral part of land transfers for former USAF property. Overall, no concerns or issues were identified during the site inspection.

6.6 INTERVIEWS

During October 2003, Mr. Doug Downey of Parsons conducted interviews with 11 individuals representing a cross-section of community, regulatory, and AFRPA involvement with the former Wurtsmith AFB remediation program. Most interviews were conducted in person, although several were completed over the phone. The purpose of these interviews was to document the perceived status of the Wurtsmith AFB remediation program and to document successes and any problems with the implemented remedies. Each interview followed a set of standard questions recommended in Appendix C of the USEPA *Comprehensive Five-Year Review Guidance* (USEPA, 2001).

The following individuals were interviewed:

Mr. Gary Kellan – Oscoda Township Economic Development Coordinator;

Mr. Charles Andrina – District Ranger USFS;

Mr. Scott Landry – VP for Strategic Development, YMCA;

Ms. Diana Mally – Region 5 USEPA;

Mr. Robert Delaney – MDEQ;

Mr. Paul Rekowski – Base Environmental Coordinator AFRPA;

Ms. Claudia Schiller – TolTest project coordinator (O&M contractor);

Mr. Larry Dekett – TolTest environmental technician (O&M foreman);

Mr. C. Lee Major – senior project administrator (DynCorp/AFRPA);

Ms. Tiffany Yusko – MWH project manager (consultant); and

Mr. Tom Barzyk – technical support, BB&E Consultants.

6.6.1 Summary of General Comments Received

6.6.1.1 From Community Representatives

Mr. Gary Kellan – Oscoda Township: The USAF is keeping me informed of remediation activities. Need to combat some local citizens' negative attitudes that are largely unfounded. Recommend more frequent public meetings be held off of the base in a community building. Some prospective home buyers have been wary of deed restrictions on groundwater use. Please retain a local AFRPA contact on the site to resolve transfer issues.

Mr. Charles Andrina – USFS: Overall, the USAF is doing a good job in remediating the sites. Paul Rekowski is responsive and doing a good job. I am able to get information from the USAF when I need it. The restrictions on groundwater use have had some negative impact on local real estate value. The USFS has no intention of allowing residential development or groundwater use

on USFS land that has been impacted by Wurtsmith AFB plumes. One concern is that the USAF always coordinate new well locations on USFS land in advance of drilling.

Mr. Scott Landry – YMCA: The Wurtsmith AFB remediation effort is well-organized and makes information available to the public. Wurtsmith AFB has a professional staff. Paul Rekowski has been responsive to my needs. We need an AFRPA representative on the site now and in the future. One concern is the amount of time it takes to get new off-base sampling data into the hands of the public. Data need to be made available in a more timely manner.

6.6.1.2 From Regulatory Representatives

Ms. Diana Mally – USEPA: Overall impression of the Wurtsmith AFB remediation program is good. Generally responsive to regulatory concerns. Community relations would be improved by more frequent public meetings and information sheets on the progress that has been made. There have been no public complaints, discharge violations, or other negative incidents requiring a response from USEPA in the past five years.

Mr. Robert Delaney – MDEQ: AF responsiveness to MDEQ has improved in the past few years. Most issues are resolved through the BCT meetings and action items. There have been no public complaints, discharge violations, or other negative incidents requiring a response from MDEQ in the past five years. There is a general concern over the proper enforcement of ICs in off-base areas and a general concern that there may be undiscovered sources of contamination on the base. MDEQ has several protectiveness issues that are also being discussed as a part of MDEQ's review of the C-RAP (URS, 2002b).

6.6.1.3 From AFRPA Employees and Contractors

Mr. Paul Rekowski – AFRPA: The remediation approach at Wurtsmith AFB has been aggressive groundwater pumping and treatment. It is now time to optimize these systems for the next decade. In general, our remediation systems are meeting design objectives and reducing soil and groundwater concentrations. We have added one O&M person to our staff to improve system uptime and protectiveness. We are also completing Phase II RPO evaluations on three of our largest PTSs. The current remediation systems are protective. USAF has offered to

purchase easements for groundwater restrictions on 16 off-base properties, but only two landowners were interested. The county currently restricts new well permits in impacted areas and a city water supply has been provided to impacted residents.

Ms. Claudia Schiller – TolTest: The remediation systems are generally performing as expected and contaminant levels are decreasing. O&M manuals are updated annually. Several new systems have been added over the past five years, but we have added one O&M person and have a very experienced maintenance crew. As a long-time Oscoda resident, I would encourage the USAF to continue to improve the public relations process.

Mr. Larry Dekett – TolTest: The remediation program is solid and generally has enough O&M funding to keep systems in good repair. All systems are operating according to design. Continuity of O&M staff has improved system uptime and we are using more standardized equipment to simplify O&M.

Mr. C. Lee Major - DynCorp: We have a comprehensive program to deal with a difficult problem. Remediation systems are operating as designed and concentrations of contaminants are decreasing. The current RPO efforts should improve PTSs. The groundwater monitoring network has been regularly optimized.

Ms. Tiffany Yusko – MWH: The USAF has made a concerted effort to meet groundwater cleanup criteria. There has been excellent AFRPA/consultant/O&M team continuity. Remediation systems are functioning as designed to capture plumes, but systems are in need of optimization. There needs to be a concerted effort to keep the public informed of improvements such as RPO.

Mr. Tom Barzyk – BB&E: There is a high level of commitment to meeting the end goals and to funding the program. Could improve inter-contractor coordination. There have been several monitoring optimizations as the plumes have shrunk and systems become more predictable.

6.6.2 Site Specific Comments

6.6.2.1 Site FT-02

MNA results for groundwater are not yet conclusive due to some recent concentration spikes. The SVE system is making good progress. (Paul Rekowski)

MNA does not appear to be stopping plume migration. Metals discharging to wetlands may not be protective of ecological receptors. GSI criteria apply. MDEQ is currently assessing protectiveness through the C-RAP (URS, 2002b) review process. (Robert Delaney)

MNA trend at this site is uncertain. Need additional monitoring to determine if concentrations and plume size are decreasing. (Tiffany Yusko)

6.6.2.2 Site SS-08

There may still be sources of groundwater contamination in this area that have not been fully characterized. (Robert Delaney)

6.6.2.3 Sites OT-16 and LF-27

Formal ICs are not in place with the USFS to prevent groundwater use in the off-base plume. LF-27 discharge of PCE to the wetland is a potential concern. (Robert Delaney).

No direct exposure is occurring at this site from soil or groundwater. GSI criteria for PCE are exceeded at LF-27 but it has not been determined if a protectiveness issue exists due to dilution, volatilization, and lack of receptors. (Tiffany Yusko)

USFS has provided a letter stating that the USFS has no intention to install drinking water wells downgradient of OT-16 and LF-27. (Charles Andrina)

6.6.2.4 Site OT-24

AFRPA should be checking to make sure housing improvements are not impacting their electrical lines, pumping, or monitoring systems. (Gary Kellan)

Southern portion of the plume is not being captured by the pumping system and TCE is migrating off-base into wooded lowlands and outside of ICs. (Robert Delaney)

This system needs optimization. Three wells are pumping clean water. (Paul Rekowski)

More monitoring wells are needed to define migration. (Tiffany Yusko)

Minimal O&M problems. One pipe break caused water to enter a sanitary sewer, but this has been corrected with a new automatic shut-down to prevent continued leaking. (Tom Barzyk)

6.6.2.5 Site SS-05

There is a potential protectiveness concern at this site if the USEPA's new indoor air pathway model indicates a risk due to TCE under residential properties along Van Etten Lake. The USAF should recheck this pathway using the new model to determine if the remedy is protective for this residential area. (Diana Mally)

6.6.2.6 LF- 30/LF-31

Although a final remedy has not been determined for this site, there is concern over the effectiveness of the interim sparging and small PTS. The sparge system's effectiveness for removing TCE and adding oxygen (to remove dissolved iron) has not been determined. (Paul Rekowski, Tiffany Yusko, and Robert Delaney)

The YMCA has had to move their swimming beach because of iron staining from LF-30/LF-31 seeps. This is an aesthetic concern for the YMCA that needs to be solved. YMCA needs data from seeps provided in a more timely manner. (Scott Landry)

The interim treatment system may require modification and additional monitoring is needed to determine if it is working. The USAF is providing replacement sand and is considering other options to improve the beach. (Paul Rekowski)

6.6.2.7 Arrow Street Pump and Treat System

System needs optimization. Two hot spots have asymptotic concentrations and more monitoring wells could better define source for additional treatment. The capture zone is adequate but we need to optimize this system. (Tiffany Yusko and Tom Barzyk)

The ASPTS is old, expensive to run, and needs to be upgraded. Pumping systems need automatic shut-down capability. (Larry Dekett)

This system is the number one priority for optimization. We also need to address hot spots that are not decreasing. (Paul Rekowski)

6.6.2.8 Benzene Plant Pump and Treat System

This system is nearing the end of its usefulness for groundwater treatment as all BTEX is now below cleanup criteria. (Claudia Schiller and Paul Rekowski)

The Site SS-06 sparging system electrical supply has caused several power failures and needs to be replaced. (Claudia Schiller, Larry Dekett, and Lee Major)

The lower levels of TCE entering this site needs to be monitored and trends tracked. (Tiffany Yusko)

Free product recovery has fallen off a lot in the past couple of years. Iron fouling is a big problem at this site (due to anaerobic conditions as fuel degrades). (Larry Dekett)

SECTION 7

TECHNICAL ASSESSMENT

The primary goal of the five-year review is to determine whether the RA at a site protects human health and the environment. To provide a framework for organizing and evaluating data and information and to ensure that all relevant issues are considered when determining the protectiveness of the remedy, USEPA guidance lists three questions to consider:

- Is the remedy functioning as intended by the DD?
- Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid?
- Has any other information come to light that could call into question the protectiveness of the remedy?

The following sections provide responses to these three questions for each of the sites being reviewed. In some cases, the DD for the site has not been approved. In this case, the five-year review team evaluated the protectiveness of the current remedy in place in order to provide a baseline for future reviews.

