FINAL
FIVE-YEAR REVIEW REPORT

FORMER McCLELLAN AIR FORCE BASE

April 2004

Air Force Center for Environmental Excellence
Brooks City-Base
Texas
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Task Order 77

Prepared for:
Air Force Real Property Agency
McClellan, California

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Director, Air Force Real Property Agency
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FINAL
FIVE-YEAR REVIEW REPORT

FORMER McCLELLAN AFB

TABLE OF CONTENTS

Section			Page
	PROTECTIVENESS DETERMINATION		1
	LETTER FROM THE U.S. EPA, DATED 13 MAY 2004, REGARDING POLICY VERSUS STATUTORY REVIEW (IMMEDIATELY FOLLOWING THE PROTECTIVENESS DETERMINATION)		
	EXECUTIVE SUMMARY		ES-1
1.0	INTRODUCTION		1-1
	1.1	STATEMENT OF AUTHORITY AND PURPOSE	1-1
	1.2	REQUIREMENTS AND GUIDANCE FOR FIVE-YEAR REVIEWS	1-2
	1.3	SCOPE AND NATURE OF 1999 FIVE-YEAR REVIEW	1-3
	1.4	SCOPE AND NATURE OF CURRENT FIVE-YEAR REVIEW	1-4
	1.5	ORGANIZATION OF THE FIVE-YEAR REVIEW REPORT	1-6
2.0	ADMINISTRATIVE COMPONENTS		2-1
	2.1	FIVE-YEAR REVIEW TEAM	2-1
	2.2	COMMUNITY NOTIFICATION AND INVOLVEMENT	2-1
3.0	McCLELLAN BACKGROUND		3-1
	3.1	HISTORY OF ENVIRONMENTAL PROGRAM	3-1
4.0	GROUNDWATER OPERABLE UNIT		4-1
	4.1	DESCRIPTION AND BACKGOUND OF GROUNDWATER OU	4-1
	4.2	PREVIOUS AND CURRENT INVESTIGATIONS FOR GROUNDWATER OU	4-4
		4.2.1 VOC Background and Investigations	4-4
		4.2.2 Hexavalent Chromium Background and Investigations	4-5
		4.2.3 1,4-Dioxane Background and Investigations	4-6
		4.2.4 Metals Background and Investigations	4-7
		4.2.5 Radiological Constituents and Perchlorate Investigations	4-7
	4.3	INTERIM REMEDIAL ACTIONS FOR GROUNDWATER OU	4-8
		4.3.1 Groundwater Treatment Plant	4-8
		4.3.2 Dual-Phase Extraction System at IC 29	4-10
		4.3.3 Dual-Phase Extraction System at IC 23	4-11
	4.4	PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR GROUNDWATER OU	4-11
	4.5	FIVE-YEAR REVIEW PROCESS FOR GROUNDWATER OU	4-12

TABLE OF CONTENTS
(continued)

Section			Page
		4.5.1 Document Review for Groundwater OU	4-12
		4.5.2 Data Review for Groundwater OU	4-14
		4.5.3 Site Inspection for Groundwater OU	4-14
		4.5.4 Interviews for Groundwater OU	4-14
		4.5.5 Technical Assessment for Groundwater OU	4-15
	4.6	ISSUES FOR GROUNDWATER OU	4-31
5.0	VOC VADOSE ZONE		5-1
	5.1	DESCRIPTION AND BACKGROUND OF VADOSE ZONE	5-1
	5.2	PREVIOUS INVESTIGATIONS OF VADOSE ZONE	5-3
	5.3	INTERIM REMOVAL ACTIONS FOR VADOSE ZONE	5-4
	5.4	PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR VADOSE ZONE	5-5
	5.5	FIVE-YEAR REVIEW PROCESS FOR VADOSE ZONE	5-6
		5.5.1 Document Review for Vadose Zone	5-6
		5.5.2 Data Review for Vadose Zone	5-7
		5.5.3 Site Inspection for Vadose Zone	5-7
		5.5.4 Interviews for Vadose Zone	5-7
		5.5.5 Technical Assessment for Vadose Zone	5-8
	5.6	ISSUES FOR VADOSE ZONE	5-16
6.0	OPERABLE UNIT B1 CAP AND DRAINAGE DITCHES		6-1
	6.1	DESCRIPTION AND BACKGROUND FOR OU B1 CAP AND DRAINAGE DITCHES	6-1
	6.2	PREVIOUS INVESTIGATIONS FOR OU B1 CAP AND DRAINAGE DITCHES	6-2
	6.3	INTERIM REMEDIAL ACTIONS FOR OU B1 CAP AND DRAINAGE DITCHES	6-3
	6.4	PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR OU B1 CAP AND DRAINAGE DITCHES	6-5
	6.5	FIVE-YEAR REVIEW PROCESS FOR OU B1 CAP AND DRAINAGE DITCHES	6-6
		6.5.1 Document Review for OU B1 Cap and Drainage Ditches	6-6
		6.5.2 Data Review for OU B1 Cap and Drainage Ditches	6-7
		6.5.3 Site Inspection for OU B1 Cap and Drainage Ditches	6-7
		6.5.4 Interviews for OU B1 Cap and Drainage Ditches	6-8
		6.5.5 Technical Assessment for OU B1 Cap and Drainage Ditches	6-8
	6.6	ISSUES FOR OU B1 CAP AND DRAINAGE DITCHES	6-15
7.0	OPERABLE UNIT D CAP		7-1
	7.1	DESCRIPTION AND BACKGROUND FOR OU D CAP	7-1
	7.2	PREVIOUS INVESTIGATIONS FOR OU D CAP	7-2

TABLE OF CONTENTS
(continued)

Section			Page
7.3	INTERIM REMEDIAL ACTIONS FOR OU D CAP		7-3
	7.4	PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR OU D CAP	7-4
	7.5	FIVE-YEAR REVIEW PROCESS FOR OU D CAP	7-4
		7.5.1 Document Review for OU D Cap	7-4
		7.5.2 Data Review for OU D Cap	7-5
		7.5.3 Site Inspection for OU D Cap	7-5
		7.5.4 Interviews for OU D Cap	7-5
		7.5.5 Technical Assessment for OU D Cap	7-6
	7.6	ISSUES FOR OU D CAP	7-9
8.0	POTENTIAL RELEASE LOCATION S-033		8-1
	8.1	DESCRIPTION AND BACKGROUND FOR PRL S-033	8-1
	8.2	PREVIOUS INVESTIGATIONS FOR PRL S-033	8-2
	8.3	INTERIM REMOVAL ACTION FOR PRL S-033	8-4
	8.4	PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR PRL S-033	8-4
	8.5	FIVE-YEAR REVIEW PROCESS FOR PRL S-033	8-4
		8.5.1 Document Review for PRL S-033	8-4
		8.5.2 Data Review for PRL S-033	8-5
		8.5.3 Site Inspection for PRL S-033	8-5
		8.5.4 Interviews for PRL S-033	8-5
		8.5.5 Technical Assessment for PRL S-033	8-6
	8.6	ISSUES FOR PRL S-033	8-8
9.0	POTENTIAL RELEASE LOCATION 32		9-1
	9.1	DESCRIPTION AND BACKGROUND FOR PRL 32	9-1
	9.2	PREVIOUS INVESTIGATIONS FOR PRL 32	9-2
	9.3	INTERIM REMOVAL ACTIONS FOR PRL 32	9-3
	9.4	PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR PRL 32	9-3
	9.5	FIVE-YEAR REVIEW PROCESS FOR PRL 32	9-4
		9.5.1 Document Review for PRL 32	9-4
		9.5.2 Data Review for PRL 32	9-4
		9.5.3 Site Inspection for PRL 32	9-5
		9.5.4 Interviews for PRL 32	9-5
		9.5.5 Technical Assessment for PRL 32	9-5
	9.6	ISSUES FOR PRL 32	9-10
10.0	TIME CRITICAL REMOVAL ACTION AT CONFIRMED SITE 10		10-1
	10.1	DESCRIPTION AND BACKGROUND FOR CS 10	10-1
	10.2	PREVIOUS INVESTIGATIONS FOR CS 10	10-1
	10.3	INTERIM REMOVAL ACTIONS FOR CS 10	10-2
	10.4	PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR CS 10	10-4

TABLE OF CONTENTS
(continued)

Section			Page
	10.5	FIVE-YEAR REVIEW PROCESS FOR CS 10	10-4
		10.5.1 Document Review for CS 10	10-4
		10.5.2 Data Review for CS 10	10-5
		10.5.3 Site Inspection for CS 10	10-6
		10.5.4 Interviews for CS 10	10-6
		10.5.5 Technical Assessment for CS 10	10-6
	10.6	ISSUES FOR CS 10	10-10
11.0		CERCLA SITES WITH FUEL COMPONENTS	11-1
	11.1	ISSUES FOR CERCLA SITES WITH FUEL COMPONENTS	11-3
12.0		LAND USE CONTROLS	12-1
	12.1	PROPERTY TRANSFER STATUS AT McCLELLAN	12-2
	12.2	LAND USE CONTROLS/INSTITUTIONAL CONTROLS AT McCLELLAN	12-4
		12.2.1 LUC/IC Mechanisms	12-4
		12.2.2 LUC/IC Management Program	12-8
		12.2.3 Incidents	12-9
	12.3	PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR LUC/ICs	12-10
	12.4	FIVE-YEAR REVIEW PROCESS FOR LUC/ICs	12-11
		12.4.1 Document Review for LUC/ICs	12-11
		12.4.2 Data Review for LUC/ICs	12-12
		12.4.3 Site Inspections for LUC/ICs	12-12
		12.4.4 Interviews for LUC/ICs	12-12
		12.4.5 Technical Assessment for LUC/ICs	12-13
	12.5	APPROACH TO LUC/ICs	12-16
	12.6	LUC/ICs AS A PROTECTIVE MEASURES AT OTHER IRP SITES AND AREAS OF CONCERN WHERE REMEDIAL ACTIONS ARE STILL TO BE DETERMINED	12-17
	12.7	ISSUES FOR LUC/ICs	12-18
13.0		ECOLOGICAL EVALUATION	13-1
	13.1	DESCRIPTION AND BACKGROUND	13-2
	13.2	SEASONAL WETLANDS AND VERNAL POOLS	13-3
	13.3	CREEKS AND FLOODPLAINS	13-4
		13.3.1 Conceptual Site Model and Data Gap Assessment/Field Sampling Plan	13-4
		13.3.2 Tailings Piles	13-5
	13.4	ONGOING ECOLOGICAL RISK ASSESSMENT EFFORTS	13-6
	13.5	ONGOING INTERIM ACTIONS	13-7

TABLE OF CONTENTS
(continued)

Section			Page
	13.6	ECOLOGICAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS	13-8
	13.7	CONCLUSIONS	13-9
14.0		NO ACTION ROD SITES	14-1
	14.1	DESCRIPTION AND BACKGROUND OF NO ACTION ROD SITES	14-1
	14.2	FIVE-YEAR REVIEW PROCESS FOR NO ACTION ROD SITES	14-1
		14.2.1 Technical Assessment for No Action ROD Sites	14-2
	14.3	ISSUES FOR NO ACTION ROD SITES	14-4
15.0		RECOMMENDATIONS	15-1
	15.1	GROUNDWATER OU	15-1
	15.2	VOC VADOSE ZONE	15-2
	15.3	OU B1 CAP AND DRAINAGE DITCHES	15-2
	15.4	OU D CAP	15-3
	15.5	PRL S-033	15-3
	15.6	PRL 32	15-3
	15.7	CS 10	15-3
	15.8	CERLCA SITES WITH FUEL COMPONENTS	15-3
	15.9	LAND USE CONTROLS	15-4
	15.10	NO ACTION ROD SITES	15-4
	15.11	ECOLOGICAL SITES	15-4
16.0		PROTECTIVENESS STATEMENT	16-1
17.0		NEXT FIVE-YEAR REVIEW	17-1
		REFERENCES	R-1

APPENDICES

A – Site Inspection Documentation
B – Site Interview Documentation
C – Risk Review and Summary of Changes to Toxicity Criteria and Risk Methodologies
D – Responses to Comments

LIST OF FIGURES
(located at end of text)

Figure No.

3-1 Site Location Map
3-2 Location of Sites and Operable Units
3-3 ROD Locations

4-1 Generalized Hydrogeologic Cross-Section of McClellan AFB
4-2 Groundwater Extraction Well and Treatment System Locations
4-3 Groundwater Plume Status as of First Quarter 2003
4-4 Off-Base Public Well Locations

5-1 SVE Sites and Treatment Systems
5-2 Cumulative Contaminant Mass Removad

6-1 OU B1 Site Layout

7-1 OU D CAP Location

8-1 PRL S-033 Site Location

9-1 PRL 32 Site Location

10-1 CS 10 Site Location

12-1 Lease Relationships at Former McClellan AFB
12-2 Land Use Controls

13-1 Sensitive Habitat Locations

LIST OF TABLES
(located at end of text)

Table No.	
1-1	Five-Year Review Summary Form
2-1	Key Personnel
3-1	Site Summary
4-1	Groundwater Contaminants of Concern and Potential Concern and Relevant Action Levels
4-2	Operating Parameters for Groundwater Operable Unit Treatment Systems During First Quarter 2003
4-3	Groundwater Recommendations in 1999 Five-Year Review
4-4	Summary of Progress Towards Meeting Remedial Actions Objectives, Groundwater Operable Unit
4-5	Groundwater Plume Status as of First Quarter 2003
5-1	Vadose Zone Treatment Systems Summary
5-2	Vadose Zone Treatment Systems Operational Summary
5-3	Preliminary Cleanup Goals for Volatile Organic Compounds in Shallow Soil Gas and Equilibrium Soil Gas Concentrations Equivalent to Maximum Contaminant Levels
5-4	Vadose Zone Treatment Systems Compliance
5-5	Preliminary Soil Gas Screening RAO Assessment
6-1	Non-VOC Remedial Action Sites History and Background
6-2	Non-VOC Remedial Action Site Summary
6-3	Summary of Progress Towards Meeting Remedial Action Objectives, OU B1 Cap and Drainage Ditches
7-1	Summary of Progress Towards Meeting Remedial Action Objectives, OU D Cap
8-1	Summary of Progress Towards Meeting Remedial Action Objectives, PRL S-033
9-1	Summary of Progress Towards Meeting Remedial Action Objectives, PRL 32
10-1	Summary of Progress Towards Meeting Remedial Action Objectives, CS 10
12-1	Reuse Selection for McClellan

ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency (now AFRPA)
AFCEE	Air Force Center for Environmental Excellence
AFRPA	Air Force Real Property Agency
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AST	Aboveground Storage Tank
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BCG	Biota Concentration Guides
BCT	Base Realignment and Closure Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
BTAG	Biological Technical Assistance Group
CAAQS	California Ambient Air Quality Standards
Cal/EPA	California Environmental Protection Agency
CatOx	catalytic oxidation
CE	civil engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	carbon monoxide
COC	contaminant of concern
COPC	contaminants of potential concern
Cr(VI)	hexavalent chromium
CRC	Clearwater Revival Company
CRP	Community Relations Plan
CS	confirmed site
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CTR	California Toxics Rule
DCA	dichloroethane
DCE	dichloroethene
DERP	Defense Environmental Restoration Program
DHS	Department of Health Services
DoD	Department of Defense
DoE	Department of Energy
DRMO	Defense Reutilization and Marketing Office
DTSC	Department of Toxic Substances Control
EBS	Environmental Baseline Survey
EE/CA	Engineering Evaluation/Cost Analysis
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FOSET	Finding of Suitability for Early Transfer
FOSL	Finding of Suitability to Lease
FOST	Finding of Suitability to Transfer

ACRONYMS AND ABBREVIATIONS
(continued)

FS	feasibility study
FSP	Field Sampling Plan
FTO	Flameless Thermal Oxidation
F&WS	Fish and Wildlife Service
GAC	granular activated carbon
gpm	gallons per minute
GWMP	Groundwater Monitoring Plan
GWTP	Groundwater Treatment Plant
HAZWOPER	Hazardous Waste Operation and Emergency Response
Hcl	hydrochloric acid
HDC	Hampton Door Company
HDPE	high density polyethylene
HEPA	high efficiency particulate air
HERD	Human and Ecological Risk Division
HF	hydrofluoric acid
HI	hazard index
HQ	hazard quotient
HVOC	halogenated volatile organic compound (e.g., PCE or TCE)
IAG	interagency agreement
IC	Institutional Controls (used in discussion of land use controls)
IRIS	Integrated Risk Information System
IROD	Interim Record of Decision
IRP	Installation Restoration Program
IWTP	Industrial Wastewater Treatment Plant
JEG	Jacobs Engineering Group
LGAC	Liquid-Phase Granular Activated Carbon
LRA	Local Reuse Authority
LUC	land use control
LUC/IC	land use control/institutional control
LTO/LTM	long term operation and monitoring
L/min	liter per minute
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
McClellan	(former) McClellan Air Force Base
MCL	maximum contaminant level
MDL	method detection limit
MWH	MWH Americas, Inc.
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
NCP	National Contingency Plan
NDMA	n-Nitrosodimethylamine
NEPA	National Environmental Policy Act
NFA	no further action

ACRONYM AND ABBREVIATIONS
(continued)

NIOSH	National Institute for Occupation Safety and Health
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NREL	NIOSH Recommended Exposure Limit
NTR	National Toxics Rule
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
OWS	oil water separator
O&M	Operational and Maintenance
PAH	polycyclic aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PCE	perchloroethylene, a.k.a. tetrachloroethene
pCi/g	picoCuries per gram
PEC	Probable Effects Concentration
PM	particulate matter
PMSA	PM Strauss & Associates
POL	petroleum, oil and lubricant
ppb	parts per billion
PRG	Preliminary Remediation Goal
PRL	Potential Release Location
Pu	plutonium
P&PR	Performance and Protectiveness Review
QAPP	Quality Assurance Project Plan
RAB	Restoration Advisory Board
Radian	Radian International
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
REL	reference exposure level
RI	remedial investigation
RICS	Remedial Investigation Characterization Summary
RMI	Resource Management International
ROD	Record of Decision
RPF	Relative Potency Factors
RPM	Remedial Project Manager
RWQCB	Regional Water Quality Control Board
SA	study area
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SGA	Sacramento Groundwater Authority
SEC	Senior Executive Committee
SIP	State Implementation Plan

ACRONYMS AND ABBREVIATIONS
(continued)

SLUC	State Land Use Covenant
SNARL	Suggested No-Adverse-Response Level
SO_x	sulfur oxides
Sr	strontium
SSA	special study area
SSG	Shallow Soil Gas
SVE	soil vapor extraction
SVM	soil vapor monitoring
SVOC	semivolatile organic compounds
SWRCB	State Water Resources Control Board
TCA	trichloroethane
TCDD	tetrachlorodibenzodioxin
TCE	trichloroethene
TCP	trichloropropane
TCRA	time critical removal action
TEC	Threshold Effects Concentration
TEF	Toxicity Equivalency Factor
TLD	Thermoluminescent Dosimeters
TPH	total petroleum hydrocarbons
TPH-g	total petroleum hydrocarbons as gasoline
TVH	total volatile hydrocarbons
U	uranium
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UV/OX	ultraviolet/oxidation
VGAC	vapor-phase granular activated carbon
VOC	volatile organic compound
WIMS-ES	Waste Information Management System-Environmental Subsystem
WQL	water quality level

PROTECTIVENESS DETERMINATION

The actions taken pursuant to the Operable Unit (OU) B1 and Groundwater OU Interim Records of Decision (IRODs) to address contamination identified in OU B1 and the Groundwater OU at the former McClellan Air Force Base (AFB) (McClellan) have addressed the immediate threats to human health and the environment and are protective. The recommendations from the 1999 Five-Year Review Report for OU B1 and Groundwater OU have been implemented or superceded by the ongoing programs during the last five years. However, there are additional or continuing actions required to be fully successful in containing the contaminants or contaminant plumes and eliminating the potential to expose the public to contaminants.

