UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

75 Hawthorne Street
San Francisco, CA 94105-3901

September 30, 2010

Mr. Douglas V. Fortun
AFRPA Western Region Execution Center
3411 Olson Street
McClellan CA 95652-1003

Dear Mr. Fortun:

SUBJECT: THIRD FIVE-YEAR REVIEW REPORT FOR THE FORMER MATHER AIR FORCE BASE, SACRAMENTO COUNTY, CA.

Dear Mr. Fortun,

The U.S. Environmental Protection Agency (EPA) Region IX received the Draft Final Third Five-Year Review Report for the Former Mather Air Force Base (AFB), Sacramento County, California; dated August 2010 (5YR Report). EPA reviewed the 5YR Report along with other supporting documents and except for the issues identified below, EPA concurs with the findings, recommendations, and conclusions of the 5YR Report. EPA's protectiveness determinations for each Operable Unit (OU) in the 5YR Report are set forth below.

Institutional Controls for all OUs - Institutional Controls (ICs) are included as part of the remedial actions for each of the 19 sites included in the 5YR Report and the ICs are described in the Record of Decision (ROD) for each OU. As described in the 5YR Report, several of the RODs were recently updated by an Explanation of Significant Difference (ESD) to describe the new ICs. The recent ESDs were finalized after the 5YR Report had been submitted. In accordance with the RODs and ESDs, the Air Force should submit an annual IC report to the regulatory agencies for review.

OU1 (AC&W) - The remedial action at the OU1 (AC&W) is protective of human health and the environment in the short term.

OU2 (Groundwater) – OU2 contains remedies for three groundwater plumes: the Northeast Plume, the Main Base/SAC Area Groundwater Plume, and the Site 7 plume. The remedial action at the Northeast Plume is protective of human health and the environment. However, additional data has been collected at the Main Base/SAC Area Plume and the Site 7 Plume that is relevant to our evaluation of the long-term protectiveness of the remedy. Although the remedies

selected appear to be protective in the short term, in order to determine if the remedies are protective in the long-term, the following actions must be completed at the Main Base/SAC Area Plume and the Site 7 Plume:

> **Main Base/SAC Area Groundwater Plume -** The remedial action for the Main Base/SAC Area Groundwater Plume is protective in the short term and additional information is required in order to determine protectiveness in the long term. Contamination was detected in one off-base industrial pumping well where contamination levels are below the Maximum Contaminant Levels (MCLs). New monitoring wells were recently installed near the leading edge of the off-base portion of the plume known as the SW Lobe. The Air Force needs to develop a plan to address data gaps and continue to monitor the new wells
>
> In addition, there are other industrial wells in the vicinity which need to be assessed and monitored. If the new data shows that the existing groundwater remedy is no longer meeting the requirements of the ROD, then the remedy needs to be optimized and/or modified to address the current site conditions.
>
> **Site 7 Groundwater Plume -** The remedial action for the Site 7 Plume is protective in the short term and additional information is required in order to determine protectiveness in the long term. Groundwater monitoring data indicates that the existing pump and treat system may need additional monitoring locations to adequately evaluate the effectiveness of the system. Additional monitoring data should be collected to determine if the existing groundwater remedy is meeting the requirements of the ROD.

OU3 (Soils) - The remedial action at the OU3 (Soils) is protective of human health and the environment in the short term.

OU4 (Landfills) - The remedial action at the OU4 (Landfills) is protective of human health and the environment in the short term.

OU5 (Basewide) - The remedial action at the OU5 (Basewide) is protective of human health and the environment in the short term.

OU6 (Supplemental Basewide) - The remedial action at the OU6 (Supplemental Basewide) is protective of human health and the environment in the short term.

Site-wide Protectiveness Statement – A site-wide protectiveness statement is required because all OUs achieved construction complete in September 2009. The Former Mather AFB is protective in the short term; however, in order to ensure long term protectiveness, additional data must be collected and evaluated at the Main Base/SAC Groundwater Plume, the Site 7 Groundwater Plume. The Air Force should also submit an annual IC report to the regulatory agencies for review.

Pursuant to Section 27.2 of the FFA, EPA requests that the information identified in EPA's comments be provided as part of a comprehensive evaluation, including continued monitoring and analysis of site conditions at the Main Base/SAC Groundwater Plume, the Site 7 Groundwater Plume, and Site 69. If you have questions regarding these comments, please contact John Lucey at (415) 972-3145 or you can reach me at (415) 972-3438.

Mr. Michael M. Montgomery
Assistant Director of Federal Facilities and
Site Cleanup Branch, Region 9,
U.S. Environmental Protection Agency

Cc:	Franklin Mark,	DTSC
	Marcus Pierce,	RWQCB

DEPARTMENT OF THE AIR FORCE
AIR FORCE REAL PROPERTY AGENCY

MEMORANDUM FOR U.S. Environmental Protection Agency, Region IX
Attn: John Lucey (SFD-8-1)
75 Hawthorne Street
San Francisco CA 94105-3919

AUG 20 2010

FROM: AFRPA Western Region Execution Center
3411 Olson Drive
McClellan CA 95652-1003

SUBJECT: Draft Final Third Five-Year Review Report for former Mather Air Force Base

1. Attached is the Draft Final Third Five-Year Review Report for former Mather Air Force Base for receipt on or about August 23, 2010. The report is scheduled to become final under the Federal Facility Agreement 30 days after receipt.

2. Note that the protectiveness statement included in the Draft Final version reflects the fact that the two Explanation of Significant Difference (ESD) documents clarifying institutional controls for the Basewide, Soil, and Groundwater operable units had not been signed as of 18 August. Given that the final signatures are expected, the protectiveness statement will be revised if the ESDs are signed prior to finalization of the five-year review report.

3. Please address any questions to me at (916) 643-6420, ext. 203, or to Bill Hughes, at (916) 997-1564.

DOUGLAS V. FORTUN
BRAC Environmental Coordinator

Attachment:
Draft Final Third Five-Year Review Report w/RTC (URS, Aug 2010)

cc:
AFCEE/ EXC, Attn: Stanley Pehl w/o enclosure
AFCEE/EXC-McClellan, Attn: Paul Bernheisel
ASE, Attn: Bill Hughes
CA IWMB, Attn: Frank Davies
CVWB, Attn: Marcus Pierce
DTSC, Attn: Franklin Mark
Noblis, Attn: Ken Smarkel
RAB Co-chair, Attn: Sandra Lunceford
Sacramento County EDD, Attn: Rick Balazs
SMAQMD, Attn: Angela Davy
TechLaw, Attn: Amanda Accomazzo-Delgado

18600766.20030

DRAFT FINAL

FORMER MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

THIRD FIVE-YEAR REVIEW REPORT

Prepared by:

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Air Force Real Property Agency
Western Region Execution Center

August 2010

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LIST OF ABBREVIATIONS AND ACRONYMS

AC&W	Aircraft Control and Warning
ACL	aquifer cleanup level
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Engineering and the Environment (formerly Air Force Center for Environmental Excellence)
AFRPA	Air Force Real Property Agency
AGE	aerospace ground equipment
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
ATC	Air Training Command
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and total xylenes
BV	bioventing
Cal Am	California American Water Company
Cal/EPA	California Environmental Protection Agency
CBRA	comprehensive baseline risk assessment
CCR	California Code of Regulations
CCl_4	carbon tetrachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
cfm	cubic feet per minute
CHHSL	California human health screening level
CIWMB	California Integrated Waste Management Board
COC	contaminant of concern
Contingency Plan	Mather AFB Off-Base Water Supply Contingency Plan
CVWB	Central Valley (Regional) Water (Quality Control) Board
CZA	capture zone analysis
DCE	dichloroethene
DD	drainage ditch (IRP site designation)
DTSC	California Department of Toxic Substances Control
EA Engineering	EA Engineering, Science, and Technology
EPA	United States Environmental Protection Agency
ESD	explanation of significant difference(s)
FAA	Federal Aviation Administration
FFA	Federal Facility Agreement
FFS	focused feasibility study
FS	feasibility study
FT	fire training (IRP site designation)

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

GAC	granular activated carbon
gpm	gallons per minute
GWMPER	Groundwater Monitoring Program Evaluation Report
HLC	Henry's law constant
HSG	hydrostratigraphic
IC	institutional control
ID	identification
ILCR	incremental lifetime cancer risk
ILS	instrumented landing system
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
lb/day	pounds per day
LF	landfill (IRP site designation)
LMT	Laguna-Mehrten Transition
Mather	former Mather Air Force Base
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram per day
mg/L	milligrams per liter
MNA	monitored natural attenuation
msl	mean sea level
MWH	Montgomery Watson Harza Americas, Inc.
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OEHHA	Office of Environmental Health Hazard Assessment
O&M	operations and maintenance
OPS	operating properly and successfully
OT	other (IRP site designation)
OU	Operable Unit
OWS	oil-water separator
PAH	polycyclic aromatic hydrocarbon
PCE	perchloroethene (a.k.a. tetrachloroethene)
PHG	Public Health Goal
POL	petroleum, oil, and lubricant
ppmv	parts per million by volume
PRG	preliminary remediation goal
PRP	potentially responsible party

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

RAB	Restoration Advisory Board
RAO	remedial action objective
RI	remedial investigation
ROC	reactive organic compound
ROD	record of decision
ROI	radius of influence
RPM	Remedial Project Manager
RSL	regional screening level
RW	radioactive waste (IRP site designation)
SAC	Strategic Air Command
scfm	standard cubic feet per minute
SCWA	Sacramento County Water Agency
SD	storm drain (IRP site designation)
SLUC	State Land Use Covenant
SMAQMD	Sacramento Metropolitan Air Quality Management District
SNARL	suggested no-adverse-response level
SS	sanitary sewer (IRP site designation)
ST	storage tank (IRP site designation)
SVE	soil vapor extraction
SVMP	soil vapor monitoring point
SWBZ	shallow water bearing zone
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TPHD	total petroleum hydrocarbons reported as diesel
TPHG	total petroleum hydrocarbons reported as gasoline
USAF	United States Air Force
UST	underground storage tank
VOC	volatile organic compound
WP	waste pit (IRP site designation)
WREC	Western Region Execution Center
µg/L	micrograms per liter
%	percent
1Q05	first quarter 2005 (quarter, year)

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Mather Air Force Base		
EPA ID *(from WasteLAN)*: CA8570024143		
Region: 9	**State:** CA	**City/County:** Rancho Cordova/Sacramento
SITE STATUS		
NPL status: **Final** Deleted Other (specify)		
Remediation status (choose all that apply): Under Construction **Operating** **Complete**		
Multiple OUs?* **YES** No	**Construction completion date:** 09/29/09	
Has site been put into reuse? **YES** NO		
REVIEW STATUS		
Lead agency: EPA State Tribe Other Federal Agency **US Air Force**		
Author name: Doug Fortun		
Author title: BRAC Environmental Coordinator (BEC)	**Author affiliation:** Air Force Real Property Agency (AFRPA)	
Review period: **January 2004 through December 2008		
Date(s) of site inspection: On-site presence by AFRPA (weekly) and O&M contractor (daily)		
Type of review: **Post-SARA** Pre-SARA NPL-Removal only Non-NPL Remedial Action Site NPL State/Tribe-lead Regional Discretion		
Review number: 1 (first) 2 (second) **3 (third)** Other (specify) _____		
Triggering action: Actual RA Onsite Construction at OU #____ Actual RA Start at OU #____ Construction Completion **Previous Five-Year Review Report** Other (specify)		
Triggering action date *(from WasteLAN)*: 11 / 24 / 2004 **Triggering action date (signature of previous five-year review report)** 07 / 10 / 2005		
Due date *(agreed by AFRPA and U.S. EPA to resolve different interpretations of triggering action date):* 09 / 30 / 2010, extended during review of draft Third Five-Year Review Report at request of U.S. EPA and during comment resolution by AFRPA.		

*["OU" refers to operable unit.]

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

Five-Year Review Summary Form (cont'd.)

Issues:

No issues were identified for Sites WP-07/FT-11 and SD-59 in the Soil OU; Sites LF-03 and LF-04 in the Landfill OU; or Sites FT-10C/ST-68, LF-18, OT-23C, and OT-87 in the Basewide OU.

AC&W OU

Boeing extraction well EX-2 is located northeast, regionally upgradient, of the AC&W Plume and is completed in Unit D, in the horizon just below Unit C that contains the AC&W Plume. The well began operating in 2006 to remove perchlorate not associated with Mather or the AC&W Plume. Upward vertical gradients induced by pumping for the AC&W remedial action have helped to limit or prevent downward transport of TCE into Unit D. Vertical gradient analysis conducted in 2006 showed that upward vertical gradients in the western and central portions of the AC&W Plume do not appear affected by pumping in EX-2. However, vertical gradients in the eastern (upgradient) portions of the plume may have been reversed or weakened by pumping from the EX-2 well. Groundwater samples collected from monitoring wells completed in Unit D in the eastern portions of the plume area did not have any detections of TCE in 2007 and 2008.

All the operating extraction wells and most monitoring wells at the AC&W Site have shown decreasing TCE concentration trends in response to the remedial action since 1997. These trends have generally continued during the last five years with two of the extraction wells exhibiting asymptotic concentrations. One extraction well has had TCE concentrations less than the ACL since the second quarter of 2006, and another well had a TCE concentration less than the ACL starting in the second quarter of 2008. Trends in monitoring and extraction wells along the center axis of the plume show TCE concentrations have been stable to decreasing over the last two years. The extraction wells with TCE concentrations less than ACLs should be considered for rebound testing and evaluated against the decision logic for shutting down extraction wells. Information from the rebound testing may be used to optimize the system and used in modeling to predict time frames for full remediation of the plume.

Groundwater OU

Main Base/SAC Area Plume. The interpreted extent of CCl_4 greater than the MCL in Unit B increased in an area near Happy Lane in 2008. This increase was due to recent CCl_4 detections in existing monitoring wells and newly installed well MAFB-451, and reinterpretation of the Unit B portion of the plume. This resulted in a CCl_4 plume interpretation in this area that is more continuous than previous interpretations. Information from the Southwest Lobe CZA suggests the eastern portions of the plume in this area may be captured by new extraction well MBS EW-13BuB. The western portions of this plume area may be captured by pumping from the Juvenile Hall water-supply wells. However, continued monitoring and analysis may be warranted to evaluate concentration trends and confirm capture of this portion of the plume.

Sampling results from the new monitoring wells generally define the extent of the Southwest Lobe of the Main Base/SAC Area Plume to ACLs or near ACLs. Evaluations conducted for the Southwest Lobe CZA show that extraction well MBS EW-13BuB (brought online in April 2008) captures much of the Southwest Lobe. However, the conclusions regarding definition and capture of the lobe are based on only a few rounds of sampling. In addition, samples collected in 2009 from off-base well OFB-72 had detectable concentrations of TCE at 3.8 and 3.6 μg/L. OFB-72 is located approximately 2,700 feet southwest of monitoring wells MAFB-457Bs and

MAFB-458Bd. Wells MAFB-457Bs and MAFB-458Bd have had TCE concentrations greater than the ACL. Two dual completion monitoring wells (MAFB-460Bs/Bd and MAFB-461Bs/Bd) were installed in late 2009 in the area of OFB-72 to better define the extent of the Southwest Lobe and collect potentiometric data in the vicinity of the leading edge of the plume. MAFB-460Bs/Bd is located approximately 700 feet northeast of OFB-72 and approximately 2,050 feet southwest of MAFB-458Bs/Bd and MAFB-457Bs/Bd. Initial sample results from MAFB-460Bs/Bd were less than the ACL for TCE. TCE was not detected in the initial samples collected from MAFB-461Bs/Bd (located approximately 1,150 feet west and slightly south of MAFB-460Bs/Bd). Additional monitoring of these new wells will aid in confirming this definition of the extent of the Southwest Lobe.

The Air Force installed a wellhead treatment system at the Moonbeam Drive water-supply well in 1997 and has maintained the GAC system since in compliance with the Contingency Plan. The well has had more than six consecutive monthly samples with concentrations of COCs less than one-half MCLs. A six-month advance notice of termination of wellhead treatment maintenance at the Moonbeam Drive supply well was submitted to Cal Am. The memorandum states that the Air Force plans to terminate the maintenance of the system (six months from 9 March 2009) in accordance with the Contingency Plan. Termination of maintenance would take place on or after 9 September 2009.

Site 7 Plume. Performance monitoring of the Site 7 Plume remedial action since the system was restarted in December 2006 has demonstrated COC removal from groundwater. Evaluation of 2007 monitoring data and a more detailed CZA for Site 7 conducted in 2009 suggest a majority of the plume is being captured by the extraction system. Continued monitoring is warranted to evaluate concentration trends and confirm capture of the plume.

Northeast Plume. The area of the plume exceeding the ACLs has decreased over time since groundwater monitoring began. Well MAFB-132 has the highest concentration of PCE and cis-1,2-DCE in the plume. From approximately 2003 until the fourth quarter of 2006, the well had increasing PCE and cis-1,2-DCE concentration trends. Subsequently, there has been an overall decreasing trend in concentrations of these constituents through the second quarter of 2009. If the decreasing trend in PCE and cis-1,2-DCE concentrations at MAFB-132 persist at the current rate, concentrations less than the ACLs may be attained within the next five years. PCE concentrations at MAFB-136 since 2006 had been less than the ACL until an increase greater the ACL occurred in the fourth quarter of 2008. The concentration decreased to just above the ACL in the second quarter of 2009.

The Groundwater OU ROD included a commitment to perform modeling prior to the first five-year review, to predict how much time will be required for the contaminant concentrations to decrease to less than the ACLs. The modeling was not accomplished for that review. However, an evaluation of the Northeast Plume was conducted in 2001 and 2002. Inspection of the wells with contaminant detections revealed that the concentrations exhibited sporadic patterns that did not allow confident predictions of future concentrations. The report recommended continued monitoring of the Northeast Plume as opposed to initiating active remediation. It also recommended a similar evaluation be conducted periodically as monitoring data warrant, but no less frequently than the five-year reviews.

The second five-year review stated that future predictive modeling was potentially viable based on the evident initial decreasing contaminant concentration trends observed within that time period. The forecast would be dominated by predictions based on results from well MAFB-132, which was the only well with concentrations significantly greater than ACLs. The report

recommended that the annual groundwater monitoring reports provide projections and an assessment of trends in the wells with the highest concentrations that may indicate when ACLs might be reached.

The recommendation in the last five-year review remains valid. It appears that decreasing PCE and/or cis-1,2-DCE concentration trends at MAFB-132 from 2006 through 2009 allow the projection of concentrations of these analytes to at or less than the ACLs. Trend extrapolation was conducted for PCE and cis-1,2-DCE data from MAFB-132. The extrapolation suggests that if the trends through 2009 continue, ACLs would be reached in 2012 (extrapolation of a best-fit linear trend line) or 2025 (extrapolation of a best-fit exponential trend line). The trend analysis was conducted using standard curve-fitting formulas found in Microsoft Excel 2007. If the assumption that the area near MAFB-132 will require the longest time to achieve ACLs holds true (MAFB-132 has had the highest concentrations of PCE and cis-1,2-DCE), and the trends observed from 2006 through 2009 continue, the Northeast Plume will meet ACLs around 2025. However, the prediction is not intended to be relied upon with any great certainty, but rather to indicate whether at this time modeling indicates that the contaminants will not meet the ACLs within a reasonable time, or at least forty years from the date of the ROD. It is too early to determine whether the recent concentration decreases at MAFB-136 indicate a consistent trend.

Soil OU

Site 37/39/54. Residual contaminants adsorbed to fine-grained, high moisture content soils are difficult to remediate and are prolonging achievement of the RAOs for Site ST-37/ST-39/SS-54. Performing status quo SVE may not be adequate because SVE readily becomes diffusion-limited and is inefficient.

Site 57. Concentrations of TCE have generally decreased across the site to concentrations less than 1 ppmv. Only two locations (57-MPMP-11/57-PZ-11 and 57-MPMP-12/57-PZ-12) in the deep vadose zone at the site exhibit TCE vapor concentrations of approximately 2 ppmv, and the contaminants are contained within the moist smear zone just above the water table at the transition between the vadose zone and the saturated zone. Removal of contaminants in these conditions through SVE is not likely to be technically achievable or cost effective.

Institutional Controls

Sites WP-12 (AC&W Site) and OT-89. The Air Force is required to conduct annual monitoring, provide annual reports and undertake prompt action to address activity that is inconsistent with the IC objective or use restrictions, or any action that may interfere with IC effectiveness. The requirements for annual monitoring reports were instituted in 2006 for the Basewide OU Site OT-89 and in 2008 for Site WP-12 (AC&W Site). Through 2008, annual monitoring reports on the status of ICs for Sites OT-89 and WP-12 have not been completed. These annual monitoring reports are also necessary in the preparation of five-year reviews to evaluate the effectiveness of the ICs.

Recommendations and Follow-Up Actions:

No recommendations or follow-up actions were identified for Sites WP-07/FT-11 and SD-59 in the Soil OU; Sites LF-03 and LF-04 in the Landfill OU; or Sites FT-10C/ST-68, LF-18, OT-23C, and OT-87 in the Basewide OU.

AC&W OU

Continue sampling of the Unit D monitoring wells in the eastern portion of the plume area near Boeing extraction well EX-2 to help confirm pumping from the extraction well is not causing migration of TCE into Unit D.

Implement plans to shut down extraction wells with TCE concentrations less than ACLs and monitor for potential rebound while maintaining plume capture. Continued progress of the remedy has been evident during the last five years with two extraction wells exhibiting asymptotic levels. One extraction well has also had TCE concentrations less than the ACL since the second quarter of 2006, and another well had a TCE concentration less than the ACL in the second quarter of 2008. The plume appears to be shrinking in size and trends in monitoring and extraction wells along the center axis of the plume show TCE concentrations have been stable to decreasing over the last two years. Data collected from the rebound monitoring may be used to optimize the system and to predict (via modeling) when ACLs may be achieved.

Groundwater OU

Main Base/SAC Area Plume. Continue monitoring and evaluation of sample results from Unit B wells in the area near Happy Lane. The interpreted extent of CCl_4 greater than the MCL in Unit B increased in the area near Happy Lane in 2008. Data evaluation and the Southwest Lobe CZA suggest this area of the plume is captured by extraction well MBS EW-13BuB and the Juvenile Hall supply wells. The sampling results will be used to assess concentration trends and confirm capture of this portion of the plume.

Continue monitoring of newly installed monitoring wells MAFB-460Bs/Bd and MAFB-461Bs/Bd in the area of OFB-72. Initial sampling of these wells defined the extent of the Southwest Lobe to ACLs. Additional monitoring will aid in confirming this definition of the extent of the Southwest Lobe and the extent of capture by extraction well MBS EW-13BuB. In addition, continue monitoring the off-site private wells in the area of the Southwest Lobe to confirm the wells are not impacted.

Implement the termination of wellhead treatment maintenance at the Moonbeam Drive supply well. The well has had six consecutive monthly samples with concentrations of COCs less than one-half MCLs. A memorandum to Cal Am states that the Air Force plans to terminate the maintenance of the system (six months from 9 March 2009) in accordance with the Contingency Plan. The well will continue to be sampled as part of the off-base water-supply well monitoring program.

Site 7 Plume. Continue monitoring and evaluate results relative to the detailed CZA of the Site 7 Plume conducted in 2009. The 2009 CZA incorporated data not available during the earlier capture analysis that used data through 2007. The results of future monitoring may be used to evaluate future system performance, demonstrate capture of the plume, and show progress of the remedy toward achieving objectives.

Northeast Plume. Continue to monitor and evaluate concentration trends at monitoring wells MAFB-132, MAFB-133, and MAFB-136. ACLs are currently predicted to be achieved by approximately 2025 at MAFB-132, which is assumed to require the longest time to achieve ACLs in the Northeast Plume. It is too early to determine whether the recent concentration decreases at MAFB-136 indicate a consistent trend. Predictions of time to achieve ACLs should

be updated periodically (e.g., as part of each five-year review) to incorporate future monitoring results.

Soil OU

Site 37/39/54. Evaluate alternative remediation approaches (e.g., excavation of shallow soils) or enhancements/modifications (e.g., fracturing or thermal enhancement technologies) to the SVE remedy that are capable of expediting cleanup of residual contamination adsorbed to low-permeability soil.

Site 57. As previously recommended in SVE reports, conduct vadose zone modeling at Site 57 to determine whether the residual contaminant concentrations in the deep vadose zone just above the water table will result in sufficient mass flux to groundwater to result in aqueous concentrations that exceed ACLs. If contaminant concentrations will impact groundwater, conduct a cost-benefit analysis to assess the need for additional deep SVE wells versus allowing concentrations to persist and be remediated by the Main Base/SAC Area Plume groundwater treatment system.

Institutional Controls

Sites WP-12 (AC&W Site) and OT-89. Ensure that the ICs established in the RODs, ESDs, and the Landfill OU memorandum of post-ROD changes, are monitored on an annual basis, as required, and establish an ICs checklist and monitoring program. In addition, following signature on the Soil OU and Groundwater OU ESD and Basewide OU ESD, annual IC monitoring will be required at the sites noted in those documents.

Protectiveness Statement:

The following statements address the protectiveness of the remedial actions taken at Mather for each OU.

AC&W OU

The remedy for the AC&W OU is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Groundwater OU

The remedies for the Groundwater OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Soil OU and Groundwater OU ESD that is pending authorizing signatures.

Soil OU

The remedies for the Soil OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Soil OU and Groundwater OU ESD that is pending authorizing signatures.

Landfill OU

The remedies for the Landfill OU are protective of human health and the environment.

Basewide OU

The remedies for the Basewide OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Basewide OU ESD that is pending authorizing signatures.

Supplemental Basewide OU

The remedy for the Supplemental Basewide OU is protective of human health and the environment.

Comprehensive Protectiveness Statement for Mather

The remedial actions at the AC&W OU, Landfill OU, and Supplemental Basewide OU are protective. However, because the remedial actions at the Groundwater, Soil, and Basewide OUs are not protective in the long term, the site is not protective of human health and the environment at this time. The remedial actions at these OUs are not protective because ICs are not in place. To ensure protectiveness, ICs need to be implemented per the Soil OU and Groundwater OU ESD and Basewide OU ESD that are pending authorizing signatures.

1.0 INTRODUCTION

This is the third five-year review report for remedial actions performed at the former Mather Air Force Base (Mather) pursuant to the records of decision (RODs) for Operable Units (OUs) 1 through 6:

- OU 1 – *Superfund Record of Decision: Aircraft Control and Warning Site* (AC&W), *Mather Air Force Base, Sacramento County, California* (Air Force Base Conversion Agency [AFBCA], 1993), referred to herein as the AC&W OU ROD.

- OUs 2 (Groundwater) and 3 (Soil) – *Superfund Record of Decision, Soil Operable Unit Sites and Groundwater Operable Unit Plumes, Mather Air Force Base, Sacramento County, California* (AFBCA, 1996a), referred to herein as the Groundwater OU ROD or the Soil OU ROD, as appropriate.

- OU 4 – *Superfund Record of Decision, Landfill Operable Unit Sites, Mather Air Force Base, Sacramento County, California* (AFBCA, 1995), referred to herein as the Landfill OU ROD.

- OU 5 – *Record of Decision, Basewide Operable Unit Sites, Mather Air Force Base, California* (AFBCA, 1998a), referred to herein as the Basewide OU ROD.

- OU 6 – *Record of Decision for the Supplemental Basewide Operable Unit Sites, Mather Air Force Base, Sacramento County, California* (Air Force Real Property Agency [AFRPA], 2006), referred to herein as the Supplemental Basewide OU ROD.

This third five-year review covers the period from January 2004 to mid-2009. Five-year reviews of remedial actions at Mather are required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

1.1 Purpose and Statement of Authority

The purpose of a five-year review is to determine whether the remedial response actions are protective of human health and the environment and, as necessary, to provide recommendations for attaining and/or maintaining sustainable protection. As this is the third five-year review for remedial actions at Mather, this review evaluated changes in remedy implementation during this five-year period and actions taken in response to recommendations in the *Second Five-Year Review of Remedial Actions* (AFRPA, 2005a). The second five-year review for Mather can be viewed online at https://afrpaar.lackland.af.mil/ar/getdoc.aspx?file=MATHR_AR_2157.pdf or at http://www.epa.gov/superfund/sites/fiveyear/f05-09001.pdf.

Executive Order 12580 delegates review responsibility to federal facilities that control the sole source of the release. This five-year review for Mather was conducted by the United States Air Force (Air Force)/ AFRPA, using URS Group, Inc. (URS) under contract to the Air Force Center for Engineering and the Environment (AFCEE). This report will become part of the Administrative Record for each site for which a five-year review is herein documented.

The Air Force is responsible for managing environmental programs at Mather, including the Installation Restoration Program (IRP). The IRP at Mather is managed in accordance with the Federal Facility Agreement (FFA) developed specifically for Mather. The FFA ensures that environmental impacts are thoroughly investigated and that appropriate cleanup actions are taken to protect human health, welfare, and the environment. As described in the FFA, authority for IRP decision making rests with a team of

remedial project managers (RPMs) from the Air Force, United States Environmental Protection Agency Region 9 (EPA), and the State of California. The State of California is represented by the California Environmental Protection Agency (Cal/EPA), Department of Toxic Substances Control (DTSC), in coordination with the Central Valley Regional Water Quality Control Board (CVWB), the Integrated Waste Management Board, and other State agencies as appropriate. The Air Force is the lead agency responsible for funding and implementing remedial actions, and EPA provides final approval for decisions regarding remedial actions taken at Mather. EPA, DTSC, and CVWB also provide regulatory oversight, including technical support, review, and comment on all CERCLA investigative and remedial work at Mather.

The Air Force is providing this five-year review report in accordance with CERCLA Section (§)121 and the National Oil and Hazardous Substances Pollution 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 EPA 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.*

This third five-year review was prepared using the guidelines provided in *Comprehensive Five-Year Review Guidance* (EPA, 2001). The trigger for this review is the signing of the second five-year review. EPA signed the second five-year review report for Mather on 24 November 2004, and the Air Force signed the report on 10 July 2005. This third review was initiated in April 2009 and spans the period from January 2004 to mid-2009. The completion due date of 24 September 2009 identified in the prior report for this third five-year review report was extended based on the five-year anniversary of the signing of the prior review report. EPA and AFRPA each interpreted the due date as based on their own agency's signature date (i.e., either November 2004 or July 2005, respectively). At the June 2009 Base Realignment and Closure (BRAC) Cleanup Team (BCT) meeting, the RPMs agreed to a completion due date of January 2010 for this third five-year review for Mather. However, during the comment resolution period, EPA and AFRPA extended this date to 30 September 2010.

1.2 Scope and Nature of Third Five-Year Review

This five-year review addresses the IRP sites at Mather that trigger either a statutory review or a policy review. Five-year statutory reviews are required by statute for all sites for which a remedial action is selected that result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. Policy reviews are conducted by EPA at sites, which on completion of remedial action will allow unlimited use and unrestricted exposure, but which will require at least five years to attain the cleanup levels specified in the ROD. This review identifies the sites at Mather that fit EPA's definitions for statutory or policy reviews. However, the five-year review is

the same, regardless of whether it is required by statute, or identified in EPA guidance as a site to be reviewed as a matter of policy. A summary list of Mather's IRP sites, their remediation status, and the type of five-year review that was conducted is presented in Table 1-1. For completeness, Table 1-2 identifies the Mather IRP sites that do not require a five-year review because contaminants do not remain at those sites at concentrations that preclude unlimited use and unrestricted exposure.

Table 1-1. Installation Restoration Program Sites that Require a Five-Year Review

Site ID	Site Description	OU	Requirement for Review		Comments
			Statutory	Policy	
LF-03	NE Perimeter Landfill No. 1	4	X		Cap in place; LTO&M; ICs.
LF-04	NE Perimeter Landfill No. 2	4	X		Cap in place; LTO&M; ICs.
WP-07	"7100" Waste Pit Area Disposal Site	3	X		Cap in place; LTO&M; ICs; SVE operated between September 1998 and March 2006; BV began in April 2007 (WP-07 remediated with FT-11). Clarification of ROD ICs and additional ICs pending signature of Soil OU and Groundwater OU ESD.
FT-10C	Former Fire Training Area 3 (revised location)	5		X	SVE system turned off in August 2008; excavation of lead contaminated soil in November 2008; draft final closure report issued in November 2009 (FT-10C remediated with ST-68). ICs pending signature of Basewide OU ESD.
FT-11	Existing Fire Training Area (used from 1958 to 1993)	3		X	ICs; SVE operated between September 1998 and March 2006; BV began in April 2007 (FT-11 remediated with WP-07). Clarification of ROD ICs and additional ICs pending signature of Soil OU and Groundwater OU ESD.
WP-12	AC&W Site	1	X		Groundwater extraction and treatment since 1994; ICs; OPS concurrence by EPA in November 1998.
LF-18	Old Burial Site (north of Facility 4120)	5		X	SVE turned off in November 2008 (treatment system at SD- 59); draft final closure report issued in November 2009. ICs pending signature of Basewide OU ESD.
OT-23	Main Base Sanitary Sewer System	5		X	SVE operating since April 2000. ICs pending signature of Basewide OU ESD.
ST-37	Five Former USTs at Bioenvironmental Storage Yard, Facility 3389	3		X	SVE operating since December 1998 (remediated with ST-39 and SS-54). ICs pending signature of Soil OU and Groundwater OU ESD.
ST-39	Eight Former USTs at Hazardous Waste Storage Facility 4305	3		X	SVE operating since December 1998 (remediated with ST-37 and SS-54). ICs pending signature of Soil OU and Groundwater OU ESD.

Table 1-1. (Continued)

Site ID	Site Description	OU	Requirement for Review: Statutory	Requirement for Review: Policy	Comments
SS-54	Hazardous Waste Accumulation Point at AGE Shop, Facility 4348	3		X	SVE operating since December 1998 (remediated with ST-37 and ST-39). ICs pending signature of Soil OU and Groundwater OU ESD.
SD-57	OWS at Facility 7019	3		X	SVE operating since August 1997. ICs pending signature of Soil OU and Groundwater OU ESD.
SD-59	OWS at ATC Wash Rack, Facility 4251	3		X	Excavation followed by SVE; SVE operating since February 2000. ICs pending signature of Soil OU and Groundwater OU ESD.
ST-68	Eighteen USTs for SAC Area JP-4 Hydrant System	5		X	SVE system turned off in August 2008; excavation of lead contaminated soil in November 2008; draft final closure report issued in November 2009 (ST-68 remediated with FT-10C). ICs pending signature of Basewide OU ESD.
OT-87	Rod and Gun Club Skeet and Trap Range (Facility 10330)	5	X		Excavation and soil stabilization; ICs; ROD-required small mammal monitoring ongoing in 2009. Clarification of ROD ICs pending signature of Basewide OU ESD.
OT-89	Old Trap Range	6	X		ICs.
	Main Base/SAC Area Plume	2		X	Phased groundwater extraction and treatment began in 1998; ICs. Clarification of ROD ICs and additional ICs pending signature of Soil OU and Groundwater OU ESD.
	Northeast Plume	2		X	Long-term groundwater monitoring since 1996; ICs. Draft OPS report submitted to EPA in January 2009. Clarification of ROD ICs and additional ICs pending signature of Soil OU and Groundwater OU ESD.
	Site 7 Plume	2		X	Groundwater extraction and treatment began in 1999; intermittent operation due to mining activities; system has been operating consistently since December 2006; ICs. Clarification of ROD ICs and additional ICs pending signature of Soil OU and Groundwater OU ESD.

Table 1-1. (Continued)

AC&W	=	Aircraft Control and Warning	No.	=	number
AGE	=	aerospace ground equipment	OT	=	other
ATC	=	Air Training Command	OPS	=	operating properly and successfully
BV	=	bioventing	OU	=	operable unit
EPA	=	United States Environmental Protection Agency	OWS	=	oil-water separator
ESD	=	explanation of significant difference	ROD	=	record of decision
FT	=	fire training	SAC	=	Strategic Air Command
IC	=	institutional control	SD	=	storm drain
ID	=	identification	SS	=	sanitary sewer
JP-4	=	jet propellant fuel	ST	=	storage tank
LF	=	landfill	SVE	=	soil vapor extraction
LTO&M	=	long-term operations and maintenance	UST	=	underground storage tank
NE	=	northeast	WP	=	waste pit

Note that as of June 2010, two explanations of significant differences (ESDs) are pending signature for the Soil and Groundwater OUs and the Basewide OU. The ESDs add institutional controls (ICs) to soil sites that are subject to policy reviews for this third five-year review and will trigger statutory reviews for the fourth five-year review, if the sites are closed with ICs during the period covered by the fourth five-year review. If the sites are not closed during the period of the fourth five-year review, a policy review will still be required. Sites in this category may include FT-10C, FT-11, LF-18, OT-23, ST-37, ST-39, SS-54, SD-57, SD-59, and ST-68. In addition, upon signature of the Soil OU and Groundwater OU ESD, ICs will be implemented for the Main Base/SAC Area, Site 7, and Northeast groundwater plumes; therefore, these groundwater plumes will require a statutory five-year review for the fourth five-year review.

Table 1-2. Installation Restoration Program Sites that Do Not Require a Five-Year Review

Site ID	Site Description	OU	Comments
LF-01	Runway Overrun Landfill	4	NFA in Landfill OU ROD.
LF-02	“8150” Area Landfill	4, 5	Landfill waste moved to Site LF-04 as removal action; confirmed as selected remedy in Basewide OU ROD; closed with RAR concurrence in September 2000.
LF-05	NE Perimeter Landfill No. 3	4	Landfill waste moved to Site LF-04; groundwater monitoring associated with LF-05 remedy completed.
LF-06	Firing Range Area Landfill Sites	4	Landfill waste moved to Site LF-04; groundwater monitoring completed in 2002; regulatory agency concurrence in April 2003.
FT-08	Former Fire Training Area 1	5	NFA in Basewide ROD.
FT-09	Former Fire Training Area 2 (used from 1945 to 1947)	3	NFA in Soil OU and Groundwater OU ROD.
FT-10	Former Fire Training Area 3 (used from 1947 to 1958)	3	NFA in Soil OU and Groundwater OU ROD.
SD-13	Drainage Ditch No. 1 (east of Facility 2950)	3	Excavation of ditch sediment and surface soils; closed with RAR concurrence in September 2000.
SD-14	Drainage Ditch No. 2 (northeast of Facility 3975)	3	NFA in Soil OU and Groundwater OU ROD.
SD-15	Drainage Ditch No. 3 (West), includes OWS Facility 7039	3	Excavation of ditch sediment; closed with RAR concurrence in September 2001.

Table 1-2. (Continued)

Site ID	Site Description	OU	Comments
RW-16	Electron Tube Burial Site under Facility 8170	3	NFA in Soil OU and Groundwater OU ROD.
WP-17	Weapons Storage Area Septic Tank (south of Facility 18080)	5	NFA in Basewide OU ROD.
WP-19[a]	Fuel Tank 4015 and Sludge Burial Site (near Facility 4012)	3	NFA in Soil OU and Groundwater OU ROD; closed by CVWB letter in February 2002.
ST-20	Sewage Treatment Plant UST and Sludge Drying Beds	3/5	CERCLA closure pending results of ROD-required groundwater sampling for phthalates completed in 2009; phthalates were not detected. RAR expected to be finalized in 2010. UST closure letters from SCEMD in June 1987 and June 1998; UST also closed by CVWB letter in May 1998.
OT-21	Asphalt Rubble Storage Site (northeast of Facility 7125)	3	NFA in Soil OU and Groundwater OU ROD.
OT-22	Asphalt Rubble Storage Site	3	NFA in Soil OU and Groundwater OU ROD.
ST-24	JP-4 Spill Site at SAC Aircraft Parking Apron	3	NFA in Soil OU and Groundwater OU ROD.
ST-25	Former UST for Emergency Generator, Facility 10100	1	NFA in AC&W ROD; also closed by CVWB letter in November 2001.
ST-26	Former UST for ILS Localizer Emergency Generator, Facility 10072	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-27	Former UST for Communications Transmitter Emergency Generator, Facility 10060	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in August 2001.
ST-28	Former UST for Water Supply Emergency Generator, Facility 16100	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-29[a]	Four Former USTs at Military Gas Station, Facility 3167	3	NFA in Soil OU and Groundwater OU ROD, but remains to be closed under other regulations; SVE operating since August 1995 (remediated with ST-71 by treatment system for Sites 37/39/54).
ST-30	Former UST Security Police Emergency Generator, Facility 10300	1	NFA in AC&W ROD; also closed by CVWB letter in November 2001.
ST-31	Former UST Transmitter Emergency Generator, Facility 10090	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-32[a]	Six Former USTs at AAFES Service Station, Facility 2410	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in April 1997.
ST-33	Six Former USTs at Civil Engineering Paint Shop, Facility 3308	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in August 2001.

Table 1-2. (Continued)

Site ID	Site Description	OU	Comments
ST-34[a]	Five Former USTs at AAFES Service Station, Facility 21030	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2000.
ST-35[a]	Four Former USTs at POL Yard 1, Facility 3226	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in February 2005.
ST-36 [a]	Four Former USTs at Old Rail Yard 2, Facility 3286	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in February 2005.
ST-38	Two Former USTs at Bioenvironmental Storage Yard, Facility 3388	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-40	Former UST for Training Classroom Boiler, Facility 3875	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991 and CVWB letter in August 2001.
ST-41	Two Former USTs at Old Motor Pool, Facility 2995	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991and CVWB letter in August 2001.
ST-42	Former UST at Old Motor Pool, Facility 2898	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991and CVWB letter in August 2001.
ST-43	Two Former USTs Water Supply Emergency Generator, Facility 10150	3	NFA in Soil OU and Groundwater OU ROD; closed by SCEMD letters in January 1991and October 1996.
SD-44	Former OWS at old Weapons Storage Area, Facility 8540	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991.
ST-45	Former Ammonia UST for Missile Facility, Facility 7003	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in January 1991.
ST-46	Former UST for Alert Crew Emergency Generator, Facility 8158	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996.
ST-47	Former UST near Security Police Facility 10400B	1	NFA in AC&W ROD; also closed by SCEMD letter in October 1996.
ST-48	Former UST for Security Police Facility 10410	3	NFA in Soil OU and Groundwater OU ROD.
ST-49	Former UST for Security Police Facility 10450	3	NFA in Soil OU and Groundwater OU ROD; also closed by CVWB letter in November 2001.
ST-50	Same as ST-34	NA	
ST-51	Former UST for ILS Glide Slope Emergency Generator Facility 10030	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996.
ST-52	Former UST for Security Police Emergency Generator Facility 10400A	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996.
ST-53	Former UST for Weapons Storage Area Boiler, Facility 18051	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996.
SD-55	OWS at Facility 7038	3	NFA in Soil OU and Groundwater OU ROD.

Table 1-2. (Continued)

Site ID	Site Description	OU	Comments
SD-56	OWS at former Motor Pool Wash Rack, Facility 2989	3	Excavation followed by SVE and BV; closed with RAR concurrence in October 2002.
SD-58	OWS at Army Helicopter Wash Rack, Facility 4771	3	NFA in Soil OU and Groundwater OU ROD.
SD-60	OWS at Facility 6900 (north side of Facility 7005)	3	Excavation followed by SVE; closed with RAR concurrence in February 2002.
SD-61	OWS at Facility 6905 (south side of Facility 7005)	3	NFA in Soil OU and Groundwater OU ROD.
OT-62	OWS at Facility 7110 (Jet Engine Test Stand Facility 7099)	3	Excavation of surface and shallow subsurface soil; closed with RAR concurrence in June 2001.
SD-63	OWS and two USTs at former Auto Hobby Shop, Facility 3320	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in October 1996.
SD-64	OWS at Fuel Truck Wash Rack, Facility 4120	3	NFA in Soil OU and Groundwater OU ROD.
SD-65	OWS at Facility 6910 (north corner of Facility 7009)	3	Excavation of surface and shallow subsurface soils; closed with RAR concurrence in September 2000.
SD-66	OWS at Facility 6915 (north corner of Facility 7024)	3	NFA in Soil OU and Groundwater OU ROD.
SD-67	Sanitary Sewer System in the SAC Area	5	NFA in Basewide OU ROD.
OT-69	Ordnance Burning and Detonation Area	3	Excavation of surface soil and sediments; closed with RAR concurrence in October 2003. Temporary ICs pending signature of Soil OU and Groundwater OU ESD, which will trigger evaluation in fourth five-year review.
ST-70	Former UST at Dining Hall, Facility 1226	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in August 1994 (referred to as Site A in ROD).
ST-71[a]	Five Former USTs at AVGAS Pumping Station, Facility 3271	3	NFA in Soil OU and Groundwater OU ROD, but remains to be closed under other regulations; SVE operating since August 1995 (remediated with ST-29 by treatment system for Sites 37/39/54); ST-71 referred to as Site B in ROD.
ST-72	Former UST at Water Plant, Facility 3975	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996 (referred to as Site C in ROD).
ST-73	Former UST for ILS Localizer Emergency Generator Facility 10015	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996 (referred to as Site E in ROD).
ST-74	Former UST for Utility Vault Emergency Generator Facility 10065	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996 (referred to as Site F in ROD).
ST-75	Former UST at Weapons Storage Area, Facility 18018	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letters in June 1996 (referred to as Site G in ROD).
ST-76	Former UST at Weapons Storage Area, Facility 18011 and 18020	3	NFA in Soil OU and Groundwater OU ROD; 18011 also closed by SCEMD letters in June 1996; 18011 and 18020 referred to as Site H in ROD.
ST-77	Former UST Army Helicopter Pad, Facility 4853	3	NFA in Soil OU and Groundwater OU ROD; also closed by SCEMD letter in October 1996 (referred to as Site I in ROD).

Table 1-2. (Continued)

Site ID	Site Description	OU	Comments
ST-78	Two USTs East of Facility 2527 (2527 and 2527B)	NA	Closed by SCEMD letters in June 1987, July 1997, and June 1998; 2527B also closed by CVWB letter in May 1998.
ST-79	UST East of Facility 4540	NA	Closed by SCEMD letters in June 1987 and June 1998; also closed by CVWB letter in May 1998.
SD-80	Golf Course Maintenance Area Drainage	6	NFA in Supplemental Basewide OU ROD.
ST-81	Sewage Oxidation Ponds	5	NFA in Basewide OU ROD.
OT-82[a]	Golf Course Maintenance Area (near Facility 8869)	5	NFA in Basewide OU ROD; also closed by CVWB letter in August 1999.
SD-83[a]	Army Aviation Helicopter Washrack (Facility 4771)	5	NFA in Basewide OU ROD, but remains to be closed under other regulations.
SD-84	Sewer Lines SAC Area to Sewage Treatment Plant	5	NFA in Basewide OU ROD.
SD-85	South Ditch (NE Morrison Creek Tributary from Facility 10030 to 10085)	6	NFA in Supplemental Basewide OU ROD.
OT-86	Military Small Arm Firing Range (Facility 12500)	5	Excavation and soil stabilization; closed with RAR concurrence in October 2003.
DD-88	Drainage Ditch Morrison Creek from Mather Lake to AC&W Area	6	NFA in Supplemental Basewide OU ROD.

[a] Petroleum-only, non-CERCLA sites.

AAFES = Army Air Force Exchange Service
AC&W = Aircraft Control and Warning
AVGAS = aviation gasoline
BV = bioventing
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CVWB = Central Valley Regional Water Quality Control Board
DD = drainage ditch
FT = fire training
IC = institutional control
ID = identification
ILS = instrumented landing system
JP-4 = jet propellant fuel
LF = landfill
NA = not applicable
NE = northeast
NFA = no further action
No. = number
OT = other
OU = operable unit
OWS = oil-water separator
POL = petroleum, oil, and lubricant
RAR = remedial action report
ROD = record of decision
RW = radioactive waste
SAC = Strategic Air Command
SCEMD = Sacramento County Environmental Management Department
SD = storm drain
ST = storage tank
SVE = soil vapor extraction
UST = underground storage tank
WP = waste pit

As outlined in Appendix E of *Comprehensive Five-Year Review Guidance* (EPA, 2001), this five-year review report is presented in the following sections.

Section 1.0 Introduction: Identifies the purpose of the review, the authority for conducting the review, the areas of the site addressed in the review and those areas not addressed in the review, and the action that triggered the review.

Section 2.0 Chronology: Presents important site events for each OU.

Section 3.0 Background: Provides a succinct description of site characteristics. The purpose of the section is to identify the threat posed to the public and environment at the time of the ROD so that the performance of the remedy can be easily compared with the site conditions the remedy was intended to address.

Section 4.0 Remedial Actions: Provides a concise description of implementation history and the current status of the remedy.

Section 5.0 Progress Since Last Review: Restates the recommendations from the second five-year review and discusses actions taken or relevant events that have occurred since.

Section 6.0 Five-Year Review Process: Describes activities performed during the five-year review (e.g., site interviews and document review) and summarizes the findings, as appropriate.

Section 7.0 Technical Assessment: Provides answers to the three questions required for the assessment (i.e., Question A: Is the remedy functioning as intended by the decision documents? Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid? Question C: Has any other information come to light that could call into question the protectiveness of the remedy?)

Section 8.0 Issues: Identifies issues related to current site operations, conditions, or activities, noting which issues, if any, prevent the remedy from being protective, currently or in the future.

Section 9.0 Recommendations and Follow-Up Actions: Specifies required and suggested improvements to current site operations, activities, remedies, or conditions for those issues that affect current and/or future protectiveness.

Section 10.0 Protectiveness Statement: Provides a protectiveness statement for each OU at which a remedial action has begun.

Section 11.0 Next Five-Year Review: Identifies the need and time frame for the next five-year review.

Section 12.0 References: Provides reference information for sources cited in the document.

The report is supplemented with the following appendices:

Appendix A: Operational and Remedial Histories of the SVE/Bioventing Systems

Appendix B: Interview Records

Appendix C: Response to Comments

2.0 SITE CHRONOLOGIES

This section incorporates information about the site chronology for Mather as a whole, followed by a chronology of major events for each IRP site at Mather that requires a five-year review. For site chronology information on IRP sites that do not require a five-year review, the reader is referred to the five RODs listed in Section 1.0, closure and remedial action reports (RARs), and the first and second five-year reviews (AFBCA, 1999a; AFRPA, 2005a). These documents are readily available in the Administrative Record for Mather, which can be accessed at 3411 Olson Street, McClellan, California 95652 or online at https://afrpaar.lackland.af.mil/ar/docsearch.aspx.

2.1 Overview of Mather Air Force Base History

There are now 89 IRP sites at Mather, the locations of which are shown on Figure 2-1. There are also four major volatile organic compound (VOC) groundwater plume areas (Figure 2-1). The 89 IRP sites have been categorized into six OUs, based on similarities in type of site and/or timing of cleanup decisions. OU 1 (referred to as the AC&W OU) consists of a contaminated groundwater plume, as well as three sites where underground storage tanks (USTs) were removed. OU 2 (referred to as the Groundwater OU) consists of three other contaminated groundwater plumes with sources at Mather, which lie beneath and two of which extend downgradient of Mather. OU 3 (referred to as the Soil OU) is comprised of contaminated soil associated with waste disposal pits, oil-water separators (OWS), gas stations, USTs, fire training areas, and other miscellaneous sites. OU 4 (referred to as the Landfill OU) consists of six sites where municipal waste was buried. OUs 5 and 6 (referred to as the Basewide OU and Supplemental Basewide OU, respectively) consist of the remaining contaminated soil sites identified at Mather.

2.2 AC&W OU Chronology

The AC&W site is the location of a radar station now operated by the Federal Aviation Administration (FAA) but formerly operated jointly by the FAA and the Air Force. The AC&W OU consists of IRP Site WP-12 and three nearby IRP sites (ST-25, ST-30, and ST-47) where USTs were removed between 1987 and 1993 (Figure 2-1). No further action was required at the UST sites per the AC&W OU ROD. The outline of the AC&W groundwater plume as of the fourth quarter of 2008 is shown on Figure 2-1.

2.2.1 AC&W Plume

In 1979, the water-supply well serving the AC&W area was sampled by the Air Force and found to be contaminated with the VOC trichloroethene (TCE). Follow-on investigations in the 1980s revealed a TCE plume extending from the vicinity of the radar site approximately one mile southeast to the family housing area, predominantly in the upper 60 feet of the aquifer. The maximum concentration of TCE reported was approximately 1,000 micrograms per liter (µg/L).

Remedial investigation/feasibility study (RI/FS) activities, which included a baseline risk assessment (BRA) were completed in 1991 (IT Corporation, 1991a; 1991b). A proposed plan was released to the public in October 1991. A revised proposed plan was released to the public in March 1992. Subsequently, the AC&W OU ROD was signed in December 1993 (AFBCA, 1993), and a pump-and-treat remedial action with discharge of treated effluent to injection wells began operating in December 1994. However, because the injection system could not accommodate the design flow, treated water was diverted from the injection system to surface water discharge at Mather Lake starting in June 1997. The change in the discharge component of the remedy is documented in the *Explanation of Significant Difference to the AC&W OU Record of Decision: Discharge of Treated Groundwater to Mather Lake* (AFBCA, 1997a).

In September 1998, the Air Force issued a report of proper and successful operation (a.k.a. operating properly and successfully [OPS]) for the AC&W remedial action (AFBCA, 1998b), which received EPA concurrence in November 1998 (EPA, 1998).

In 2008, ICs were added to the groundwater remedy through a second ESD for the AC&W OU (AFRPA, 2008a).

2.3 Groundwater OU Chronology

The Groundwater OU consists of all groundwater contamination originating from sources at Mather, with the exception of the AC&W OU Plume (see Section 2.2). The Groundwater OU has been subdivided into the following four plumes with their apparent major sources in parentheses:

- Main Base/Strategic Air Command (SAC) Area Plume
  - Main Base Plume (dry cleaner at IRP Site OT-23C);
  - SAC Industrial Area Plume (OWS at IRP Site SD-57);
- Site WP-07 Plume (waste pit at IRP Site WP-07); and
- Northeast Plume (landfills at IRP Sites LF-03 and LF-04).

The RI for the Groundwater OU identified VOC plumes in groundwater beneath Mather (IT Corporation, 1993a). In March 1995, a focused feasibility study (FFS) of remedial alternatives for the Main Base, SAC Area, Site WP-07, and Northeast Plumes was completed (IT Corporation, 1995), and the Proposed Plan was released to the public in May 1995. In June 1996, the Groundwater OU ROD was signed, and remedial actions were selected for each of the identified groundwater plumes (AFBCA, 1996a). A brief summary of the remedial actions selected for the Groundwater OU plumes and the startup of those actions is described in Sections 2.3.1 through 2.3.3, as well as in more detail in Sections 4.0 and 7.0. Known vadose zone sources are addressed as part of the Soil, Landfill, or Basewide OUs and discussed in Sections 2.4 through 2.6. Figure 2-1 shows the outline of the Groundwater OU plumes as of the fourth quarter of 2008.

2.3.1 Main Base/SAC Area Plume

The Groundwater OU ROD combined the Main Base and SAC Industrial Area groundwater plumes for purposes of selecting a remedial alternative. The contaminants of concern (COCs) for the Main Base/SAC Area Plume include multiple VOCs (see Section 3.5), total petroleum hydrocarbons as diesel (TPHD), total petroleum hydrocarbons as gasoline (TPHG), and lead. The remedial action for the Main Base/SAC Area Plume includes groundwater extraction, air stripping with off-gas treatment (carbon adsorption) as necessary, reinjection and possibly alternate methods of discharge for treated water, groundwater monitoring, and land-use restrictions. The Groundwater OU ROD calls for a phased implementation of the remedial action for the Main Base/SAC Area Plume. Phase I extraction wells, addressing hot spots of groundwater contamination on the former base, began operating in April 1998. Phase II extraction wells, addressing off-base hot spots, and Phase III extraction wells, augmenting Phase I capture, began operating in January 2000. To complete the Phase III expansion, three additional extraction wells were installed and began operating during the third quarter of 2001. Phase IV extraction wells, expanding capture off base and further augmenting extraction on Mather, began operating in September 2002. Two additional extraction wells, addressing capture of the off-site leading edges of the plume to the west and southwest of the Main Base/SAC Area, began operating in 2005 and 2008, respectively. All operating (as of

September 2009) Main Base/SAC Area Plume extraction wells are listed in Section 4.1.2 and shown on Figure 4-2.

An ESD has been prepared to clarify and supplement the Groundwater OU land-use restrictions with respect to their implementation and to add ICs (AFRPA, 2009a).

2.3.2 Site 7 Plume

The remedial action selected in the Groundwater OU ROD for the Site WP-07 Plume (referred to as the Site 7 Plume) consists of groundwater extraction, treatment by air stripping with off-gas treatment (carbon adsorption) as necessary, injection of treated effluent, and land-use restrictions (AFBCA, 1996a). The COCs for the Site 7 Plume include multiple VOCs (see Section 3.5) and TPHD. Construction of the Site 7 treatment system was completed in October 1998. Between 1998 and 2004, the Site 7 system operated for three separate periods as a result of interruptions by off-base aggregate mining activities. However, the system has operated continuously with two extraction wells since December 2006.

An ESD has been prepared to clarify and supplement the Groundwater OU land-use restrictions with respect to their implementation and to add ICs (AFRPA, 2009a).

2.3.3 Northeast Plume

The remedial action selected in the Groundwater OU ROD for the Northeast Plume consists of long-term groundwater monitoring and land-use restrictions. The COCs for the Northeast Plume include multiple VOCs (see Section 3.5). The remedy calls for reconsideration of active remediation if monitoring or modeling indicates that the contaminants will not meet cleanup standards within a reasonable time, or within 40 years of the ROD, or indicates that significant migration of the contaminants will occur at concentrations greater than the cleanup levels that will impact public health or the environment. An ESD has been prepared to clarify and supplement the Groundwater OU land-use restrictions with respect to their implementation and to add ICs (AFRPA, 2009a).

In January 2009, the Air Force issued a draft report of proper and successful operation (a.k.a. OPS) for the Northeast Plume remedial action (AFRPA, 2009b). As of June 2010, comment resolution with EPA has commenced, and a draft final OPS report is in preparation.

2.4 Soil OU Chronology

The Soil OU is comprised of contaminated soils associated with waste disposal pits, OWSs, gas stations, USTs, fire training areas, and other miscellaneous sites. RIs for Soil OU sites were conducted as part of the IRP Program and completed in 1993 (IT Corporation, 1993a, 1993b). In March 1995, an FFS of remedial alternatives for the Soil OU sites was completed (IT Corporation, 1995), and the Proposed Plan was released to the public in May 1995. In June 1996, the Soil OU ROD was signed (AFBCA, 1996a).

Remedial actions were selected for 14 IRP sites in the Soil OU ROD (AFBCA, 1996a). Of those 14 sites, remedial actions have been completed at 7 sites, and they require no further action (Table 1-1). The other seven sites are currently undergoing remedial actions, and a brief summary of those remedial actions are described in Sections 2.4.1 through 2.4.4, as well as in more detail in Sections 4.0 and 7.0. Some sites are grouped together because of proximity and a common remedial action. Although all of the sites may require groundwater monitoring, if contamination that threatens groundwater quality remains at the sites, impact to groundwater underlying these sites is addressed by the Groundwater OU (Site 7 Plume or the Main Base/SAC Area Plume), as discussed in Section 2.3. The location of the sites discussed below in relation to the groundwater plumes is shown on Figure 2-1.

2.4.1 Site WP-07/FT-11

Site WP-07 (7100 Area Disposal Site) and Site FT-11 (Existing Fire Training Area) were combined for the purpose of implementing in situ treatment to remediate soil contaminated with TPHD and TPHG. Site WP-07 is the apparent source area for the Site 7 groundwater contaminant plume that extends off base to the south-southwest (Figure 2-1). The remedial action selected in the Soil OU ROD for Site WP-07/ FT-11 consists of filling in the depression at Site WP-07 with inert fill; treating the contaminated shallow and deep soils by bioventing (BV) and possibly soil vapor extraction (SVE); installing a landfill cover; and land-use restrictions to protect the landfill cap at Site WP-07. The remedy was modified by an ESD to allow use of contaminated soil from other sites to build up the cap foundation (AFBCA, 1998c).

The former disposal area was brought up to grade by receiving soils excavated from the West Ditch (Site SD-15), the South Ditch (Site SD-85), and from other IRP cleanup activities. An engineered cap was constructed over the disposal area in 1999. VOCs in the vadose zone at Site WP-07/FT-11 were initially remediated by separate SVE systems starting in late 1998 but were later combined and operated with a single treatment unit. In April 2007, the SVE treatment system was converted to a BV system, as volatile contaminant concentrations had significantly decreased.

An ESD to clarify and augment the remedy by establishing ICs has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. The ESD also deletes numeric soil cleanup levels for TPHD and TPHG and adds narrative soil cleanup levels at Site WP-07/FT-11.

2.4.2 Site ST-37/ST-39/SS-54

Sites ST-37, ST-39, and SS-54 have been combined for the purpose of implementing in situ treatment to remediate soil contaminated with total petroleum hydrocarbons (TPH) and benzene, toluene, ethyl-benzene, and total xylenes (BTEX). Site ST-37 consisted of five USTs, which were removed. Site ST-39 was the former hazardous waste storage yard and prior to that a storage and distribution point for aviation gasoline. Site ST-39 also contained pipelines and fuel filter sumps and eight USTs, which were removed. Site SS-54 was the aerospace ground equipment (AGE) repair shop and contained a hazardous waste accumulation point and a wash rack. The remedial action selected in the Soil OU ROD for Site ST-37/ ST-39/SS-54 includes excavation and ex situ treatment of soil by bioremediation and in situ treatment of contaminated shallow and deep soils by BV and possibly SVE.