7.1 SITE FT-02

7.1.1 Is the remedy functioning as intended by the decision documents?

The RAP and RAOs have not been finalized by written approval from the USAF and USEPA. However, a review of documents, proposed ARARs, risk assumptions, and the results of the site inspection indicates that the current remedies (SVE, MNA, and ICs) are being implemented as intended by draft RAPs (ICF, 1998d and URS, 2002a). The effective implementation of ICs (restrictions on groundwater use, on soil movement, or on land use) has prevented exposure to contaminated soil and groundwater. Downgradient land has recently been transferred to the

USFS. As a condition of the transfer, the USFS accepted a memorandum of agreement (MOA) to implement the deed restrictions associated with FT-02 while they own the land, and to record the restrictions in the deed during the next property transfer. No new uses of groundwater and soil movement were observed. The site land use remains industrial/airfield.

The MNA, which started on May 2001, appears to be minimizing the migration of VOC contaminants in groundwater beyond the source area. However, groundwater monitoring data do not show a consistent downward trend for the COC concentrations detected in source area groundwater. Whether the SVE remedy is completely treating the source and minimizing the impact to groundwater cannot be determined based on the limited groundwater monitoring results.

7.1.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

Final RAOs and clean up objectives have not been approved for this site, however there have been no changes in the physical conditions of the site that would affect the protectiveness of the current remedy, and the current remedy selection is still valid.

Changes in Standards and To Be Considereds (TBCs)

The most current MDEQ groundwater and surface water standards are being considered in the RAO approval process that is underway.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the baseline human health risk assessment for this site included current exposures for Base workers and potential future exposures for recreational receptors (ICF, 1997e). Based on the baseline risk assessment there were no unacceptable risks to human health at the site. There have been no changes to exposure pathways, toxicity values, or contaminant concentrations that would call the baseline human health risk assessment into question. Ecological risk to the wetlands is currently being evaluated in conjunction with nearby Site LF-27. Any surface water concerns will be addressed by the final RAOs for the site.

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

Some of the wells at FT-02 show clearly decreasing trends in COC concentrations while other wells show more erratic or cyclical trends in COC concentrations. Continued groundwater monitoring is required to evaluate future protectiveness of the wetlands.

No weather-related events have affected the protectiveness of the remedy, and no other information calls into question the protectiveness of the remedy.

7.1.4 Technical Assessment Summary

Although a final remedy has not been approved for Site FT-02, the data review, the site inspection, and the interviews indicate the remedy is generally performing as intended by the draft RAPs (ICF, 1998d and URS, 2002a). There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. A soil vapor rebound test and additional groundwater monitoring data are recommended to evaluate the long-term effectiveness of the soil remedy. Additional remediation in the capillary fringe should be considered if source area groundwater concentrations do not show a consistent downward trend.

Risks to wetlands ecological receptors from low levels of manganese are under review and may result in specific RAOs that address wetlands protection. No other information calls into question the protectiveness of the current remedy.

7.2 SITE WP-04

7.2.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the remedy, MNA, is functioning as intended by the RAP (ICF, 1998e). The effective implementation of IC (deed groundwater used restriction) has prevented exposure to, or ingestion of, contaminated groundwater.

Although TCE and PCE were historically detected in exceedance of MDEQ Residential and Industrial criteria, PCE is the only compound detected above MDEQ Residential criteria in recent groundwater analytical results. TCE has naturally attenuated and is no longer present in

monitoring wells at Site WP-04 above MDEQ criteria. To evaluate the effectiveness of the MNA, VOCs were sampled annually in WP04-MW1, WP04-MW2, WP04-MW3, WP04-MW4, and R76D. The groundwater analytical results showed that PCE concentrations in groundwater are highest in the area of well WP04-MW2 and decrease outward, indicating a small plume of PCE associated with monitoring well WP04-MW2. The combined effect of ASPTS pumping and MNA has achieved the remedial objective of minimizing the migration of PCE contaminants in groundwater. Groundwater monitoring data indicate that the groundwater PCE concentrations have been steadily decreasing since August 2001, which indicates that the remedy is effectively minimizing the migration of PCE impacted groundwater. The estimated duration of the remedial activity for PCE is six to 30 years, with completion of two years annual post-closure monitoring following the RA end date.

The monitoring well network provides sufficient data to assess the progress of natural attenuation within the plume. The groundwater monitoring wells data indicated that the PCE concentrations are gradually decreasing. Future monitoring at wells WP04-MW1, MW3, and MW4 may not be necessary as they have remained below cleanup criteria. An additional well east of WP04-MW2 would be useful in demonstrating on off-base migration. Any potential migration beyond the WP-04 site boundary should be captured by the ASPTS.

The ICs in place include prohibitions on the use or disturbance of groundwater until cleanup levels are achieved. No new uses of groundwater were observed.

7.2.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. Restore groundwater to meet MDEQ Part 201 Residential Drinking Water

criteria have been applied throughout the groundwater plume. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. MDEQ Part 201 Residential Drinking Water criteria have changed for TCE (from 2.2 µg/l to 5 µg/l) and PCE (from 0.7 µg/l to 5 µg/l). The updated ARARs are higher than the original ARARs. The new standards do not affect the protectiveness of the remedy. There have been no TBCs affecting the protectiveness of the remedy. The residential drinking water criteria apply to the site because the contamination extends beyond the industrial site boundaries at which point groundwater usage is outside the control of the site owner.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the human health risk assessment included both current exposures (on-site commercial worker) and potential future exposures (commercial workers or off-site child and adult residents). These assumptions are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy were identified. The remedy is progressing as expected, and it is expected that all groundwater cleanup levels will be met in considerably less than 30 years.

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

No ecological targets were identified during the five-year review, and therefore monitoring of ecological targets is not necessary. No weather-related events have affected the protectiveness of the remedy. There is no other information that calls into question the protectiveness of the remedy.

7.2.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is being implemented as intended by the RAP. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. Although ARARs for groundwater contamination cited in the RAP have not been met, the groundwater monitoring data show that the COC concentrations detected in groundwater are decreasing. An additional monitoring well

located to the east of WP04-MW2 should be considered to demonstrate that the plume is not migrating toward the base boundary. No other information calls into question the current protectiveness of the remedy.

7.3 SITE SS-05

7.3.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that MNA is functioning as intended by the RAP (ICF, 1998i). The implementation of ICs, such as residential connections to the City of Oscoda water system and new well permit restrictions, have prevented human exposure to, or ingestion of, contaminated groundwater. Some residents have agreed to permanent easements on their property restricting groundwater use.

The MNA sampling began in April 1998. VOCs were sampled annually in R13S, R19S/D, R27D, R31S, R33S, SS05-MW1, SS05-MW2, SS05-MW3, SS05-MW4, SS05-MW5, SS05-MW6, and SS05-MW7. Groundwater monitoring data indicate that the groundwater concentrations are very gradually decreasing and the remedy is effectively minimizing the migration of TCE and PCE impacted groundwater. The estimated completion dates of the remedial activity for TCE and PCE are April 2014 (16 years) and April 2005 (7 years), with completion of two years post-closure monitoring following the RA end date.

There was one opportunity for monitoring optimization observed during this review. At least one well should be added to the east of MW4 to delineate that edge of the plume toward the houses in that direction.

The monitoring well network provides sufficient data to assess the progress of natural attenuation within the plume. Although the groundwater monitoring wells data indicated that the plume appears to be migrating to Van Etten Lake, groundwater sampling upgradient of the area of discharge to Van Etten Lake indicates that the plume discharge appears to be well below the SWQD's allowable monthly average discharge value.

ICs are in place to provide clean drinking water and prevent new well drilling in this area until cleanup levels are achieved. Some groundwater easements are also in place. No new uses of groundwater were observed.

7.3.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy as discussed below.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow and deep aquifers may be used for domestic purposes. Restoration of groundwater to meet MDEQ Part 201 Residential Drinking Water criteria should apply to the entire groundwater plume. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. Although the toxicity value for TCE has been withdrawn from the USEPA Integrated Risk Information System (IRIS) database, that database lists no replacement toxicity value. MDEQ still recognizes the old toxicity value for TCE; therefore, there have been no changes in the toxicity factors for the COCs that were used in the BLRA. The State of Michigan has established its own set of criteria for surface water under the Natural Resources and Environmental Protection Act (Act 451 of 1994), which are applicable for the site. The CWA is applicable because of the proximity of Van Etten Lake. The WQBVGL of 940 µg/L should apply to TCE in groundwater monthly discharging to Van Etten Lake. MDEQ Part 201 Residential Drinking Water criteria have changed for TCE (from 2.2 µg/l to 5 µg/l) and PCE (from 0.7 µg/l to 5 µg/l). The updated ARARs are higher than the original ARARs. The new standards do not affect the protectiveness of the remedy. There have been no TBCs affecting the protectiveness of the remedy. The residential drinking water criteria apply to the site because the industrial site boundaries at which point groundwater usage is outside the control of the site owner.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The Groundwater volatilization to indoor air exposure pathway is a potential concern for the off-site residential properties along Van Etten Lake, which has not been evaluated previously. MDEQ Part 201 Residential and Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria were used to evaluate whether the pathway will pose any unacceptable risk to the off-site residents. The detected groundwater TCE and PCE concentrations are below the MDEQ Part 201 criteria of 15 mg/L for TCE and 25 mg/L for PCE. Although USEPA recently revised the indoor air pathway model, MDEQ has not adopted the revision because the guidance is still in a draft stage. There have been no changes in the toxicity factors for the COCs that were used in the BLRA; MDEQ still recognizes the old TCE toxicity value. However, the TCE toxicity value is currently under review by USEPA. The proposed TCE toxicity value is much more conservative than the previous TCE toxicity value. Therefore, the existing MDEQ Part 201 criteria may not be protective if the proposed TCE toxicity value is finalized by USEPA.

These assumptions are considered to be conservative and reasonable in evaluating risk. There have been no changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy. The remedy is progressing as expected, and it is expected that TCE and PCE groundwater cleanup levels will be met within approximately 16 years and seven years, respectively.