Steps to be taken to address the recommendations from this second Five-Year Review and meet the goal to protect human health and the environment are:

For OU B1

1. Continue sampling and evaluating the analytical results of the sediment traps to determine if contaminants are present and if so, determine if they originate from under the OU B1 Cap, represent residual contamination from the lined section of the OU B1 Drainage Ditch, or are the result of some new source.
2. Develop decision criteria to evaluate the monitoring results and make recommendations for actions or changes to the monitoring program until the final Record of Decision (ROD) can be implemented.
3. Ensure that any Institutional Controls established in the ROD are monitored and responsibility is delegated to an appropriate party upon property transfer (carried forward and modified from the 1999 Five-Year Review Protectiveness Determination).

For Groundwater OU

1. Complete the Phase III Data Gaps investigation to adequately define all volatile organic contaminant (VOC) plumes exceeding the maximum contaminant level (MCL); and complete the design and installation of the Phase III expansion to prevent VOC MCL contamination from migrating.
2. Continue implementing groundwater monitoring programs for radiological constituents and other non-VOC and inorganic contamination to identify and better define their presence at McClellan.

3. Continue to evaluate the potential affect of non-VOC and inorganic contamination in the groundwater treatment plant (GWTP) effluent on protectiveness to human health and the environment.
4. Issue a letter to the County Health Department to request that they conduct an outreach program to identify those homeowners within the area of the off-base contamination who still have groundwater wells and are using those wells for domestic purposes.
5. Install additional extraction wells, and continue to install monitoring wells, and piezometers recommended in the groundwater monitoring program (GWMP) Quarterly Monitoring reports, and address additional areas of contamination identified during the remedial investigations (carried forward and modified from the 1999 Five-Year Review Protectiveness Determination).
6. Continue the well abandonment program as needed to destroy wells and piezometers that are no longer functional or are not needed for groundwater monitoring or extraction; these wells could become conduits for contaminant migration (carried forward from the 1999 Five-Year Review Protectiveness Determination).
7. Ensure that any Institutional Controls established in the ROD are monitored. A checklist and monitoring program should be established, and responsibility delegated to an appropriate party upon property transfer (carried forward and modified from the 1999 Five-Year Review Protectiveness Determination).
8. Implement Department of Defense (DoD) policy regarding "emergent chemicals" once DoD policy is established.
9. Evaluate and prove out the treatment options for non-VOCs in extracted groundwater.

In terms of the other interim remedial actions that are underway at McClellan and were evaluated in this second Five-Year Review Report, they have addressed the immediate threats to human health and the environment and are protective. However, there are additional actions recommended to ensure protectiveness to the public and the environment.

Steps to be taken to address the recommendations for other interim remedial actions evaluated in this Five-Year Review and meet the goal to protect human health and the environment are:

For VOC Vadose Zone

1. Continue to monitor and evaluate the stack emissions from the vadose zone treatment systems for dioxins/furans and VOCs and the radon gas concentrations in carbon vessels at points of potential exposure.
2. Incorporate site-specific shallow soil gas and soil parameters from ongoing investigations and evaluate changes in toxicity criteria for soil gas in the most recent accepted indoor air model to develop site-specific remedial action objectives (RAOs).

For Potential Release Location (PRL) 32

1. Complete the sampling and evaluation of radiological contaminants at PRL 32 in order to expedite site restoration as soon as practical.

For Confirmed Site (CS) 10

1. Use a site-specific risk based decision process to develop RAO cleanup levels to verify completion of the excavation.
2. Resume off-site disposal of contaminated soils currently stored in the tent as soon as funding becomes available.

For Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Sites with Fuel Components

1. Complete sampling to determine which sites are commingled.
2. Apply final cleanup levels for total petroleum hydrocarbon (TPH) once they have been determined.

For Land Use Controls (LUCs)

1. Develop a central repository or database to capture all incidents or breaches of land use controls/institutional controls (LUC/ICs) and develop formal tracking method for LUC/ICs.
2. Following discovery of any new contaminants of potential concern, reevaluate land parcel LUC requirements.
3. Ensure that any Institutional Controls established in the site-specific RODs are monitored and responsibility is delegated to an appropriate party upon property transfer (carried forward and modified from the 1999 Five-Year Review Protectiveness Determination).

For Ecological Sites

1. Complete ongoing ecological investigations, assessments, and/or future action plans that will determine whether ecological risks exist in sensitive habitats at McClellan, and help identify and select protective and cost-effective remedies for cleanup of sensitive habitat areas in the Ecological Sites ROD. Cleanup of sites that could pose an ongoing risk to ecological receptors (if contaminants are left in place at levels that exceed ecological thresholds) will be determined in the applicable RODs for those sites.
2. Prepare an engineering evaluation/cost analysis (EE/CA) for the creek tailings removal action, and implement the removal of contaminated tailings according to the accepted plan.

AUTHORIZING SIGNATURES:

Albert F. Lowas, Jr. 15 April 2004
Director, Air Force Real Property Agency Date
U.S. Air Force

~~Michelle Schmitz~~ Kathleen H. Johnson 5/14/04
Chief, Federal Facility and Site Cleanup Branch Date
U.S. Environmental Protection Agency, Region IX

Anthony J. Landis, P.E. 5-04-04
Chief, Northern California Operations Date
Office of Military Facilities
Department of Toxic Substances Control, California EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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75 Hawthorne Street
San Francisco, CA 94105

13 May 2004

Mr. Paul G. Brunnér
Air Force Real Property Agency
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McClellan Air Force Base, CA 95652

Subject: Final Five-Year Review Report
DSR # 870
Former McClellan Air Force Base, California

Dear Mr. Brunner:

The U.S. Environmental Protection Agency (EPA) has received the April 2004 final Five-Year Review Report for the former McClellan Air Force Base. EPA concurs with the Protectiveness Determination and transmits herewith the authorizing signature page. The report thoroughly discusses the current status of the remediation program at McClellan.

As stated in EPA's letter of 24 February 2004, EPA guidance indicates that it would be more accurate to call this Five-Year Report a statutory review, not a policy review. Since the Five-Year Review Report meets the substantive requirements for a statutory review and in other respects meets National Contingency Plan requirements for conducting a five-year review, we have agreed to disagree on this point. Additionally, it has come to our attention that the final Five-Year Review Report contains changes inserted subsequent to regulator review and response to comments. This action is inconsistent with document review procedures. In the future, please ensure that all changes made to a document undergo regulatory review before issuance of the final draft.

If you have any question for EPA regarding the Five-Year Review Report, please contact Michelle Schutz at (415) 972-3021.

Sincerely,

Kathleen H. Johnson, Chief
Federal Facility and Site Cleanup Branch

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EXECUTIVE SUMMARY

This report is the second Five-Year Review of the environmental cleanup projects at the former McClellan Air Force Base (AFB) (McClellan). The review has been prepared pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP), which require that remedial actions that result in any hazardous substances, pollutants, or contaminants remaining above levels that allow for unlimited use and unrestricted exposure are subject to a Five-Year Review. The requirement for a Five-Year Review is also specified in the two Interim Records of Decision (IRODs) for McClellan, namely, the Operable Unit (OU) B1 IROD [Radian International (Radian), 1993a] and the Basewide Groundwater OU IROD (CH2M Hill, 1995). Since the remedial actions are not complete and final RODs for McClellan have not been developed, this study was carried out as a policy review.

This Five-Year Review Report closely follows the *Comprehensive Five-Year Review Guidance* [U.S. Environmental Protection Agency (USEPA), 2001b], and it evaluates 1) the remedial actions that have taken place in terms of system effectiveness to meet the remedial objectives; 2) general changes in standards that may have occurred since the remedial action was conducted; 3) new information that may have developed; and 4) overall protectiveness of public health and the environment from the continuing remedial actions. Each technical assessment section of this Five-Year Review addresses three questions from the USEPA Guidance (USEPA, 2001b):

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

In addition, each technical assessment identifies pending actions, possible future issues and recommendations resulting from the evaluation of the above-referenced three questions.

Since there are more than 300 sites at McClellan under assessment or with interim remedial actions, this Five-Year Review has focused on evaluating the larger zones of contamination and their associated cleanup actions (or remedial treatment systems). In addition, this Five-Year Review has also considered land use controls (LUCs) and ecological sites at McClellan. The following list represents the most significant interim remedial/removal actions or environmental issues at McClellan during the last five years:

- Groundwater OU
- Volatile Organic Compound (VOC) Vadose Zone
- Operable Unit B1 Cap and Drainage Ditches
- Operable Unit D Cap
- Potential Release Location (PRL) S-033
- PRL 32
- Confirmed Site (CS) 10
- CERCLA Sites with Fuel Components
- LUCs
- Ecological Sites
- No Action ROD Sites

In terms of assessing protectiveness of the interim remedial actions, this Five-Year Review has evaluated the old standard, where appropriate, against the new toxicity criteria, methods, or thresholds compared to the acceptable cancer risk range of 10^{-6} to 10^{-4} or a non-cancer hazard index (HI) of 1.0. If the result was within these levels, then the old standard was still considered protective. If not, (i.e., the results exceeded 10^{-4} cancer risk or a non-cancer HI of 1) then adoption of the new standard should be considered and the remedy should be evaluated. This Five-Year Review has also identified those remedial actions or sites where State action levels differ from the Federal levels for the significant contaminants of concern (COCs). In addition, action levels and treatment system discharges have been evaluated against ecological thresholds, and this Five-Year Review has identified where these standards have changed or new thresholds have been developed. Where action levels or discharges are below current ecological thresholds,

or where processes are in place to evaluate these action levels or discharges against current thresholds to protect ecological receptors, the remedy was considered protective.

For the Five-Year Review, this acceptable risk range (i.e., 10^{-6} to 10^{-4}) has been used to assess the potential impact to public health or the environment from ongoing remedial activities at McClellan. As such, the use of this risk range is not intended to imply that a site-specific cleanup level has been achieved, or that the screening evaluation is establishing a risk-based cleanup level. McClellan intends that all cleanup levels will be developed according to the appropriate CERCLA decision document process and with concurrence of the State and Federal Remedial Project Managers.

Please refer to Appendix C for a summary of changes in standards, methodologies, and toxicity criteria during the last five years that were used in this evaluation and may affect the protectiveness of the remedies in place. A more thorough analysis of applicable or relevant and appropriate requirements (ARARs) will be conducted as part of the feasibility studies and RODs that have yet to be completed.

GROUNDWATER OPERABLE UNIT

Although numerous contaminants have been detected in the groundwater underlying McClellan, the four most significant contaminants defined as COCs in the IROD include: trichloroethene (TCE), tetrachloroethene (PCE), 1,2-dichloroethane (1,2-DCA also known as DCA12), and cis-1,2-dichloroethene (cis-1,2-DCE also known as DCE12C). Since the last Five-Year Review in 1999, several other organic and inorganic constituents have been detected and identified as potential contaminants of concern (e.g., 1,4-dioxane; hexavalent chromium and other metals), and several more (i.e., perchlorate and radionuclides) are being investigated to determine their existence and significance.

The selected remedy described in the Groundwater OU IROD consists of the following (CH2M Hill, 1995, p. 2):

- **Containment**: Groundwater contaminated at levels greater than maximum contaminant levels (MCLs) will be extracted at pumping rates that prevent its further migration. Containment to prevent lateral plume migration is the highest priority, followed by containment of the hot spots, and containment to prevent vertical migration.
- **Treatment**: The Groundwater Treatment Plant (GWTP) removes the VOCs from the water by air stripping followed by liquid granular activated carbon (LGAC) polishing. The air stripper offgas is treated by thermal oxidation.
- **End-Use**: The final decision on the end use will be determined in the Final ROD.

The IROD outlines a three phased approach to implement the remedy:

- **Phase I**: Completed in 1987, a total of 15 extraction wells and 39 monitoring wells were installed to implement Phase I.
- **Phase II**: Completed in 1999, an additional 21 extraction wells and 21 monitoring wells were installed to contain contaminant migration and to further define the extent of contamination.
- **Phase III**: This Phase is being implemented and the main objective is containment of the groundwater contaminated with VOC concentrations greater than MCLs. The planning and design for Phase III, including a comprehensive Phase III Data Gap investigation, is currently underway and is expected to include the installation of about 62 additional extraction wells to complete the hydraulic control of groundwater plumes that exceed MCLs.

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

The remedy is functioning as intended and is consistent with the current Phase II level of implementation. The performance measures include the degree of hydraulic control and the contaminant mass removed. Although full hydraulic containment has not been achieved, the on-going implementation of Phase III should accomplish the IROD goals.

McClellan has sought to satisfy the containment goals by hydraulically controlling the flow of contaminated groundwater, primarily through the GWTP system. While much progress has been made toward containment with the implementation of Phases I and II of the Groundwater OU program, full hydraulic containment has not been achieved for the following off-base areas: 1) the OU A northern plume in monitoring zone A; 2) the OU A southern plume in monitoring zone B (although this is still being evaluated); and 3) a small suspected off-base plume in monitoring zone B, located about 1,200 feet west of the southern tip of the base boundary. All of these plume boundaries are being defined by the Phase III Data Gaps investigation, and the Phase III groundwater expansion will address final plume capture in these areas. All other plumes at McClellan are within base boundaries, or the off-base portion of the plume is generally within hydraulic control of the Phase I and Phase II Groundwater OU treatment systems. In terms of completing the Phase III groundwater program, plumes in OUs G and H (A and B monitoring zones) have not been addressed by the current groundwater extraction system. These areas are also being defined as part of the Phase III Data Gaps investigation and will be addressed in the Phase III expansion.

Another measure of progress in the performance of the Groundwater OU treatment systems is the amount of contaminant mass that has been removed and the reduction of contaminant concentrations. TCE is the most common and widespread groundwater contaminant at McClellan and has been used as an indicator to evaluate the success of extraction systems as a whole in removing VOCs (Radian, 1999a, p. 23):

- **OU A** - From 1994 to 2002, the total mass of TCE in all zones has decreased from an estimated 15,000 pounds to 8,150 pounds; TCE concentrations greater than 10,000 micrograms per liter (µg/L) have been removed and concentrations of 1,000 µg/L have significantly decreased (URS, 2003c).
- **OU B/OU C** - From 1995 to 2001, the total mass of TCE in all areas has decreased from an estimated 11,200 pounds to 1,000 pounds; TCE concentrations greater than 1,000 µg/L have been removed from the A monitoring zone, and trends toward lower concentrations are indicated in the C and D zones (URS, 2002i).
- **OU D** - From 1990 to 2002, the total mass of TCE in all areas decreased from an estimated 2,037 pounds to 44 pounds; TCE concentrations greater than 100 µg/L

have been removed. The plume boundary in the A monitoring zone has not changed significantly (URS, 2003l).

During the last five years, the GWTP has experienced several system interruptions and two violations of the discharge requirements to Magpie Creek for exceedances of allowable hexavalent chromium concentrations. Following these violations, procedures were put into place to discharge the treated effluent to the sewer system, and a Time Critical Removal Action (TCRA) was completed to evaluate potential treatment alternatives. An additional treatment system (ion exchange) was installed on the GWTP in June 2003 to treat the hexavalent chromium to below the discharge limits.

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

Although there have been some changes in the toxicity criteria (e.g., benzene and TCE) and risk models during the last five years, the Five-Year Review evaluation indicates that the protectiveness of the RAOs in terms of groundwater cleanup levels, vapor intrusion into indoor air from groundwater, and vapor emissions are within acceptable human health risk ranges. In terms of ecological exposure to GWTP discharges to Magpie Creek, the current discharge requirements are protective of ecological receptors for the current list of analytes; however, no ecological standards currently exist for ecological exposure to low levels of 1,4-dioxane, which is currently being detected in the GWTP effluent.

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

Since the 1999 Five-Year Review, several issues have come to light that may call into question the protectiveness of the groundwater RAOs. These issues include: 1) the discovery of 1,4-dioxane; hexavalent chromium; and other metals in the current groundwater monitoring program; 2) investigations for radiological constituents and perchlorate in the groundwater; and 3) potential evaluations for other “emergent” chemicals being requested by the California Regional Water Quality Control Board (RWQCB).