Prior to excavation, trenching activities were conducted to determine the extent of soil requiring removal to meet the site's cleanup levels. Based on the trenching results, the site met the cleanup levels without further excavation (Montgomery Watson, 2000a). Therefore, no excavation was conducted with the exception of the soils from the investigative trenches.

An SVE system was constructed in summer 1998, and after a period of startup and troubleshooting, became operational in December 1998. At the time of this review, the treatment unit at Site ST-37/ ST-39/SS-54 also was connected to and treated vapors from the extraction systems at Site ST-29/ST-71, which is a non-CERCLA IRP site.

An ESD to add ICs to the remedy for Site ST-37/ST-39/SS-54 (as well as Sites OT-23B and -23D from the Basewide OU, which is remediated with Site ST-37/ST-39/SS-54) has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. The ESD also deletes numeric soil cleanup levels for BTEX, TPHD, and TPHG and adds narrative soil cleanup levels at Site ST-37/ST-39/SS-54.

2.4.3 Site SD-57

Site SD-57 consisted of the former AGE washrack OWS located at Facility 7019. A TCE soil gas plume extends from this apparent source area to the southwest, overlying the heart of the TCE groundwater plume (Figure 2-1). SVE is the remedy selected in the Soil OU ROD for Site SD-57 (AFBCA, 1996a).

The SVE system began operating at Site SD-57 in August 1997. In 2001, dual-phase extraction was initiated at three water table groundwater extraction wells for the purpose of removing vapor and increasing the groundwater extraction rate for these wells.

An ESD to add ICs to the remedy for Site SD-57 has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures.

2.4.4 Site SD-59

Site SD-59 consisted of the former Air Training Command (ATC) washrack OWS located at Facility 4251. Contaminants in soil at Site SD-59 include TPHD and TPHG. The remedial action selected in the Soil OU ROD for Site SD-59 includes excavation and ex situ treatment of soil by bioremediation.

The OWS and surrounding soil were excavated in 1996 in accordance with the remedial action selected in the ROD, but some contamination remained. As a result, additional remediation by in situ methods (SVE/BV) was chosen by the Air Force to address the residual contamination and documented in an ESD (AFBCA, 1998d). The SVE system was installed and became operational in February 2000, following a pilot test in December 1998.

An ESD to add ICs to the remedy for Site SD-59 (as well as Site LF-18 from the Basewide OU, which is remediated with Site SD-59) has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. The ESD also deletes numeric soil cleanup levels for TPHD and TPHG and adds narrative soil cleanup levels at Site SD-59.

2.5 Landfill OU Chronology

Contamination exists at the Landfill OU sites as a result of past military operations conducted between 1918 and 1974. The landfills were mainly used for the disposal of general and sanitary refuse. In addition to garbage and household trash, it was reported that petroleum, oil, and lubricant (POL) wastes, as well as waste solvents, may have been disposed in the landfills. It was also reported that daily burning of the refuse occurred at two of the landfills (Sites LF-03 and LF-04).

Investigations were conducted at the inactive landfill sites during the RI (IT Corporation, 1993a), and in October 1993, an FFS of remedial alternatives was completed for the Landfill OU (IT Corporation, 1993c). In January 1994, the Proposed Plan was released to the public for review and comment, and the *Superfund Record of Decision, Landfill Operable Unit Sites, Mather Air Force Base, Sacramento County, California* was signed in July and August 1995 (AFBCA, 1995).

Remedial actions were selected for five IRP sites in the Landfill OU ROD (AFBCA, 1995). Of those five sites, remedial actions have been completed at three sites (LF-02, LF-05, and LF-06), and they require no further action (Table 1-1). The other two sites (LF-03 and LF-04) are undergoing remedial actions, and a brief summary of those remedial actions are described in Sections 2.5.1 and 2.5.2, as well as in more detail in Sections 4.0 and 7.0. Both sites require groundwater monitoring, and impact to groundwater underlying these sites is addressed in part by the Landfill OU ROD and in part by the Groundwater OU

ROD (Northeast Plume monitoring for VOCs), as discussed in Section 2.3. The location of the sites discussed below in relation to the groundwater plumes is shown on Figure 2-1.

2.5.1 Site LF-03

Site LF-03 was reportedly the main sanitary landfill for Mather from 1950 through 1967. Site LF-03 is located in the northeast portion of Mather (Figure 2-1). The remedial action selected in the Landfill OU ROD for Site LF-03 includes an engineered cap, groundwater and landfill gas monitoring, access restrictions (i.e., fencing and signage) and ICs (i.e., deed restrictions prohibiting incompatible land uses). The site was capped in 1996, and groundwater and landfill gas monitoring continue to the present. In addition, a memorandum of post-ROD changes has been prepared to clarify and supplement the ICs for Site LF-03 (AFRPA, 2009c).

2.5.2 Site LF-04

Site LF-04 is to the east of Site LF-03 (Figure 2-1) and was reportedly the main sanitary landfill site for the entire Base from 1967 through 1971. The remedial action selected in the Landfill OU ROD for Site LF-4 consists of an engineered cap, flood control measures (i.e., an embankment), groundwater and landfill gas monitoring, access restrictions (i.e., fencing and signage) and ICs (i.e., deed restrictions prohibiting incompatible land uses). The Landfill OU ROD also includes consolidation of wastes excavated from Sites LF-05 and LF-06 into LF-04. In addition, the *Explanation of Significant Difference from the Record of Decision, Consolidation of Additional Refuse & Debris into Landfill Site 4* (AFBCA, 1996b) modifies the remedy to include consolidation of waste excavated from Site LF-02 into Site LF-04.

Site LF-04 was capped in 1996, with vegetation completed in 1997. Groundwater and landfill gas monitoring continue to the present. In addition, a memorandum of post-ROD changes has been prepared to clarify and supplement the ICs for Site LF-04 (AFRPA, 2009c).

2.6 Basewide OU Chronology

The Basewide OU addresses sites which were not included as part of the OUs described in Sections 2.2 through 2.5. The Basewide OU is comprised of contaminated soils associated with an area of suspected waste burial and runoff from aircraft operations, USTs, fire training areas, sewage treatment facility/systems, a firing range, and a skeet/trap range. The Basewide OU sites were investigated under the Mather IRP and are described and evaluated in the RI/FFS documents (IT Corporation, 1993a; 1993b; 1996a; 1997a; 1997b). The Proposed Plan became available to the public in May 1997. In September 1998, the Basewide OU ROD was signed (AFBCA, 1998a).

Remedial actions were selected for six IRP sites in the Basewide OU ROD (AFBCA, 1998a). Of those six sites, a remedial action has been completed at one site (OT-86), which requires no further action (Table 1-1). The other five sites are currently undergoing remedial actions, although draft final closure reports have been prepared for sites FT-10C/ST-68 and LF-18. (Sites FT-10C and ST-68 are grouped together because of their proximity and common remedial action.) A brief summary of the remedial actions are described in Sections 2.6.1 through 2.6.4, as well as in more detail in Sections 4.0 and 7.0. Any impact to groundwater underlying these sites is addressed by the Groundwater OU (Main Base/SAC Area Plume), as discussed in Section 2.3. The location of the sites discussed below in relation to the groundwater plumes is shown on Figure 2-1.

2.6.1 Site FT-10C/ST-68

Site FT-10C was the site of fire training exercises from approximately 1947 to 1958 where POL waste was ignited and extinguished during training exercises conducted at the site. Site ST-68 is the adjacent site where a fuel storage facility consisting of sixteen 50,000-gallon and two 2,000-gallon USTs for storing jet propellant fuel #4 (JP-4), a fuel distribution manifold, and pumps previously existed (fire training was relocated to Site FT-11 when the fuel storage system was built). After site investigation and prior to the signing of the Basewide OU ROD, debris and soil (including lead-impacted surface soil) were excavated from Site FT-10C and disposed at Site LF-04 under a removal action memorandum (AFBCA, 1996c). An additional investigation was conducted and a pilot SVE system was installed in 1997 to determine the extent of subsurface VOC and petroleum hydrocarbon contamination and evaluate the effectiveness of in situ remediation technologies at Site FT-10C/ST-68 (EA Engineering, Science, and Technology [EA Engineering], 1997).

In situ treatment (SVE and/or BV) of subsurface soil contaminated with TPHD, TPHG, and BTEX is the remedial action selected in the Basewide OU ROD for Site FT-10C/ST-68 (AFBCA, 1998a). SVE and BV have each been used as part of the remedy since August 1997. Additional lead-contaminated soil was discovered at the site in 2002. Therefore, an ESD was prepared to add excavation of the lead-contaminated soil to the remedy for Site FT-10C/ST-68 (AFRPA, 2008b). The lead-contaminated soil was excavated in November and December 2008 and disposed at an appropriately permitted off-site landfill (MWH Americas, Inc. [MWH], 2009a). In addition, an ESD to add ICs to the remedy at Site FT 10C/ST-68 has been prepared (AFRPA, 2009d), and as of June 2010, is awaiting signatures. These ICs address residual VOC contamination in soil only; lead-contaminated soil has been removed to levels that allow for unrestricted use. Further, the ESD deletes the numeric soil cleanup levels for TPHD and TPHG and adds narrative soil cleanup levels (AFRPA, 2009d). A draft final closure report has been prepared to document that no further treatment is required at Site FT-10C/ ST-68 (MWH, 2009b).

2.6.2 Site LF-18

Site LF-18 is located adjacent to the aircraft parking apron at the west end of the Main Base flight line (Figure 2-1). Historically, Site LF-18 had been identified as the Old Burial Site, however, investigations found no evidence of landfill or burial activities. Soil contamination (TCE and 1,2-dichloroethene [DCE]) may be from storm runoff or contaminants from the nearby tarmac where aircraft maintenance activities may have occurred, rather than from a burial site. SVE pilot tests were conducted at Site LF-18 in 1993, 1995, and 1998 (IT Corporation, 1995; 1996b; Montgomery Watson, 1999a). The pilot tests confirmed that SVE was an effective technology to remove VOCs from the soil at Site LF-18. Therefore, an SVE system comprised of extraction wells and possibly passive injection wells is the remedy selected in the Basewide OU ROD for Site LF-18 (AFBCA, 1998a). An SVE system was constructed in 1999 and began operation in 2000. A draft final closure report has been prepared to document that no further treatment is required at Site LF-18 (MWH, 2009c).

An ESD to add ICs to the remedy for Site LF-18 to prevent health risks from exposure to VOC-contaminated soils has been prepared (AFRPA, 2009d), and as of June 2010, is awaiting signatures. In addition, because Site LF-18 is being remediated with Soil OU Site SD-59, the protection of remaining SVE piping and wells is included with Site SD-59 in an ESD for the Soil OU remedies (AFRPA, 2009a). The Basewide OU ESD adds ICs to the remedy for Site SD-59 and Site LF-18 (including Site OT-23A).

2.6.3 Site OT-23

Site OT-23 was originally identified and defined as two leaky sections of the sanitary sewer line. During the RI, the site was redefined to consist of all the sewer lines on the Main Base that drained buildings

where TCE was reported as stored or used (IT Corporation, 1993a) (Figure 2-1). Sampling from soil borings during the RI identified no significant contamination associated with Site OT-23. Additional RI work focused on the portions of the sanitary sewer line that were located above water-table contamination (IT Corporation, 1996a). A sewer-line flushing and soil-gas survey project was conducted along the suspect lines, and although no significant contaminants were found within the sewer lines, contamination was identified in some of the soil gas samples collected from borings near the sewer lines. On this basis, the Basewide OU ROD identifies four areas (Subsites OT-23A, -23B, -23C, and -23D) requiring remedial action (AFBCA 1998a). Subsite OT-23A is addressed by the SVE remedial action at Site LF-18 (Section 2.6.2), and Subsites OT-23B and OT-23D are addressed by the SVE remedial action at Site ST-37/ST-39/SS-54 (Section 2.4.2). TCE was identified as a COC at Site OT-23A and Site OT-23B; cis-1,2-DCE was identified as a COC at Site OT-23B; and xylenes were identified as COCs at Site OT-23D.

Site OT-23C was further defined in 1998, near the site of a former dry cleaning plant where a source of tetrachloroethene (PCE) contamination was found. SVE is the remedy selected in the Basewide OU ROD for Subsite 23C (AFBCA, 1998a). The SVE system for Site OT-23C was constructed in 1999 and began operation in 2000. An ESD to add ICs to the remedy at Site OT-23C has been prepared (AFRPA, 2009d), and as of June 2010, is awaiting signatures.

2.6.4 Site OT-87

Site OT-87 was a skeet and trap range at Mather located near the AC&W Site (Figure 2-1). It contained an area where clay pigeon fragments had accumulated, and an area of lead shot that encompassed part of Morrison Creek. COCs in sediments at Site OT-87 include arsenic and lead; COCs in surface soil include lead and multiple semivolatile organic compounds (SVOCs) (see Section 3.5). The remedial action selected in the Basewide OU ROD for Site OT-87 consists of excavation and backfill with clean soil, separation of lead shot, treatment of lead-containing soil, disposal of the treated soil at Site WP-07, and ICs (AFBCA, 1998a). The contaminated soil, clay pigeon material, and lead shot were excavated in 1998. The soil was processed to remove recoverable lead and stabilized as necessary for use in building the foundation for the Site WP-07 cap.

In addition, the Basewide OU ROD requires small mammal monitoring to ensure that the residual levels of lead left in place at Site OT-87 do not present a hazard to small mammals. To accomplish this goal, monitoring of lead levels in small mammal tissue is required on an annual basis for three years, with the results evaluated in an annual monitoring report to the regulatory agencies (AFBCA, 1998a). The third year of monitoring was completed in 2009, but consensus has not yet been reached on the significance of the findings. The Basewide OU ROD also requires evaluation of any dead waterfowl found at the site.

The remedial action was conducted with a cleanup standard for lead that is consistent with recreational use. Therefore, unrestricted use (i.e., residential use) of the property is not permitted, and ICs are in place as a part of the remedy. An ESD has been prepared to clarify the implementation of ICs at Site OT-87 (AFRPA, 2009d). A remedial action report was finalized in September 2009 (AFRPA, 2009e) and received EPA concurrence (EPA, 2009a).

2.7 Supplemental Basewide OU Chronology

The Supplemental Basewide OU was established to address four IRP sites and an area of concern (AOC) which had not been addressed in previous Mather RODs. Sites SD-80, SD-85, and DD-88, all of which are drainage ditch sites, were initially investigated, evaluated, and proposed for remedial action in the Basewide OU RI and FFS (IT Corporation, 1996a; 1997b) and Basewide OU Proposed Plan. At that time, it was noted by the regulatory agencies that the extent of contamination (pesticides primarily plus

polycyclic aromatic hydrocarbons (PAHs), metals, and TPH at Site SD-85) for these sites was not adequately defined, toxicity tests were not conclusive, and consensus was not reached on cleanup levels; therefore, the sites were not included in the Basewide OU ROD. Consequently, additional site data were collected, and the sites were incorporated into the Supplemental Basewide OU. In addition, a newer IRP site (Site OT-89) and an AOC (the Suspected Ordnance Burial AOC) were included in the Supplemental Basewide OU. These latter two were not part of the IRP when the Basewide OU was defined.

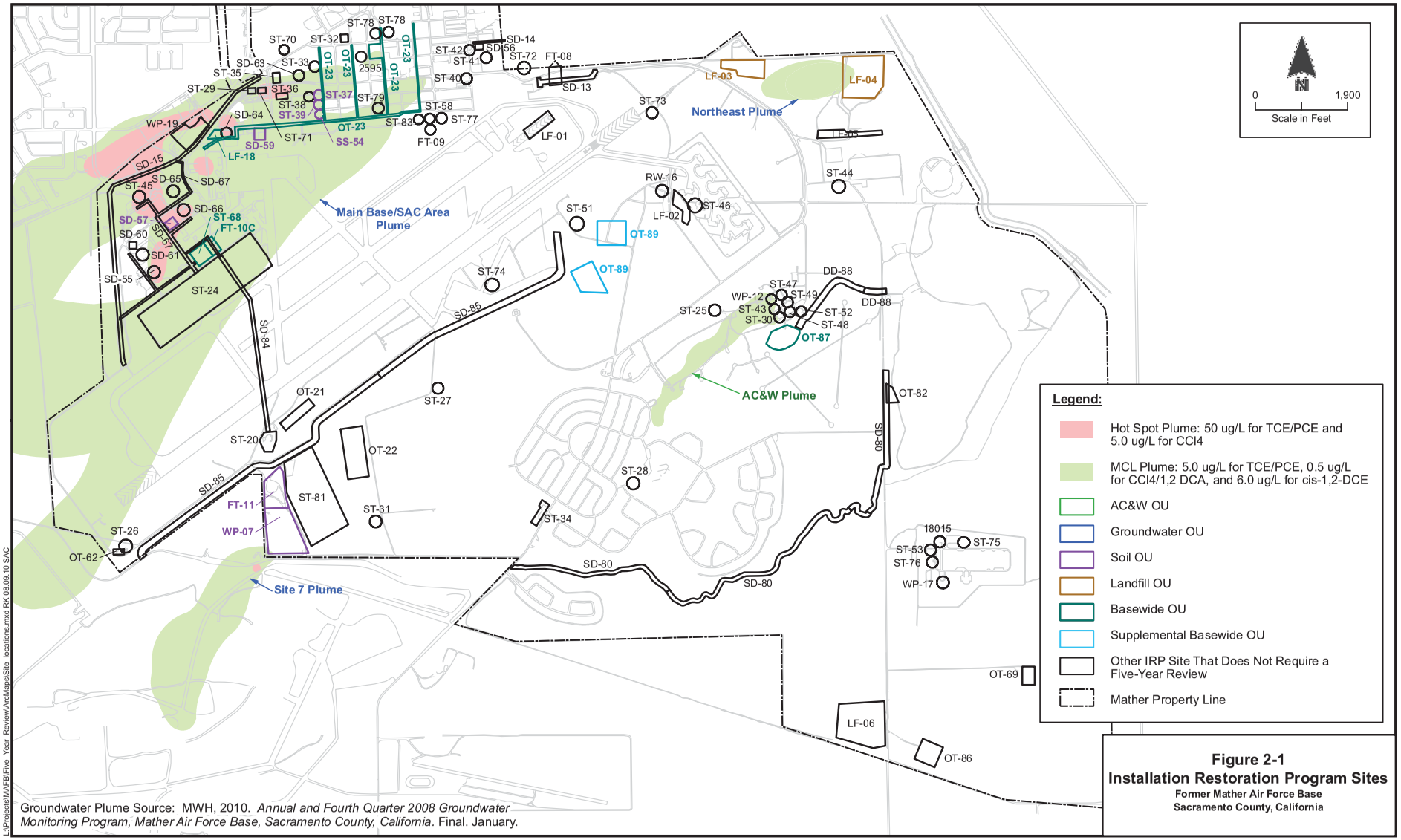
Excavation of contaminated sediment was conducted as part of removal actions for Sites SD-80, SD-85, DD-88, and OT-89 under the Air Force IRP and CERCLA programs (AFBCA, 1997b; 1999b; 2001a; 2001b; MWH, 2002a; 2002b). In addition, a pilot study was conducted at Site OT-89 during the remedial action for Site OT-87 (Basewide OU) to determine whether the soil from Site OT-89, containing lead shot, could be successfully cleaned using the same stabilization technology used for Site OT-87 (Montgomery Watson, 2000b).

The Supplemental Basewide OU FFS was finalized in September 2000 (IT Corporation, 2000), and the Proposed Plan was released to the public. The Supplemental Basewide OU ROD was finalized in September 2006 (AFRPA, 2006). Finalization of the Supplemental Basewide OU ROD was delayed to resolve disagreements regarding implementation of ICs. As a result of the removal actions, no further action is required at Sites SD-80, SD-85, and DD-88 (AFRPA, 2006). The selected remedy for the Suspected Ordnance Disposal AOC is also no further action because site investigations did not identify site contamination or evidence of ordnance disposal at the AOC (EOD Technology, 1999 and AFRPA, 2006). A brief summary of the remedial action selected for Site OT-89 is described in Section 2.7.1, as well as in more detail in Sections 4.0 and 7.0. The locations of the Supplemental Basewide OU sites are shown on Figure 2-1.

2.7.1 Site OT-89

Site OT-89, known as the old trap range, is located between the northeast end of the runway and the former base family housing area. Little information is available for the site; however, aerial photographs suggest that the range was operational during the 1940s and early 1950s. The site contained two semi-circular sets of firing stations and several support buildings that were removed during the 1950s.

At Site OT-89, ICs are the remedy selected in the Supplemental Basewide OU ROD because lead remains in soil at concentrations that do not allow for unrestricted use (AFRPA, 2006). Therefore, Site OT-89 requires a five-year review.



Groundwater Plume Source: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.

Figure 2-1
Installation Restoration Program Sites
Former Mather Air Force Base
Sacramento County, California

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3.0 BACKGROUND INFORMATION ON MATHER

Mather Air Force Base (AFB) was constructed in 1918, primarily to serve as a flight training school. The base operated continuously as a training base for aviators from 1942 until 1993. The activities that resulted in contamination at the facility and the physical characteristics that influence contaminant behavior and remediation are described in this section. The initial response actions taken prior to signing of the RODs are also described, as are the results of risk evaluations.

3.1 Physical Characteristics

Mather is located in the Sacramento Valley of Northern California (Figure 3-1). The former base is located in Sacramento County, partially within the limits of the City of Rancho Cordova, a community that was incorporated in 2003. Mather is south of U.S. Highway 50, a major highway connecting Sacramento and South Lake Tahoe. The former base encompassed approximately 5,845 acres at the time of closure (129 acres of easements) in an unsurveyed part of Township 8 North, Ranges 6 East and 7 East.

3.1.1 Surface Water Hydrology

The original surface hydrology of the former Mather AFB consisted of ephemeral drainages (arroyos) and vernal pools. The entire base lies within the Morrison Creek watershed, which flows southwest across the base, through the center of the Middle Terrace. Other drainages located on base flow into Morrison Creek, connecting with it either on or off base. Between the drainages, vernal pools are found where natural depressions, underlain by hardpan, collect surface runoff and hold it as free surface water or saturated soil for most of the spring and early summer. Modifications to the original surface hydrologic conditions at Mather include engineered drainage systems in and around developed areas, the elimination of some vernal pools, the creation of other vernal pools through grading and construction activities, and the development of artificial surface-water bodies.

A prominent feature east of the base is the Folsom South Canal. This large canal follows the entire length of the east base-boundary fence and effectively separates the base from most off-site surface flows originating in the upper (eastern) parts of the Morrison Creek watershed.

Engineered drainages channel runoff away from the main base and runway areas. The majority of the main base runoff flows into the West Ditch, which follows the western base boundary as an unlined ditch. Runoff from the West Ditch is channeled under the western end of the runway through a culvert and discharges into the South Ditch prior to leaving the base. Lawn and landscape watering plants provide a small but constant flow of water into the West Ditch as well as in some of the channels draining the housing development. The South Ditch is a long, unlined channel south of and parallel to the runways. It collects runoff from a small portion of the eastern part of the main base, the eastern part of the runways, and part of the housing development and routes it to a tributary channel off Morrison Creek at the southwest corner of the base. Runoff from the eastern portions of the main base and runways, as well as some off-base runoff, is conducted to this channel through a culvert beneath the east end of the runway.

Two artificially created water bodies occur along Morrison Creek. The larger, Mather Lake, is a 64-acre impoundment near the eastern boundary of the base. The smaller water body is a 1-acre impoundment on Morrison Creek located approximately 1 mile downstream of Mather Lake, near the former skeet-shooting range.

3.1.2 Regional Hydrogeology

Mather is situated in the northern half of the Great (Central) Valley physiographic province. The former base is situated on ancient stream terraces south of the American River. The topography of Mather consists of three nearly flat terraces that step progressively lower toward the American River to the north, with elevations on each decreasing gently toward the southwest.

Groundwater in the eastern Sacramento area occurs in Oligocene or younger geologic formations that include thick deposits of fluvial sands and gravels. In the area of Mather, these sediments are present to a depth of approximately 900 feet below ground surface (bgs). Groundwater within these geologic units receives recharge from surficial streamflow and rainfall. Possible significant local recharge sources include the American River, Mather Lake, Morrison Creek, drainage ditches, injection wells, and numerous settling or recycling ponds and excavations associated with gravel and sand operations south (Teichert Aggregates Company) and west-southwest (Granite Construction Company) of Mather. Other potential sources of recharge are the sanitary and storm sewer lines on and near Mather, the Folsom South Canal, and flood detention basins, one northeast (west of Landfill LF-03) and one northwest (at the intersection of Systems Parkway and Routier Road). Former recycling ponds north of the eastern half of Mather were in use by RMC Lonestar in the 1980s and 1990s and were likely a significant source of recharge during that time period.

Three geologic units are recognized at Mather (from youngest to oldest): the Terrace Gravels, the Laguna Formation, and the Mehrten Formation (Figure 3-2). These units are described below.

Terrace Gravels. Terrace Gravels of Quaternary Age comprise the uppermost geologic unit at Mather. Three distinct terraces were formed by the ancestral American River (from oldest to youngest): the Arroyo Seco Terrace, the “Middle” Terrace (informal name), and the Riverbank Terrace. The Arroyo Seco Terrace, at the highest elevation, underlies the southeastern third of Mather. The Middle Terrace is found northwest of the Arroyo Seco Terrace. The Riverbank Terrace occurs at the lowest elevation and underlies the northwestern half of Mather. The Terrace Gravels consist primarily of sandy to silty gravel deposited by the northwestward migration of the ancestral American River. The gravels are unconsolidated to weakly cemented, are unsaturated across Mather, and are capped by silt to sandy silt. The Terrace Gravels range in thickness from 5 to 60 feet (Montgomery Watson, 1999b). A soil horizon (locally up to 10 feet thick) has developed above the Terrace Gravels.

Laguna Formation. The Laguna Formation of Tertiary to Quaternary Age underlies the Terrace Gravels across and west of Mather. The ancestral American River eroded its channel into the Laguna Formation, producing an unconformable contact between the Terrace Gravels and the Laguna Formation. The Laguna Formation consists of unconsolidated fluvial silts, sands, and gravels of Pliocene to Pleistocene Age. These sediments were deposited in a westward-thickening wedge by streams draining the Sierra Nevada (California Department of Water Resources, 1964). The coarse sediments of the Laguna Formation represent multiple episodes of channel deposition and are stacked (or aggraded) vertically; the silts and clays represent overbank sediments deposited during floods. The Laguna Formation is exposed east of Mather, where it is estimated to be at least 200 feet thick. Stratigraphic data collected during characterization efforts suggest the Laguna Formation is more than 350 feet thick beneath portions of Mather. The formation has been informally divided into three divisions designated Upper, Middle, and Lower Laguna. The Upper Laguna locally underlies the Terrace Gravels and consists predominantly of silt with some interbedded sand. The Middle Laguna beneath the Main Base/SAC Area is characterized by sandy gravel with some sand and silty sand. The Lower Laguna consists predominantly of silt and clay with intermittent sand and gravel channel-fill deposits (Montgomery Watson, 1999b).

Mehrten Formation. The lowermost geologic unit identified at Mather is the late Tertiary Mehrten Formation, a primary source of potable water to water-supply wells on and west of Mather. The Mehrten Formation is composed of fluvial, volcaniclastic sediments consisting primarily of black andesitic sand and interbeds of blue to brown clay. Locally, channels are filled with andesitic gravels. The Mehrten Formation forms a sedimentary wedge that dips and thickens to the west. The Mehrten Formation is 200 feet thick in outcrops east of Mather and thickens westward in the subsurface to approximately 400 to 500 feet. The Mehrten Formation is locally an excellent source of groundwater (Montgomery Watson, 1999b). The contact between the top of the Mehrten Formation and the bottom of the Laguna Formation is generally not clearly defined. A transitional zone composed of both granitic Laguna sands and andesitic sands with a thickness of between 60 and 100 feet has been observed (Shlemon, 1967; IT Corporation, 1994a).

3.1.3 Site Geology and Groundwater Hydrology

Much of the shallow soil at Mather is fine-grained "hardpan" silt that serves as a barrier to infiltration of rainwater. There are significant areas of seasonal wetlands, many of which are vernal pools, which hold water through the winter rainy season and into the spring, supporting unique communities of plant and animal life. Beneath the hardpan are various layers of sediment that range in character from gravels to fine silts and clays.

The water table at Mather is generally encountered between 90 to 110 feet bgs in the Laguna Formation beneath the Riverbank Terrace deposits and deeper beneath the higher-elevation terraces. The coarse sands and gravels of the Middle Laguna Formation are relatively transmissive and apparently continuous through the Main Base and SAC Industrial Areas, extending west beyond Mather. Consequently, they are important to the flow of groundwater and the transport of contaminants.

Overall, groundwater beneath Mather flows toward the southwest, conforming to the regional groundwater flow direction. Increased municipal and agricultural pumping across the basin created three groundwater "cones of depression" to the northwest, southwest, and south of Mather. The Elk Grove cone of depression to the southwest influences groundwater flow direction at Mather (Montgomery Watson, 1999b).

Functional Hydrostratigraphy at Mather. Four Hydrostratigraphic (HSG) Units, A to D, are designated at Mather. Each of these units is described below.

Because the water table slopes at a slightly smaller angle than the dip of the HSGs, the water table beneath Mather transects Units A, B, and C progressively to the east (Figure 3-2), for the area north of the runways. Accordingly, the saturated thickness of the units decreases to the east. The water table occurs in fine-grained sediments characterized as Unit C near Sites WP-07, AC&W, LF-03, LF-04, and LF-05. Unit D and the Mehrten Formation are saturated throughout the base.

Unit A (the water table occurs in Unit A in the western portion of Mather and west of Mather) corresponds with the Upper Laguna and consists primarily of overbank deposits of silt and fine sand, but some channel-fill sand and gravel do occur. The sediments are fairly continuous across Mather. In most areas, overbank deposits of Unit A overlie coarse sediment of Unit B, but locally, channel deposits from the two units are continuous from above the water table to the bottom of Unit B (Montgomery Watson, 1999b).

Unit B corresponds with the Middle Laguna and consists of coarse channel-fill deposits of sandy gravel beneath the Main Base/SAC Area, extending west of Mather. The deposits range in thickness from roughly 20 to 60 feet and are first encountered at depths of roughly 120 feet bgs in the east and 180 feet

bgs in the west. In areas south of the runway (i.e., Site WP-07), the coarse sediments of Unit B transition laterally to finer-grained Unit C sediments. Generally, in the eastern portion of Mather, Unit A is above the water table or absent, and groundwater is first encountered in Unit B or Unit C. Unit B is the most transmissive unit of the Laguna Formation in areas north of the runway and in areas where the Middle Laguna Formation is characterized by channel-fill deposits of sandy gravel. In the western portions of Mather and extending west off the base, Unit B is divided into two subunits, an upper channel subunit (Unit Bu) and a lower channel subunit (Unit B) (IT Corporation, 1996a). Unit Bu is only identified as a distinct unit where fine overbank deposits, referred to as the Unit Bu/B aquitard, are present. The Unit Bu/B aquitard is locally discontinuous; in some areas along the Mather boundary the aquitard is not present and Units Bu and B are indistinguishable, allowing effective vertical hydraulic communication throughout the Middle Unit of the Laguna Formation (Montgomery Watson, 1999b). For this reason, these subunits are grouped together for purposes of describing the nature and extent of COCs. Hydrogeologic Unit B is important to the flow of groundwater and movement of COCs. Because of its high transmissivity, channel-fill deposits of Unit B provide a primary pathway for the flow of contaminated groundwater beneath Mather and to the west (IT Corporation, 1996a).

Unit C is a portion of the Lower Laguna and consists predominantly of silt and clay. Unit C is defined as the vertical interval between Unit B sands and gravels and the uppermost Unit D sands, north and west of the runways. Unit C may functionally constitute an aquitard because of its persistent extent and thickness and the significant differences in hydraulic head between units lying above and below it. Unit C is generally 10 to 50 feet thick throughout the area (Montgomery Watson, 1999b). The water table occurs in Unit C in relatively small portions of Mather near Sites LF-03, LF-04, and LF-05; the finer-grained sediments at the water table at Site WP-07 and the AC&W Site are also interpreted as Unit C, but the stratigraphic relationships are not the same at these sites as north of the runways.

Unit D is the other deeper portion of the Lower Laguna and extends from the base of Unit C to the top of the Laguna-Mehrten Transition (LMT). Unit D is interpreted to be approximately 140 to 200 feet thick throughout the site. Unit D consists primarily of fine overbank deposits of silt and clay and less frequent coarse channel deposits 20 to 40 feet thick that behave as confined aquifer units. Unit D channel deposits are encountered approximately 220 to 300 feet bgs and are characterized by sands and silty sands (Montgomery Watson, 1999b).

Underlying Unit D is a transition zone between the Laguna and Mehrten formations. The transition zone is characterized by materials derived from both andesitic source terrains and granitic source materials. The elevation of the top of the LMT zone is interpreted to range from approximately 250 feet below mean sea level (msl) beneath the northwestern portion of Mather near the injection wells for the Main Base/SAC Area treatment system to approximately 380 feet below msl west of Mather near the Oaken Bucket water-supply well (MWH, 2007a).

3.2 Land and Resource Use

Mather AFB was first activated in 1918 as a combat pilot training school, and then placed on inactive status from 1922 until 1930 and again from 1932 until 1941. The base reopened in 1941 as a pilot and navigator training post. After World War II, Mather AFB was the sole aerial navigation school for the United States military and its allies. In addition to the training conducted by the 323rd Flying Training Wing, Mather AFB hosted the Strategic Air Command 320th Bombardment Wing from 1958 to 1989 and hosted the 940th Air Refueling Group from 1976 to 1993. On 30 September 1993, the base was decommissioned under the Base Realignment and Closure Act (BRCA). A wing of the SAC was located at Mather AFB from the late 1950s until 1989. Since its closure in September 1993, the base has been in transition to civilian use. Approximately half the former base is now leased to Sacramento County for use as an airport. The airport is used for cargo and general aviation. Approximately a third of the base is

leased to Sacramento County for use as parkland. The golf course sale to Sacramento County was completed in 2004. The former military family housing has been sold and redeveloped. The previous military homes, numbering approximately 1,200, have been replaced by a similar number of larger single family homes. Much of the rest of Mather has been leased or sold for business development. Other land uses at Mather are a National Guard station, a Veterans Affairs hospital, a residential job retraining facility, a daycare facility, two FAA radar facilities, two churches, and two elementary schools. The major change anticipated for the future is that the property now leased will eventually be deeded to Sacramento County.

Land surrounding Mather is used for a variety of purposes, including agricultural, residential, commercial, and industrial uses. Residential developments lie to the north and northwest of Mather, with major retail centers and other business uses centered along Folsom Boulevard, Mather Field Road, and Zinfandel Road. This area includes schools and outdoor public recreation facilities. To the west are gravel processing, business office and industrial properties, and rural residences, although further west, land is used for more suburban residential and business purposes. Land to the southwest and south has been extensively excavated for gravel mining operations. Also south of Mather is land used for agricultural and some commercial activities. To the east and northeast, land use includes industrial with some agricultural areas and recently constructed residential developments.

There are several public water-supply wells located on and in the vicinity of Mather. Water-supply wells located in the former housing area and at the northern end of Mather are now owned and controlled by Sacramento County Water Agency (SCWA). Water-supply wells located off base are owned by SCWA and the California American Water Company (Cal Am). The *Mather AFB Off-Base Water Supply Contingency Plan* (Contingency Plan) is in place, providing the strategy to address the impact or threat of impact to public water-supply wells from groundwater contamination migrating to the west and off of Mather property (AFRPA, 2008c). The Contingency Plan is required by the Groundwater OU ROD (AFBCA, 1996a). Groundwater contamination was also detected in several off-base, private domestic and irrigation wells to the west of Mather. These wells are no longer used for drinking water, and the contamination is not considered to imminently threaten any public or private drinking water wells (AFRPA, 2008c). Bottled water was initially provided in the 1980s to residents whose water had contamination exceeding State action levels. These residences were later connected to either the Mather water supply or the Citizens Utilities Company (now Cal Am) water supply. In addition, groundwater samples were collected from private drinking water wells downgradient from the Southwest Lobe of the Main Base/SAC Area Plume for the first time in 2009; no notable detections of COCs were reported (MWH, 2010a). Continued monitoring of these wells is planned to provide assurance that the plumes are not continuing to migrate toward private drinking water wells.

3.3 History of Contamination

Military activities occurred at Mather between 1918 and 1993. Fulfillment of the military missions involved the use and generation of a wide range of toxic and hazardous chemicals and substances, including industrial chemicals (e.g., chlorinated solvents), aviation fuels, and a variety of oils and lubricants. The use and disposal of these chemicals has resulted in contamination of soil and groundwater at many locations at Mather through a variety of fate-and-transport processes. For example, chlorinated solvents (VOCs) may have migrated downward through the soil column via direct infiltration or through leaching (i.e., dissolving in percolating surface water).

In addition, landfills were operated at Mather for the disposal of garbage and trash generated at Mather. Much of this was household waste, including household hazardous waste, but there was also industrial waste generated, some of which may have been taken to these landfills. A dry cleaning plant was located at Mather in the 1950s and 1960s, and discharges from the plant to the sanitary sewer apparently leaked

into soil. Contaminants dissolved in groundwater have migrated over 2 miles beyond Mather's western boundary. The routine application of pesticides also resulted in contamination of sediments. As environmental awareness and regulation increased in the 1970s and 1980s, the Air Force mobilized to change the practices that caused release of contamination into the environment and to address contamination that had resulted from past practices.

3.4 Initial Responses

Environmental studies have been underway at Mather since 1979 when groundwater contamination (TCE) was first detected at Mather in the water-supply well serving the AC&W area. The IRP began in 1982 and identified locations at Mather where hazardous substances or other pollutants might have been released to the environment. These investigations confirmed the presence of VOCs and other hydrocarbons at several of the IRP sites. Based on this evidence, the entire base was proposed for listing on the Superfund (CERCLA) National Priorities List (NPL) in July 1989 and was placed on the NPL on November 21, 1989. In July 1989, the Air Force, EPA, and State of California signed the FFA for Mather (United States Air Force [USAF], 1989) under CERCLA Section 120 to ensure that environmental impacts from past and present operations are thoroughly investigated and appropriate cleanup actions are taken to protect human health, welfare, and the environment (USAF, 1989). The FFA sets enforceable deadlines for documents, defines roles and responsibilities of each signatory party, and provides a vehicle for dispute resolution. The Air Force is the owner (or past owner) of the site, the principal responsible party, and lead agency for conducting investigative and cleanup activities. There have been no CERCLA enforcement actions related to any of the sites at Mather.

For some IRP sites, cleanup activities were conducted prior to a final remedial action being authorized by a signed ROD. Several removal actions were conducted as either time-critical (e.g., Sites LF-02 and FT-10C) or non-time critical (e.g., Sites ST-20 [evaluated via an engineering evaluation/cost analysis (EE/CA)], SD-80, SD-85, DD-88, and OT-89). The time-critical removal actions were conducted to allow for excavation and consolidation of waste into LF-04 (AFBCA, 1996c; 1996d). The non-time critical actions were used to take early actions (IT Corporation, 1994b; AFBCA, 1997b; 1999b; 2001a; 2001b; MWH, 2002a; 2002b). The decision and authorization to conduct a removal action is documented in a removal action memorandum rather than a ROD, although the final remedy (and cleanup standards, if further action is necessary) is then selected in a ROD.

In addition, in situ pilot studies (SVE/BV) were conducted at Sites FT-10C/ST-68, OT-23, LF-18, ST-39, SD-57, and SD-59 to determine whether in situ remediation technologies were feasible at those sites (EA Engineering, 1997; IT Corporation, 1995; 1996b; Montgomery Watson, 1999a). In addition, a pilot study was conducted at Site OT-89 during the remedial action for Site OT-87 (Basewide OU) to see if the soil from Site OT-89, containing lead shot, could be successfully cleaned using the same stabilization technology used for Site OT-87 (Montgomery Watson, 2000b).

3.5 Basis for Taking Action

Exposure to significant concentrations of contaminants in soil, sediment, surface water, and/or groundwater is associated with unacceptable human health risks and/or ecological health risks. Cleanup is required for contamination for which chemical concentrations exceed regulated thresholds, or for which concentrations exceed management criteria developed or accepted by the regulatory agencies and the Air Force. The over-riding basis for cleanup at Mather is protection of human health and the environment, as required by CERCLA.

A comprehensive baseline risk assessment (CBRA), including human health and ecological risk assessments, was conducted in 1996 for 85 IRP sites (IT Corporation, 1996c). Chemicals of potential

concern for human health and ecological risk included solvents, fuel constituents, chlorinated pesticides, PAHs, polychlorinated biphenyls, dioxins/furans, metals, and explosive residues. The CBRA quantified the potential impacts on human health and the environment for a no remedial action scenario. Potentially exposed human populations included then current on-base workers, future on-base workers, and future on-base and off-base residents. Potentially exposed base environments included vegetation, wildlife, and aquatic organisms associated with 18 IRP sites, each exhibiting completed exposure pathways, and related drainage areas. The risk estimates in the CBRA were considered highly conservative and protective of potentially exposed human and ecological populations as described in the current and future land-use scenarios (IT Corporation, 1996c). Additional human health and ecological risk assessments were conducted for IRP sites that were identified after the CBRA was completed, including OT-86 and OT-87 (AFBCA, 1998a) and SD-80, SD-85, DD-88, and OT-89 (IT Corporation, 2000).

Environmental contaminants that require cleanup at Mather have been discovered in soil, sediment, surface water, and groundwater. A list of the COCs and the cleanup levels for each site requiring a five-year review are listed in Table 3-1. COCs and cleanup levels for each site are established in the various RODs and/or ESDs.

Table 3-1. COCs and Cleanup Levels for Mather IRP Sites Requiring a Five-Year Review

IRP Site Number	COCs	Cleanup Level
LF-03	NA	NA
LF-04	NA	NA
WP-07/FT-11	**Subsurface Soil**	**ppm**
	TPH as diesel	10[a]
	TPH as gasoline	1[a]
FT-10C	**Subsurface Soil**	**ppm**
	Carbon tetrachloride	Narrative
	Benzene	Narrative
	Toluene	Narrative
	Ethylbenzene	Narrative
	Xylenes	Narrative
	TPH as diesel	100[b]
	TPH as gasoline	5[b]
ST-68	**Subsurface Soil**	**ppm**
	TPH as gasoline	5[b]
FT-10C/ST-68	**Soil**	**ppm**
	Lead	800
		15 mg/L (soluble)
WP-12 (AC&W Plume)	**Groundwater**	**µg/L**
	Trichloroethene	5
LF-18	**Subsurface Soil**	
	Trichloroethene	Narrative
	1,2-Dichloroethene	Narrative
OT-23	**Subsurface Soil**	
	Tetrachloroethene	Narrative
	Trichloroethene	Narrative
	1,2-Dichloroethene	Narrative
	Xylenes	Narrative

Table 3-1. (Continued)

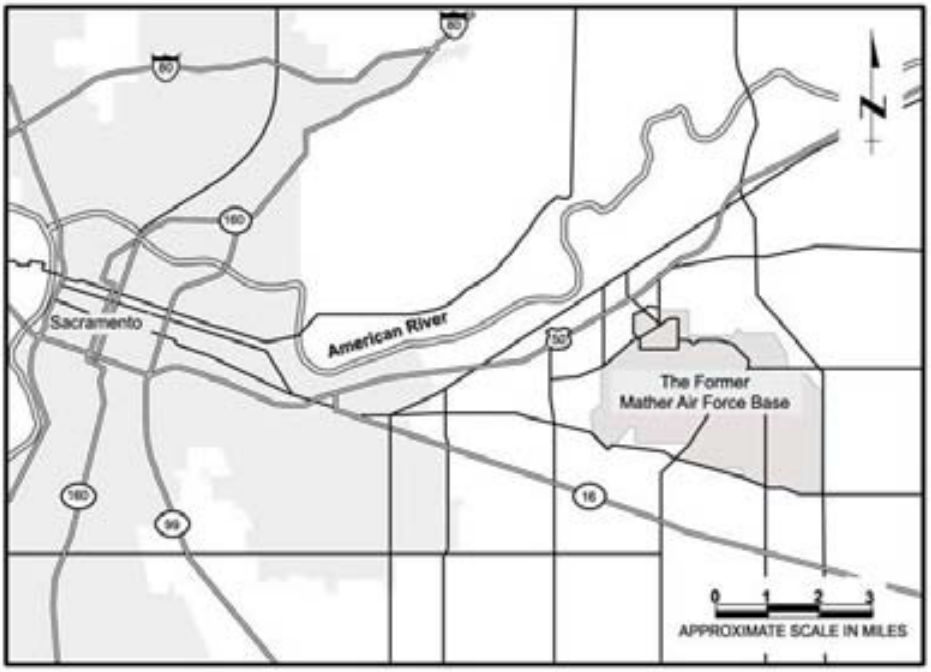
IRP Site Number	COCs	Cleanup Level
ST-37	**Subsurface Soil**	**ppm**
	TPH as diesel	10[a]
	TPH as gasoline	1[a]
	Oil and grease	430[a]
ST-39	**Surface Soil**	**ppm**
	TPH as diesel	100[a]
	Oil and grease	430[a]
	Subsurface Soil	**ppm**
	Benzene	0.1[a]
	Ethylbenzene	2.9[a]
	Toluene	4.2[a]
	Xylene	1.7[a]
	TPH as diesel	10[a]
	TPH as gasoline	1[a]
SS-54	**Subsurface Soil**	**ppm**
	Benzene	0.1[a]
	TPH as gasoline	1[a]
SD-57	**Subsurface Soil**	
	Trichloroethene	Narrative
SD-59	**Subsurface Soil**	**ppm**
	TPH as diesel	10[a]
	TPH as gasoline	1[a]
OT-87	**Sediments (and pellet removal)**	**ppm**
	Arsenic	9.6
	Lead	15.5
	Surface Soil	**ppm**
	Lead	700
	Benzo(a)pyrene	0.33
	Benzo(g,h,i)perylene	0.33
	Dibenzo(a,h)anthracene	0.33
	Fluoranthene	0.33
	Phenanthrene	0.33
OT-89	**Soil**	**ppm**
	Lead	192[c]
Main Base/SAC Area Plume	**Groundwater**	**µg/L**
	Tetrachloroethene	5
	Trichloroethene	5
	1,1-Dichloroethene	6
	cis-1,2-Dichloroethene	6
	1,2-Dichloroethane	0.5
	Carbon tetrachloride	0.5
	TPH as Diesel	100
	TPH as Gasoline	50
	Benzene	1
	Xylenes	17
	Chloromethane	3
	Lead	15

Table 3-1. (Continued)

IRP Site Number	COCs	Cleanup Level
Northeast Plume	**Groundwater**	**µg/L**
	Tetrachloroethene	5
	cis-1,2-Dichloroethene	6
	Carbon tetrachloride	0.5
	Chloromethane	3
	1,2-Dichloropropane	5
Site 7 Plume	**Groundwater**	**µg/L**
	Tetrachloroethene	5
	Trichloroethene	5
	1,1-Dichloroethene	6
	cis-1,2-Dichloroethene	6
	Vinyl chloride	0.5
	1,2-Dichloroethane	0.5
	1,4-Dichlorobenzene	5
	Benzene	1
	Chloromethane	3
	TPH as diesel	100

[a] These cleanup levels will be deleted and narrative soil cleanup levels will be applied (AFRPA, 2009a).
[b] These cleanup levels will be deleted and narrative soil cleanup levels will be applied (AFRPA, 2009d).
[c] 192 ppm lead is a threshold concentration above which land-use restrictions apply for Site OT-89 (AFRPA, 2006).

AC&W = Aircraft Control and Warning
AFRPA = Air Force Real Property Agency
COC = contaminant of concern
IRP = Installation Restoration Program
mg/L = milligrams per liter
NA = not applicable
ppm = parts per million
SVE = soil vapor extraction
TPH = total petroleum hydrocarbons
µg/L = micrograms per liter



Modified from: MWH, 2010. *Annual Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.

Mather\5-Yr Review\07-09-Mather-loc-map.indd - VMG 08/09/10 SAC

Figure 3-1. Regional Location Map, Former Mather Air Force Base, Sacramento County, California

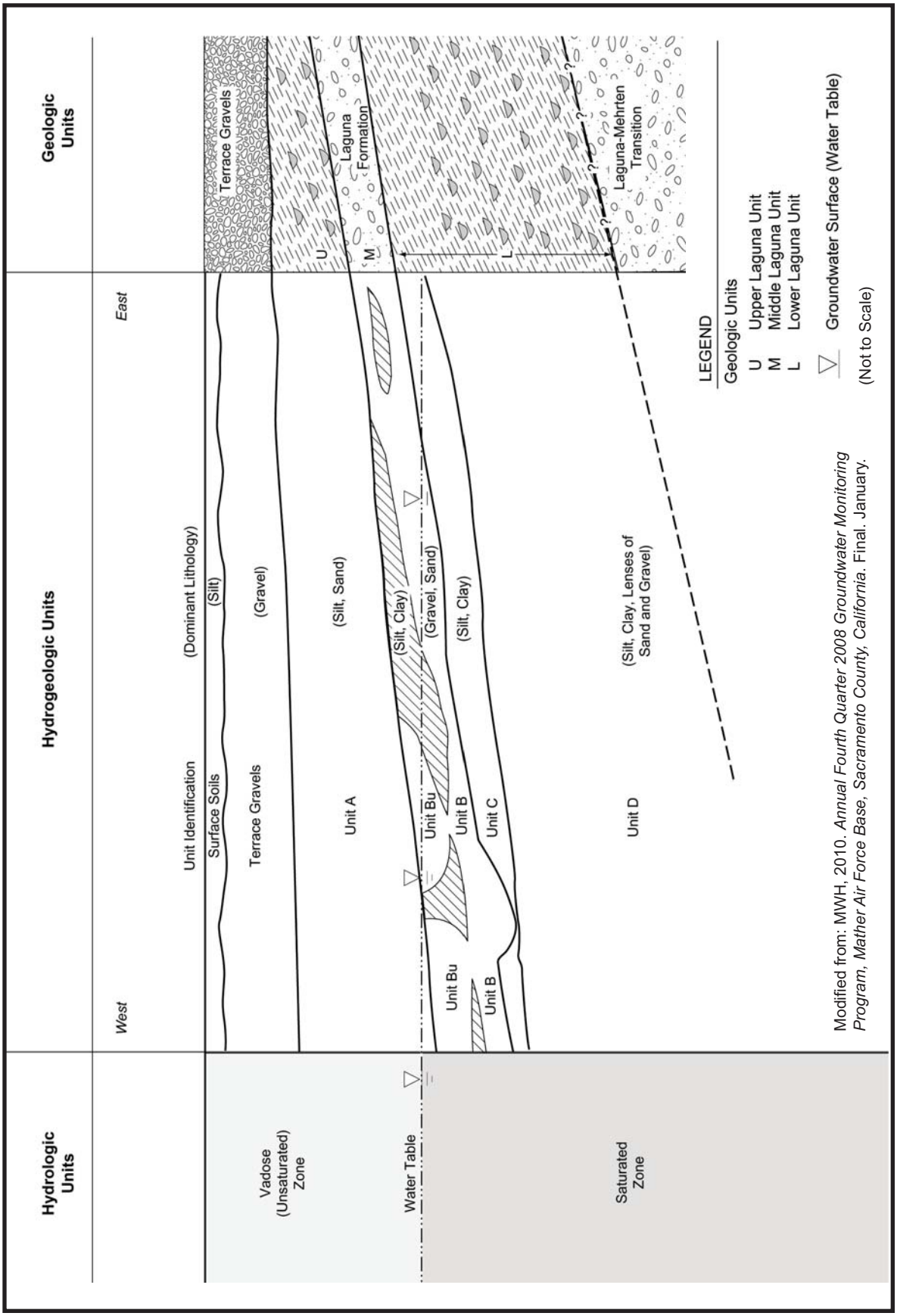


Figure 3-2. Generalized Hydrogeologic Cross-Section North of Runways, Former Mather Air Force Base, Sacramento County, California

Mather\5-Yr Review\07-09-Mather-geo-xsec.indd - VMG 08/09/10 SAC

4.0 REMEDIAL ACTIONS

This section describes the remedial actions taken at Mather in accordance with the five RODs. This section identifies the RAOs for each site requiring a five-year review, describes the selected remedies and their implementation, and discusses system operation and maintenance (O&M).

4.1 Groundwater Remedies

4.1.1 AC&W OU

Remedy Selection. The AC&W OU ROD was signed in December 1993 by the AFBCA, EPA, and DTSC to address contaminated groundwater at Site WP-12 (AC&W Site) at Mather. The RAOs identified in the AC&W OU ROD are to remove contaminant mass from the groundwater plume and remediate the plume to the aquifer cleanup level (ACL) of 5 µg/L for TCE; comply with the discharge standard for disposing of the treated water; and comply with air emission requirements (AFBCA, 1993).

The selected remedy for the AC&W Plume includes groundwater extraction and air stripping with on-site injection of treated water (effluent) into the aquifer. The discharge component of the remedy was modified via an ESD to surface water discharge into Mather Lake (AFBCA, 1997a). In addition, the remedy includes vapor-phase carbon adsorption of TCE from the stripped vapor, if required to meet Sacramento Metropolitan Air Quality Management District (SMAQMD) applicable or relevant and appropriate requirements (ARARs), and off-site regeneration of spent activated carbon, if necessary.

In 2008, ICs on Air Force property were added to the AC&W OU groundwater remedy through a second ESD (AFRPA, 2008a). The cleanup remedy selected in the AC&W OU ROD did not include ICs to prevent exposure to groundwater or to protect the remedial system components, although the Air Force implemented land-use restrictions for these purposes through land ownership and later lease and deed restrictions. The ESD includes temporary groundwater use restrictions as a component of the AC&W groundwater remedial action until the ACL for TCE is met for the AC&W groundwater plume. The ICs include the following components:

- Controls to prevent drilling of water-supply wells that could result in exposure to contaminated groundwater or interfere with the remedial action. These well installation restrictions will be implemented within the area overlying the plume where concentrations exceed the ACL of 5 µg/L TCE, and in addition, will extend to a buffer area around the plume where operation of a supply well could either result in unacceptable risk of exposure to contaminants, or interfere with the containment of the AC&W Plume. Installation or operation of wells within the IC boundary would be allowed only with approval of the Air Force, EPA, and State of California.

- Controls to prohibit the destruction or disturbance of, or interference with, the remedial action, including the air stripper treatment plant; groundwater extraction, monitoring, or injection wells; conveyance pipelines; electrical and fiber optic lines; and any other component of the remedial action.

Remedy Implementation. The pump-and-treat system for the AC&W OU began operating in January 1995. The original groundwater extraction and treatment system for the AC&W Plume consisted of eight extraction wells, a packed tower air stripper, an effluent tank, and eight injection wells. A pipeline that discharges treated water from the AC&W treatment system to Mather Lake was later constructed, and the injection wells have not been used since 1997. The injection wells were decommissioned in 2009 (MWH, 2009d). Vapor-phase carbon adsorption of contaminants from the stripped vapor was not required because emission rates did not exceed the SMAQMD limit of 2 pounds per day (lbs/day) above which treatment would be required.

During 2009, seven extraction wells (ACW AT-1 and AT-2, ACW EW-1 through EW-4, and EW-6R) operated as part of the AC&W Site extraction system (Figure 4-1) with a combined average influent flow rate of approximately 180 gallons per minute (gpm). Extraction well ACW EW-5 has not operated since late 2000 because TCE concentrations have been less than the ACL. A recommendation was made in the 2008 annual groundwater monitoring report to evaluate whether capture of the toe of the TCE plume can be maintained if ACW EW-4 is taken offline; TCE concentrations at ACW EW-4 have been less than the cleanup level since the second quarter of 2006 (MWH, 2010b).

Performance of the extraction system is monitored by a network of monitoring wells and piezometers completed at the water table in the shallow water bearing zone (SWBZ), at the base of the SWBZ; and in the lower water bearing zone (LWBZ).

ICs were added to the AC&W OU remedy in 2008 and include an enforceable use restriction on the use of certain properties where the AC&W groundwater remedy requires use restrictions (AFRPA, 2008a). The area of the AC&W OU requiring ICs is shown on Figure 4-1. The Air Force is responsible for implementing, maintaining, and monitoring the ICs before and after property transfer. Land-use restrictions will be incorporated in any deed transferring all or part of the site subject to ICs, as grantee covenants. The deed will also include a condition that the transferee execute and record a State Land Use Covenant (SLUC), within 10 days of transfer, to address any State obligations pursuant to State law, including 22 California Code of Regulations (CCR), Section 67391.1. Any grantee of property constrained by ICs imposed in their transfer document may request modification or termination of the ICs. Modification or termination of these ICs requires approval by the Air Force, EPA and the State of California.

The Air Force may contractually arrange for third parties to perform any and all of the actions associated with ICs, although the Air Force is ultimately responsible under CERCLA for the successful implementation of the remedy, including protecting the integrity of the remedy and enforcing the land use controls (ICs) that are a part of the remedy.

4.1.2 Groundwater OU – Main Base/SAC Area Plume

The Groundwater OU ROD was signed in 1996 by the AFBCA, EPA, and DTSC to address contaminated groundwater in the Main Base, SAC Industrial Area, Site 7, and Northeast Plume areas. For the purpose of selecting a remedial alternative, the Groundwater OU ROD combined the Main Base and SAC Industrial Area Plumes. The remedy selected for the Main Base/SAC Area Plume and its implementation are described below. Remedy selection and implementation for the Site 7 and Northeast Plumes are described in Sections 4.1.3 and 4.1.4, respectively.

Remedy Selection. The RAOs identified in the Groundwater OU ROD for the Main Base/SAC Area Plume are to achieve the ACLs throughout the contaminated aquifer, and comply with the discharge standards for disposing of the treated water. In addition, the remedial action calls for land-use restrictions on Air Force property, as appropriate, and groundwater monitoring.

The remedial action selected in the Groundwater OU ROD for the Main Base/SAC Area Plume is a groundwater extraction and treatment program with the following components:

- A phased implementation program;
- Groundwater extraction, to achieve ACLs, estimated at but not limited to a total rate of 1,300 gpm;

- Treatment of the extracted groundwater through air stripping with off-gas treatment (i.e., carbon adsorption) to achieve ACLs (see Table 3-1) and to achieve discharge standards (for treated water and offgas);

- Groundwater injection in compliance with discharge standards (see Table 6-7, AFBCA, 1996b), in combination with other discharge options (to be evaluated during remedial design) that are (a) consistent with attainment of cleanup standards, and (b) cost-effective;

- Land-use restrictions will be implemented on Air Force property as appropriate, in order to preclude installation of groundwater wells that would not be compatible with protection of public health and the environment; and

- Monitoring the groundwater.

An ESD that clarifies the next-to-last bullet with respect to the implementation of land-use restrictions on Air Force property, and establishes additional ICs to protect the remedial system components and to preclude any activities that are inconsistent with the remedial actions or access to the remedial system components has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures.

The RAOs for the ICs are: (1) preventing human exposure to groundwater with concentrations exceeding the cleanup levels that are specified in the Groundwater OU ROD; (2) protecting the integrity of the groundwater remedial actions and systems, including the associated monitoring systems; and (3) preserving access for the Air Force, EPA, and the State of California to the remedial systems and associated monitoring systems. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs.

Following signature on the ESD, the Air Force will impose the following ICs to protect the remedial systems associated with the Main Base/SAC Area Plume. The transferee will be prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation;

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component;

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to any equipment or component associated with the groundwater remediation systems;

- Conducting, or allowing others to conduct, any surface activities that introduce or allow infiltration of water/other fluids into the groundwater (e.g., construction/creation of any groundwater recharge area, percolation ponds, unlined surface impoundments/trenches, or irrigation for agricultural purposes), unless specifically approved in writing by the Air Force, EPA, and the State of California; and

- Installing wells or extracting groundwater, or allowing others to install wells or extract groundwater, for any purpose other than remediation or monitoring.

In addition, the Groundwater OU ROD requires the development of a Mather-specific, off-base water supply contingency plan, which applies to contaminants from the Main Base/SAC Area Plume (AFBCA,

1996a). The Contingency Plan describes the Air Force's plan for addressing the impact or the threat of impact to public water-supply wells from groundwater contamination migrating from Mather west and north of Mather property. Key elements of the Contingency Plan are as follows:

- Determine which wells will likely be affected.
- Provide an ongoing monitoring plan of supply wells and their guard wells, including increased frequency of sampling once a constituent from the plume has been detected.
- Determine the impact of supply well pumping on the plume(s) and recommend action(s) to minimize plume migration.
- Evaluate the short-term and long-term options for providing alternate water supplies (the evaluation shall consider the technical effectiveness in dealing with the health threat, implementation time frame, cost, and acceptability to the water purveyor).
- Propose a preferred alternative, including an implementation time schedule, which should address the sequencing of alternate remedies if the final solution is to include short-term and long-term solutions.
- Develop a "trigger" for ascertaining when option(s) should be implemented.
- Propose measures and an implementation schedule to mitigate the vertical migration of contaminants to deeper aquifer zones for each well likely to be impacted by the plume.
- Determine when the monitoring can be terminated.

The original Contingency Plan was finalized in February 1998 (AFBCA, 1998e). A revised plan finalized in November 2008 supersedes the 1998 plan (AFRPA, 2008c).

Remedy Implementation. The Main Base/SAC Area Plume remedial system is installed and has been operating since 1998. Carbon adsorption of contaminants from the stripped vapor was not required because emission rates did not exceed the ARARs for mass per day or health risk . Construction of the first phase (Phase I) of the groundwater extraction and treatment system for the Main Base/SAC Area Plume was completed in early spring of 1998. The Main Base/SAC Area system began continuous operation in April 1998. Phase I of groundwater remediation of the Main Base/SAC Area Plume emphasized mass removal from hot spots in the Main Base/SAC Area Plume that were identified on Mather property. A hot spot is defined as an area having contaminant concentrations at least 10 times the ACL. Twelve extraction wells were initially installed as part of the Phase I Main Base/SAC Area treatment system.