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

COCs (cis-1,2-DCE and TCE) were identified in sediments of Van Etten Lake downgradient of SS-05. The ecological risk assessment included in the Final RI Report (ICF, 1998f) indicated that there is little potential for adverse effects to ecological receptors as a result of the observed concentrations of potential concern in sediments. No ecological targets were identified during the five-year review, and therefore monitoring ecological targets is not necessary. The groundwater analytical results in monitoring wells up-gradient to the surface water do not exceed the GSI criteria.

No weather-related events have affected the protectiveness of the remedy. There is no other information that calls into question the current protectiveness of the remedy.

7.3.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is being implemented as intended by the RAP. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Although ARARs for groundwater contamination cited in the RAP have not yet been met, the groundwater monitoring data show that the TCE concentrations detected in groundwater are gradually decreasing in most monitoring wells, indicate the effectiveness of the remedy. In addition, TCE breakdown products (e.g., 1,2-DCE) concentrations do not exceed the MDEQ Part 201 Residential Drinking Water Criteria. However, TCE concentrations detected in MW-3 and MW-4 slightly increased, and the PCE concentrations detected in groundwater do not appear to be decreasing, even though the size of the plume is limited to the vicinity of R13S. At least one well should be added to the east of MW4 to delineate that edge of the plume toward the houses in that direction.

No other information calls into question the current protectiveness of the remedy. In order to improve the protectiveness of the off-base SS-05 groundwater remedy, annual public education (such as providing literature on well restrictions) should be provided to all off-base residents potentially impacted by the SS-05 VOC plume. As a long-term protectiveness measure, the USAF should continue to pursue easements to prevent groundwater use on all private property and reevaluate the volatilization to indoor air pathway if MDEQ revises the Part 201 criteria based on TCE toxicity data.

7.4 SITES SS-06, SS-13, ST-40, AND ST-46

7.4.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that the remedy (BPPTS/Free Product Removal, Bioventing and Biosparging/SVE) is functioning as intended by the RAP (ICF, 1998g). The effective implementation of ICs (deed

groundwater use restriction, soil movement restriction, industrial land use restriction and excavation restriction) has prevented exposure to, or ingestion of, contaminated soil and groundwater.

Consisting of four pumping wells (P1, P2, P3, and P4), two air-stripper towers, thermal off-gas treatment, and a free-phase LNAPL recovery system, the BPPTS became operational in January 1992. The LNAPL system was installed after the BPPTS became operational. Two additional pumping wells (P5 and P6) were added to the BPPTS in January 5, 2000. An SVE, bioventing, and biosparging system was installed in November 1999.

VOCs in groundwater were sampled annually in GST2, H191S, H195S, H28S, H43D, H43S, MW3D, MW3S, MW4D, MW4S and R87D. The groundwater PTS is achieving the remedial objectives to minimize the migration of contaminants to groundwater to MDEQ Part 201 industrial drinking water criteria. The groundwater annual monitoring data indicated that the groundwater concentrations are decreasing in most of the monitoring wells (except H191S and MW4S), which indicate that the remedy is effective in treating and minimizing the migration of the impacted groundwater. Although the groundwater annual monitoring data show that 1,2,4-TMB collected from H191S and 1,2,4-TMB, 1,3,5-TMB and xylenes collected from MW4S appear to have increased, these wells are close to the BPPTS pumping wells and may be within the zone of influence.

The estimated completion time for the remedial activities stated in the RAP is eight years (11/99 to 11/2007) for BPPTS/Free Product Removal, six to eight years (11/99 to 11/2005-2007) for bioventing and six to eight years (11/99 to 11/2005-2007) for biosparging/SVE and monitoring and sampling for eight to 10 years (11/99 to 11/2007-2009). Groundwater annual monitoring data will determine the completion of the remedial activities. Based on 2003 data, it appears that groundwater will achieve cleanup criteria ahead of these estimates. Some free product is expected to remain at the site even after the primary cleanup criteria are achieved. Based on groundwater monitoring data, the free product is highly weathered and is not adding significant dissolved hydrocarbons to the aquifer.

There were opportunities for system optimization observed during this review. The USAF is conducting a separate pumping and treatment optimization evaluation for the BPPTS. A reduction in the number of extraction wells appears possible given the progress toward cleanup criteria. The monitoring well network provides sufficient data to assess the progress of groundwater pump and treat within the plume. The groundwater monitoring well data indicated that the fuel-related COC concentrations in groundwater appear to be decreasing. TCE and cis-1,2-DCE have entered the BPPTS capture zone from outside sources at levels above MDEQ Industrial Drinking Water criteria. The continued removal of these VOCs using BPPTS extraction wells is anticipated under a future optimized pumping system.

The ICs in place include prohibitions on the use or disturbance of soil and groundwater until cleanup levels are achieved. No new uses of groundwater or disturbance of soil were observed.

7.4.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. Restoring groundwater to meet MDEQ Part 201 Industrial Drinking Water criteria is the cleanup goal for the groundwater plume according to the RAP. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. MDEQ Part 201 Industrial Drinking Water criteria for acenaphthylene, carbon disulfide, naphthalene, phenanathrene, toluene and lead have been revised to levels of 150 µg/l, 2,300 µg/l, 1,500 µg/l, 150 µg/l, 790 µg/l and 4 µg/l, respectively. The original ARARs for these chemicals listed in Table 4-2 of this report are more conservative. Therefore, the changes in these ARARs do not affect the protectiveness of the remedy. There have been no TBCs affecting the protectiveness of the remedy.

During the past five years, four former facilities (190, 404, 405, and 410) down-gradient (i.e., not within the footprint of Sites SS-06, SS-13, ST-40 and ST-46 [see Appendix A]) have been transferred to different owners without soil use restrictions. Although a groundwater use restriction has been incorporated into the deeds for all parcels associated with these former facilities, industrial land-use restrictions should be applied to these deeds if areas of contaminated soil are identified. An ESD was being prepared at the time of this review to modify the ICs for these sites in the RAP/DD.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the human health risk assessment include both current exposures for commercial workers and potential future exposures for commercial workers. Soil exposure pathways not evaluated in the RI include direct soil contact and inhalation of constituents through volatilization from soil or inhalation of airborne particulates. However, these pathways will not pose any potential risk as long as the soil movement restriction and soil excavation restriction are implemented. The observed removal of benzene from site soil gas and groundwater has significantly reduced future exposure risk from these soils. The remedy is progressing as expected.

There have been no changes in the toxicity factors for the COCs that were used in the BLRA. These assumptions are considered as conservative and reasonable in evaluating risk for areas remaining as industrial land use. A screening risk evaluation will be performed using MDEQ Part 201 Residential criteria for parcels transferred from Wurtsmith AFB to ensure that there is no potential risk to human health due to unrestricted use of these properties. There have been no changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy.

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

The sites are located within an industrial area, no ecological targets were identified during the five-year review, and therefore monitoring ecological targets is not necessary. The groundwater analytical results in monitoring wells indicated that the COC concentrations detected in

groundwater are decreasing. No weather-related events have affected the protectiveness of the remedy. There is no other information that calls into question the protectiveness of the remedy.

7.4.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is being implemented as intended by the RAP. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. Although ARARs for groundwater contamination cited in the RAP have not yet been met, the groundwater monitoring data show that COC concentrations detected in groundwater are decreasing and will soon attain Industrial Drinking Water criteria. Additional pumping optimization, including a review of free product recovery, is recommended. No other information calls into question the protectiveness of the remedy.

7.5 SITES SS-08, ST-41, SS-42, AND SS-53

7.5.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that the remedy (AS/SVE contingent upon operation of ASPTS for plume A and MNA for plume B) is functioning as intended by the RAP for SS-08(ICF, 1998j). The effective implementation of ICs (groundwater use deed restriction, soil movement restriction, industrial land use restriction and excavation restriction) has prevented exposure to, or ingestion of, contaminated soil and groundwater. At the time of this review, the RAP for ST-41, SS-42, and SS-53 has not been approved. The next five-year review will address progress on meeting the objectives of the RAP for Sites SS-08, ST-41, SS-42 and SS-53.

AS/SVE systems were installed in November 1999 to remediate the source of SS-53/Plume A groundwater contamination. The AS/SVE systems were shut down in November 2001. Post-closure monitoring is currently being conducted in this area for a two-year period. After 15 months of monitoring 1,2,4-TMB concentrations were at 86 μg/L, and after 18 months (July 2003) levels had dropped to less than 8 μg/L, well below the MDEQ Industrial Drinking Water criteria of 63 μg/L. If this data trend continues for the next 6 months, the groundwater will have

clearly achieved MDEQ cleanup criteria. Plume B groundwater contamination is captured in the down-gradient BPPTS or ASPTS. The groundwater annual monitoring data indicate that the groundwater concentrations are decreasing in most of the monitoring wells, which indicate that the remedy is effective in treating and minimizing the migration of the impacted groundwater. Groundwater annual monitoring data will be used to determine the completion of the remedial activities.

There were no opportunities for system optimization observed during this review. Post-treatment monitoring indicates that the source of groundwater contamination has been significantly reduced. The monitoring well network provides sufficient data to assess the progress of natural attenuation within the plume. The groundwater monitoring well data indicated that the COC concentrations in groundwater appear to be decreasing.

The ICs in place include prohibitions on the use or disturbance of soil and groundwater until cleanup levels are achieved. No new uses of groundwater or disturbance of soil were observed.

7.5.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for industrial purposes. Restoring groundwater to meet MDEQ Part 201 Industrial Drinking Water criteria is the final cleanup goal according to the RAP. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. Annual groundwater monitoring data were compared to the updated ARARs to evaluate the protectiveness of the remedy. The updated ARARs do not affect the protectiveness of the remedy. There have been no TBCs affecting the protectiveness of the remedy.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

Because COCs for soil are identified only at Site SS-42, exposure pathways for these sites are mainly associated with the impacted groundwater. The soil exposure pathways at Site SS-42 include direct soil contact pathways for intrusive workers during deep excavation activities. No intrusive activities have been conducted or are planned at these sites as part of the final reuse plans.

The remedy is progressing as expected. There have been no changes in the toxicity factors for the COCs. The MDEQ criteria are considered to be conservative and reasonable in evaluating risk for areas remaining as industrial land use.