- Since 1999, hexavalent chromium concentrations in the GWTP effluent have intermittently exceeded discharge limits requiring the GWTP to either shut down or implement interim discharge to the sewer. In response, McClellan installed an additional treatment system (ion exchange) in June 2003 at the GWTP to reduce the hexavalent chromium concentration in effluent to levels that allow discharge to Magpie Creek (URS, 2003f, p. ES-2). Initial prove-out sampling suggests that the system is working as intended.
- Currently, 1,4-dioxane is being analyzed in groundwater wells during the quarterly sampling events and in the GWTP effluent on a monthly basis. Detections in the GWTP effluent are averaging well below the USEPA preliminary remediation goal (PRG) for tapwater. However, the concentrations of 1,4-dioxane are at or slightly above more stringent water quality goals that are being proposed by the RWQCB. In addition, there are no established standards for ecological risk from low levels of 1,4-dioxane. Further studies or treatment options for 1,4-dioxane may be required following evaluation of data compiled during the quarterly sampling events.
- Following the discovery of radiological soil contamination, two quarters of groundwater samples were collected from locations upgradient and downgradient of 11 locations that could potentially have radiological soil contamination to confirm that potential releases of radioactive or chemical constituents from these facilities have not contaminated the groundwater. In addition to these locations, samples were collected from the GWTP influent and effluent to verify that it is free of contamination exceeding the applicable MCL or PRG. None of the samples collected had concentrations above these action levels. Since there has been anecdotal evidence that perchloric acid was used at some locations, six of 36 samples were also analyzed for perchlorate, with no detections found (URS, 2003g, p. 3-62 through 3-63).
- Recently, the California RWQCB has issued a new list of emergent chemicals consisting of hexavalent chromium; 1,4-dioxane; perchlorate; n-nitrosodimethylamine (NDMA); polybrominated diphenyl ether (PBDE); and 1,2,3-trichloropropane (TCP). All military bases are being requested to evaluate their sites for these compounds and submit a report. The Department of Defense (DoD) is currently evaluating the request and developing a position. MCLs have not yet been established for these compounds. Investigations for hexavalent chromium and 1,4-dioxane at McClellan are ongoing.

The primary recommendations resulting from this Five-Year Review for the interim groundwater remedial actions include:

1. Complete the Phase III Data Gaps investigation to adequately define all VOC MCL plumes and complete the design and installation of the Phase III expansion to prevent VOC MCL contamination from migrating.
2. Continue implementing groundwater monitoring programs for radiological constituents, 1,4-dioxane, and hexavalent chromium to identify and better define non-VOC and inorganic contamination at McClellan.
3. Continue to evaluate the potential effect of non-VOC (including 1,4-dioxane) and inorganic contamination in the GWTP effluent on protectiveness to human health and the environment.
4. Issue a letter to the County Health Department to request that they conduct an outreach program to identify those homeowners within the area of off-base contamination who still have groundwater wells and are using those wells for domestic purposes.
5. Install additional extraction wells, and continue to install monitoring wells, and piezometers recommended in the Groundwater Monitoring Plan (GWMP) Quarterly Monitoring reports, and address additional areas of contamination identified during the remedial investigations (RIs) (recommendation carried forward and modified from the 1999 Five-Year Review Protectiveness Determination).
6. Continue the well abandonment program as needed to destroy wells and piezometers that are no longer functional or are not needed for groundwater monitoring or extraction; these wells could become conduits for contaminant migration (recommendation carried forward from the 1999 Five-Year Review Protectiveness Determination).
7. Ensure that any Institutional Controls (ICs) established in the ROD are monitored. A checklist and monitoring program should be established, and responsibility delegated to an appropriate party upon property transfer (recommendation carried forward and modified from the 1999 Five-Year Review Protectiveness Determination).
8. Implement DoD policy regarding "emergent chemicals" once DoD policy is established.
9. Evaluate and prove out the treatment options for hexavalent chromium and 1,4-dioxane.

VOC VADOSE ZONE

In 1993, the Air Force and regulatory agencies approved soil vapor extraction (SVE) as the presumptive remedy for VOC cleanup in the vadose zone at McClellan. The interim removal actions were considered to be part of a basewide process to achieve early risk reduction and prevent future VOC migration to groundwater by removing significant quantities of VOCs in the vadose zone. In March 1993, SVE operations began at McClellan with a pilot system/treatability study at OU D. Currently, the SVE program at McClellan is composed of 13 treatment systems treating 23 removal action areas which affect an estimated 91 Installation Restoration Program (IRP) Sites. The systems (URS, 2003r, p. ES-1) include:

- Three Catalytic Oxidation (CatOx) systems
- Three Flameless Thermal Oxidation (FTO) systems
- Seven Vapor-Phase Granular Activated Carbon (VGAC) systems

All of the original 23 removal action sites have had halogenated VOC contamination present. Six of the sites have very little residual contamination left and have had a formal closure evaluation (i.e. STOP evaluation) initiated.

The specific RAOs for soil at McClellan are (CH2M Hill, 1999, p. ES-7):

- Protect human health from exposure through ingestion, inhalation, and direct contact with soil that presents an unacceptable risk.
- Remove or isolate vadose zone contaminants in source areas to reduce cost and time of groundwater cleanup.
- Remove contaminants from the vadose zone to the extent technically and economically feasible to protect groundwater.

Question A: Is the remedy functioning as intended?

The current remedy is removing VOCs that could potentially migrate to groundwater and is functioning as intended by the engineering evaluation and cost analysis (EE/CA) (McClellan, 1993). As of the Second Quarter 2003, 11 of the 13 SVE systems were operating, and during the Second Quarter 2003, approximately 1,478 pounds of speciated VOCs were removed from the vadose zone. Cumulatively, the SVE program has removed over one million pounds of total volatile hydrocarbon (TVH) mass since 1995 (URS, 2003r).

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

During the last five years, there have been changes in 1) the methodology recommended for assessment of soil gas vapor migration to indoor air, 2) default input parameters to the model,

and 3) toxicity values for a number of VOC constituents assessed. Since the development of the preliminary RAOs for soil gas, changes have occurred in modeling parameters, including changes in guidelines and criteria, which indicate that the generic proposed residential and industrial RAOs for six shallow soil gas VOCs no longer explicitly meet the protectiveness goal of HI less than 1.0. These chemicals include acetone, chlorobenzene, chloroform, toluene, 1,2-cis-DCE, and 1,2-DCA. However, all carcinogenic VOCs have chemical-specific risk estimates that are within the acceptable risk range of 10^{-6} to 10^{-4} utilizing current California Environmental Protection Agency (Cal/EPA) or current USEPA toxicity criteria (excluding the draft TCE revision). It should be pointed out that the original model was based on very conservative assumptions that could be revised using site-specific parameters. According to Mitretek (Mr. B. Walser, 2003 interview, Appendix B), final site-specific RAOs for shallow soil gas (0-15 feet bgs) will be based on protection of residential indoor air utilizing the latest site-specific modeling and risk assessment. Given the uncertainties and the generic nature of the preliminary RAO calculations, and the sensitivity of the model to site-specific information, final site-specific RAO development is warranted.

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

The most significant issue that has developed with the SVE systems since implementation includes the accumulation of radon gas in the VGAC systems. During the Fourth Quarter 2002 and the First Quarter 2003, radiation barrier walls were constructed of cement-filled blocks around the carbon vessels at the SVE systems to provide shielding from excess radiation. In addition, the vessels are allowed to stand idle for approximately two weeks before used carbon is replaced to allow for natural radioactive decay to occur prior to carbon change-out, thus reducing or eliminating exposure to workers.

The primary recommendations resulting from this second Five-Year Review for the interim vadose zone removal actions include:

1. Continue to monitor and evaluate the stack emissions from the vadose zone treatment systems for dioxins/furans and VOCs, as well as the radon gas concentrations in carbon vessels at the points of potential exposure.
2. Incorporate site-specific shallow soil gas and soil parameters from ongoing investigations, as well as revised toxicity criteria for soil gas, into the most recent accepted indoor air model to develop site-specific RAOs.

OU B1 CAP AND DRAINAGE DITCHES

OU B1 is approximately 18 acres in size and consists of 1) an open storage lot formerly operated by the Defense Reutilization and Marketing Office (DRMO), 2) a former transformer storage, loading, and unloading area, and 3) the Civil Engineering (CE) Storage Yard. OU B1 also includes the adjacent drainage ditches that received runoff from the DRMO storage yard. Past activities at OU B1 have resulted in soil contamination from primarily polychlorinated biphenyls (PCBs), and secondarily dioxins and metals. In 1993, an IROD was signed by the USEPA that addressed an area of known PCB contamination in surface soils and the drainage ditches in OU B1 (Radian, 1993a). In 1994, contaminated soils were consolidated and a temporary eight-acre asphalt cap was installed to prevent exposure or migration of the contamination until a final remedy could be selected. Additionally, two sediment traps were installed in the drainage ditches as an additional measure to prevent contaminated sediment from migrating off-site via stormwater runoff.

During the previous Five-Year Review (1999), it was determined that the confirmation sampling of soils in the drainage ditches was not properly documented and there was some question as to whether PCB contamination remained in the drainage ditches connected to OU B1. Additional sampling was conducted and the Air Force removed contaminated soil and sediment from the unlined drainage ditches in 2002 and 2003. Since then, quarterly inspections and maintenance are conducted at the lined portions of the ditches, and accumulated sediments are periodically removed from the sediment traps. Additionally, a third sediment trap was installed in November 2003 to allow future monitoring of sediment runoff from the southeast portion of the OU B1 Cap and to protect the downstream section of the unlined ditch from receiving contaminated sediment.

Question A: Is the remedy functioning as intended?

The cap constructed in 1994 has reduced the human health risk posed by the PCBs in the soil and has reduced or eliminated the potential for exposure by site workers and visitors. Based on the site interviews, inspections, and review of the maintenance logs, the operation and maintenance of the cap has been effective. The most common problems found during the quarterly inspections are small cracks, softening of the asphalt from fuel or oil spills by the tenant, settlement, and gouges by equipment. Site interviews indicate that the prompt repairs of the cap are ensuring that the cap is operating properly and is protective.

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

When the OU B1 Cap was installed in 1994, a risk-based approach was not utilized to develop cleanup levels for the cap. Soils, to a depth of three feet and containing PCBs at a concentration exceeding 10 milligrams per kilogram (mg/kg), were consolidated and placed under a cap as an interim remedial measure, therefore mitigating potential exposures. The site is currently occupied and access is controlled. Exposures to soils containing PCBs at a concentration of less than 10 mg/kg - in an industrial setting utilizing USEPA or Cal/EPA toxicity criteria - result in an estimated cancer risk that falls within the acceptable risk range of 10^{-6} to 10^{-4}.

The cleanup levels used for the drainage ditch soil removal, are below concentrations that would result in a 10^{-6} cancer risk for residential receptors utilizing either USEPA or Cal/EPA current toxicity criteria. No changes to toxicity criteria or exposure assessment protocols have occurred that would change this conclusion. Therefore, the interim remedy for the unlined drainage ditches remains protective of human health.

Removal of soils under the lined sections of the OU B1 Drainage Ditches was not conducted because sampling determined minimal contamination is present and the lining is in good condition and currently eliminates exposures by providing a physical barrier between impacted sediments and potential receptors. Accumulated sediment and debris were removed from the top

of the gunite lining, and necessary restrictions have been implemented to maintain the gunite lining. As long as the lining is maintained, the interim action remains protective of human health. The final RAOs should address risks to receptors associated with any potential future land use.

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

One elevated concentration of PCBs was detected in March 2003 at the sediment trap located between the western-most section of the lined ditch and the unlined section south of Magpie Creek. The source of this detection is believed to be residual sediment and silt that could not be completely removed from the top of the gunite lining in the upstream section of drainage ditch. Additional monitoring will be conducted to ensure that there is no ongoing source of PCB contamination.

The primary recommendations resulting from this Five-Year Review for the interim remedial actions at OU B1 Cap and Drainage Ditches include:

1. Continue sampling and evaluating the analytical results of the sediment traps to determine if contaminants are present and if so, determine if they originate from under the OU B1 Cap, represent residual contamination from the lined sections of the drainage ditches, or are the result of some new source.
2. Develop decision criteria to evaluate the monitoring results and make recommendations, as appropriate, for action or changes to the monitoring program until the final ROD can be implemented.
3. Ensure that any ICs established in the ROD are monitored and responsibility is delegated to an appropriate party upon property transfer (recommendation carried forward and modified from the 1999 Five-Year Review Protectiveness Determination).

OU D CAP

The OU D cap covers nine sites that were used primarily for the disposal of sludge from the McClellan industrial waste treatment plant (IWTP). Because the IWTP treated wastewaters coming from a variety of industrial processes, some of which involved radioactive materials

(such as radium paint), some of the waste sludges may have also contained radioactive materials. The waste pits are unlined and have no collection sumps. An engineered cap was placed over these disposal pits in 1985, and an SVE system and groundwater extraction system have also been installed on the property. The cap at OU D was installed as a temporary measure to prevent infiltration from precipitation and control off-gas emissions. The final remedy will be developed as part of the Strategic Sites Feasibility Study and ROD which will determine whether the cap represents the final solution for this site. The cap is surrounded by a chain link fence and is closed to public access.

Question A: Is the remedy functioning as intended?

The cap has reduced the human health risk posed by the contaminants in the soil and has reduced or eliminated the potential for exposure to site workers and visitors. Operation and maintenance (O&M) of the cap has been effective. The most common problems found during the quarterly inspections are vegetation buildup in the drainage ditches, minor cracks in the surface soil on the cap, and well monument damage. According to the site interviews and maintenance records, prompt repairs of the cap ensure that the cap is operating properly and is protective.

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

The only potentially complete exposure pathway to COCs at the site consists of vapor emissions from soil and groundwater into ambient air. An evaluation (included in the Vadose Zone discussion) concluded that carcinogenic chemicals are within the acceptable risk range of 10^{-6} to 10^{-4}. The engineered cap with the liner, combined with the SVE and groundwater extraction systems, effectively minimize or eliminate the potential for significant vapor emissions from the property to ambient air. Since the site is not currently occupied and access is strictly controlled, the cap is considered to be protective of human health.

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

There is no new information that has come to light that would call into question the protectiveness of the remedy.

The OU D Cap is considered environmentally protective as long as 1) significant habitat or biota of concern cannot contact consolidated soils, 2) the engineered cap over the consolidation area is maintained, 3) man-made structures, pavement, and bare soil continue to dominate the area, and 4) land use continues to be restricted, and appropriate restrictions are in place to prevent exposure.

There are no recommendations resulting from this Five-Year Review for the interim remedial actions at OU D Cap.

POTENTIAL RELEASE LOCATION S-033

PRL S-033, a 2.5-acre site in the northwest portion of OU B, consists of one bay which is part of a large warehouse building (Building 786A), and the property immediately adjacent. Since its opening, Building 786A has been utilized for a variety of warehousing functions. From 1955 to 1980 the building was used as a chemical and chemical waste storage facility. The facility was a collection point for chemical wastes and was used for receiving and distributing chemicals. Based on the earlier Preliminary Assessment/Site Investigation and the Remedial Investigation, polycyclic aromatic hydrocarbons (PAHs) to a depth of about two feet bgs are considered the only COCs at the site.

In 2001, approximately 608 cubic yards of contaminated soil with PAH levels above the benzo(a)pyrene equivalent concentration of 0.062 mg/kg were excavated and removed from PRL S-033. Confirmation sampling was conducted and verified that all soils with PAH levels above the 1999 residential PRG had been removed. A final human health risk assessment was performed which verified that the cumulative residual cancer risk is less than 1×10^{-6} and that the non-cancer HI is less than 1. Therefore, the site has been cleared for unrestricted land use.

The minor changes that have occurred in the PAH toxicity criteria will not significantly affect this conclusion. An ecological assessment was not conducted for PRL S-033 because it was determined that the site contained minimal habitat. Review of available, updated information indicates that this finding is still valid.

Question A: Is the remedy functioning as intended?

A review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the remedy is functioning as intended by the EE/CA (CH2M Hill, 2000a). The PAH-contaminated soils were removed from the site and the site was cleared for unrestricted use.

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

The exposure assessment is considered current for future potential receptors including on-site commercial workers and hypothetical future residents. No significant changes have occurred that affect the protectiveness of the remedy at PRL S-033. A post remediation risk assessment demonstrated that residual risks were less than 10^{-6} and residual hazards were less than 1.0. The minor changes that have occurred in the PAH toxicity criteria do not significantly affect this conclusion.

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

No new information has come to light that could call into question the protectiveness of the remedy.

There are no recommendations for PRL S-033.

POTENTIAL RELEASE LOCATION 32

PRL 32 is located in OU C and is a former hazardous waste and low-level radioactive waste storage area used between 1956 and 1978. Wastewater used in decontaminating aircraft was stored at the site for testing and was eventually discharged at an unknown location.

Based on the results of two previous RIs, radium 226 was the only identified COC at PRL 32, with contamination extending from the surface soil to a depth of approximately five feet bgs. Radium 226 concentrations are defined laterally but not vertically, though data show decreasing radium 226 concentrations with depth. RI results indicate that the contamination was the result of a surface release. The chosen removal action for PRL 32 was an interim action consisting of an excavation and off-site disposal.

Question A: Is the remedy functioning as intended?

The remedy at PRL 32 is functioning as intended. The interim cleanup level for radium 226 in soil is 2.0 picoCuries per gram (pCi/g). As of spring 2002, the soil excavation had been completed, and preliminary sampling of the excavation area confirmed that soils contaminated with radium 226 above the cleanup goal were removed. However, following the discovery of plutonium at CS 10, the soil waste bins at PRL 32 were sampled and a small amount of plutonium (<1 pCi/g, Personal Communication with Mr. D. Green, Appendix B) was discovered in some of the bins. Currently a sampling plan is being prepared to sample the open excavation at PRL 32 for plutonium, and plutonium has been added to the list of COCs at PRL 32.

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

An exposure assessment was conducted during the 2002 RI, which considered exposure of current and future potential receptors, including on-site commercial workers and hypothetical future residents, to radium 226 (URS, 2002g). Although there have been recent changes in USEPA radionuclide PRGs with associated changes in the toxicity criteria and exposure assumptions, the changes should have no effect on the overall protectiveness of the interim

remedy for radionuclides given the current land use as well as the future potential industrial land use. For potential residential land uses, the cleanup level for radium 226 of 2 pCi/g results in a cancer risk of 2×10^{-4}. Current levels of plutonium detected at PRL 32 are less than 1.0 pCi/g for plutonium 238 or plutonium 239, which if representative, should not pose an unacceptable cancer risk under current industrial or future potential residential scenarios.

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

No new information has come to light that might call into question the protectiveness of the remedy. McClellan is currently preparing a detailed Screening-level/Tier 1 ecological risk assessment (ERA) to document the results of the basewide vernal pool scoping assessment and to identify potential ecological risks associated with contaminant concentrations at IRP sites with surface water pathways to sensitive habitats, including PRL 32. If a potential impact is identified, a Tier 2 ecological risk assessment will be conducted using site-specific soil samples.