As part of the initial Phase II/III system expansion, completed in January 2000, 12 additional extraction wells were installed and connected to the system. The Phase II wells were installed in hot spots that extended beyond the Mather property boundary, and the Phase III extraction wells were installed to more aggressively remediate groundwater near source areas at Mather, particularly at Sites OT-23C and SD-57. During the second quarter of 2001, three additional Phase III extraction wells were installed to complete the Phase III system expansion. The three new extraction wells were brought online during the third quarter of 2001.

During the second quarter of 2002, eight extraction wells were installed as part of the Phase IV expansion of the Main Base/SAC Area remedial action. The objective of the Phase IV expansion was to augment the existing extraction system, primarily in the off-base portions of the Main Base/SAC Area Plume, and to

increase the area of hydraulic capture imparted by the extraction wells installed under the previous three groundwater remediation phases. The Phase IV extraction wells were brought online in September 2002.

A supplemental Phase IV extraction well, MBS EW-12B, was installed in September 2004 to capture the toe of the plume in Unit B. Startup for MBS EW-12B occurred in May 2005 but damage to the sump in the bottom of the well and faulty wiring to the pump prevented the well from running continuously. A packer was installed in the sump to keep sediment from entering the screen from deeper in the sump, the wiring was repaired, and the well was redeveloped and restarted in December 2005. MBS EW-1A and EW-2A were replaced by two new wells, MBS EW-7ABu and EW-2AR, which began operation in March 2005.

Extraction well MBS EW-13BuB was installed in late 2007 and began operation in April 2008. The purpose of the new extraction well was to address the Southwest Lobe of the Main Base/SAC Area Plume.

During 2009, the following Main Base/SAC Area extraction wells, organized by HSG Unit, operated at a combined average influent flow rate of approximately 1,640 gpm:

- Extraction wells screened across the water table and HSG Unit Bu: EW-1ABu, EW-1Bu, EW-2AR, EW-2ABu, EW-4ABu, EW-4Bu, EW-5ABu, EW-6ABu, EW-7ABu, EW-12AB, and EW-39ABuB.

- HSG Unit Bu/B: EW-1B, EW-2B, EW-3B, EW-4B, EW-5B, EW-6B, EW-7B, EW-8B, EW-9B, EW-10B, EW-11B, EW-12B, and EW-13BuB.

- HSG Unit D: EW-1D, EW-2D, EW-3D, EW-4D, EW-5D, and EW-6D.

Several extraction wells were offline for a portion of 2008 due to limited capacity at the injection wells. The wells taken offline were chosen based on the professional judgment of supervising hydrogeologists with the main goal of maintaining plume capture. Two injection wells (MBS IW-501 and MBS IW-502) were redeveloped in 2008 to help restore the capacity of the treatment system. Extraction wells were returned to service as injection capacity allowed. Redevelopment of the two injection wells has provided the necessary capacity to operate all extraction wells in the system at their target flow rates. However, it is anticipated that the operational capacity of the injection wells will once again decline. During the redevelopment of the injection wells, supplemental surface discharge to the West Ditch was planned (see Section 7.3.1.2).

The following wells are no longer used for extraction and did not operate in 2008: 39EW02, 19EW01, EW-1A (replaced by EW-7ABu), EW-2A (replaced by EW-2AR), EW-3A, EW-4A, EW-5A, and EW-3Bu. In addition, five extraction wells (EW-1Bu, EW-6ABu, EW-7ABu, EW-8B, and EW-12AB) have been recommended for shutdown because the wells have had more than four consecutive sampling events with COC detections less than ACLs and are no longer contributing to the capture of significant portions of the plume (MWH, 2009e; 2010b).

Figure 4-2 shows the layout of the groundwater extraction and treatment system as of the second quarter of 2009, including 30 operating and 8 non-operating extraction wells, 4 injection wells (MBS IW-501 through MBS IW-504), and underground piping.

In accordance with the Groundwater OU ROD, land-use restrictions prohibiting or requiring approval for any groundwater well construction on Air Force property have been implemented through direct Air Force control prior to property transfer through conditions of leases and through deed restrictions where property has been deeded for all property overlying Groundwater OU contamination. No land-use

restrictions have been systematically applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, the County of Sacramento adopted a revised ordinance (County Code Chapter 6.28) in 2002 that governs drilling of wells within 2,000 feet of any known groundwater contamination. Any permit application to drill or modify a well within this zone requires consultation with CVWB prior to issuing any well permits. This revised ordinance allows recommendations to the County regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application. The ICs applied on Mather are clarified in an ESD (AFRPA, 2009a) that as of June 2010, is awaiting signatures. Further, implementation of additional ICs will occur following signature on the ESD (AFRPA, 2009a). The implementation and effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

The Contingency Plan has been in place since 1998 (AFBCA 1998e; AFRPA, 2008c). Since 1997, the Air Force has operated two granular activated carbon (GAC) treatment systems to remove VOCs from three of the off-base drinking water-supply wells: OFB-4 (Cal Am Moonbeam Drive Well) and both OFB-51 and OFB-52 (Sacramento County wells at Juvenile Hall). Monthly sample collection and analysis at these treatment systems continued through the period of this five-year review to monitor concentrations of COCs in the system influent, midfluent, and effluent, as needed. In addition, carbon changeouts of the GAC vessels were performed as necessary and in accordance with the Contingency Plan. Monitoring of these wells and other off-base water-supply wells is described in Section 4.1.5.

4.1.3 Groundwater OU – Site 7 Plume

Remedy Selection. The RAOs identified in the Groundwater OU ROD for the Site 7 Plume are to achieve the ACLs throughout the contaminated aquifer, and comply with the discharge standards for disposing of the treated water. In addition, the remedial action calls for land-use restrictions on Air Force property, as appropriate, and groundwater monitoring.

The remedial action selected in the Groundwater OU ROD for the Site 7 Plume uses pump-and-treat technology, with removal of volatile contaminants by air stripping, and injection of the treated water into the aquifer. The major components of this remedy include:

- Groundwater extraction at a rate of approximately 250 gpm;
- Treatment of the extracted groundwater through air stripping with off-gas treatment (i.e., carbon adsorption) to achieve ACLs (see Table 3-1) and to achieve discharge standards (for treated water and offgas);
- Groundwater injection in compliance with discharge standards (see Table 6-7, AFBCA, 1996a), in combination with other discharge options (to be evaluated during remedial design) that are (a) consistent with attainment of cleanup standards, and (b) cost-effective;
- Land-use restrictions will be implemented on Air Force property as appropriate, in order to preclude installation of groundwater wells that would not be compatible with protection of public health and the environment; and
- Monitoring the groundwater.

An ESD that clarifies the next-to-last bullet with respect to the implementation of land-use restrictions on Air Force property and establishes additional ICs has been prepared (AFRPA, 2009a), and as of June 2010, the ESD is awaiting signatures. The RAOs and components of the ICs for the Site 7 Plume are the same as those described in Section 4.1.2 for the Main Base/SAC Area Plume and are not repeated here.

Remedy Implementation. The Site 7 Plume remedial system is installed and has operated intermittently since 1998 due to gravel mining activities. Groundwater was extracted initially from only one well during the initial phase of the operation. However, this well (FFS-EW7-1) was destroyed in July 1999 due to gravel mining operations in the area.

One extraction well (7-EW-1) was installed near the leading edge of the Site 7 Plume during the fourth quarter of 2000. Startup of the extraction well and restart and proveout of the treatment system began in early April 2001. However, gravel mining activities in the vicinity of 7-EW-01 resumed in July 2001, and consequently, the conveyance piping was removed and the system was taken offline to accommodate the mining.

An additional extraction well (7-EW-02) was installed during the first quarter of 2002, and the treatment system was restarted in March 2002 with only 7-EW-02 operating. The treatment system was taken offline in April 2003 to accommodate aqueduct construction for rerouting of Morrison Creek and other mining and reclamation activities.

The Site 7 groundwater extraction and treatment system resumed operation with both extraction wells (7-EW-01 and 7-EW-02) in December 2006. The use of two extraction wells rather than the three included in the original remedial design was the result of both additional groundwater monitoring and model simulations. During 2009, the quarterly average flow rate was approximately 65 gpm. The groundwater extraction and treatment system for the Site 7 Plume, including two extraction wells (7-EW-01 and 7-EW-02), four injection wells (7-IW-01 through 7-IW-04), and conveyance piping, is shown on Figure 4-3.

Implementation of ICs for the Site 7 Plume is the same as described in Section 4.1.2 for the Main Base/SAC Area Plume and is not repeated here.

4.1.4 Groundwater OU – Northeast Plume

Remedy Selection. The RAO identified in the Groundwater OU ROD for the Northeast Plume is to protect the public from inadvertent significant exposure to contaminated groundwater. The Groundwater OU ROD determined that active remediation of the Northeast Plume was not warranted because action was being taken to remediate the source (Landfill Site LF-04) and because removing the low-concentration contaminants from the groundwater would provide little benefit while incurring high costs. The remedial action selected contains the following components:

- ICs (such as deed restrictions) are required to prohibit the installation of groundwater-supply wells on Mather that would jeopardize public health or the environment from the Northeast Plume. If off-base groundwater wells are proposed or constructed that could result in exposure to contaminated groundwater from the Northeast Plume, the need for active cleanup or other action must be revisited. Contaminant concentration levels in the groundwater will be re-evaluated annually. If the contaminant concentrations decrease to less than the ACLs (see Table 3-1) for one year, any ICs may be removed.

- Long-term groundwater monitoring will be continued and modified as necessary to monitor contaminant concentrations. Monitoring will be conducted pursuant to Title 23, CCR, Section 2550.10 (Corrective Action Monitoring) for at least one year from the date that the ACLs are attained. After that time, monitoring will, as required by the Landfill OU ROD, be conducted pursuant to Title 23, CCR, Section 2550.8 (Detection Monitoring), in order to detect potential future releases from Landfill Site LF-04.

- Prior to the first CERCLA five-year review, additional predictive modeling will be conducted in order to assess whether the contaminants will meet the ACLs within a reasonable time. The results of that modeling will be published in an appropriate document or an ESD, if necessary. If, at any time monitoring or modeling indicates that the contaminants will not meet the ACLs within a reasonable time, or at least 40 years from the date of the ROD, or that significant migration of the contaminants may occur at concentrations greater than the ACLs which impacts public health or the environment, active remediation will be reconsidered.

An ESD that clarifies the ICs that are to be applied to Air Force property as part of the Northeast Plume remedy to protect human health and the environment and establishes ICs to protect the monitoring wells used to monitor the performance of the remedy has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. The RAOs and components of the ICs for the Northeast Plume are the same as those described in Section 4.1.2 for the Main Base/SAC Area Plume and are not repeated here.

Remedy Implementation. Implementation of ICs for the Northeast Plume is the same as described in Section 4.1.2 for the Main Base/SAC Area Plume and is not repeated here.

The ARARs cited in the Groundwater OU ROD and governing groundwater monitoring include portions of CCR Title 23, Division 3, Chapter 15, Article 5 that describe groundwater monitoring programs for discharges of hazardous wastes to land. (Landfill Sites LF-03 and LF-04 are known or suspected sources for VOC groundwater contamination for the Northeast Plume.) The applicable monitoring programs include detection and corrective action monitoring programs. Accordingly, the Northeast Plume performance monitoring program that has been in place since the Groundwater OU ROD was signed in 1996 fulfills the corrective action monitoring ARAR. In addition, monitoring for new releases of VOCs from landfill Sites LF-03 and LF-04 is conducted under the detection monitoring ARAR. The wells used for monitoring the Northeast Plume are shown on Figure 4-4.

The ROD commitment to perform modeling prior to the first five-year review, to predict how much time will be required for the contaminant concentrations to decrease to less than the ACLs, was not accomplished for that review. An evaluation of the Northeast Plume was conducted between 2001 and 2002 (AFBCA, 2002). A review of concentration data over time revealed that concentrations of COCs exhibited sporadic patterns that did not allow for confident predictions of future concentrations. The report recommended continued monitoring of the Northeast Plume, as opposed to initiating active remediation, and recommended a similar evaluation be conducted periodically as monitoring data warrant, but no less frequently than the five-year reviews. The second five-year review stated that future predictive modeling was potentially viable based on the evident start of decreasing contaminant concentration trends observed within that time period (AFRPA, 2005a). The report recommended that the annual groundwater monitoring reports provide projections and an assessment of trends in the wells with the highest concentrations that may indicate when ACLs might be achieved or an assessment that the data indicates a pattern insufficient for a projection (AFRPA, 2005a). Concentration changes and trends in groundwater in the Northeast Plume monitoring wells are evaluated in each annual groundwater monitoring report. However, predictive modeling was not conducted in the annual groundwater monitoring reports due to increasing concentration trends at wells with concentrations greater than ACLs between approximately 2004 and 2006/2007. Since then, overall decreasing concentration trends have become apparent at these wells and a projection of when (approximately 2025) ACLs may be achieved in the Northeast Plume has been made (see Section 7.3.3).

4.1.5 Groundwater Monitoring Program

The Groundwater Monitoring Program at Mather provides periodic groundwater data from wells located on the former base and properties beyond the boundaries of the former base. Figure 4-5 shows the

locations of Mather groundwater monitoring wells, extraction wells, injection wells, piezometers, and potable water wells. Approximately 600 wells and piezometers and 39 active extraction wells were included in the monitoring program at Mather during 2009.

The objectives of the quarterly groundwater monitoring program are to:

- Monitor seasonal variation in groundwater elevation and gradients within each HSG unit.
- Monitor the extent of contamination and progress toward achieving cleanup levels.
- Evaluate the hydraulic capture of the groundwater extraction wells.
- Evaluate the performance of groundwater extraction and treatment systems, including monitoring of mass removal efficiency and compliance with discharge standards.
- Assess the potential impact of contaminant plumes on the off-base drinking-water-supply wells.
- Monitor water quality of the landfill areas and the treated-water-injection zones.

Groundwater monitoring data are collected periodically at Mather, and monitoring results are presented quarterly. Depth-to-groundwater measurements were collected at least quarterly from 1990 through 2006; starting in 2007, however, they have been collected semiannually during the second and fourth quarter sampling events. Additional water level measurements are collected as necessary to determine horizontal and vertical gradient patterns in sensitive areas of the monitoring program. Data collected each quarter are presented in quarterly fact sheets (first, second, and third quarters only). Interpretation of the data is performed and reported annually in the annual groundwater monitoring reports that are prepared following the fourth quarter monitoring event. The interpretation includes evaluation of groundwater level changes, gradients, flow directions, capture, and groundwater quality.

As the Groundwater Monitoring Program at Mather has matured, the focus of the program has transitioned from investigation and characterization to performance monitoring of the remedial actions (MWH, 2009f). The current emphasis is on monitoring migration at plume boundaries and receptor pathways. Therefore, the sampling frequency decision tree presented on Figure 4-6 has evolved over time since it was first developed in 1992. A detailed discussion regarding the Groundwater Monitoring Decision Tree is presented in the *2006 Groundwater Monitoring Program Evaluation Report* (GWMPER) (MWH, 2007b) with additional changes described in the *2009 Groundwater Monitoring Program Sampling Plan* (MWH, 2009f), the successor to the GWMPER. In addition, an extraction well shutdown decision logic has been developed (Figure 4-7). This decision logic provides the logical criteria used to determine when an extraction well may be taken offline.

4.1.6 Operations and Maintenance

The groundwater remedies are operated in accordance with the O&M manuals for the AC&W OU, Main Base/SAC Area Plume, and the Site 7 Plume, which describe procedures to operate and maintain the three groundwater treatment systems at Mather (EA Engineering, 1995; Montgomery Watson, 1997a; 1999c; MWH, 2003a). Modifications to the groundwater treatment systems, such as the installation of new extraction wells for refinement of plume control, are planned and implemented independently of the groundwater treatment system O&M program. Accordingly, the decision-making criteria and guidance for long-term management of the groundwater treatment systems are evaluated in the annual groundwater monitoring reports, not the O&M manuals.

A combination of routine weekly, monthly, quarterly, semiannual, and annual O&M activities are conducted for the extraction and treatment systems. These O&M activities include but are not limited to:

- Recording and monitoring all pertinent operational data.
- Inspecting mechanical operation of all equipment at the wellhead of each extraction well, injection well, and along the Mather Lake discharge pipeline (AC&W only).
- Maintaining the equipment based on manufacturer specifications.
- Redevelopment/rehabilitation of extraction and injection wells.
- Performing necessary repairs and system upgrades.
- Compiling data into appropriate tables and charts that allow observations to be made about overall system performance.

Scheduled and unscheduled treatment system shutdowns are reported in annual groundwater monitoring reports, which are provided to regulatory agencies. Numerous maintenance activities and system improvements have been implemented since the treatment plants have been put into operation.

Costs. Costs related to the remedial actions for the AC&W OU and Groundwater OU from 2005 through 2009 are summarized in Table 4-1. Annual costs include costs for the O&M of extraction and treatment plant systems, including the costs to perform improvements; the costs for performance monitoring (sampling, laboratory analysis, data validation, and reporting); and costs associated with the Groundwater Monitoring Program, which is used to evaluate groundwater remedy effectiveness. Costs for non-routine activities are also included, such as costs for well redevelopment/rehabilitation, extraction well and monitoring well installation, and carbon backwash/changeout for the GAC vessels at the Moonbeam Drive and Juvenile Hall water supply wells.

Table 4-1. O&M Costs for AC&W OU and Groundwater OU 2005-2009

AC&W OU		Groundwater OU	
Year	**Annual Cost ($)**	**Year**	**Annual Cost ($)**
2005	472,586	2005	2,000,051
2006	331,261	2006	1,918,387
2007	354,174	2007	2,115,768
2008	360,415	2008	2,031,623
2009	354,972	2009	2,079,762
Total	**$1,873,408**	**Total**	**$10,145,591**

AC&W = Aircraft Control and Warning
O&M = operation and maintenance
OU = operable unit

4.2 Soil OU

4.2.1 Site WP-07/FT-11

Remedy Selection. The RAOs identified in the Soil OU ROD for Site WP-07/FT-11 are to achieve cleanup standards for the COCs, to mitigate any residual source of groundwater contamination that may be present, and to comply with ARARs for the Site WP-07 solid waste disposal site.

The remedial action selected in the Soil OU ROD for Site WP-07/FT-11 was modified by an ESD (AFBCA, 1998c). The major components of the remedy, with the ESD modifications shown in *italics,* include:

- Filling in the depression at Site WP-07 with inert fill *or soils meeting acceptance criteria in the ESD*;
- Treating the contaminated shallow and deep soils at Sites WP-07 and FT-11 by in situ bioremediation and possibly SVE. The in situ bioremediation system could be converted to an SVE system if significant amounts of solvents are encountered, in order to speed up remediation;
- Installing a prescriptive landfill cover over the Site WP-07 impacted area [*the ESD deletes the following ROD condition,* "if site conditions indicates it is appropriate, or a vegetative cover if there is no threat to groundwater quality nor generation of landfill gases,"] using inert soils and/or non-designated soils to construct the foundation for the cap/cover; and
- Monitoring the groundwater (if contamination remains in place that threatens groundwater quality).

The ROD remedy also includes land-use restrictions to protect the landfill cap at Site WP-07. An ESD that clarifies the ICs and augments the remedy by establishing additional ICs at Site WP-07 has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. The ESD also deletes numeric soil cleanup levels for TPHD and TPHG and adds narrative soil cleanup levels at Site WP-07/FT-11.

The RAOs for the ICs are: (1) protecting the integrity of the soil remedial actions and systems, including the associated monitoring systems, and (2) preserving access for the Air Force, EPA, and the State of California to the remedial systems and associated monitoring systems. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs.

Following signature on the ESD, the Air Force will impose the following ICs to protect the remedial systems associated with Site WP-07/FT-11. The transferee will be prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation;
- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component;
- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to any equipment or component associated with the soil remediation systems;

- Interfering with the remedial action or damaging/disturbing/penetrating the engineered landfill cap or damaging/disturbing/ tampering with/removing or interfering with any associated remedial system components (e.g., containment system, drainage systems, erosion control systems for the landfill cover, survey monuments, gas vents, gas migration monitoring wells, groundwater monitoring system, access roads, settlement monuments, fencing, signage), or allowing others to do so, until such time as remediation is complete or the component is no longer used for the remedial action;

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of the landfill cap or any associated remedial system component;

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to the landfill cap or any associated remedial system component; and

- Using, or allowing others to use, the Property within the landfill cap outline identified in Figure 3 of the ESD for residential purposes (including mobile or modular homes), hospitals for human, public or private schools for persons under 18 years of age, nursery schools, or for day care centers for children.

Site WP-07 will also have the following institutional controls:

- Controls to minimize potential for completing the inhalation exposure pathway for methane and other gasses potentially migrating from the landfill sites require future landowners to obtain approval from the State of California for any changes in land use or site improvements within 1,000 feet of a landfill, until and unless it is demonstrated that the landfill is no longer a threat to human health and the environment. This requirement is based on regulations at 27 CCR § 21190 that apply to landfill properties.

During the time between the adoption of the Soil OU and Groundwater OU ESD and deeding of the property, equivalent restrictions will be implemented pursuant to the terms of the existing lease which requires the approval of the USAF for any construction or soil disturbance activity. The lease restrictions are in place and operational and will remain in place until the property is transferred by deed. At the time of deed transfer, lease restrictions will be superseded by equivalent use restrictions to be included in the federal deed and the SLUC as described in the Soil OU and Groundwater OU ESD.

The deeds or associated transaction documents will also contain a reservation of access to the property for the USAF, EPA, and the State, and their respective officials, agents, employees, contractors, and subcontractors for purposes consistent with the USAF IRP or the FFA.

Remedy Implementation. The depression at Site WP-07 was filled with soil from other IRP sites to create positive drainage away from the disposal site, and a landfill cap was constructed at the site in 1999.

Site WP-07 has been closed in accordance with ARARs for a Class III landfill. Post-closure inspections and maintenance of the cap, drainage system, and other landfill structures; monitoring of landfill gas generation and migration, and monitoring of groundwater quality are conducted in accordance with the *Closure and Post-Closure Maintenance Plan for the Engineered Cap at Remedial Action Site 7* (Montgomery Watson, 1999d). The results of these activities are reported in the quarterly field logs and annual post-closure landfill inspection and gas monitoring reports. The results of groundwater monitoring for the landfill program are reported in conjunction with the Site 7 Plume VOC data in the quarterly and annual groundwater monitoring reports. Periodic topographic surveys are conducted approximately every five years to monitor differential settlement of Site WP-07; the most recent survey was completed in 2008 (MWH, 2008a).

VOCs in the vadose zone at Site WP-07/FT-11 were initially remediated by separate SVE systems starting in late 1998 but were later combined and operated with a single treatment unit. In April 2007, the SVE treatment system was shut down, and a BV system was started, as volatile contaminant concentrations had significantly decreased. Groundwater monitoring at Site WP-07/FT-11 is conducted by the Groundwater Monitoring Program, as described in Section 4.1.5.

The two remedial systems (one SVE thermal oxidizer and one BV system) are located adjacent to one another within a fenced compound in the northeastern portion of Site WP-07/FT-11. The system manifolds are designed such that the pipe configuration can be changed to allow either SVE or BV operations to remediate the site. The Site WP-07/FT-11 BV system consists of 34 BV air injection wells, 16 horizontal BV wells, and 23 vapor monitoring wells (Figure 4-8). The operational and remedial history for the Site WP-07/FT-11 remedial system is provided in Appendix A.

Implementation of the additional ICs will occur following signature on the ESD (AFRPA, 2009a). The implementation and effectiveness of the additional ICs will be assessed in the fourth five-year review for Mather.

4.2.2 Site ST-37/ST-39/SS-54

Remedy Selection. The RAOs identified in the Soil OU ROD for Site ST-37/ST-39/SS-54 are to achieve cleanup standards for the COCs and to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Soil OU ROD for Site ST-37/ST-39/SS-54 includes these major components:

- Excavating approximately 220 cubic yards of contaminated surface soils to remove all contamination above acceptable levels;
- Transporting the excavated soils to the on-base ex situ bioremediation facility;
- Treating the excavated soils by ex situ bioremediation as appropriate;
- Transporting the treated soils to, and consolidating them with landfill cap foundation materials at Site WP-07, as appropriate;
- Treating the contaminated shallow and deep soils by in situ bioremediation and possible SVE. The in situ bioremediation system could be converted if appropriate, to an SVE system if significant amounts of solvents are encountered in order to speed up remediation; and
- Monitoring the groundwater if contamination that threatens groundwater quality remains at the site.

An ESD that adds ICs to the remedy at Site ST-37/ST-39/SS-54 has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. The ESD also deletes numeric soil cleanup levels for BTEX, TPHD, and TPHG and adds narrative soil cleanup levels at Site ST-37/ST-39/SS-54.

The RAOs for the ICs are: (1) preventing unacceptable human exposure to soil vapor or residual contamination at Sites 37/39/54; (2) protecting the integrity of the soil remedial actions and systems, including the associated monitoring systems; and (3) preserving access for the Air Force, EPA, and the State of California to the remedial systems and associated monitoring systems. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs.

Following signature on the ESD, the Air Force will impose the following ICs to protect the remedial and monitoring systems associated with Site ST-37/ST-39/SS-54 (including the extension to Site ST-29/ ST-71, a non-CERCLA site, and monitoring wells at Sites OT-23B and -23D from the Basewide OU). The transferee will be prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation;

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component; and

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to any equipment or component associated with the soil remediation systems.

During the time between the adoption of the Soil OU and Groundwater OU ESD and deeding of the property, equivalent restrictions will be implemented pursuant to the terms of the existing lease which requires the approval of the USAF for any construction or soil disturbance activity. The lease restrictions are in place and operational and will remain in place until the property is transferred by deed. At the time of deed transfer, lease restrictions will be superseded by equivalent use restrictions to be included in the federal deed and the SLUC as described in the Soil OU and Groundwater OU ESD.

The deeds or associated transaction documents will also contain a reservation of access to the property for the USAF, EPA, and the State, and their respective officials, agents, employees, contractors, and subcontractors for purposes consistent with the USAF IRP or the FFA.

In addition to the ICs identified above, the Air Force will impose the following ICs, if necessary, to prevent health risks from exposure to VOC-contaminated shallow soils. The property recipient will be prohibited from:

- Engaging in any surface or shallow soil disturbance at Site ST-37/ST-39/SS-54, until and unless it is demonstrated that VOC contamination at these site(s) is no longer a threat to human health and the environment; and

- Constructing any structures for human occupation at Site ST-37/ST-39/SS-54 without evaluating or addressing the risks posed by vapor intrusion.

These ICs will be imposed only if necessary. If the site soil gas data demonstrate that all of the soil gas concentrations for each COC are compatible with unrestricted land use, then the Air Force will not impose these ICs.

Remedy Implementation. The Soil OU ROD stated that approximately 220 cubic yards of surface soils were to be excavated and treated at the on-base ex situ bioremediation facility. Following treatment, the soil was to be consolidated with landfill cap foundation materials at Site WP-07. However, prior to excavation, trenching activities were conducted to determine the extent of soil requiring removal to meet the site's cleanup levels. Based on the trenching results, the portion of the site identified by the Soil OU ROD as requiring excavation met the cleanup levels without further excavation (Montgomery Watson, 2000a). Therefore, no excavation was conducted with the exception of the soils from the investigative trenches.

An SVE system (vapor extraction with vapor treatment by a thermal oxidizer with a capacity of 1,000 standard cubic feet per minute [scfm]) was constructed in summer 1998, and after a period of start-up and troubleshooting, became fully operational in December 1998. This system operated until January 2006 when it was taken offline due to a faulty heat exchanger. A replacement treatment system (500 scfm thermal oxidizer) became operational in February 2007. At the time of this review, the treatment unit at Site ST-37/ST-39/SS-54 also was connected to and treated vapors from the extraction systems at Site ST-29/ST-71, which is a non-CERCLA site. During the period of this five-year review, the system operated for periods of continuous operation or on a cycled schedule (four days on, three days off).

The Site ST-37/ST-39/SS-54 system consists of 24 SVE wells and 26 vadose zone monitoring probes/wells to monitor vapor concentrations and remedial progress at the site (Figure 4-9). The operational and remedial history for the Site ST-37/ST-39/SS-54 remedial system is provided in Appendix A.

Implementation of ICs will occur following signature on the ESD (AFRPA, 2009a). The implementation and effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

4.2.3 Site SD-57

Remedy Selection. The RAOs identified in the Soil OU ROD for Site SD-57 are to achieve cleanup standards for the COCs and to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Soil OU ROD for Site SD-57 includes the following major components:

- Treating the contaminated shallow and deep soils by in situ SVE; and
- Monitoring the groundwater if contamination that threatens groundwater quality remains at the site.

An ESD that adds ICs to the remedy at Site SD-57 has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. The RAOs and components of the ICs for Site SD-57 are the same as those described in Section 4.2.2 for Site ST-37/ST-39/SS-54 and are not repeated here.

Remedy Implementation. In August 1997, an SVE system began operating at Site SD-57 and SVE has since operated in various treatment modes (i.e., catalytic mode and GAC). The current SVE system is composed of a 650-scfm vacuum extraction system. With concurrence from SMAQMD, from February 2004 until August 2008, the Site SD-57 SVE system operated without air emission treatment. In September 2008, GAC was temporarily added to the treatment system for air emissions abatement control following the addition of two SVE wells to the SVE system because of the increased concentration of carbon tetrachloride (CCl_4) in the treatment system influent. With concurrence from SMAQMD, the SVE system at Site SD-57 has operated without GAC since March 2009. In 2001, dual-phase extraction was initiated in three water-table groundwater extraction wells that not only removed vapor but also increased the groundwater extraction rate for the wells.

The Site SD-57 system consists of 13 SVE wells, 3 dual-phase extraction wells, and 27 vadose zone monitoring probes/wells to monitor vapor concentrations and remedial progress at the site (Figure 4-10). The operational and remedial history for the Site SD-57 remedial system is provided in Appendix A.

Implementation of ICs will occur following signature on the ESD (AFRPA, 2009a). The implementation and effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

4.2.4 Site SD-59

Remedy Selection. The RAOs identified in the Soil OU ROD for Site SD-59 are to achieve cleanup standards for the COCs and to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Soil OU ROD for Site SD-59 includes the following major components:

- Excavating approximately 1,200 cubic yards of contaminated shallow soils to remove all contamination above acceptable levels;
- Transporting the excavated soils to the on-base ex situ bioremediation facility;
- Treating the excavated soils by ex situ bioremediation as appropriate;
- Transporting the treated soils to and consolidating them with landfill cap foundation materials at Site LF-04 or Site WP-07, as appropriate; and
- Monitoring the groundwater if contamination that threatens groundwater quality remains at the site.

As discussed below under remedy implementation, contaminated soil remained following the excavation at Site SD-59 that would have been prohibitively costly to remove and would have required demolition of nearby structures. Therefore, an ESD was prepared to add in situ treatment (SVE/BV) to the remedy (AFBCA, 1998d). The following components were added to the Site SD-59 remedy:

- Installation of injection/extraction wells and monitoring points;
- Removal of contaminated surface soil with off-site disposal as appropriate;
- Pilot test to optimize the efficiency and cost of the SVE and/or the BV system;
- Startup, operation, and maintenance of the system (including a potential switch from SVE to BV); and
- Closure of the site after remedial goals have been met.

A second ESD that adds ICs to the remedy at Site SD-59 has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. This ESD also deletes numeric soil cleanup levels for TPHD and TPHG and adds narrative soil cleanup levels at Site SD-59. The RAOs and components of the ICs for Site SD-59 are the same as those described in Section 4.2.2 for Site ST-37/ST-39/SS-54 and are not repeated here. Note that the ICs for protection of remedy components will also apply to the SVE components at Site LF-18 (Basewide OU), which is being remediated with Site SD-59.

Remedy Implementation. In August and September 1996, approximately 750 cubic yards of contaminated soil were excavated in an attempt to reach the cleanup levels for TPHG and TPHD. However, petroleum hydrocarbons were detected in samples collected between 10 to 22 feet bgs in the sidewalls and from soil borings at concentrations greater than the cleanup levels for both TPHG and TPHD (Montgomery Watson, 1997b). Thus, remediation to the cleanup levels through excavation was no longer considered feasible because costs to continue excavating were prohibitive and because surrounding structures would have needed demolition to allow access for excavation.

After the soil excavation, regulatory review of Site SD-59 raised issues regarding the presence of chlorinated VOCs in the soil samples collected at the sidewalls of the excavation, and the concern that these VOCs could potentially migrate to groundwater. Soil cleanup levels were not specified for chlorinated VOCs in the Soil OU ROD (AFBCA, 1996a). The ROD requirements were modified by an ESD, which required characterization and evaluation for the presence of chlorinated VOCs in shallow soils and installation of an SVE system at Site SD-59 (AFBCA, 1998d). If chlorinated VOCs were detected at concentrations that posed a threat to groundwater quality, additional SVE wells would be considered for installation to extract the VOCs from the vadose zone.

Two phases of post-ROD characterization were conducted at Site SD-59, which included installation of multi-probe soil vapor monitoring points (SVMPs) and SVE wells and a pilot test of the SVE system beginning in December 1998. Full-scale operations began in 2000. Starting in August 2001, the 750-scfm SVE GAC system located at Site SD-59 was used to remediate vapors at Site SD-59 and/or Site LF-18 (Basewide OU). Risk calculations performed with source testing results indicated soil vapors from Site SD-59 did not pose a significant health risk to residential and commercial receptors. As a result, active emissions controls were not needed, and the carbon treatment was removed. Due to an elevated concentration of TPHG reported in the October 2004 compliance sample, carbon treatment was reintroduced as part of the SVE system. However, since March 2006, the Site SD-59 SVE system has operated without air emission treatment due to low reactive organic compound (ROC) emission rates.

The Site SD-59 system consists of 11 SVE wells and 16 monitoring probes/wells to monitor vapor concentrations and remedial progress at the site (Figure 4-11). The operational and remedial history for the Site SD-59 remedial system is provided in Appendix A.

Implementation of ICs will occur following signature on the ESD (AFRPA, 2009a). The implementation and effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

4.2.5 Operations and Maintenance

During the period of this five-year review, the SVE/BV treatment systems for the Soil OU sites described in Sections 4.2.1 through 4.2.4 were operated in accordance with their respective O&M manuals, including:

Site WP-07/FT-11 – *Operations and Maintenance Manual for Sites 7/11 Soil Vapor Extraction and Biovent Systems* (Montgomery Watson, 1999f);

Site ST-37/ST-39/SS-54 – *Operations and Maintenance Manual for Site 37/39/54 Soil Vapor Extraction System* (Montgomery Watson, 1999e); and

Site SD-57 and Site SD-59 – *Operations and Maintenance Manual for Sites 18/59, Site 23, and Site 57 Soil Vapor Extraction Systems* (Montgomery Watson, 2000c).

A combination of routine weekly, monthly, quarterly, semiannual, and annual O&M activities are conducted for the SVE/BV treatment systems. Specific O&M tasks are outlined in the applicable O&M manual(s).

Starting in 2009, these O&M manuals have been updated and combined into *the Soil Vapor Extraction and Bioventing Remedial Treatment Systems Operations and Maintenance Manual for Sites 7/11, 10C/68, 23C, 29/71, 37/39/54, 57, and 18/59* (MWH, 2009g) to provide for consistent operations, maintenance, and monitoring activities at all active Mather SVE/BV sites.

In addition, the landfill cap at Site WP-07 described in Section 4.2.1 is being maintained and monitored in accordance with the *Closure and Post-Closure Maintenance Plan for the Engineered Cap at Remedial Action Site 7* (Montgomery Watson, 1999d) and the *Addendum to the Final Basewide Groundwater Monitoring Sampling and Analysis Plan for Landfill Gas Monitoring – Revision 1* (Montgomery Watson, 2000d).

Costs. Costs related to the remedial actions for the Soil OU from 2005 through 2009 are summarized in Table 4-2. Annual costs include costs for the O&M of the SVE/BV systems and the WP-07 landfill, including the costs to perform improvements and repairs and the costs for performance monitoring (cap inspection at WP-07, gas monitoring, soil vapor well sampling, laboratory analysis, data validation, and reporting). Costs for non-routine activities are also included, such as costs for soil vapor well installation and the quinquennial topographic survey of the WP-07 landfill in 2008.

Table 4-2. O&M Costs for Soil OU 2005-2009

Site WP-07/FT-11		Site ST-37/ST-39/SS-54		Site SD-57		Site SD-59	
Year	Annual Cost ($)	Year	Annual Cost ($)	Year	Annual Cost ($)	Year	Annual Cost ($)
2005	147,486	2005	114,442	2005	98,387	2005	83,799
2006	138,941	2006	222,030	2006	156,944	2006	106,947
2007	131,068	2007	192,904	2007	157,776	2007	152,034
2008	54,748	2008	127,028	2008	108,469	2008	139,120
2009	110,821	2009	120,798	2009	147,167	2009	145,663
Total	**$583,064**	**Total**	**$777,201**	**Total**	**$668,742**	**Total**	**$627,563**

O&M = operations and maintenance
OU = operable unit

4.3 Landfill OU

4.3.1 Site LF-03

Remedy Selection. The RAOs identified in the Landfill OU ROD for Site LF-03 are to close the landfill in compliance with ARARs and to, thereby, protect human health and the environment.

The remedy selected in the Landfill OU ROD for Site LF-03 is an engineered cap (AFBCA, 1995). The major components of the remedy include:

- Installing an engineered cap;
- Installing passive gas vent wells;
- Monitoring of groundwater and landfill gas for at least five years; and
- Invoking access restrictions (i.e., fencing and deed restrictions).

A memorandum of post-ROD changes that clarifies and supplements the ICs at Site LF-03 was issued in 2009 (AFRPA, 2009c). The RAOs for the ICs are: (1) preventing human exposure to methane in structures that may be built within 1,000 feet of Site LF-03; (2) protecting the integrity of the remedial

system(s), including the associated monitoring system; and (3) protecting necessary access to the remedial system(s), including the associated monitoring system.

The ICs include:

- Controls to minimize potential for completing the inhalation exposure pathway for methane and other gasses potentially migrating from the landfill sites, require future landowners to obtain approval for any changes in land use or site improvements within 1,000 feet of a landfill from the State, until and unless it is demonstrated that the landfill is no longer a threat to human health and the environment. This requirement is based on regulations at 27 CCR § 21190 that apply to landfill properties.

- Controls to prohibit the destruction or disturbance of, or interference with, the remedial action, including the landfill caps and associated remediation system components, drainage systems, erosion control systems for the landfill cover, survey monuments, gas vents, gas migration monitoring wells, groundwater monitoring wells, fencing, signage, and access roads, until such time as remediation is complete or components are no longer to be used for remediation.

- Controls to prohibit any activities that would limit access to any equipment or systems associated with the remedial action, including the landfill caps and drainage structures and systems, gas monitoring wells, groundwater monitoring wells, gas venting equipment, survey monuments, fences and signage, and any other component of the remedial action.

Remedy Implementation. Site LF-03 was capped and closed successfully in 1996. The site is fenced and protected from disturbance by conditions in the lease to Sacramento County. Post-closure inspections and maintenance of the cap, drainage system, and other landfill structures; monitoring of landfill gas generation and migration, and monitoring of groundwater quality are conducted in accordance with the *Closure and Post-Closure Maintenance Plan for the Landfill Operable Unit* (Montgomery Watson, 1996a). The results of these activities are reported in the quarterly and annual post-closure landfill inspection and gas monitoring reports. The results of groundwater monitoring for the landfill program are reported in conjunction with the Northeast Plume VOC data in the quarterly and annual groundwater monitoring reports. Periodic topographic surveys are also conducted approximately every five years to monitor differential settlement of LF-03; the most recent survey was completed in 2008 (MWH, 2008a).

In 2006, research of historic records revealed that screen depths for the gas migration probes at Site LF-03 only extended to depths of approximately 6 feet bgs, while the deepest known waste at Site LF-03 is approximately 18 feet deep, as reported in the *Landfill Operable Unit Focused Feasibility Study* (IT Corporation, 1993c). Therefore, four dual-completion and two single-completion gas migration probes were installed at LF-03. Each of the new gas migration probes was installed to a depth to match the deepest reported waste (MWH, 2008b). As of December 2008, landfill gas generation at Site LF-03 is monitored by a network of four passive landfill gas vents and 11 perimeter landfill gas migration probes (Figure 4-12).

Implementation of ICs to prevent human exposure to methane, to protect the remedial system components (including the landfill and associated groundwater/vapor monitoring wells), and to prevent any activities that are inconsistent with the remedial actions or access to the remedial system components is described in the memorandum of post-ROD changes (AFRPA, 2009c). The implementation and effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

4.3.2 Site LF-04

Remedy Selection. The RAOs identified in the Landfill OU ROD for Site LF-04 are to close the landfill in compliance with ARARs and to, thereby, protect human health and the environment.

The remedy selected in the Landfill OU ROD for Site LF-04 is an engineered cap (AFBCA, 1995). The major components of the remedy include:

- Installing an engineered cap;
- Installing flood control measures (e.g., embankment);
- Installing passive gas vent wells;
- Monitoring of groundwater and landfill gas for at least five years; and
- Invoking access restrictions (i.e., fencing and deed restrictions).

The Landfill OU ROD also includes consolidation at Site LF-04 of wastes excavated from Sites LF-05 and LF-06. In addition, the Explanation of Significant Difference from the Record of Decision, Consolidation of Additional Refuse & Debris into Landfill Site 4 (AFBCA, 1996b) modifies the remedy at Site LF-02 to include consolidation of waste at Site LF-04.

A memorandum of post-ROD changes that clarifies and supplements the ICs at Site LF-04 was issued in 2009 (AFRPA, 2009c). The RAOs and components of the ICs for Site LF-04 are the same as those described in Section 4.3.1 for Site LF-03 and are not repeated here.

Remedy Implementation. In 1996, Site LF-04 was capped, and in 1997 the placement of vegetation on the cap was completed. The site is fenced and protected from disturbance by conditions in the lease to Sacramento County. Post-closure inspections and maintenance of the cap, drainage system, and other landfill structures; monitoring of landfill gas generation and migration, and monitoring of groundwater quality are conducted in accordance with the *Closure and Post-Closure Maintenance Plan for the Landfill Operable Unit* (Montgomery Watson, 1996a). The results of these activities are reported in the quarterly and annual post-closure landfill inspection and gas monitoring reports. The results of groundwater monitoring for the landfill program are reported in conjunction with the Northeast Plume VOC data in the quarterly and annual groundwater monitoring reports. Periodic topographic surveys are also conducted approximately every five years to monitor differential settlement of LF-04; the most recent survey was completed in 2008 (MWH, 2008a).

Because historic concentrations of methane measured at the north property boundary were greater than the action level of 5 percent (%) methane by volume in air, suggesting the potential for off-base methane gas migration, a passive gas migration control system was constructed in June 1998 along the north perimeter of Site LF-04. Further, a contingency plan was prepared to address additional measures to be taken should gas concentrations fail to meet standards in a reasonable amount of time (Montgomery Watson, 1999g).

As of December 2008, landfill gas generation at Site LF-04 is monitored by a network of 19 gas migration probes, 25 passive landfill gas migration control trench system vents, and 10 landfill gas vents (Figure 4-13). During the five-year review period, there were methane detections greater than the 5% compliance concentration several times in gas migration well MW-29B, which was monitored quarterly for methane concentrations. The methane concentrations exceeded the 5% compliance concentration in

the first quarter of 2005 and again in the first and second quarters of 2006. During the first quarter of 2007, additional gas migration wells were installed, and the alternate facility boundary was subsequently expanded at Site LF-04. Methane in both gas migration probes replacing MW-29B have been less than the five percent methane compliance level since installation. MW-403, one of the new gas migration wells installed along the northern margin of the landfill compliance boundary, had detections of methane greater than the 5% compliance level in one of its screens (see Section 7.5.2); this migration was addressed by installation of a solar-powered fan system in an adjacent vent trench.

Implementation of ICs to prevent human exposure to methane, to protect the remedial system components (including the landfill and associated groundwater/vapor monitoring wells), and to prevent any activities that are inconsistent with the remedial actions or access to the remedial system components is described in the memorandum of post-ROD changes (AFRPA, 2009c). The implementation and effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

4.3.3 Operations and Maintenance

During the period of this five-year review, the landfill caps at Sites LF-03 and LF-04 described in Sections 4.3.1 and 4.3.2 were maintained and monitored in accordance with their post-closure O&M manuals, including:

- *Closure and Post-Closure Maintenance Plan for the Landfill Operable Unit* (Montgomery Watson, 1996a);
- *Landfill LF04 Methane Gas Migration Contingency Plan, Mather Air Force Base, California* (Montgomery Watson, 1999g); and
- *Addendum to the Final Basewide Groundwater Monitoring Sampling and Analysis Plan for Landfill Gas Monitoring – Revision 1* (Montgomery Watson, 2000d).

Quarterly landfill inspections and gas monitoring includes:

- Inspection of the final caps, drainage systems, and other landfill structures, including access roads, fencing and signs, and condition of gas vents, gas migration probes, and groundwater monitoring wells.
- Monitoring of landfill gas vents (on the landfill cap) and gas migration probes (outside the cap perimeter with a combustible gas indicator and infrared gas analyzer calibrated for methane and used to monitor methane at the perimeter landfill gas migration probes.
- Monitoring the passive gas migration control trench system at the northern boundary of Site LF-04.
- Monitoring of groundwater quality.

In addition, every five years, a topographic survey is conducted to monitor differential settlement of the landfills. Numerous maintenance activities and gas monitoring and drainage system improvements have been implemented since the final caps were constructed at Sites LF-03 and LF-04.

Costs. Costs related to the remedial actions for the Landfill OU from 2005 through 2009 are summarized in Table 4-3. Annual costs include costs for the O&M of the landfills at Site LF-03 and Site LF-04, including the costs to perform improvements and repairs and the costs for performance monitoring (cap inspection, gas monitoring, laboratory analysis [as needed], data validation [as needed], and reporting).

Costs for non-routine activities are also included, such as costs for fence and erosion repair, migration probe installation, and the quinquennial topographic survey in 2008.

Table 4-3. O&M Costs for Landfill OU 2005-2009

Year	Annual Cost ($)
2005	405,020
2006	345,465
2007	346,276
2008	389,215
2009	276,927
Total	**$1,762,903**

O&M = operation and maintenance
OU = operable unit

4.4 Basewide OU

4.4.1 Site FT-10C/ST-68

Remedy Selection. The RAOs identified in the Basewide OU ROD for Site FT-10C/ST-68 are to achieve cleanup standards for the COCs, and to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Basewide OU ROD for Site FT-10C/ST-68 includes the following major components:

- In situ treatment of the fuel contaminated subsurface soils at Sites FT-10C and ST-68;
- Treatment of offgas by GAC or more cost-effective means of best available control technology as necessary to comply with ARARS; and
- Monitoring any thermal treatment effluent for dioxins (at least three sampling events during the first month of operation), and conducting a risk assessment if emissions exceed 200 picograms per dry standard cubic meter.

As discussed below under remedy implementation, lead-contaminated soil was discovered in 2002. Therefore, an ESD was prepared to add excavation of the lead-contaminated soil to the remedy for Site FT-10C/ST-68 (AFRPA, 2008b).

The RAOs for the lead excavation portion of the remedy are to at a minimum, eliminate the presence of concentrations incompatible with industrial land use (800 milligrams per kilogram [mg/kg]) and protect water quality in the underlying aquifer at or less than the maximum contaminant level (MCL) (15 µg/L) for lead by excavating soil with soluble lead concentrations greater than 15 milligrams per liter (mg/L).

The ESD anticipated that the excavation effort might result in lead concentrations remaining at the site that are above 151 mg/kg, the unrestricted use level established through site-specific determination using DTSC's LEADSPREAD model (AFRPA, 2008b). Therefore, the ESD stipulated that if residual lead remained at Site FT-10C/ST-68 at concentrations incompatible with unrestricted land use (i.e., lead

concentrations remaining at the site that are greater than 151 mg/kg), then ICs would be established by a decision document and implemented to prevent unacceptable risks that may result from disturbance of, and exposure to, lead contaminated soils at this location (AFRPA, 2008b). The excavation occurred in 2008, and no lead concentrations remain at the site that are greater than 151 mg/kg (MWH, 2009a). In addition, all soluble lead concentrations were less than 15 mg/L (MWH, 2009a). Therefore, ICs related to lead contamination are not required.

An ESD for Site FT-10C/ST-68 that adds ICs to the remedy at Site FT-10C/ST-68 has been prepared (AFRPA, 2009d), and as of June 2010, is awaiting signatures. The ESD also deletes the numeric soil cleanup levels for TPHD and TPHG and adds narrative soil cleanup levels.

The RAOs for the ICs are: (1) preventing unacceptable human exposure to soil vapor or residual contamination at Site FT-10C/ST-68; (2) protecting the integrity of the remedial system, including the associated monitoring system at Site FT-10C/ST-68; and (3) preserving access to the remedial system and associated monitoring system at Site FT-10C/ST-68. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs.

Following signature on the ESD, the Air Force will impose the following ICs, if necessary, to prevent health risks from exposure to VOC-contaminated shallow soils. The property recipient will be prohibited from:

- Engaging in any surface or shallow soil disturbance at Site FT-10C/ST-68, except in connection with construction that complies with the institutional control that addresses vapor intrusion; and

- Constructing any structures for human occupation at Site FT-10C/ST-68.

These ICs will be imposed only if necessary. The Air Force will determine if ICs are necessary nearer the time of transfer. If the site soil gas data demonstrate that all of the soil gas concentrations for each COC are compatible with unrestricted land use, then the Air Force will not impose these ICs.

In addition to the ICs identified above, the Air Force will impose the following ICs to protect the remedial systems at the Site FT-10C/ST-68. The transferee will be prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation;

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component; and

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to any equipment or systems associated with the soil remediation system components.

During the time between the adoption of the Basewide OU ESD and deeding of the property, equivalent restrictions will be implemented pursuant to the terms of the existing lease which requires the approval of the USAF for any construction or soil disturbance activity. The lease restrictions are in place and operational and will remain in place until the property is transferred by deed. At the time of deed transfer, lease restrictions will be superseded by equivalent use restrictions to be included in the federal deed and the SLUC as described in the Basewide OU ESD.

The deeds or associated transaction documents will also contain a reservation of access to the property for the USAF, EPA, and the State, and their respective officials, agents, employees, contractors, and subcontractors for purposes consistent with the USAF IRP or the FFA.

Remedy Implementation. After site investigation and prior to the signing of the Basewide OU ROD, debris and soil (including lead-impacted surface soil) were excavated from Site FT-10C and disposed at the Site LF-04 landfill under a removal action memorandum (AFBCA, 1996c). A remediation system, SVE and/or BV have been operating at Site FT-10C/ST-68 since 1997. Initially, Site FT-10C/ST-68 underwent SVE of the shallow soils; SVE systems with thermal destruction using a catalytic oxidizer or a GAC system were operated. Then, a combination of BV of the shallow soils with SVE of the deep soils was performed between 1998 and 2001, and later in 2001 a thermal SVE system without catalytic oxidation was relocated from Site ST-29 and put into operation. Starting in October 2004 and with concurrence from SMAQMD, the SVE system operated without air emission treatment. A new 650-scfm SVE system was installed and operated between May 2005 and August 2008, when the system was shut down for rebound sampling and closure evaluation. A draft final closure report has been prepared to document that no further treatment is required at Site FT-10C/ST-68 (MWH, 2009b).

The Site FT-10C/ST-68 system consists of 22 SVE/BV wells, 2 dual-purpose groundwater monitoring/ SVE wells (screened in the deep vadose zone and across the water table), 6 horizontal SVE/BV wells, and 33 vadose zone monitoring probes/wells to monitor vapor concentrations and remedial progress at the site (Figure 4-14). The operational and remedial history for the Site FT-10C/ST-68 remedial system is provided in Appendix A.

The additional lead-contaminated soil discovered in 2002 was excavated in November and December 2008 and disposed at an appropriately permitted off-site landfill (MWH, 2009a). Approximately 140 cubic yards of soil were removed from Site FT-10C/ST-68. The soil was excavated such that ICs related to residual lead will not be required (i.e., residual lead concentrations met the 151 mg/kg unrestricted use level designated in the ESD).

Implementation of ICs will occur following signature on the ESD (AFRPA, 2009d). The implementation and effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

4.4.2 Site LF-18

Remedy Selection. The RAO identified in the Basewide OU ROD for Site LF-18 is to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Basewide OU ROD for Site LF-18 includes the following major components:

- Installing an in situ SVE system comprised of extraction wells and possibly passive injection wells;
- Treatment of offgas by GAC or more cost-effective means of best available control technology as necessary to comply with ARARs; and
- Monitoring any thermal treatment effluent for dioxins (at least three sampling events during the first month of operation), and conducting a risk assessment if emissions exceed 200 picograms per dry standard cubic meter.

An ESD to add ICs to the remedy for Site LF-18 to prevent health risks from exposure to VOC-contaminated soils has been prepared (AFRPA, 2009d), and as of June 2010, is awaiting signatures. In

addition, because Site LF-18 is being remediated with Soil OU Site SD-59, the protection of remaining SVE piping and wells is included with Site SD-59 in an ESD for the Soil OU remedies (AFRPA, 2009a) that as of June 2010, is also awaiting signatures. This ESD adds ICs to the remedy for Site SD-59 and Site LF-18 (including Site OT-23A). The RAOs and the ICs related to preventing unacceptable human exposure to soil vapor and preserving access to the remedial system are the same as those described in Section 4.4.1 for Site FT-10C/ST-68, and the RAOs and the ICs related to protection of remaining remedial system components and preserving access are the same as those described in Section 4.2.2 for Site ST-37/ST-39/SS-54.

Remedy Implementation. Pilot tests using SVE were conducted at Site LF-18 in 1993, 1995, and 1998 (IT Corporation, 1995; 1996b; Montgomery Watson, 1999a). The pilot tests confirmed that SVE was effectively able to remove VOCs from the soil at Site LF-18. Therefore, an SVE system was constructed in 1999 and began operation in 2000. In accordance with ROD requirements, three samples for dioxins analysis were collected in February and May 2000 from the emission of the catalytic oxidizer treatment system. The results ranged from 9.1 to 148.2 picograms per dry standard cubic meter. Because the results were less than 200 picograms per dry standard cubic meter, conducting a risk assessment was not required (Montgomery Watson, 2000e). Two systems (catalytic oxidizer and GAC) operated concurrently from June 2000 to June 2001. Currently, no remedial treatment system is located at Site 18. Remediation at Site LF-18 is performed by a 750-cubic feet per minute (cfm) SVE system located at Site SD-59. The SVE system can operate with Site LF-18 and/or Site SD-59 vapor extraction wells online to the system. Since March 2006, the Site SD-59 SVE system has operated without air emission treatment due to low ROC emission rates. The SVE system was shut down in November 2008 for treatment of vapors from Site LF-18 and remained offline through the end of 2008. The results of well-field rebound samples suggest that contaminant concentrations have decreased to a level for which continued in situ remediation is no longer considered cost effective (MWH, 2009h). A draft final closure report has been prepared to document that no further treatment is required at Site LF-18 (MWH, 2009c).

The Site LF-18 system consists of 6 SVE wells and 10 vadose zone monitoring probes/wells to monitor vapor concentrations and remedial progress at the site (Figure 4-15). The operational and remedial history for the Site LF-18 remedial system is provided in Appendix A.

Implementation of ICs to prevent potential unacceptable exposure to volatile contaminants and to protect the remedial system components will occur following signature on the Soil OU and Basewide OU ESDs (AFRPA, 2009a; 2009d). However, the draft final closure report indicates that site closure will not require land-use restrictions to be protective of human health. The effectiveness of the additional ICs, if implemented, will be assessed in the fourth five-year review for Mather.

4.4.3 Site OT-23C

Remedy Selection. The RAO identified in the Basewide OU ROD for Site OT-23C is to mitigate any potential or residual source of groundwater contamination that may be present.

The remedial action selected in the Basewide OU ROD for Site OT-23C includes the following major components:

- Installing an in situ SVE system comprised of extraction wells and passive injection wells;
- Treatment of offgas by GAC or more cost-effective means of best available control technology; and

- Monitoring any thermal treatment effluent for dioxins (at least three sampling events during the first month of operation), and conducting a risk assessment if emissions exceed 200 picograms per dry standard cubic meter.

Note that Subsite OT-23A is addressed by the SVE remedial action at Site LF-18, and Subsites OT-23B and OT-23D are addressed by the SVE remedial action at Site ST-37/ST-39/SS-54.

An ESD that adds ICs to the remedy at Site OT-23C has been prepared (AFRPA, 2009d), and as of June 2010, is awaiting signatures. The RAOs for the ICs are: (1) protecting the integrity of the remedial systems, including the associated monitoring systems at Site OT-23C and (2) preserving access to the remedial system(s) and associated monitoring systems at Site OT-23C. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs.

Following signature on the ESD, the Air Force will impose the following ICs to protect the remedial systems at the sites. The transferee will be prohibited from:

- Damaging/disturbing/tampering with, or allowing others to damage/disturb/tamper with, the remediation system components, including but not limited to the extraction and injection systems, treatment systems, conveyance pipes, electrical, gas, or fiber optic lines, or monitoring wells, until such time as remediation is complete or components are no longer to be used for remediation;

- Engaging in, or allowing others to engage in, activities that interfere with the effectiveness of any remediation system component; and

- Engaging in, or allowing others to engage in, activities that would limit access for the Air Force, EPA, or the State of California to any equipment or systems associated with the soil remediation system components.

During the time between the adoption of the Basewide OU ESD and deeding of the property, equivalent restrictions will be implemented pursuant to the terms of the existing lease which requires the approval of the USAF for any construction or soil disturbance activity. The lease restrictions are in place and operational and will remain in place until the property is transferred by deed. At the time of deed transfer, lease restrictions will be superseded by equivalent use restrictions to be included in the federal deed and the SLUC as described in the Basewide OU ESD.

The deeds or associated transaction documents will also contain a reservation of access to the property for the USAF, EPA, and the State, and their respective officials, agents, employees, contractors, and subcontractors for purposes consistent with the USAF IRP or the FFA

Remedy Implementation. Two phases of post-ROD characterization were conducted at Site OT-23C, which included installation of multi-probe SVMPs and SVE wells and a pilot test of the SVE system beginning in 1999. Full-scale operations began in April 2000 with catalytic oxidation treatment until January 2002 when treatment was converted to GAC. In accordance with ROD requirements, three samples for dioxins analysis were collected in June 2000 from the emission of the catalytic oxidizer treatment system. The results ranged from 3.2 to 5.2 picograms per dry standard cubic meter. Because the results were less than 200 picograms per dry standard cubic meter, conducting a risk assessment was not required (Montgomery Watson, 2000e). Currently, the Site OT-23C SVE remedial system includes a 350-cfm vacuum extraction system and two 3,000-pound GAC vessels in series for air contaminant emissions abatement.

The Site OT-23C system consists of 10 SVE wells and 14 vadose zone monitoring probes/wells to monitor vapor concentrations and remedial progress at the site (Figure 4-16). The operational and remedial history for the Site OT-23C remedial system is provided in Appendix A.

Implementation of ICs to protect the only remedial system component (one monitoring well) on Air Force property will occur following signature on the ESD (AFRPA, 2009d). The effectiveness of the additional ICs will be assessed in the fourth five-year review for Mather.

4.4.4 Operations and Maintenance

During the period of this five-year review, the SVE/BV treatment systems for the Basewide OU sites described in Sections 4.4.1 through 4.4.3 were operated in accordance with the following O&M manuals, including:

Site FT-10C/ST-68 – *Operations and Maintenance Manual for Site 10C/68 Soil Vapor Extraction System* (Montgomery Watson, 1999h) and *Operations and Maintenance Manual for Site 29 Soil Vapor Extraction System* (Montgomery Watson, 1995) (thermal oxidizer moved from Site ST-29 to FT-10C/ST-68 in 2001).

Site LF-18 – *Operations and Maintenance Manual for Sites 18/59, Site 23, and Site 57 Soil Vapor Extraction Systems* (Montgomery Watson, 2000c).

Site OT-23C – *Operations and Maintenance Manual for Sites 18/59, Site 23, and Site 57 Soil Vapor Extraction Systems* (Montgomery Watson, 2000c) and *Operations and Maintenance Manual for Site 10C/68 Soil Vapor Extraction System* (Montgomery Watson, 1999h) (GAC moved from Site 10C/68 to Site OT-23C in 2002).

A combination of routine weekly, monthly, quarterly, semiannual, and annual O&M activities are conducted for the SVE/BV treatment systems. Specific O&M tasks are outlined in the various O&M manuals.

Starting in 2009, these O&M manuals have been updated and combined into *the Soil Vapor Extraction and Bioventing Remedial Treatment Systems Operations and Maintenance Manual for Sites 7/11, 10C/68, 23C, 29/71, 37/39/54, 57, and 18/59* to provide for consistent operations, maintenance, and monitoring activities at all active Mather SVE/BV sites (MWH, 2009g).

Costs. Costs related to the remedial actions for the Basewide OU from 2005 through 2009 are summarized in Table 4-4. Annual costs include costs for the O&M of the SVE systems, including the costs to perform improvements and repairs and the costs for performance monitoring (sampling, laboratory analysis, data validation, and reporting). Cost decreases at Site FT-10C/ST-68 and Site LF-18 are due to the shutdown of the SVE systems in late 2008; costs in 2009 are related to rebound testing and closure evaluation.