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

The sites are located within an industrial area and no ecological targets were identified during the five-year review; therefore monitoring ecological targets is not necessary. The groundwater analytical results in monitoring wells indicate that the COC concentrations detected in groundwater are decreasing. No weather-related events have affected the protectiveness of the remedy. There is no other information that calls into question the protectiveness of the remedy.

7.5.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is being implemented as intended by the RAP. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. Although ARARs for groundwater contamination cited in the RAP have not been met, groundwater monitoring data show that the COC concentrations in groundwater are decreasing.

No other information calls into question the protectiveness of the remedy. Continued groundwater monitoring is recommended downgradient of the SS-08 maintenance area to insure that any sources of contamination continue to be attenuated without significant downgradient groundwater impacts.

7.6 SITE OT-16

7.6.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the remedy, MNA, is functioning as intended by the RAP (ICF, 1998h). The effective implementation of ICs (groundwater use restriction, industrial land use restriction, soil movement and basement restrictions) has prevented exposure to, or ingestion of, contaminated soil and groundwater.

To evaluate the effectiveness of the MNA, groundwater VOCs, SVOCs, iron, and manganese were sampled annually in OT16-MW1 through OT16-MW16 and PW14. The annual groundwater analytical results show that contaminants in groundwater are highest in the area of well OT16-MW3. The MNA has not yet achieved the remedial objectives of MDEQ Part 201 Industrial Drinking Water criteria on-site and MDEQ Part 201 Residential Drinking Water criteria off-site. However, the groundwater monitoring data indicate that the groundwater concentrations have been generally decreasing since August 2001, which indicates that the remedy is effectively minimizing the migration of the VOC-impacted groundwater. The estimated completion date of the remedial activity for COCs in groundwater was six years, with completion of two years annual post-closure monitoring following the RA end date.

There were no opportunities for system optimization observed during this review. The monitoring well network provides sufficient data to assess the progress of natural attenuation within the plume. The groundwater monitoring wells data indicated that the 1,2,4-trimethylbezene, benzene, ethylbenzene, xylenes concentrations in OT16-MW3, and TCE concentrations in OT16-MW9, OT16-MW10, and OT16-MW12 are generally decreasing. It is noted that TCE was detected in OT16-MW15 (one of the farthest down-gradient monitoring wells) at a concentration exceeding the MDEQ Part 201 Residential Drinking Water criteria in August 2002. Additional groundwater data should be collected from OT16-MW15 to evaluate the potential for TCE migration toward the wetlands.

The on-base ICs in place include prohibitions on the use or disturbance of groundwater until cleanup levels are achieved. The MOU with the USFS (Andrina, 1997) needs to be expanded to cover all of the OT-16 downgradient plume area. No new uses of groundwater were observed.

7.6.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. Restoring groundwater to meet MDEQ Part 201 Industrial Drinking Water and GSI criteria is the current goal for the groundwater plume on-site and MDEQ Part 201 Residential Drinking Water and GSI Criteria is the cleanup goal for the groundwater plume off-site. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. The current MDEQ Part 201 GSI criteria are more stringent for ethylbenzene (18 µg/l), xylenes (35 µg/l), naphthalene (13 µg/l) and phenanthrene (5 µg/l) comparing to the original ARARs listed in Table 4-3 of this report. Annual groundwater monitoring data were compared to the updated ARARs to evaluate the protectiveness of the MNA. The groundwater annual monitoring analytical results show that the groundwater concentrations have been generally decreasing since August 2001, which indicates that the remedy is effectively minimizing the migration of the VOC-impacted groundwater. The updated ARARs do not affect the protectiveness of the remedy. There have been no TBCs affecting the protectiveness of the remedy. The residential drinking water criteria have been applied off-site because the contamination extends beyond the industrial site boundaries at which point groundwater usage is outside the control of the site owner.

The USFS MOU (Andrina, 1997), states that the USFS has no intention of allowing residential development on USFS property. The MOU should be expanded to the entire OT-16 downgradient area.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

No new exposure pathways were identified during the five-year review. The contaminants detected in surface soil do not exceed the MDEQ Part 201 Residential Direct Contact criteria. The subsurface soil analytical results indicate that benzo(a)pyrene concentrations detected in soil sample SB16-007, at a depth of 9 to 11 feet bgs, provided the only exceedance of MDEQ Residential Direct Contact criteria. However, the concentration is below the MDEQ Industrial Direct Contact criteria.

Any potential exposure to subsurface soil would be eliminated by a soil excavation restriction below nine feet. Although the toxicity value for TCE has been withdrawn by the USEPA IRIS database, no replacement toxicity value is listed there, and MDEQ still recognizes the old toxicity value for TCE. Therefore, there have been no changes in the toxicity factors for the COCs that were used in the BLRA. These assumptions are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy were identified.

The remedy is progressing nearly as expected; although TCE levels are gradually decreasing, it is possible that groundwater will take more than the estimated six years to reach cleanup goals.

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

Groundwater migration to the wetlands is a potentially complete pathway because of potential exposure to the surface water and sediments. However, it was previously concluded that Site OT-16 was not contributing to contamination found in Beaver Pond surface water or sediment (ICF, 1997e), and the most recent groundwater analytical results collected from OT16-MW14, OT16-MW15, and OT16-MW16 show that the detected TCE concentrations do not exceed the MDEQ Part 201 GSI criteria. Therefore, the impacted groundwater from Site OT-16 has not migrated to the surface water body, and monitoring of ecological targets is not necessary. No weather-related events have affected the protectiveness of the remedy. No other information calls into question the protectiveness of the remedy.

7.6.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is being implemented as intended by the RAP. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. Although MDEQ Part 201 Industrial Drinking Water and GSI On-Site and MDEQ Part 201 Residential Drinking Water criteria have not been met, the groundwater monitoring data show that the COC concentrations detected in groundwater are generally decreasing; however, an increase in TCE in well OT-MW15 signals the need for additional monitoring near surface water to ensure protectiveness in maintained. To ensure future protectiveness, the USFS MOU needs to be expanded to cover the entire OT-16 plume area. No other information calls into question the protectiveness of the remedy.

7.7 SITES SS-17, SS-21, AND SS-47

7.7.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that the RA is functioning as intended by the RAP (ICF, 1998k). The effective implementation of IC (deed groundwater used restriction) has prevented exposure to, or ingestion of, contaminated groundwater.

Consisting of five pumping wells (PW1, PW2, PW3, PW4, and AF3), the ASPTS started in December 1981. To provide a more effective capture zone pumping well, AF3 was replaced with pumping well AF1 in 1984. VOCs are sampled annually in 26 monitoring wells to track the reductions in plume concentrations and ensure plume containment.

The groundwater PTS has not yet achieved the remedial objectives to reduce all contaminants to MDEQ Part 201 Industrial Drinking Water criteria. However, the groundwater annual monitoring data indicate that the groundwater concentrations are decreasing in most of the monitoring wells. Two monitoring wells have exhibited more persistent TCE levels. Monitoring well G14S/D (the presumed source at SS-21) and well W512 (an unknown source near SS-47) both appear to be located near a TCE generating source. These areas will require additional source identification and reduction activities if the ASPTS is to attain cleanup goals in a reasonable timeframe.

The estimated completion time for the remedial activity stated in the RAP is 2009; however, the cleanup goals will not be reached in this timeframe without more attention to source remediation. The completion dates of the remedial activity will be determined based on the groundwater annual monitoring data, with completion of two years annual post-closure monitoring following the RA end date.

There are significant opportunities for the optimization of the ASPTS, including more optimum well placements, improved well controls, reduced pumping rates, and source reduction activities. The USAF is currently conducting RPO evaluations at the ASPTS. The monitoring well network provides sufficient data to assess the progress of groundwater pump and treat within the plume. The groundwater monitoring well data indicated that the plume is being captured and groundwater exceeding MDEQ Industrial Drinking Water criteria is not migrating downgradient toward Van Etten Lake. Additional temporary monitoring wells may be required to better define the source areas for treatment and LTM.

The ICs in place include prohibitions on the use or disturbance of groundwater until cleanup levels are achieved. No new uses of groundwater were observed.

7.7.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. Restoring groundwater to meet MDEQ Part 201 Industrial Drinking Water criteria is the primary cleanup goal for the groundwater plume according to the RAP. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. The updated ARARs listed in Table 4-4 were used to evaluate the protectiveness of the groundwater PTS. MDEQ Part 201 Industrial Drinking

Water criteria for benzene, toluene, ethylbenzene and xylenes are the same as the original ARARs. MDEQ Part 201 Industrial Drinking Water criteria for TCE and PCE have increased from 2.2 µg/l and 0.7 µg/l originally to 5 µg/l for both compounds. Therefore, the changes of ARARs do not affect the protectiveness of the remedy. There have been no TBCs affecting the protectiveness of the remedy.

During the past five years, four former facilities (190, 404, 405, and 410) down-gradient (i.e., not within the footprint of Sites SS-17, SS-21 and SS-47 [see Appendix A]) have been transferred to different owners without soil use restrictions. Although a groundwater use restriction has been incorporated into the deeds for all parcels associated with these former facilities, industrial land-use restrictions should be applied to these deeds if areas of contaminated soil are identified.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the human health risk assessment included both current exposures for commercial workers and potential future exposures for commercial workers. There have been no changes in the toxicity factors for the COCs that were used in the BLRA. Although the toxicity value for TCE has been withdrawn by the USEPA IRIS database, no replacement toxicity value is listed there, and MDEQ still recognizes the old toxicity value for TCE. Therefore, there have been no changes in the toxicity factors for the COCs that were used in the BLRA. These assumptions are considered to be conservative and reasonable in evaluating risk for areas remaining as industrial land use.

A screening risk evaluation will be performed using MDEQ Part 201 Residential criteria for the parcels already transferred from Wurtsmith AFB to ensure that there is no potential risk to human health due to unrestricted use of these properties.

There have been no changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy. The remedy is progressing as expected.