The recommendations for PRL 32 include:

1. Complete the sampling and evaluation of radiological contaminants at PRL 32 in order to expedite site restoration as soon as practical.

TIME CRITICAL REMOVAL ACTION AT CS 10

CS 10 is one of five inactive disposal pits located in the northern portion of OU C. It was used from approximately 1949 to the mid-1960s for the disposal of industrial waste and burn residues from waste incinerated at McClellan. Based on earlier RIs, a non-time critical removal action (non-TCRA) was initiated, which removed 480 cubic yards of soil and excavated 109 55-gallon drums containing laboratory items, laboratory equipment, and radium commodities. The removal action was halted on 6 September 2000, when a 20-gallon drum was discovered containing bottles and vials marked with the chemical symbol for plutonium (Pu). Following this discovery, the Air Force, USEPA, and the State of California concurred that the entire CS 10

site be removed, and the removal action was changed to time critical (TCRA), which began in December 2000.

For the TCRA, a weatherization tent covering the entire CS 10 site was constructed to allow for year-round operations in a dry environment sheltered from the wind and rain. A chain link perimeter fence topped with barbed wire restricts access to the site. All access gates are locked and only site personnel with badges are allowed to enter the site unescorted. Given the radiological material at the site, security at the site during off-hours, 7 days a week, is provided by the Sacramento County Sheriff's Department.

The status of the removal action at CS 10 through 31 July 2003 is: 1) 501 drums were excavated and were generally found to be in poor condition; 2) radiological air samples inside and outside the containment area were all within regulatory compliance levels; 3) 28,575 cubic yards of soil have been excavated and sent to off-site disposal; 4) 22,953 cubic yards have been stockpiled inside the tent; and 5) several practice bombs and one practice land mine were found in the excavation, but no explosive material was found.

Because of funding shortfalls, the Air Force revised the TCRA to include excavation and stockpiling of the soil and debris rather than transport and disposal. The stockpiling began in November 2002. Disposal of removed drums will continue; however, the soil will be stockpiled inside the tent until funding becomes available.

Question A: Is the remedy functioning as intended?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the remedy is functioning as intended by the TCRA Work Plan (URS, 2001d). The current remedy includes the excavation of disposal pit debris until the site is visually clean. Interim cleanup levels were established in the Work Plan and will be updated in the Final Status Survey Field Sampling Plan to be developed at a later date. Final cleanup goals will be established in the ROD. The ongoing excavation beneath the weatherized tent with the security

measures, drainage control, and ongoing air monitoring are functioning as intended in the TCRA Work Plan and addenda.

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

The current interim removal action is based on excavation of radionuclide, non-VOC, and inorganic contaminated soils to concentrations that will be determined in the Final Status Survey Field Sampling Plan and the final ROD. Until the final cleanup levels are determined, interim removal activities should be protective of the current potential on and off-site receptors because controls measures are currently in place at the site. These control measures include the ongoing excavation beneath the weatherization tent, the drainage system around the site, security measures including site security, chain-link fencing, and access gates, as well as the air monitoring. McClellan intends to develop final RAOs for soil based on site-specific risk assessments including the most recent risk assessment methods, models, and toxicity criteria.

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

No new information has come to light that might question the protectiveness of the remedy. An ecological evaluation was not conducted for CS 10 because the 1994 Basewide ERA Scoping Report determined that the site contained only marginal habitat. No new sensitive habitats have been identified in the vicinity of CS 10 since completion of the scoping report. A tributary drainage to Don Julio Creek is located on the south and west sides of the site. However, the contaminants at CS 10 are subsurface and do not have a surface pathway to the adjacent drainage. The current interim measures (i.e., weatherization tent, drainage control, security, waste storage, compliance monitoring, and LUCs) are reasonable and effective for the protection of sensitive habitats and biotic receptors of concern pending completion of the TCRA.

The recommendations for CS 10 include:

1. Use site-specific risk-based decision processes to develop RAO cleanup levels to verify completion of the excavation.
2. Resume off-site disposal of contaminated soils currently stored in the tent as soon as funding becomes available.

CERCLA SITES WITH FUEL COMPONENTS

The fuels program at McClellan has evolved from tank closures to encompassing fuel-contaminated sites basewide. The current list of petroleum, oil and lubricant (POL) sites includes sites where fuel contamination is commingled with other CERCLA contaminants. In the future, the fuels program will only address those sites contaminated with fuels and fuel-related constituents, including fuels-only sites within an IRP boundary. Sites where fuel contamination is commingled with other contaminants will be addressed as CERCLA sites under the restoration program. All sites in the fuels program are currently undergoing a screening process to determine if the sites are commingled so that the appropriate closeout program can be applied. In some cases, additional data are necessary to make this determination.

The Air Force has already conducted some sampling as part of the initial shallow soil gas sampling effort to determine whether sites are commingled. The Air Force is currently preparing a Remedial Investigation Characterization Summary (RICS) Addendum to formalize the data. If additional data are necessary to determine whether a site is commingled, that data will be collected as part of the preparation of the individual parcel RODs. The Air Force will prepare a Field Sampling Plan (FSP) that will propose sampling locations and analytical methods to characterize the site adequately. Based on the data from the sampling effort, the sites can be categorized and closed out appropriately under either the Fuels Program or the CERCLA Program.

Question A: Is the remedy functioning as intended?

The determination of which sites will be associated with CERCLA remedial actions is still being addressed through the sampling efforts that are associated with the individual parcel RODs. Therefore, no remedy has been designated for these sites.

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

Final action levels for the TPH at commingled sites are still being developed. Recently, DTSC has requested the RWQCB ensure cleanup levels for TPH and other petroleum constituents at fuel sites be protective of human health and not just water quality. Up to this point, the RWQCB has cleared TPH-contaminated sites based on threat to groundwater and surface water. The final action levels will consider surface risk, including exposure to indoor air.

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

There are outstanding issues such as the uncertainty over which sites are commingled; the development of final action levels for TPH at commingled sites, and the verification that all TPH sites have been adequately identified and/or characterized. Future sampling associated with the preparation of the individual parcel RODs will provide the necessary additional information to determine whether sites will be remediated under CERCLA and identify site-specific RAOs. The RWQCB is working with DTSC to develop final cleanup levels for TPH and verify that all fuel-related sites have been adequately defined and characterized. A complete evaluation of fuel sites is recommended for the next Five-Year Review (2009).

The recommendations for CERCLA Sites with Fuel Components include:

1. Complete sampling to determine which sites are commingled.
2. Apply final cleanup levels for TPH once they have been determined.

LAND USE CONTROLS

Currently, the implementation of LUC/ICs at McClellan is not governed by any decision document. The RODs are still being prepared and the two IRODs for McClellan, the Groundwater OU and the OU B1 Cap, do not contain specific requirements for LUC/ICs. At present, there are four general LUC/IC mechanisms being used at McClellan to ensure that protection of human health and the environment is maintained, namely: 1) administrative, 2) legal, 3) physical (primarily site controls), and 4) other mechanisms. Most of these LUC/IC mechanisms and any of their supporting actions are currently used at McClellan; others are planned for future implementation as part of the Air Force Real Property Agency (AFRPA) LUC/IC Management Program, which is in development and was completed in draft form at the end of 2003.

Question A: Is the remedy functioning as intended?

For the most part, McClellan has adopted a practical interim approach, which has addressed the most immediate LUC/IC needs. This interim approach includes implementation of a relatively thorough set of site controls to 1) prevent unauthorized access by the public to contaminated sites and environmentally sensitive areas; 2) prevent accidental encroachment or vandalism to existing remedial systems; 3) ensure maintenance and monitoring of key remedial activities and systems; 4) ensure procedures and plans for managing contaminated soils; and 5) ensure health and safety plans for every phase of the cleanup activities. With regards to site controls, the interim LUC/IC program at McClellan is functioning as intended and is generally protective of public health and the environment.

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

The response to Question B can not be determined at this time because final RODs have not been completed and the two interim RODs did not include LUC/ICs or criteria for determining when and where to apply LUC/ICs. Final RODs at McClellan are expected to address these concerns.

During the interim, lease restrictions apply everywhere and appear to be sufficiently conservative until RODs specify unrestricted use standards for individual LUC/ICs.

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

There is no new information that has come to light that would call into question the protectiveness of the remedy. New environmental information is being developed constantly from the ongoing investigations and remedial actions being carried out at McClellan. As a result, new contaminants of potential concern (COPCs) are being identified that may affect the number of sites that will have residual contamination above levels that allow unrestricted use, and therefore may require LUC/ICs. This may require the periodic reevaluation of LUC/ICs for sites that have been transferred as well as those that remain to be remediated and closed.
The recommendations for LUC/ICs include:

1. Develop a central repository or database to capture all incidents or breaches of LUCs and develop a formal tracking method for LUC/ICs.
2. Reevaluate the parcels following discovery and confirmation of any new COPCs.
3. Ensure that any ICs established in the site-specific RODs are monitored and responsibility is delegated to an appropriate party upon property transfer (carried forward and modified from the 1999 Five-Year Review Protectiveness Determination).

ECOLOGICAL EVALUATION

As noted earlier, in addition to specific interim remedial actions or specific sites, this second Five-Year Review has also evaluated the ecological program that is focused on sensitive habitats and resources. During the last several years, a number of important studies have been conducted or initiated to define the ecological issues at McClellan, including:

- Basewide Vernal Pool Screening level/Tier 1 ERA;
- West Nature Area Tier 2 ERA;
- Basewide Creeks Data Gap Assessment and Field Sampling Plan (FSP); and
- Creek Tailings Investigation (part of a future Removal Action).

McClellan has developed and is currently implementing a basewide approach to investigating ecological exposures and assessing potential impacts to sensitive habitats and biotic receptors of concern. Risk assessments are planned for assessing potential impacts to sensitive habitats and receptors in the vernal pools, creeks and floodplains. The results of these risk assessments will be considered when evaluating remedial alternatives in the Ecological Sites Feasibility Study (FS) and, if necessary, will provide the basis for the development of risk-based cleanup goals that are protective of biota of concern.

Question A: Is the remedy functioning as intended?

There is no remedy in place at the ecological sites, with the exception of the removal of contaminated soil from the unlined sections of the OU B1 Drainage Ditches, which is discussed in Section 6.

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

There is no remedy in place at the ecological sites, with the exception of the removal of contaminated soil from the unlined sections of the OU B1 Drainage Ditches, which is discussed in Section 6.

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

Based on available information, sites that may pose an ecological risk at McClellan have on-going investigations, assessments, and/or future actions/plans. It is anticipated that results from these studies will provide information needed to determine whether ecological risks exist and select the appropriate remedies.

The recommendations for ecological sites include:

1. Complete ongoing ecological investigations, assessments, and/or future action plans that will determine whether ecological risks exist in sensitive habitats at McClellan, and help identify and select protective and cost-effective remedies for cleanup of sensitive habitat areas in the Ecological Sites ROD. Cleanup of sites that could pose an ongoing risk to ecological receptors (if contaminants are left in place at levels that exceed ecological thresholds) will be determined in the applicable RODs for those sites.
2. Prepare an EE/CA for the creek tailings removal action, and implement the removal of contaminated tailings according to the accepted plan.

NO ACTION ROD SITES

Following further investigation, some soil sites have been listed as no further action and do not require further risk analysis or data collection to complete site closeout. Six sites are specifically included in the No Action ROD (AFRPA, 2003d). This Five-Year Review evaluation included the six sites in the No Action ROD.

A quantitative risk-based approach was not utilized to recommend no action at these six sites; however, based on historical uses and previous data, no evidence of contamination was found or activities at the site were reported to comply with applicable regulations.

Question A: Is the remedy functioning as intended?

There is no remedy in place at these sites and therefore this question does not apply.

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

There is no remedy in place at these sites and therefore this question does not apply.

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

No new information has come to light that would call into question the protectiveness of the No Action ROD Sites. In terms of potential ecological issues, the basewide vernal pool scoping assessment, conducted in 2002, did not identify any of the No Action ROD sites as having potential to impact sensitive habitat areas.

There are no recommendations for the No Action ROD Sites.

1.0 INTRODUCTION

1.1 STATEMENT OF AUTHORITY AND PURPOSE

The Air Force Real Property Agency (AFRPA) at McClellan has initiated a Five-Year Review at the former McClellan Air Force Base (AFB) (McClellan), Sacramento, California. The review was conducted under the Air Force Center for Environmental Excellence (AFCEE) Contract No. F41624-00-D-8022, Task Order 77 and represents the second Five-Year Review for McClellan (Radian International [Radian], 1999a).

The overall purpose of this Five-Year Review is to determine if selected remedies are functioning as intended and are protective of human health and the environment. Methods, findings, and conclusions are documented in this Five-Year Review Report, which also identifies remaining issues and makes recommendations to attain or maintain protectiveness.

The Air Force is preparing this Five-Year Review 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 agency interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the

lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

1.2 REQUIREMENTS AND GUIDANCE FOR FIVE-YEAR REVIEWS

The *Comprehensive Five-Year Review Guidance* (United States Environmental Protection Agency [USEPA], 2001b) was the primary document used in preparing the second Five-Year Review Report for McClellan. This guidance provides an overview of the review process and describes the roles and responsibilities of the lead and support agencies, components of the Five-Year Review, and procedures for assessing the protectiveness of the remedies. In addition, other relevant guidance that was considered during the Five-Year Review includes the NCP in 40 CFR §300.430(f)(4)(ii) as well as the Office of Solid Waste and Emergency Response (OSWER) Directive No. 9355.4-28, *Guidance for Monitoring at Hazardous Waste Sites*.

The requirement for a Five-Year Review is specified in the two existing Interim Records of Decision (IRODs) for McClellan: 1) Operable Unit (OU) B1 IROD (Radian, 1993a), and 2) Basewide Groundwater OU IROD (CH2M Hill, 1995). These documents require a review to be conducted at these sites five years after initiation of the remedial action, and every five years thereafter, to ensure that the remedy continues to provide adequate protection of human health and the environment.

Under the 2001 USEPA guidance, Five-Year Reviews are typically conducted either to meet the statutory mandate required by CERCLA §121(c) or as a matter of USEPA policy. Therefore, Five-Year Reviews are classified as either "statutory" or "policy". A statutory review requires that both of the following conditions are true: 1) upon completion of the remedial action, hazardous substances, pollutants, or contaminants will remain above levels that allow for unlimited use and unrestricted exposure; and 2) the Record of Decision (ROD) was signed on or after the effective date of the Superfund Amendments and Reauthorization Act (SARA) (October 17, 1986) and the remedial action was selected under CERCLA §121. Since the remedial actions are not complete and final RODs for McClellan have not been developed, this study was carried out as a policy review. As a result, an analysis for applicable or relevant and appropriate requirements (ARARs) was not conducted as part of this Five-Year Review.

The Five-Year Review Summary Form has been completed for the ongoing environmental cleanup at McClellan and is included in Table 1-1, located at the end of the text, in the Table section.

1.3 SCOPE AND NATURE OF 1999 FIVE-YEAR REVIEW

The first Five-Year Review for McClellan was finalized in 1999. The signature date by USEPA in April 1999 serves as the trigger date for the current Five-Year Review which is scheduled for completion and signature by April 2004. The first Five-Year Review was conducted by McClellan under Executive Order 12580, which delegated the review responsibility to federal facilities at which the sole source of the release is under the control of the facility.

The 1999 Five-Year Review consisted of a Type 1a statutory review. It included the evaluation of the status and performance of interim remedial actions taken prior to 1999 and made the determination if those actions met or demonstrated progress toward the specific goals of the IRODs. The two interim remedial actions that were evaluated included the OU B1 Cap and the Groundwater OU interim remedial action. The review was triggered by the start of construction for the cap at OU B1 on April 11, 1994.

Following issuance of the first Five-Year Review Report, the Restoration Advisory Board (RAB) at McClellan contracted PM Strauss & Associates (PMSA) to review the document. The contractor concluded that the Five-Year Review Report presented a good snapshot of the cleanup status and provided adequate detail on how the remedial strategy evolved (PMSA, 1999, p. 2); however, a number of recommendations were made. Site-specific recommendations from this third-party evaluation are included in the individual sections of this Five-Year Review, where appropriate.

In addition, the RAB contracted Clearwater Revival Company (CRC) to review the *First and Second Quarter 1999 Groundwater Monitoring Reports* (CRC, 1999a). In general, CRC agreed with the report's conclusions and recommendations with some exceptions which are further detailed in Section 4. CRC also reviewed the *Groundwater Monitoring Plan* (Radian, 1997b) and concluded that the plan meets the requirements of a program document; however, CRC disagreed with one aspect of the plan (CRC, 1999b). Further details are provided in Section 4.

1.4 SCOPE AND NATURE OF CURRENT FIVE-YEAR REVIEW

The 1999 Five-Year Review assumed that all remedial investigations and decision documents would have been completed by the time the second Five-Year Review was issued and would provide the basis for a comprehensive evaluation of all remedial actions in terms of the criteria established in the Basewide, volatile organic compound (VOC), and Non-VOC RODs. Since then, those schedules have been revised and a comprehensive evaluation will have to be covered in the subsequent Five-Year Review.

This Five-Year Review has evaluated the status and performance of interim remedial actions taken to date, and has determined if those actions meet or demonstrate progress consistent with the specific goals and objectives stated in the IRODs and other decision documents. Additionally, the recommendations made in the first Five-Year Review to ensure effectiveness and protectiveness of the OU B1 and Groundwater OU interim actions have been evaluated during this Five-Year Review. This Five-Year Review provides a snapshot in time and has incorporated all data and information that was available by the submittal date of the draft version of this report (18 August 2003); any information that has become available after this date has not and will not be incorporated in future revisions of this document.

This Five-Year Review follows the intent of the USEPA guidance document, as specified in the *Final McClellan Five-Year Review Work Plan* [MWH Americas, Inc. (MWH), 2003c]. The focus of this Five-Year Review is on evaluating the larger zones of contamination and their associated cleanup actions (or remedial treatment systems) rather than focusing on environmental characteristics and evaluations of the 318 individual sites at McClellan.