Table 4-4. O&M Costs for Basewide OU 2005-2009

Site FT-10C/ST-68		Site LF-18		Site OT-23C	
Year	**Annual Cost ($)**	**Year**	**Annual Cost ($)**	**Year**	**Annual Cost ($)**
2005	105,289	2005	105,382	2005	136,657
2006	147,212	2006	94,293	2006	170,864
2007	150,530	2007	67,523	2007	182,153
2008	130,178	2008	56,648	2008	116,396
2009	8,734	2009	48,518	2009	164,016
Total	**$541,943**	**Total**	**$372,364**	**Total**	**$770,086**

O&M = operation and maintenance
OU = operable unit

4.4.5 Site OT-87

Remedy Selection. Although no specific RAOs are identified in the Basewide OU ROD for Site OT-87, the basis for cleanup is protection of human health, groundwater quality, surface-water quality, and ecological receptors.

The remedial action selected in the Basewide OU ROD for Site OT-87 includes of the following major components:

- Excavating approximately 28,000 cubic yards of contaminated sediments and surface soils to a 6-inch depth through the fall zone of the lead shot.
- Stabilizing (if needed for disposal) approximately 28,000 cubic yards of contaminated sediments and surface soils.
- Constructing diversion dams to channel the water flow away from the areas to be excavated, if any surface water is present. These dams would be removed following completion of the excavation activities. If diversion dams are not appropriate, the water will be discharged to the publicly owned treatment works (POTW), if approved by Sacramento County.
- Transporting the soil, stabilized as necessary, to Site WP-07 for use as foundation material in construction of a cap, or an off-base facility if sample screening indicates that Site WP-07 acceptance criteria are not met.
- Backfilling the excavated areas with uncontaminated soils and/or recontouring to create effective drainage.
- Implementing ICs with the goal of protecting human health.

The Basewide OU ROD also has an additional requirement identified in the text: The Air Force will perform monitoring to insure that the residual levels of lead left in place at Site OT-87 do not represent a hazard to small mammals and waterfowl. To accomplish this, monitoring of lead levels in small mammal tissue will be required on an annual basis for three years, with the results evaluated in an annual monitoring report to the regulatory agencies. In addition, any dead waterfowl found in the area of Site 87 must be reported to the regulatory agencies, and necropsied by a certified laboratory for signs of lead toxicity. The details of the monitoring program are to be worked out cooperatively between the Air Force and the regulatory agencies.

If small mammal tissue lead levels are lower than those reported to cause adverse effects (Eisler, 1998) after a minimum of two years of monitoring, then monitoring will be discontinued upon agreement by the regulatory agencies. If small mammal tissue lead levels are higher than those reported to cause adverse effects (Eisler, 1998) after a minimum of two years of monitoring, then further ecological investigation and re-evaluation of the lead cleanup level will be conducted. The Air Force may have to undertake additional remedial action to reduce lead levels at Site OT-87.

If necropsied waterfowl show evidence of adverse effects due to ingestion of lead, then further ecological investigation and re-evaluation of the lead cleanup level will be conducted. The Air Force may have to undertake additional remedial action to reduce lead levels at Site OT-87.

In addition, an ESD that clarifies the implementation of ICs at Site OT-87 has been prepared (AFRPA, 2009d), and as of June 2010, is awaiting signatures. The RAO for the ICs is to prevent unacceptable

human exposure to residual contamination at Site OT-87. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs.

As part of the remedy originally selected in the Basewide OU ROD for Site OT-87, the Air Force will impose the following ICs to prevent health risks from exposure to soils contaminated with lead. The ROD merely stated, "institutional controls will be implemented with the goal of protecting human health", and provided as a reason, "institutional controls provide further protection of human health and the environment." The ESD clarifies that the ICs that are to be implemented will prohibit the transferee from:

- Engaging in any surface or shallow soil disturbance activities at Site OT-87, including any activities that would alter drainage or sub-drainage in the area; and

- Using, or allow others to use, Site OT-87 for residential purposes (including mobile or modular homes), hospitals for human care, public or private schools for persons under 18 years of age, nursery schools, or for daycare centers for children.

Remedy Implementation. Remediation activities at Site OT-87 commenced in August 1998 and were finished when site restoration was completed in July 1999 (Montgomery Watson, 1999i) (Figure 4-17). Approximately 1,100 excavated cubic yards of a clay shard/soil mixture were excavated and treated at the site and then transported to Site WP-07. The majority of the PAH-impacted soil excavated, approximately 9,570 cubic yards, met Site WP-07 acceptance criteria and was directly transported to Site WP-07. An additional estimated 730 cubic yards of soil removed from the PAH-impacted area had total lead concentrations exceeding the Site WP-07 acceptance criteria. This material was treated on site and then transported to Site WP-07. The total volume of lead-impacted sediments excavated from the site was 4,540 cubic yards. Of that material, approximately 2,150 cubic yards were treated due to high lead concentrations. The treated 2,150 cubic yards, as well as the additional 2,390 cubic yards excavated (not treated), were transported to Site WP-07. The total volume of lead-impacted soil excavated from the site (not including soil from the PAH-impacted area) and treated was approximately 14,000 cubic yards. The treated soil was characterized at Site OT-87 and transported to Site WP-07 once the Site WP-07 acceptance criteria had been met. All material transported to Site WP-07 was used as foundation material for the landfill cap. All recovered spent bullets and shot from the density separation activities, approximately 57,000 lbs, were sent to A-1 Metals in Sacramento for recycling of the lead. Based on the field observations and analytical results of the confirmation samples, the cleanup levels specified in the ROD were met. In addition, site restoration, including backfilling, grading, and hydroseeding, was completed at the site. No further cleanup action is planned at Site OT-87. A remedial action report was finalized in September 2009 (AFRPA, 2009e) and received EPA concurrence (EPA, 2009a).

The small mammal monitoring was initiated in 2007 and is ongoing through at least 2009. No small mammals were trapped at Site OT-87 in 2007. The results of the 2008 sampling are reported in the *Results of 2008 Small Mammal Monitoring at Site 87* (MWH, 2009i). The 2009 trapping effort successfully caught both mice and voles. The results of the 2009 sampling are reported in the draft *Results of 2009 Small Mammal Monitoring at Site 87* (MWH, 2009j), which as of June 2010, is in comment resolution.

Use restrictions are implemented through Air Force ownership of the land, and through the terms of the lease to Sacramento County for use of the land as a regional park. When the ownership of the property is transferred to the County, the ICs will be incorporated in the deed or other transactional documents. The ICs for Site OT-87 required by the Basewide OU ROD are clarified in an ESD (AFRPA, 2009d); their implementation and effectiveness will be assessed in the fourth five-year review for Mather.

4.5 Supplemental Basewide OU

4.5.1 Site OT-89

Remedy Selection. The RAOs identified in the Supplemental Basewide OU ROD for Site OT-89 are to (1) prevent unrestricted human exposure to lead concentrations greater than 192 mg/kg; (2) prevent plant exposure to lead concentrations greater than 700 mg/kg; and (3) prevent disturbance of subsurface soil that could threaten water quality.

The remedy selected in the Supplemental Basewide OU for Site OT-89 is ICs. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs. The following ICs are in place to prevent health risks from exposure to soils contaminated with lead. The transferee will be prohibited from:

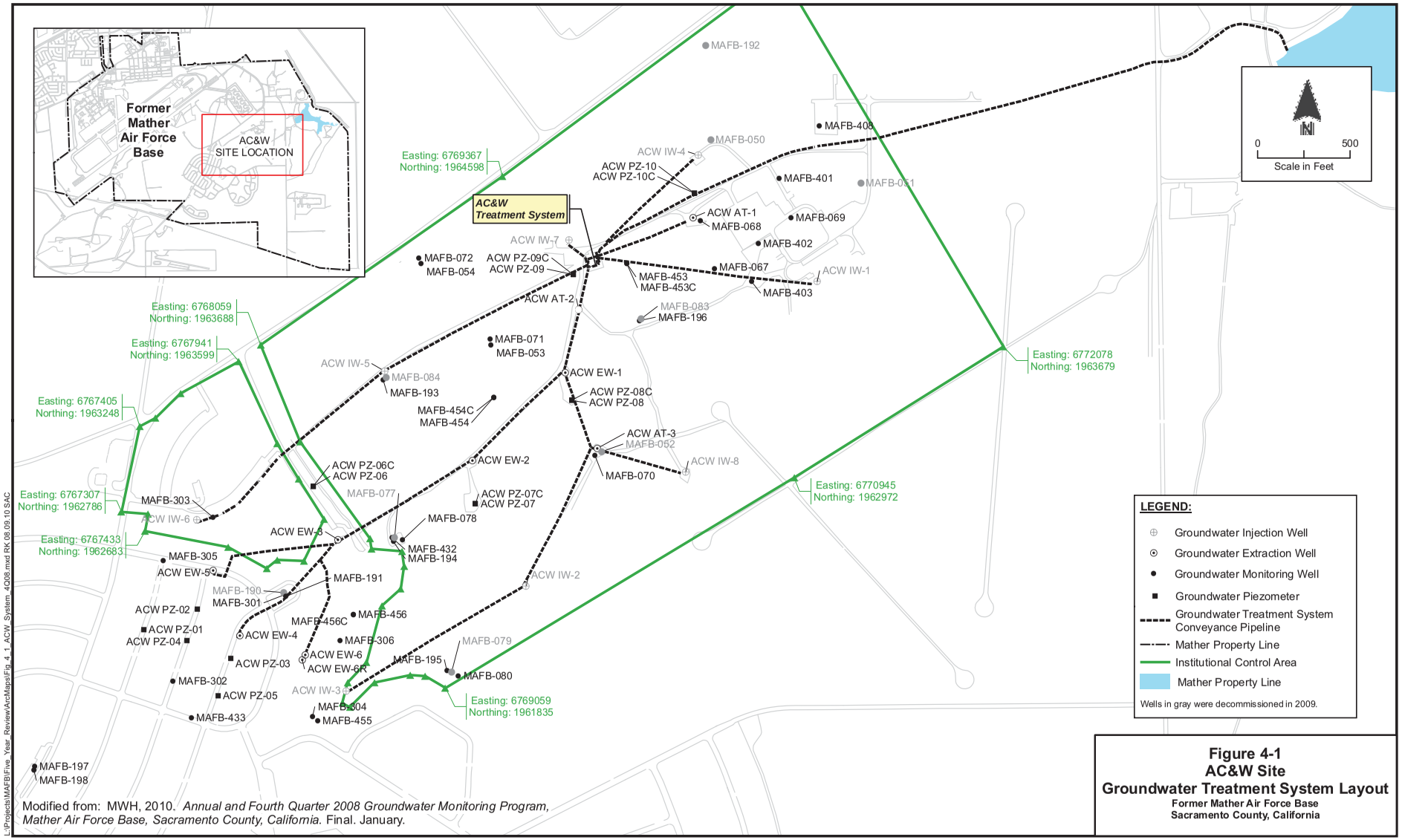
- Engaging in any surface or shallow soil disturbance activities at Site OT-89 (including any activities that would alter drainage, or sub-drainage, in the area), until and unless it is demonstrated that the lead concentrations in the soils at this site are no longer a threat to human health and the environment; and

- Using, or allow others to use, Site OT-89 for residential purposes (including mobile or modular homes), hospitals for human care, public or private schools for persons under 18 years of age, nursery schools, or for daycare centers for children.

Removal Implementation. Prior to the signing of the Supplemental Basewide OU ROD, a pilot study was conducted at Site OT-89 during the remedial action for Site OT-87 (Basewide OU) to see if the soil from Site OT-89, containing lead shot, could be successfully cleaned using the same stabilization technology used for Site OT-87 (Montgomery Watson, 2000b). Approximately 650 cubic yards of lead-contaminated soils were excavated, successfully stabilized, and then placed into the Site WP-07 landfill. These pilot study activities were completed in July 1999.

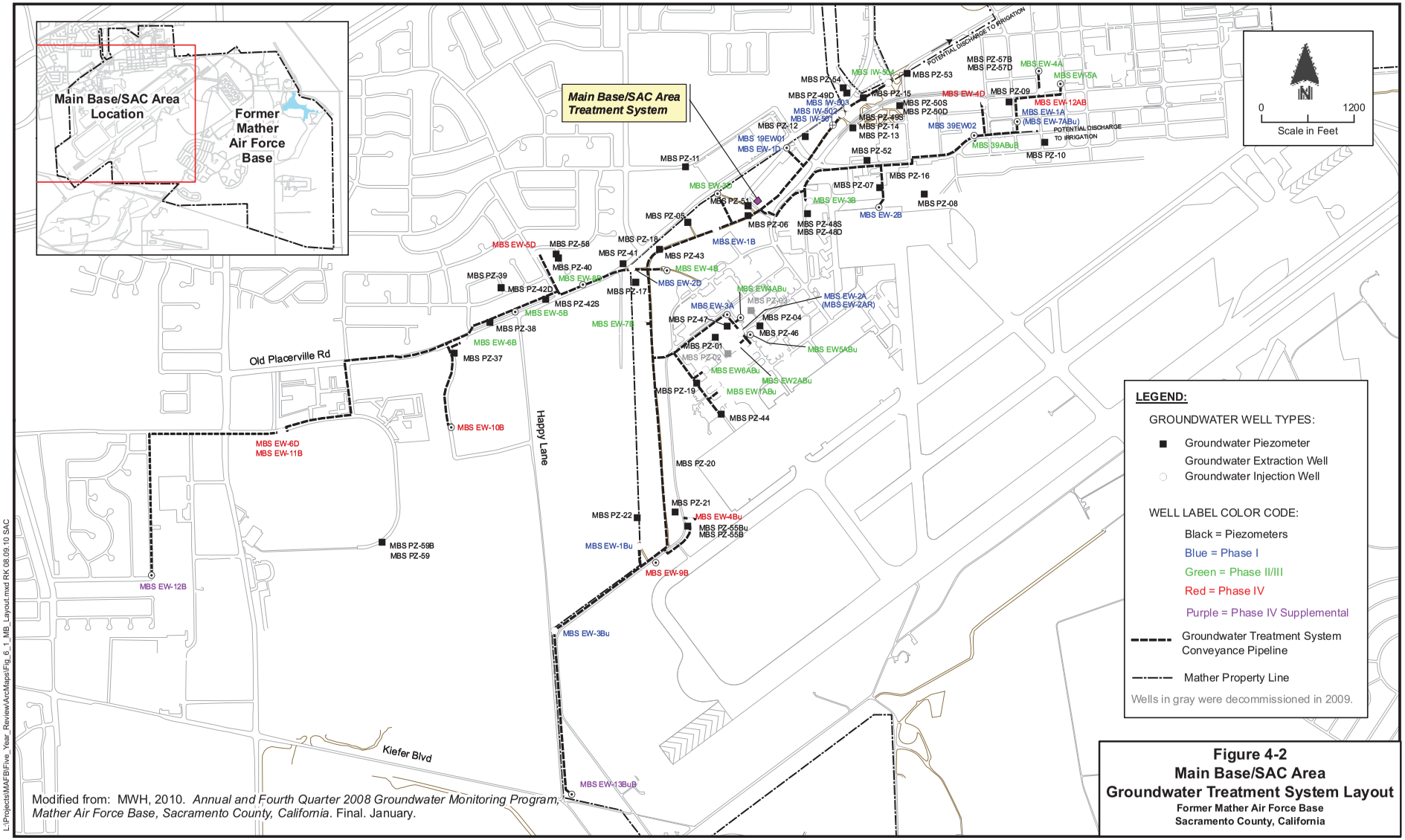
In addition, excavation of contaminated sediment was conducted as part of a time-critical removal action for Site OT-89 (AFBCA, 2001b; MWH, 2002a). Excavation activities commenced in July 2001 and were completed in December 2001. Approximately 300 cubic yards of soil were excavated and disposed at an appropriately permitted off-site landfill. Based on confirmation sample results, the removal cleanup goals specified in the removal action memorandum were achieved (AFBCA, 2001b). These removal cleanup goals are protective of human health under an occupational exposure scenario and protective of the environment. However, because the residual buried lead in the southwestern shot-fall area is not compatible with unrestricted (i.e. residential) land use, land-use restrictions are required to be protective of human health.

Remedy Implementation. ICs have been implemented at Site OT-89 in accordance with the Supplemental Basewide OU ROD to prevent unacceptable exposure to surface and subsurface lead contamination (Figure 4-18). Use restrictions are implemented through Air Force ownership of the land, and through the terms of the lease to Sacramento County for use of the land as part of the airport. When the ownership of the property is transferred to the County, the ICs required by the Supplemental Basewide OU ROD will be incorporated in the deed or other transactional documents.



Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 4-1
AC&W Site
Groundwater Treatment System Layout
Former Mather Air Force Base
Sacramento County, California



Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.

Figure 4-2
Main Base/SAC Area
Groundwater Treatment System Layout
Former Mather Air Force Base
Sacramento County, California

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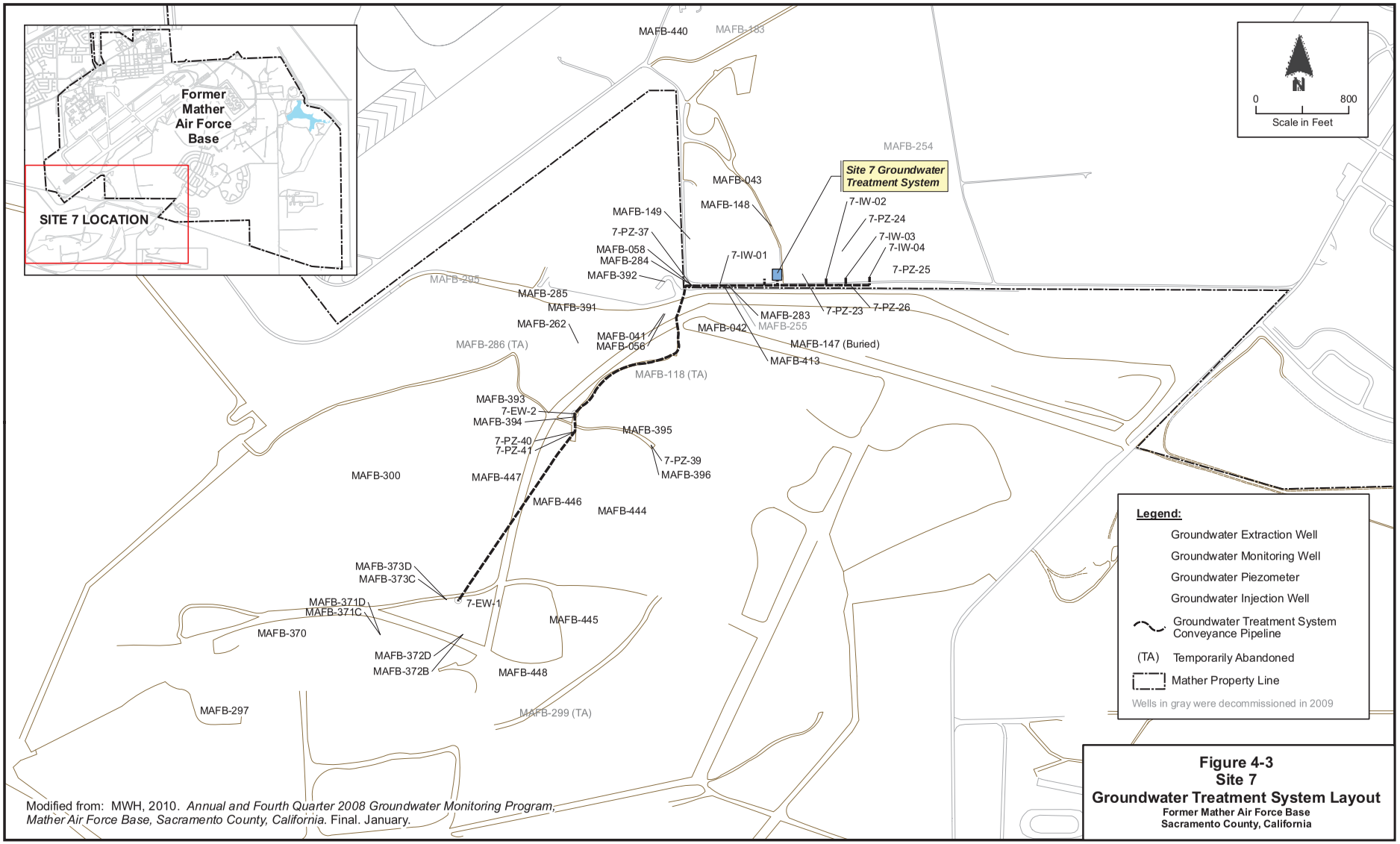
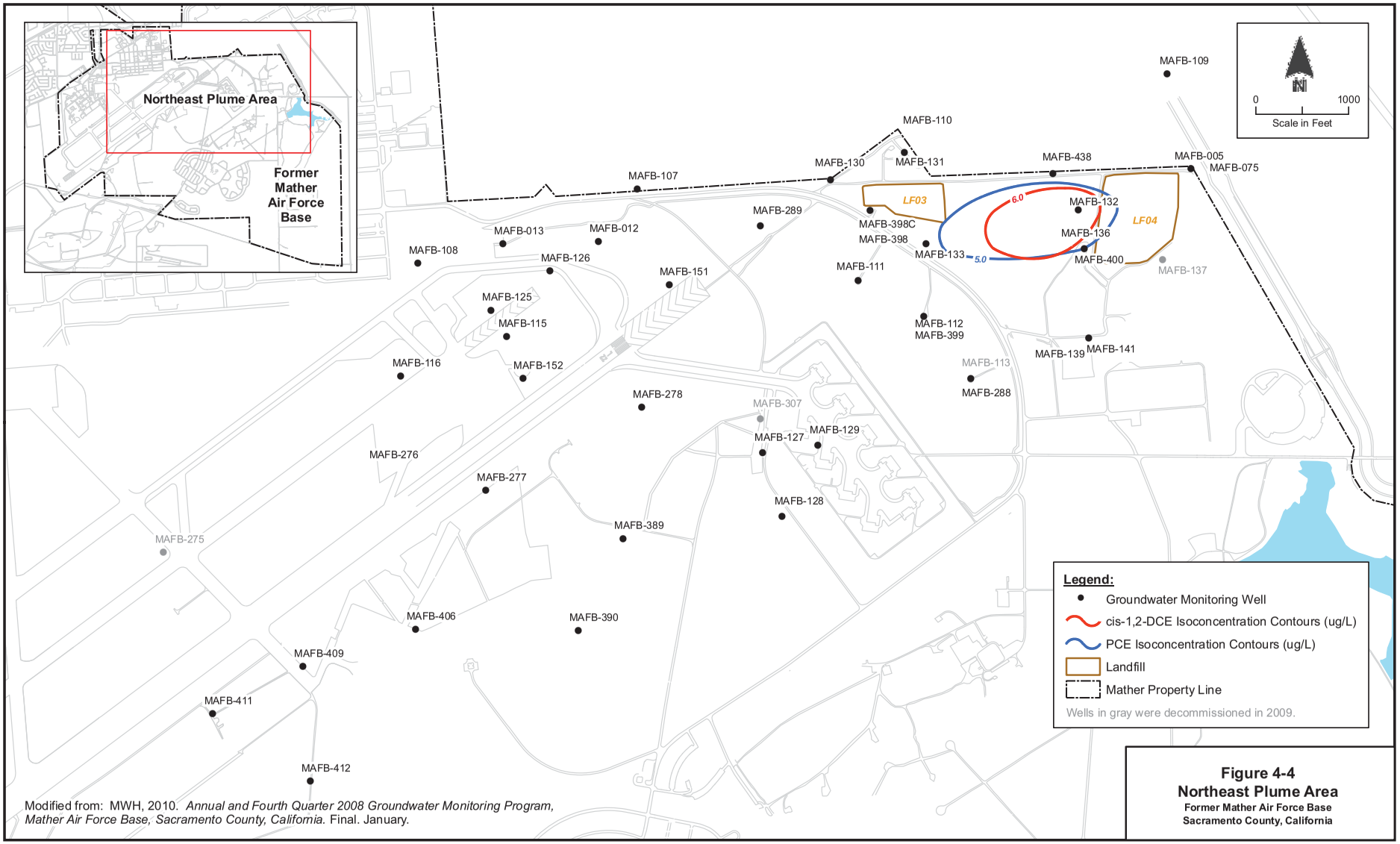


Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 4-3
Site 7
Groundwater Treatment System Layout
Former Mather Air Force Base
Sacramento County, California

L:\Projects\MAFB\Five_Year_Review\ArcMaps\Fig_4_3_Site_7_Plumes_4Q08.mxd RK 08.09.10 SAC



Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 4-4
Northeast Plume Area
Former Mather Air Force Base
Sacramento County, California

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LOCID	HYDRO UNIT	GRID ID	LOCID	HYDRO UNIT	GRID ID	LOCID	HYDRO UNIT	GRID ID
7-IW-01	B	M11	MAFB-220	B	K6	MAFB-407	WT/Bu	M4
7-IW-02	B	N11	MAFB-221	Bu	K5	MAFB-408	WT/C	T7
7-IW-03	B	N11	MAFB-222	B	K5	MAFB-409	WT/B	O7
7-IW-04	B	N11	MAFB-223	B	L6	MAFB-410	WT/A	L5
7-PZ-23	B	N11	MAFB-224	B	L6	MAFB-411	WT/B	N8
7-PZ-24	B	N10	MAFB-225	B	L6	MAFB-412	WT/B	O8
7-PZ-25	B	N11	MAFB-226	B	L6	MAFB-413	WT/B	M11
7-PZ-26	B	N11	MAFB-227	B	L5	MAFB-414	WT	M5
7-PZ-37	WT	M11	MAFB-228	B	L5	MAFB-415	WT/B	N4
7-PZ-37P	WT/PERCH	M11	MAFB-229	B	M5	MAFB-416	WT/B	N3
7-PZ-38P	WT/PERCH	M11	MAFB-230	B	M4	MAFB-417	WT/B	L6
7-PZ-39	C	M12	MAFB-231	B	N4	MAFB-418	WT	L6
7-PZ-40	C	L12	MAFB-232	WT/B	O4	MAFB-419	WT/B	M4
7-PZ-41	C	L12	MAFB-233	WT/B	P3	MAFB-420	WT	K6
ACW AT-1	C	T7	MAFB-234	B	N4	MAFB-421	WT/B	M5
ACW AT-2	C	S7	MAFB-235	D	L5	MAFB-422	WT/Bu	N6
ACW EW-1	C	S8	MAFB-239	D	K7	MAFB-423	WT/Bu	M7
ACW EW-2	C	S8	MAFB-240	D	K6	MAFB-423B	B	M7
ACW EW-3	C	R8	MAFB-241	D	K6	MAFB-424	WT/C	N9
ACW EW-4	C	R9	MAFB-242	D	K5	MAFB-425	WT	K9
ACW EW-5	C	R8	MAFB-243	D	K5	MAFB-426	B	F8
ACW EW-6R	C	R9	MAFB-244	WT	M4	MAFB-427	B	F9
ACW PZ-01	C	R9	MAFB-245	WT/Bu	M6	MAFB-428	WT/B	L4
ACW PZ-02	C	R9	MAFB-246	WT/Bu	L5	MAFB-429Bd	Bd	J10
ACW PZ-03	C	R9	MAFB-247	WT/B	L7	MAFB-429Bs	Bs	J10
ACW PZ-04	C	R9	MAFB-248	WT/B	M6	MAFB-429Bu	WT/Bu	J10
ACW PZ-05	C	R9	MAFB-249	B	N5	MAFB-430	LMT	K5
ACW PZ-06	WT/C	R8	MAFB-250	D	N4	MAFB-431Bd	Bd	J10
ACW PZ-06C	C	R8	MAFB-251	WT	K4	MAFB-431Dd	Dd	J10
ACW PZ-07	WT/C	S8	MAFB-252 (A)	WT	M4	MAFB-431Ds	Ds	J10
ACW PZ-07C	C	S8	MAFB-253	WT	N3	MAFB-432	WT/C	S8
ACW PZ-08	WT/C	S8	MAFB-254	WT/B	N10	MAFB-433	WT/C	R9
ACW PZ-08C	C	S8	MAFB-255	WT/B	M11	MAFB-434Bd	Bd	J11
ACW PZ-09	WT/C	S7	MAFB-256	WT/PERCH	L11	MAFB-434Bs	Bs	J11
ACW PZ-09C	C	S7	MAFB-258	WT/Bu	K9	MAFB-434Bu	WT/Bu	J11
ACW PZ-10	WT	T7	MAFB-259	Bu	I10	MAFB-435	Dd	K5
ACW PZ-10C	C	T7	MAFB-260	Bu	I9	MAFB-437Dd	Dd	I5
FFS EW15-1	NA	J8	MAFB-261	Bu	H8	MAFB-437Ds	Ds	I5
FFS EW15-2	NA	J8	MAFB-262	D	L11	MAFB-438	WT	U3
FFS MW15-1	NA	J8	MAFB-263	Bu	H7	MAFB-439	WT	L4
FFS MW15-2	NA	J8	MAFB-264	WT/Bu	L5	MAFB-440	WT	M9
FFS MW15-3	NA	J8	MAFB-265	B	L5	MAFB-440P	WT/PERCH	M9
FFS MW15-6	D	L6	MAFB-266	B	K8	MAFB-441	D	M7
MAFB-005	WT/B	V3	MAFB-267	B	I10	MAFB-442	D	L6
MAFB-006	WT/B	P2	MAFB-268	B	I9	MAFB-443	D	F9
MAFB-012	WT/B	Q4	MAFB-269	B	H8	MAFB-444	B	L12
MAFB-013	WT/B	Q4	MAFB-270	B	G6	MAFB-445	B	L13
MAFB-022	WT/B	U5	MAFB-271	B	I5	MAFB-446	C	L12
MAFB-026	WT/B	S4	MAFB-272	B	J4	MAFB-447	C	L12
MAFB-033	WT/Bu	L5	MAFB-273	B	K4	MAFB-448	B	L13
MAFB-034	WT	L5	MAFB-274	B	M4	MAFB-449Bd	Bd	J12
MAFB-037	WT/Bu	L7	MAFB-275	WT/Bu	N6	MAFB-449Bs	Bs	J12
MAFB-039	WT/PERCH	M10	MAFB-276	WT/B	P6	MAFB-450	WT/Bu	J9
MAFB-041	B	M11	MAFB-277	WT/B	P6	MAFB-451	B	K9
MAFB-042	WT/B	M11	MAFB-278	WT/B	R5	MAFB-452B	B	K8
MAFB-043	C	M10	MAFB-280	B	O3	MAFB-452Bu	WT/Bu	K8
MAFB-044	WT/PERCH	M10	MAFB-281	B	O3	MAFB-453	WT	S7
MAFB-046	WT/PERCH	K11	MAFB-282	B	N4	MAFB-453C	C	S7
MAFB-047	WT/Bu	K7	MAFB-283	B	M11	MAFB-454	WT	S8
MAFB-048	WT	K5	MAFB-284	B	M11	MAFB-454C	C	S8
MAFB-050	WT/C	T7	MAFB-285	C	L11	MAFB-455	WT	R9
MAFB-051	WT/C	T7	MAFB-286	C	L11	MAFB-456	WT	R9
MAFB-052	WT/C	S8	MAFB-288	B	T5	MAFB-456C	C	R9
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MAFB-054	WT/C	S7	MAFB-290	D	I4	MAFB-457Bs	Bs	J11
MAFB-056	D	M11	MAFB-291	D	J4	MAFB-458Bd	Bd	J11
MAFB-058	D	M11	MAFB-292	D	K4	MAFB-458Bs	Bs	J11
MAFB-059	B	K11	MAFB-293	D	G6	MAFB-459D	D	F8
MAFB-060	D	K7	MAFB-294	D	U5	MAFB-459Dd	Dd	F8
MAFB-061	D	K7	MAFB-295	D	L11	MB-3	NA	O3
MAFB-062	D	K6	MAFB-296	D	I4	MB-4	NA	P3
MAFB-063	D	K5	MAFB-297	C	J13	MBS 19EW01	B	L4
MAFB-064	D	V4	MAFB-299 (D)	B	L13	MBS 19MW01	Bu	L4
MAFB-065	D	V3	MAFB-300	C	K12	MBS 19MW02	Bu	L4
MAFB-066	Dd	P3	MAFB-301	C	R8	MBS 19MW03	D	L4
MAFB-067	D	T7	MAFB-302	C	R9	MBS 19MW04	D	L4
MAFB-068	D	T7	MAFB-303	C	R8	MBS 39ABuB	WT/B	N4
MAFB-069	D	T7	MAFB-304	C	R9	MBS 39MW01	WT	N4
MAFB-070	D	S8	MAFB-305	C	R8	MBS 39MW02	WT	M4
MAFB-071	D	S8	MAFB-306	C	R9	MBS 39MW03	Bu	M4
MAFB-072	D	S7	MAFB-307	WT/B	R5	MBS 39MW04	Bu	M4
MAFB-073	B	P3	MAFB-308	B	L4	MBS EW-10B	B	I7
MAFB-074	WT/C	S7	MAFB-309	B	I4	MBS EW-11B	B	G7
MAFB-075	WT/B	V3	MAFB-310	B	H5	MBS EW-12AB	WT/B	N4
MAFB-077	WT/C	S8	MAFB-311	B	F6	MBS EW-12B	B	F8
MAFB-078	D	S8	MAFB-312	B	G8	MBS EW-13BuB	Bu	J10
MAFB-079	WT/C	S9	MAFB-313	B	I6	MBS EW-1A	WT	N4
MAFB-080	D	S9	MAFB-314	D	L4	MBS EW1ABu	WT/Bu	K7
MAFB-081	WT/C	T9	MAFB-315	D	I4	MBS EW-1B	B	K5
MAFB-082	WT/C	T8	MAFB-316	D	H5	MBS EW-1Bu	WT/Bu	K8
MAFB-083	WT/C	T7	MAFB-317	D	F6	MBS EW-1D	D	L4
MAFB-084	WT/C	S8	MAFB-318	D	G8	MBS EW-2A	WT	K6
MAFB-085	WT/B	J9	MAFB-319	D	I5	MBS EW2ABu	WT/Bu	K6
MAFB-086	WT/B	K8	MAFB-320	D	L4	MBS EW-2AR	WT/A	K6
MAFB-087	WT	K6	MAFB-321	Dd	I5	MBS EW-2B	B	M5
MAFB-088	WT	L6	MAFB-322	B	G5	MBS EW-2Bu	Bu	K7
MAFB-089	WT	L5	MAFB-323	B	F7	MBS EW-2D	D	K5
MAFB-090	WT/Bu	L5	MAFB-324	B	I5	MBS EW-3A	WT	K6
MAFB-091	WT	M4	MAFB-325	B	I4	MBS EW-3B	B	L5
MAFB-092	WT	M4	MAFB-326	D	G5	MBS EW-3Bu	Bu	J9
MAFB-093	WT/B	P4	MAFB-327	D	F7	MBS EW-3D	D	K5
MAFB-094	WT/B	O4	MAFB-328	D	I5	MBS EW-4A	WT/B	N4
MAFB-095	WT	N4	MAFB-329	D	I4	MBS EW4ABu	WT/Bu	K6
MAFB-096	WT/B	P4	MAFB-330	B	G9	MBS EW-4B	B	K5
MAFB-097	WT/B	O4	MAFB-331	B	F8	MBS EW-4Bu	WT/Bu	K8
MAFB-099	WT	M5	MAFB-332	D	H7	MBS EW-4D	D	N4
MAFB-101	B	L5	MAFB-333	WT/C	V8	MBS EW-5A	WT/B	N4
MAFB-102	D	L6	MAFB-334	WT/B	V8	MBS EW5ABu	WT/Bu	L6
MAFB-103	D	K8	MAFB-335	WT/C	U8	MBS EW-5B	B	J6
MAFB-104	D	J6	MAFB-336	D	G9	MBS EW-5D	D	J5
MAFB-105	WT	M5	MAFB-337	Dd	G5	MBS EW6ABu	WT	K6
MAFB-106	WT	N3	MAFB-338	Dd	I5	MBS EW-6B	B	I6
MAFB-107	WT/B	R4	MAFB-339	WT/B	N4	MBS EW-6D	D	G7
MAFB-108	WT/B	P4	MAFB-340	WT/B	N4	MBS EW7ABu	WT/Bu	N4
MAFB-109	WT/C	U3	MAFB-341	WT/B	N4	MBS EW-7B	B	K6
MAFB-110	WT/B	S3	MAFB-342	WT/B	N4	MBS EW-8B	B	J6
MAFB-111	WT/B	S4	MAFB-343	WT/B	N4	MBS EW-9B	B	K8
MAFB-112	WT/C	T5	MAFB-344	WT/B	N3	MBS IW-501	LMT	L4
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MAFB-115	WT/B	Q5	MAFB-346Bd	Bd	H8	MBS IW-503	LMT	L4
MAFB-116	WT/B	P5	MAFB-346Bs	Bs	H8	MBS IW-504	LMT	M4
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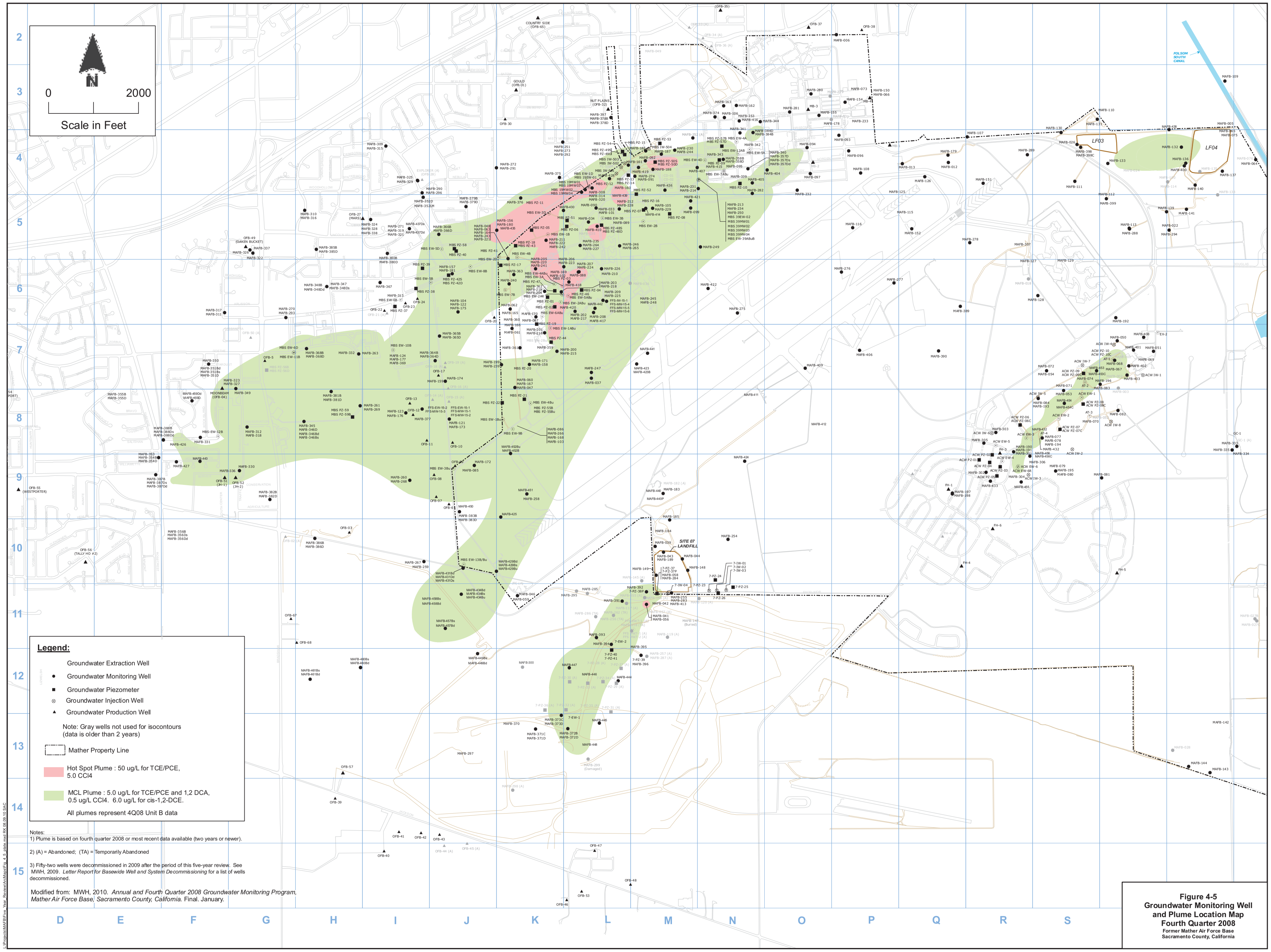
MAFB-121	WT	J8	MAFB-347	LMT	H6	MBS PZ-02	WT	K6
MAFB-122	WT	J6	MAFB-348B	B	H6	MBS PZ-03	WT	L6
MAFB-123	WT	I8	MAFB-348Dd	Dd	H6	MBS PZ-04	WT	L6
MAFB-124	WT	I7	MAFB-348Ds	D	H6	MBS PZ-05	B	K5
MAFB-125	WT/B	P5	MAFB-349	LMT	G7	MBS PZ-06	B	L5
MAFB-126	WT/B	Q4	MAFB-350	LMT	F7	MBS PZ-07	B	M5
MAFB-127	WT/C	R6	MAFB-351Bd	B	F7	MBS PZ-08	B	M5
MAFB-128	WT/B	S6	MAFB-351Bs	B	F7	MBS PZ-09	B	N4
MAFB-129	WT/C	S6	MAFB-351D	D	F7	MBS PZ-10	B	N4
MAFB-130	WT/B	S4	MAFB-352D	Dd	I5	MBS PZ-11	B	K5
MAFB-131	WT/B	S3	MAFB-352LM	LMT	I5	MBS PZ-12	LMT	L4
MAFB-132	WT/B	U4	MAFB-353	LMT	E9	MBS PZ-13	Dd	L4
MAFB-133	WT/B	T4	MAFB-354B	B	E9	MBS PZ-14	LMT	L4
MAFB-136	WT/B	U4	MAFB-354D	D	E9	MBS PZ-15	LMT	M4
MAFB-137	WT/C	U4	MAFB-355B	B	E8	MBS PZ-16	B	M5
MAFB-139	WT/C	T5	MAFB-355D	D	E8	MBS PZ-17	D	K6
MAFB-140	WT/C	U4	MAFB-356B	B	F10	MBS PZ-18	D	K5
MAFB-141	WT/B	U5	MAFB-356Dd	Dd	F10	MBS PZ-19	WT	K6
MAFB-142	WT/C	U13	MAFB-356Ds	Ds	F10	MBS PZ-20	Bu	K7
MAFB-143	WT/C	U13	MAFB-357D	D	N4	MBS PZ-21	WT/Bu	K8
MAFB-144	WT/C	U13	MAFB-357Dd	Dd	N4	MBS PZ-22	WT/Bu	K8
MAFB-145	WT/C	M10	MAFB-357Ds	Ds	N4	MBS PZ-37	B	I6
MAFB-147(Buried))	B	M11	MAFB-358B	B	N4	MBS PZ-38	B	I6
MAFB-148	B	M10	MAFB-358D	D	N4	MBS PZ-39	B	I6
MAFB-149	WT/B	M10	MAFB-359	WT/Bu	K7	MBS PZ-40	B	J5
MAFB-150	WT/B	P3	MAFB-360	B	K6	MBS PZ-41	B	J5
MAFB-151	WT/B	R4	MAFB-361	B	K7	MBS PZ-42D	B	J6
MAFB-152	WT/B	Q5	MAFB-362	B	K6	MBS PZ-42S	B	J6
MAFB-154	WT/B	P3	MAFB-363	B	K6	MBS PZ-43	B	K5
MAFB-155	WT/B	O3	MAFB-364B	B	J7	MBS PZ-44	B	K7
MAFB-156	WT	K5	MAFB-364D	D	J7	MBS PZ-46	B	L6
MAFB-157	WT	J6	MAFB-365B	B	J7	MBS PZ-47	B	K6
MAFB-158	WT/Bu	K7	MAFB-365D	D	J7	MBS PZ-48D	B	L5
MAFB-159	WT	J7	MAFB-366B	B	J5	MBS PZ-48S	B	L5
MAFB-160	WT	L4	MAFB-366D	D	J5	MBS PZ-49D	LMT	L4
MAFB-161	WT	L4	MAFB-367	D	I6	MBS PZ-49S	B	L4
MAFB-162	WT	N3	MAFB-368B	B	H7	MBS PZ-50D	LMT	M4
MAFB-163	WT	N3	MAFB-368D	D	H7	MBS PZ-50S	Dd	M4
MAFB-164	B	K5	MAFB-369	D	I7	MBS PZ-51	D	L5
MAFB-165	B	K6	MAFB-370	C	K13	MBS PZ-52	D	M4
MAFB-166	B	K7	MAFB-371C	C	K13	MBS PZ-53	D	M4
MAFB-167	B	K7	MAFB-371D	D	K13	MBS PZ-54	D	L4
MAFB-168	WT/Bu	K8	MAFB-372B	B	L13	MBS PZ-55B	B	K8
MAFB-169	B	L6	MAFB-372D	D	L13	MBS PZ-55Bu	Bu	K8
MAFB-170	B	K6	MAFB-373C	C	K13	MBS PZ-57B	B	N4
MAFB-171	B	K7	MAFB-373D	D	K13	MBS PZ-57D	D	N4
MAFB-172	WT/Bu	J9	MAFB-374	D	N3	MBS PZ-58	D	J5
MAFB-173	B	J8	MAFB-375	D	K4	MBS PZ-59	WT/A	H8
MAFB-174	Bu	J7	MAFB-376	D	K5	MBS PZ-59B	B	H8
MAFB-175	B	J6	MAFB-377	D	I8	OFB-03	NA	H10
MAFB-176	Bu	I8	MAFB-378B	B	L3	OFB-04	NA	F7
MAFB-177	B	I7	MAFB-378D	D	L3	OFB-06	NA	J9
MAFB-178	D	O3	MAFB-379B	B	J5	OFB-07	NA	J9
MAFB-179	D	Q4	MAFB-379D	D	J5	OFB-08	NA	J9
MAFB-180	D	K5	MAFB-380B	B	I5	OFB-09	NA	J9
MAFB-181	D	J6	MAFB-380D	D	I5	OFB-11	NA	I8
MAFB-183	WT/C	M9	MAFB-381B	B	H8	OFB-12	NA	I8
MAFB-184	WT/PERCH	M10	MAFB-381D	D	H8	OFB-17	NA	J7
MAFB-185	WT/PERCH	M10	MAFB-382B	B	G9	OFB-23	NA	I6
MAFB-186	WT	M4	MAFB-382D	D	G9	OFB-24	NA	I6
MAFB-187	WT	M4	MAFB-383B	B	J9	OFB-30	NA	K3
MAFB-188	WT	M4	MAFB-383D	D	J9	OFB-31	NA	K3
MAFB-189	WT/PERCH	M10	MAFB-384B	WT/B	N4	OFB-32	NA	L3
MAFB-190	WT/C	R8	MAFB-384D	D	N4	OFB-35	NA	N2
MAFB-191	D	R8	MAFB-385B	B	H5	OFB-37	NA	O2
MAFB-192	WT/C	T6	MAFB-385D	D	H5	OFB-38	NA	P2
MAFB-193	C	S8	MAFB-386B	B	H10	OFB-39	NA	H14
MAFB-194	C	S8	MAFB-386D	D	H10	OFB-40	NA	I15
MAFB-195	C	S9	MAFB-387B	B	E9	OFB-41	NA	I14
MAFB-196	C	T7	MAFB-387Dd	Dd	E9	OFB-42	NA	I14
MAFB-197	WT/C	Q9	MAFB-387Ds	Ds	E9	OFB-43	NA	J14
MAFB-198	C	Q9	MAFB-388B	B	F8	OFB-44	NA	J15
MAFB-199	WT/Bu	K7	MAFB-388Dd	Dd	F8	OFB-45	NA	J15
MAFB-200	WT	K7	MAFB-388Ds	Ds	F8	OFB-46	NA	L15
MAFB-201	WT/Bu	K7	MAFB-389	WT/B	Q6	OFB-47	NA	L15
MAFB-202	WT	L6	MAFB-390	WT/B	Q7	OFB-48	NA	M15
MAFB-203	WT	K6	MAFB-391	C	L11	OFB-49	NA	G5
MAFB-204	WT	K6	MAFB-392	C	M11	OFB-51	NA	F9
MAFB-205	WT	K6	MAFB-393	C	L11	OFB-52	NA	G9
MAFB-206	WT	L6	MAFB-394	C	L11	OFB-53	NA	L15
MAFB-207	WT	L6	MAFB-395	C	L12	OFB-54	NA	C8
MAFB-208	WT	L6	MAFB-396	B	M12	OFB-55	NA	C9
MAFB-209	WT	L6	MAFB-397	Dd	L3	OFB-56	NA	D10
MAFB-210	WT	L6	MAFB-398	WT/B	S4	OFB-57	NA	H13
MAFB-211	WT	K5	MAFB-398C	C	S4	OFB-58	NA	B9
MAFB-212	WT	L5	MAFB-399	C	T5	OFB-60	NA	B6
MAFB-213	WT	N4	MAFB-400	C	U4	OFB-61	NA	A8
MAFB-214	WT	N4	MAFB-401	WT/C	T7	OFB-62	NA	A8
MAFB-215	B	K7	MAFB-402	WT/C	T7	OFB-63	NA	A10
MAFB-216	B	K7	MAFB-403	WT/C	T7	OFB-65	NA	K2
MAFB-217	B	L6	MAFB-404	WT/B	O4	OFB-67	NA	G11
MAFB-218	B	K6	MAFB-405	WT/B	N4	OFB-68	NA	H11
MAFB-219	B	K6	MAFB-406	WT/B	P7			



Notes:
1) Plume is based on fourth quarter 2008 or most recent data available (two years or newer).

2) (A) = Abandoned; (TA) = Temporarily Abandoned

3) Fifty-two wells were decommissioned in 2009 after the period of this five-year review. See MWH, 2009. *Letter Report for Basewide Well and System Decommissioning* for a list of wells decommissioned.

Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 4-5
Groundwater Monitoring Well and Plume Location Map
Fourth Quarter 2008
Former Mather Air Force Base
Sacramento County, California

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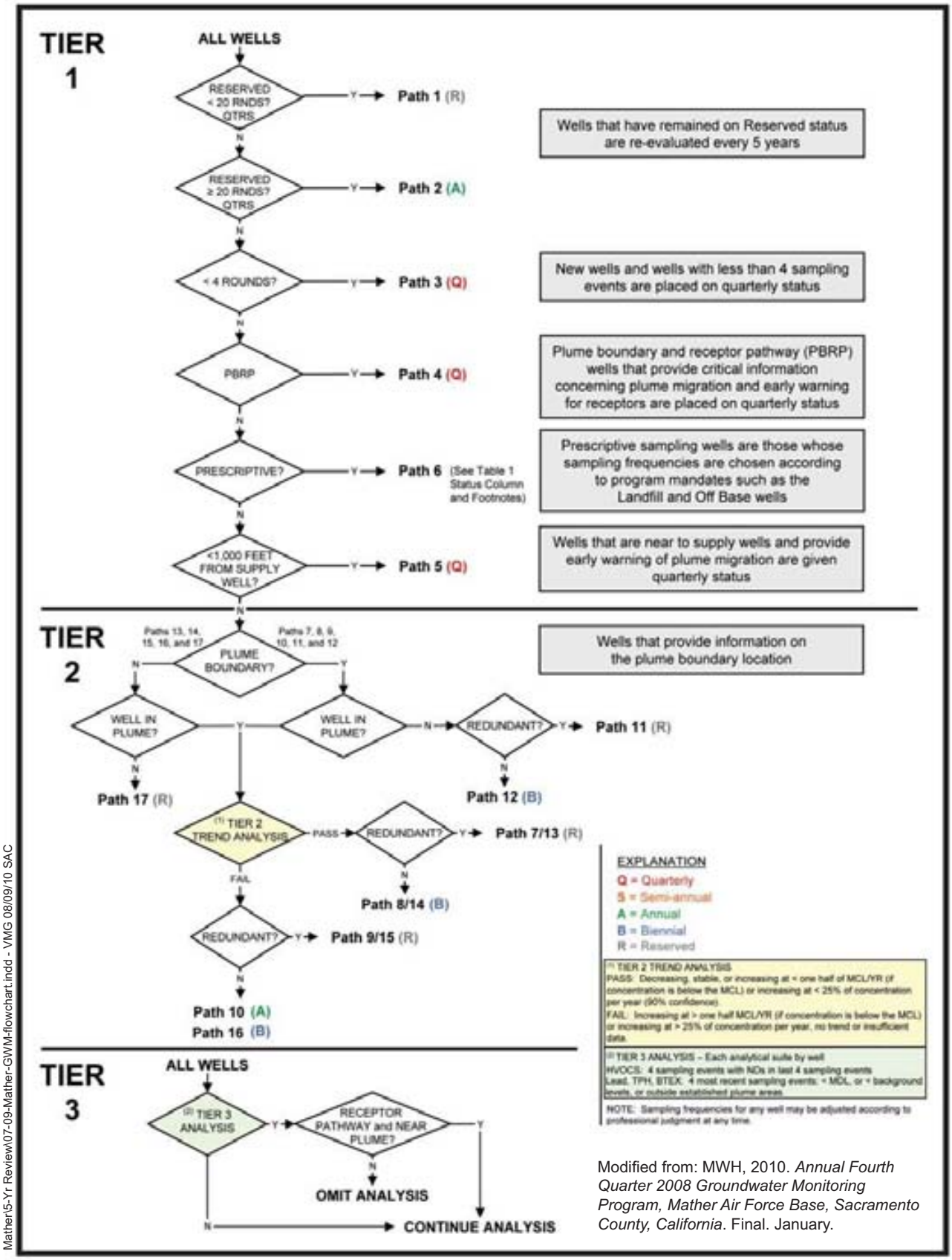
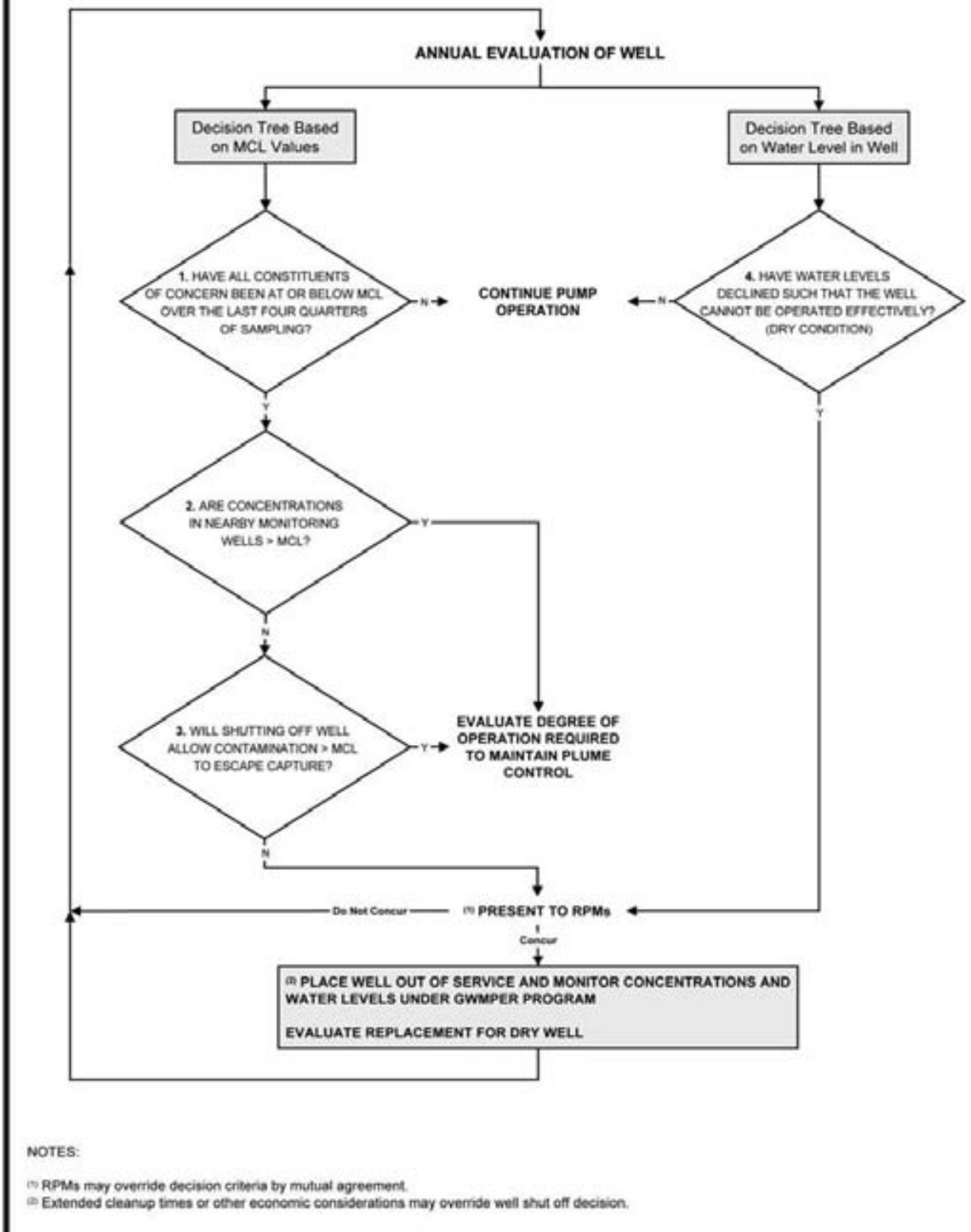


Figure 4-6. Groundwater Monitoring Decision Tree, Former Mather Air Force Base, Sacramento County, California



Modified from: MWH, 2010. *Annual Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.

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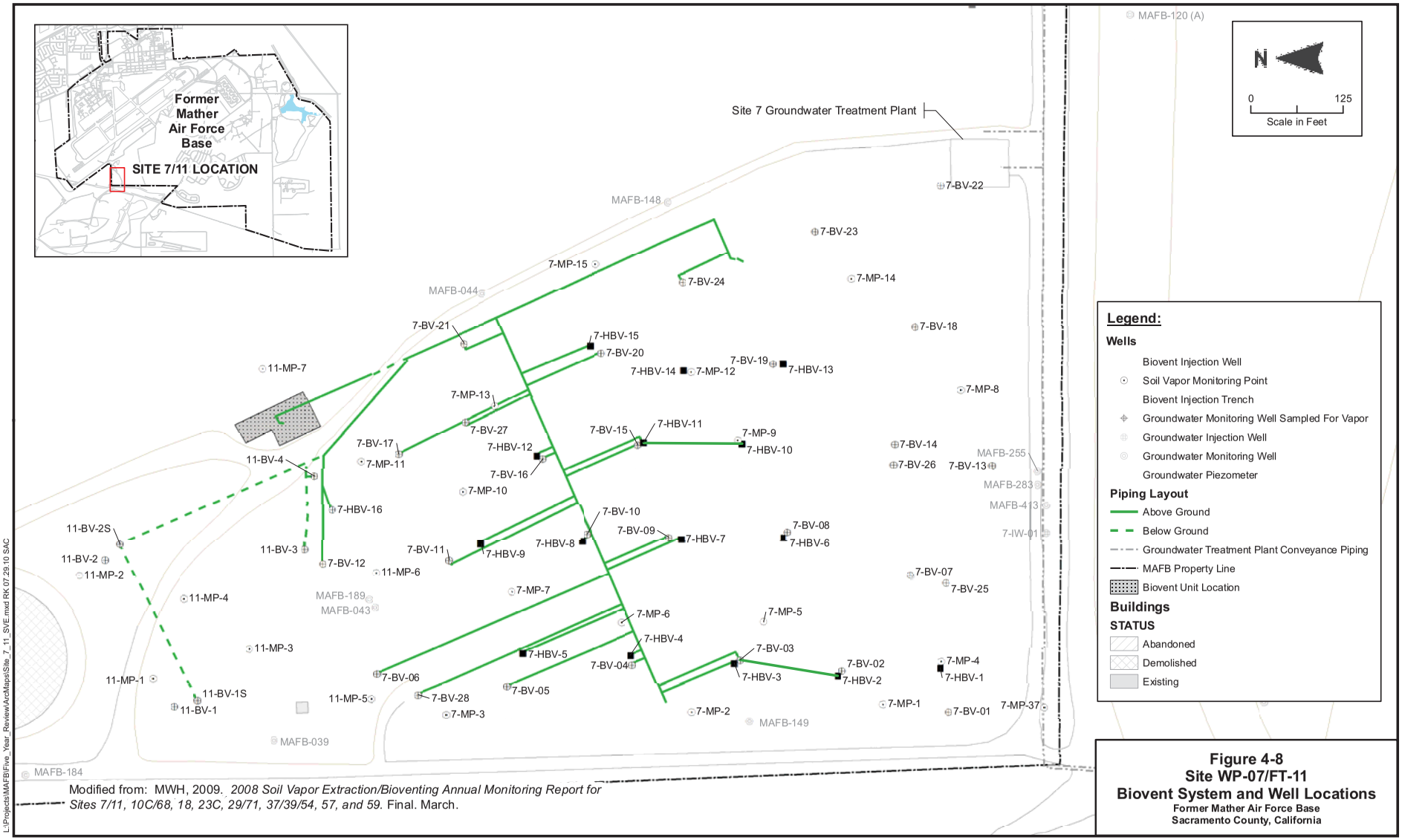
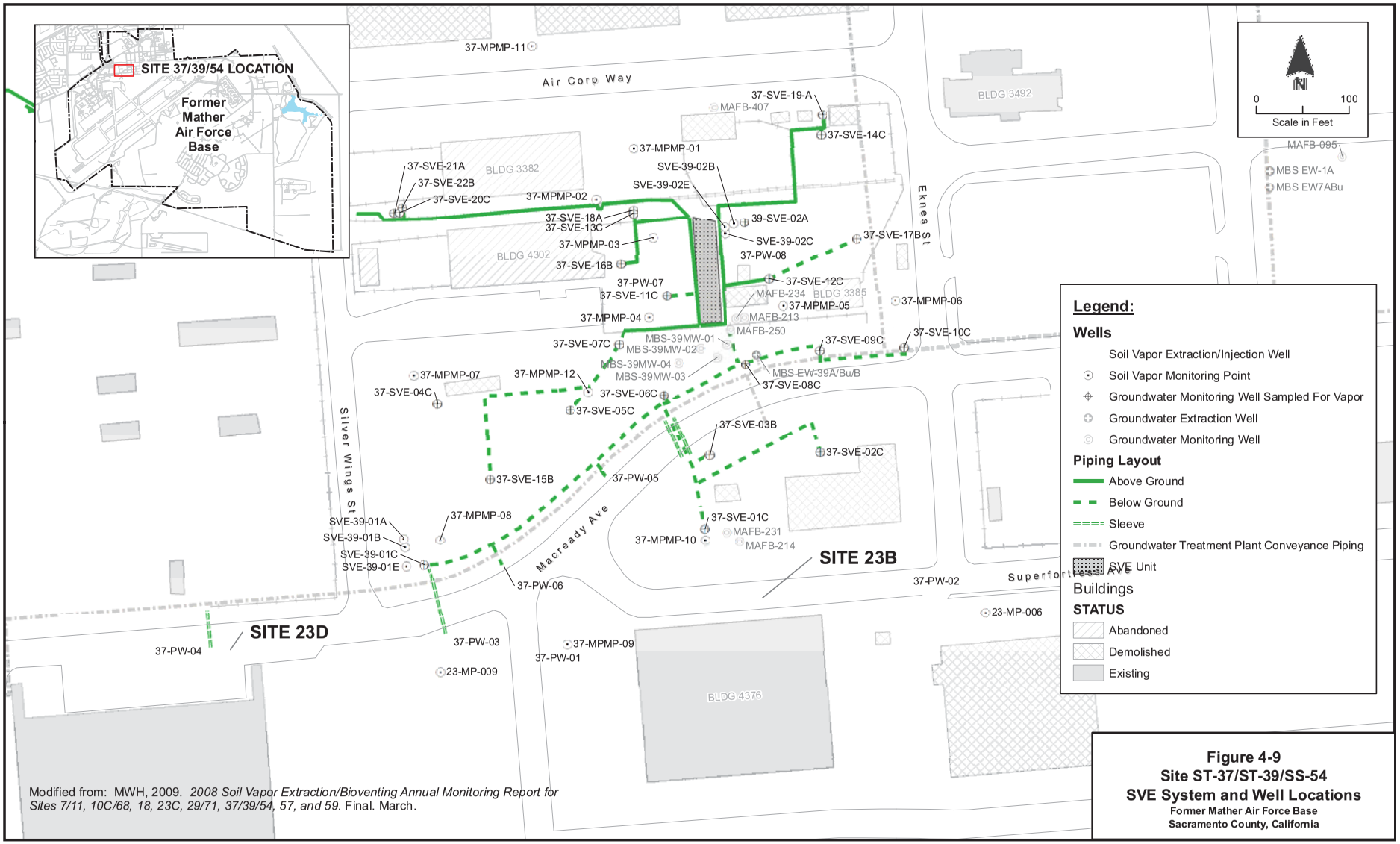
Figure 4-7. Extraction Well Shutdown Decision Tree, Former Mather Air Force Base, Sacramento County, California



Modified from: MWH, 2009. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59.* Final. March.