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

The sites are located within an industrial area and no ecological targets were identified during the five-year review; therefore monitoring ecological targets is not necessary. The groundwater analytical results in monitoring wells indicated that the groundwater plume does not migrate to Van Etten Lake at concentrations exceeding the MDEQ Industrial Drinking Water or GSI criteria. No weather-related events have affected the protectiveness of the remedy. No other information calls into question the protectiveness of the remedy.

7.7.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is being implemented as intended by the RAP and is generally effective. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Although ARARs for groundwater contamination cited in the RAP have not been met, the groundwater monitoring data show that the plume is contained and COC concentrations detected in groundwater are gradually decreasing in most of monitoring wells. The system needs to be upgraded to improve well controls and optimized to focus extraction closer to remaining source areas and reduce the total volume of water extracted. Additional source area definition and remediation should be considered to speed up the time to achieve groundwater cleanup objectives. No other information calls into question the protectiveness of the remedy.

7.8 SITE LF-23

7.8.1 Is the remedy functioning as intended by the decision documents?

Based on the RAP (ICF, 1998l), ICs only are required at the site. Based on the groundwater data collected during the Supplemental RI at Site LF-23 in November 2001 (URS, 2003), there is no evidence that groundwater has been impacted above MDEQ criteria due to previous operations at Site LF-23.

During the five-year review, MDEQ Part 201 Generic Soil and Groundwater Cleanup criteria are used to evaluate the data collected from 1995 RI and 2001 Supplemental RI. In soil, the 95%

UCL for antimony calculated by ICF in the RI (ICF, 1997) is below the MDEQ Part 201 Residential Drinking Water Protection criterion. The 95% UCL for magnesium exceeds the MDEQ Part 201 Residential Drinking Water Protection criterion, but is below the MDEQ Part 201 Industrial Drinking Water Protection criterion. The 95% UCL for iron is above the MDEQ Part 201 Residential and Industrial Drinking Water Protection criteria, but below the statewide default background level. The maximum lead concentration exceeds the MDEQ Part 201 Residential Direct Contact criterion, but is below the MDEQ Part 201 Industrial Direct Contact criterion. However, the groundwater analytical results collected from 2001 Supplemental RI show that dissolved aluminum, chromium and lead, other metals, VOCs and SVOCs are all below the MDEQ Part 201 Residential and Industrial criteria. The 2001 groundwater analytical results indicate that metals concentrations in soil are not leaching into groundwater at concentrations above MDEQ Residential and Industrial criteria. It is noted that MDEQ has requested that UCL calculations be revisited because they do not reflect current guidelines for statistical analysis, as issued by the State of Michigan.

The ICs (groundwater use deed restriction and industrial use deed restriction) have been implemented to prevent any potential exposure to residual metals exceeding MDEQ criteria in soil. No new uses of groundwater were observed. The land use at the site remains light industrial/commercial.

7.8.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the no further action remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. MDEQ Residential and Industrial Drinking Water criteria are used for the site. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. The updated MDEQ Part 201 Generic

Soil and Groundwater Cleanup criteria do not affect the protectiveness of the no further action remedy. No changes in TBCs have been made.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

There have been no changes in the exposure pathways evaluated for the site. The land use remains the same: light industrial/commercial. A risk assessment was conducted for the site, and MDEQ criteria have been implemented. These assumptions are considered to be conservative in evaluating risk. Because conservative MDEQ criteria are being implemented at the site, changes to the standardized risk assessment methodology that could affect the protectiveness of the no further action remedy were not evaluated.

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

Based on the Supplemental RI performed in 2001, the groundwater analytical results showed that the dissolved metal concentrations do not exceed the MDEQ criteria. No ecological targets were identified during the five-year review, and therefore monitoring ecological targets is not necessary. No weather-related events have affected the protectiveness of the remedy. No other information calls into question the protectiveness of the no further action remedy.

7.8.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the no further action remedy is protective for the site. There have been no changes in the physical conditions of the site that would affect the protectiveness of the no further action remedy. No other information calls into question the protectiveness of the no further action remedy.

7.9 SITE OT-24

7.9.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the remedies are functioning as intended by the RAP (ICF, 1996h), as modified by the C-RAP (URS, 2002b). The effective implementation of on-base ICs (deed restriction for groundwater use) has prevented exposure to, or ingestion of, contaminated groundwater. The

remedies for Site OT-24 include the groundwater pump and treat system (MDPTS) and MNA for the groundwater plumes that are off-base on the southern portion of the site near Duell Lake and Three Pipes Drainage Ditch.

The MDPTS was constructed and operated in June 1987. Three groundwater extraction wells were installed along Mission Drive, south of Perimeter Road, and a fourth was installed northwest of the intersection of Mission Drive and Perimeter Road. However, additional groundwater investigation activities indicated that the entire contaminant plume has not been captured by the MDPTS, as evidenced by the present of TCE downgradient of the site. Redesign of the existing MDPTS was the preferred remedial alternative in the RAP (ICF, 1996g). The MDPTS was redesigned in 2001 to optimize the placement of extraction wells. The four existing extraction wells were abandoned and seven new extraction wells were installed in March 2001. The redesigned MDPTS became operational in April 2001.

The redesigned MDPTS and MNA for the groundwater plume on the southern portion of the site have not yet achieved the remedial objectives to achieve MDEQ GSI criteria and minimize the migration of contaminants to surface water. However, groundwater monitoring data indicate that the groundwater PTS is effective for treating the TCE impacted groundwater. Additional groundwater data are required to evaluate whether the groundwater PTS is effective for minimizing the southern migration of TCE impacted groundwater. Additional groundwater extraction in the southern portion of the plume (near monitoring wells H52D and H64D) would reduce plume migration and assist the USAF in achieving MDEQ GSI criteria by the estimated completion date. The estimated completion of remedial activity is April 2007, with completion of post-closure monitoring in April 2009.

There were opportunities for system optimization observed during this review. As discussed in Section 6.4.9, there are several wells on the eastern side of the site that are removing very little contamination. This pumping capacity could be better used by a new extraction well in the southern portion of the plume where TCE concentrations are highest. An RPO evaluation is underway to address these potential improvements. The monitoring well network generally provides sufficient data to assess the progress of groundwater pump and treat and natural

attenuation within the plume. A new monitoring well 600 feet north of H119 would better define the southeastern extent of the OT-24 Plume A.

ICs are in place on the base to prohibit the use or disturbance of groundwater until cleanup levels are achieved. Off-base land use is controlled by the USFS and the State of Michigan. No formal groundwater use restrictions are in place for USFS or State of Michigan property. No new uses of groundwater were observed. It was noted by the MDEQ that the MDNR owns some land around Duell Lake in the area affected by low concentrations of TCE. A separate MOU may be needed with MDNR to prevent groundwater use in this off-base forested area.

7.9.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standard and TBCs

MDEQ Part 201 Residential Drinking Water/GSI criteria are used for off-site wells for TCE and cis-1,2-DCE. The changes in standards from 1995 to date for the potential COCs are listed in Table 7-1.

TABLE 7-1
CHANGES IN MDEQ PART 201 RESIDENTIAL DRINKING WATER/GSI STANDARDS SINCE 1995 AFFECTING SITE OT-24
CERCLA 5-YEAR REVIEW
WURTSMITH AFB, MICHIGAN

Chemicals	MDEQ Drinking Water Criteria (mg/L) (1995)	GSI Value (mg/L)	MDEQ Drinking Water Criteria (mg/L) (December 2002)	MDEQ GSI Criteria (mg/L) (December 2002)
TCE	0.0022	0.094	0.005	0.2
cis-1,2-DCE	0.077	NA	0.07	0.62

Changes in new standards will not affect the protectiveness of the remedy. No changes in TBCs have been made.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the human health risk assessment included current exposures for child and adult residents and potential future exposures for child and adult residents. Because the land use for the area remains residential, no changes have been made to the exposure assumptions.

There have been no changes in the toxicity factors for the COCs that were used in the BLRA. Although there are discussions for revising the TCE toxicity value, USEPA has not finalized the revision. Therefore, the exposure and toxicity assumptions used in the BLRA are still considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes in chemical-specific standards, action-specific requirements and location-specific requirements were identified for the COCs at the site. There have been no changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy.

The remedy is progressing. However, additional groundwater monitoring data is needed to evaluate the effectiveness of the remedy. The ability of the remedy to achieve all criteria in the predicted timeframe (by 2007) is unknown.

The groundwater volatilization to indoor air pathway was originally evaluated because of the potential concern that TCE in the groundwater could volatilize and infiltrate the living spaces of houses constructed over the groundwater plume at Site OT-24. The evaluation concluded that there were no unacceptable risks associated with the volatilization of TCE from the groundwater plume. Detailed discussion of this evaluation can be found in Addendum to the RI Report, Site OT-24 (ICF, 1996g).

Groundwater volatilization to the indoor air pathway was evaluated during the five-year review. The MDEQ Part 201 Residential and Commercial I Groundwater Volatilization to Indoor Air Inhalation criteria for TCE (15,000 µg/l) was used to screen the TCE concentrations

detected at Site OT-24. None of the TCE concentrations detected at Site OT-24 exceeded these criteria. Therefore, the pathway is not currently a concern. This exposure pathway may become a concern if USEPA's revised TCE toxicity value is adopted, because the revised TCE value is more conservative. The groundwater volatilization to indoor air pathway should be reevaluated if new standards for volatilization to indoor air criteria are adopted.

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

No ecological targets were identified during the ecological risk assessment and none were identified during the five-year review; therefore monitoring ecological targets is not necessary. The groundwater analytical results in monitoring wells near and upgradient to the surface water do not exceed the current GSI criteria for TCE of 200 µg/L. No weather-related events have affected the protectiveness of the remedy. No formal groundwater use restrictions are in place for USFS or State of Michigan property. This is a future protectiveness issue that needs to be addressed. No other information calls into question the current protectiveness of the remedy.

7.9.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is functioning as intended by the RAP, as modified by the C-RAP (URS, 2002b). There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. ARARs for groundwater contamination cited in the RAP have been met except for TCE and cis-1,2-DCE. On and off-base concentration trends for these contaminants are generally downward. Additional groundwater extraction in the southern portion of the plume would accelerate site cleanup and prevent potential off-base migration. An additional monitoring well north of existing well H119 would improve plume delineation. An RPO evaluation is underway to address the OT-24 groundwater extraction system and monitoring network.