Many of the early remedial actions at McClellan were presumptive remedies that were implemented under a wide range of decision documents and remedial action objectives (RAOs). As a result, it was not effective or practical to completely analyze ARARs for 318 sites as part of this Five-Year Review. The approach has been to review the changes in standards, methods, exposure, and toxicity criteria over the last five years for the primary list of contaminants of concern (COCs) occurring at McClellan and identify those sites and remedial actions where performance and protectiveness might be affected in terms of human health and the environment. Where required, preliminary risk screening assessments have been performed for those sites where exposures, toxicity criteria, cleanup levels, or standards have changed to determine if more detailed studies should be recommended. This process is consistent with the approaches outlined in the Comprehensive Five-Year Review Guidance (USEPA, 2001b) and the Final Five-Year Review Work Plan (MWH, 2003c).

For each of the interim remedial actions implemented to date, this Five-Year Review assessed the protectiveness of the remedy, and evaluated the old standard against the new toxicity criteria, methods, or exposures. For example, standards such as maximum contaminant levels (MCLs) are developed considering a risk-based approach, which incorporates toxicity criteria (i.e., cancer slope factor [CSF], non-cancer reference dose). If the toxicity criteria become more stringent, then the old standard may no longer be protective. Protectiveness can be evaluated using the same risk-based equation substituting the new toxicity criteria. The results can then be compared to the acceptable cancer risk range of 10^{-6} to 10^{-4}, or a non-cancer hazard index (HI) of 1.0 (USEPA, 1990, USEPA, 1991a, and USEPA, 1991b). If the result is within these levels, then the old standard can still be considered protective. If not, i.e., the result exceeds 10^{-4} cancer risk or a non-cancer HI of 1, then adoption of the new standard should be considered and the remedy should be evaluated. This Five-Year Review has also identified those interim remedial actions or sites where state action levels differ from the federal levels for the significant COCs. In addition, remedial action levels and treatment system discharges have been evaluated against ecological thresholds. The Five-Year Review has identified where these standards have changed or new standards have been developed. Where action levels or discharges are below current ecological thresholds, or where processes are in place to evaluate these action levels or discharges against current metrics to protect ecological receptors, the remedy can be considered protective.

For the Five-Year Review, the acceptable risk range (i.e. 10^{-6} to 10^{-4}) has been used to assess the potential impact to public health or the environment from ongoing remedial activities at McClellan. As such, the use of this risk range is not intended to imply that a site-specific cleanup level has been achieved, or that the screening evaluation is establishing a risk-based cleanup level. McClellan intends that all cleanup levels will be developed according to the appropriate CERCLA decision document process and with concurrence of the State and Federal Remedial Project Managers.

Please refer to Appendix C for a summary of changes in standards, methodologies, and toxicity criteria during the last five years that were used in this evaluation and may affect the protectiveness of the remedies in place. A more thorough analysis of ARARs will be conducted as part of the feasibility studies and RODs that have yet to be completed.

The following sources were the primary focus of the Five-Year Review:

- A comprehensive review of decision documents, baseline surveys, operational data, monitoring reports, performance assessments, institutional procedures, toxicity data, risk assumptions, and feasibility studies;
- Interviews with selected tenants, site managers, contractors, and Air Force personnel; and
- Site inspections of the facilities and adjacent areas.

1.5 ORGANIZATION OF THE FIVE-YEAR REVIEW REPORT

The Five-Year Review evaluation for each of the interim remedial actions conducted at McClellan includes a discussion of the following:

- Description and Background
- Previous and Ongoing Investigations
- Interim Remedial Actions
- Progress Since the 1999 Five-Year Review

- Five-Year Review Process which includes:
  - Document Review – This section lists the documents that were reviewed during the Five-Year Review evaluation.
  - Data Review – This section describes the data that was reviewed.
  - Site Inspection – This section details the results of the site inspections.
  - Interviews – This section lists the people interviewed during the Five-Year Review.
  - Technical Assessment – This section answers the three questions from the USEPA Guidance (USEPA, 2001b):
    1. Question A: Is the remedy functioning as intended by the decision documents?
    2. Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?
    3. Question C: Has any other information come to light that could call into question the protectiveness of the remedy?
  - Technical Assessment Summary – This section provides a summary of the results of the assessment and a determination of whether the remedy remains protective.
- Issues

This Five-Year Review report is organized into the following sections. Sections 4 through 10 address each of the interim remedial actions that have been implemented at McClellan. Section 11 presents the current program for CERCLA sites with fuel components. An evaluation of the land use controls (LUCs) is contained in Section 12. Section 13 contains an ecological evaluation and Section 14 addresses those sites that are listed in the No Action ROD (AFRPA, 2003d). The table on the following page provides a roadmap to the remainder of this document.

Furthermore, many of the sites or interim remedial actions include discussions of radiological issues, ecological issues, or LUCs. The table on the following page also identifies where discussions of these topics can be found.

Roadmap to the remainder of the Five-Year Review report:

	Radiological	Land Use Controls	Ecological
Section 1 - Introduction			
Section 2 - Administrative Components			
Section 3 - McClellan Background			
Section 4 - Groundwater OU	x	x	x
Section 5 - VOC Vadose Zone	x	x	x
Section 6 - OU B1 Cap/Drainage Ditches		x	x
Section 7 - OU D Cap		x	x
Section 8 - Potential Release Location S-033		x	x
Section 9 - Potential Release Location 032	x	x	x
Section 10 - Confirmed Site 10	x	x	x
Section 11 - CERLCA Sites with Fuel Components		x	
Section 12 - Land Use Controls	x	x	
Section 13 - Ecological Evaluation		x	x
Section 14 - No Action ROD Sites	x	x	x
Section 15 - Recommendations	x	x	x
Section 16 - Protectiveness Statement			
Section 17 - Next Five-Year Review			
Appendix A - Site Inspection Documentation			
Appendix B - Site Interview Documentation			
Appendix C – Risk Review and Summary of Changes to Toxicity Criteria and Risk Methodologies	x		
Appendix D – Responses to Comments			

References, Figures and Tables are located at the end of the main text in special tab sections. Appendices A, B, C, and D follow the tables section.

2.0 ADMINISTRATIVE COMPONENTS

This section outlines the administrative components of this Five-Year Review, including the Five-Year Review Team, as well as community notification and involvement.

2.1 FIVE-YEAR REVIEW TEAM

The Administrative Components requirement identifies the lead agency for the review and the key members of the Five-Year Review Team. The members include representatives of the Air Force (Environmental Management, Community Relations, and Technical Contractors), and the regulatory project managers representing McClellan (USEPA, Department of Toxic Substances Control [DTSC] also referred to as California Environmental Protection Agency [Cal/EPA], and California Regional Water Quality Control Board [RWQCB]). Additionally, the Agency for Toxic Substances and Disease Registry (ATSDR) and the Biological Technical Assistance Group (BTAG), consisting of the U.S. Fish and Wildlife Service (F&WS), the California Department of Fish and Game, Sacramento Metropolitan Air Quality Management District (SMAQMD), and a USEPA technical specialist, have been added to the list of the Five-Year Report Reviewers. A list of key personnel and affiliations is included in Table 2-1.

2.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

The community involvement coordinators for the Air Force and the regulatory agencies determined the appropriate level of community involvement. The community involvement activities conducted during the Five-Year Review included:

- Notifying the community that the Five-Year Review will be conducted.

To fulfill the notification requirements for the Five-Year Review at McClellan, a public notice was placed in the Sacramento Bee, identifying the following:

- The site name, location and web address;
- The lead agency conducting the review;

- A contact name and telephone number for further information; and
- The scheduled completion date of the Five-Year Review.

For this Five-Year Review, the requirement for special interviews of community members has been fulfilled by the interviews conducted by the McClellan Community Relations team in completing the update to the *Community Relations Plan* (CRP) (Base Realignment and Closure Cleanup Team [BCT] meeting minutes, September 2002). As a result, more community interviews were not conducted as part of the Five-Year Review; however four tenant interview were conducted to supplement the CRP interviews. The results of these prior interviews were reviewed when compiling information for the Five-Year Review Report. During the community interviews held in 2001 and 2002, the primary concerns included the following:

- Adequate funding to complete the cleanup efforts;
- The type of contamination that may be found at McClellan;
- The conclusions of the health studies that were conducted;
- The health impacts on past employees and on new tenants;
- Protection of the public from contamination at McClellan;
- Cleanup progress relevant to the reuse process;
- Cleanup of the property before the Air Force transfers it to the county; and
- Information flow to residents and involvement in the cleanup process.

Section 2 of the CRP lists the on-going and new actions the Air Force is undertaking to address these specific community concerns (URS, 2003k, pp. 1-1 through 1-3).

A public notice similar to the one referenced above will be prepared once the Five-Year Review is complete and will include the following:

- Location(s) where a copy of the Five-Year Review can be obtained or viewed (including site repositories);
- A contact name and telephone number where community members can obtain more information or ask questions about the results; and

- The date of the next Five-Year Review or a statement and supporting rationale that Five-Year Reviews will no longer be required.

In addition to the public notices, an article describing the Five-Year Review in more detail will be placed in the McClellan Newsletter, the *Environmental Action Update*. Periodic updates may be included in the quarterly newsletters, as applicable; to keep the public informed of the progress of the review. Once the review is completed, the main points of the Five-Year Review will be summarized in another newsletter article.

3.0 McCLELLAN BACKGROUND

McClellan is located seven miles northeast of downtown Sacramento, California. The installation comprises approximately 3,000 acres bounded by the City of Sacramento on the west and southwest, the communities of Antelope on the north, Rio Linda on the northwest, and North Highlands on the east (Figure 3-1).

McClellan, originally called Sacramento Air Depot, was dedicated in 1936 as an active industrial facility. Past operations at the base include maintenance of bombers during World War II and the Korean War; maintenance of jet aircraft since the 1960s; and, until closure, the maintenance and repair of communications equipment and electronics (URS, 2002f, p. 2-2 through 2-3). Materials used at the base in conjunction with the maintenance activities include industrial solvents, caustic cleaners, electroplating chemicals, heavy metals, polychlorinated biphenyls (PCBs), low-level radioactive materials, and various fuels and oils (URS, 2002f, p. 2-3).

In 1995, the Congressional Base Realignment and Closure (BRAC) Committee recommended the closure of McClellan, and the base was officially closed on July 13, 2001. Following closure, the Air Force's remaining objectives are to 1) efficiently complete the environmental cleanup to ensure the protection of human health and the environment, 2) facilitate property transfer, and 3) minimize the level of land use or institutional controls (ICs) required to ensure that the protectiveness goal is met. AFRPA is responsible for achieving this mission.

3.1 HISTORY OF ENVIRONMENTAL PROGRAM

Groundwater contamination was discovered in 1979, and investigations began with the Department of Defense (DoD) establishing its Installation Restoration Program (IRP) in 1981. McClellan's comprehensive program was revised to conform with this federal program, and it changed again in 1987 when the base was added to the National Priority List (NPL), also called the Superfund list. The Air Force, USEPA, and California Department of Health Services (DHS) signed an interagency agreement (IAG) in 1989 for the cleanup of McClellan. The IAG was implemented in 1990 to comply with federal regulations, including CERCLA, the Resource

Conservation and Recovery Act (RCRA), the National Environmental Policy Act (NEPA), the Defense Environmental Restoration Program (DERP), Executive Order 12580, and the California Health and Safety Code. The duties and responsibilities of the DHS were transferred to the Cal/EPA's DTSC in a subsequent reorganization (URS, 2003a, p. 4).

The base was originally divided into geographic OUs for the investigation of contamination. Each OU included the surface soil, vadose zone, and groundwater within its boundary. In 1992, the base was reorganized into 11 OUs. Ten OUs have geographic boundaries and include OUs A, B, B1, C, C1, D, E, F, G, and H (Figure 3-2). An eleventh OU, the Groundwater OU, was established in 1993 to address the VOC contamination in groundwater on- and off-base.

McClellan currently lists 318 sites where contaminants may have been released. The Davis Global Communications Site (not part of this count) is located off-base and is not addressed in this report. The Working Copy Five-Year Review for the Davis Global Communications Site has been completed and has been presented to the Air Force under separate cover (MWH, 2003a). Table 3-1 lists the sites and the OU locations. These sites were identified with a variety of designations over the years: Confirmed Site (CS), Potential Release Location (PRL), Study Area (SA), Special Study Area (SSA), or Area of Concern (AOC). Following the initial designation, these names are not updated if new information is discovered. For example, "PRL" is not changed to "CS" if contamination is reported. These sites are now tracked using the Air Force-wide Waste Information Management System-Environmental Subsystem (WIMS-ES) numbers and these are shown on Table 3-1.

The initial geographic OU site groupings were later determined to be inadequate since any OU could contain sites, or groups of sites that may be affecting groundwater. The OUs did not permit efficient investigation at multiple sites or clusters across the installation. Priorities were later shifted to identify sites that posed an immediate health risk or were actively contributing to groundwater contamination (to facilitate groundwater cleanup). Therefore, during remedial investigations adjacent sites were grouped into ICs. The purpose of the investigation clusters was to facilitate the investigations and decrease the redundancy in sampling. The investigation clusters may include three to ten sites, depending on proximity and type of contamination

expected at each site (URS, 2002f, p 2-22). However, not all sites at McClellan were grouped into investigation clusters. In those cases, the geographic OU designations have been retained for site location and identification purposes. Table 3-1 shows the investigation cluster associated with each site. It should be noted that the acronym 'IC' - to designate 'investigation cluster' - will be spelled out where possible to avoid confusion with the use of 'IC' for 'institutional control'.

Following the base closure, future land use is now the primary consideration for prioritizing site investigation and remediation. It should be noted that even though future land use is the primary consideration for prioritizing cleanup, safety has not been compromised and cleanup has occurred or is underway for the most significant contamination that has threatened or currently threatens public safety.

To facilitate the transfer of Air Force property, the base was divided into geographic areas (parcels) reflecting both the reuse priorities and the complexity of the cleanup requirements. Remedial investigation (RI) reports are organized by OU; however, the activities for the remainder of the CERCLA process, including feasibility studies (FSs) and RODs, will be conducted for sites based on reuse potential (for the Initial Parcel) and on the complexity and groupings of distinct or similar types of sites. The VOC contamination in the groundwater and vadose zone is being considered separately, as is the cleanup of ecological sites. Cleanup decisions for each parcel will be addressed under separate RODs. A complete discussion of the history of the Installation Restoration Program is presented in the BRAC Cleanup Plan (URS, 2003a).

Table 3-1 presents the ROD associated with each site. The fourteen RODs currently being developed are shown on Figure 3-3 and include:

- Basewide VOC Groundwater (ROD 1)
- Non-VOC Groundwater (ROD 10)
- Local Reuse Authority (LRA) Initial Parcel ROD #1 (ROD 2)
- LRA Initial Parcel ROD #2 (ROD 11)

- LRA Initial Parcel ROD #3 (ROD 12)
- Small Volume Sites (ROD 3)
- CS 10/PRL 32 (ROD 4)
- Strategic Sites (ROD 5)
- Building 252 Area (ROD 6)
- Ecological Sites (ROD 7)
- No Action for Soil (ROD 8)
- Davis (ROD 9) – not shown on Figure 3-3
- Breakout Shallow Soil Gas (SSG) (ROD 13)
- Basewide SSG (ROD 14)

4.0 GROUNDWATER OPERABLE UNIT

The following sections provide a description and brief background of groundwater contamination at McClellan, an overview of previous investigations and interim remedial actions, summary of progress since the last Five-Year Review (1999), and a technical assessment of the selected remedy. This second Five-Year Review evaluates the protectiveness to public health and the environment of the interim remedial actions conducted to satisfy the RAOs detailed in the IROD (CH2M Hill, 1995). This evaluation also includes more recent groundwater concerns about hexavalent chromium and other metals; 1,4-dioxane; perchlorate; radiological constituents; and other California RWQCB "emergent chemicals."

4.1 DESCRIPTION AND BACKGROUND OF GROUNDWATER OU

Groundwater contamination at McClellan was first discovered in 1979 in wells on and adjacent to the base. Since then, numerous investigations have been conducted to define the type, magnitude, and extent of contamination, and to identify the hydrologic and geologic conditions so that a clearer picture of the contaminants and their potential migration pathways could be obtained. Based on those investigations, five groundwater monitoring zones (A through E) have been identified and characterized at McClellan. Figure 4-1, located in the Figures section, presents a representative hydrogeologic cross section of the base along with the typical range of depths and thickness for the five monitoring zones. The groundwater surface and top of the A monitoring zone occur at approximately 100 feet below ground surface (bgs) across the base (Radian, 1999a, p. 9).

Historically groundwater has been pumped from the areas surrounding McClellan for irrigation and municipal or domestic water supply. As a result of the pumping, more groundwater has been extracted than has been supplied by natural recharge. The water level within the aquifer system has been dropping continuously for approximately 50 years (CH2M Hill, 1995, p. 25) but has since stabilized. From 1982 to 1995, groundwater elevations beneath the base were decreasing at a rate of approximately one-foot per year. However, from 1996 to the present, the decline of

groundwater elevation appears to have halted, and in some cases may actually be rising (URS, 2003g, p. 2-25).

Regional groundwater flow directions have varied in the past, but are generally in a south to southwesterly direction. Domestic production wells, groundwater remediation extraction wells, and regional pumping affect local groundwater flow directions. The vertical hydraulic gradients between monitoring zones A and B are predominately upward in the winter and downward the remainder of the year. The horizontal hydraulic conductivity of layered sediments is about 5 to 15 times the vertical hydraulic conductivity (URS, 2003g, p. 2-25).

As a result of past base operations and disposal practices, chlorinated solvents have contaminated groundwater underlying the base. Although numerous contaminants have been detected in the groundwater underlying McClellan, the four most significant contaminants, defined as COCs in the IROD, are: trichloroethene (TCE), tetrachloroethene (PCE), 1,2-dichloroethane (1,2-DCA also known as DCA12), and cis-1,2-dichloroethene (cis-1,2-DCE also known as DCE12C). Figure 4-3 shows the current configuration (First Quarter 2003) of the composite MCL plumes for these contaminants for each affected monitoring zone (A through C). Since the last Five-Year Review, several other organic and inorganic constituents have been detected and identified as contaminants of potential concern (e.g., 1,4-dioxane, hexavalent chromium, and other metals), and several others (perchlorate and radionuclides) are being investigated to determine their existence and significance. These are discussed in more detail in Sections 4.2 and 4.5.5.

The selected remedy described in the IROD consists of the following (CH2M Hill, 1995, p. 2).