Figure 4-8
Site WP-07/FT-11
Biovent System and Well Locations
Former Mather Air Force Base
Sacramento County, California



Modified from: MWH, 2009. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59.* Final. March.

Figure 4-9
Site ST-37/ST-39/SS-54
SVE System and Well Locations
Former Mather Air Force Base
Sacramento County, California

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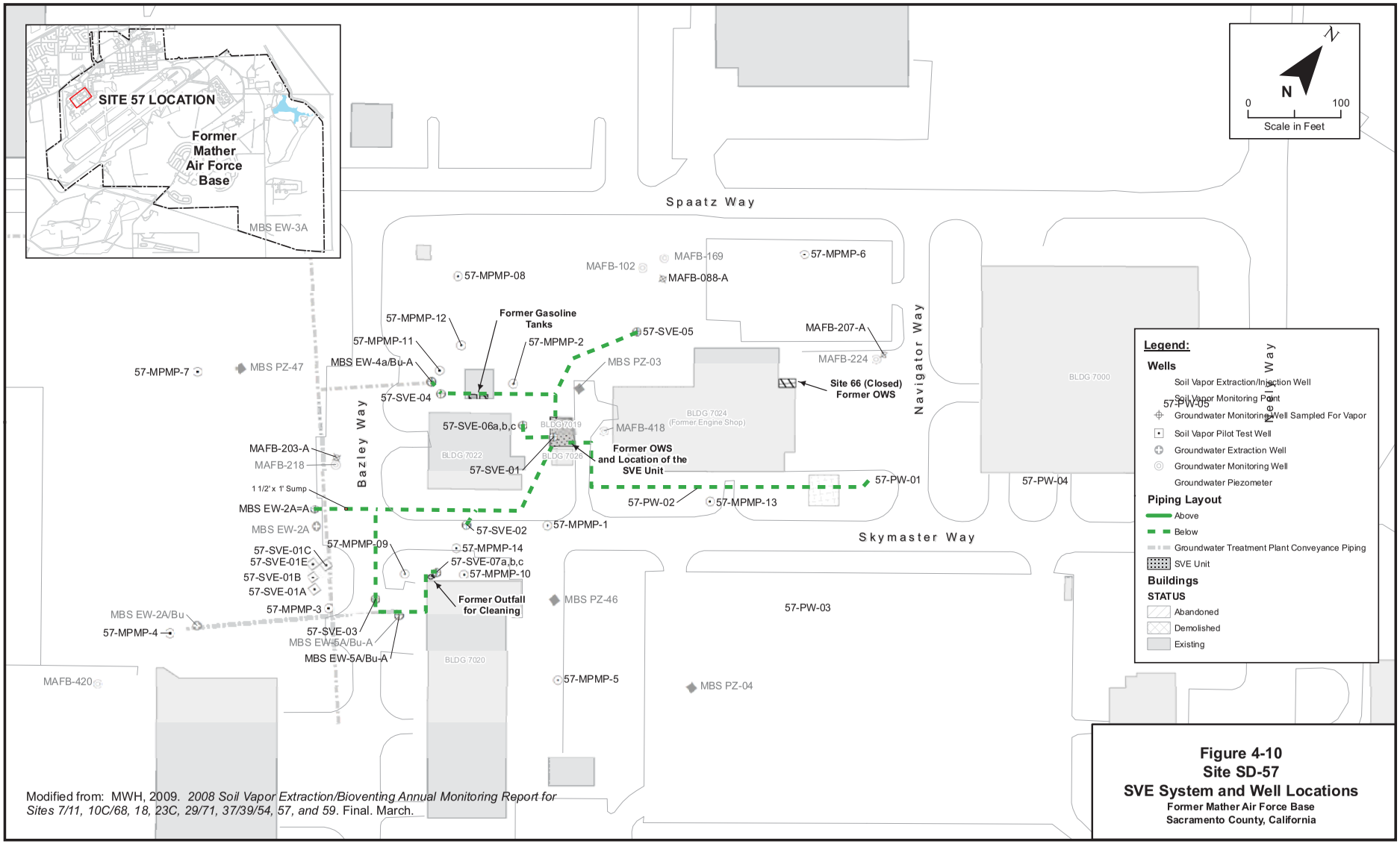

Modified from: MWH, 2009. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59*. Final. March.

Figure 4-10
Site SD-57
SVE System and Well Locations
Former Mather Air Force Base
Sacramento County, California

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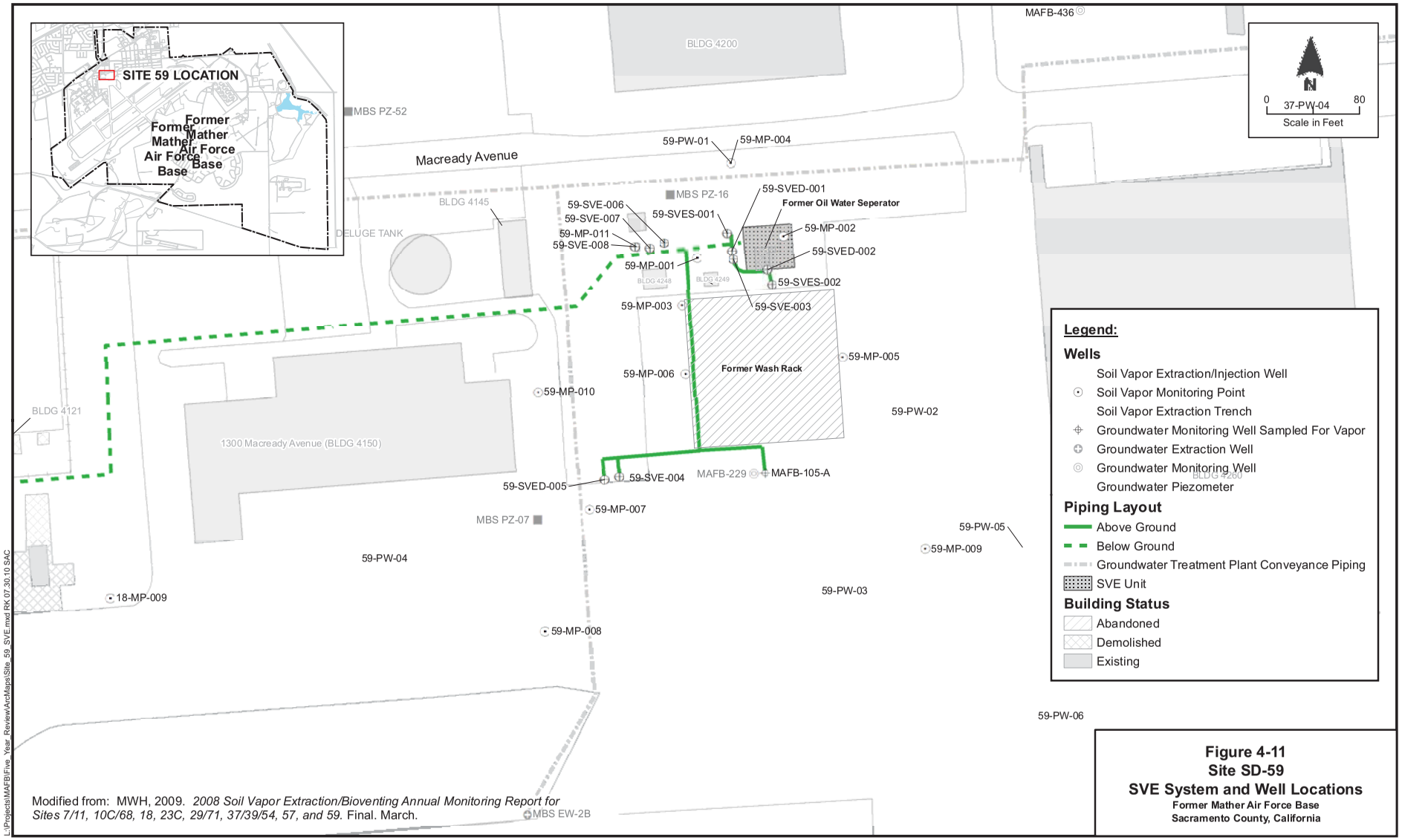

Modified from: MWH, 2009. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59.* Final. March.

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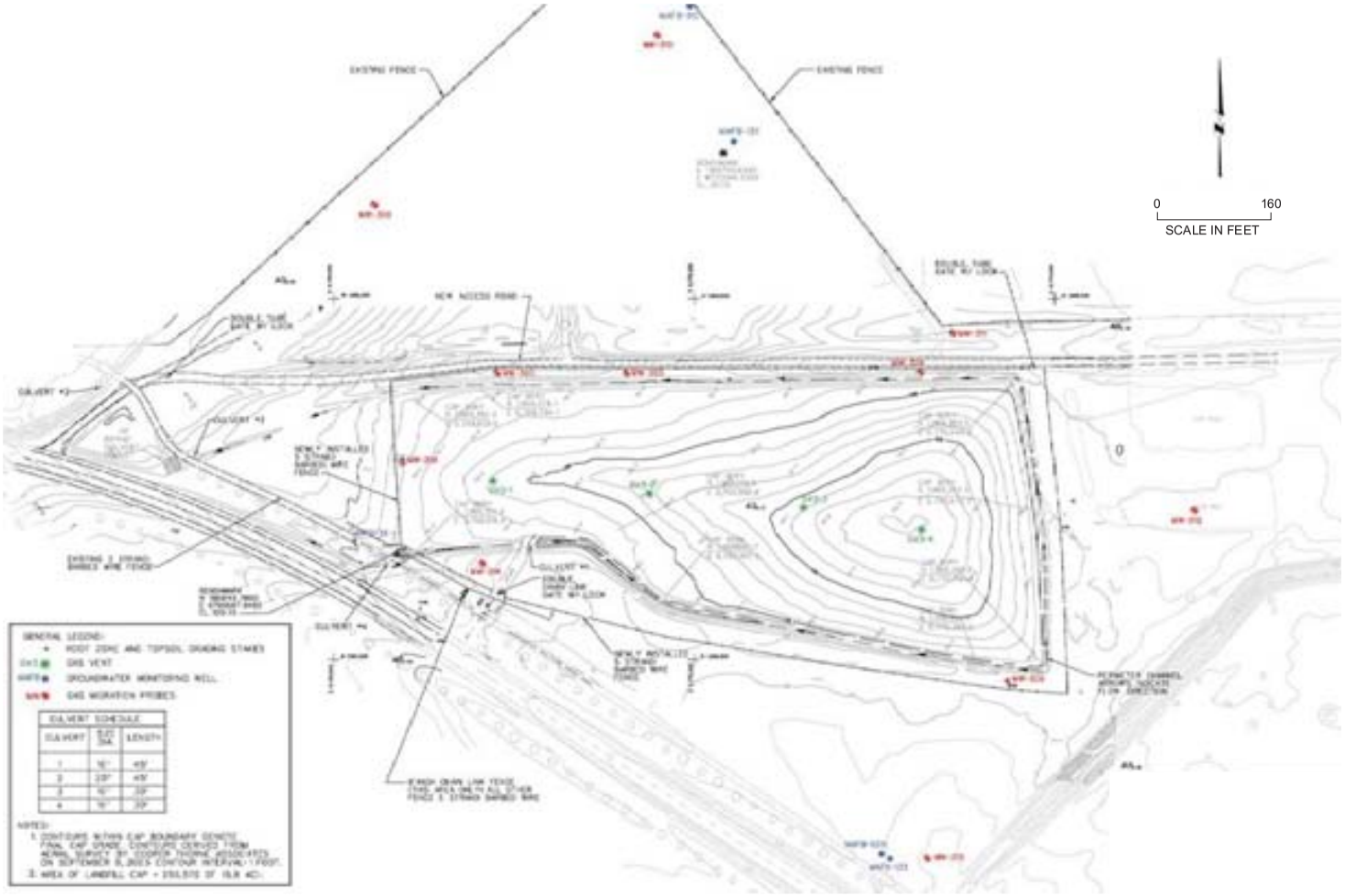
Figure 4-11
Site SD-59
SVE System and Well Locations
Former Mather Air Force Base
Sacramento County, California



Modified from:
MWH, 2009. *Annual Report for 2008 Post-Closure Landfill Inspection and Gas Monitoring.* Final. April.

Figure 4-12
Site LF-03
Site Layout
Former Mather Air Force Base
Sacramento County, California

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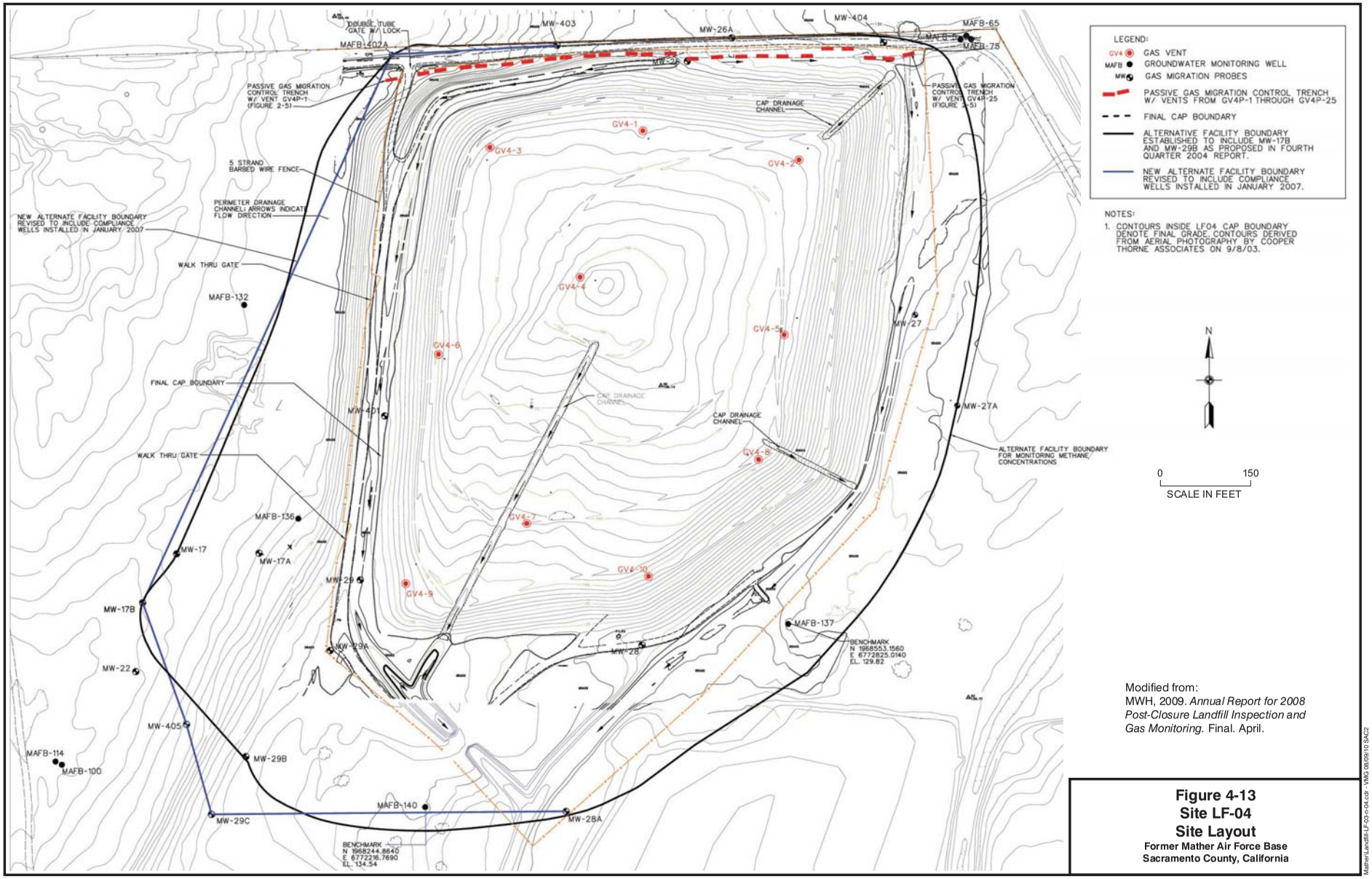
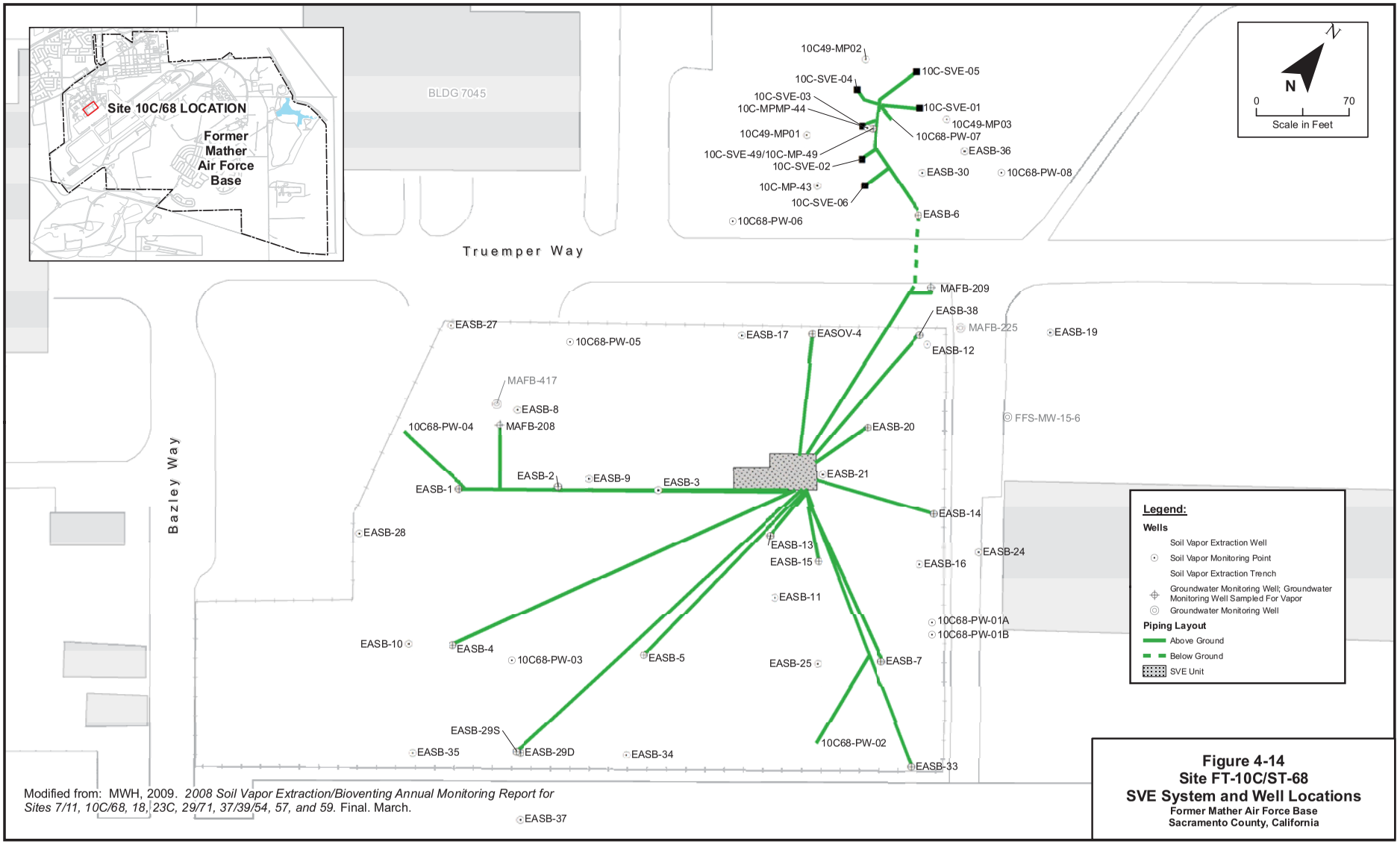


Modified from:
MWH, 2009. *Annual Report for 2008 Post-Closure Landfill Inspection and Gas Monitoring.* Final. April.

Figure 4-13
Site LF-04
Site Layout
Former Mather Air Force Base
Sacramento County, California

Mather\Landfill-LF-03-n-04.cdr - VMG 08/09/10 SAC2



Modified from: MWH, 2009. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59.* Final. March.

Figure 4-14
Site FT-10C/ST-68
SVE System and Well Locations
Former Mather Air Force Base
Sacramento County, California

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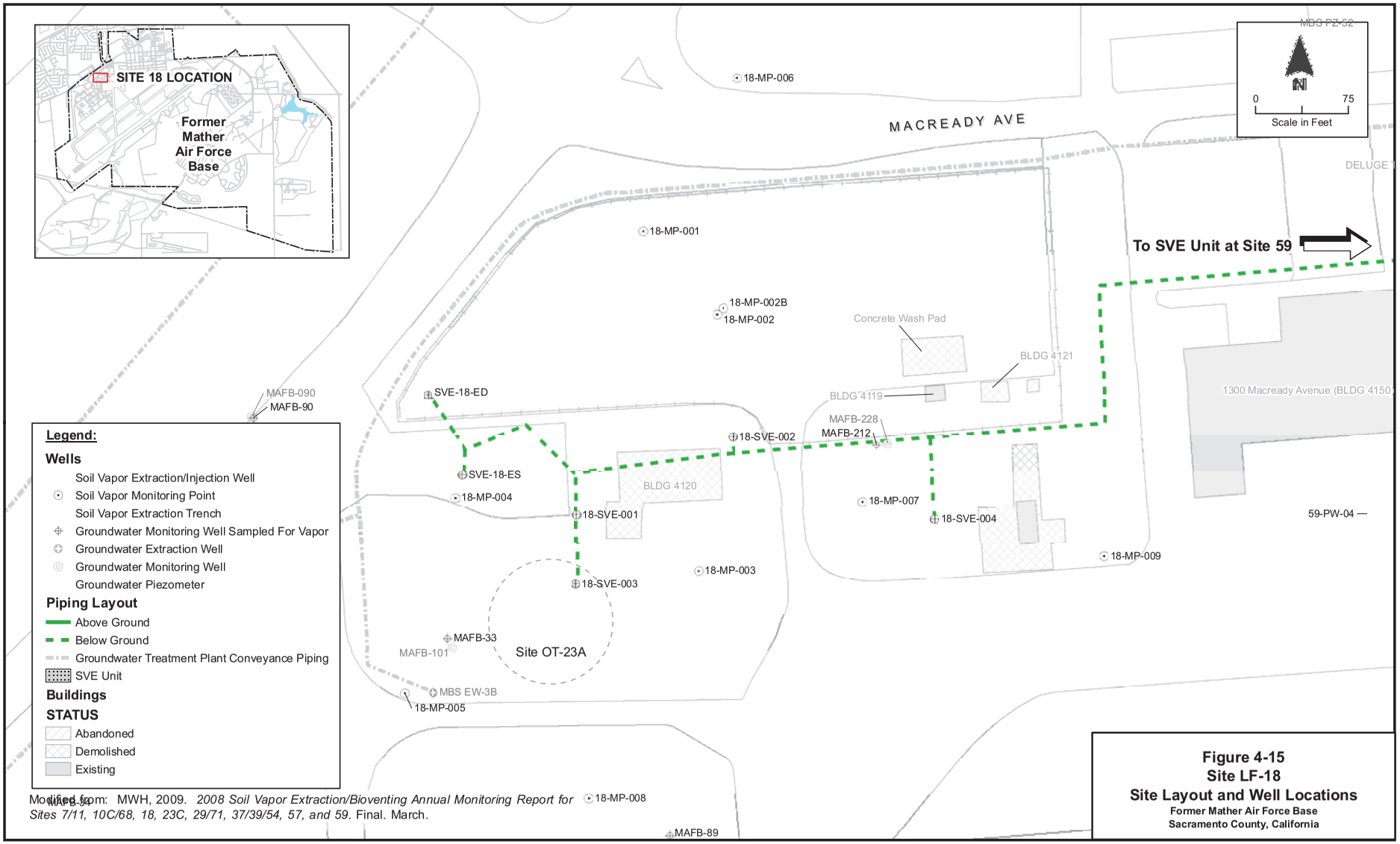

Modified from: MWH, 2009. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59*. Final. March.

Figure 4-15
Site LF-18
Site Layout and Well Locations
Former Mather Air Force Base
Sacramento County, California

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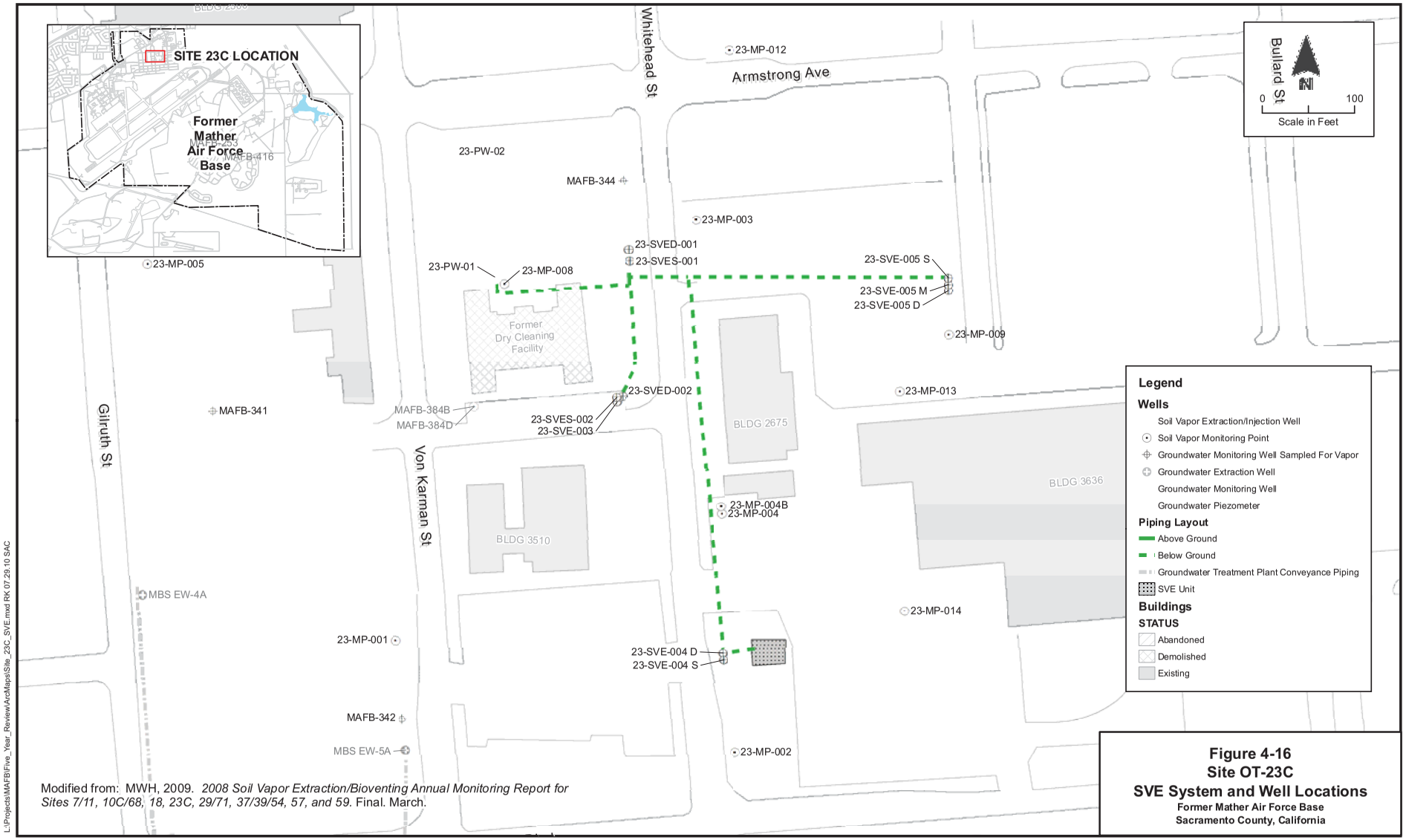

Modified from: MWH, 2009. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Report for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59.* Final. March.

Figure 4-16
Site OT-23C
SVE System and Well Locations
Former Mather Air Force Base
Sacramento County, California

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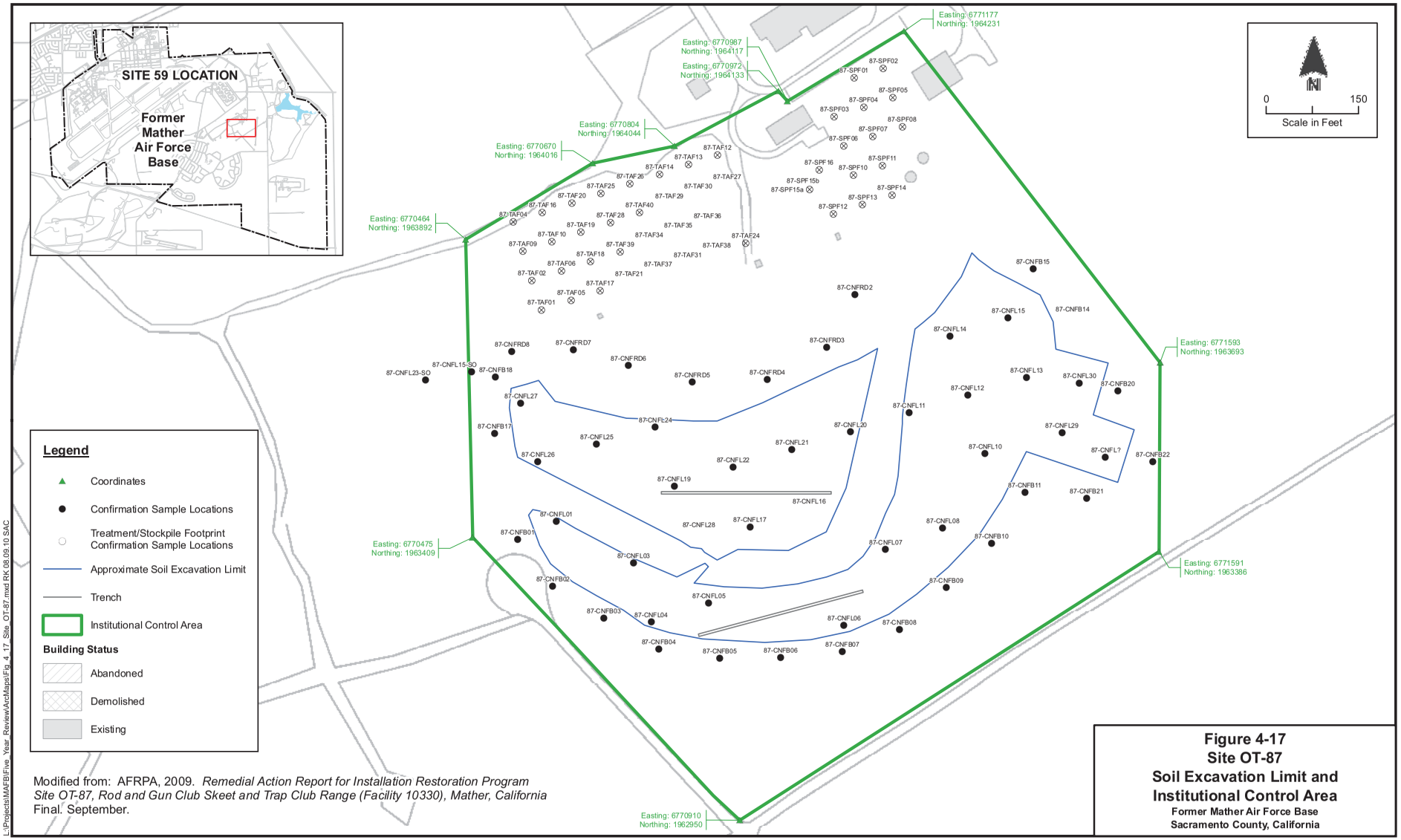

Modified from: AFRPA, 2009. *Remedial Action Report for Installation Restoration Program Site OT-87, Rod and Gun Club Skeet and Trap Club Range (Facility 10330), Mather, California* Final. September.

Figure 4-17
Site OT-87
Soil Excavation Limit and Institutional Control Area
Former Mather Air Force Base
Sacramento County, California

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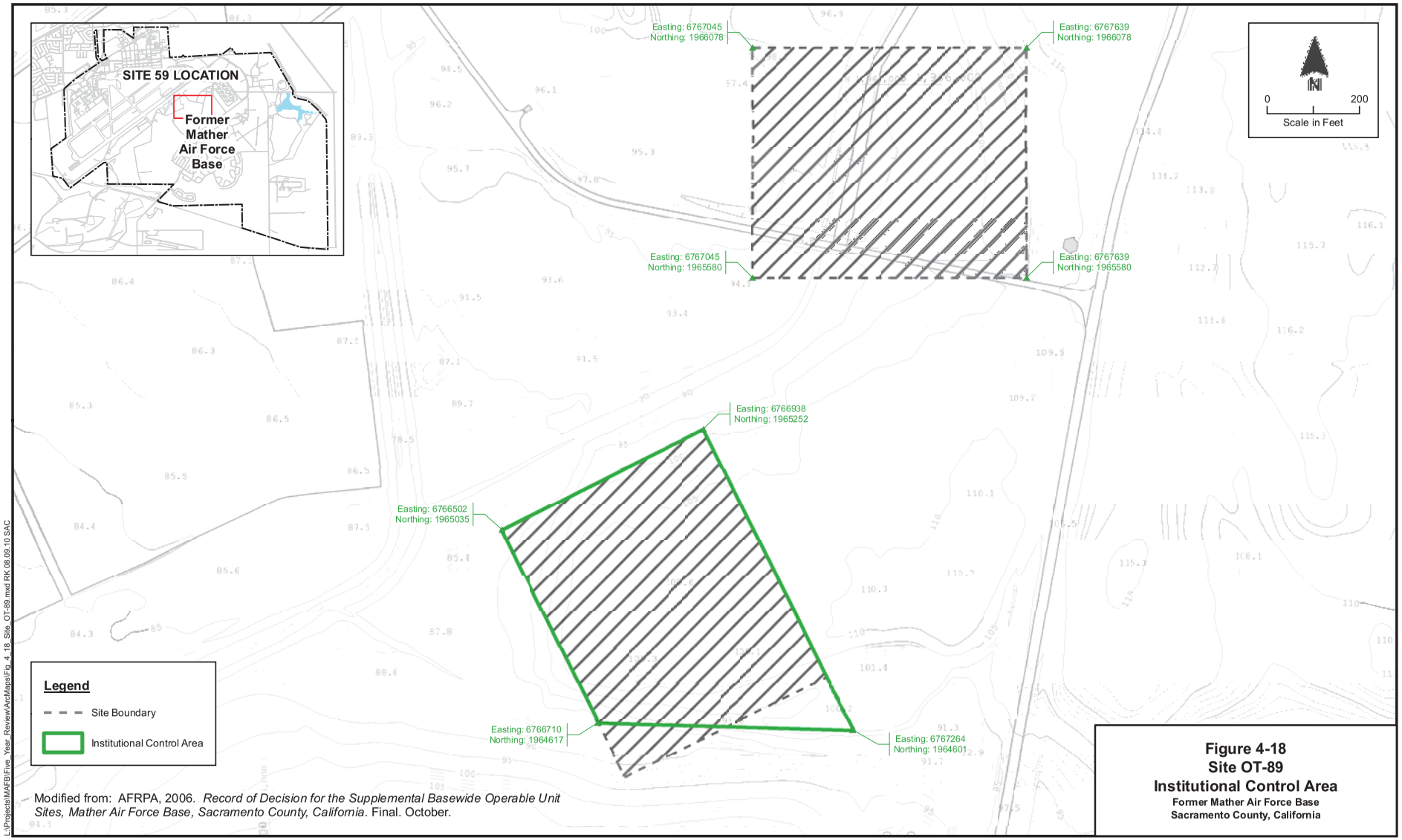

Modified from: AFRPA, 2006. *Record of Decision for the Supplemental Basewide Operable Unit Sites, Mather Air Force Base, Sacramento County, California*. Final. October.

Figure 4-18
Site OT-89
Institutional Control Area
Former Mather Air Force Base
Sacramento County, California

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5.0 PROGRESS SINCE LAST REVIEW

This section describes the progress since the second five-year review, including a description of the protectiveness statements, the status of recommendations and follow-up actions presented in the *Second Five-Year Review of Remedial Actions* (AFRPA, 2005a) and the status of any other prior issues.

5.1 Protectiveness Statement from Previous Review

The protectiveness statement in the second five-year review report reads:

> *Based on the information provided in this Five-Year Review Report, it is determined that the remedial actions selected and implemented for environmental contamination at sites at Mather AFB, and for groundwater contaminated by historical activities at Mather AFB, are functioning as designed, and are protective of human health and the environment. It is further determined that all necessary operations and maintenance are being performed.*

As described in Section 5.2, the recommendations and follow-up actions presented in the second five-year review were implemented. The technical assessment of the remedial actions in Section 7.0 of this report describe the investigations and evaluations conducted and the remedial system modifications made over the past five years to address the protectiveness concerns described in the second five-year review. The results of this assessment were used to develop the protectiveness statements presented in Section 10.0 of this third five-year review.

5.2 Recommendations and Follow-Up Actions from Second Five-Year Review

5.2.1 Potential Risk from Vapor Intrusion

Recommendation: *The modeling process recommended by EPA guidance predicts that TCE could migrate from the water table to the ground surface and into buildings. The model predicts that the concentration of TCE in indoor air above water table concentrations above about 60 µg/L health risk could be unacceptable, based upon a proposed risk factor for TCE. Although the Air Force has not adopted the proposed risk factor, the Air Force believes the best way to address this issue is to measure TCE concentrations in indoor air, or in shallow soil gas, in order to validate or refute the model predictions. The Air Force is developing a sampling strategy for review by the regulators for implementation in mid-2004.*

Status: Since the second five-year review, the presence of VOCs in groundwater continues to be part of potentially complete pathways for the intrusion of subsurface vapors into indoor air at various areas of Mather. In the absence of indoor air or shallow soil gas data, the vapor intrusion pathway can only be evaluated based on groundwater data. In accordance with EPA guidance (EPA, 2002), Tier 2 Secondary Screening of groundwater data was performed using EPA's health-protective "Regional Screening Levels" (RSLs) for ambient air (EPA, 2010), the Henry's law constant (HLC) partitioning coefficient (EPA, 2009b), and 2009 groundwater monitoring data for the Main Base/SAC Area Plume (on- and off-site wells) and Site 7 Plume (off-site wells) (MWH, 2010a).

Health-protective screening concentrations for groundwater were back-calculated for each analyte detected in groundwater from corresponding RSL and HLC values, and either an empirical attenuation factor ("generic screening" as per EPA, 2002) or a theoretical attenuation factor ("semi-site-specific screening" as per EPA, 2002, and a site-specific depth to groundwater with a subsurface soil type representative of the site). The derivation of these screening concentrations is provided in Table 5-1.

Table 5-1. Health-Protective Screening Concentrations for the Analytes Detected in Groundwater (via the Vapor Intrusion Pathway and Inhalation of Indoor Air)

Description:	Variable	Value	Units
Generic Attenuation Factors (G-α ; EPA, 2002):	$G\text{-}\alpha_{GW}$	0.001	dimensionless
Semi-Site-Specific Attenuation Factors (SS-α ; EPA, 2002): vadose zone = 50% loam/sandy loam, 50% sand; depth to water 20--30 m	$SS\text{-}\alpha_{GW}$	2E-04	dimensionless
Unit Conversion Factor	CF_V	0.001	m^3/L
Generic Screening Concentrations:			
Residential Land Use, Groundwater	$GSC_R\text{-}GW$	derived herein	µg/L
Commercial Land Use, Groundwater	$GSC_C\text{-}GW$	derived herein	µg/L
Semi-Site-Specific Screening Concentrations:			
Residential Land Use, Groundwater	$SSSC_R\text{-}GW$	derived herein	µg/L
Commercial Land Use, Groundwater	$SSSC_C\text{-}GW$	derived herein	µg/L
Henry's law constant (EPA, 2009b)	H'	chemical-specific	L_{water}/L_{air}
Ambient Air Regional Screening Levels (EPA, 2010)			
Residential Land Use	RSL_R	chemical-specific	$\mu g/m^3$
Commercial Land Use	RSL_C	chemical-specific	$\mu g/m^3$

Equations:

$$GSC_{[R \text{ or } C]}-GW = \frac{RSL_{[R \text{ or } C]}}{G-\alpha_{GW} \times H'} \times CF_V$$

$$SSSC_{[R \text{ or } C]}-GW = \frac{RSL_{[R \text{ or } C]}}{SS-\alpha_{GW} \times H'} \times CF_V$$

Analyte Detected in Groundwater	Surrogate (if no Ambient Air RSL for the target analyte)	C or NC	H' (L_{water}/L_{air})	Residential Land-Use Scenario: *Ambient Air RSL_R* ($\mu g/m^3$)	Residential: GSC_R-GW (µg/L)	Residential: $SSSC_R$-GW (µg/L)	Commercial Land-Use Scenario: *Ambient Air RSL_C* ($\mu g/m^3$)	Commercial: GSC_C-GW (µg/L)	Commercial: $SSSC_C$-GW (µg/L)
VOCs									
1,1-DCE		NC	1.0701E+00	2.1E+02	2.00E+02	9.8E+02	8.8E+02	8.2E+02	4.1E+03
1,2-DCA		C	4.8380E-02	9.4E-02	1.90E+00	9.7E+00	4.7E-01	9.7E+00	4.9E+01
CCl_4		C	1.1316E+00	1.6E-01	1.40E-01	7.1E-01	8.2E-01	7.2E-01	3.6E+00
cis-1,2-DCE	trans-1,2-DCE	NC	1.6728E-01	6.3E+01	3.80E+02	1.9E+03	2.6E+02	1.6E+03	7.8E+03
PCE		C	7.2570E-01	4.1E-01	5.60E-01	2.8E+00	2.1E+00	2.9E+00	1.4E+01
TCE		C	4.0385E-01	1.2E+00	3.00E+00	1.5E+01	6.1E+00	1.5E+01	7.6E+01

C = carcinogen
CCl_4 = carbon tetrachloride
DCA = dichloroethane
DCE = dichloroethene
EPA = United States Environmental Protection Agency
GSC = generic screening concentration
m = meter
m^3/L = cubic meter per liter
NC = noncarcinogen
PCE = tetrachloroethene
RSL = regional screening level
SSSC = semi-site-specific screening concentration
TCE = trichloroethene
VOC = volatile organic compound
µg/L = micrograms per liter
$\mu g/m^3$ = micrograms per cubic meter

The maximum detected VOC concentrations in each of the plumes were then compared to the corresponding screening levels. The EPA derives the RSLs to be health-protective at a specified cancer risk estimate of one in one million (1E-06) or a noncancer hazard index of 1.0. Consequently, risk- and hazard-estimates for the site-specific data can be estimated using a ratio approach. Cumulative risk or hazard estimates can then be derived as the sum of the risk estimates or hazard quotients for all detected analytes (Table 5-2) and evaluated for compliance with de minimus levels (i.e., site cancer risk less than 1E-06 or site noncancer hazard index less than 1.0), EPA's "risk management range" for Superfund (1E-04 to1E-06), or exceedance of the risk management range (greater than 1E-04). Site-specific results are discussed below and presented in Table 5-2.

Main Base/SAC Area Plume. For the on-site portion of the Main Base/SAC Area Plume, the generic and semi-site-specific vapor intrusion risk screening analyses were conducted using data from MAFB-420 and MAFB-439, which have the highest VOC concentrations at the water table. The commercial generic screening and semi-site-specific screening estimates were within the risk management range of 1E-06 to 1E-04. The residential semi-site-specific screening estimates reflecting more site-specific soil types are also within the risk management range. The generic residential risk estimate was slightly above the risk management range at 2.4E-04, but the generic screening does not consider site conditions (i.e., depth to groundwater and subsurface soil type) as the semi-site-specific assessment does. In addition, these two wells represent worst-case conditions at specific locations in the Main Base/SAC Area Plume, which is not representative of the risk across the entire site. It should also be noted that there are no residential-type buildings overlying these portions of the plume, and residential-type development in these areas is unlikely given the current use as an air field. Therefore, there is no completed on-site residential exposure pathway.

Relative to potential commercial exposure, MAFB-439 is currently in an open field, and the hot spot at MAFB-420 underlies an open field, a taxiway, and hangars. These facilities do not fit the typical building conditions for commercial indoor air exposure, so it is likely that this risk is less than estimated (Table 5-2). TCE, PCE and CCl_4 concentrations have been decreasing at MAFB-420 since 2007. Also, the water table has been declining and is now approximately 95 feet bgs, which is close to 100 feet bgs. As noted in the EPA guidance, vapor concentrations generally decrease with increasing distance from a subsurface vapor source, and eventually at some distance the concentrations become negligible (EPA, 2002). Available information suggests that 100 feet laterally and vertically is generally conservative (EPA, 2002).

Vapor intrusion is not considered an issue off site from the former Mather AFB, as there are no completed exposure pathways and none are likely. Off site to the west of the Main Base/SAC Area, a small TCE plume is present in groundwater at water table well MAFB-121 (Figure 7-3). This well is located to the east of Happy Lane adjacent to an open area previously mined for gravel. The most recent concentration of TCE reported at this well was 6.0 µg/L during the second quarter of 2008, and the approximate depth to groundwater was approximately 92 feet bgs. The commercial generic screening and semi-site-specific screening estimates were less than 1E-06. The residential semi-site-specific screening estimate reflecting more site-specific soil types is also less than 1E-06. The generic residential risk estimate is 3.6E-06, which is slightly above 1E-06. However, there are no residential-type buildings overlying this plume, and concentrations in well MAFB-121 were decreasing over the last five years prior to the well becoming dry in the fourth quarter of 2009.

Site 7 Plume. For the Site 7 Plume, the generic and semi-site-specific vapor intrusion risk screening analyses were conducted using data from MAFB-041 and MAFB-446, which have the highest VOC concentrations in the Site 7 Plume. Both the commercial and residential generic screening and semi-site-specific screening estimates were within the risk management range of 1E-06 to 1E-04. However, there are currently no buildings over the footprint of the Site 7 Plume. Almost the entire Site 7 Plume is off site

Table 5-2. Risk and Hazard Estimates for the Vapor Intrusion Pathway Based on Analytes Detected in Groundwater

Description:	Variable	Value	Units
Generic Screening Concentrations (*GSC*):			
Residential Land Use, Groundwater	GSC_R-GW	derived (Table 5-1)	µg/L
Commercial Land Use, Groundwater	GSC_C-GW	derived (Table 5-1)	µg/L
Semi-Site-Specific Screening Concentrations (*SSSC*):			
Residential Land Use, Groundwater	$SSSC_R$-GW	derived (Table 5-1)	µg/L
Commercial Land Use, Groundwater	$SSSC_C$-GW	derived (Table 5-1)	µg/L

Equations:

$$Risk\ Ratio = \frac{C_{GW} \times 1\times10^{-6}\ Target\ Risk}{[G\ or\ SS]SC_{[R\ or\ C]} - GW}$$

$$Hazard\ Quotient = \frac{C_{GW} \times 1.0\ Target\ Hazard}{[G\ or\ SS]SC_{[R\ or\ C]} - GW}$$

Location		Maximum Detected Concentration	Generic Screening						Semi-Site-Specific Screening					
			Residential Land Use			Commercial Land Use			Residential Land Use			Commercial Land Use		
Well Identifier Detected Analyte	C or NC	C_{GW} (µg/L)	GSC_R-GW (µg/L)	*Risk Ratio*	*Hazard Quotient*	GSC_C-GW (µg/L)	*Risk Ratio*	*Hazard Quotient*	$SSSC_R$-GW (µg/L)	*Risk Ratio*	*Hazard Quotient*	$SSSC_C$-GW (µg/L)	*Risk Ratio*	*Hazard Quotient*
Site 7 Plume														
Well MAFB-041														
1,2-DCA	C	8.3	1.9E+00	**4.4E-06**	—	9.7E+00	8.6E-07	—	9.7E+00	8.6E-07	—	4.9E+01	1.7E-07	—
cis-1,2-DCE	NC	9	3.8E+02	—	2.4E-02	1.6E+03	—	5.6E-03	1.9E+03	—	4.7E-03	7.8E+03	—	1.2E-03
PCE	C	3.6	5.6E-01	**6.4E-06**	—	2.9E+00	**1.2E-06**	—	2.8E+00	**1.3E-06**	—	1.4E+01	2.6E-07	—
TCE	C	35	3.0E+00	**1.2E-05**	—	1.5E+01	**2.3E-06**	—	1.5E+01	**2.3E-06**	—	7.6E+01	4.6E-07	—
		Cumulative Risk or Hazard Index:		**2.2E-05**	2.4E-02		**4.4E-06**	5.6E-03		**4.5E-06**	4.7E-03		8.9E-07	1.2E-03
Well MAFB-446														
1,2-DCA	C	0.5	1.9E+00	2.6E-07	—	9.7E+00	5.2E-08	—	9.7E+00	5.2E-08	—	4.9E+01	1.0E-08	—
cis-1,2-DCE	NC	1.8	3.8E+02	—	4.7E-03	1.6E+03	—	1.1E-03	1.9E+03	—	9.5E-04	7.8E+03	—	2.3E-04
PCE	C	9.3	5.6E-01	**1.7E-05**	—	2.9E+00	**3.2E-06**	—	2.8E+00	**3.3E-06**	—	1.4E+01	6.6E-07	—
TCE	C	57	3.0E+00	**1.9E-05**	—	1.5E+01	**3.8E-06**	—	1.5E+01	**3.8E-06**	—	7.6E+01	7.5E-07	—
		Cumulative Risk or Hazard Index:		**3.6E-05**	4.7E-03		**7.1E-06**	1.1E-03		**7.2E-06**	9.5E-04		**1.4E-06**	2.3E-04
Main Base/SAC Area Plume (On base)														
Well MAFB-420														
CCl_4	C	0.38	1.4E-01	**2.7E-06**	—	7.2E-01	5.3E-07	—	7.1E-01	5.4E-07	—	3.6E+00	1.1E-07	—
1,1-DCE	NC	8.8	2.0E+02	—	4.4E-02	8.2E+02	—	1.1E-02	9.8E+02	—	9.0E-03	4.1E+03	—	2.1E-03
PCE	C	83	5.6E-01	**1.5E-04**	—	2.9E+00	**2.9E-05**	—	2.8E+00	**3.0E-05**	—	1.4E+01	**5.9E-06**	—
TCE	C	270	3.0E+00	**9.0E-05**	—	1.5E+01	**1.8E-05**	—	1.5E+01	**1.8E-05**	—	7.6E+01	**3.6E-06**	—
		Cumulative Risk or Hazard Index:		**2.4E-04**	4.4E-02		**4.7E-05**	1.1E-02		**4.8E-05**	9.0E-03		**9.6E-06**	2.1E-03
Well MAFB-439														
CCl_4	C	14	1.4E-01	**1.0E-04**	—	7.2E-01	**1.9E-05**	—	7.1E-01	**2.0E-05**	—	3.6E+00	**3.9E-06**	—
PCE	C	77	5.6E-01	**1.4E-04**	—	2.9E+00	**2.7E-05**	—	2.8E+00	**2.8E-05**	—	1.4E+01	**5.5E-06**	——
TCE	C	0.24	3.0E+00	8.0E-08	—	1.5E+01	1.6E-08	—	1.5E+01	1.6E-08	—	7.6E+01	3.2E-09	--
		Cumulative Risk or Hazard Index:		**2.4E-04**	—		**4.6E-05**	—		**4.7E-05**	—		**9.4E-06**	—

Table 5-2. (Continued)

Location		Maximum Detected Concentration	Generic Screening						Semi-Site-Specific Screening					
			Residential Land Use			Commercial Land Use			Residential Land Use			Commercial Land Use		
Well Identifier Detected Analyte	C or NC	C_{GW} (µg/L)	GSC_R-GW (µg/L)	*Risk Ratio*	*Hazard Quotient*	GSC_C-GW (µg/L)	*Risk Ratio*	*Hazard Quotient*	$SSSC_R$-GW (µg/L)	*Risk Ratio*	*Hazard Quotient*	$SSSC_C$-GW (µg/L)	*Risk Ratio*	*Hazard Quotient*
Main Base/SAC Area Plume (Off base)														
Well MAFB-121														
PCE	C	0.91	5.6E-01	**1.6E-06**	—	2.9E+00	3.1E-07	—	2.8E+00	3.3E-07	—	1.4E+01	6.5E-08	—
TCE	C	6	3.0E+00	**2.0E-06**	—	1.5E+01	4.0E-07	—	1.5E+01	4.0E-07	—	7.6E+01	7.9E-08	—
		Cumulative Risk or Hazard Index:		**3.6E-06**	—		7.1E-07	—		7.3E-07	—		1.4E-07	—

Notes:
A **bold** value indicates a cancer risk ratio greater than 1E-06 or a noncancer hazard quotient greater than 1.0.
Screening concentrations were derived in Table 5-1.

C = carcinogen
DCA = dichloroethane
DCE = dichloroethene
GSC = generic screening concentration
NC = noncarcinogen
PCE = tetrachloroethene
SSSC = semi-site-specific screening concentration
TCE = trichloroethene
µg/L = micrograms per liter
— = not calculated (hazard quotients not calculated for carcinogens; risk ratios not calculated for noncarcinogens).

under an area previously excavated for gravel mining, and there are no known future plans for buildings in this area. An area near the plume has been reclaimed as a seasonal wetland/marsh, so it is unlikely that buildings will be placed near the wetlands and plume. Consequently, there is no completed commercial or residential vapor intrusion exposure pathway for the Site 7 Plume.

AC&W Plume. Vapor intrusion is not considered an issue for the AC&W Plume because of the depth to water and low concentrations of TCE (the only COC for this plume) in groundwater. In 2009, the depth to groundwater was approximately 130 feet bgs, and groundwater levels are declining. Considering this depth to groundwater (i.e., in excess of 100 feet), there is no completed pathway (EPA, 2002). In addition, a hardpan layer is present in shallow soils over much of the AC&W area that would further impede vapor migration from the groundwater plume and completion of the vapor intrusion pathway. The maximum concentration of TCE in groundwater beneath the housing area was 7.7 µg/L at ACW EW-6R, which is an operating extraction well. No monitoring wells in the housing area had a concentration of TCE greater than the ACL in 2009. Concentrations in the plume have been decreasing and will continue to decrease with operation of the extraction system. Consequently, the remaining TCE concentrations in the AC&W Plume do not pose an unacceptable risk via the vapor intrusion pathway to any industrial or residential receptors.

5.2.2 Lead in Soil beneath Truemper Way

Recommendation: *The shallow soil beneath Truemper Way that contains lead and ash is likely related to Site 10C fire training activities. This lead is planned to be addressed under an explanation of significant difference to the Basewide Operable Unit ROD in 2004.*

Status: As discussed in Section 4.4.1, an ESD was prepared and added the excavation of the lead-contaminated soil to the remedy for Site FT-10C/ST-68 (AFRPA, 2008b). The additional lead-contaminated soil beneath and north of Truemper Way (Figure 4-14) was excavated in November and December 2008 and disposed at an appropriately permitted off-site landfill (MWH, 2009a). Approximately 140 cubic yards of soil were removed from Site FT-10C/ST-68. The soil was excavated such that ICs related to residual lead will not be required (i.e., residual lead concentrations met the 151 mg/kg unrestricted use level designated in the ESD).

5.2.3 In Situ Treatment at Sites OT-23A, OT-23B, and OT-23D and Site SD-59

Recommendation. *Additional work is required to ensure that extent of contamination is determined at Site 23 (Subsites 23A, 23B, and 23D) and Site 59, and to ensure that the extraction systems relied upon to remediate this contamination are both adequate and adequately monitored. It is recommended that this be a focus of the SVE program management during 2004.*

Status of Site OT-23 - Subsites OT-23A, OT-23B, and OT-23D. Contamination associated with Subsite OT-23A is addressed by the Site LF-18 SVE system, and contamination associated with Subsites OT-23B and OT-23D is addressed by the Site ST-37/ST-39/SS-54 SVE system.

Subsite OT-23A, southwest of former Building 4120, was addressed by the Site LF-18 remedial activities (Figure 4-15). Subsite OT-23A was defined as the area near soil boring SLB-MBF-02A (drilled during the Additional Site Characterization RI [IT Corporation, 1996a]), located along the southwestern boundary of Site LF-18. The installation of monitoring points 18-MP-005 and 18-MP-008 and extraction well 18-SVE-003 define the extent of contamination associated with Subsite OT-23A. Soil vapor samples collected from 18-MP-005 and 18-MP-008 during RI drilling did not specifically target the sample interval (24 feet bgs) where the highest concentrations were detected in boring SLB-MFB-02A, but they did show that the sampled column did not have significant VOC concentrations in either well. The

baseline soil vapor samples collected after subsurface stabilization from the 26- to 27-feet bgs and 30- to 31-feet bgs monitoring points in 18-MP-005 and 18-MP-008, respectively, also did not detect any significant VOC concentrations. SLB-MFB-02A also had TCE soil detections at 58 and 73 feet bgs. VOCs were not detected in the any of the soil samples collected from well 18-MP-005, which was sampled at 10, 40, 50, 60, 70, and 80 feet bgs. Though soil samples were not collected from 18-MP-008 and 18-SVE-003, the soil vapor samples define the extent of contamination at depth. Results from soil vapor samples collected while drilling 18-MP-008 were insignificant at all depths. Soil vapor samples collected while drilling 18-SVE-003 did result in TCE concentrations of 3.9, 1.7, and 1.2 parts per million by volume (ppmv) at 50.5, 60.5, and 71 feet bgs, respectively. The results from baseline soil vapor samples collected after subsurface stabilization from the 70- to 71-feet bgs monitoring point in 18-MP-008 were insignificant. However, the 58- to 78-feet bgs extraction point in well 18-SVE-003 had a TCE concentration of 28 ppmv. Therefore, the extent of potential contamination, both shallow and deep, from Subsite OT-23A (boring SLB-MFB-02A) was confined to the Site LF-18 area of concern by wells 18-MP-005 and 18-MP-008, and additional characterization following the second five-year review was not necessary. The deep contamination in boring SLB-MFB-02A has been addressed by extraction at 18-SVE-003, and the shallow contamination has been addressed by 18-SVE-002 (MWH, 2009c). The Site LF-18 SVE system was shut down in November 2008, while closure of Site LF-18 and OT-23A was being evaluated. Data presented in the draft final *Site 18 and 23A Closure Report* show that Subsite OT-23A and the surrounding area have been remediated and no further treatment is required (MWH, 2009c).