There have been no changes in the toxicity factors for the COCs that were used in the BLRA, and there have been no changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy. The USAF should reevaluate the volatilization to indoor air pathway if MDEQ updates the related standard. No formal groundwater use restrictions are

in place for USFS or State of Michigan (MDNR) property. This is not a current protectiveness issue as the land is uninhabited forest land. Establishing an MOU with these landowners would ensure future protectiveness. No other information calls into question the protectiveness of the remedy.

7.10 SITE LF-26

7.10.1 Is the remedy functioning as intended by the decision documents?

Based on the RAP (ICF, 1998c), only ICs are required at the site.

The ICs (groundwater use restriction and industrial use restriction) have been implemented to prevent any potential exposure to residual metals in Area A exceeding MDEQ Residential criteria in soil. No new uses of groundwater were observed. The land use at the site remains industrial.

7.10.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the no further action remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. MDEQ residential and industrial drinking water criteria are used for the site. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act.

MDEQ Residential and Industrial Direct Contact criteria also apply to the site. There are some changes in standards comparing MDEQ June 2000 with the 1995 MDEQ Residential and Industrial direct contact criteria (Table 7-2). The changes of ARARs do not affect the protectiveness of the no further action remedy. No changes in TBCs have been made.

TABLE 7-2
CHANGES IN MDEQ PART 201 RESIDENTIAL AND INDUSTRIAL DIRECT CONTACT CRITERIA SINCE 1995 AFFECTING SITE LF-26
CERCLA 5-YEAR REVIEW
WURTSMITH AFB, MICHIGAN

Chemicals	Concentrations (µg/kg)	1995 MDEQ Direct Contact Criteria		2000 MDEQ Direct Contact Criteria	
		Residential	Industrial	Residential	Industrial
Arsenic	19,300	8,600	100,000	7,200	61,000
Beryllium	2,700	2,300	35,000	410,000	3,100,000
Lead	405,000	400,000	400,000	400,000	900,000

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

There have been no changes in the exposure pathways evaluated for the site. The land use remains the same as industrial. Although a risk assessment was conducted for the site, MDEQ direct contact criteria are implemented at the site. These assumptions are considered to be conservative in evaluating risk. Likewise, changes to the standardized risk assessment methodology that could affect the protectiveness of the no further action remedy were not evaluated, because conservative MDEQ direct contact criteria are being implemented at the site.

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

No ecological targets were identified during the five-year review, and therefore monitoring ecological targets is not necessary. No weather-related events have affected the protectiveness of the remedy. No other information calls into question the protectiveness of the no further action remedy.

7.10.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the no further action remedy is protective for the site, and there have been no changes in the physical conditions of the site that would affect the protectiveness. No other information calls into question the protectiveness of the no further action remedy.

7.11 SITE LF-27

Since site investigations are still underway, and the RAP for this site is still in the development stage, a complete technical assessment of the remedy is not possible.

The review of available documents, ARARs, risk assumptions, and the results of the site inspection indicates that additional monitoring points are required to determine the extent of VOC and metals contamination. The USAF is installing additional wells along the toe of the landfill and in upgradient areas to determine the source of PCE.

Surface water and sediment have been sampled for metals and toxicity testing is being conducted to determine if metals at Site LF-27 have negatively impacted surface water and sediments in the wetlands downgradient of Site LF-27. PCE has been detected in two seep areas at concentrations exceeding MDEQ GSI criteria. The potential impact to surface water is currently being assessed by the USAF and regulatory agencies. A black sooty material presumed to be fly-ash was observed in areas on the ground surface during site visits. The recent analysis of this material and soils for arsenic indicates that surface soils do not exceed the MDEQ Industrial Direct Contact criteria. A statistical analysis of arsenic data is under review to determine if there is any risk from surface soils.

The effective implementation of ICs in this area by the USFS should prevent exposure to, or ingestion of, contaminated groundwater or surface water. Protectiveness of ecological receptors in the nearby wetlands is the primary issue that must be addressed. There is not enough information on the impact of metals and PCE on the wetlands to render a protectiveness determination at this time. Exceedences of MDEQ GSI criteria for PCE must be addressed by the USAF.

7.12 SITES LF-30 AND LF-31

Since the RAP for these sites is still in the development stage, a complete technical assessment is not possible.

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that the current remedy (groundwater pump and treat, AS, injection of ORC, MNA,

periodic beach maintenance, LTM and maintenance of landfill area, ICs, municipal water line extension, and well restrictions) has been implemented as proposed in the proposed RAP (Montgomery Watson, May 1, 2001).

The potential concerns for Sites LF-30 and LF-31 include subsurface soil exposure on-site at LF-30 or LF-31, groundwater exposure off-site through consumption of groundwater from a future private well, and groundwater migration to the downgradient Van Etten Lake. The effective implementation of IC (municipal water supply, restrictions on new wells) has prevented exposure to, or ingestion of, contaminated groundwater. Additional definition of the extent of off-base contaminant migration is needed to improve long-term monitoring and protectiveness. On base industrial land use restrictions are in force for the source area (landfills), however, public access to these areas may need to be restricted to prevent breaches of the landfill cover. These protectiveness concerns should be addressed in the final remedy.

In addition, the YMCA beach area should be monitored for VOCs in seeps and for iron staining. Although not a protectiveness concern, iron staining is identified under MDEQ Part 201 as an aesthetic issue and is subject to cleanup criteria. The YMCA has requested that groundwater and seep monitoring data be made available as soon as possible after collection to assist them in their evaluation of the site before the camping season. More permanent groundwater easements are recommended if an agreement can be reached with the YMCA.

7.13 SITE SS-51

7.13.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that MNA is functioning as intended by the RAP (Parsons, 1996g). The effective implementation of IC (groundwater used deed restriction) has prevented exposure to, or ingestion of, contaminated groundwater.

The MNA started in October 1997. VOCs were sampled annually in USGS-4, W409S, W409D, and W411. The groundwater monitoring data indicated that the groundwater concentrations are decreasing overall, which indicates that the remedy is effectively treating and

minimizing the migration of the impacted groundwater. The most recent groundwater monitoring data show that ethylbenzene, xylenes, 1,2,4-TMB and 1,3,5-TMB are still being detected at concentrations exceeding the MDEQ Part 201 Industrial Drinking Water criteria in the source area. The estimated completion date of the remedial activity for these COCs is October 2005, with completion of two years annually post-closure monitoring following the RA end date.

There were no opportunities for system optimization observed during this review. The monitoring well network provides sufficient data to assess the progress of groundwater natural attenuation within the plume. The groundwater monitoring wells data indicated that the plume appears to be limited in the vicinity of source area near USGS-4.

ICs in place include prohibitions on the use or disturbance of groundwater until cleanup levels are achieved. No new uses of groundwater were observed.

7.13.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. Restoring groundwater to meet MDEQ Part 201 Industrial Drinking Water criteria is the primary cleanup objective for the groundwater plume. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. The groundwater annual monitoring data were compared to the updated ARARs to evaluate the protectiveness of the remedy. The groundwater annual monitoring analytical results show that the groundwater concentrations are decreasing overall, which indicate that the remedy is effective in treating and minimizing the migration of the impacted groundwater. The updated ARARs do not affect the protectiveness of the MNA

remedy. There have been no TBCs affecting the protectiveness of the remedy. The industrial drinking water criteria apply to the site because the impacted groundwater plume is limited to the industrial/airfield land use area.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

Groundwater remains the only impacted environmental medium at the site that could possibly be a significant exposure pathway. The land use of the site remains industrial/airfield. MDEQ Part 201 Industrial Drinking Water criteria are used as the cleanup levels for the site, and are considered to be conservative for evaluating risk and developing risk-based cleanup levels. No changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy were identified. The remedy is progressing as expected.

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

No surface water body is near the site, the plume is stable or shrinking, and no significant ecological targets were identified during the five-year review; therefore monitoring ecological targets is not necessary. No weather-related events have affected the protectiveness of the remedy. No other information calls into question the protectiveness of the remedy.

7.13.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is implemented as intended by the RAP. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. Although MDEQ Industrial Drinking Water Criteria for groundwater contamination have not been met for ethylbenzene, xylenes, 1,2,4-TMB and 1,3,5-TMB, the groundwater monitoring data show that their concentrations in groundwater are decreasing and the plume is stable or shrinking. No other information calls into question the protectiveness of the remedy.

7.14 SITE SS-57

7.14.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that the long-term remediation of the down-gradient portions of the plume (continued operation of ASPTS) is being implemented as intended by the RAP (Versar, 2002). Installation of bioventing and biosparging systems for remediation of the hot spot area has been completed; however, this part of the remedy has not been implemented because free-phase product was detected in monitoring wells A48 and MW4S during April 2001 sampling event and one of the newly installed monitoring well MW-5 during March 2003 sampling event. The free-product levels and the potential movement of the free-product in adjacent wells have been monitored and passive recoveries have been performed in these monitoring wells. A short-term SVE remedy has been implemented to reduce initial high vapor concentrations before proceeding with biosparging and bioventing. The effective implementation of ICs (groundwater use, industrial land use and soil excavation restrictions) have prevented exposure to, or ingestion of, contaminated soil and groundwater.

VOCs, SVOCs and bioremediation parameters will be sampled quarterly in six monitoring wells A48, MW4S, MW5, MW6, MW7, and MW8 for the remediation of the hot spot area. VOCs and SVOCs will be sampled quarterly in eight monitoring wells MW2S, MW2I, MW2DS, MW3S, MW3D, H83S, H83D, and R5S to monitor the long-term remediation of the down-gradient portions of the plume. The estimated completion date of the remedial activity for soil and groundwater contaminants will be determined based on the starting date of the bioventing/biosparging systems (estimated at four to five years bioventing/biosparging and 26 years continued operation of ASPTS). Fuel hydrocarbons are also undergoing natural attenuation which will likely shorten the groundwater cleanup time and eventually eliminate the need for the ASPTS.