- Containment: Groundwater contaminated at levels greater than MCLs will be extracted at pumping rates that prevent its further migration. Containment to prevent off-base plume migration is the highest priority, followed by containment of the hot spots, and containment to prevent vertical downward migration. Eventually, all groundwater will be contained so that no water above California MCLs will leave the base boundaries. Table 4-1 presents the groundwater COCs and the associated action levels. Groundwater extraction wells will also be located in areas with the highest contaminant concentrations (hot spot/sources). Aggressive pumping of these wells will rapidly reduce the total amount of groundwater contamination and its associated risk.

- Treatment: Groundwater extracted on the west side of the base will be treated at the existing Groundwater Treatment Plant (GWTP). The GWTP removes the VOCs from the water by air stripping followed by liquid-phase granular activated carbon (LGAC) polishing. The air stripper offgas is treated by thermal oxidation.

- End-Use: The Air Force believes it is premature at this time to specify any one or any combination of end uses for the treated water. The final decision on the end use will be determined in the Final ROD, depending on the actual quantity of water that needs an end use and further discussion with potential recipients of the treated water.

The IROD outlines a three phased approach to implement the remedy. Each phase is planned and executed to further the containment and remediation of the groundwater (URS, 2003g, p. 2-2).

- Phase I: In 1987, a total of 15 extraction wells and 39 monitoring wells were installed to implement Phase I. Extraction wells were installed in hot spot areas in an effort to contain contaminant mass. In addition, extraction wells were installed along the eastern side of the base to capture contaminated groundwater and to prevent it from migrating off-base. Phase I also included the installation of extraction wells in OU B and OU C in the C and D monitoring zones.
- Phase II: In 1999, an additional 21 extraction wells and 21 monitoring wells were installed. The extraction wells aid in containing contaminant migration and the monitoring wells aid in defining the extent of contamination.
- Phase III: The main objective is containment of the groundwater contaminated with VOC concentrations greater than MCLs. The planning and design for Phase III, including a comprehensive Phase III Data Gap investigation, is currently underway and is expected to include the installation of about 62 additional extraction wells and includes completing the capture of groundwater plumes that exceed MCLs.

There are currently three active groundwater treatment systems at McClellan (Figure 4-2): the GWTP, the IC 29 Dual Phase Extraction system, and the IC 23 Dual Phase Extraction system. These systems process contaminated groundwater from 56 extraction wells (URS, 2003g, p. 2-25). Table 4-2, located in the Tables section, presents summary information for the three treatment systems.

4.2 PREVIOUS AND CURRENT INVESTIGATIONS FOR GROUNDWATER OU

This section describes the previous and current investigations for the primary groundwater contaminants (VOCs) that were evaluated in the 1999 Five-Year Review Report and for contaminants of potential concern that have been identified or suspected since 1999 (e.g., hexavalent chromium and other metals; 1,4-dioxane; radiological constituents; and perchlorate).

4.2.1 VOC Background and Investigations

The initial records search (Phase I) was performed in 1981 and identified groundwater contaminated with TCE as a main area of concern. A second phase groundwater investigation, performed in 1983, involved sampling off-base supply wells, existing monitoring wells, and wells installed during the field program. This investigation detected organic and inorganic compounds in the shallow water-bearing zone. McClellan began the off-base sampling program in 1983. Results of this sampling program were used to evaluate the extent of off-base contamination and as a basis for providing bottled water to residents with contaminated wells (CH2M Hill, 1995, p. 13).

Later phases of the groundwater investigation were performed at OU D in 1985 to evaluate remedial action alternatives and to provide conceptual design information for the selected alternative. An interim remedial action (engineered cap) was performed at OU D to limit the infiltration of surface water/precipitation and to control off-gas emissions (CH2M Hill, 1995, p. 13). The OU D remedial action is described and evaluated separately in Section 7.0.

The groundwater RI began in 1990 to develop a conceptual model of the hydrogeology and groundwater flow patterns under McClellan and to further define the extent of groundwater contamination. Results from the RI indicated that several VOC contaminants had been consistently detected in groundwater under the base at levels above federal drinking water standards. The contaminant with the greatest spatial extent was TCE (CH2M Hill, 1995, p. 16).

In 2002, the Phase III Data Gaps investigation began to further define plume boundaries both on and off-base. Forty data gap locations were investigated as part of the Phase III program. Phase III involves exploratory borings to obtain field groundwater samples, installation and sampling of monitoring wells, and aquifer testing. The scope is outlined in the Groundwater Operable Unit Phase III VOC Data Gaps Field Sampling Plan (CH2M Hill, 2002b). The results of this program will lead to the planning efforts for implementation of Phase III expansion of the GWTP.

4.2.2 Hexavalent Chromium Background and Investigations

Hexavalent chromium concentrations in GWTP influent and effluent have been monitored since June 1998. Although concentrations of hexavalent chromium occasionally exceeded the discharge standards (10 micrograms per liter [µg/L]), it was not considered a concern until the concentration rapidly rose to a maximum of 64 µg/L in July 1999. This spike coincided with a restart of the GWTP following a shut down for Phase II upgrades. Effluent concentrations of hexavalent chromium were below discharge limits for two years following the spike before concentrations once again began to fluctuate in 2001 to just above 10 µg/L. As a result, the GWTP was shut down in January 2002 due to exceedances of the average monthly discharge limit (URS 2003f, p. 2-10).

Although the background concentrations of hexavalent chromium in the vicinity of McClellan are not known at this time, several investigations are ongoing or planned for hexavalent chromium. Currently, groundwater monitoring and extraction wells are being sampled and analyzed for hexavalent chromium in order to determine the concentration range and spatial distribution (URS, 2002a, p. 6). A new study is planned to determine the background levels of inorganics, including hexavalent chromium, in groundwater in the vicinity of McClellan (URS, 2003j, p. 1). Recommendations to address hexavalent chromium concentrations in groundwater will be made following the background study (URS, 2003g, p. ES-11). As of yet, no specific source of hexavalent chromium contamination at McClellan has been found, although suspected source areas have been identified. An extensive investigation will be conducted as part of the non-VOC future investigation to determine the potential source(s).

4.2.3 1,4-Dioxane Background and Investigations

The chemical compound 1,4-dioxane was detected in three of five monitoring well samples collected in October 1995. Concentrations ranged from 6.2 to 173 µg/L compared to a preliminary remediation goal (PRG) of 6.1 µg/L, and the wells sampled during this earlier effort were located in areas where the highest TCE concentrations were reported. Because 1,4-dioxane is a potential trace constituent in TCE and/or PCE solvents historically used in base operations, it was assumed to be associated with high or "hot spot" (i.e., greater than 100 times MCL) concentrations of TCE or PCE in the groundwater. However, given its chemical and physical properties, it is possible that 1,4-dioxane may travel faster and beyond the TCE plumes (URS, 2002a, p. 2-3).

An investigation to determine the extent of 1,4-dioxane contamination is currently ongoing using a phased approach. During the first phase, samples were collected and analyzed for 1,4-dioxane for all monitoring and extraction wells scheduled for the Second Quarter 2002. Because 1,4-dioxane contamination was not confined only to TCE "hot spots" or high concentration wells, additional wells were sampled and analyzed for 1,4-dioxane during subsequent sampling rounds.

Four quarters of samples have been collected for 1,4-dioxane (as of First Quarter 2003). Analytical results for the First Quarter 2003 showed 8 of the 72 wells sampled had 1,4-dioxane results greater than the PRG for tapwater (6.1 µg/L) (URS, 2003m, p. ES-10). In comparison, analytical results for the Fourth Quarter 2002 showed 11 of the 90 wells sampled had detectable concentrations ranging from 0.68 µg/L to 18.1 µg/L. Two of the wells sampled had concentrations greater than the PRG for tapwater, and both of these locations are located within the TCE target areas and capture zones (URS, 2003g, p. 3-43).

Generally, the wells with the 1,4-dioxane concentrations greater than 6.1 µg/L have been located within or in close proximity to a TCE plume. The highest 1,4-dioxane concentration (173 µg/L during Third Quarter 2002) occurred in OU D (URS, 2003g, p. 3-43).

Monitoring and extraction wells will continue to be sampled during each quarterly event until all wells have been analyzed at least once for 1,4-dioxane. At that time, the data will be evaluated to determine the extent of contamination. Currently, results do not suggest that 1,4-dioxane has generally migrated downgradient of the TCE target areas (URS, 2003g, p. 3-44).

4.2.4 Metals Background and Investigations

During the last three sampling quarters (Third Quarter 2002, Fourth Quarter 2002, and First Quarter 2003), 88 wells sampled for metals had concentrations exceeding the California or Federal MCL for drinking water, 52 of which exceed the proposed background levels (i.e., proposed background concentrations for thallium, antimony, and nickel are greater than MCL based on background concentrations presented in the *Inorganic Background Concentration Report* [CH2M Hill, 1997, p. 2-3]). Although a new inorganic background study is being planned (URS, 2003j), the 1997 proposed background levels are being used as a qualitative comparison to assess whether metals may be contaminants in groundwater at McClellan.

4.2.5 Radiological Constituents and Perchlorate Investigations

Following the discovery of radiological soil contamination (See Section 10.0), two quarters (First and Third Quarter 2002) of groundwater samples were collected from locations upgradient and downgradient of 11 facilities to confirm that potential releases of radioactive or chemical constituents from these facilities have not contaminated the groundwater. The sites of potential release include B334, PRL 32, CS 10, OU D, B1080, CS 24, IWTP #1, B336, B252, B628, and PRL 60. In addition to these locations, samples were collected from the GWTP influent and effluent to verify that it is free of contamination exceeding the applicable MCL or PRG levels. None of the samples collected had concentrations above these action levels. Since there has been anecdotal evidence that perchloric acid was used at some locations, six of 36 samples were also analyzed for perchlorate, with no detections found (URS, 2003g, p. 3-62 through 3-63).

4.3 INTERIM REMEDIAL ACTIONS FOR GROUNDWATER OU

This section describes the interim remedial actions for the three groundwater treatment systems (GWTP, IC-29 and IC-23).

4.3.1 Groundwater Treatment Plant

The GWTP is located on the west side of McClellan in OU C1, east of the former Industrial Wastewater Treatment Plant (IWTP). The GWTP has been in operation since July 1987, when it began treating groundwater from the extraction well field in OU D. The system originally included air stripping, LGAC, thermal incineration, and biological treatment to remediate the contaminated groundwater. Originally, the treatment system was designed to treat approximately 1,000 gallons per minute (gpm) of influent. From 1988 to 1995, modifications were made to increase the efficiency of the GWTP in order to accommodate the lower than anticipated flow rate of 232 gpm. The OU C extraction well field began operation in 1988 (URS, 2003g, p. 2-30).

Currently, the system consists of 56 extraction wells, including wells for the dual phase extraction systems that have been installed to contain the groundwater contaminant plumes and remove the contamination in the vadose zone. Incoming groundwater is directed through an air stripper and then the LGAC system for polishing. The air stripper vapor is sent through a thermal oxidizer for treatment prior to discharge to the atmosphere. An ultraviolet treatment system was originally installed to treat the water for vinyl chloride, but was shut off at the end of 2001 when vinyl chloride concentrations declined. Monitoring and extraction wells are routinely sampled according to the sampling frequency defined in the Groundwater Monitoring Plan (Radian, 1997b) and the Final Change Pages to the Groundwater Monitoring Plan (GWMP) (URS, 2003s). The treatment system influent and effluent are sampled according to the Final Addendum to the GWTP Operations and Maintenance (O&M) Manual (URS, 2003e, Appendix I) which specifies annual influent samples for VOC COCs and monthly effluent samples for VOC COCs to Magpie Creek and to Don Julio Creek via Beaver Pond. A sample from Magpie Creek, discharge point for the effluent, is sampled monthly to meet the substantive requirements of the GWTP O&M Manual.

The GWTP was designed to remove and destroy VOCs in groundwater. However, the GWTP was not designed with the capability to treat non-VOCs, such as hexavalent chromium and other metals or 1,4-dioxane because these contaminants were not a concern at the time of design and implementation. The following sections describe the status of interim remedial actions for the primary non-VOC contaminants that have been detected within the last five years.

Hexavalent Chromium Remedial Actions

Interim actions were taken immediately to control hexavalent chromium discharge in the GWTP effluent. These actions consisted of diverting GWTP effluent discharge from Magpie Creek to the sewer system when concentrations exceeded 10 µg/L. Prior to turning the GWTP system back on, the Air Force proceeded with shutting down selected extraction wells that had high hexavalent chromium concentrations to ensure the GWTP effluent stayed below the discharge limit set by the GWTP O&M Manual.

The sampling protocol for the GWTP effluent is established in the GWTP O&M Manual Addendum (URS, 2003e) and calls for a monthly sample to be collected. If the initial sample contains target constituents exceeding the maximum daily discharge criteria, then additional samples will be collected weekly until the average monthly criteria are achieved. If the initial sample is below the discharge limit, discharge continues to Magpie Creek. If the average monthly criteria are not achieved, then the effluent is discharged to the sanitary sewer (URS, 2003e, p. 7).

Following the shutdown of the GWTP in January 2002 due to hexavalent chromium exceedences in the GWTP effluent, a time critical removal action (TCRA) was undertaken (URS, 2003f). While these interim remedial actions were effective, they were not acceptable long-term solutions. The final action of the TCRA has placed an additional treatment system at the GWTP to reduce hexavalent chromium concentrations in the extracted groundwater to acceptable levels prior to discharge to Magpie Creek. Based on the pilot-scale test results, ion exchange was selected as the treatment technology for full scale-implementation. The GWTP was modified to allow for the ion exchange resin to be contained in two of the existing granular activated carbon (GAC) vessels, providing a slipstream treatment capacity of 250 to 750 gpm (URS, 2003f,

p. 3-10). Modifications to the GWTP were completed on 24 June 2003, and the ion exchange system is currently in a six-month period of performance testing (as of August 2003). The latest analytical results (June 2003) of the discharge effluent indicate that the new ion exchange system is reducing discharge concentrations to below the current limit presented in the GWTP O&M Manual Addendum (URS, 2003e).

1,4-Dioxane Remedial Actions

Ultraviolet/Oxidation (UV/OX) is the preferred treatment for 1,4-dioxane contamination. On 21 February 2003, the UV/OX treatment system, which was originally installed to treat vinyl chloride, was brought on-line to determine if it would be an acceptable method of treating 1,4-dioxane contamination as part of the influent to the GWTP. While UV/OX was effective at treating the 1,4-dioxane contamination, it also increased hexavalent chromium concentrations in the effluent by converting trivalent chromium Cr(III) to hexavalent chromium Cr(VI). As a result, the UV/OX treatment was taken off-line 10 March 2003. Following installation of the ion exchange treatment system for hexavalent chromium, the UV/OX system may be brought back on-line to treat the 1,4-dioxane contamination (Ms. D. Kiyota, 2003 interview, Appendix B). In the meantime, the concentrations of 1,4-dioxane in the GWTP effluent are being monitored and sampling has just begun for 1,4-dioxane in the influent and effluent of the GWTP. The detections in the effluent for May (1.6µg/L), June (<0.94 µg/L), July (1.4 µg/L), and August 2003 (1.4 µg/L) have been well below the current PRG (6.1 µg/L) (Ms. B. Callen, 2003 interview, Appendix B).

4.3.2 Dual-Phase Extraction System at IC 29

The IC 29 Dual-Phase Extraction system became operational in January 1997. Since startup, the system has been used to simultaneously extract contaminants from the vadose zone, capillary fringe, and saturated zone in OU A Northern hot spot of the Groundwater OU. Water and soil vapors are extracted using a combination of low-vacuum and high-vacuum dual-phase extraction. Contaminated water is then pretreated using an air stripper and LGAC before being sent to the GWTP via the pipeline. Vapors from the air stripper are routed to the adjacent IC 31

soil vapor extraction (SVE) system for treatment using catalytic oxidation (URS, 2003g, p. 2-31*)*.

4.3.3 Dual-Phase Extraction System at IC 23

The IC 23 Dual-Phase Extraction system became operational in August 2001 and consists of one extraction well, EW-367, located near Building 252 (Figure 4-2). In November 2001, the system was upgraded with a new pump and is currently capable of treating approximately 15 to 17 gpm. The system was temporarily turned off due to elevated radiation levels in the carbon canisters exceeding the public allowable dose limits (assuming continuous exposure over 24 hours per day, 365 days per year) at the treatment system fence line (URS, 2003g, p. 2-31 and 2-32*)*. Further explanation of the radon issues in the SVE systems is provided in Section 5.5.5.

Following the installation of a protective barrier around the system to protect the public and workers from radon buildup in the carbon canisters, the system was restarted in April 2003. The system is sampled as part of the SVE program. Treated groundwater is discharged to the sanitary sewer.

4.4 PROGRESS SINCE 1999 FIVE-YEAR REVIEW FOR GROUNDWATER OU

The previous Five-Year Review included the evaluation of the Phase I activities conducted as part of the IROD to treat the two large groundwater contaminant plumes identified at the base at that time. Activities conducted since the 1999 review to meet the objectives of the IROD are listed below and evaluated in the technical assessment presented in Section 4.5:

- Phase II of the groundwater treatment system expansion was completed in 1999. This phase further defined the extent of contamination, completed containment of the high concentration portions of the plumes, and began containment of the lower concentration portions.
- Phase III, currently underway, is focusing on addressing the data gaps identified in the quarterly reports and completing the containment of identified target areas. A new groundwater model is being developed to include the data gap information

during the Phase III investigation, and the latest aquifer and regional water supply well pumping data.

- The groundwater treatment system was expanded to be capable of treating over 2,000 gpm during the Phase II activities.
- UV/OX system was shut off in 2001 when vinyl chloride concentrations declined.
- An ion exchange system was added to the GWTP in June 2003 to treat hexavalent chromium.

Recommendations outlined in the 1999 Five Year review and the actions taken to meet them are outlined in Table 4-3.

4.5 FIVE-YEAR REVIEW PROCESS FOR GROUNDWATER OU

The Five-Year review process for the Groundwater OU remedial actions consists of document review, data review, a site inspection, interviews, and technical assessment.