Subsites OT-23B and -23D are located along Superfortress and Macready Avenues, respectively, south of the Site ST-37/ST-39/SS-54 SVE system (Figure 4-9). Two monitoring points (23-MP-006 and 23-MP-007) were installed in 1998 to monitor remedial progress at these sites, and samples have been collected annually since 2003, with the exception of 2007. In 2007, three soil borings were proposed at locations along the base sanitary sewer system associated with Subsites OT-23B and -23D to assess the level of contamination relative to historical contaminant concentrations of TCE and xylenes. These borings were drilled in early 2008 and three multiprobe SVMPs (37-PW-02, 37-PW-03, and 37-PW-04) were installed (Figure 4-9). In addition, the County of Sacramento installed 8-inch blank sleeves beneath Macready Avenue, as shown on Figure 4-9, to provide conduits to allow the installation of SVE conveyance piping to wells associated with 37-PW-03 and 37-PW-04, if needed for future remediation. Soil vapor samples were collected from 37-PW-03 and 37-PW-04 in February and September 2008; the data do not indicate the need for remediation at those locations (MWH, 2009h). Consequently, Subsites OT-23B and OT-23D are being adequately monitored.

Status of Site SD-59. During the second quarter of 2004, eight boreholes were drilled, and four multiprobe monitoring points, six SVE wells, and one groundwater well were constructed at Site SD-59 to characterize the area surrounding the ATC washrack, a known contaminant source area (MWH, 2004a). During the third quarter of 2004, the newly installed SVE wells were tied into the SVE system.

Three of newly installed wells were constructed as dual-purpose wells to address a perched water zone at 50 feet bgs and any residual contamination at the north side of Site SD-59. Extraction wells 59-SVE-006I, 59-SVE-006D, and 59-SVE-007 (Figure 4-11) were constructed with well screens exposed to the vadose zone and the perched zone. By turning an isolation valve, isolating the well from the system, a submersible pump can be installed and any water present in the well can be removed. Dewatering activities were attempted in December 2004 at 59-SVE-007 and 59-SVE-006I. A flow rate of approximately 0.5 gpm was achieved at 59-SVE-007; however, due to a slow recharge rate, minimal water was removed from 59-SVE-006I.

A radius of influence (ROI) test was conducted at Site SD-59 in December 2006 to determine if the SVE system had sufficient influence over the areas with significant remaining contamination, including the

area surrounding the former ATC washrack investigated in 2004. The ROI test results indicated the extraction well field provides appropriate influence at all monitoring locations where measurements were recorded (MWH, 2007c).

Additional characterization was performed in December 2007, early 2008, and late 2009 with the installation of six multiple-completion vapor monitoring/extraction wells. Vapor data from these wells are being reviewed to evaluate potential impact to groundwater quality and to evaluate future SVE operations at Site SD-59. In the meantime, extraction from the vadose zone in the southern and southeastern portions of the site at depths of 50 to 90 feet bgs continues to address cleanup of chlorinated VOCs (predominantly TCE and CCl_4), and field readings and samples continue to be collected to monitor remedial progress.

5.3 Issues Raised Following Completion of the Second Five-Year Review

Following completion of the *Second Five-Year Review of Remedial Actions* (AFRPA, 2005a), EPA and DTSC issued letters of concurrence that the remedial actions selected and implemented at Mather are protective of human health and the environment (EPA, 2004; 2005; DTSC, 2005). However, both agencies stated concerns regarding long-term protectiveness. These concerns were addressed by AFRPA in a letter to EPA and DTSC dated 20 April 2005 (AFRPA, 2005b), and they are provided here with status updates.

1. Concern. *Institutional Controls (ICs) where not established through existing records of decision (RODs) should be put in place through either a ROD amendment or an Explanation of Significant Differences (ESD). As Mather is a Base Closure and Realignment Act site, the U.S. Air Force (USAF) cannot rely on property ownership as a long-term IC, nor can local ordinances be cited as providing long-term protection of public health and the environment.*

Status. As discussed in Sections 2.0 and 4.0, ICs are being added to the remedial actions at several sites via ESDs. At sites where ICs are already a component of the remedy selected in a ROD, the ICs are clarified and supplemented with additional ICs. At one site (OT-89), ICs are the selected remedy (AFRPA, 2006). The following is a list of documents that have been issued since the second five-year review that incorporate ICs as part of the remedial actions for specific Mather sites.

- AC&W OU – *Explanation of Significant Difference: Institutional Controls for Groundwater Remedy, Site WP-12, Aircraft and Control Warning Site, Mather, California* (AFRPA, 2008a);

- Groundwater and Soil OU – Draft Final *Explanation of Significant Difference from the Record of Decision for the Soil Operable Unit Sites and Groundwater Operable Unit Plumes: Soil Sites WP-07/FT-11, ST-37/ST-39/SS-54, SD-57, SD-59, Main Base/SAC Area Plume, Site 7 Plume, Northeast Plume, Mather, California* (AFRPA, 2009a);

- Landfill OU – *Memorandum of Post-ROD Changes: Clarification of Institutional Controls for the Landfill Operable Unit Remedies, Mather California* (AFRPA, 2009c);

- Basewide OU – Draft Final *Explanation of Significant Difference from the Record of Decision for the Basewide Operable Unit Sites: Sites FT-10C/ST-68, OT-23C, and OT-87, Mather, California* (AFRPA, 2009d); and

- Supplemental Basewide OU – *Record of Decision for the Supplemental Basewide Operable Unit Sites, Mather Air Force Base, Sacramento County, California* (AFRPA, 2006).

2. Concern. *The USAF is commended for the installation of extraction well EW-12B in the Main Base/SAC Industrial Area Plume and should continue developing an evaluation of remedy performance once this well is established within overall extraction and treatment system for this plume.*

Status. EW-12B was installed in September 2004 to capture the toe of the Main Base/SAC Area Plume in Unit B. Startup for EW-12B occurred on 4 May 2005, but a variety of issues during 2005 prevented the well from running continuously. A packer was installed in the sump and the well was redeveloped in early December 2005. With the exception of routine maintenance issues, EW-12B has run continuously since that time. In 2007, a capture zone analysis (CZA) of the Main Base/SAC Area Plume was conducted and concluded that EW-12B and the Juvenile Hall supply wells effectively capture the downgradient extent of CCl_4 contamination greater than MCL concentrations in Unit B (MWH, 2007a). However, because low levels of CCl_4 continue to be detected at the western toe of the plume, the flow rate at MBS EW-12B was increased from 125 gpm to 175 gpm in 2007 to increase the capture radius of the well (MWH, 2008c). An update to the 2007 CZA, which includes evaluation of the four areas of concern identified in the 2007 CZA and updated fate-and-transport model runs, was issued as an appendix to the 2008 annual groundwater monitoring report (MWH, 2010b).

3. Concern. *Due to the ubiquitous low-level detections of perchlorate in the Main Base/SAC Industrial Area Plume effluent, the USAF should develop a plan for the continued monitoring of perchlorate in groundwater at Mather.*

Status. The low concentrations of perchlorate (generally about 1 µg/L) detected in the Main Base/SAC Area Plume extraction wells at Mather do not exhibit a pattern that suggests a specific origin for the chemical. These detections do not appear to be related to the perchlorate plume(s) from upgradient sources. During the period of this five-year review, the Air Force monitored the effluent from the Main Base/SAC Area and AC&W Site groundwater treatment plants quarterly, and all results were less than the practical quantitation limit. Therefore, the Air Force terminated sampling for perchlorate starting in 2010.

If perchlorate levels related to the upgradient perchlorate plume(s) arrive at the Mather IRP groundwater wells, the Air Force expects the EPA and State of California to engage with the potentially responsible parties (PRPs) regarding additional sampling, analysis, and appropriate corrective action. The PRPs for the upgradient perchlorate sources are Aerojet-General Corporation and the Boeing Company. The perchlorate contamination in groundwater is the result of aerospace-related activities at what is known as the Inactive Rancho Cordova Test Site [IRCTS]). Aerojet cleanup activities are conducted under the Federal Superfund Program with oversight by EPA Region 9 and CVWB, and Boeing cleanup activities are overseen by DTSC and CVWB.

4. Concern. *Agreements for wellhead treatment at the Moonbeam and Juvenile Hall public water supply wells should remain in effect as per the Off-Base Water Supply Contingency Plan.*

Status. An agreement for wellhead treatment for the Moonbeam Drive water-supply well is in place. However, in accordance with the *Mather AFB Off-Base Water Supply Contingency Plan* (AFRPA, 2008c), the Air Force submitted a six-month notice to Cal Am on 9 March 2009 to terminate wellhead treatment based on six months of influent concentrations reported at less than one-half their respective MCLs (AFRPA, 2009f). Details of termination are being discussed between AFRPA and Cal Am. Termination of the treatment is contingent on continued results less than one-half MCLs.

The Air Force attempted to establish an agreement with Sacramento County in 1997 for wellhead treatment at the Juvenile Hall water-supply wells; however, the County did not sign the agreement. The Air Force has and will continue to operate a wellhead treatment system on the two Juvenile Hall wells, which is consistent with the Contingency Plan.

5. Concern. *While it is understood that current land uses in the off-post portions of the Site 7 Plume have caused disruptions in remedial actions, the USAF should resume operations in as expedient a manner as possible and determine the effectiveness of the pump and treat system operation on plume containment and/or groundwater restoration prior to the next five-year review.*

Status. The Site 7 groundwater extraction and treatment system resumed operation with two extraction wells (7-EW-01 and 7-EW-02) in December 2006. Several monitoring wells at the toe of the Site 7 Plume (single-completion monitoring well MAFB-370, and dual-completion monitoring wells MAFB-371C and D, MAFB-372B and D, and MAFB-373C and D) were rehabilitated and sampled during the third and fourth quarters of 2006 as part of system startup activities (MWH, 2008c). Five new groundwater monitoring wells were installed in 2008 to help define the plume boundaries and gauge the effectiveness of remedial operations (MWH, 2010b). During 2008, 7-EW-01 and 7-EW-02 extracted contaminated groundwater at a combined average rate of approximately 67 gpm. All of the water treated is injected into the aquifer through four injection wells. Groundwater flow as interpreted by the potentiometric surface maps suggests that the extraction wells are capturing at least a majority of the groundwater plume (MWH, 2010b). A detailed CZA of the Site 7 Plume was issued as an appendix to the 2008 annual groundwater monitoring report (MWH, 2010b)..

6. Concern. *The USAF should consider the appropriateness of monitored natural attenuation (MNA) as the remedy for the Northeast Plume through an extensive evaluation of the monitoring data; if the data support MNA as the long-term remedial action as per EPA guidance, the USAF should develop an ESD for this site.*

Status. The Air Force does not believe the existing condition of the plume warrants the development of an ESD for MNA. The areal extent of the Northeast Plume greater than ACLs has decreased in size. As of mid-2009, only two wells have concentrations of COCs (PCE and/or cis-1,2,-DCE) greater than ACLs; and the MCL volume is not expected to expand (MWH, 2010b). The plume has been defined in all directions with the addition of a well installed in 2008 at the northern extent of the plume. Concentrations of COCs in groundwater at this well were reported at less than ACLs during the initial fourth quarter of 2008 sampling event and the subsequent first quarter and second quarter of 2009 sampling events (MWH, 2009e; 2010b). In January 2009, the Air Force submitted a draft report to EPA documenting proper and successful operation of the remedy (AFRPA, 2009b).

7. Concern. *DTSC and the Air Force are in dispute statewide over the Air Force's lack of commitment to assure payment of the State's oversight costs to administer the Institutional Controls (ICs) as required by the California Code of Regulations (CCR), Title 22, Section 67391.1.*

Status. For future transfers, the State of California will recover oversight costs for ICs from the land recipient through the SLUC.

8. Concern. *DTSC and the Air Force are in dispute regarding the Supplemental Basewide ROD over several institutional control issues.*

Status. The ICs issues were resolved with the finalization and signing of the *Record of Decision for the Supplemental Basewide Operable Unit Sites, Mather Air Force Base, Sacramento County, California* by AFRPA, EPA, and DTSC in October 2006 (AFRPA, 2006).

6.0 FIVE-YEAR REVIEW PROCESS

This section describes the activities performed during the Mather five-year review process, including identification of the five-year review team, notification of the local community, review of relevant documents and data, inspection of current site conditions, and performance of interviews to assist in determining site status.

6.1 Administrative Components

The Mather third five-year review team is composed of the following RPMs:

Douglas Fortun	AFRPA-Western Region Execution Center (WREC)
John Lucey	EPA (Region 9)
Franklin Mark	DTSC
Marcus Pierce	CVWB

William Hughes, ASE Inc., who has been providing technical oversight for the Mather IRP for numerous years and prepared the first and second five-year reviews for Mather, is also a key member of the five-year review team. Note that the list of RPMs does not include all those who have contributed to this program over the last five years. Each of the RPM positions listed above has been filled by successive managers during the last five years, and many of these have support staff that has made significant contributions to project management or implementation. As of 2009, other contributors to the Mather IRP include:

Paul Bernheisel	AFCEE Field Engineer
Linda Geissinger	AFRPA Public Affairs Manager
Viola Cooper	EPA Community Involvement Coordinator
Nathan Schumacher	DTSC Public Participation Specialist
Frank Davies	CIWMB Remedial Project Manager
Angela Thompson	SMAQMD Representative
Sandra Lunceford	Mather RAB Community Co-Chairperson
Rick Balazs	Sacramento County Department of Economic Development
Gregg Weissenfluh	Sacramento County Airport System
Jill Ritzman	Sacramento County Department of Regional Parks
Amanda Delgado	TechLaw, Inc., Technical Advisor to EPA
Daniel Shafer	MWH, Remedial Action Contractor Program Manager
Todd Daniels	MWH, Remedial Action Contractor Project Manager

Members of the review team were notified of the initiation of the third five-year review for Mather at the June 2009 BCT meeting. The schedule for this third five-year review report is presented in Table 6-1.

Table 6-1. Five-Year Review Schedule

Document Title	Document Status	Draft			Final			Finalization Date
		Submission Date	Review Period	Comments Due Date	Draft Final Due Date	Review Period for Draft Final	Final Submission Date	
Third Five-Year Review Report	Primary	28 Sep 09	60 days	30 Nov 09[a]	23 Aug 10[b]	30 days	21 Sep 10	21 Sep 10

Table 6-1. (Continued)

[a] Extension of the review period requested by EPA. Comments on draft received on 22 March 2010.
[b] Extension of the comment resolution period requested by AFRPA.
AFRPA = Air Force Real Property Agency
EPA = United States Environmental Protection Agency
RTCs = responses to comments

6.2 Community Involvement and Notification

The Mather IRP has maintained an active community involvement program since the 1980s. Information on the Community Relations Program and community participation can be found in the *Mather Community Relations Plan* (MWH, 2004b). Key components of the Community Relations Program include:

- Providing general information updates to the community through the distribution of fact sheets and newsletters to a community mailing list consisting of interested citizens, regulatory agencies, media, government officials, civic and community groups. Mailing list subscribers receive newsletters, fact sheets, environmental updates, flyers, and other documents.

- Holding open houses, posterboard sessions, and site tours that offer the public opportunities to meet government representatives, ask questions one-on-one, express concerns, and receive information about the Mather cleanup program.

- Notifying the community of upcoming RAB meetings and general public meetings, program milestones, the release of documents, and public comment periods through public notices (paid newspaper advertisements) placed in local newspapers, as required by EPA guidance.

- Holding public meetings to provide information about the IRP and opportunities for community involvement and to present milestone documents and solicit public review and comment, as required.

- Providing program updates to community members through the RAB. Since 1994, the RAB has served to provide a greater opportunity for members of the public to learn about Mather's environmental cleanup program, to review and comment on environmental plans and reports, and to provide input to the Air Force and regulatory agencies on cleanup decisions. The RAB consists of several community members and is co-chaired by a community member and a representative from the Air Force. The RAB holds regular meetings open to the public, and meeting minutes are distributed to a mailing list of interested people. As of 2009, the RAB meets approximately three times a year.

In accordance with EPA guidance, AFRPA will notify the community of Mather's third five-year review at both the beginning and the conclusion of the process (EPA, 2001). The RAB was informed of the start of the third five-year review during the August 2009 RAB meeting.

A public notice was published on 29 September 2009 in the *Sacramento Bee*. The notice provided an overview of the third five-year review process, outlined the five-year review schedule, and noted how and where the public will be able to view the final report.

As part of the third five-year review process, AFRPA solicited regional stakeholders for feedback regarding ongoing environmental restoration activities at Mather. Stakeholders asked to participate in

interviews included a cross-section of community members. A summary of the interviews is provided in Section 6.5.

A public notice will be published in the *Sacramento Bee* to notify the community of the completion of the review process and finalization of the third five-year review. This notice will briefly summarize the review, note how and where the public can view the report, and list points of contact for community members who would like to obtain more information or ask questions about the results of the third five-year review.

This third five-year review report for Mather will be available for viewing by the public in the Mather Administrative Record, located at 3411 Olson Street, McClellan, California 95652, or online at https://afrpaar.lackland.af.mil/ar/docsearch.aspx.

6.3 Document and Data Review

The five-year review process included a review of documents relevant to the Mather IRP Program, including RODs for each OU, subsequent ESDs, and previous five-year reviews. Documents relevant to the implementation and performance of the groundwater, vadose zone, and landfill remedies were also reviewed in the preparation of this five-year review. These documents include quarterly, semiannual, and/or annual monitoring reports, as well as various closure, remedial action, and CZA reports. Documents relevant to the performance of the various treatment systems were reviewed to ensure the systems are operating in accordance with their O&M manuals. In addition, RI/FS and risk assessment documents were reviewed as needed. Documents that were consulted during the preparation of this report are cited throughout this document and included in the reference list in Section 12.0 of this report.

In general, data reviewed for the technical assessment in this third five-year review include those data presented and evaluated in the quarterly, semiannual, and/or annual progress monitoring reports, which are cited throughout this document, where appropriate. For groundwater remedy performance assessments, hydraulic and analytical data reviewed include groundwater level changes, gradients, flow directions, capture zones, groundwater quality data, including trends, mass removal data, and effluent compliance data. For SVE/BV remedy performance assessments, data reviewed include analytical concentration data from both field measurements and laboratory analysis of vapor samples, extraction and emission rate data, mass removal data, compliance data, and operational data (e.g., uptime, electrical usage, and destruction rate efficiency). For the landfill remedy performance assessments, data reviewed include gas monitoring data, compliance data, and site inspection reports.

6.4 Site Inspection

Site inspections were not conducted as part of this review. However, AFRPA and AFCEE staff are located at McClellan, California, approximately 10 miles from Mather, and are familiar with the physical condition of the sites and remedial systems through frequent traverses of the facility. Through these personnel, remedial action contractors that are on site on a daily basis, and regulatory staff visits, the Air Force has maintained familiarity with environmental remediation activities and site conditions.

6.5 Site Interviews

As part of the five-year review process, a series of interviews were conducted to evaluate opinions and concerns regarding the environmental restoration activities at Mather. The interview process included two components – interviews with community members and interviews with O&M representatives, including the RPMs and O&M contractor for Mather. All potential interviewees were initially contacted by electronic mail to request their participation in the interview process by completing a survey. Of the

13 individuals asked to participate in the interview process, 6 responded that they were willing to participate and completed surveys by electronic mail.

Four of the seven community representatives who were contacted responded to AFRPA's request for input: the Deputy Director of Sacramento County Regional Parks, the Sacramento County Mather Airport Manager, the RAB Community Co-chairperson, and a RAB member. All four respondents expressed knowledge of Mather's environmental operations and appreciate the Air Force's commitment to keeping them well informed. Respondents generally noted that the time for cleanup has been slow, and the RAB Co-chairperson stated concern that contamination may remain at Mather that has not been discovered. Both RAB members expressed concern about ongoing and future community participation due to the length of time cleanup requires. However, they indicated the Air Force should continue to keep the community informed and attempt to increase their participation by engaging them in activities such as reviewing draft documents and providing oversight of IC enforcement. Both RAB members also noted positive effects of the environmental cleanup on the surrounding community, including confidence in the drinking water supply, jobs created from base redevelopment, and new infrastructure.

Two of the six O&M representatives who were contacted for an interview participated: the RPM for AFRPA and the O&M program contractor. In general, the overall impression of the remedies selected for Mather's IRP was favorable, and the remedies are functioning as expected, although some concern was expressed by the O&M contractor regarding the effectiveness of the SVE systems in remediating residual low-level contaminant concentrations due to the moisture in the soil and the soil types (fine-grained) where the contaminants remain. This issue may delay closure of the SVE sites. Other unexpected O&M difficulties during the last five years that were noted by the O&M representatives include: (1) longer than expected shut-down periods for the Site 7 groundwater extraction and treatment system due to mining activities off site; (2) unexpected costs to collect and analyze soil samples in an area where elevated concentrations of hydrocarbons were not detected in previous investigations; (3) methane concentrations in excess of the compliance level at Site LF-04 that required installation of a fan system to remove methane from a gas migration control trench; and (4) injection capacity for the Main Base/SAC Area treatment plant effluent, which had been declining and prompted development of a supplemental discharge option. In general, the O&M representatives stated that the treatment systems and monitoring programs are being optimized and that contaminant data indicate decreasing concentration trends of COCs in both groundwater and soil gas.

The responses from the five-year review interviews will be taken into account as AFRPA moves forward with the public outreach program and continues its environmental restoration activities at Mather. Interview records are provided in Appendix B.

7.0 TECHNICAL ASSESSMENT

The technical assessment for remedial and removal actions at Mather consists of determining whether those actions are, or on completion will be, protective of human health and the environment. To reach a protectiveness determination, EPA guidance recommends that the following three questions be addressed for each action (EPA, 2001):

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

Answers to these three questions help ensure that all relevant issues are considered when determining the protectiveness of the remedy.

Questions A and C are addressed on a site-by-site basis in Sections 7.2 through 7.7. Question B is discussed in Section 7.1. The technical assessment for each site focuses on the performance of the remedial actions during the period of this third five-year review (2004 through mid-2009).

For reference, the cleanup levels for each site are presented in Table 3-1.

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

Question B is discussed here because the same discussion applies to the RAO for most of the remedial actions (i.e., protection of groundwater quality, etc.). This avoids repeating much of the same text in the assessment for each site.

Each of the components in Question B is addressed below and includes a discussion of changes and a general assessment. This assessment is referred to as appropriate in the site-specific subsections that follow in Sections 7.2 through 7.7.

7.1.1 Are the exposure assumptions used at the time of the remedy still valid?

The exposure assumptions used during the risk assessments for Mather were based on current and anticipated future land use at each site. The exposure assumptions used at all sites were for residential use. An additional set of exposure assumptions were evaluated for some sites where industrial or recreational use was anticipated. Sites OT-87, OT-89, and the landfills (Sites LF-03, LF-04, and WP-07) have remedies that are incompatible with unrestricted land use, and therefore, have ICs as a part of their remedy.

Intrusion of vapors originating from volatile chemicals in subsurface media (soil or groundwater) into building interiors potentially utilized by workers or residents is an exposure pathway that was not addressed in the original risk assessments. Therefore, ICs to prevent potential unacceptable exposure to VOCs in indoor air are being added to the remedies for Sites FT-10C/ST-68, LF-18, ST-37/ST-39/SS-54, SD-57, and SD-59. However, the ICs will only be imposed at the time of transfer, if necessary (AFRPA, 2009a; 2009d). If the site soil gas data demonstrate that all of the soil gas concentrations at a given site are compatible with unrestricted land use, then the Air Force will not impose these ICs at that site.

For groundwater, an evaluation of the potential risk from the vapor intrusion pathway is presented in Section 5.2.1. Cumulative risk or hazard estimates were evaluated for compliance with de minimus levels (i.e., site cancer risk less than 1E-06 or site noncancer hazard index less than 1.0), EPA's "risk management range" for Superfund (1E-04 to1E-06), or exceedance of the risk management range (greater than 1E-04). Site-specific results are presented in Table 5-2. All generic and semi-site-specific risk estimates for the on- and off-site portions of the Main Base/SAC Area Plume and off-site portion of the Site 7 Plume were less than or within the risk management range for commercial and residential land use, except for the on-site portion of the Main Base/SAC Area Plume, which had a generic screening risk estimate for residential land use that was slightly greater than 1E-04 (Table 5-2). However, the generic screening estimate does not consider site conditions (e.g., depth to groundwater and subsurface soil type) as the semi-site-specific assessment does. In addition, the concentration data from the two groundwater wells (MAFB-420 and MAFB-439) evaluated represent worst-case conditions at specific locations in the Main Base/SAC Area Plume, which is not representative of the risk across the entire site. It should also be noted that there are no residential-type buildings overlying these portions of the plume, and residential-type development in these areas is unlikely given the current use as an air field. Therefore, there is no currently completed on-site residential exposure pathway. For the AC&W Plume, vapor intrusion is not considered an issue because of the depth to water (greater than 100 feet), low concentrations of TCE (the only COC for this plume), and the presence of a hardpan layer in shallow soil over much of the AC&W area that would further impede vapor migration from the groundwater plume and completion of the vapor intrusion pathway.

No other exposure assumptions have changed or otherwise become invalid since the risk assessments and remedy selections.

7.1.2 Are the toxicity data used at the time of the remedy still valid?

With the exception of lead, the basis for cleanup at all of the non-landfill sites covered in this review is protection of groundwater quality. The ongoing soil cleanup by SVE and/or BV is based on protection of groundwater quality by removing sources in the soil that would otherwise prolong groundwater cleanup or render groundwater cleanup more expensive.

EPA policy states that it will not reopen remedy selection decisions contained in RODs unless a new or modified requirement calls into question the protectiveness of the selected remedy. As noted in Section 7.1.3, none of the ACLs established for groundwater contaminants have been revised since the RODs were signed. ACLs for groundwater COCs were established as the contaminant-specific California or Federal MCL, if an MCL existed. If an MCL did not exist, some other health-based guideline, such as an EPA-suggested no-adverse-response level (SNARL) or secondary MCL was used to establish an ACL. Since approval of the Groundwater OU ROD, Federal and California MCLs for total xylenes have been promulgated; total xylenes are a COC for the Main Base/SAC Area Plume. However, the ACL (17 µg/L) is still more stringent than either the Federal (10,000 µg/L) or California (1,750 µg/L) MCLs. Consequently, a review of ARARs indicates that no new standards have been promulgated or proposed since the RODs that would call into question the protectiveness of the remedy for groundwater. However, this review evaluates the ACLs with respect to the latest risk estimates supported by EPA and the State of California.

The numbers recommended for use in risk assessments have changed for many of the COCs at Mather since the risk assessments were completed, and remedial actions were selected. The relationships between contaminant concentrations and health effects are quantified in cancer slope factors and hazard indices that represent estimates based on the available toxicological data. These factors are combined with exposure assumptions to provide estimates of the risk of health effects that would result from the assumed exposure to a given concentration of a contaminant (or group of contaminants).

Therefore, the groundwater ACLs were re-evaluated with the latest toxicity data. The primary source for toxicity data for a five-year review is the EPA Integrated Risk Information System (IRIS) database (EPA, 2008). However, the IRIS database is lacking oral toxicity data for several chemicals that are COCs for Mather. The IRIS data for the remaining COCs indicates no greater risk than the more stringent risk estimates provided as either California Public Health Goals (PHGs) or the EPA regional screening levels (RSLs) (formerly termed preliminary remediation goals [PRGs]). The former are developed by Cal/EPA Office of Environmental Health Hazard Assessment (OEHHA) (OEHHA, 2009) and assume lifetime (70 years) exposure. The latter also assume a 70-year exposure period (EPA, 2010).

Table 7-1 compares the ACLs for COCs in the AC&W OU and Groundwater OU RODs to RSLs and PHGs. The RSLs and PHGs include concentrations in drinking water that correspond to a de minimus (inconsequential) cancer risk of 1E-06. Table 7-1 also lists the incremental lifetime cancer risk (ILCR) estimated for that ACL using both the RSL and PHG risk assumptions. To evaluate protectiveness of the ACLs, the associated ILCR estimates are compared to the acceptable risk management range defined in the NCP (40 CFR 300). The risk management range in 40 CFR 300.430(e)(2)(i)(A)(*2*) is between 10^{-4} and 10^{-6}, which is equivalent to 100 per million to 1 per million. All of the risk estimates for the ACLs are within or less than this range. Of note, during the second five-year review, the risk associated with the ACL for TCE was estimated to be about 179 in a million using the more stringent EPA PRG assumptions; therefore, the PRG-based estimate exceeded the acceptable risk management range. However, the risk associated with the ACL for TCE is approximately 2.9 in a million using the current EPA RSL. The risk associated with the ACL for PCE is estimated to be approximately 45 in a million using the RSL assumptions, whereas the risk associated with the former PRG was only 7.6 in a million. This risk estimate is still within the risk management range.

Table 7-1. Groundwater Aquifer Cleanup Levels Compared to EPA Regional Screening Levels and California Public Health Goals

Contaminant of Concern	Aquifer Cleanup Level (µg/L)	RSL (µg/L)	ILCR Based on RSL (per million)	PHG (µg/L)	ILCR Based on PHG (per million)
Benzene	1	0.41	2.4	0.15	6.7
Carbon tetrachloride	0.5	0.20	2.5	0.1	5.0
Chloromethane	3	190	0.02	NA	NC
1,1-Dichloroethene	6	340	0.02	10	0.6
1,2-Dichloroethane	0.5	0.15	3.3	0.4	1.3
cis-1,2-Dichloroethene	6	370	0.02	100	0.06
1,2-Dichloropropane	5	0.39	13	0.5	10.0
1,4-Dichlorobenzene	5	0.43	12	6	0.8
Tetrachloroethene	5	0.11	45	0.06	83
Trichloroethene	5	2.0	2.5	1.7	2.9
Xylenes, total	17	200	0.09	1,800	0.01
Vinyl chloride	0.5	0.016	31	0.05	10

EPA = United States Environmental Protection Agency
ILCR = incremental lifetime cancer risk
NA = not available
NC = not calculated
PHG = public health goal
RSL = regional screening level
µg/L = micrograms per liter

The other consideration when evaluating the risk associated with the cleanup level is that the plume consists of various mixtures of the COCs. When all of the ACLs are met, there may still be mixtures of COCs at concentrations at or less than the ACLs. The health risk of some or all of the contaminants in

these mixtures may be cumulative, or in other words some or all of the remaining contaminants may contribute in an additive way to the cancer risk. At the time of the first five-year review, a sum of the estimated risks associated with all the groundwater ACLs fell within the risk management range (AFBCA, 1999a). The revised risk estimates from this five-year review, however, are such that using the RSL risk assumptions, the sum of risk estimates for all of the ACLs is about 112 in a million, which is slightly greater than the risk management range. However, this cumulative risk estimate is lower than the 265 in a million estimate calculated during the second five-year review in which TCE alone (at 179 in a million) exceeded the risk management range (AFRPA, 2005a), using the more stringent cancer slope factor preferred by EPA. The cumulative risk using the PHG risk assumptions is 120 in a million, of which PCE contributes significantly (approximately 69% of total). However, it is not known that the risks are actually cumulative, and this assessment presents the worst-case scenario by assuming that the risk from all the contaminants is additive. This evaluation also assumes that concentrations in a hypothetical water sample consist of all of the COCs at ACL concentrations and that this is the sole drinking water source for the assumed exposure. This assumption may be overly conservative, as some of the COCs are rarely detected in groundwater at Mather. For example, vinyl chloride was only detected in three wells in 2008 and 2009. If vinyl chloride is excluded from the cumulative risk estimate, the sum of the risk estimates is 82 in a million and 90 in a million, using the RSL and PHG risk assumptions, respectively. These estimates are within the risk management range.

The cleanup levels for lead in soil at Sites FT-10C/ST-68, OT-87, and OT-89 are 800 mg/kg (15 mg/L soluble), 700 mg/kg, and 192 mg/kg, respectively. These concentrations are health-protective under commercial or industrial land use but not unrestricted use. Consequently, ICs are in place as a part of the remedies for Sites OT-87 and OT-89. However, at Site FT-10C/ST-68, it was anticipated that the excavation effort would also meet the unlimited use and unrestricted exposure threshold of concern of 151 mg/kg that was established through site-specific determinations using DTSC's LEADSPREAD model and documented in the Basewide OU ESD for Site FT-10C/ST-68 (AFRPA, 2008b). Following excavation, lead concentrations at the site were less than 151 mg/kg, and all soluble lead concentrations were less than 15 mg/L (MWH, 2009a). Therefore, ICs related to lead contamination are not required at Site FT-10C/ST-68. In addition, it should be noted that 151 mg/kg is less than EPA's 400 mg/kg residential RSL for lead.

In 2009, OEHHA developed revised industrial and residential California human health screening levels (CHHSLs) for lead. The residential CHHSL for lead in soil is 80 mg/kg, and the industrial CHHSL for lead in soil is 320 mg/kg (OEHHA, 2009). The residential CHHSL is less than the 151 mg/kg threshold of concern compatible with unrestricted use established in the Basewide ESD for Site FT-10C/ST-68; however, it is the Air Force's position that CHHSLs are not promulgated standards, are not enforceable, and are not ARARs for Site FT-10C/ST-68. The 151 mg/kg unrestricted use level established in the ESD is health-protective, and ICs are not needed at Site FT-10C/ST-68. In addition, the area excavated at Site FT-10C/ST-68 mostly lies underneath Truemper Way and is located in an area planned for airport use. Construction of a building or other structure at this location in the future is unlikely. Consequently, no new standards have been promulgated or proposed since remedy selection that would call into question the protectiveness of the remedy for soil at Site FT-10C/ST-68.

7.1.3 Are the cleanup levels used at the time of the remedy still valid?

For groundwater, regardless of the changes in toxicity data, the ACLs used at the time of the remedy selection are still valid. The bases for the various ACLs have not changed. These include California or Federal MCLs for most groundwater contaminants; secondary MCLs for petroleum hydrocarbons; and the SNARL for chloromethane. MCLs are legally enforceable standards that are agency-derived after formal review of health risk and technological and economic considerations; RSLs and PHGs are based solely on

health risk assessment. Groundwater ACLs remain protective of human health because the values of the ACLs are generally equal to, or less than, a corresponding MCL.

For soils and/or soil vapor, numeric cleanup levels established for some of the SVE sites, including Sites WP-07/FT-11, ST-37/ST-39/SS-54, SD-59, and FT-10C/ST-68, are being deleted via ESDs (AFRPA, 2009a; 2009d). Rather than use artificially low numeric cleanup levels, the ESDs remove the numeric cleanup levels and apply the existing narrative soil cleanup levels established in the Soil OU and Basewide OU RODs (AFBCA, 1996a; 1998a) and reiterated in the ESDs (ARFPA, 2009a; 2009d).

As discussed in Section 7.1.2, the cleanup levels for lead in soil at Site FT-10C/ST-68, Site OT-87, and Site OT-89 are still valid and protective of human health and the environment.

7.1.4 Are the remedial action objectives used at the time of the remedy still valid?

None of the RAOs used at the time of remedy selection have changed and all are still valid. The RAOs for each site are listed site-by-site in Section 4.0. Additional RAOs are or will be established for the sites where ICs are being added to the remedies (see Section 4.0). As discussed below, the various remedies have made progress toward meeting their RAOs.

7.2 AC&W OU Selected Remedy and Remedial Objectives Evaluation

7.2.1 AC&W OU Selected Remedy

The AC&W Plume consists primarily of dissolved-phase TCE. The plume defined to the AC&W OU ROD ACL is that portion greater than the TCE MCL of 5.0 µg/L. The remedial action selected in the AC&W OU ROD (AFBCA, 1993) was extraction of contaminated groundwater, treatment by air stripping, and discharge of treated water by reinjection into the aquifer horizon from which it was extracted. The pump and treat system began operating in January 1995 with eight extraction and eight injection wells. However, the injection well capacity could not be maintained at sufficient levels to discharge the design capacity, and the system was only able to consistently operate at about half of the design capacity of 270 gpm. The remedial action was modified in 1997 to change the discharge from injection to discharge into Mather Lake, thereby allowing the system to operate up to the design capacity. This decision was documented in the *Explanation of Significant Difference to the AC&W OU Record of Decision: Discharge of Treated Groundwater to Mather Lake* (AFBCA, 1997a). In 2008, ICs were added to the AC&W OU groundwater remedy through a second ESD (AFRPA, 2008a).

More detail on the selected remedial action is provided in Section 4.1.1.

7.2.2 AC&W OU Evaluation Questions

A. Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the AC&W OU ROD (AFBCA, 1993) and the ESDs (AFBCA, 1997a; AFRPA, 2008a).

System Performance. AFBCA issued a report of proper and successful operation (a.k.a. OPS) for the AC&W remedial action (AFBCA, 1998b), which received concurrence from EPA in November 1998 (EPA, 1998). The OPS report documents that the remedial action is operating as designed and is successfully remediating the contamination at the site.

A visual comparison of the fourth quarter 2005 TCE plume (Figure 7-1) to the fourth quarter 2008 TCE plume (Figure 7-2) shows a decrease in plume area from 2005 to 2008, reflective of continued progress of the remedial action. All the operating extraction wells and many monitoring wells have shown decreasing TCE concentration trends since the system was modified to surface discharge in 1997. During the period of this five-year review, concentrations have become asymptotic at extraction wells ACW AT-1 and ACW AT-2. At ACW EW-4, the TCE concentration has been less than the ACL since the second quarter of 2006, and the TCE concentration at ACW EW-2 decreased to less than the ACL in the second quarter of 2008. Trends in monitoring and extraction wells along the center axis of the plume show TCE concentrations have been stable or decreasing over the last two years (MWH, 2010b).

Capture of the AC&W Plume was modeled, and the results were presented in the *Informal Technical Information Report AC&W Treatment System Evaluation* (Montgomery Watson, 1996b) and the 1999 annual groundwater monitoring report (Montgomery Watson, 2000f). Figures 7-1 and 7-2 from 2005 and 2008, respectively, show the entire area of the plume greater than the ACL lies within the area of contoured drawdown created by the extraction wells and suggests hydraulic capture of the plume during this time frame.

The previous five-year review noted that TCE concentrations at extraction well ACW AT-1 were persisting at approximately 30 µg/L and that this concentration may indicate a persistent contribution of TCE to the aquifer from either the vadose zone or a source in the saturated zone. The second five-year review suggested addressing this potential residual source by adding carbon substrate to promote biodegradation of TCE. However, the residual source area, if present, needed to be delineated (i.e., vadose zone and/or saturated zone), and a conceptual model of its mass and flux to the groundwater needed to be refined before the cost and duration of cleanup by adding carbon substrate or another alternative could be compared to the groundwater extraction and treatment system cost. Consequently, several groundwater piezometers were installed in suspected source areas and near selected extraction wells. In addition, an SVE pilot study was conducted in 2002 to determine whether there was TCE in the vadose zone. The groundwater piezometers did not identify any residual source areas within the saturated zone, and the SVE pilot study indicated there was no TCE source within the vadose zone (MWH, 2005a). Continued performance monitoring has shown the TCE concentrations at ACW AT-1 have been at or less than 16 µg/L since October 2007.

Boeing extraction well EX-2 is located northeast of the AC&W Plume (Figure 7-1) and is completed in Unit D, the horizon beneath that containing the AC&W Plume. The well began operating in 2006 to remove perchlorate not associated with Mather or the AC&W Plume, which is present in the shallower Unit C. Upward vertical gradients induced by pumping for the AC&W remedial action have helped to limit or prevent vertical transport of TCE into Unit D. Vertical gradient analysis conducted in 2006 showed that upward vertical gradients in the western and central portions of the AC&W Plume do not appear to be affected by pumping at EX-2. However, vertical gradients in the eastern (regionally upgradient) portions of the plume near wells MAFB-53 and MAFB-71 may have been reversed or weakened by pumping from the EX-2 well (MWH, 2010b). Wells MAFB-67, MAFB-68, and MAFB-69, all completed in Unit D in the eastern portion of the plume area (Figure 7-2), did not have any reportable detections of TCE in 2007 or 2008. TCE concentrations at ACW PZ-09C increased from 0.33 to 13 µg/L between the second quarter of 2007 and the second quarter of 2008. This well is located between MAFB-53 and ACW EW-2 and is completed in the deeper horizon of Unit C. ACW PZ-09C was sampled in second quarter 2009 and the TCE concentration was 0.22 µg/L (MWH, 2010a). This result suggests the 2008 concentration was anomalous, possibly due to a switch in samples with ACW PZ-09. There is no evidence of consistent downward vertical migration.

System Compliance. A discharge pipeline was constructed and began discharging effluent from the AC&W treatment system to Mather Lake in June 1997. During the period of this five-year review,

quarterly samples were collected from the AC&W treatment system influent and biweekly samples were collected from the effluent. From 2004 through 2008, the effluent samples met the total VOC discharge treatment standards (total monthly median of 0.5 µg/L and daily maximum of 1.0 µg/L). Samples were also collected quarterly at the Mather Lake receiving water location (R-2). From 2004 through 2008, low concentrations (less than 0.6 µg/L) of one of three VOCs (chloroform, chloromethane, or PCE) were detected in four samples. However, none of those VOCs have been identified as COCs for the AC&W Site, and they were not detected in the effluent sample collected in conjunction with the Mather Lake sample. In addition, Mather Lake is inspected biweekly for any unusual conditions (algae blooms, turbidity, foams, etc.) resulting from the discharge of the treated groundwater. No adverse conditions have been observed. The AC&W groundwater treatment system was also in compliance with the air emissions ARARs from 2004 through 2008 (based on the substantive requirements of rules promulgated by SMAQMD). Discharge monitoring results are presented in the annual groundwater monitoring reports (MWH, 2005a; 2007d; 2007e; 2008c; 2010b).

Progress Toward Meeting RAOs. The results of performance monitoring of the AC&W remedial action for the last five years indicate continued success with TCE removal from groundwater and with meeting the discharge standards for the treated groundwater. The calculated total TCE mass removed from February 1995 through October 2008 was approximately 463 lbs with 1.3 billion gallons of groundwater removed (MWH, 2010b). The influent concentration to the air stripping system has decreased from approximately 17 µg/L in early 2004 to approximately 7 µg/L during the latter half of 2008 (by comparison, the initial influent concentration in 1995 was 130 µg/L.)

TCE concentrations at several monitoring and extraction wells have decreased to less than the ACL. The decreasing concentrations demonstrate that groundwater extraction and treatment continues to be effective. The concentrations in most of the extraction wells are tracking closely with previous model predictions. The extraction wells with TCE concentrations less than ACLs should be considered for rebound testing and evaluated against the decision logic for shutting down extraction wells (Figure 4-7). The data from rebound monitoring may be used to optimize the system and to model the potential time for TCE concentrations to decrease to less than the ACL.

B. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but the MCL used to establish the TCE ACL has not changed since the ACL was established in the AC&W OU ROD; and the changes in toxicity data do not result in the ACL exceeding the NCP risk management range. Therefore, the TCE ACL is still considered protective of human health and the environment.

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

The desirability of ICs had been discussed among the RPMs. ICs are required for the Groundwater OU as necessary to prevent exposure to contaminated groundwater that could threaten human health. The first five-year review determined that the risk posed by potential exposure to groundwater from the AC&W plume was within the acceptable range, but also documented that the RPMs had agreed to amend the remedy to include ICs similar to those required for the Groundwater OU. The second five-year review stated the details were not subsequently agreed on at that time, and the method of implementation, monitoring, and enforcement of ICs had been in dispute since 2001.

In 2008, ICs were added to the AC&W OU groundwater remedy through a second ESD (AFRPA, 2008a). The ESD includes temporary groundwater use restrictions as a component of the AC&W groundwater

remedial action until the ACL for TCE is met for the plume. The Air Force is responsible for implementing, maintaining and monitoring the ICs before and after property transfer. Land-use restrictions will be incorporated in any deed transferring all or part of the site subject to the ICs.

7.3 Groundwater OU Selected Remedies and Remedial Objectives Evaluation

7.3.1 Main Base/SAC Area Plume Remedial Action

7.3.1.1 Main Base/SAC Area Plume Selected Remedy

The Main Base/SAC Area Plume originates in the northern and western portions of Mather and extends beyond Mather to the west and southwest. The plume consists primarily of dissolved-phase VOCs (primarily PCE, TCE, and CCl_4). The plume defined to Groundwater OU ROD ACLs is that portion greater than the MCL for PCE (5.0 µg/L), TCE (5.0 µg/L), and/or CCl_4 (0.5 µg/L). The plume extends to the west approximately 7,000 feet beyond the Mather property boundary. A southwestern lobe of the plume extends across the western end of the main runway and approximately 3,200 feet southwest of the property boundary.

The remedial action selected in the Groundwater OU ROD for the Main Base/SAC Area Plume is a pump and treat program with the following components:

- A phased implementation program;
- Groundwater extraction, to achieve aquifer cleanup standards, estimated but not limited to a total rate of 1,300 gpm;
- Treatment of the extracted groundwater through air stripping with off-gas treatment (i.e., carbon adsorption) to achieve aquifer cleanup standards and to achieve discharge standards (for treated water and offgas);
- Groundwater injection in compliance with discharge standards; in combination with other discharge options (to be evaluated during remedial design) that are (a) consistent with attainment of cleanup standards, and (b) cost-effective;
- Land-use restrictions will be implemented on USAF property as appropriate, in order to preclude installation of groundwater wells that would not be compatible with protection of public health and the environment; and
- Monitoring the groundwater.

In addition, the Groundwater OU ROD required the development of a Mather-specific off-base water supply contingency plan, which applies to contaminants from the Main Base/SAC Area Plume. This plan was finalized in February 1998 and superseded in November 2008. It contains requirements for additional sampling of off-base water-supply wells near the Main Base/SAC Area Plume and for response actions when any COCs are detected in a supply well at one-half the MCL.

7.3.1.2 Main Base/SAC Area Plume Evaluation Questions

A. Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Groundwater OU ROD (AFBCA, 1996a).

System Performance. The phased construction of the remedial action for the Main Base/SAC Area Plume has been completed since the last five-year review. During the period of this five-year review, MBS EW-12B (Figure 4-2), a supplemental Phase IV extraction well, was installed in September 2004 to capture the toe of the plume in Unit B and began operating in 2005. Two extraction wells, MBS EW-7ABu and EW-2AR were installed and began operation in March 2005 to replace MBS EW-1A and EW-2A, respectively. Another supplemental Phase IV extraction well, MBS EW-13BuB, was installed near the intersection of Kiefer Boulevard and Happy Lane (Figure 4-2) and began operating in April 2008. The well is screened in the Bu, shallow B (Bs), and deep B (Bd) units (MWH, 2010b). This extraction well was installed to capture the Southwest Lobe of the Main Base/SAC Area Plume.

A list of extraction and injection wells associated with each phase of construction is provided in Table 7-2. Figure 4-2 shows the layout of the groundwater extraction and treatment system as of the fourth quarter of 2008, including 30 operating and eight non-operating extraction wells, four injection wells (MBS IW-501 through IW-504), and underground piping. The letter designations indicate the screen depth in one or more of the progressively deeper aquifer units A, Bu, B, and D. More detail about well construction and lithology can be found in the following reports: Montgomery Watson, 1999k; 2000g and MWH, 2003b; 2009k; 2010b.

Table 7-2. Well Installation for Main Base/SAC Area Plume Remediation

Phase	Wells	Year Installed
I	EW-1A, EW-2A, EW-3A	1997
	EW-1Bu, EW-2Bu, EW-3Bu	
	EW-1B, EW-2B	
	EW-2D	
	IW-501, IW-502, IW-503	
II/III	EW-4A, EW-5A	1999
	EW-1ABu, EW-2ABu,	
	EW-4ABu, EW-5ABu,	
	EW-6ABu	
	EW-39ABuB	
	EW-3B, EW-4B, EW-5B,	
	EW-6B, EW-8B	
	IW-504	
IV	EW-4Bu	2002
	EW-12AB	
	EW-9B, EW-10B, EW-11B	
	EW-4D, EW-5D, EW-6D	
IV Supplemental	EW-12B	2004
	EW-7ABu, EW-2AR	2005
	EW-13BuB	2008

Figures 7-3 through 7-5 depict the fourth quarter 2008 composite COC plume extent greater than ACLs and the location of wells screened in Unit A/water table, Unit B, and Unit D, respectively. Since the previous five-year review, the interpreted extent of some portions of the plume has expanded, primarily due to additional characterization, and portions of the plume have contracted, due to continued pumping at extraction wells.

Unit A/Water Table. Near the Site OT-23C source area and the upgradient portion of the plume none of the active water-table extraction wells in the area (i.e., MBS EW-12AB, EW-7ABu, and EW-39ABuB) had COCs reported at concentrations greater than ACLs in the fourth quarter of 2008 (MWH, 2010b).

MBS EW-7ABu has not had detections greater than ACLs since the second quarter of 2005, and MBS EW-12AB has not had detections greater than ACLs since the second quarter of 2003. Portions of the plume in this area are captured by the extraction system as shown in the *Capture Zone Analysis, Main Base/SAC Area Plume* (2007 Main Base/SAC Area CZA) (MWH, 2007a).

In the Site SD-59 and Site LF-18 area, the interpretation of the plume extent expanded due to the addition and sampling of water-table monitoring well MAFB-439 (Figure 7-3). Results of the baseline sample collected from the well in fourth quarter of 2008 were 33 and 7.2 µg/L for PCE and CCl_4, respectively. The source of the VOCs is not clear. Based on the capture zone evaluation conducted as part of the 2007 Main Base/SAC Area CZA, portions of this plume may be captured by the Site SD-57 source area extraction wells (MWH, 2007a).

The water-table portion of the plume in the Site SD-57 source area appears to be relatively stable. Groundwater with relatively high concentrations of COCs continue to be extracted by wells MBS EW-1ABu, EW-2ABu, EW-4ABu, EW-5ABu, and EW-2AR (Figure 7-3). One well in this area, MBS EW-6ABu, did not have COC concentrations greater than ACLs from the fourth quarter of 2003 through 2007. The well was inoperable in 2008 due to mechanical, pressure, and injection capacity issues but was restored to service in 2009 (MWH, 2010b). A lobe of the water-table portion of the plume still exists immediately east of the Site SD-57 source area in the vicinity of monitoring wells MAFB-209, MAFB-248, MAFB-417, and MAFB-247 (Figure 7-3). The northern portion of the lobe is likely captured by the source-area extraction wells. Capture or fate of the southern portion is not clear (MWH, 2007a); however, the detected concentrations of COCs in the southern portion of the lobe are relatively low. MAFB-247 had detections of TCE at 4.6 µg/L and CCl_4 at 0.71 µg/L in the fourth quarter of 2008. Therefore, any uncaptured COC mass in this portion of the lobe is likely to be minimal.

Unit B. Several Unit B extraction wells along Old Placerville Road (i.e., situated along the northern portion of the plume) had no COC detections greater than ACLs in the fourth quarter of 2008 (Figure 7-4). Extraction well MBS EW-8B has had seven consecutive samples with COC concentrations less than ACLs. The other wells with COC concentrations less than ACLs in the fourth quarter of 2008 included MBS EW-1B, EW-4B, and EW-6B. This decrease in plume area is reflective of capture and continued progress of the remedial action for this portion of the plume in Unit B.

The second five-year review noted an area between the Juvenile Hall water-supply wells and the Moonbeam Drive water-supply well that was beyond the area of capture of the wells. Therefore, extraction well MBS EW-12B was installed in 2004 to control and remove mass from this portion of the plume (Figure 7-4). The leading edge of the COC plume in Unit B in the vicinity of extraction well MBS EW-12B has been relatively stable to shrinking since operation of the well began in 2005. Concentrations of CCl_4 (the main COC comprising the plume in this area) decreased at MAFB-387B to less than the ACL (0.50 µg/L) in the second quarter of 2008 (MWH, 2010b). This well is located southwest of MBS EW-12B. The 2007 Main Base/SAC Area CZA suggests that most, if not all, of the plume in this area is captured by MBS EW-12B (MWH, 2007a).

The Unit B CCl_4 interpretation of extent greater than the MCL increased in the area near Happy Lane in 2008 (MWH, 2010b). This increase is due in part to recent CCl_4 detections of 1.0 and 0.88 µg/L in monitoring wells MAFB-173 and MAFB-268, respectively; and, a detection of 0.49 µg/L in newly installed well MAFB-451 (Figure 7-4). Reinterpretation of the Unit B portion of the plume removed Unit Bu wells that had been less than ACLs. This combined with the recent detections cited above yielded a CCl_4 plume in this area that is more continuous than previous interpretations. Evaluations presented in the *Capture Zone Analysis for the Southwest Lobe of the Main Base/SAC Area Plume* (Southwest Lobe CZA) (MWH, 2009k) suggest that portions of the plume east of MAFB-268 may potentially be captured by new

extraction well MBS EW-13BuB (MWH, 2010b). Portions of the plume west of MAFB-268 may be captured by the Juvenile Hall water-supply wells (Figure 7-4).

Since the previous five-year review, several new monitoring wells have been installed to better define an extension of the Main Base/SAC Area Plume known as the Southwest Lobe. These new wells include MAFB-429Bu/Bs/Bd, MAFB-431Bd/Ds/Dd, MAFB-434Bu/Bs/Bd, MAFB-449Bs/Bd, MAFB-457Bs/Bd, and MAFB-458Bs/Bd (Figures 7-3 through 7-5). Results of the installation and sampling of the new wells are presented in the 2007 and 2008 annual reports (MWH, 2008c; 2010b) and the Southwest Lobe CZA (MWH, 2009k). Sampling results from the new wells have aided in definition of the lobe as shown on Figure 7-6. Samples collected during the fourth quarter of 2008 and the first quarter of 2009 from MAFB-457Bs and MAFB-458Bd were greater than the ACL for TCE.

Fifteen additional off-base private water-supply wells were sampled during the second quarter of 2009. These wells were located to the southwest and regionally downgradient of the Southwest Lobe. Only one well, OFB-72, had a detectable concentration of TCE (3.8 µg/L). A second sample collected from the well had a TCE concentration of 3.6 µg/L. OFB-72 is located approximately 2,700 feet southwest of MAFB-457Bs/Bd and MAFB-458Bs/Bd well clusters. Two dual completion monitoring wells (MAFB-460Bs/Bd and MAFB-461Bs/Bd) were installed in late 2009 in the area of OFB-72 to better define the extent of the Southwest Lobe and collect potentiometric data in the vicinity of the leading edge of the plume (MWH, 2010c). MAFB-460Bs/Bd is located approximately 700 feet northeast of OFB-72 and approximately 2,050 feet southwest of MAFB-458Bs/Bd and MAFB-457Bs/Bd. Initial sample results from MAFB-460Bs/Bd were less than the ACL for TCE. TCE was not detected in the initial samples collected from MAFB-461Bs/Bd (located approximately 1,150 feet west and slightly south of MAFB-460Bs/Bd).

Extraction well MBS EW-13BuB was installed and brought online in April 2008 to control and remove mass from the Southwest Lobe. Figure 7-6, modified from the Southwest Lobe CZA (MWH, 2009k), shows that MBS EW-13BuB captures much of the lobe of the plume.

Unit D. Through the time period of this five-year review, the extent of the plume in Unit D has generally remained stable or decreased as a result of continued removal of COCs by the groundwater extraction system. Figure 7-5 shows a lobe of the plume in Unit D extending to the southeast (roughly perpendicular to the groundwater flow direction) in the vicinity of monitoring wells MAFB-102 and FFS-MW15-6. Wells MAFB-441 and MAFB-442 were installed and sampled in the fourth quarter 2008 to evaluate the extent of the lobe. Results of the initial (baseline) sampling showed this lobe is defined to ACLs. Review of the 2007 Main Base/SAC Area CZA shows this lobe is generally within the capture zone of the Unit D extraction wells (MWH, 2007a).

Unit D monitoring well MAFB-318 has had increasing concentrations of CCl_4. The well is located southwest of extraction well MBS EW-6D, and the area where the well is located was identified for further evaluation. Consequently, monitoring well MAFB-443 was installed in Unit D to the southwest (i.e., downgradient) of MAFB-318 and was sampled for the first time in the fourth quarter of 2008. CCl_4 was not detected, indicating the extent of this portion of the plume has been adequately characterized. Review of the potentiometric data on Figure 7-5 suggests this portion of the plume may be captured by the Moonbeam or Juvenile Hall water-supply wells.

System Compliance. During the period of this five-year review, water samples were collected biweekly (through 2006) or quarterly (2007 to present) from the Main Base/SAC Area air stripper influent and analyzed for VOCs, TPH, general minerals, and metals. Water samples were collected biweekly from the air stripper effluent for VOCs and collected quarterly for TPH, perchlorate, general minerals, and metals analysis. From 2004 through 2008, the treatment system complied with discharge standards. In addition,

the Main Base/SAC Area groundwater treatment system was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs based on calculations from compliance samples collected from 2004 through 2008. Discharge monitoring results are presented in the annual groundwater monitoring reports (MWH, 2005a; 2007d; 2007e; 2008c; 2010b).

Land-Use Restrictions and Off-Base Water Supply Contingency. Land-use restrictions prohibiting or requiring approval for any groundwater well construction on USAF property have been implemented through direct Air Force control prior to property transfer through conditions of leases and through deed restrictions when property has been deeded for all property overlying Groundwater OU contamination. No land-use restrictions have been systematically applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, the County of Sacramento adopted a revised ordinance (County Code Chapter 6.28) in 2002 that governs drilling of wells to incorporate a consultation zone within 2,000 feet of any known groundwater contamination. Any permit application to drill or modify a well in this zone requires consultation with CVWB prior to issuing any well permits. This revised ordinance allows recommendations to the County regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application.

The remedial action has remained protective during extraction system build-out and operation by continuing to limit exposure by providing wellhead treatment on supply wells as required by the *Mather AFB Off-Base Water Supply Contingency Plan* (AFBCA, 1998e; AFRPA; 2008c) (see Section 7.3.1.3 et seq.).

Groundwater Monitoring. Groundwater monitoring continues as part of the Groundwater Monitoring Program that includes routine monitoring and performance monitoring for the groundwater remedial actions. The monitoring program is governed by a decision logic (Figure 4-6) that has been improved through the years in an effort to enhance the cost-effectiveness of the monitoring program. In addition to the logic governing sampling frequency, changes have been made to sampling method, such as changing from conventional purging to micropurging to passive diffusion bag sampling for VOCs, and the list of analytes (i.e., shorter list), where appropriate. A separate decision logic guides the shutdown of extraction wells that have four or more consecutive quarters of COC concentrations less than MCLs (Figure 4-7).

In addition to the routine monitoring of Mather's VOC plumes, voluntary sampling has also been conducted to address a topic of concern identified in the previous five-year review, the potential commingling of perchlorate from known upgradient sources or other unknown sources. Perchlorate contamination has migrated beneath portions of the Northeast Plume and the Main Base/SAC Area Plume, and another migration route has carried perchlorate near the AC&W Plume at a depth that would bring it just beneath the Mather AC&W TCE plume. To date, sampling has not indicated any commingling. The cleanup of perchlorate from known upgradient sources is occurring through two programs, one under EPA and CVWB regulatory authority, and the other under CVWB and DTSC regulatory authority. Low concentrations of perchlorate have also been detected in all the Main Base/SAC Area extraction wells in a pattern that is not compatible with a specific source area and does not appear to be related to the deeper perchlorate plume from upgradient sources. Perchlorate concentrations in these wells have never exceeded 2 µg/L. Consequently, the Air Force discontinued the voluntary sampling in 2010.

Injection and Discharge Capacity. The technologies of groundwater extraction, air stripping, and reinjection have been demonstrated to be effective at remediating groundwater contamination at the Main Base/SAC Area plume. The reinjection was planned in more transmissive aquifer zones, and excess capacity was constructed to allow for possible capacity losses over time. However, several groundwater extraction wells were taken offline for part of 2008 due to diminished capacity of the injection wells.

Supplemental surface discharge was established to the West Ditch and injection wells MBS IW-502 and MBS IW-503 were redeveloped. MBS IW-502 was taken offline for redevelopment in May 2008 and restored to service in September. The injection capacity of the well improved from 300 gpm to roughly 900 gpm after redevelopment. MBS IW-503 was taken offline for redevelopment in September 2008 and restored to service in October. The injection capacity of the well improved from roughly 450 gpm to more than 1,000 gpm after redevelopment. Besides improved injection capacity of the injection wells, the overall flexibility of future discharge of the plant has been enhanced by the addition of surface discharge to the West Ditch.

Progress Toward Meeting RAOs. The results of performance monitoring of the Main Base/SAC Area Plume remedial action since the last five-year review have demonstrated effective COC removal from the aquifer and capture of the majority of the plume. The calculated total VOC mass removed by the treatment system from 1998 through the end of 2008 was approximately 3,400 lbs with nearly 6.5 billion gallons of groundwater extracted and treated (MWH, 2010b). The influent VOC concentration to the treatment system in the fourth quarter of 2008 was 16 µg/L. For comparison the influent concentration in early 2004 was approximately 47 µg/L.

Continued monitoring will help to confirm trends and future plume capture. COC concentrations have decreased to less than ACLs at several monitoring and extraction wells and cessation of groundwater extraction at five extraction wells has been recommended to monitor for and evaluate potential rebound (MWH, 2009e; 2010b). The treatment system has also been successful at meeting discharge standards for the treated groundwater and for air emissions, and the flexibility of water discharge from the plant has been enhanced with the addition of a surface discharge option.

Based on system operation and performance to date, the remedial action is expected to require at least another five years to attain ACLs, and consequently will require another five-year review.

B. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but none of the numerical standards used to establish ACLs have changed since they were established in the Groundwater OU ROD; and the changes in toxicity data do not result in the ACLs exceeding the NCP risk management range. Therefore, the ACLs are still considered protective of human health and the environment.

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

The EPA, DTSC, and CVWB had all expressed concern in the previous five-year review that the first four phases of the extraction system had not resulted in full capture of the Main Base/SAC Area Plume. The regulatory agencies and the Air Force continued to work together to identify the additional extraction wells or wells needed to complete the extraction system to satisfy the Groundwater OU ROD (AFBCA, 1996a). These additional extraction wells were installed in 2004 and 2008 as a supplement to Phase IV, and additional monitoring wells were installed to help confirm the extent of the plumes and provide data to evaluate plume capture. Capture zone analyses conducted within the five-year review period have helped to confirm capture of a majority of the plume (MWH, 2007a; 2010b; 2009k). The *Mather AFB Off-Base Water Supply Contingency Plan* was revised in 2008 (AFRPA, 2008c). In the meantime, the Air Force has maintained protectiveness by providing wellhead treatment on affected drinking water-supply wells (see Section 7.3.1.3) in compliance with the plan.

Another topic of concern in the previous five-year review was the potential commingling of perchlorate from known upgradient sources or other unknown sources. The cleanup of perchlorate from known upgradient sources is occurring through two programs, one under EPA and CVWB regulatory authority, and the other under CVWB and DTSC regulatory authority. Voluntary sampling was initiated and low concentrations of perchlorate were detected in all the Main Base/SAC Area extraction wells in 2004, in a pattern that is not compatible with a specific source area. The concentrations have not exceeded 2 µg/L in this sampling. Consequently, the Air Force discontinued the voluntary sampling in 2010.

The Groundwater OU ROD for the Main Base/SAC Area Plume requires land-use restrictions be implemented on Air Force property as appropriate, in order to preclude installation of groundwater wells that would not be compatible with protection of public health and the environment. An ESD that clarifies implementation of land-use restrictions on Air Force property, and establishes ICs to protect the remedial system components and preclude any activities that are inconsistent with the remedial actions or access to the remedial system components has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. The RAOs for the ICs are: (1) preventing human exposure to groundwater with concentrations exceeding the cleanup levels that are specified in the Groundwater OU ROD; (2) protecting the integrity of the groundwater remedial actions and systems, including the associated monitoring systems; and (3) preserving necessary access to the remedial systems and associated monitoring systems. The specific ICs will be documented as environmental restrictive covenants in deeds and restrictions/prohibitions in SLUCs. Following signature on the ESD, the Air Force will impose the additional ICs to protect the remedial systems associated with the Main Base/SAC Area Plume. Components of the ICs for the Main Base/SAC Area Plume are described in Section 4.1.2.

7.3.1.3 Mather Off-Base Water Supply Contingency Plan

The objectives of the Contingency Plan are to evaluate the effect of water-supply wells on contaminant migration, establish action levels for implementing response actions of water treatment or alternate water supply, to assess the options for response actions, and to recommend appropriate response actions.

Ten drinking water-supply wells were identified as wells of concern, and the Contingency Plan was developed to monitor these wells and nearby monitoring wells. The Contingency Plan concludes that plume migration and vertical migration are best addressed through the extraction and treatment of contaminated water per the remedial action for the Main Base/SAC Area Plume. The Contingency Plan indicates that once a contaminant reaches a supply well such that concentrations in the well exceed or will exceed one-half the MCL, the Air Force will provide wellhead treatment for that well. Wellhead treatment can be terminated upon six months notice once concentrations of PCE, TCE, and CCl_4 are less than one-half the MCLs for six months. Monitoring well sampling will continue as long as groundwater contamination exceeds MCLs or until remedial action is determined to have been completed under CERCLA. Monitoring of each individual supply well and monitoring wells in close proximity to the supply wells may be terminated once contamination is reduced for one year below 0.5 µg/L for PCE and/or TCE and below 0.2 µg/L for CCl_4. Monitoring of other groundwater monitoring wells may be terminated once contamination is reduced below MCLs (or stays below MCLs) for one year, there is adequate monitoring between any groundwater contamination exceeding MCLs and the supply well, and the well is not considered critical for protection of public health or the environment consistent with the cleanup standard established for the Groundwater OU, subject to provisions of any other monitoring requirements established under CERCLA.

Two carbon adsorption treatment systems were installed for off-base water-supply wells, consistent with the Contingency Plan, at the water-supply well on Moonbeam Drive now owned by Cal Am, and at the Sacramento County water system on Branch Center Drive supplied by the two Juvenile Hall water-supply wells (see Figure 4-5 for well locations). Influent concentrations for the Juvenile Hall wells have

remained at concentrations that require treatment or alternate water supply under the Contingency Plan. At the Moonbeam Drive water-supply well, a six-month advance notice of termination of wellhead treatment maintenance was submitted to Cal Am in March 2009 (AFRPA, 2009f). The memorandum states that the Air Force plans to terminate the maintenance of the Moonbeam Drive well system (six months from 9 March 2009) in accordance with the Contingency Plan, as the well had more than six consecutive monthly samples with concentrations of COCs less than one-half MCLs. The effluent from both treatment systems has continued to contain no detected COCs (MWH, 2005a; 2007d; 2007e; 2008c; 2010b).

The Mars Way well had not been operated for drinking water supply since 1997, when the well owner, Citizens Utilities Company of California (now Cal Am) took the well offline after a reported detection of TCE. The well was returned to service in September 2008. The well has been sampled throughout the period of this five-year review. PCE concentrations from this sampling have ranged from not detected to a maximum of 0.14 µg/L. TCE concentrations during the same period have ranged from not detected to a maximum of 0.34 µg/L. These results for both constituents are much less than their respective MCLs and further action has not been required in accordance with the Contingency Plan (AFRPA, 2008c).

Low concentrations (less than 1.0 µg/L) of PCE have been reported in the Gould Way well starting in April 2006. TCE has also been detected periodically at low concentrations since 2002. The PCE and TCE concentrations have been less than their respective MCLs and have not required further action based on the requirements in the Contingency Plan (AFRPA, 2008c).

7.3.2 Site 7 Plume Remedial Action

7.3.2.1 Site 7 Plume Selected Remedy

The Site 7 Plume extends beyond Mather from its source in the southwestern portion of Mather and consists primarily of dissolved-phase VOCs (i.e., TCE, 1,2-dichloroethane [1,2-DCA], PCE and cis-1,2-dichloroethene [cis-1,2-DCE]). The plume defined to Groundwater OU ROD ACLs is that portion greater than the MCL for TCE (5.0 µg/L), 1,2-DCE (0.5 µg/L), PCE (5.0 µg/L) and cis-1,2-DCE (6.0 µg/L). The plume extends to the southwest approximately 4,000 feet beyond the property boundary from the southwestern corner of the Site 7 disposal area.

The remedial action selected in the Groundwater OU ROD for the Site 7 Plume is a pump and treat program with the following components:

- Groundwater extraction at a rate of approximately 250 gpm;
- Treatment of the extracted groundwater through air stripping with off-gas treatment (i.e., carbon adsorption) to achieve aquifer cleanup standards and to achieve discharge standards (for treated water and offgas);
- Groundwater injection in compliance with discharge standards; in combination with other discharge options (to be evaluated during remedial design) that are (a) consistent with attainment of cleanup standards, and (b) cost-effective;
- Land-use restrictions will be implemented on USAF property as appropriate, in order to preclude installation of groundwater wells that would not be compatible with protection of public health and the environment; and
- Monitoring the groundwater.

More detail on the selected remedial action is provided in Section 4.1.3.

7.3.2.2 Site 7 Plume Evaluation Questions

A. Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Groundwater OU ROD (AFBCA, 1996a). However, the operation of the remedy has been interrupted three times by aggregate mining operations and reclamation activities by one or both of the two landowners on whose property the extraction wells are located.

System Performance. The groundwater extraction and treatment system resumed operation with pumping from 7-EW-01 and 7-EW-02 in December 2006. The system has been online since then, except for a short period of time (2 until 10 July 2008 and 25 until 28 July 2008) when the treatment plant was shut down in order to repair a damaged fiber optic line.

Several monitoring wells at the toe of the plume were rehabilitated and sampled as part of the system startup activities in late 2006. In addition, five new monitoring wells (MAFB-444 through MAFB-448) were installed in 2008 to evaluate the mid-plume area and the eastern portions of the plume area (Figure 7-7). These new wells were initially sampled in the fourth quarter of 2008.

Extraction well 7-EW-01 was redeveloped in June 2008 as its yield had decreased from roughly 40 gpm at startup in 2006 to 25 gpm in early 2008. A six-inch plug was placed in the bottom of the well casing as sand was entering the well through a damaged portion of the casing. The well then operated for the remainder of 2008 at approximately 35 gpm (MWH, 2010b).

Both extraction wells appear to be effectively removing mass from the plume. After maximum TCE concentrations were reported in April 2007, concentrations have decreased at both wells. Extraction well 7-EW-01 removed mass from the toe of the plume even with the observed decrease in capacity. Monitoring wells MAFB-372B and MAFB-373C, located in the toe of the plume, have exhibited decreasing TCE concentrations since the resumption of pumping in December 2006 (Figures 7-8 and 7-9). Additional monitoring will need to be conducted to confirm the observed trends in the monitoring wells. The results of the capture zone evaluation presented in the 2007 annual groundwater monitoring report show capture of the toe of the plume extending downgradient of wells MAFB-372B and MAFB-373C (MWH, 2008c). An updated and more detailed CZA for Site 7 was conducted in 2009 and incorporated additional groundwater monitoring data through the first quarter of 2009. The results of this analysis show capture of the plume at and in the area surrounding MAFB-448, as well as downgradient of MAFB-372B and MAFB-373C (MWH, 2010b).

Monitoring well MAFB-448 was first sampled in the fourth quarter of 2008; TCE was reported at a concentration of 7.1 µg/L. In the first and second quarters of 2009, TCE was reported at concentrations of 7.5 and 8.5 µg/L, respectively. Temporarily abandoned monitoring well MAFB-299 had been recommended in the 2008 annual groundwater monitoring report for rehabilitation and sampling in 2009 (MWH, 2010b). However, based on the results of the 2009 Site 7 CZA, which showed plume capture around MAFB-448, the Air Force believed there was insufficient evidence to warrant the rehabilitation of MAFB-299 or installation of additional groundwater monitoring wells. The Air Force recommended continued monitoring of the plume. If concentrations increase significantly in monitoring wells near the plume margins (e.g., MAFB-448, MAFB-371C, MAFB-300) then the Air Force, in coordination with the RPMs, will present an engineering analysis of alternatives to address improving plume capture (MWH, 2010b).

Concentrations of TCE at MAFB-393, MAFB-394, and MAFB-395 decreased in 2007 and 2008. These wells are located mid-plume near 7-EW-02, and the decreasing concentrations at these wells combined with potentiometric data corroborate capture by the extraction well. Additional monitoring will need to be conducted to confirm the observed decreasing trends in the monitoring wells. Evaluations of capture presented in the 2007 annual groundwater monitoring report and in the 2009 Site 7 CZA show capture of this area of the plume by 7-EW-02 (MWH, 2008c; 2010b).

System Compliance. Following startup of the Site 7 treatment system in December 2006 and through February 2007, influent samples were collected biweekly for VOCs, TPH, and general minerals analyses. After February 2007, the influent sampling frequency was reduced to quarterly. The effluent of the treatment system was sampled biweekly for VOCs and TPHG and quarterly for TPHD, metals, and general minerals. Between December 2006 and 2008, the treatment system complied with discharge standards, as no COCs were detected in the treatment system effluent, except for two different startup and prove out samples collected in July 2008, which had estimated concentrations of TCE (0.39 µg/L) in one sample and chloromethane (0.16 µg/L) in the other sample (MWH, 2010b). These concentrations are less than the discharge standards established in the Groundwater OU ROD. In addition, the Site 7 groundwater treatment system was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). During operation, air emissions did not exceed 10 lbs/day for total ROCs based on calculations from compliance samples collected between 2007 and 2008. Discharge monitoring results are presented in the annual groundwater monitoring reports (MWH, 2008c; 2010b).

Progress Toward Meeting RAOs. Performance monitoring of the Site 7 Plume remedial action since the system was restarted in December 2006 has demonstrated COC removal from groundwater and capture of the plume. The system has also been successful at meeting discharge standards for the treated groundwater and for air emissions. Additional monitoring will help to confirm trends and demonstrate plume capture. Future model predictions incorporating additional monitoring data may be used to evaluate the potential time for groundwater concentrations to decrease to less than ACLs.

Based on system operation and performance to date, the remedial action is expected to require at least another five years to attain ACLs, and consequently will require another five-year review.

B. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but none of the numerical standards used to establish ACLs have changed since they were established in the Groundwater OU ROD; and the changes in toxicity data do not result in the ACLs exceeding the NCP risk management range. Therefore, the ACLs are still considered protective of human health and the environment.

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

While the interruptions of the groundwater extraction and treatment system have been of concern and have delayed the progress of the remedial action, they have not compromised the protectiveness. The plume extent did not measurably change during the time the system was offline to the time it was restarted. The Site 7 treatment system was restarted in December 2006 and has since been online. Corresponding operation and performance monitoring also resumed.

No land-use restrictions have been systematically applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, the County of Sacramento adopted a revised ordinance (County Code Chapter 6.2.8) in 2002 that governs drilling of wells within 2,000 feet of any known

groundwater contamination. Any permit application to drill or modify a well within this zone requires consultation with CVWB prior to issuing any well permits. This revised ordinance allows recommendations to the County regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application.

An ESD that clarifies implementation of land-use restrictions on Air Force property, and establishes ICs to protect the remedial system components and preclude any activities that are inconsistent with the remedial actions or access to the remedial system components has been prepared (AFRPA, 2009a), and as of June 2010, is awaiting signatures. Components of the ICs for the Site 7 Plume are the same as those described in Section 4.1.2 for the Main Base/SAC Area Plume and are not repeated here.

7.3.3 Northeast Plume Remedial Action

7.3.3.1 Northeast Plume Selected Remedy

The Northeast Plume consists primarily of dissolved-phase PCE and cis-1,2-DCE. The plume defined to Groundwater OU ROD ACLs is that portion greater than the MCLs for PCE (5.0 µg/L) and/or cis-1,2-DCE (6.0 µg/L). The Groundwater OU ROD determined that active remediation of the Northeast Groundwater Plume was not warranted in 1996 because action was being taken to remediate the source (Landfill Site LF-04), and because removing the low-concentration contaminants from the groundwater would provide little benefit while incurring high costs. The remedial action selected contains the following components:

- ICs (such as deed restrictions) to prohibit the installation of groundwater supply wells on Mather that would jeopardize public health or the environment from the Northeast Plume area.
- Long-term groundwater monitoring to be continued and modified as necessary to monitor contaminant concentrations.
- Additional predictive modeling to be conducted prior to the first CERCLA five-year review in order to assess whether the contaminants will meet the ACLs within a reasonable time.

7.3.3.2 Northeast Plume Evaluation Questions

A. Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the Groundwater OU ROD (AFBCA, 1996a).

System Performance. AFRPA issued a report of proper and successful operation (a.k.a. OPS) for the Northeast Plume groundwater remedial action (AFRPA, 2009b), which is currently in review by the regulatory agencies. The OPS report documents that the remedial action is operating as designed. The administrative portion of the remedial action, land-use restrictions, has been implemented through lease restrictions.

No land-use restrictions have been systematically applied under CERCLA where the Groundwater OU plumes underlie off-base property. However, the County of Sacramento adopted a revised ordinance (County Code Chapter 6.28) in 2002 to incorporate a consultation zone within 2,000 feet of any known groundwater contamination that requires consultation with CVWB prior to issuing any well permits. CVWB makes recommendations to the County regarding their permitting choices: to approve, approve with conditions, or deny approval for each permit application.

ICs are in place on Mather via continued Air Force ownership of the property overlying the Northeast Plume. These controls are intended to prevent significant exposure to contaminated groundwater from occurring (i.e. limiting new wells or requiring testing if water is intended for human consumption and treatment if groundwater contamination is detected at significant concentrations). The property overlying the Northeast Plume is still owned by the Air Force and leased to the County. There are ICs within the lease (Lease Agreement between the Department of the Air Force and the Sacramento County Mather Conversion Authority for Mather Air Force Base, California, executed 21 March 1995, conditions 10.13, 17.3, 24.1, and 24.2) that prohibit drilling on the leased property without written permission from the Air Force. Condition 20 requires that these requirements also bind any sublessee. Therefore, ICs are in effect on Air Force property to further ensure that the chance of exposure is minimized, as stipulated in the Groundwater OU ROD and clarified in an ESD (AFBCA, 1996a; AFRPA, 2009a).

New water-table monitoring well MAFB-438 was installed in August 2008 along the northern property line to the northwest of MAFB-132 to assess the northern extent of the plume. The well was sampled in the fourth quarter of 2008, and PCE and cis-1,2-DCE were detected at concentrations of 3.7 µg/L and 1.0 µg/L, respectively. These results show the Northeast Plume is within the boundary of land under Air Force ownership (Figure 7-10). This interpretation was supported by sample results from the first and second quarters of 2009. The plume is not likely to migrate northward because the potentiometric gradient interpreted from the monitoring network indicates a consistent southerly to southwesterly groundwater flow direction in the area of the Northeast Plume.

Groundwater monitoring has occurred at wells throughout the area of the Northeast Plume for the 13 years since the Groundwater OU ROD was issued. Only two of the five COCs have exceeded ACLs in this time. Historically, a total of 16 different wells have had at least one sample where the concentration of either PCE or cis-1,2-DCE (or both) has exceeded its ACL. Only one sample historically exceeded the cleanup standard for CCl_4, and only one sample historically exceeded the cleanup standard for 1,2-dichloropropane (1,2-DCP). Since the issuance of the Groundwater OU ROD, only nine wells have had concentrations of COCs that have exceeded the ACLs.

The areal extent of the Northeast Plume has decreased since 1996. The interpreted extent of the Northeast Plume in the second quarter of 1996 was compared with the interpreted extent of the plume in second quarter of each year through 2008 in Table 7-3 (AFRPA, 2009b). The comparison shows that the area of the plume has decreased since implementation of the remedy from 133 acres in 1996 to 28 acres in 2008. Since the second five-year review, the plume has decreased from 56 to 28 acres.

Table 7-3. Second Quarter Estimates of Northeast Plume Area Greater than ACLs, 1996-2009

Year	Acres	Comments	MAFB Wells with Detections Greater than ACLs (MAFB-XXX)
1996	133	Includes 16 acres from DCE interpretation.	130, 132, 133, 136, 278
1997	230		130, 132, 133, 136, 152, 277, 278
1998	161		130, 132, 133, 136, 278
1999	181	Just below cleanup level in MAFB-152 and MAFB-278; 5 µg/L contour included MAFB-109 but should not have.	130, 132, 133, 136
2000	163	Just below cleanup level in MAFB-152 and MAFB-277.	26, 130, 132, 133, 136, 278

Table 7-3. (Continued)

Year	Acres	Comments	MAFB Wells with Detections Greater than ACLs (MAFB-XXX)
2001	116		26, 132, 133, 136
2002	110		26, 132, 133, 136
2003	42		132, 398
2004	58		132, 398
2005	56	MAFB-398 at cleanup level for PCE.	132
2006	66	MAFB-398 at cleanup level for PCE; 5 µg/L contour included MAFB-136 but should not have.	132, 133
2007	36		132, 133, 398
2008	31		132, 133
2009	33		132, 136

Source: *Northeast Plume Groundwater Remedial Action Report of Proper and Successful Operation for the Former Mather Air Force Base* (AFRPA, 2009b) and recalculated areas for 2008 and 2009.

ACL = aquifer cleanup level
AFRPA = Air Force Real Property Agency
DCE = dichloroethene
PCE = perchloroethene (a.k.a. tetrachloroethene)
µg/L = micrograms per liter

A visual comparison of the plume contours from the fourth quarter of 2004 (Figure 7-11) to the fourth quarter of 2008 (Figure 7-10) shows the decrease in plume area. The only area where COCs now exceed ACLs is beneath and downgradient of landfill Site LF-04. A decrease in the water-table elevation has resulted in the restriction of the COCs to the fine-grained overbank deposits of Hydrogeologic Unit C. It is likely that less dilution of the COCs will occur in Unit C resulting in a smaller but possibly higher-concentration plume than in the past when the water table was in the coarser-grained Unit B, which is more transmissive.

The monitoring well network appears to be adequately distributed throughout the plume area. The contaminant plume is fully defined where it exceeds ACLs. The northern limit was defined by the sampling beginning in the fourth quarter of 2008 from newly installed monitoring well MAFB-438. Though this definition is based on a few sample results, a southerly gradient at the water table near the Northeast Plume has persisted at least since the 1990s; contamination from sources at Mather (i.e., Landfill Sites LF-03 and LF-04) is not expected to have migrated very far to the north, remaining within the facility boundary.

Well MAFB-400, completed in the deeper portion of Unit C adjacent to MAFB-136, has consistently had PCE and cis-1,2-DCE concentrations less than ACLs throughout its monitoring history. These results do not indicate a significant downward movement of COCs through the lower portion of the Laguna Formation.

Figures 7-12 and 7-13 display time-concentration plots for wells MAFB-132 and MAFB-136, respectively. The second five-year review stated an additional period of monitoring would be required to ascertain whether data from these wells show a discernable trend. Well MAFB-132 has historically had the highest concentrations of PCE and cis-1,2-DCE in the plume. Figure 7-12 shows a trend of increasing PCE and cis-1,2-DCE concentrations at MAFB-132 from approximately June 2003 to the fourth quarter of 2006. Subsequently, there has been an overall decreasing trend in concentrations of these constituents

through the second quarter of 2009. Figure 7-13 shows PCE concentrations at MAFB-136 have fluctuated just above and below the ACL since the fourth quarter of 2003; increased to 8.2 µg/L in the first quarter of 2009; and decreased to 5.3 µg/L (i.e., near the ACL) in the second quarter of 2009 (MWH, 2009e; 2010b). Concentrations of cis-1,2-DCE in this well have exhibited an overall increasing trend over the last five years to just greater than the ACL in the first quarter of 2009 (Figure 7-13). The concentration of cis-1,2-DCE at MAFB-136 then decreased to less than the ACL in the second quarter of 2009. PCE and cis-1,2-DCE concentrations during the last five years have generally been less than the maximum concentrations reported between 1996 and 2003 (Figure 7-13).

Figure 7-14 displays a time-concentration plot for MAFB-133. PCE and cis-1,2-DCE concentrations during the last five years have generally been less than the maximum concentrations reported between 1998 and 2001. Since the fourth quarter of 2005, PCE concentrations at this well increased to 6.5 µg/L in early 2007 but decreased to less than the ACL by the third quarter of 2008. Figure 7-14 shows this overall decreasing trend in PCE concentrations since early 2007. Concentrations of cis-1,2-DCE have been less than the ACL during this time frame.

The apparent decreasing concentration trends at MAFB-132 and MAFB-133 are important because if they persist, they will support predictions of further concentration decrease and eventual achievement of ACLs. Figure 7-12 shows that if the decreasing trend in PCE and cis-1,2-DCE concentrations in MAFB-132 persist at the current rate, concentrations less than the ACLs may be attained within the next five years. At the time of the *Northeast Plume Evaluation Report*, no such clear indication of potential achievement of ACLs was suggested (AFBCA, 2002), and a decreasing trend at the two wells initially evident in the previous five-year review needed to be further evaluated. Figure 7-13 shows that since 2006, PCE concentrations at MAFB-136 had been less than the ACL until the fourth quarter of 2008 when the PCE concentration increased to greater than the ACL. The concentration decreased to just greater than the ACL (5.3 µg/L) in second quarter of 2009. Concentrations of cis-1,2-DCE in MAFB-136 have shown a similar trend but decreased to less than the ACL in the second quarter of 2009. More monitoring data are required to determine whether the concentration patterns evident over the last two years will continue at MAFB-132, MAFB-133, and MAFB-136.

The Groundwater OU ROD commitment to perform modeling prior to the first five-year review, to predict how much time will be required for the contaminant concentrations to decrease to less than ACLs, was not accomplished for that review. However, an evaluation of the Northeast Plume was conducted in 2001 and 2002 (AFBCA, 2002). Inspection of the wells with contaminant detections revealed that the concentrations exhibited sporadic patterns that did not allow confident predictions of future concentrations. The report recommended continued monitoring of the Northeast Plume as opposed to initiating active remediation. It also recommended a similar evaluation be conducted periodically as monitoring data warrant, but no less frequently than the five-year reviews.

The second five-year review stated that future predictive modeling was potentially viable based on the evident start of decreasing contaminant concentration trends observed within that time period. The forecast would be dominated by predictions based on results from well MAFB-132, which was the only well with concentrations significantly greater than ACLs. The report recommended that the annual groundwater monitoring reports provide projections and an assessment of trends in the wells with the highest concentrations that may indicate when ACLs might be reached.

The recommendation in the last five-year review remains valid. Decreasing PCE and/or cis-1,2-DCE concentration trends at MAFB-132 from 2006 through 2009 allow the projection of concentrations of these analytes to at or less than the ACLs. Trend extrapolation was conducted for PCE and cis-1,2-DCE data from MAFB-132. The extrapolation suggests that if the trends through 2009 continue, ACLs would be reached in 2012 (extrapolation of a best-fit linear trend line) or 2025 (extrapolation of a best-fit

exponential trend line). The trend analysis was conducted using standard curve-fitting formulas found in Microsoft Excel 2007. If the assumption that the area near MAFB-132 will require the longest time to achieve ACLs holds true (MAFB-132 has had the highest concentrations of PCE and cis-1,2-DCE), and the trends observed from 2006 through 2009 continue, the Northeast Plume will meet ACLs around 2025. However, the prediction is not intended to be relied upon with any great certainty, but rather to indicate whether at this time modeling indicates that the contaminants will not meet the ACLs within a reasonable time, or at least forty years from the date of the ROD.

It is too early to determine whether the recent concentration decreases at MAFB-136 indicate a consistent trend. Predictions of time to achieve ACLs will be updated periodically to incorporate future monitoring results, most likely during each five-year review.

Progress Toward Meeting RAOs. Significant progress has been made within the last five years toward achieving RAOs. The extent of the plume is decreasing. ICs are in place to protect the public from significant exposure to contaminated groundwater, and data from newly installed monitoring well MAFB-438 indicate the plume is within the boundary of land under Air Force ownership. Additional monitoring will likely be needed to confirm trends and evaluate (model) the potential time for concentrations to decrease to less than ACLs.

B. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but none of the numerical standards used to establish ACLs have changed since they were established in the Groundwater OU ROD; and the changes in toxicity data do not result in the ACLs exceeding the NCP risk management range. Therefore, the ACLs are still considered protective of human health and the environment.

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

No information has come to light that indicates the remedy is not protective. In the past, the regulatory agencies have expressed concern regarding a lack of satisfactory demonstrable progress toward the achievement of ACLs. However, the area of the plume has decreased over time since monitoring of the Northeast Plume began. More monitoring data are required to determine whether the concentration patterns evident over the last two years will continue at MAFB-132, MAFB-133, and MAFB-136.

7.4 Soil OU

7.4.1 Site WP-07/FT-11

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

SVE/BV Performance. In 2004, decreasing TPHG concentrations at Site WP-07/FT-11 hot spot areas indicated that a change from SVE to BV might be warranted (MWH, 2004a; 2005b). Field readings measured during rebound testing indicated that the formation was aspirating; oxygen was being naturally introduced in the subsurface; and oxygen levels were sufficient for aerobic biodegradation. In 2005, the SVE system continued to operate but was optimized to remediate any remaining hot spots and to ensure oxygen was being introduced into the vadose zone to allow biodegradation of petroleum hydrocarbons. In September 2005, the results of a respiration test indicated the operation of the SVE system was inducing oxygen flow to allow for biodegradation (MWH, 2006a).

In March 2006, the Site WP-07/FT-11 SVE system was shut down for evaluation. Following shutdown, it was determined that the heat exchanger was faulty. Further site evaluations, including long-term rebound testing and oxygen and carbon dioxide monitoring were conducted to determine the most appropriate remedial action going forward. Results from the site evaluations showed that concentrations of VOCs in the soil vapor had decreased significantly since SVE operations began in 1999, and a cumulative total of approximately 99,529 lbs of contaminants had been removed by the SVE system. However, elevated concentrations of heavier hydrocarbons, such as TPHD, were believed to be present at Site WP-07/FT-11 based on historical soil samples. Because heavier hydrocarbons are not effectively removed using SVE and are most commonly remediated through natural or enhanced bioremediation, BV operation was selected to optimize remedial progress at Site WP-07/FT-11.

The BV system began operation on 10 April 2007 and was operated on a continuous basis throughout 2008, with the exception of planned downtimes for maintenance and rebound testing. Air flow to the BV well network was focused on zones within the subsurface where respiration monitoring of the subsurface indicated active biodegradation of TPH contaminants was occurring and supplemental air flow was needed to maintain oxygen levels at or greater than 10 percent. The original volume of TPH-impacted soil at the site before initiating remedial actions was estimated at approximately 218,500 cubic yards (AFBCA, 1996a). The remedial progress drilling completed at the site in October 2007 showed significant reductions in TPH concentrations in soil when compared to remedial investigative data collected in 1995 (MWH, 2009h). Therefore, the volume of TPH-impacted soil at the onset of BV operations in April 2007 is not known. However, it is assumed the TPH degradation rate of 0.157 mg/kg/day, which was determined in 2007, was applicable for 2008 since field monitoring indicated biodegradation was continuing to occur.

SVE System Compliance. During the period of this five-year review, the Site WP-07/FT-11 SVE system (when operating) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs or 0.10 lbs/day for benzene based on calculations from monthly compliance samples. Compliance monitoring results are reported in the semiannual/annual SVE/BV reports (MWH, 2004a; 2005b; 2005c; 2006a; and 2006b). The Site WP-07/FT-11 SVE system did not operate after 16 March 2006; therefore, the ARARs governing air emissions were no longer applicable.

Landfill WP-07. Quarterly inspections of Site WP-07 were performed during the period of this five-year review. In 2004, minor subsidence was observed on the surface of the cap, but neither drainage problems nor any signs of breaching of the landfill cap liner were noted (MWH, 2005d). However, in 2005, slow drainage was observed in the western drainage ditch along the landfill cap fencing at the southwest corner of the landfill cap, and in 2006, this slow drainage continued to be observed (MWH, 2006c; 2007f). Therefore, minor drainage improvements were made to the southwest corner of the landfill cap in November 2006. In addition, two areas of the drainage system to the north of the landfill were cleared of debris, and excess vegetation and debris were cleared from the western drainage ditch. In December 2006, a minor slump in the drainage ditch outside of the northwestern corner of the landfill was removed, and the side of the ditch was repaired.

In October and November 2007, grading to correct the drainage issues at the southwestern corner of the landfill cap was completed. After the first major rain event in December 2007, some small puddles were observed along the established flow line of the newly graded portion of the landfill cap (MWH, 2008b). Through 2008, the drainage system was observed to be in good condition and has adequate vegetative cover.

In February 2008, an aerial survey of Site WP-07 was conducted in accordance with the post-closure landfill requirement for the completion of an aerial survey every five years (Montgomery Watson,

1999d). The purpose of the aerial survey was to measure elevation data across the landfill cap at Site WP-07. The elevation data were compared to elevation data from the 2003 survey to identify areas of settlement. Results of the 2008 survey indicate that the southern area of the landfill cap has had an average of 1 foot increase in elevation due cap repairs in 2007 to correct drainage problems, and no areas of the Site WP-07 landfill cap have any significant settlement of 0.5 foot or greater (MWH, 2008a). During future landfill inspections, care will be taken to monitor any areas of known settlement on the landfill cap to verify the cap is intact and drainage is maintained. Any observed areas of potential settlement, recommended corrective actions, and repair activities to correct settlement will be noted in the quarterly landfill inspection reports.

Landfill Gas Monitoring. During (and prior to) the period of this five-year review, post-closure gas monitoring indicates that little methane is being produced at the Site WP-07 landfill. From 2004 through 2008, methane concentrations measured at the four gas migration probes and the nine passive gas vents did not exceed the compliance level of 5% by volume in air. Note that historical high concentrations of methane were reported at two of the passive gas vents (19,000 parts per million by volume [ppmv] or 1.9% at the base sample location and 10,500 ppmv at the vent sample location at GV7-5, and 11,000 ppmv at the base and 9,000 ppmv at the vent at GV7-8) in the first quarter of 2008. Methane concentrations decreased to less than 1,000 ppmv in these two gas vents in the third quarter of 2008; however, they increased in the fourth quarter to 2,400 and 1,200 ppmv, respectively. VOC emissions from the gas vents were also monitored from 2004 through 2008, and all results were less than the 15 ppmv action level for VOCs that would trigger sampling for laboratory analysis. Compliance monitoring results are reported in the annual post-closure landfill inspection and gas monitoring reports (MWH, 2005d; 2006c; 2007f; 2008b; and 2009l).

Institutional Controls. The ROD remedy also includes land-use restrictions to protect the landfill cap at Site WP-07. Access restrictions including fencing and warning signs are in place and were observed to be in good condition during the period of this five-year review. Implementation of additional ICs to prevent human exposure to methane; to protect the remedial system components (including the landfill, SVE system, and associated groundwater/vapor monitoring wells); and to prevent any activities that are inconsistent with the remedial actions or access to the remedial system components will occur following signature on the ESD (AFRPA, 2009a). The effectiveness of the additional ICs will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. During the last five years, the SVE/BV system at Site WP-07/FT-11 has made progress toward meeting the RAOs of achieving cleanup standards for the COCs and mitigating any residual source of groundwater contamination that may be present. Contaminants measured in vapor from the subsurface indicate only low levels of VOCs and TPHG concentrations remain in soil at Site WP-07/FT-11 (MWH, 2009h). BV is targeting remaining TPH contaminants, particularly TPHD and other heavier hydrocarbons, within the subsurface soil. Respiration testing and continued monitoring of oxygen levels within the subsurface indicate BV is effectively aiding in the remedial progress and biodegradation of the heavier hydrocarbon contaminants present at the site.

The post-closure maintenance of the landfill cap and landfill gas monitoring at Site WP-07 are meeting the RAO of compliance with ARARs established in the Soil OU ROD, including portions of the CFR 40, Part 258, and CCR Titles 14 and 23.

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

Yes (see Section 7.1). There have been changes in toxicity data, but the remedy is still protective. The site closure process agreed to by the RPMs for SVE remedies includes a determination that the site poses no

unacceptable health risk (MWH, 2002c). This ensures that any changes in exposure assumptions or toxicity data are incorporated into the remedial action.

Relative to landfills, as discussed in the second five-year review, the ARARs from CCR Titles 14 and 23 have been revised since the Soil OU ROD was issued. These regulations have been combined, revised, and recodified into Title 27 of the CCR. Only the ARARs addressing the post-closure status of Site WP-07 remain applicable or relevant and appropriate. These ARARs are summarized in Table 7-4 with a general Title 27 citation provided for cross-reference. However, the cross-reference may not be an exact equivalent to the ARAR cited in the RODs. Some of the sections were reworded or edited or may have additional content. Consequently, the current regulatory citations are not necessarily equivalent to the ARARs, and it is possible that some of the Title 27 citations might not contain ARAR (i.e., substantive) portions of the regulations. As the ARAR citations are the same for Sites LF-03 and LF-04, this discussion is also relevant to those two sites (see Section 7.5).

Table 7-4. Recodified Post-Closure Landfill ARARs

ARARs Citation	Title 27 Citation	Notes
14 CCR 17766 Emergency Response Planning	27 CCR 21130	
14 CCR 17767 Site Security	27 CCR 21135	
14 CCR 17773(b) to (e) Final Cover Design	27 CCR 21140	Potentially relevant to post-closure maintenance
14 CCR 17774((a) & (c) to (h) Construction Quality Assurance	27 CCR 20324	Potentially relevant to post-closure maintenance
14 CCR 17776(a), (c) to (f) Final Grades	27 CCR 21142, 21769	Potentially relevant to post-closure maintenance
14 CCR 17777(a) to (c) Final Site Face	27 CCR 21090, 21142, 21145	Potentially relevant to post-closure maintenance
14 CCR 17778(a) & (c) to (j), Final Drainage	27 CCR 20365, 21150, 21769	Potentially relevant to post-closure maintenance
14 CCR 17779(a) & (c) to (i), Slope Protection and Erosion Control	27 CCR 21090	Potentially relevant to post-closure maintenance
14 CCR 17783, Gas Monitoring and Control	27 CCR 20918, 20921, 20937, 21160	
14 CCR 17788, Post-closure Maintenance	27 CCR 21180(a)	
14 CCR 17796, Post-closure Land Use	27 CCR 21190	
23 CCR 2511(d), Applicability	27 CCR 20090	
23 CCR 2541(d), Containment Materials	27 CCR 20320	Potentially relevant to post-closure maintenance
23 CCR 2546(a) & (c) to (f), Drainage Control	27 CCR 20365	
23 CCR Article 5, Groundwater Monitoring	27 CCR 20380 – 20435, 22222	
23 CCR 2580(a), Post-closure Maintenance	27 CCR 20950(a)	
23 CCR 2580(d), Monuments	27 CCR 20950(d)	
23 CCR 2580(e), Vegetation	27 CCR 20950(e)	
23 CCR 2581, Maintenance of Final Cover	27 CCR 21090	
23 CCR 2597, Post-closure Maintenance	27 CCR 21769	

ARAR = applicable or relevant and appropriate requirement
CCR = California Code of Regulations

Based on the continued protectiveness of the ARARs identified in the ROD, and satisfaction of the Integrated Waste Management Board and CVWB that the listed ARARs are equivalent to the recodified regulatory requirements, these ARARs are still considered valid.

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

No other information has come to light that calls into question the protectiveness of the remedy.

7.4.2 Site ST-37/ST-39/SS-54

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

SVE Performance. During the last five years, SVE operations at Site ST-37/ST-39/SS-54, which includes remediation of Sites OT-23B and OT-23D, have focused on remediating TPHG and BTEX hot spot areas at 37-MPMP-4 and 37-MPMP-08 (Figure 4-9). TPHG and BTEX concentrations at monitoring points 37-MPMP-04 and 37-MPMP-08 continue to decrease, but are still elevated and are keeping closure activities from proceeding. Remedial progress at the hot spot locations may be limited, due to the low permeability and high moisture content of the soil (MWH, 2005c).

The SVE treatment system at Site ST-37/ST-39/SS-54 was shut down in January 2006 due to a faulty heat exchanger. A new system was installed in December 2006 with startup in February 2007. Results from rebound sampling conducted in October 2006 while the SVE system was shut down were used to focus 2007 remedial operations at selected extraction wells that would address the hot spot locations (MWH, 2007g).

The SVE system was offline between 27 December 2007 and 4 April 2008 for drilling activities at the site. Eight soil borings were drilled across the site, and eight multiprobe wells were installed. Two wells (37-PW-05 and 37-PW-06) were connected to the Site ST-37/ST-39/SS-54 SVE system. In addition, the County of Sacramento installed four 8-inch blank sleeves beneath Macready Avenue, as shown on Figure 4-9, to provide conduits to allow the installation of SVE conveyance piping to potential SVE wells (e.g., 37-PW-03 and 37-PW-04) south of Macready Avenue, if needed for future remediation.

Between July and November 2008, the SVE system was shut down for rebound sampling. During the same period of rebound sampling and treatment system shutdown, the County of Sacramento completed construction activities associated with the installation of an 84-inch diameter sewer interceptor along the length of Macready Avenue, between Silver Wings Street and Eknes Street (Figure 4-9). During trenching and excavation activities, multiple soil samples were collected. The objective of the sampling was to confirm or improve the conceptual site model that (1) the hydrocarbon source area(s) were associated with leaks from the former aviation gasoline (AVGAS) pipelines, which crossed Macready Avenue in several locations, and (2) that the distribution of hydrocarbons was influenced by their migration within the backfill and bedding for utility lines beneath Macready Avenue (MWH, 2009h). Observations made during excavation activities and the distribution of hydrocarbons detected in the soil excavated along the alignment of the pipeline in conjunction with historical data to the north and south of the pipeline alignment supported the conceptual site model that the hydrocarbons migrated through the backfill of underground utility lines (MWH, 2009h). The soil excavated from the trench was sorted and segregated by the County of Sacramento for disposal of the contaminated soil, while clean fill was used to backfill the excavated trench.

In December 2008, a shallow-zone vacuum extraction pilot test using extraction wells 37-PW-05 and 37-PW-06, the existing 500-scfm SVE system, and a 1,000-scfm positive-displacement blower, was

conducted to better assess the ability to effectively extract vapors from the shallow vadose zone in the area of known hydrocarbon contamination near the northeast intersection of Silver Wings Street and Macready Avenue (Figure 4-9). The operation of the high-vacuum portable positive-displacement blower (13 inches Hg) induced vacuum pressures greater than 0.5 H_2O out to 100 to 125 feet away from 37-PW-05 and 37-PW-06; however, the maximum measured vacuum pressure was only 1.0 H_2O and the maximum flow rate was only 24 scfm. Despite having a large vacuum pressure induced by the blower, the relatively low magnitude of vacuum influence and flow rate is likely caused by lower soil permeability in the shallow and intermediate zones at the site (MWH, 2009h). Although analytical samples were not collected from the wellheads at 37-PW-05 and 37-PW-06, it is believed that insignificant mass removal rates would result and that significant mass removal cannot likely be sustained in the zones of remaining residual contamination, given the existing well field and in situ conditions (MWH, 2009h).

Operation of the SVE treatment system in 2009 is planned for continued remediation of elevated BTEX and TPHG contaminants that remain in the shallow vadose zone around 37-MPMP-04, 37-MPMP-08, 37-PW-05, and 37-PW-06. Similarly at depth, BTEX constituents and TPHG concentrations present at SVE well 37-PW-05 are being targeted by extraction. Soil vapor samples collected in 2008 from the new wells are being evaluated and will be used to optimize SVE operations at the site (MWH, 2009h).

SVE System Compliance. With one exception during the period of this five-year review, the Site ST-37/ST-39/SS-54 SVE system (when operating) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs or 0.69 lbs/day for benzene based on calculations from monthly compliance samples. The results of the compliance samples collected in December 2005 indicated the system was not operating properly or the compliance samples were compromised. The emission rate of 29 lbs/day calculated from the compliance samples was greater than the mass extraction rate of 20 lbs/day. Further investigation revealed that the heat exchanger on the SVE unit was faulty. The SVE system was shut down on 13 January 2006, and a replacement system came online in February 2007. Compliance monitoring results are reported in the semiannual/annual SVE/BV reports (MWH, 2004a; 2005b; 2005c; 2006a; 2006b; 2007c; 2007g; 2008d; 2009h).

Institutional Controls. Implementation of ICs to prevent potential unacceptable exposure to volatile contaminants and to protect the remedial system components will occur following signature on the ESD (AFRPA, 2009a). The effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. During the last five years, the SVE system at Site ST-37/ST-39/SS-54, which includes remediation of Sites OT-23B and OT-23D, has made progress toward meeting the RAOs of achieving cleanup standards for the COCs and mitigating any residual source of groundwater contamination that may be present. Despite the low permeability and high moisture content of the soil, nearly 1,300 lbs of contaminants are estimated to have been removed in 2008, and a total of approximately 3,600 lbs of contaminants are estimated to have been removed during the last five years at Site ST-37/ST-39/SS-54 (MWH, 2009h). In addition, contaminated soil was excavated and disposed by the County of Sacramento in 2008 during the trenching for the sewer interceptor along the length of Macready Avenue.

The Site ST-37/ST-39/SS-54 SVE system has effectively operated for its designed intent (high concentration removal) and continues to be optimized to maximize uptime and maintain compliance (see MWH interview record in Appendix B).

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

Yes (see Section 7.1). There have been changes in toxicity data, but the remedy is still protective. The site closure process agreed to by the RPMs for SVE remedies includes a determination that the site poses no unacceptable health risk (MWH, 2002c). This determination ensures that any changes in exposure assumptions or toxicity data are incorporated into the remedial action.

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

As discussed in Section 7.4.2.1, residual TPHG and BTEX adsorbed to fine-grained, high-moisture content soils are difficult to remediate and are prolonging achievement of the RAOs for Site ST-37/ ST-39/SS-54.

7.4.3 Site SD-57

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

SVE Performance. In 2004, rebound test results indicated a decreasing trend in TCE and PCE concentrations and that only approximately 0.5 lbs/day of mass were being removed by the Site SD-57 SVE system. Therefore, closure activities were initiated (MWH, 2004a). Also in 2004, risk calculations were performed to determine if the SVE system could operate without carbon treatment. The results from modeling indicated emissions from the Site SD-57 SVE system do not pose significant health risk and as such, air emission treatment is not required at Site SD-57 (MWH, 2004a). Starting in February 2004, with concurrence from SMAQMD, the SVE system operated without air emission treatment.

While the closure activities proceeded, the Site SD-57 system continued to operate to enhance the dual-phase extraction system (EW-2A, EW-5ABu, and EW-4ABu) and address any residual contaminants at Site SD-57. In May 2005, a former pilot study SVE well (57-SVE-7A) was connected to the SVE system to remediate residual TCE contamination in the vicinity of 57-MPMP-009 and 57-MPMP010 (Figure 4-10). Vacuum readings indicated the system was providing more than adequate influence to the this area, and the system influent sample collected after 57-SVE-7A was tied into the SVE system indicated an approximately four-fold increase in the TCE mass removal rate since the previous sampling event (MWH, 2005c).

The *Site SD-57 Appendix A to the Remedial Action Report* (MWH, 2004c) was submitted in August 2004, and comments were received in September 2005. To address an EPA comment which specified additional characterization was required to the east side of the site, an additional multi-probe monitoring point, 57-MPMP-13 was constructed at Site SD-57 in May 2005 (Figure 4-10). A baseline sample collected from the vapor probe at 74 feet bgs detected CCl_4 at 9.6 ppmv. CCl_4 had been detected elsewhere at Site SD-57, but at significantly lower concentrations, indicating a separate source(s) area for the CCl_4 observed at 57-MPMP-13 (MWH, 2006a).

An ROI test was conducted at Site SD-57 in December 2006 and targeted locations where rebound samples collected in November 2006 showed residual contaminant concentrations would likely impact groundwater if left in place. The ROI test results indicated that the extraction well field provides appropriate influence at all monitoring locations where measurements were recorded (MWH, 2007c). The results of the test were used to optimize remedial operations for 2007.

A drilling program was completed at Site SD-57 in 2007 and 2008. Five soil borings were drilled with the installation of 19 monitoring/extraction wells. CCl_4 detections in baseline samples were highest in wells (57-PW-01 and 57-PW-02) located in the vicinity of 57-MPMP-13 (Figure 4-10). As a result of the CCl_4 detections, 57-PW-01 and 57-PW-02 were connected to the Site SD-57 SVE system in August 2008. The screen intervals were designed to target extraction of the CCl_4 contamination detected in the deeper vadose zone and persistent contamination at 57-MPMP-13 (MWH, 2009g).

The Site SD-57 SVE system was restarted on 19 February 2008 following the completion of drilling and installation of vapor monitoring/extraction wells initiated at the site in late 2007. The system was shut down in August 2008 to connect 57-PW-01 and 57-PW-02 to the system. GAC was temporarily added to the treatment system for air emissions abatement control following the addition of 57-PW-01 and 57-PW-02 to the SVE system because of the increased concentration of CCl_4 in the treatment system influent, even though the ILCR was less than one in a million (MWH, 2009h). On 3 December 2008, the SVE treatment system shut down due to a failure of the system's blower and motor. The system remained offline through the end of 2008.

The SVE system was restarted on 25 February 2009 with GAC while system compliance samples were collected. The system was turned off following the February compliance sampling and remained offline while the samples were analyzed by the laboratory. The GAC was removed from the system upon receipt of analytical data from the laboratory and confirmation that the ILCR did not exceed one in a million (MWH, 2010d). Therefore, the system was restarted on 16 March 2009 without GAC and operated uninterrupted until 27 May 2009 when the SVE system was shut down for rebound sampling. The SVE system was restarted on 15 July 2009 without GAC and operated through the remainder of 2009.

SVE System Compliance. With one exception during the period of this five-year review, the Site SD-57 SVE system (when operating) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs based on calculations from monthly compliance samples. Because the system had been offline for an extended period in 2005, carbon treatment was added to the system to ensure emission rates complied with substantive requirements prior to bringing the system back online. However, the sample collected in December 2005 did not comply with the substantive requirements. Air emissions (49 lbs/day) exceeded 10 lbs/day for total ROCs. The carbon used for treatment during startup had contained TPH, which apparently was displaced during startup at Site SD-57. It was suspected that the spent carbon contributed to the emissions exceedance. Compliance monitoring results are reported in the semiannual/annual SVE/BV reports (MWH, 2004a; 2005b; 2005c; 2006a; 2006b; 2007c; 2007g; 2008d; 2009h).

Institutional Controls. Implementation of ICs to prevent potential unacceptable exposure to volatile contaminants and to protect the remedial system components will occur following signature on the ESD (AFRPA, 2009a). The effectiveness of the additional ICs will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. During the last five years, the SVE system at Site SD-57 has made progress toward meeting the RAOs of achieving cleanup standards for the COCs and mitigating any residual source of groundwater contamination that may be present. Despite relatively low mass extraction rates in 2008, an estimated 88 lbs of total contaminants were extracted from the vadose zone at Site SD-57, and a total of approximately 393 lbs of contaminants are estimated to have been removed during the last five years (MWH, 2009h).

Continued extraction from the vadose zone in the easternmost portion of the site at depth will continue to remediate CCl_4. Concentrations of TCE have generally decreased across the site to concentrations less than 1 ppmv. Only two locations (57-MPMP-11/57-PZ-11 and 57-MPMP-12/57-PZ-12) at the site exhibit

TCE vapor concentrations of approximately 2 ppmv, and the contaminants are contained within the moist zone just above the water table at the transition between the vadose zone and the saturated zone. Removal of contaminants in these conditions through SVE is not likely to be technically achievable or cost effective (MWH, 2009h). Continued operation of the SVE unit is planned to remediate the significant residual concentrations of chlorinated VOCs, specifically CCl_4, in the eastern side of the site at depth in the vicinity of 57-MPMP-13. After continued SVE operations and rebound sampling planned for 2009 are completed, site conditions will be evaluated to determine whether closure activities may once again be initiated, and SVE operations discontinued at Site SD-57 (MWH, 2009h).

7.4.3.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but the remedy is still protective. The site closure process agreed to by the RPMs for SVE remedies includes a determination that the site poses no unacceptable health risk (MWH, 2002c). This ensures that any changes in exposure assumptions or toxicity data are incorporated into the remedial action.

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

Residual TCE in the smear zone just above the water table is difficult to remediate and may prolong achievement of the RAOs for Site SD-57.

7.4.4 Site SD-59

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

SVE Performance. During the second quarter of 2004, eight boreholes were drilled, and four multiprobe monitoring points, six SVE wells, and one groundwater well were constructed at Site SD-59 to characterize the area surrounding the ATC washrack, a known contaminant source area (MWH, 2004a). During the third quarter of 2004, the newly installed SVE wells were tied into the SVE system.

Three of newly installed wells were constructed as dual-purpose wells to address a perched water zone at 50 feet bgs and any residual contamination at the north side of Site SD-59. Extraction wells 59-SVE-006I, 59-SVE-006D, and 59-SVE-007 (Figure 4-11) were constructed with well screens exposed to the vadose zone and the perched zone. By turning an isolation valve, isolating the well from the system, a submersible pump can be installed and any water present in the well can be removed. Dewatering activities were attempted in December 2004 at 59-SVE-007 and 59-SVE-006I. A flow rate of approximately 0.5 gpm was achieved at 59-SVE-007; however, due to a slow recharge rate, minimal water was removed from 59-SVE-006I.

In 2005, results from multiple samples collected during a long-term rebound test confirmed that elevated concentrations of TCE remain at Site SD-59 and elevated concentrations of CCl_4 remain at depth at 59-MPMP-008 and 59-MPMP-009 (MWH, 2006a).

An ROI test was conducted at Site SD-59 in December 2006 to determine if the SVE system had sufficient influence over the areas with significant remaining contamination that could impact groundwater if left in place, including the area surrounding the former ATC washrack investigated in 2004. ROI test results indicated the extraction well field provides appropriate influence at all monitoring locations where measurements were recorded (MWH, 2007c).

In 2007, the SVE system targeted operation at two extraction wells (59-SVE-004 and MAFB-105) to address contaminant concentrations that could potentially impact groundwater. Additional characterization was performed in December 2007 and early 2008 with the installation of four multiple-completion vapor monitoring/extraction wells. The Site SD-59 SVE system was restarted in April 2008 following the completion of drilling and well installation activities. The SVE system was shut down in November 2008 for replacement of the system's air-water-separator pump and heat exchanger. The system remained offline through the end of 2008 but was brought back online 9 January 2009 once the air-water-separator pump and heat exchanger were replaced. However, the SVE system was shut down again on 12 January 2009 because the motor and blower failed and was restarted on 22 July 2009 after the motor and blower were replaced (MWH, 2010d). On 25 August 2009, the SVE system was shut down during installation of two soil vapor monitoring points (four screen intervals each). The SVE system was restarted on 9 December 2009.

SVE System Compliance. During the period of this five-year review, the Site SD-59 SVE system (when operating) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs based on calculations from monthly compliance samples. In addition, since March 2006, the Site SD-59 SVE system has operated without air emission treatment due to low ROC emission rates. Compliance monitoring results are reported in the semiannual/annual SVE/BV reports (MWH, 2004a; 2005b; 2005c; 2006a; 2006b; 2007c; 2007g; 2008d; 2009h).

Institutional Controls. Implementation of ICs to prevent potential unacceptable exposure to volatile contaminants and to protect the remedial system components will occur following signature on the ESD (AFRPA, 2009a). The effectiveness of the additional ICs will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. During the last five years, the SVE system at Site SD-59 has made progress toward meeting the RAOs of achieving cleanup standards for the COCs and mitigating any residual source of groundwater contamination that may be present. Despite relatively low mass extraction rates in 2008, an estimated 53 lbs of total contaminants were extracted from the vadose zone at Site SD-59 (and Site LF-18, which is remediated with Site SD-59) during 2008, and a total of approximately 1,000 lbs of contaminants are estimated to have been removed during the last five years (MWH, 2009h). Concentrations of TCE have generally decreased near the location of the former wash rack and oil-water separator at the site to concentrations less than 1 ppmv, although concentrations of TCE and/or CCl_4 greater than 1 ppmv are still detected at depth at a few monitoring points (MWH, 2009h).

Vapor data are being reviewed to evaluate potential impact to groundwater quality and to evaluate future SVE operations at Site SD-59. In the meantime, extraction from the vadose zone in the southern and southeastern portions of the site continues to address cleanup of chlorinated VOCs (predominantly TCE and CCl_4) at depth, and field readings and samples continue to be collected to monitor remedial progress.

7.4.4.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but the remedy is still protective. The site closure process agreed to by the RPMs for SVE remedies includes a determination that the site poses no unacceptable health risk (MWH, 2002c). This ensures that any changes in exposure assumptions or toxicity data are incorporated into the remedial action.

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

No other information has come to light that calls into question the protectiveness of the remedy.

7.5 Landfill OU

The Landfill OU addresses only remedies related to disposal of waste at Sites LF-03 and LF-04. The Landfill OU remedy requires associated groundwater monitoring, some of which for VOCs is satisfied as part of the Groundwater OU remedy for the Northeast Plume (see Section 7.3) and also requires landfill gas monitoring.

7.5.1 Site LF-03

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

Landfill. Quarterly inspections at Site LF-03 were performed during the period of this five-year review. During the fourth quarter of 2004 and second quarter of 2005, gas sampling ports at the gas vents were replaced as needed. During the fourth quarter of 2005, minor ruts were observed in the surface of the all-weather access road, which was otherwise in good condition (MWH, 2006c). These ruts were repaired in December 2006 (MWH, 2007f).

In March 2006, an inspection was conducted following heavy rains. The northern drainage ditch was observed to be partially blocked due to a small soil slump. This area of the drainage ditch was repaired in December 2006 (MWH, 2007f).

In 2006, research of historic records revealed that screen depths for the gas migration probes at Site LF-03 only extended to depths of approximately 6 feet bgs, while the deepest known waste at Site LF-03 is approximately 18 feet deep, as reported in the *Landfill Operable Unit Focused Feasibility Study* (IT Corporation, 1993c). Therefore, four dual-completion and two single-completion gas migration probes were installed at LF-03 in June 2007. Each of the new gas migration probes was installed to a depth to match the deepest reported waste (MWH, 2008b).

During the first and second quarters of 2008, the stopcocks on some gas probes appeared to have been damaged by an animal chewing on them. All damaged stopcocks were replaced during the quarterly inspections (MWH, 2009l).

On multiple occasions during the period of this five-year review, a perimeter fence, which acts as a secondary security fence for Sites LF-03 and LF-04 was observed to be cut. The fence was repaired following each observation of vandalism (MWH, 2006c; 2007f; 2008b; and 2009l). In addition, trash is occasionally found inside the outer perimeter fence between Sites LF-03 and LF-04 at Zinfandel Road following weekends. The trash is removed during quarterly inspections.

In February 2008, an aerial survey of Site LF-03 was conducted in accordance with the post-closure landfill requirement for the completion of an aerial survey every five years (Montgomery Watson, 1996a). The purpose of the aerial survey was to measure elevation data across the landfill cap at Site LF-03. The elevation data were compared to elevation data from the 2003 survey to identify areas of settlement. Results of the 2008 survey indicate only two areas of the Site LF-03 cap have undergone significant settlement of 0.5 foot or greater since the previous survey (MWH, 2008a). One location where settlement was greater than 0.5 foot was on the north side of the drainage ditch located on the southwestern corner of the landfill cap. The other location is a single point located along the drainage ditch running on the

southern portion of the landfill cap that had settlement of 1 foot. Neither occurrence of settlement has had a significant impact on drainage, and no repairs are warranted or planned at this time (MWH, 2008a). During future landfill inspections, care will be taken to monitor any areas of known settlement on the landfill cap to verify the cap is intact and drainage is maintained. Any observed areas of potential settlement, recommended corrective actions, and repair activities to correct settlement will be noted in the quarterly landfill inspection reports.

Landfill Gas Monitoring. From 2004 through 2008, methane concentrations measured at the gas migration probes and the nine passive gas vents did not exceed the compliance level of 5% by volume in air. As discussed above, gas migration probes were not installed to the depth of the deepest known waste at Site LF-03 until mid-2007 when additional gas migration probes were installed. Therefore, the results of methane monitoring after June 2007 are considered more appropriate for evaluating compliance. VOC emissions from the gas vents were also monitored during the period of this five-year review, and all results were less than the 15 ppmv action level for VOCs that would trigger sampling for laboratory analysis. Since the second quarter of 2002 monitoring effort, VOC concentrations have been measured using field instrumentation only. Therefore, estimated mass contaminants discharged to the atmosphere from each gas vent were not calculated on a quarterly basis. Flow rates and PID readings recorded from gas vents from 2004 through 2008 were consistent with the historical field readings when Summa canisters were collected from the gas vents for air emission calculations. Because emissions at that time were below the active treatment threshold of 2 lbs/day as required by ARARs from SMAQMD, it can be concluded that the VOCs emitted from the gas vents at Site LF-03 continue to remain below the threshold limit. Compliance monitoring results are reported in the quarterly and annual post-closure landfill inspection and gas monitoring reports (MWH, 2005d; 2006c; 2007f; 2008b; and 2009l).

Institutional Controls. The ROD remedy also includes land-use restrictions to protect the landfill cap at Site LF-03 and to prevent significant exposure to landfill gases. Access restrictions including fencing and warning signs are in place. The site is also protected from disturbance by conditions in the lease to Sacramento County. As discussed above, numerous repairs have been made to the outer (secondary) fence due to vandalism. No issues have been noted with the condition of the warning signs during the period of this five-year review. ICs to prevent human exposure to methane; to protect the remedial system components (including the landfill and associated groundwater/vapor monitoring wells); and to prevent any activities that are inconsistent with the remedial actions or access to the remedial system components were clarified by a memorandum of post-ROD changes (AFRPA, 2009c). The effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. The post-closure maintenance of the landfill cap and landfill gas monitoring at Site LF-03 are meeting the RAO of compliance with ARARs established in the Soil OU ROD, including portions of the CFR 40, Part 258, and the CCR Titles 14 and 23. Quarterly landfill inspections revealed no major issues, with the exception of the inadequate depth of the gas migration probes, which were installed to approximately 6 feet bgs, while waste was known to be as deep as 18 feet bgs. In June 2007, appropriately screened gas migration probes were installed at Site LF-03 to address this issue. Landfill gas monitoring results met the methane compliance level during the period of this five-year review both before and after the installation of the new gas migration probes.

7.5.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see discussion in Section 7.4.1.2 and Table 7-4 regarding landfill ARARs). There have been no changes in toxicity data that affect the protectiveness of the remedy.

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

No other information has come to light that calls into question the protectiveness of the remedy.

7.5.2 Site LF-04

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

Landfill. Quarterly inspections at Site LF-04 were performed during the period of this five-year review. During the fourth quarter of 2004, approximately 500 feet of the all-weather access road was reconditioned with gravel; approximately 65 tons of aggregate base rock were spread at approximately 3 inches thick over the stretch of the road requiring repair (MWH, 2005d). Also during the fourth quarter of 2004, the gas sampling ports at three gas vents were replaced, and a swing gate on the west side of Site LF-04 was retrofitted to allow the gate to be properly locked (MWH, 2005d).