There were no opportunities for system optimization observed during this review. There are not enough data to determine whether the monitoring well network provides adequate coverage to assess the progress of the groundwater PTS within the plume.

ICs in place include prohibitions on the use or disturbance of groundwater until cleanup levels are achieved. The site remains industrial. No new uses of groundwater and soil excavation were observed.

7.14.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. Restoring groundwater to meet MDEQ Part 201 Industrial Drinking Water and criteria should apply throughout the groundwater plume. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. The groundwater annual monitoring data are compared to the updated ARARs to evaluate the protectiveness of the remedy. The updated ARARs for COCs at the site include new levels for n-propylbenzene, 1,2,4-TMB, and 1,3,5-TMB and an increased level for bis(2-ethylhexyl)phthalate. Levels for n-propylbenzene, 1,2,4-TMB, and 1,3,5-TMB were previously unspecified. The updated ARARs do not affect the protectiveness of the remedy but may extend the cleanup time.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

No new exposure pathways were identified during the five-year review. The risk assessment concluded that RA is required due to the associated groundwater plume. The exposure assumptions used in the BLRA to evaluate the direct contact exposure risk for commercial/industrial workers and visitors are considered conservative by using data from subsurface soil, where the source of the contamination was located. This is, because the commercial/industrial workers and visitors would be exposed to surface soil rather than subsurface soil. Although surface soil data were not available, it is likely to be lower than the subsurface soil. The human health risk to noncarcinogenic effects of COCs including

benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene were not calculated in the BLRA. This was because the non-carcinogenic toxicity values were not available for these COCs and these values are still not available. No changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy were identified.

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

Although the remedy has not been fully implemented, the impacted groundwater from Site SS-57 is captured by the ASPTS and has not migrated to a surface water body. Therefore, monitoring of ecological targets is not necessary. The presence of free product may extent the time required for the active remedy to reduce soil concentrations of COCs. No weather-related events have affected the protectiveness of the remedy. No other information calls into question the protectiveness of the remedy.

7.14.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy has not yet been fully implemented as intended by the RAP. A temporary SVE system is now being tested as a method of reducing initial high vapor levels and minimizing vapor migration. The current potential exposure pathways are eliminated by continued ASPTS and ICs. The five-year review team recommends soil gas monitoring in the vicinity of underground utilities or buildings soon after bioventing and biosparging is implemented. This will provide a safeguard against undesirable vapor migration. No other information calls into question the protectiveness of the remedy.

7.15 SITE ST-68

Since the RAP for this site is still in the development stage, a complete technical assessment is not possible.

The baseline human health risk assessment indicated that exposure to impacted soil and/or groundwater may pose an unacceptable human health risks to a potential future adult or child

resident. The COCs at the site include benzene, ethylbenzene, total xylenes, 1,3,5-TMB, 1,2,4-TMB, tert-butylbenzene, n-butylbenzene, sec-butylbenzene, and n-prophybenzene. The pathways of concern associated with the unacceptable risk are direct contact with impacted soil and the ingestion of groundwater.

The preferred RA alternative for soil cleanup is removal of the OWSs, natural attenuation for soils, and implementation of ICs. In May 2003, the OWS was removed along with contaminated soil and site was restored. The excavation were backfilled and with approximately 1,000 cubic yards of clean sand and 80 cubic yards of clean topsoil, which removes the source and mitigates the unacceptable risk associated with the direct contact with soil.

The preferred RA alternative for groundwater is to maintain the existing ASPTS and implement ICs at the site. The effective implementation of ICs should prevent any potential exposure to contaminated soil and groundwater. ICs for the site include (1) limit future land use to industrial, (2) prevent excavations below 15 feet bgs and prevent basements in the ST-68 footprint, (3) review and approval by USAF of an HSP prior to excavations of depths less than 15 feet bgs in the ST-68 footprint, (4) prevent groundwater use as drinking water, and (5) groundwater monitoring for the life of the alternative. These ICs have been implemented and will be included in the final DD for Site-68.

7.16 SITE ST-69

7.16.1 Is the remedy functioning as intended by the decision documents?

The RAP for this site is still unsigned, however, a review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that the implemented remedy (MNA) is functioning as intended. The effective implementation of IC (groundwater use restriction) has prevented exposure to, or ingestion of, contaminated groundwater.

The MNA started in 1997. VOCs were sampled quarterly in six wells and data shows that TCE levels are naturally attenuating. The MNA for the groundwater plume has almost achieved the remedial objective to decrease the TCE contamination present in the groundwater at ST-69 to MDEQ Part 201 Industrial Drinking Water criteria. The most recent sampling event conducted

in 2003 shows that the only wells with exceedances of MDEQ Residential and Industrial criteria for TCE are wells ST45-MW2 and ST69-TW2. These wells have exhibited slight variations in TCE concentrations above and below the MDEQ criteria. The estimated completion date of the remedial activity for TCE was 2003, with completion of two years annually post-closure monitoring following the RA end date. Additional groundwater monitoring is required because the 2003 data indicate slightly increasing TCE concentrations in ST69-TW2.

There were no opportunities for system optimization observed during this review. The monitoring well network provides sufficient data to assess the progress of groundwater natural attenuation within the plume. The groundwater monitoring wells data indicated that the plume appears to be limited in the vicinity of the source area near ST45-MW2 and ST69-TW2.

The ICs in place include prohibitions on the use or disturbance of groundwater until cleanup levels are achieved. No new uses of groundwater were observed.

7.16.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the implemented remedy.

Changes in Standard and TBCs

The Michigan Safe Drinking Water Act is the applicable regulation for establishing the drinking water criteria for the site because groundwater from the shallow aquifer may be used for domestic purposes. Restoring groundwater to meet MDEQ Part 201 Industrial Drinking Water criteria is the cleanup objective for the groundwater plume. The MDEQ Part 201 Drinking Water Criteria are equal to, or are more stringent than, the MCLs established under the Safe Drinking Water Act. The updated ARARs do not affect the protectiveness of the MNA remedy. There have been no new standards or TBCs affecting the protectiveness of the remedy.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

Groundwater remains the only impacted environmental medium at the site that could possibly be a significant exposure pathway. Because the land use of the site remains industrial, MDEQ Part 201 Industrial Drinking Water criteria apply to TCE cleanup at the site. The assumptions in these criteria are considered to be conservative in evaluating risk and developing risk-based cleanup levels.

USEPA has not finalized proposed TCE toxicity value revisions, and MDEQ still recognizes the previous TCE toxicity value. No changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy were identified. The remedy appears to be progressing; however, 2003 data show that TCE concentrations are slightly increasing in ST69-TW2 to concentrations exceeding MDEQ Part 201 Drinking Water criteria. In addition, the TCE concentration detected in ST45-MW2 exceeds the MDEQ Part 201 Drinking Water criteria. Therefore, the remedy has not achieved all criteria in the predicted timeframe (by 2003). Additional monitoring is required to determine whether the TCE will continue to increase and whether TCE may be migrating off-site.

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

The TCE plume is localized and the potential adverse impacts from contaminants migrating to and discharging into surface water bodies are negligible. No significant ecological targets were identified during the five-year review, and therefore monitoring ecological targets is not necessary. No weather-related events have affected the protectiveness of the remedy. No other information calls into question the protectiveness of the remedy.

7.16.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the MNA remedy has been successfully implemented. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. MDEQ Industrial Drinking Water criteria for TCE groundwater contaminations have not been consistently met in two monitoring wells. Additional groundwater monitoring data is required to determine whether TCE will

continue to increase in monitoring well ST69-TW2 and whether TCE may be migrating off site. No other information calls into question the protectiveness of the remedy.

7.17 SITE WP-70

7.17.1 Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicates that the remedy (limited ACM removal followed by maintenance of existing cover) is functioning as intended. The effective implementation of IC (site-specific industrial use with restrictions) has prevented exposure to a small amount of non-friable ACM. Groundwater use restriction has also been implemented to prevent drinking water consumption due to potential groundwater contamination from Site OT-24. No new uses of groundwater were observed.

The implementation of the remedy has been completed. Surficial ACM and large construction debris were removed. A natural soil cover of 6 inches has maintained at the site over the ACM. The restrictions for the site include the followings:

- Maintenance of six inches of natural soil cover over the ACM,
- Require an HSP to be provided by the landowner/contractor and reviewed and approved by the USAF prior to excavation or construction,
- Require a survey to provide a legal description of the site footprint,
- Restrict future land use recreational vehicle,
- Restrict groundwater consumption,
- Require permanent markers, and
- Require an O&M plan for inspection and maintenance of the permanent markers and natural soil cover.

Permanent markers will be placed around the perimeter of the former landscape disposal area. The design of the permanent markers will be discussed in more detail in the declaration of restrictive covenant or LEA currently being prepared by the USAF.

7.17.2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

The test pit investigation performed at the site identified construction debris and a small amount of non-friable ACM (transite pipe and sheets). No sampling of soil or groundwater was completed at Site WP-70 because the ACM appears to be in small quantities and is non-friable transite, which is unlikely to impact groundwater. A baseline human health risk assessment was not completed for the site.

Changes in Standard and TBCs

There have been no TBCs affecting the protectiveness of the remedy. No ARARs apply to the site because no soil and groundwater samples were collected.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

Based on the results of the test pit investigation, the only potential exposure to the small amount of non-friable ACM would involve digging in the area, uncovering ACM, and rendering it friable. Upon the completion of the remedy and implementation of ICs, no potentially completed exposure pathway is identified for the site. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

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

No significant ecological targets were identified during the five-year review, and therefore monitoring ecological targets is not necessary. No weather-related events have affected the protectiveness of the remedy. No other information calls into question the protectiveness of the remedy.

7.17.4 Technical Assessment Summary

According to the data review, the site inspection, and the interviews, the remedy is being implemented as intended. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy, and no other information calls into question the protectiveness of the remedy.

7.18 SITE SS-71

Since the RAP for this site is still in the development stage, a technical assessment is not possible. However, a remedy was proposed during an October 8, 2003 RAB meeting as described below. The preferred remedy for Site SS-71 is MNA for groundwater with groundwater use restrictions and public education.