4.5.1 Document Review for Groundwater OU

This five-year review consisted of a review of the following documents:

- Performance and Protectiveness Review Scoping Visit, Former McClellan Air Force Base, AFBCA, July 29 through August 8, 2002 (2002d).
- Installation Restoration Program Five-Year Review Report. Prepared for McClellan Air Force Base/Environmental Management, Radian International, October 1999 (1999a).
- Basewide Groundwater Operable Unit Interim Record of Decision, CH2M Hill, June 1995.
- Final Groundwater Operable Unit Phase III VOC Data Gaps Field Sampling Plan, CH2M Hill, April 2002 (2002b).
- Technical Memorandum Off Base Groundwater Operable Unit Phase III Volatile Organic Compound Data Gaps Investigation, MWH, April 2003 (2003b).
- Final Groundwater Monitoring Program Quarterly Report, Third Quarter 2002, URS, January 2003 (2003b).
- Final Groundwater Monitoring Program Quarterly Report, Fourth Quarter 2002, URS, April 2003 (2003g).

- Final Groundwater Monitoring Plan, McClellan Air Force Base Groundwater Monitoring Program, Radian International, September 1997 (1997b).Final Change Pages to the Groundwater Monitoring Plan (GWMP), URS, April 2003 (2003s).
- Final Groundwater Operable Unit Phase III Workplan, CH2M Hill, May 2002 (2002a).
- Addendum to the Groundwater Monitoring Program Field Sampling Plan for 1,4-Dioxane, Hexavalent Chromium, and Total Metals in Groundwater Monitoring and Extraction Wells, URS, September 2002 (2002a).
- Time Critical Removal Action Work Plan for Hexavalent Chromium, URS, May 2003 (2003f).
- Draft Field Sampling Plan to Determine Background Levels of Inorganics in Groundwater, URS, January 2003 (2003j).
- Addendum to the Groundwater Treatment Plant Operation and Maintenance Manual, URS, May 2003 (2003e).
- Basewide Ecological Risk Assessment (ERA) Scoping Summary Status Report, Jacobs Engineering Group, JEG, December 1995.
- Special Status Species Monitoring Report: McClellan Air Force Base and Davis Communications Facilities, JEG & Resource Management International (RMI), November 1995.
- Interim Basewide Remedial Investigation Report, Part 2C – Site Characterization Summary/Field Sampling Plan and Remedial Investigation Characterization Summaries, Radian International, August 1997 (1997a).
- Interim Basewide Remedial Investigation Report, Operable Unit C, Volume 14 URS, May 2000 (2000b).
- Draft Basewide Remedial Investigation Report, Part 1 General Framework, Revision 2, URS, December 2002 (2002f).
- Delineation of Wetlands and Other Jurisdictional Waters of the United States at McClellan Air Force Base, California, Resource Management International, (RMI), June 2001.
- Final Ecological Risk Assessment for the Initial Parcel, CH2M Hill, August 2003 (2003c).
- Draft Final Basewide Quality Assurance Project Plan (QAPP), Version 5, URS, July, 2003 (2003q).
- Decision of the Senior Executive Committee (SEC) Resolving the Formal Dispute over the Proposed Plan for the VOC Operable Unit, McClellan AFB, SEC, 2001.
- Air Force Position on the Substantive Requirements of the NPDES Permit No. R5-2003-0052, AFRPA, June 2003 (2003f).

4.5.2 Data Review for Groundwater OU

Data presented in the quarterly monitoring reports, monthly monitoring reports, data gap technical memorandum, and the previous Five-Year Review were reviewed.

4.5.3 Site Inspection for Groundwater OU

The site inspection was conducted on 29 May 2003 by MWH. The purpose of the inspection was to assess the protectiveness of the remedy. The groundwater treatment system was operating and discharging to Magpie Creek and Beaver Pond. In addition, a separate site visit was conducted to review habitat conditions for the ecological review.

4.5.4 Interviews for Groundwater OU

Interviews were conducted with various parties connected to the site. Interview records are included in Appendix B. People interviewed associated with the groundwater program included:

- Ms. B. Callen, URS Project Manager, was interviewed on 19 May 2003. Ms. Callen discussed the history of the groundwater program, issues discovered over the last five years, and system operations.
- Ms. D. Kiyota, AFRPA, was interviewed on 27 May 2003. Ms. Kiyota provided input on the discovery of the hexavalent chromium and 1,4-dioxane. She provided answers to questions regarding future improvements to the treatment system to treat these chemicals.
- Mr. D. Ross, URS Site Manager, was interviewed on 29 May 2003. Mr. Ross provided additional information on the operation of the system, installation of the ion exchange treatment system, and daily operations.
- Ms. M. Enloe, Parsons, was interviewed on 29 May 2003. Ms. Enloe provided information on the ecological issues at the base.

Personnel interviewed in addition to those listed above are documented in Appendix B. A detailed discussion of LUC/ICs is presented in Section 12.

4.5.5 Technical Assessment for Groundwater OU

In accordance with the Comprehensive Five-Year Review Guidance (USEPA, 2001b), the technical assessment includes evaluation of the following three questions.

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

In general, the interim remedy is functioning as intended by the IROD in terms of treating VOCs in groundwater. Monitoring of the contaminant concentrations off-base, providing municipal potable water, decommissioning nearby municipal production wells, and steps to contain the plumes are protecting the public health and the environment. The groundwater treatment systems are treating the VOC-contaminated groundwater to the prescribed levels.

The review of the documents, ARARs, monitoring data, and the results of the site inspection and interviews indicate that the interim remedy is functioning as intended in the IROD. The objectives outlined in the IROD include (CH2M Hill, 1995):

- Protect public health and the environment from exposure to contaminated groundwater.
- Contain the groundwater contamination by stopping lateral migration off-base and vertical migration to deeper aquifers.
- Achieve compliance with ARARs.

Table 4-4 presents the interim remedial action objectives and the actions taken to meet these objectives.

The goal of protecting the public from exposure to contaminated groundwater began when the contamination was first discovered. Residents in homes downgradient of base plumes that owned private water wells were given the option of connecting to a municipal water supply and keeping the well for irrigation purposes only or having the Air Force abandon the well. A number of residents kept their wells and were informed that this water was not potable. These private wells are not sampled as part of the McClellan groundwater monitoring program.

(Ms. D. Kiyota, 2003 interview, Appendix B). California real estate transfer disclosure laws would, by implication, require the buyer to be informed by the seller that the well is not approved for potable use but could not ensure the disclosure would be made (Mr. Jay McCain, 2003 email). It is recommended that the Air Force issue a letter to the County Health Department to request that they conduct an outreach program in order to identify those homeowners within the area of off-base contamination who still have groundwater wells and are using those wells for domestic purposes. Appropriate actions, including possible well abandonment, will result from this outreach program.

McClellan has sought to satisfy the containment goals by hydraulically controlling the flow of contaminated groundwater, especially off-base, through the GWTP and dual-phase extraction/SVE systems. While much progress has been made toward full containment with the implementation of Phases I and II of the Groundwater OU program, full hydraulic containment (i.e., containing plumes outside of base boundaries) has not been achieved for the following off-base areas: 1) the OU A northern plume in monitoring zone A; and 2) the OU A southern plume in monitoring zone B (Figure 4-3). Both of these plume boundaries are being defined by the Phase III Data Gaps investigation. The latest monitoring data coupled with the Phase III Data Gaps results suggest that the contamination interpreted in monitoring zone B of the southern plume in OU A may actually be more closely associated with monitoring zone A. The Phase III groundwater expansion will address the requirements for final plume capture in both of these areas. In addition, a small suspected off-base plume in monitoring zone B, located about 1,200 feet west of the southern tip of the base boundary (associated with MW-1050), is being defined by the Phase III Data Gaps investigation (Figure 4-3). Results of the data gaps investigation and the quarterly groundwater monitoring program indicate that the plume no longer exists. A small plume has also recently been identified at the western edge of OU B (associated with MW-281) which is outside the capture of the closest extraction well. All other plumes at McClellan are within base boundaries or the off-base portion of the plume is within hydraulic control of the Phase I and Phase II Groundwater OU treatment systems (Table 4-5). In terms of completing the Phase III groundwater program, plumes in OUs G and H (A and B monitoring zones) have not been addressed by the current groundwater extraction system. These

areas are also being defined as part of the Phase III Data Gaps investigation and will be addressed in the Phase III expansion.

It should also be noted that determination of hydraulic capture is being interpreted from groundwater elevation contours on the various monitoring zones. In the off-base areas, the elevation data points are fewer and much more scattered than on base; and as a result, the boundary of capture is more susceptible to interpretation and seasonal variation. McClellan has developed and used a groundwater flow model to assist with the placement and design of extraction wells for Phases I and II of the groundwater program. For Phase III, McClellan will be developing a new groundwater flow model with a fate and transport module that will incorporate current hydrogeologic, aquifer data, and contaminant data, including the affects of pumping from off-base water supply wells (Figure 4-4 shows water supply wells nearest the base boundaries). Development of this new groundwater model will provide a number of benefits to the program in terms of 1) predicting flow patterns and fate and transport estimations, 2) judging the capture zones of the current system, 3) improving the effectiveness in placement of the Phase III extraction wells, and 4) predicting the cleanup times.

Another measure of progress in the performance of the Groundwater OU treatment systems is the amount of contaminant mass that has been removed and the reduction of contaminant concentrations. TCE is the most common and widespread groundwater contaminant at McClellan, and has been used as an indicator to evaluate the success of extraction systems as a whole in removing VOCs (Radian, 1999a, p. 23). In terms of reduction in contaminant mass and concentrations, progress for the major OUs (i.e., those under active remediation) include the following (URS, 2002i and j; URS, 2003b, g, and m):

OU A

From 1994 to 2002, the total mass of TCE in all zones has decreased from an estimated 15,000 pounds to an estimated 8,150 pounds; TCE concentrations greater than 10,000 µg/L have been removed and concentrations of 1,000 µg/L have significantly decreased. There has not been much change (i.e., reduction) in the plume area for the A and B monitoring zones.

OU B and OU C

From 1995 to 2001, the total mass of TCE in all areas has decreased from an estimated 11,200 pounds to an estimated 1,000 pounds; TCE concentrations greater than 1,000 µg/L have been removed from the A monitoring zone, and trends toward lower concentrations in the C and D zones are indicated. There has not been much change in plume area for the B, C, and D zones during this period. There has been an increase in area of the plume within the A monitoring zone between 1991 and 1999. This is probably attributable to more monitoring locations and monitoring data.

OU D

From 1990 to 2002, the total mass of TCE in all areas decreased from an estimated 2,037 pounds to an estimated 44 pounds; TCE concentrations greater than 100 µg/L have been removed. The plume boundary in the A monitoring zone has not changed significantly.

In terms of system operation, the GWTP has experienced interruptions since the last Five-Year Review. Common causes of unscheduled system shut downs include: vehicle accidents in which the above ground piping has been damaged causing the system to shutdown, power outages, and spills due to maintenance repairs. During the last five years there have been several auto and equipment accidents involving the above ground extraction piping that have resulted in leaks. McClellan has studied the feasibility of replacing the above-ground conveyance piping with below ground piping during the Phase III expansion to improve reliability and safety. Currently, the GWTP system is automated to detect the change in pressure associated with a large leak and shut down; however, personnel are also responsible for walking the length of the pipeline weekly to monitor for smaller leaks (Ms. B. Callen, 2003 interview, Appendix B).

Violations of the GWTP substantive discharge requirements for Magpie Creek were issued on two occasions for an exceedence in the allowable hexavalent chromium concentrations. Following these violations, procedures were put in place to temporarily discharge the effluent to the sewer until a more permanent engineering solution could be implemented (Section 4.3.1). As of 24 June 2003, an ion exchange treatment system has been added to the GWTP and was undergoing prove-out.

For the purpose of the Five-Year Review Guidance (USEPA, 2001b), annual operational and maintenance costs for the Groundwater Treatment Plant are reported in the monthly Operations and Status Reports.

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

Although there have been some changes in the toxicity criteria (e.g., benzene and TCE) and risk models during the last five years, the evaluations included in this subsection indicate that the protectiveness of the RAOs in terms of groundwater cleanup levels, vapor intrusion into indoor air from groundwater, and vapor emissions are within acceptable human health risk ranges. In terms of ecological exposure to GWTP discharges to Magpie Creek, the current discharge requirements are protective of potential receptors for the current list of analytes; however, as described in response to Question C below, no standards currently exist for ecological exposure to low levels of 1,4-dioxane.

The GW OU IROD formally identifies four VOC contaminants of concern in the groundwater: TCE, PCE, cis-1,2-DCE, and 1,2-DCA. Since the last Five-Year Review Report, the list of VOCs of interest at McClellan has expanded, and the Phase III GWOU interim remedy addresses all VOCs exceeding their respective State of California MCLs. The full list of VOCs of interest at McClellan is defined in the *Basewide Quality Assurance Project Plan, Revision 5* ([QAPP] - URS, 2003q) and is presented in the *Final GWOU Phase III Sampling and Analysis Plan* ([SAP] - CH2M Hill 2003a, Subsection 2.3.3.1, page 2-13). The Sampling and Analysis Plan (SAP) lists 12 VOC compounds that have been detected in the McClellan GWOU above their respective State of California MCL (CH2M Hill 2002a, Subsection 1.1, p. 1-1). These compounds, and their respective MCLs in units of μg/L, are as follows:

- 1,1,2-Trichloroethane (5 μg/L)
- 1,1-DCE (6 μg/L)
- Benzene (1 μg/L)
- Chloroform (100 μg/L)
- Methylene chloride (5 μg/L)
- TCE (5 μg/L)
- 1,1-DCA (5 μg/L)
- 1,2-DCA (0.5 μg/L)
- Carbon Tetrachloride (0.5 μg/L)
- Cis-1,2-DCE (6 μg/L)
- PCE (5 μg/L)
- Vinyl chloride (0.5 μg/L)

Although the additional eight VOC contaminants listed above were not formally identified as COCs in the IROD, they are currently contaminants of potential concern (COPC) and are being treated by the groundwater treatment systems. As a result, this broader list of VOCs has been evaluated in this Five-Year Review Report (Table 4-1).

In terms of non-VOC contaminants that have been detected during the last five years (e.g., 1,4-dioxane; hexavalent chromium, and other metals), these contaminants are evaluated under Question C (i.e., new information that may affect the remedy) in the following section.

The approach used to evaluate protectiveness for the Groundwater OU is consistent with the process outlined in the Final McClellan Five-Year Review Work Plan (MWH, 2003c). A review was conducted to identify any significant changes in standards, exposure, or toxicity criteria that may have occurred since the last Five-Year Review Report for the primary VOC list of McClellan COCs and COPCs. Where significant changes in any of these factors were identified, a preliminary risk screening assessment was performed to determine whether protectiveness might be affected. This approach was used to evaluate potential risk to human health from consumption of groundwater, inhalation of soil gas emanating from groundwater, and inhalation of air emissions from the groundwater treatment plant. In addition, a similar screening approach was used to evaluate the potential human and ecological risk from discharges to Magpie Creek and Beaver Pond from the GWTP.

Human Health Screening Assessment

Establishment of RAOs for groundwater is currently based upon whether detected concentrations in groundwater exceed their respective California MCLs. MCLs are derived based upon three metrics: 1) protection against threshold effects (non-cancer) associated with consumption, 2) protection against non-threshold effects (cancer risk) associated with consumption, and 3) technical feasibility. There have been no changes in the assessment protocols that are used in the development of MCLs that would affect the protectiveness of the MCLs.

With respect to the consumption of water, the toxicity criteria for several of the chemicals have changed since 1999 (e.g., benzene, TCE). However, using standard default exposure assumptions for children (non-cancer) and adults (cancer), and the current toxicity criteria from both USEPA and Cal/EPA, the MCLs for individual chemicals do not present a cancer risk that exceeds the acceptable risk range of 10^{-6} to 10^{-4}, or a non-cancer HI that exceeds 1.0 (see Appendix C). Therefore, for individual chemicals of concern, no changes have occurred which affect the protectiveness of the RAO with respect to consumption of water.

Furthermore, it should be noted that because the aquifers beneath the base are contaminated, residents adjacent to the base have been connected to the municipal water system, which does not draw water from the aquifers at the base. Therefore, it is reasonably anticipated that future development and land use on the base will include connecting future developments to the existing municipal water supply and will not draw water from the currently contaminated aquifers. To further reinforce the protectiveness, the Sacramento County Code Chapter 6.28 specifies 1) a prohibition area for McClellan AFB that prevents installation of any new water supply wells; and 2) a “Consultation Zone” (i.e., a boundary zone of 2,000 feet around known groundwater contaminant plumes) that requires special review of all new well permits by appropriate County and State regulatory agencies.

In terms of potential vapor intrusion from groundwater, protectiveness of MCLs was evaluated based on indoor air using the current version of the Johnson and Ettinger model (USEPA, 2001c) and considering recent guidance from USEPA on assessing the indoor air vapor intrusion pathway (USEPA, 2002a). Based on this evaluation utilizing conservative default parameters,

standard default exposure assumptions for children (non-cancer) and adults (cancer), and the current toxicity criteria from both USEPA and Cal/EPA, the MCLs for individual chemicals do not present a cancer risk that exceeds the acceptable risk range of 10^{-6} to 10^{-4}, or a non-cancer HI that exceeds 1.0 for indoor air (Appendix C). Therefore, for individual chemicals, no changes have occurred which affect the protectiveness of the RAOs with respect to vapor intrusion into indoor air.

Protectiveness of GWTP air emissions was evaluated through modeling. GWTP exhaust stack TP-23 emissions were assessed to determine whether the concentrations of COCs emitted from the GWTP systems might present a health risk to downwind receptors.

VOCs and Dioxins/Furans

The most recent mass emission rates reported from the GWTP exhaust stack for speciated VOCs (6/26/03) and dioxins/furans (3/17/03) were combined with simple dilution modeling, default exposure parameters, and the most recent toxicity criteria from USEPA and Cal/EPA (Appendix C). Additionally, for VOCs not detected during the last sampling event but detected in previous sampling events, half the detection limit of the VOC was also modeled. Review of the historical data suggests that the detected concentrations of COCs in the stack exhaust have been relatively consistent over the past year. The estimated risks and hazards associated with the GWTP emissions were within the acceptable risk range of 10^{-6} to 10^{-4} and less than a HI of 1.0. Therefore, based on the most recent sampling data available, the VOC and dioxin/furan emissions from the GWTP appear to be within the acceptable range of risk.