Based on the soil and groundwater analytical results, only PCE detected in groundwater slightly exceeded the MDEQ Residential and Industrial Drinking Water criteria. Therefore, MNA and the effective implementation of IC (groundwater use restriction) should prevent exposure to PCE impacted groundwater and maintain protectiveness.

SECTION 8

ISSUES

Issues related to current site operations, conditions, or activities that were noted during the five-year review for each site are listed in Table 8-1. While few of these issues are impacting current protectiveness, most have the potential to impact future protectiveness.

SECTION 9

RECOMMENDED ACTIONS AND FOLLOW UP

During this five-year review, certain recommendations and suggested improvements to current site operations, activities, and remedies were developed. Recommendations and suggested improvements relating to site protectiveness are summarized in Table 9-1.

SECTION 10
PROTECTIVENESS STATEMENT

10.1 SITE FT-02

Although the final remedy at FT-02 has not been formally approved, the actions taken by the USAF (SVE, MNA, ICs and LTM) are protective of human health and the environment. Recent data indicates that the MNA remedy is preventing surface water discharge of contaminants above MDEQ GSI criteria and therefore that the remedy at FT-02 currently protects human health and the environment. Groundwater use has been eliminated through institutional controls including a MOU with the USFS (Andrina, 1997) restricting future groundwater use. Exposure pathways that could result in unacceptable risks are being controlled through groundwater use, soil movement, and industrial land use restrictions.

10.2 SITE WP-04

The MNA, LTM, and IC remedy at WP-04 is protective of human health and the environment. Although the MDEQ residential groundwater criteria have not yet been attained, the remedy at WP-04 currently protects human health and the environment through the groundwater use restriction. Future protectiveness will require that a groundwater use deed restriction be implemented when a property is transferred.

10.3 SITE SS-05

The MNA, LTM, and IC remedy at SS-05 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.

The remedy at SS-05 currently protects human health and the environment by providing an alternate drinking water supply to off-base residents and by prohibiting new well permits in impacted areas. However, for the remedy to be protective in the long-term, more permanent groundwater easements are recommended for all impacted properties and a land survey is

recommended to provide a legal description of the plume footprint. The USAF should also keep informed of potential changes to TCE toxicity values that could impact volatilization to indoor air criteria. Continued public education is an important component of this remedy. In order to improve the protectiveness of the off-base SS-05 groundwater remedy, annual public education (such as providing literature on well restrictions) should be provided to all off-base residents potentially impacted by the SS-05 VOC plume.

10.4 SITES SS-06, SS-13, ST-40, AND ST-46

The active remediation, LTM, and ICs implemented at SS-06, ST-40, SS-13, and ST-46 are protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled through ICs.

The remedy at SS-06, ST-40, SS-13 and ST-46 currently protects human health and the environment through groundwater and land use restrictions. However, in order for the remedy to be protective in the long-term, enforceable groundwater use and industrial land use restrictions must be implemented when a property is transferred.

10.5 SITES SS-08, ST-41, SS-42, AND SS-53

The final remedy for Sites ST-41, SS-42 and SS-53 has not been approved. However, the active remediation, LTM, and ICs that have been implemented at SS-08, ST-41, SS-42, and SS-53 are protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being eliminated through ICs and downgradient groundwater extraction and treatment.

The actions taken at SS-08, ST-41, SS-42, and SS-53 currently protect human health and the environment through groundwater and industrial land use restrictions. However, in order for the remedy to be protective in the long-term, enforceable groundwater and land use restrictions must be implemented when a property is transferred.

10.6 SITE OT-16

The MNA, LTM, and IC remedy at OT-16 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks have been eliminated through on-base

ICs. The USFS MOU (Andrina, 1997) needs to be expanded to all areas downgradient of OT-16 to prevent any future groundwater use. This action needs to be completed to ensure future protectiveness.

The remedy at OT-16 currently protects human health and the environment through groundwater use restriction, industrial land use restriction, and soil movement restriction. However, for the remedy to be protective in the long-term, enforceable groundwater use, industrial land use and soil movement restrictions must be implemented when a property is transferred. This includes expansion of the USFS MOU (Andrina, 1997) to cover all OT-16 downgradient areas.

10.7 SITES SS-17, SS-21, AND SS-47

The active remediation, LTM, and ICs implemented at SS-17, SS-21 and SS-47 are protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled through on-base ICs.

The remedy at SS-17, SS-21 and SS-47 currently protects human health and the environment through groundwater use restriction. However, for the remedy to be protective in the long-term, an enforceable groundwater use restriction should be implemented when a property is transferred. If unremediated soil contamination remains on the site, enforceable industrial land use and soil movement restrictions must be implemented when a property is transferred.

10.8 SITE LF-23

The IC remedy implemented at LF-23 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled through on-base ICs.

10.9 SITE OT-24

The active remediation, MNA, LTM, and ICs implemented at Site OT-24 (Including Duell Lake and Three Pipes Drain Areas) are protective of human health and the environment. On-base exposure pathways that could result in unacceptable risks are being eliminated through ICs.

The remedy at OT-24 currently protects human health and the environment through enforceable deed restrictions placed on groundwater use in this residential area and because there are no off-base receptors for groundwater use. However, for the remedy to be protective in the long-term, enforceable groundwater use restrictions should be implemented for off-base property that is impacted by the VOC plumes. The USFS MOU should be expanded to include areas south of Site OT-24. If State of Michigan property is impacted a similar MOU should be obtained.

One concern for future protectiveness is the potential for higher levels of TCE to migrate to the south and off-base toward the Three Pipes Drainage. This could lead to exceedance of GSI criteria at the drainage ditch. The five-year review team has recommended the evaluation of additional extraction wells in the southern portion of the main plume to reduce migration.

Another concern for future protectiveness is the reevaluation of TCE toxicity values that MDEQ is undertaking. If lower values are adopted, the volatilization to indoor air pathway will need to be reevaluated to ensure that residents are not being exposed to unacceptable risk from TCE in soil gas. Meanwhile, the MDPTS continues to reduce groundwater concentrations and lessens the future risk of exposure.

10.10 SITE LF-26

The IC remedy that has been implemented at LF-26 is protective of human health and the environment.

10.11 SITE LF-27

A protectiveness determination of the remedy at Site LF-27 cannot be made until additional information is obtained. Specifically, there remains uncertainty regarding ecological risk to the wetlands where the current discharge of PCE exceeds GSI criteria and the past discharge of metals to wetlands sediments. A site-specific risk evaluation is recommended to determine the current risk and potential need for additional remediation. In the interim, exposure pathways that could result in unacceptable risks to humans are being controlled through an MOU with the USFS (Andrina, 1997) restricting groundwater use or surface water exposure in the seep areas.

10.12 SITES LF-30 AND LF-31

A final remedy has not been selected for Site LF-30/31. The actions taken by the USAF are protective, but rely heavily on the enforceability of off-base ICs. An alternate water supply has been provided to the YMCA, and there are restrictions on new well permits in this area. The USAF should continue to pursue more permanent groundwater use restrictions for off-base properties. This may include additional wells to fully delineate off-base plumes. The recreational land use (beach) requires frequent monitoring to ensure that seeps do not contain VOCs at elevated risk levels. Future protectiveness will require timely monitoring and reporting of VOC levels to the YMCA staff. On-base protectiveness will rely on enforceable groundwater use, industrial land use, and soil movement deed restrictions should this landfill area ever be transferred to new property owners.

10.13 SITE SS-51

The MNA, LTM and IC remedy at SS-51 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being eliminated through ICs.

The remedy at SS-51 currently protects human health and the environment through groundwater use restriction. However, for the remedy to be protective in the long-term, an enforceable groundwater use deed restriction should be implemented when a property is transferred.

10.14 SITE SS-57

The active remediation, LTM and IC remedy at SS-57 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being eliminated through ICs.

Migration of VOCs in soil gas could create new exposure pathways and should be monitored during bioventing/biosparging startup. In addition, the migration of impacted groundwater should be monitored to ensure capture by the ASPTS.

The remedy at SS-57 currently protects human health and the environment through groundwater use restriction, industrial land use restriction, and soil movement restriction.

However, for the remedy to be protective in the long-term, enforceable groundwater use, industrial land use, and soil movement deed restrictions should be implemented when a property is transferred.

10.15 SITE ST-68

The final remedy for this site has not been approved. The proposed IC remedy at ST-68 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being eliminated through ICs. However, for the remedy to be protective in the long-term, enforceable groundwater use, industrial land use, and soil movement deed restrictions should be implemented when a property is transferred. Groundwater remaining above MDEQ industrial drinking water criteria will be captured by the ASPTS or BPPTS.

10.16 SITE ST-69

The final remedy for Site ST-69 has not been approved. The actions taken by the USAF (MNA, LTM, and ICs) are protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being eliminated through ICs. However, for the remedy to be protective in the long-term, appropriate institutional controls required by the RAP/DD will be implemented. Continued monitoring of wells near the base boundary is needed to document that TCE is not migrating off-base.

10.17 SITE WP-70

The IC remedy at WP-70 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being eliminated through ICs. However, for the remedy to be protective in the long-term, enforceable industrial land use and soil movement deed restrictions should be implemented when a property is transferred.

10.18 SITE SS-71

The final remedy for this site has not been approved. The actions taken by the USAF (MNA, LTM and IC) are protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being eliminated through ICs. However for the remedy to

be protective in the long-term, enforceable deed restrictions on groundwater use should be implemented when a property is transferred.

SECTION 11

NEXT REVIEW

After completion of the first statutory or policy five-year review, the trigger for subsequent reviews is the signature date of the previous Five-Year Review report. For reviews led by other Federal agencies, States, or Tribes, and where USEPA has a concurrence role, the trigger for subsequent reviews corresponds to USEPA's concurrence signature date of the preceding Five-Year Review report (USEPA, 2001). Accordingly, the next five-year review for Wurtsmith AFB will be required five years following the date of the USEPA concurrence signature for this review.

SECTION 12

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Figures and Appendices
can be obtained from the
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