PM, NOx, SOx, HF, HCl, and CO

The most recent mass emission rates reported from the GWTP exhaust stack for particulate matter (PM, 7/30/02), hydrochloric acid (HCl) and hydrofluoric acid (HF) (3/28/03), nitrogen oxides (NO_x), sulfur oxides (SO_x), and carbon monoxide (CO) (7/29/02) were assessed using simple dilution modeling and California Ambient Air Quality Standards (CAAQS; See Appendix C), chronic reference exposure levels (RELs), or National Institute for Occupation Safety and Health (NIOSH) recommended exposure limits (NRELs). The estimated concentrations of PM, HF, HCl, and CO were below the respective criteria. Therefore, based on the most recent

sampling data, the PM, NO_x, SO_x, HF, HCl, and CO emissions associated with the GWTP system currently appear to be within acceptable ranges.

Screening Assessment (Ecological and Human)

Protectiveness of GWTP Effluent. According to the GWTP discharge requirements (AFRPA, 2003f and URS, 2003e), USEPA adopted the National Toxics Rule (NTR; i.e., ambient water quality criteria [AWQC]) on 5 February 1993. Since the last Five-Year Review, the State Water Resources Control Board (SWRCB) adopted the *Policy for Implementation of Toxics Standards for Inland Surface Water, Enclosed Bays, and Estuaries of California* (known as the State Implementation Plan, or SIP), and USEPA adopted the California Toxics Rule (CTR; SWRCB 2000). Discharge limits for the GWTP are based upon limits set in the SIP, and subsequently the CTR. The CTR and AWQC values are the most current estimates of numerical threshold values considered protective of the health of aquatic receptors of concern.

The discharge requirements for the GWTP outfalls into Magpie Creek and Don Julio Creek via Beaver Pond are:

- Pesticides: no detected concentrations in effluent with method detection limits (MDLs) less than MDLs established in the SIP.
- Hexavalent chromium, selenium, and mercury: daily maximum/monthly average concentrations less than AWQC/CTR (SIP) values.
- VOCs: VOC concentrations less than 1 µg/L with MDLs less than MDLs established in the SIP.
- Survival of aquatic organisms in 96-hour bioassays of undiluted effluent no less than 70% for any one bioassay and 90% for the median of any three consecutive bioassays.

Review of the Draft Final Basewide QAPP (URS, 2003q) and June 2003 GWTP effluent analytical results suggests:

- The range of speciated VOC MDLs is below available AWQC/CTR values. No VOCs were detected during the June 2003 sampling event.

- The range of inorganic MDLs is below the interim and final CTR/AWQC values, and therefore is sufficiently low to detect concentrations of inorganics that might present a risk to aquatic receptors of concern. Review of the June 2003 analytical data suggests inorganics have not been detected at concentrations that exceed the CTR/AWQC.
- The range of pesticide MDLs is generally below the maximum daily CTR/AWQC values and the range of QAPP MDLs is generally consistent with the discharge limitations.
- Since April 2001, bioassay survival results have been greater than 90% for 72% of the analyses, and greater than 70% for all results except one (June, 2003).

Therefore, based upon this review, the established discharge limits for groundwater COCs are consistent with current water quality standards for the protection of aquatic life. When the discharge requirements for COCs in GWTP effluent (CTR/AWQC values) are met, the current remedy is considered protective of aquatic receptors of concern.

Because the site is controlled, there are currently no potentially complete exposure pathways for direct human exposure to undiluted effluent discharges from the GWTP other than potential occasional incidental contact. However, comparison of the GWTP discharge requirements (June 2003) to USEPA Region 9 tapwater PRGs (assuming the 10^{-6} to 10^{-4} cancer risk range) suggests the discharge requirements are sufficiently protective of potential occasional incidental human contact with surface water. Furthermore, significant dilution is expected as GWTP effluent travels away from the discharge point in Magpie Creek. Review of the recent GWTP effluent analytical results (May, June 2003) does not indicate detected chemicals at concentrations that present a risk to human health, and the detection limits are sufficiently low so as to be protective. Therefore, the current GWTP discharges are considered protective of human health.

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

A number of potential issues have come to light in the last five years that could call into question the protectiveness of the RAOs and interim remedy. These issues include: 1) non-VOC detections in the groundwater (including metals and potential "emergent chemicals"),

2) discovery of radiological soil contamination, leading to monitoring for radiological constituents in groundwater, and 3) other Groundwater OU – related issues, including a) regional efforts to manage groundwater, b) prior reviews of the 1999 McClellan Five-Year Review Report, groundwater monitoring plan, and groundwater monitoring reports by consultants to the RAB, and c) final ROD groundwater cleanup levels.

Non-VOC Detections

As described in Section 4.2, the groundwater monitoring program is continuing to sample McClellan monitoring wells, piezometers and extractions wells for a full suite of metals. In addition, a new non-VOC background study is being planned to develop a better understanding of the inorganic contamination both within and outside of the current TCE target areas. During the last three sampling quarters (ending First Quarter 2003), 88 wells sampled for metals had concentrations exceeding California or Federal MCLs for drinking water. These metals were primarily represented by nickel, antimony and chromium at concentrations up to 14 times the MCL. Although the GWTP was not designed to treat metals, the latest monthly testing (June 2003) of the GWTP effluent shows that metal detections are currently infrequent and at very low concentrations (i.e., hexavalent chromium [3.72 µg/L], mercury [0.00146 µg/L], and zinc [4.16J µg/L] URS, 2003o). Monthly monitoring will determine whether these low levels will be maintained or will trend upwards over time.

In terms of "emergent chemicals," six chemicals (perchlorate; n-nitrosodimethylamine [NDMA]; 1,2,3-trichloropropane [TCP]; Hexavalent chromium; 1,4-dioxane; and polybrominated diphenyl ether [PBDE]) have been identified as "emergent chemicals of concern" for closed military facilities by the California RWQCB (RWQCB, 2003a). The California RWQCB has requested that closing bases evaluate their sites for potential source areas. Currently the DoD is evaluating this request and has not yet established a policy. As described in Section 4.2, two of these six "emergent chemicals" have been confirmed at McClellan (i.e., Hexavalent chromium and 1,4-dioxane), and two others (i.e., perchlorate and TCP) have not been detected as part of the basewide groundwater monitoring program or other specialized sampling programs. Hexavalent chromium is currently being treated by an ion exchange system that was added to the GWTP and is currently in a six month prove-out period. The chemical 1,4-dioxane is passing through the

GWTP without specific treatment; however, the monthly monitoring results of the effluent for the last four months indicate the concentrations range from non-detect values to 1.6 µg/L, which is well below the PRG of 6.1 µg/L.

In the absence of an accepted MCL, the Air Force has used a cleanup level for 1,4 dioxane consistent with the USEPA Tap Water PRG (6.1 µg/L), which is protective of human health. The Air Force acknowledges that other levels exist or have been proposed; however, the current average concentration of 1,4 dioxane in the GWTP system effluent (1.4 µg/L) is well below the USEPA Tap Water PRG and only slightly above the most conservative water quality level (WQL) noted in the Table 4-1 (i.e., 1.3 µg/L Cal/EPA cancer potency factor used as a drinking water level) and well below the USEPA Integrated Risk Information System (IRIS) or Suggested No-Adverse-Response Level (SNARL) (3.0 µg/L). In practical terms, even assuming that 1.3 µg/L of 1,4 dioxane might represent a 10^{-6} health risk, a concentration of 1.4 µg/L does not change the risk significantly from 10^{-6}. As a result, if there was a possible risk to human health from the 1.4 µg/L concentrations, the risk would have to be considered very low and within the range acceptable to USEPA. The establishment of cleanup levels for 1,4 dioxane that are protective of both human health and the environment is still under evaluation and will be addressed in appropriate FS and ROD documents as well as the next Five-Year Review.

Currently, no ecological threshold levels have been developed for 1,4-dioxane. Therefore, the potential effects on ecological receptors of continued discharge of very low levels of 1,4-dioxane in the GWTP effluent are unknown at this time. As described in Section 4.3.1, UV/OX is a preferred treatment for 1,4-dioxane and McClellan has a functioning UV/OX that can be brought on line, if appropriate.

Radiological Constituents and Perchlorate

As described in Section 4.2, following the discovery of radiological soil contamination (see Section 10), two quarters of groundwater samples were collected from locations upgradient and downgradient of 11 facilities that are known or suspected of having had radiological contamination to confirm that potential releases of radioactive or chemical constituents from these facilities have not contaminated the groundwater. The sites of potential release include:

B334, PRL 32, CS 10, OU D, B1080, CS 24, IWTP #1, B336, B252, B628, and PRL 60. In addition to these locations, samples were collected from the GWTP influent and effluent to verify that it is free of contamination exceeding the applicable MCL or PRG. None of the samples collected had concentrations above these action levels. Concentrations of Strontium (Sr) 89/90 and Uranium (U) 238 in GWTP effluent were well below USEPA human health tapwater PRG values and well below Department of Energy (DOE) Biota Concentration Guides (BCGs) (DOE, 2002) for ecological receptors. Currently, an additional two quarters of groundwater sampling for radiological constituents is planned to complete the program. Since there has been anecdotal evidence that perchloric acid was used at some locations, 6 of 36 samples were also analyzed for perchlorate, with no detections found (URS, 2003g, p. 3-62 through 3-63).

Other Groundwater OU-Related Issues

Regional Groundwater Management. The Sacramento Groundwater Authority (SGA) is a joint powers authority created to collectively manage the Sacramento region's north area groundwater basin that includes McClellan. SGA has developed a progressive groundwater management program designed to not only provide local and regional benefits but which also has the potential to provide broader statewide benefits. One of the goals of SGA is to develop a groundwater management plan to account for pumping quantities and to promote wet-year banking of the basin resources. It is not clear how the extraction of contaminated groundwater at McClellan and the current discharge of the treated water to Magpie Creek will be affected by this management plan. The issue will need to be reevaluated in conjunction with SGA.

Prior Third Party Reviews of the 1999 McClellan Five-Year Review Report. A third-party review of the 1999 Five-Year Review Report was conducted by PMSA in 1999 (PMSA, 1999). As described in Section 1.3, the contractor concluded that the Five-Year Review Report presented a good snapshot of the cleanup status and provided adequate detail on how the remedial strategy evolved; however, a number of recommendations were made. Recommendations outlined in this report and specific to the groundwater remedial actions included monitoring water levels beneath the cap at OU B1; providing containment of off-base groundwater contamination and full characterization of groundwater contamination; and

explaining and taking appropriate steps to reduce the lateral extent of the hot spot in the southern OU A groundwater plume. Additionally, the report also recommended that the Air Force take action to ensure aggressive monitoring of the Northridge Water District well NR 17 and the two trailer park wells to prevent human consumption of the contaminated water. Additionally, PMSA also recommended that the Five-Year Review Report include goals for reducing the plume size and contaminant mass, achieving drinking water standards, and identifying the fate of the treated water. These recommendations were reviewed as part of this second Five-Year Review, and the following was concluded: 1) in terms of defining and characterizing off-base groundwater contamination, the Phase III Off-base Data Gaps Investigation (MWH, 2003b) has defined the MCL target volumes off-base sufficiently to prepare a design for the Off-base Phase III expansion to the groundwater treatment system, which is to be constructed in 2004, 2) the Air Force has undertaken sampling of the NR-17 and the Eleven Oaks Mobile Home Park wells to supplement the results from the Phase III Off-base Data Gaps investigation, and 3) the development of goals for groundwater cleanup will have to follow the implementation of the Phase III expansion to the GWTP and the basewide groundwater model, which is scheduled for 2005. The final use of treated water will be determined in the Groundwater OU ROD.

Prior Third Party Reviews of the 1999 First and Second Quarter Groundwater Monitoring Reports. In December 1999, the RAB hired an environmental consultant, Clearwater Revival Company, to review the First and Second Quarter 1999 Groundwater Monitoring Program Reports (CRC, 1999a). In general, the consultant agreed with the reports conclusions and recommendations with the following exceptions: 1) interpretation of OU D plume extent, capture zone, and groundwater elevation contours, and 2) reliance of data from previous quarters to prepare plume maps in off-base areas of investigation. The consultant's recommendations were evaluated as part of this Five-Year Review, and it was concluded that 1) continued monitoring of the OU D plume during the last five years has defined the boundaries; 2) the evaluation of the OU D capture zone indicates that the existing extraction wells coupled with regional groundwater flow directions are not allowing contaminants to migrate; and 3) in terms of defining and characterizing off-base groundwater contamination, the Phase III Off-base Data Gaps Investigation Program (MWH, 2003b) has defined the MCL target volumes off-base and

has installed a number of new monitoring wells in key locations which will be monitored frequently as part of the Phase III performance monitoring.

Prior Third Party Reviews of the 1997 Groundwater Monitoring Plan. In 1999, the RAB consultant also conducted a review of the 1997 Groundwater Monitoring Plan (Radian, 1997b). The contractor's review concluded that the plan meets the requirements of a program document; however, the consultant disagreed with the rationale used to determine groundwater monitoring well frequencies. The consultant also recommended that to better protect human health and the environment, the ability to predict groundwater elevations and changes in groundwater quality around McClellan was needed. Other recommendations included establishing data quality objectives (CRC, 1999b). The consultant's recommendations on the Groundwater Monitoring Plan were reviewed during the Five-Year Review, and it was concluded that the substantive issues have been addressed by the updated methods being incorporated into the current groundwater program such as the development of data quality objectives, trend evaluations using time series plots, statistical trend tests, tolerance limits, and comparison of trends with gradient maps and isoconcentration contour plots. Although statistical tests are being used to evaluate the analytical results and make recommendations, the final determination of groundwater sampling frequency is being based on professional judgment and consultation and concurrence with the McClellan Remedial Project Managers for important decisions. In addition, the issue of predictability of groundwater elevations and contamination is being addressed through the development of a basewide groundwater model.

Final ROD Groundwater Cleanup Levels. It should be noted that the Groundwater IROD for McClellan set interim groundwater cleanup goals based on MCLs. Final groundwater cleanup levels will be established in the Final Basewide Groundwater OU ROD, which should be completed before the next Five-Year Review in 2009. The *Decision of the Senior Executive Committee (SEC) Resolving the Formal Dispute over the Proposed Plan for the VOC Operable Unit, McClellan AFB* (SEC, 2001) set forth agreements that resolved the status of disputed ARARs. The resolution resulted in a cleanup level of 5 µg/L for PCE and TCE, which all parties agreed was protective of human health and the environment.

Achieving lower cleanup levels (e.g., 2.3 µg/L for TCE) will be based on a technical and economic feasibility evaluation after 5 µg/L is achieved in each groundwater plume. Within 60 days of achieving 5 µg/L for TCE, the Air Force will work in collaboration with State and EPA RPMs to complete an analysis, using agreed upon models, and prepare a report which evaluates the feasibility of continuing remediation until plume levels reach 2.3 µg/L TCE.

In the Resolution of the Formal Dispute on the Proposed Plan for the VOC OU, the signatory parties (USEPA, U.S. Air Force, and California RWQCB) agreed (in part):

- The parties recognize Section III.G of State Board Resolution 92-49 and the narrative toxicity objective for groundwater in Chapter III of the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins ARARs for the McClellan VOC ROD.
- Under the currently available specific facts at McClellan, the Air Force and EPA believe that both ARARs result in a cleanup standard of 5 parts per billion (ppb) TCE, based primarily on economic feasibility. The State believes that application of both ARARs results in a cleanup standard for 2.3 ppb TCE. The ROD will state 5 ppb as the cleanup standard for TCE. The parties agree to proceed with the cleanup as proposed by the Air Force until such time as 5 ppb is achieved in each plume, as defined, by the BRAC cleanup team. At that point the Air Force in collaboration with the State and EPA RPMs, agrees within 60 days to complete an analysis and prepare a report (using agreed up models), which evaluates the technical and economic feasibility of continuing remediation until plume levels reach 2.3 ppb TCE.

Technical Assessment Summary

According to the documents and data reviewed, site inspection, and interviews, the remedy is functioning as intended by the IROD. The California MCLs are protective of human health and the environment. Table 4-4 summarizes the actions taken to meet the RAOs outlined in the IROD. Containment of the contaminated groundwater above MCLs will be achieved following the completion of the Phase III data gap and expansion project. Issues resulting from this evaluation of the Groundwater OU are presented in the table below.

4.6 ISSUES FOR GROUNDWATER OU

The pending actions and recommendations for the Groundwater OU are summarized below:

Pending Actions	Impact	Plan in Place to Address Issue? (Y/N)	Is Plan Protective Short-Term? (Y/N)	Is Plan Protective Long-Term? (Y/N)	Possible Issue that Could Affect Future Protectiveness? (Y/N)
Complete the data gap investigation, design, groundwater model development, and installation of Phase III expansion to prevent VOC contamination above MCLs from migrating (See Section 4.4).	Phase III design and implementation is key to fulfilling IROD objectives.	Y	Y	Y	N
Issue a letter to the County Health Department to request that they conduct an outreach program to identify those homeowners within the area of off-base contamination who still have groundwater wells and are using those wells for domestic purposes (See Section 4.5.5).	Appropriate actions, such as well abandonment, will result from this outreach program. Ensures homeowners are not exposed to contaminated water.	Y	Y	Y	Y
Prove out the ion exchange system for treatment of hexavalent chromium concentrations in GWTP influent (See Section 4.3.1).	Affect a permanent reduction in hexavalent chromium discharge concentrations without reducing groundwater flow from extraction wells.	Y	Y	Y	N
Prepare a FS to evaluate and prove out treatment options for 1,4-dioxane in groundwater (See Section 4.3.1).	Current GWTP operation does not effectively treat 1,4-dioxane but system might be modified (UV/OX or other technologies).	Y	Y	Y	N
Implement DoD policy regarding "emergent chemicals" once DoD policy is established (See Section 4.2).	If potential source areas exist, they may require further evaluation.	Y	Y	Y	Y
Complete background surveys of non-VOC (including 1,4-dioxane) and inorganic constituents in groundwater (See Section 4.2).	Can affect the selection of remedies and strategy for cleanup of groundwater.	Y	Y	Y	N

Pending Actions	Impact	Plan in Place to Address Issue? (Y/N)	Is Plan Protective Short-Term? (Y/N)	Is Plan Protective Long-Term? (Y/N)	Possible Issue that Could Affect Future Protectiveness? (Y/N)
Complete four quarters of sampling for radiological constituents in groundwater (See Section 4.2).	Establish whether sites with known or suspected radiological contamination have affected groundwater.	Y	Y	Y	Y