In 2005, some minor potholes and ruts were observed in the all-weather access road; these deficiencies were repaired during the fourth quarter of 2006. During additional landfill inspections in March 2006, rodent burrows were observed at the top of the landfill cap. In the second quarter of 2006, holes were dug to an approximate depth of two feet in two areas where burrows were identified. The liner was not exposed at either location, and it was observed that the burrows were not deeper than 2 feet. Therefore, there was no indication that the liner had been breached by the rodent burrows at the site (MWH, 2007f). Also, in March 2006, areas of pooling water were observed at each of the four erosion control berms located on the southern portion of the landfill cap. Additional fill material was added to each of these areas to prevent the pooling.

During the first and second quarters of 2008, the stopcocks on some gas probes appeared to have been damaged by an animal chewing on them. All damaged stopcocks were replaced during the quarterly inspections (MWH, 2009l).

On multiple occasions during the period of this five-year review, the perimeter fence, which acts as a secondary security fence for Sites LF-03 and LF-04 was observed to be cut. The fence was repaired following each observation of vandalism (MWH, 2006c; 2007f; 2008b; and 2009l). In addition, trash is occasionally found inside the outer perimeter fence between Sites LF-03 and LF-04 at Zinfandel Road following weekends. The trash is removed during quarterly inspections.

In February 2008, an aerial survey of Site LF-04 was conducted in accordance with the post-closure landfill requirement for the completion of an aerial survey every five years (Montgomery Watson, 1996a). The purpose of the aerial survey was to measure elevation data across the landfill cap at Site LF-04. The elevation data were compared to elevation data from the 2003 survey to identify areas of settlement. Results of the 2008 survey indicate only two areas of the Site LF-04 cap have undergone significant settlement of 0.5 foot or greater since the previous survey (MWH, 2008a). One area was on the northeastern corner of the landfill cap, and the other area is a single point located along the access road running on the western portion of the landfill cap that had settlement of 0.7 foot. Neither occurrence of settlement has had a significant impact on drainage, and no repairs are warranted or planned at this time (MWH, 2008a). During future landfill inspections, care will be taken to monitor any areas of known settlement on the landfill cap to verify the cap is intact and drainage is maintained. Any observed areas of potential settlement, recommended corrective actions, and repair activities to correct settlement will be noted in the quarterly landfill inspection reports.

Landfill Gas Monitoring. The fourth quarter of 2004 report formally established a new alternate facility boundary for Site LF-04 (MWH, 2005d). Review of the annual report for 2003 revealed that the compliance boundary depicted for Site LF-04 in the various quarterly landfill reports was not consistent and had been confused with the interpreted 5% methane concentration contour. The new boundary assumed with the installation of new gas migration probes in 2001 was never formally established. Therefore, the fourth quarter of 2004 report documents the new alternate facility boundary for Site LF-04. The shape of the boundary changed in the western portion of the site to include MW-17B and MW-29B. In 2007, the alternate facility boundary was expanded again to include gas migration probes MW-29C and MW-405, which were installed during the first quarter of 2007 (Figure 4-13). MW-403 and MW-404 were also constructed at this time on the existing alternate facility boundary.

Throughout 2004, methane concentrations were less than the compliance level of 5% methane by volume in air at all compliance gas migration probes at Site LF-04 (MWH, 2005d). During the first quarter of 2005, methane was detected greater than the compliance level at compliance gas migration probe MW-29B at 24.5 feet bgs (MWH, 2006c). An initial confirmation sample that was collected for laboratory analysis, confirmed that methane from MW-29B exceeded the compliance threshold. However, subsequent confirmation sampling results from samples measured by several methods indicated that methane concentrations were less than the 5% compliance threshold (MWH, 2006c). During the first quarter of 2006, methane was again detected greater than the compliance level at MW-29B at 24.5 feet bgs (MWH, 2007f). Additional readings and a laboratory sample collected in May 2006 confirmed the first quarter of 2006 result. Field readings measured during the second, third, and fourth quarters of 2006 indicated that methane concentrations were less than the 5% compliance threshold (MWH, 2007f). However, weekly monitoring at MW-29B was conducted from October 2006 to June 2007 (MWH, 2007f and 2009l).

During the first quarter of 2007, one single-completion gas migration probe (MW-405) and three dual-completion gas migration probes (MW-29C, MW-403, and MW-404) were installed at Site LF-04 (MWH, 2008b). MW-29C (south of MW-29B) and MW-405 (west of MW-29B) were installed to further define the extent of methane beyond the location of MW-29B. Methane in both gas migration probes has been less than the 5% methane compliance level since installation. MW-403 and MW-404 were installed north of Site LF-04 to evaluate the performance of the passive gas migration trench vents near GV4P-8 and GV4P-24 because elevated methane readings have historically been reported at both vents. Initial field readings at MW-403 at 10.5 feet bgs resulted in methane concentrations of 10% methane by volume in air. Concentrations greater than the 5% methane compliance level continued to be reported during subsequent weekly monitoring of MW-403 at 10.5 feet bgs until May, as described below.

In May 2007, three pilot tests at the passive gas trench vents near MW-403 (GV4P-7, GV4P-8, and GV4P-9) were conducted. In each test, a blower unit was attached to the top of the riser pipe of one of the gas trench vents. When operational, the blower unit pulled flow of approximately 20 cfm from the gas trench to which it was connected. Methane readings were collected from MW-403 and the passive gas trench vents during pilot tests. The most significant reduction of methane was observed during the pilot test conducted at GV4P-8, where methane was reduced in MW-403 at 10.5 feet from 8.0% methane to 0.2% methane. During the third quarter of 2007, a small exhaust fan was installed in the riser pipe of passive gas trench vent GV4P-8 and was attached to a solar panel. Readings collected prior to and after turning the exhaust fan on showed increased flow at each depth measured within the gas trench after the fan was operated, indicating the exhaust fan was influencing air flow in the trench (MWH, 2008b).

During the landfill inspection in the first quarter of 2008, the exhaust fan in gas trench GV4P-8 was observed to not be working properly. The fan was replaced by a series of five brushless fans in February 2008. The exhaust fan system continued operation through the fourth quarter of 2008, and methane concentrations at MW-403 remained less than the compliance level. During 2008, methane values at all

other compliance gas migration probes were less than the compliance level of 5% methane by volume in air (MWH, 2009l). During the first quarter of 2009, the fan system in GV4P-8 stopped operating, and methane was detected greater than the methane compliance level at gas migration probe MW-403. The fan system was replaced in April 2009, and methane concentrations returned to compliant levels. A backup set of fans is now available should the fan system fail in the future.

VOC emissions from the gas vents were also monitored from 2004 through 2008 and, with one exception, all results were less than the 15 ppmv action level for VOCs that would trigger sampling for laboratory analysis. During the second quarter of 2004, field readings from gas vents GV4-3 and GV4-4 at Site LF-04 measured total VOC concentrations of 32.7 and 44.6 ppmv, respectively. Confirmation readings were recorded at GV4-3 and GV4-4, and only GV4-4 had total VOC concentration sustained above 15 ppmv (measured at 16 ppmv). Consequently, a Summa canister air sample was collected for laboratory analysis of VOCs. Using the analytical results, the estimated mass of volatile contaminants discharged into the atmosphere from GV4-4 was calculated to be 1.37E-04 lbs/day, which was less than the SMAQMD 2 lbs/day threshold above which active treatment of the discharge gas would be required (MWH, 2005d).

Since the second quarter of 2002 monitoring effort, VOC concentrations have been measured using field instrumentation only. Therefore, estimated mass contaminants discharged to the atmosphere from each gas vent were not calculated on a quarterly basis. Flow rates and PID readings recorded from gas vents from 2004 through 2008 were consistent with the historical field readings when Summa canisters were collected from the gas vents for air emission calculations. Because emissions at that time were less than the active treatment threshold of 2 lbs/day as required by ARARs from SMAQMD, it can be concluded that the VOCs emitted from the gas vents at Site LF-04 continue to remain below the threshold limit. Compliance monitoring results are reported in the quarterly and annual post-closure landfill inspection and gas monitoring reports (MWH, 2005d; 2006c; 2007f; 2008b; and 2009l).

Institutional Controls. The ROD remedy also includes land-use restrictions to protect the landfill cap at Site LF-04 and to prevent significant exposure to landfill gases. Access restrictions including fencing and warning signs are in place. The site is also protected from disturbance by conditions in the lease to Sacramento County. As discussed above, numerous repairs have been made to the outer (secondary) fence due to vandalism. No issues have been noted with the condition of the warning signs during the period of this five-year review. ICs to prevent human exposure to methane; to protect the remedial system components (including the landfill and associated groundwater/vapor monitoring wells); and to prevent any activities that are inconsistent with the remedial actions or access to the remedial system components were clarified by the memorandum of post-ROD changes (AFRPA, 2009c). The effectiveness of the ICs will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. The post-closure maintenance of the landfill cap and landfill gas monitoring at Site LF-04 are generally meeting the RAO of compliance with ARARs established in the Soil OU ROD, including portions of CFR 40, Part 258, and CCR Titles 14 and 23. Quarterly landfill inspections revealed no major issues. At MW-29B, the exceedances of the 5% methane compliance level were addressed by MW-29C and MW-405, which were installed to define the extent of methane beyond MW-29B. Concentrations of methane in both gas migration probes have been less than the 5% methane compliance level since installation in 2007. To address the exceedances of the 5% methane compliance level at MW-403, a set of exhaust fans was installed at passive gas trench vent GV4P-8. Since installation of the exhaust fans in the third quarter of 2007, methane concentrations have been less than the compliance level at MW-403 while the fans have operated. The fans are monitored routinely to maintain their operation.

7.5.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see discussion in Section 7.4.1.2 and Table 7-4 regarding landfill ARARs). There have been no changes in toxicity data that affect the protectiveness of the remedy. In addition, of the affected ARARs, those solely governing the operation of Site LF-04 while it was accepting waste consolidated from other sites are no longer applicable to the site because the site is now closed.

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

There is still concern that landfill gas might migrate to the north of Site LF-04 and onto adjacent property at concentrations greater than the methane compliance level; however, an exhaust fan system at passive gas trench vent GV4P-8 has been installed to alleviate this concern.

7.6 Basewide OU

7.6.1 Site FT-10C/ST-68

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

SVE Performance. Starting in 2005, SVE operations at Site FT-10C/ST-68 focused on remediating the remaining hot spot areas. The purpose of the new operating arrangement was to more aggressively address these areas because the previous SVE system was unable to provide adequate influence. The Site FT-10C/ST-68 SVE system operations focused on one hot spot at a time, and only SVE wells appropriately screened in the hot spot area were operated (MWH, 2005c). Although mass removal rates increased, remediation at the hot spot locations continued to be difficult because of the “tight” low-permeability soils found at depth. Migration of contaminants in these soil types appears to be diffusion-limited and hinders the effectiveness (MWH, 2005c) of SVE. In addition, these zones were often saturated with water, also limiting the effectiveness of the SVE system.

During the rainy season, the ROI of the Site FT-10C/ST-68 SVE system was reduced by saturation of subsurface soils. Periodically, extraction wells containing water at Site FT-10C/ST-68 were pumped dry in efforts to expose screen intervals to the vadose zone and allow the SVE system to operate more effectively. In addition, removal of the contaminated water from the SVE trenches supported the overall remedial effort at Site FT-10C/ST-68. Water removed from the wells was conveyed to the sanitary sewer for disposal under Permit GRW021.

The system was shut down in April 2006 for rebound testing and system evaluation. A large number of rebound samples were collected in July and October 2006 to assess site conditions and optimize the system to effectively remediate the site. An ROI test was conducted at Site FT-10C/ST-68 in December 2006 and targeted locations where rebound samples showed residual contaminant concentrations would likely impact groundwater if left in place. The ROI test results indicated that the system is capable of removing contamination in the targeted areas (MWH, 2007c). The results of the test were used to optimize remedial operations for 2007.

The SVE system operated continuously through the third quarter of 2007. When in operation, the system and extraction well network were configured to address hot spot areas. The system was shut down in October 2007 for drilling activities at the site. As part of the drilling activities, four extraction wells were installed. Three wells (10C68-PW-02 and 10C68-PW-04 at two depths), located on the south side of Truemper Way, were installed to remediate residual chlorinated VOCs within the deep vadose zone. The

fourth well (10C68-PW-07), located on the north side of Truemper Way, was installed to remediate benzene and TPHG contaminants located within the shallow vadose zone in that area of the site (Figure 4-14).

The SVE system was restarted in February 2008 and operated until 28 July 2008, at which point the system was shut down for rebound sampling. During the rebound period, soil vapor samples were collected from selected wells across the site and analyzed for VOCs and TPHG. The results indicated residual VOCs and TPHG concentrations have been remediated to levels deemed appropriate to initiate closure activities in accordance with the SVE shutdown criteria established in the Basewide OU ROD (AFBCA, 1998a).

SVE System Compliance. With one exception during the period of this five-year review, the Site FT-10C/ST-68 SVE system (when operating) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs based on calculations from monthly compliance samples. The results of the compliance samples collected in May 2004 indicated the system was not operating properly. The emission rate of 10.072 lbs/day calculated from the compliance samples was greater than the mass extraction rate of 5.037 lbs/day (Note: This is an atypical rate compared to the 0.1 to 0.3 lbs/day calculated for most of the five-year review period.). The SVE system was shut down on 8 June 2004 for rebound evaluation. The SVE system was restarted in August 2004. In addition, starting in October 2004 and with concurrence from SMAQMD, the SVE system operated without air emission treatment due to the low ROC emissions rate.

Compliance monitoring results are reported in the semiannual/annual SVE/BV reports (MWH, 2004a; 2005b; 2005c; 2006a; 2006b; 2007c; 2007g; 2008d; 2009h).

Soil Excavation. The additional lead-contaminated ashy debris and soil beneath and north of Truemper Way discovered in 2002 was excavated in November and December 2008, and disposed as a non-Resource Conservation and Recovery Act hazardous waste at Buttonwillow Landfill in Buttonwillow, California, a CERCLA certified Class I Landfill Facility (MWH, 2009a). Approximately 140 cubic yards of soil were removed from Site FT-10C/ST-68. The soil was excavated such that ICs related to residual lead will not be required (i.e., residual lead concentrations met the 151 mg/kg unrestricted use level designated in the ESD).

Institutional Controls. Implementation of ICs to prevent potential unacceptable exposure to volatile contaminants and to protect the remedial system components will occur following signature on the ESD (AFRPA, 2009d). The effectiveness of the additional ICs will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. During the last five years, the SVE system at Site FT-10C/ST-68 has made progress toward meeting the RAOs of achieving cleanup standards for the COCs and mitigating any residual source of groundwater contamination that may be present. The total calculated mass of contaminants extracted from the site during 2008 was estimated to be 29 lbs, and a total of approximately 350 lbs of contaminants are estimated to have been removed during the last five years (MWH, 2009h). Although mass removal rates have become asymptotic, contaminant concentrations have decreased. The operation of the SVE system has effectively remediated residual contamination to levels believed to warrant closure.

Based on remedial system performance and rebound sample results, data suggest that contaminant concentrations have decreased to a level for which continued in situ remediation is no longer considered beneficial or cost effective (MWH, 2009b). Therefore, a draft final closure report that includes the results

of fate-and-transport modeling (VapourT, VLEACH, and groundwater flow-and-transport) and the results of an indoor and outdoor air and dermal contact risk evaluation has been prepared to document that no further treatment is required at Sites FT-10C and ST-68 (MWH, 2009b). In addition, lead-contaminated soil has been removed to a level consistent with unrestricted use (MWH, 2009a).

7.6.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been no changes in toxicity data that affect the protectiveness of the remedy. The site closure process agreed to by the RPMs for SVE remedies includes a determination that the site poses no unacceptable health risk (MWH, 2002c). This ensures that any changes in exposure assumptions or toxicity data are incorporated into the remedial action.

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

No other information has come to light that calls into question the protectiveness of the remedy.

7.6.2 Site LF-18

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

SVE Performance. In 2004, field monitoring performed at all monitoring locations during the first and second quarters indicated concentrations remaining at Site LF-18 (as well as Site OT-23A, which is remediated with Site LF-18) were minimal, and oxygen levels were sufficient to sustain bioremediation. In addition, the mass being removed from Site LF-18 was low (approximately 1 lb/day) and concentrations were at asymptotic concentrations (MWH, 2004a). As a result, the four closure criteria were evaluated and it was determined that they had been met (MWH, 2004a). Therefore, site closure activities were initiated and the SVE system was shut down. The system remained offline through 2006, while additional site characterization was performed at the east boundary of Site LF-18, and vadose zone and groundwater modeling were conducted in support of the closure evaluation.

During the first quarter of 2005, a multiprobe monitoring well (18-MP-009) and an SVE well (18-SVE-004) were installed to further evaluate contaminants at the eastern boundary of Site 18 (Figure 4-15). The results from baseline samples indicated elevated concentrations of TCE, PCE, and CCl_4 (MWH, 2005c).

In March 2007, 18-SVE-004 was brought online for additional extraction of residual contamination in the deep vadose zone near 18-MP-007 (MWH, 2007g). Two other SVE wells (18-SVE-003 and SVE-18-ES) were restarted in April 2008 after VOCs (TCE/PCE) were detected in rebound samples collected in November 2007 (MWH, 2009h). The SVE system was shut down in November 2008, while closure of Site LF-18 was again being evaluated in accordance with the SVE shutdown criteria established in the Basewide OU ROD (AFBCA, 1998a).

SVE System Compliance. During the period of this five-year review, the SVE system (when operating) at Site SD-59 (used to treat vapors from Site LF-18) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs based on calculations from monthly compliance samples. In addition, since March 2006, the Site SD-59 SVE system has operated without air emission treatment due to low ROC emission rates. Compliance monitoring results are reported in the semiannual/annual SVE/BV reports (MWH, 2004a; 2005b; 2005c; 2006a; 2006b; 2007c; 2007g; 2008d; 2009h).

Institutional Controls. Implementation of ICs to prevent potential unacceptable exposure to volatile contaminants and to protect the remedial system components will occur following signature on the Soil OU and Basewide OU ESDs (AFRPA, 2009a; 2009d). However, the closure report indicates that the site closure will not require land-use restrictions to be protective of human health. The effectiveness of the additional ICs, if implemented, will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. During the last five years, the SVE treatment system at Site SD-59 (which remediates Site LF-18 and Site OT-23A) has made progress toward meeting the RAOs of achieving cleanup standards for the COCs and mitigating any residual source of groundwater contamination that may be present. The extraction wells at Site LF-18 were operated by the SVE system at Site SD-59, and the amount of mass removed and the mass extraction rate were not determined separately for Site LF-18. However, an estimated 53 lbs of total contaminants were extracted in 2008 from the vadose zone at Site SD-59, which includes all mass extracted at Site LF-18, and a total of approximately 1,000 lbs of contaminants are estimated to have been removed during the last five years (MWH, 2009h).

Based on remedial system performance and rebound sample results, data suggest that contaminant concentrations have decreased to a level for which continued in situ remediation is no longer considered beneficial or cost effective (MWH, 2009c). Therefore, a draft final closure report that includes the results of fate-and-transport modeling (VapourT and groundwater flow-and-transport) and the results of an indoor and outdoor air and dermal contact risk evaluation has been prepared to document that no further treatment is required at Site LF-18 (and Site OT-23A) (MWH, 2009c).

7.6.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but the remedy is still protective. The site closure process agreed to by the RPMs for SVE remedies includes a determination that the site poses no unacceptable health risk (MWH, 2002c). This ensures that any changes in exposure assumptions or toxicity data are incorporated into the remedial action.

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

No other information has come to light that calls into question the protectiveness of the remedy.

7.6.3 Site OT-23C

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

SVE Performance. Operations of the Site OT-23C SVE system have been continuous since 2004, except during periods of rebound testing, maintenance, and drilling activities. The system has been optimized over the years to target hot spot areas, and in general, concentrations of VOCs (particularly PCE) have decreased.

In December 2004, field readings indicated a decrease in flow rates at SVE wells 23-SVES-001 and 23-SVED-001, which are located near the hot spot area at 23-MP-008 (Figure 4-16). This may have been the result of infiltration of water from rain and irrigation activities in the local area accumulating in and saturating the vadose zone. The water likely obstructed the screen intervals of the SVE wells and impeded flow rates. After excess water was removed from the SVE system sumps and the system wells were reconfigured, the flow rate increased slightly at 23-SVES-001. Consequently, mass extraction rates at the

end of December were higher than mass extraction rates calculated at the beginning of the reporting period (October) (MWH, 2005b). A recommendation was made to reduce irrigation activities near 23-SVES-001 and 23-MP-008 to decrease saturating the shallow zones with runoff and, therefore, increase the effectiveness of the Site OT-23C SVE system (MWH, 2005c).

An ROI test was conducted at Site OT-23C in December 2006 to determine w the SVE system had sufficient influence over the areas with significant remaining contamination that could impact groundwater if left in place. The ROI test results indicated that the SVE system had no influence at a depth of 74 feet at 23-MP-003 and limited to no influence at screened intervals of 23-MP-008 (MWH, 2007c). To determine the need for additional extraction wells to address the locations where the system had little or no influence, regular measurement of influence at the monitoring points was planned.

The system was shut down in October 2007 for drilling activities. Two soil borings were drilled with the installation of four monitoring/extraction wells in each of the two soil borings. PCE was detected in all baseline samples, with the highest concentrations reported in the four wells installed at 23-PW-01, located adjacent to 23-MP-008. As a result, all four wells were connected to the Site OT-23C SVE system well network for vapor extraction. The four SVE wells at 23-PW-01 were screened in varying lithologic zones to address PCE contamination detected throughout the vadose zone and persistent contamination at 23-MP-008.

The Site OT-23C SVE system was restarted in April 2008 following the completion of the drilling operations and pipeline installation of the new SVE wells. With the addition of SVE well 23-PW-01, mass removal rates of contaminants were relatively high during the first quarter of 2008 (MWH, 2009h). The SVE system was shut down in August 2008 for rebound sampling at the site, which was completed in September 2008. The rebound sampling results indicated that PCE concentrations are still as high as 160 ppmv near the source area, but generally are at much lower concentrations across the rest of the site (MWH, 2009h). The SVE system was restarted in October 2008.

SVE System Compliance. During the period of this five-year review, the Site OT-23C SVE system (when operating) was in compliance with the air emissions ARARs (based on the substantive requirements of rules promulgated by SMAQMD). Air emissions did not exceed 10 lbs/day for total ROCs or 0.79 lbs/day for PCE based on calculations from monthly compliance samples. Currently, the Site OT-23C SVE system includes two 3,000-pound GAC vessels in series for air contaminant emissions abatement. Compliance monitoring results are reported in the semiannual/annual SVE/BV reports (MWH, 2004a; 2005b; 2005c; 2006a; 2006b; 2007c; 2007g; 2008d; 2009h).

Institutional Controls. Implementation of ICs to protect the only remedial system component (one monitoring well) on Air Force property will occur following signature on the ESD (AFRPA, 2009d). The effectiveness of the additional ICs will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. During the last five years, the Site OT-23C SVE system has made progress toward meeting the RAOs of achieving cleanup standards for the COCs and mitigating any residual source of groundwater contamination that may be present. The total calculated mass of contaminants extracted from the site during 2008 was estimated to be approximately 375 lbs, of which PCE accounted for approximately 346 lbs of the total. A total of approximately 1,120 lbs of contaminants are estimated to have been removed during the last five years, of which PCE accounted for approximately 995 lbs of the total (MWH, 2009h).

The SVE system continues to work effectively, removing almost 1 lb/day of PCE from the vadose zone. The continued mass removal of contaminants, particularly PCE, indicates that remedial progress in the vadose zone is occurring. The addition of 23-PW-01 to the vapor extraction network has provided

substantial contribution of PCE mass removal from the vadose zone for the westernmost portion of the site at all depths. Continuous operation of the SVE unit is planned for continued remediation of the PCE within the vadose zone at Site OT-23C.

7.6.3.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes (see Section 7.1). There have been changes in toxicity data, but the remedy is still protective. The site closure process agreed to by the RPMs for SVE remedies includes a determination that the site poses no unacceptable health risk (MWH, 2002c). This ensures that any changes in exposure assumptions or toxicity data are incorporated into the remedial action.

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

No other information has come to light that calls into question the protectiveness of the remedy.

7.6.4 Site OT-87

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

Small Mammal Monitoring. During the period of this five-year review, the small mammal monitoring requirement of the Basewide OU ROD was initiated to ensure that residual concentrations of lead left in place at Site OT-87 do not pose a hazard to small mammals. Monitoring began in 2007 and the third year of monitoring was completed in 2009. No small mammals were trapped during attempts at Site OT-87 in 2007. In 2008, eight small mammals, including seven mice and one vole, were trapped (MWH, 2009i). The vole was released to sustain local vole populations in accordance with a recommendation from the California Department of Fish and Game (MWH, 2008e). In 2009, 28 small mammals, including three mice and 25 voles, were trapped; fourteen of the voles were released (MWH, 2009j).

Lead concentrations were detected in the liver and kidney tissues of all small mammals captured from Site OT-87 in 2008 and 2009 (MWH, 2009j). However, a comparison of lead concentrations measured in liver and kidney tissue samples collected from small mammals at Site OT-87 with potentially toxic lead concentrations reported in the literature suggests that the measured concentrations of lead in the samples collected from Site OT-87 are within background levels and generally regarded no adverse effect levels (MWH, 2009j). Thus, there is no evidence from the 2008 or 2009 monitoring event to suggest that small mammals at Site OT-87 are accumulating lead in their tissues at concentrations greater than background levels (MWH, 2009j). Therefore, the Air Force recommended discontinuing small mammal monitoring at Site OT-87. As of June 2010, the combined 2008 and 2009 results report (MWH, 2009j) is in comment resolution.

The Basewide OU ROD also requires regulatory agency notification if any dead waterfowl are found in the area of Site OT-87, and if any are found, they must be necropsied by a certified laboratory for signs of lead toxicity. As of December 2009, no dead waterfowl have been found at Site OT-87.

Institutional Controls. Use restrictions are implemented through Air Force ownership of the land, and through the terms of the lease to Sacramento County for use of the land as a regional park. When the ownership of the property is transferred to the County, the ICs will be incorporated in the deed or other transactional documents. The ICs for Site OT-87 are clarified in an ESD (AFRPA, 2009d); their effectiveness will be assessed in the fourth five-year review for Mather.

Progress Toward Meeting RAOs. Although no specific RAOs are identified in the Basewide OU ROD for Site OT-87, the basis for cleanup is protection of human health and the environment. Prior to the period of this five-year review, lead-contaminated soil was excavated in accordance with the Basewide OU ROD remedy; however, concentrations of lead left in place are not compatible with unrestricted use of the site. Therefore, ICs are in place to prevent unacceptable exposure to residual lead in soil at Site OT-87. These ICs are clarified in an ESD (AFRPA, 2009d). In addition, the small mammal monitoring requirement of the Basewide OU ROD is underway, and results through 2009 indicate that residual lead contamination at the site does not pose a potential risk to small mammals (MWH, 2009j).

Following signature on the ESD, meeting the RAOs identified in the ESD will be the primary and fundamental indicator of ICs performance, the ultimate aim of which is to protect human health and the environment. Performance measures for the ICs are the RAOs plus the actions necessary to achieve those objectives. It is anticipated that successful implementation, operation, maintenance, and completion of these measures will achieve protection of human health and the environment and compliance with all legal requirements (AFRPA, 2009d).

7.6.4.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes. There have been no changes in toxicity data that affect the protectiveness of the remedy.

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

No other information has come to light that calls into question the protectiveness of the remedy.

7.7 Supplemental Basewide OU

7.7.1 Site OT-89

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

Institutional Controls. Use restrictions are implemented through Air Force ownership of the land, and through the terms of the lease to Sacramento County for use of the land as part of the airport. When the ownership of the property is transferred to the County, the ICs will be incorporated in the deed or other transactional documents. At the time of deed transfer, lease restrictions will be superseded by equivalent restriction to be included in the federal deed and the SLUC as described in the Supplemental Basewide OU ROD (AFRPA, 2006).

Prior to property transfer, the Air Force is required to conduct annual monitoring, provide annual reports and undertake prompt action to address activity that is inconsistent with the IC objective or use restrictions, or any action that may interfere with IC effectiveness. The Air Force is required to submit to the regulatory agencies annual monitoring reports on the status of ICs and how any IC deficiencies or inconsistent uses have been addressed. These annual monitoring reports are to be used in preparation of five-year reviews to evaluate the effectiveness of the remedy.

Five-year reviews are also to address whether the ICs in the ROD were inserted in the deed, if property was transferred during the period covered, whether the owners and State and local agencies were notified of the ICs affecting the property, and whether use of the property has conformed to such ICs.

The Supplemental Basewide OU ROD was signed in 2006, which was during the period of this five-year review. Through 2008, annual monitoring reports on the status of the ICs were not prepared. However, activities inconsistent with the specific ICs identified for Site OT-89 in the Supplemental Basewide OU ROD did not occur, and the property was not transferred during the period of this five-year review. Lease restrictions with Sacramento County are in place and are in compliance with the terms of the Supplemental Basewide OU ROD.

Progress Toward Meeting RAOs. The RAOs identified in the Supplemental Basewide OU ROD for Site OT-89 are to: (1) prevent human exposure to lead concentrations greater than 192 mg/kg; (2) prevent plant exposure to lead concentrations greater than 700 mg/kg; and (3) prevent disturbance of subsurface soil that could threaten water quality. Prior to the period of this five-year review, contaminated soil was excavated as part of a time-critical removal action for Site OT-89; however, the concentrations of lead left in place are not compatible with unrestricted use of the site. Therefore, ICs are in place to prevent unacceptable exposure to residual lead in soil at Site OT-89.

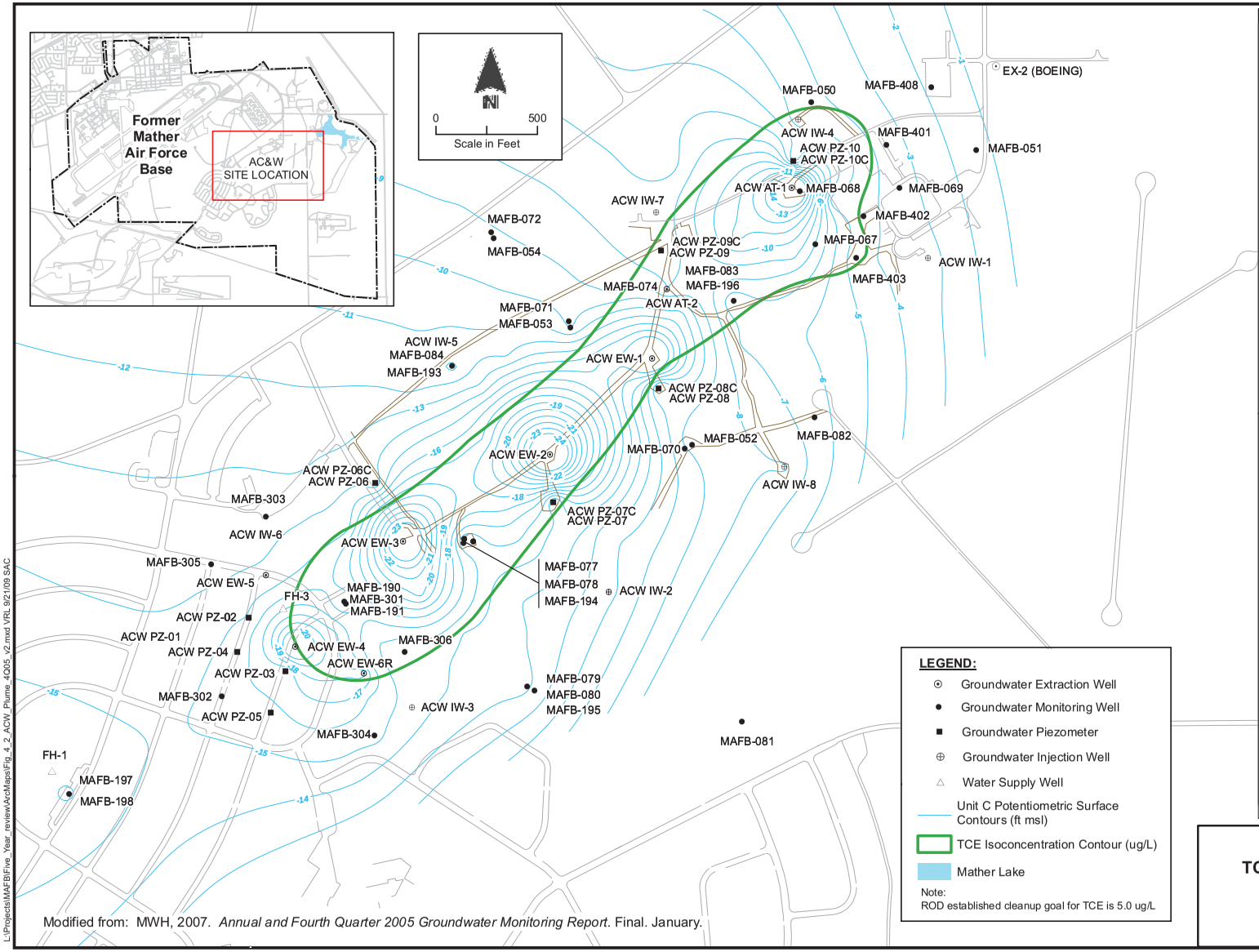
Specific language is included in the Supplemental Basewide OU ROD regarding implementation, monitoring, reporting, and enforcement of ICs. Compliance with the terms of the Supplemental Basewide OU ROD will be protective of human health and the environment. In order to be in compliance, monitoring reports must be completed and submitted to the regulatory agencies on an annual basis unless the ICs or reporting requirements are modified or eliminated. Although annual monitoring reports were not completed in 2007 or 2008, activities inconsistent with the ICs, and consequently the RAOs, did not occur.

7.7.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Yes. There have been no changes in toxicity data that affect the protectiveness of the remedy.

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

Annual monitoring reports on the status of the ICs have not been completed as required by the Supplemental Basewide OU ROD, which was signed in 2006. These annual monitoring reports are also necessary in the preparation of five-year reviews to evaluate the effectiveness of the ICs.



LOCID	UNIT	DATE	TCE
ACW AT-1	C	10/20/05	**13**
ACW AT-2	C	4/21/05	**23**
ACW EW-1	C	4/21/05	**9.8**
ACW EW-2	C	4/21/05	**8.3**
ACW EW-3	C	4/21/05	**14**
ACW EW-4	C	4/21/05	**6.3**
ACW EW-5	C	4/21/05	<0.50
ACW EW-6R	C	10/20/05	**26**
ACW PZ-01	C	6/18/03	<0.50
ACW PZ-02	C	10/19/05	<0.50
ACW PZ-03	C	7/1/03	<0.50
ACW PZ-04	C	6/18/03	<0.50
ACW PZ-05	C	10/19/05	0.35F
ACW PZ-06	WT/C	4/28/05	<0.50
ACW PZ-06C	C	4/28/05	**2.6**
ACW PZ-07	WT/C	4/28/05	**12**
ACW PZ-07C	C	4/28/05	**2.0**
ACW PZ-08	WT/C	4/28/05	**2.2**
ACW PZ-08C	C	4/28/05	0.32F
ACW PZ-09	WT/C	4/28/05	**23**
ACW PZ-09C	C	4/28/05	<0.50
ACW PZ-10	WT	10/19/05	**22**
ACW PZ-10C	C	5/31/05	<0.50
MAFB-050	WT/C	4/7/03	**1.7M**
MAFB-051	WT/C	4/21/04	0.25F
MAFB-052	WT/C	4/7/03	<0.50M
MAFB-053	C	4/12/05	**3.5M**
MAFB-054	WT/C	10/1/94	<1.0
MAFB-067	D	5/26/04	<0.50M
MAFB-068	D	4/28/05	<0.50
MAFB-069	D	6/9/04	<0.50M
MAFB-070	D	5/26/04	<0.50M
MAFB-071	D	4/26/04	<0.50
MAFB-072	D	10/1/94	<1.0
MAFB-077	WT/C	5/28/03	<0.50
MAFB-078	D	4/12/05	<0.50M
MAFB-079	WT/C	10/1/94	<1.0
MAFB-080	D	10/1/94	<1.0
MAFB-083	WT/C	5/4/01	**5.8M**
MAFB-084	WT/C	4/7/97	<0.50
MAFB-190	WT/C	4/8/03	**0.91M**
MAFB-191	D	4/11/05	<0.50M
MAFB-192	WT/C	4/21/04	<0.50
MAFB-193	C	4/12/05	<0.50M
MAFB-194	C	4/12/05	**15M**
MAFB-195	C	4/28/05	<0.50
MAFB-196	C	10/19/05	**6.2**
MAFB-197	WT/C	4/11/05	<0.50M
MAFB-198	C	4/11/05	<0.50M
MAFB-301	C	4/11/05	**26M**
MAFB-302	C	4/11/05	<0.50M
MAFB-303	C	4/11/05	<0.50M
MAFB-304	C	4/11/05	<0.50M
MAFB-305	C	4/11/05	<0.50M
MAFB-306	C	4/11/05	**6.1M**
MAFB-401	WT/C	4/12/05	**1.4M**
MAFB-402	WT/C	4/12/05	**4.4**
MAFB-403	WT/C	4/12/05	**5.8**
MAFB-408	WT/C	4/13/05	**0.85**
			Data Units: µg/L

Modified from: MWH, 2007. *Annual and Fourth Quarter 2005 Groundwater Monitoring Report*. Final. January.

Figure 7-1
TCE Isoconcentration Contour
AC&W Plume Area
Fourth Quarter 2005
Former Mather Air Force Base
Sacramento County, California

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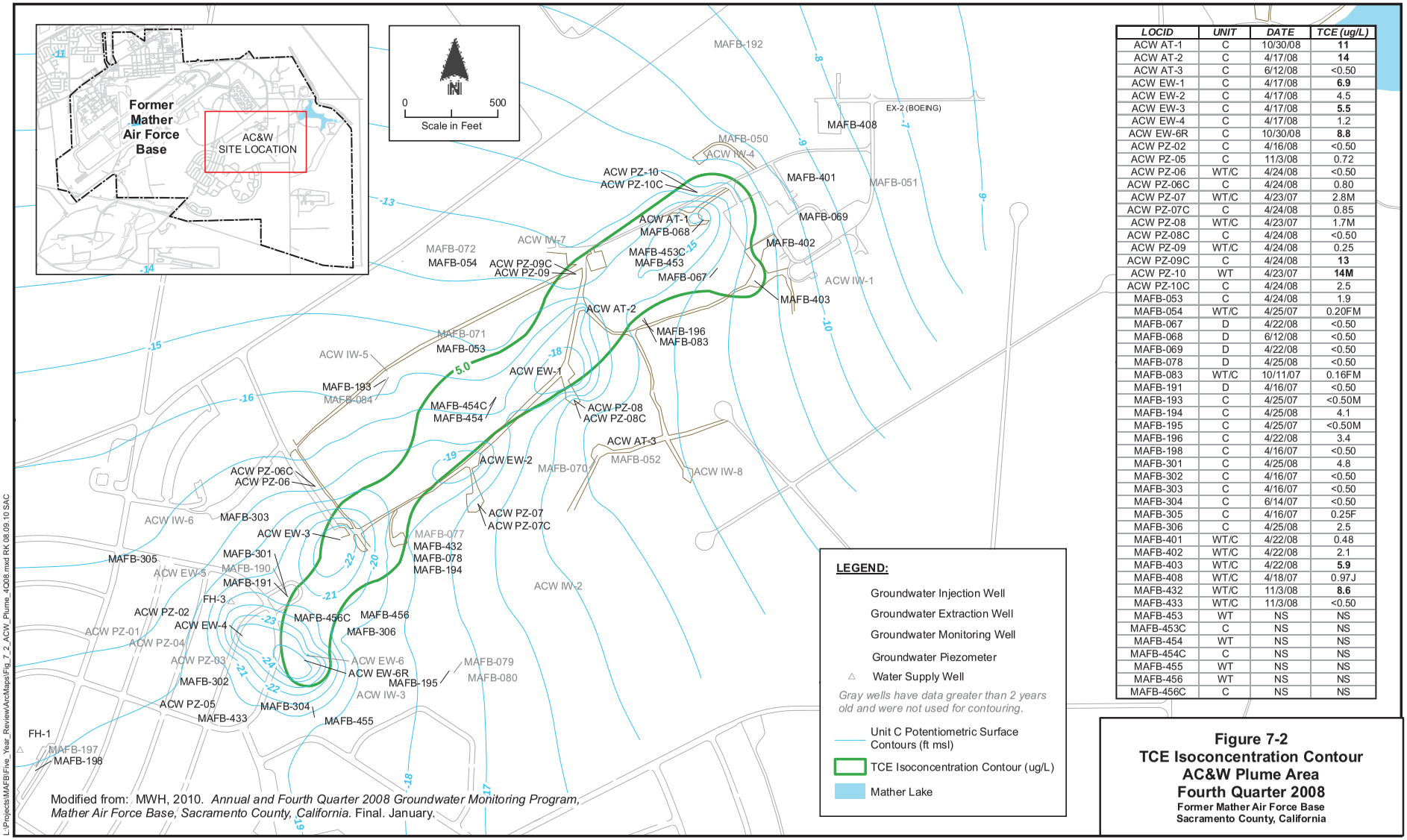

LOCID	UNIT	DATE	TCE (ug/L)
ACW AT-1	C	10/30/08	**11**
ACW AT-2	C	4/17/08	**14**
ACW AT-3	C	6/12/08	<0.50
ACW EW-1	C	4/17/08	**6.9**
ACW EW-2	C	4/17/08	4.5
ACW EW-3	C	4/17/08	**5.5**
ACW EW-4	C	4/17/08	1.2
ACW EW-6R	C	10/30/08	**8.8**
ACW PZ-02	C	4/16/08	<0.50
ACW PZ-05	C	11/3/08	0.72
ACW PZ-06	WT/C	4/24/08	<0.50
ACW PZ-06C	C	4/24/08	0.80
ACW PZ-07	WT/C	4/23/07	2.8M
ACW PZ-07C	C	4/24/08	0.85
ACW PZ-08	WT/C	4/23/07	1.7M
ACW PZ-08C	C	4/24/08	<0.50
ACW PZ-09	WT/C	4/24/08	0.25
ACW PZ-09C	C	4/24/08	**13**
ACW PZ-10	WT	4/23/07	**14M**
ACW PZ-10C	C	4/24/08	2.5
MAFB-053	C	4/24/08	1.9
MAFB-054	WT/C	4/25/07	0.20FM
MAFB-067	D	4/22/08	<0.50
MAFB-068	D	6/12/08	<0.50
MAFB-069	D	4/22/08	<0.50
MAFB-078	D	4/25/08	<0.50
MAFB-083	WT/C	10/11/07	0.16FM
MAFB-191	D	4/16/07	<0.50
MAFB-193	C	4/25/07	<0.50M
MAFB-194	C	4/25/08	4.1
MAFB-195	C	4/25/07	<0.50M
MAFB-196	C	4/22/08	3.4
MAFB-198	C	4/16/07	<0.50
MAFB-301	C	4/25/08	4.8
MAFB-302	C	4/16/07	<0.50
MAFB-303	C	4/16/07	<0.50
MAFB-304	C	6/14/07	<0.50
MAFB-305	C	4/16/07	0.25F
MAFB-306	C	4/25/08	2.5
MAFB-401	WT/C	4/22/08	0.48
MAFB-402	WT/C	4/22/08	2.1
MAFB-403	WT/C	4/22/08	**5.9**
MAFB-408	WT/C	4/18/07	0.97J
MAFB-432	WT/C	11/3/08	**8.6**
MAFB-433	WT/C	11/3/08	<0.50
MAFB-453	WT	NS	NS
MAFB-453C	C	NS	NS
MAFB-454	WT	NS	NS
MAFB-454C	C	NS	NS
MAFB-455	WT	NS	NS
MAFB-456	WT	NS	NS
MAFB-456C	C	NS	NS

Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 7-2
TCE Isoconcentration Contour
AC&W Plume Area
Fourth Quarter 2008
Former Mather Air Force Base
Sacramento County, California

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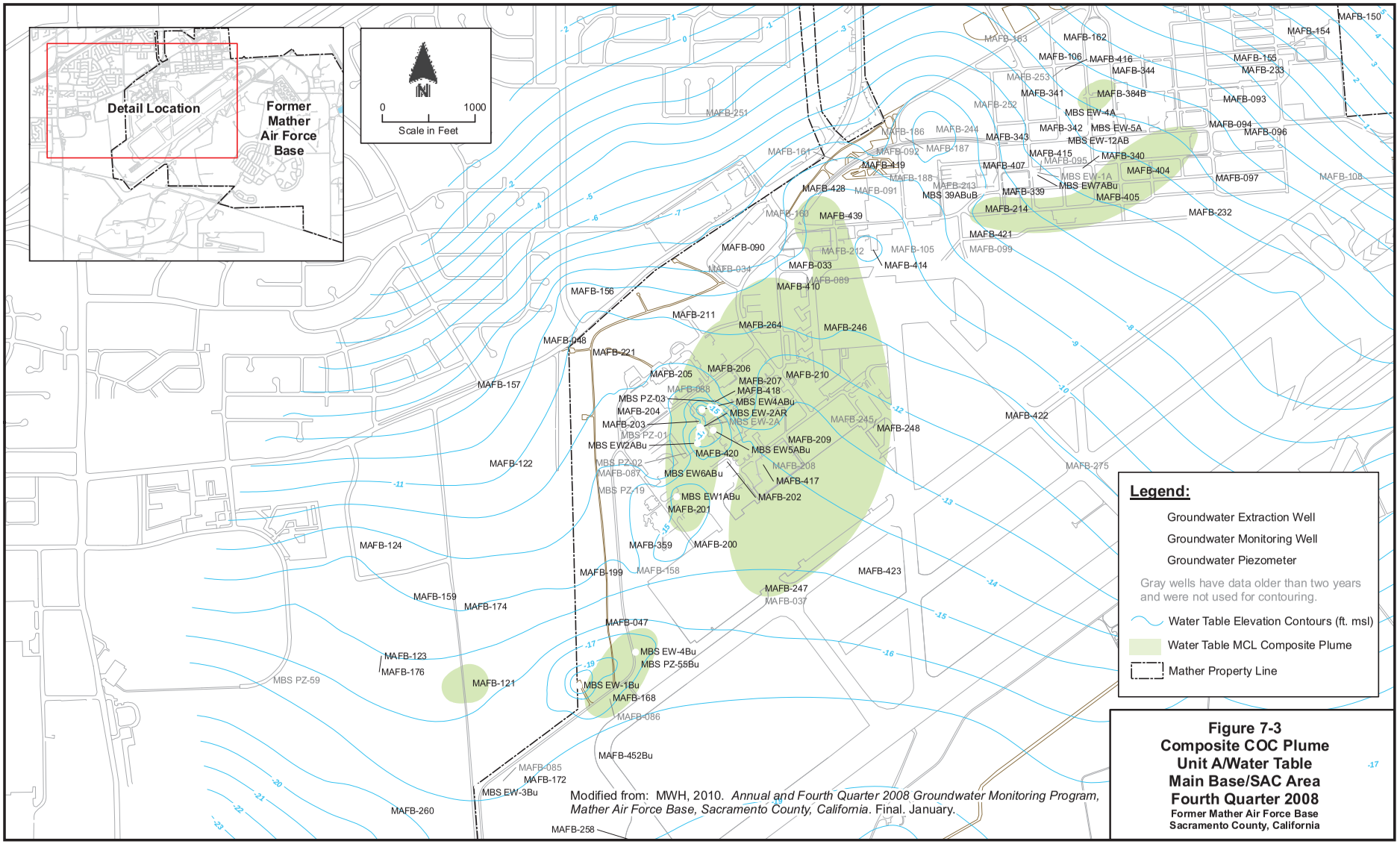

Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.

Figure 7-3
Composite COC Plume
Unit A/Water Table
Main Base/SAC Area
Fourth Quarter 2008
Former Mather Air Force Base
Sacramento County, California

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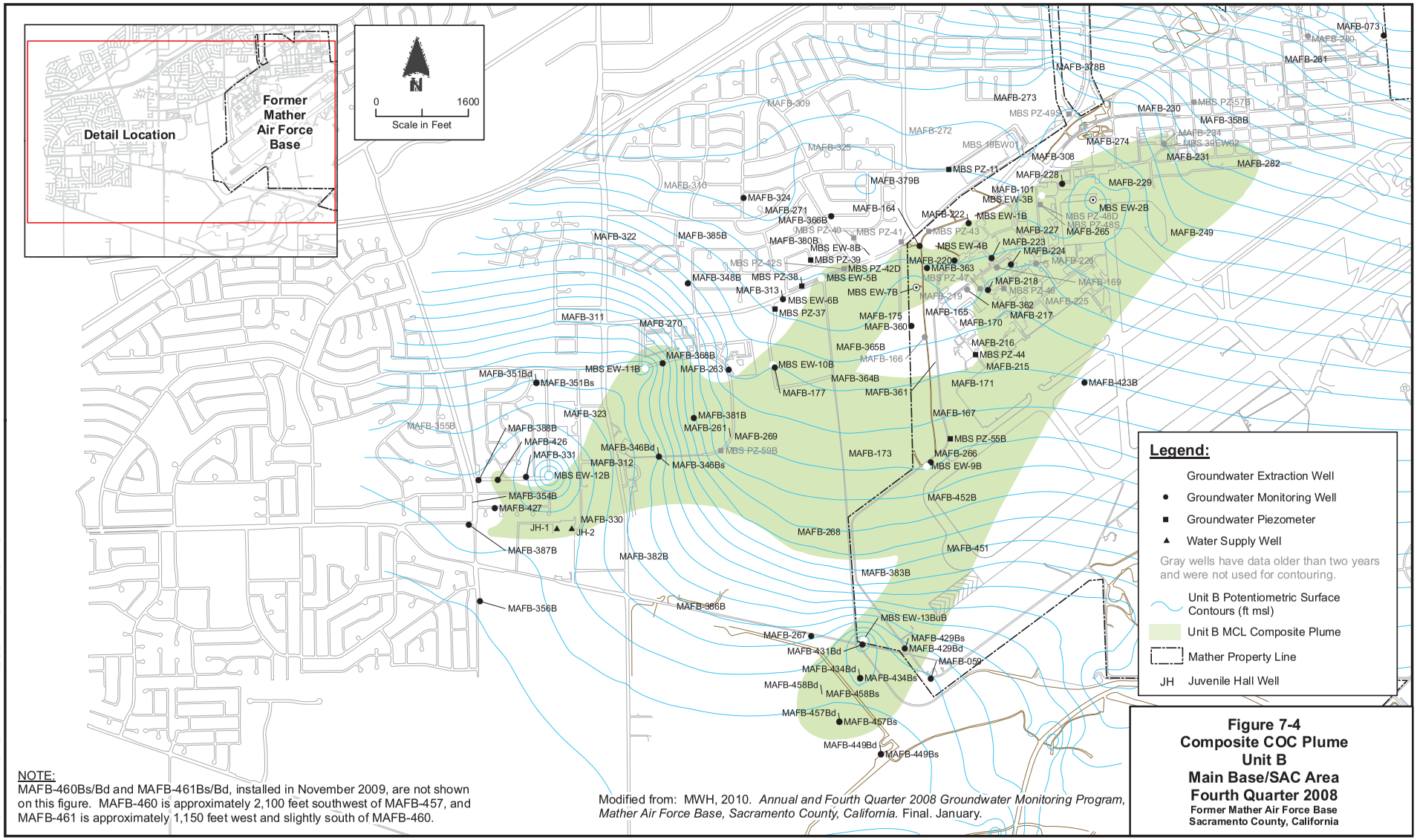

NOTE:
MAFB-460Bs/Bd and MAFB-461Bs/Bd, installed in November 2009, are not shown on this figure. MAFB-460 is approximately 2,100 feet southwest of MAFB-457, and MAFB-461 is approximately 1,150 feet west and slightly south of MAFB-460.

Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 7-4
Composite COC Plume
Unit B
Main Base/SAC Area
Fourth Quarter 2008
Former Mather Air Force Base
Sacramento County, California

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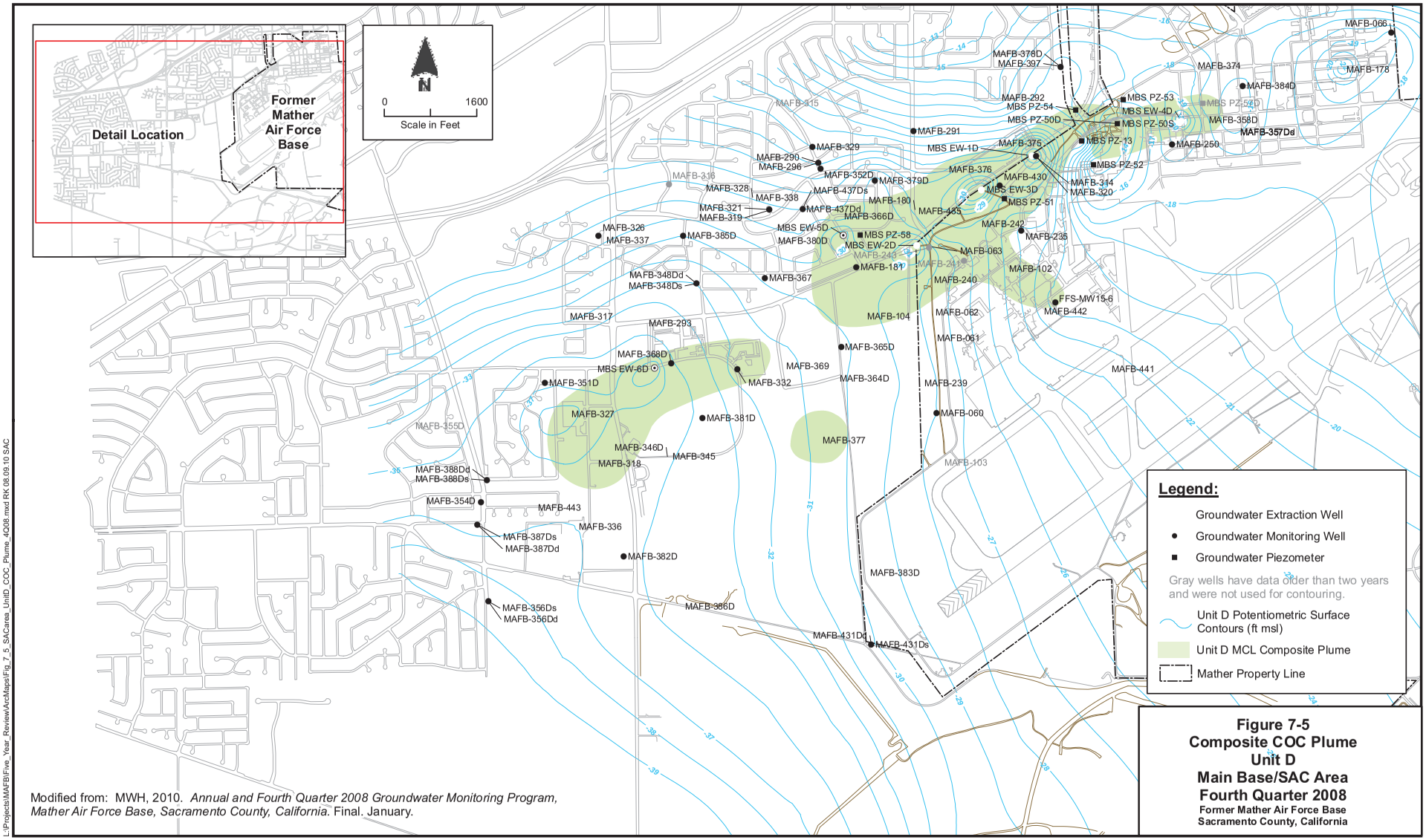

Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 7-5
Composite COC Plume
Unit D
Main Base/SAC Area
Fourth Quarter 2008
Former Mather Air Force Base
Sacramento County, California

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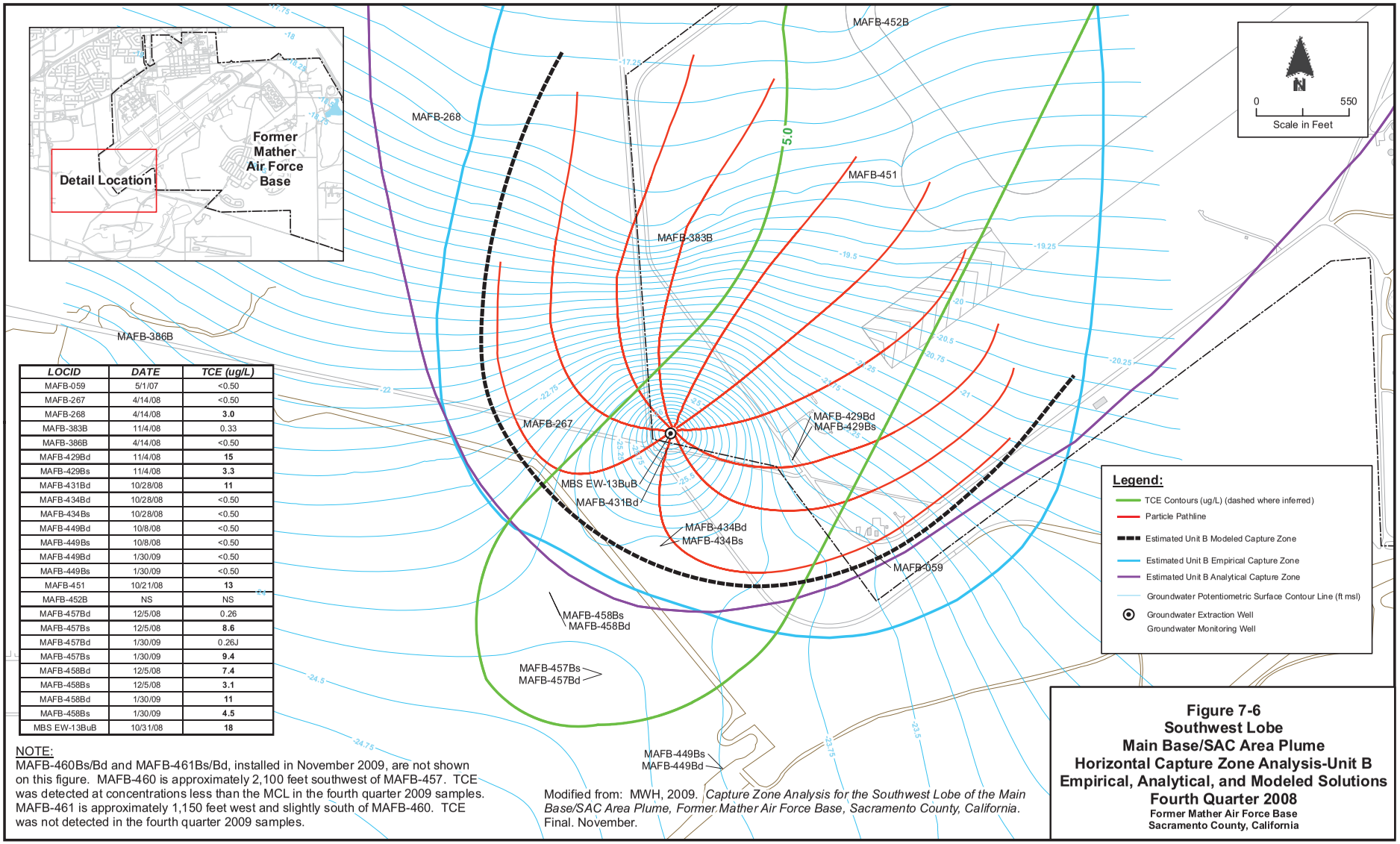

LOCID	DATE	TCE (ug/L)
MAFB-059	5/1/07	<0.50
MAFB-267	4/14/08	<0.50
MAFB-268	4/14/08	**3.0**
MAFB-383B	11/4/08	0.33
MAFB-386B	4/14/08	<0.50
MAFB-429Bd	11/4/08	**15**
MAFB-429Bs	11/4/08	**3.3**
MAFB-431Bd	10/28/08	**11**
MAFB-434Bd	10/28/08	<0.50
MAFB-434Bs	10/28/08	<0.50
MAFB-449Bd	10/8/08	<0.50
MAFB-449Bs	10/8/08	<0.50
MAFB-449Bd	1/30/09	<0.50
MAFB-449Bs	1/30/09	<0.50
MAFB-451	10/21/08	**13**
MAFB-452B	NS	NS
MAFB-457Bd	12/5/08	0.26
MAFB-457Bs	12/5/08	**8.6**
MAFB-457Bd	1/30/09	0.26J
MAFB-457Bs	1/30/09	**9.4**
MAFB-458Bd	12/5/08	**7.4**
MAFB-458Bs	12/5/08	**3.1**
MAFB-458Bd	1/30/09	**11**
MAFB-458Bs	1/30/09	**4.5**
MBS EW-13BuB	10/31/08	**18**

NOTE:
MAFB-460Bs/Bd and MAFB-461Bs/Bd, installed in November 2009, are not shown on this figure. MAFB-460 is approximately 2,100 feet southwest of MAFB-457. TCE was detected at concentrations less than the MCL in the fourth quarter 2009 samples. MAFB-461 is approximately 1,150 feet west and slightly south of MAFB-460. TCE was not detected in the fourth quarter 2009 samples.

Modified from: MWH, 2009. *Capture Zone Analysis for the Southwest Lobe of the Main Base/SAC Area Plume, Former Mather Air Force Base, Sacramento County, California.* Final. November.

Figure 7-6
Southwest Lobe
Main Base/SAC Area Plume
Horizontal Capture Zone Analysis-Unit B
Empirical, Analytical, and Modeled Solutions
Fourth Quarter 2008
Former Mather Air Force Base
Sacramento County, California

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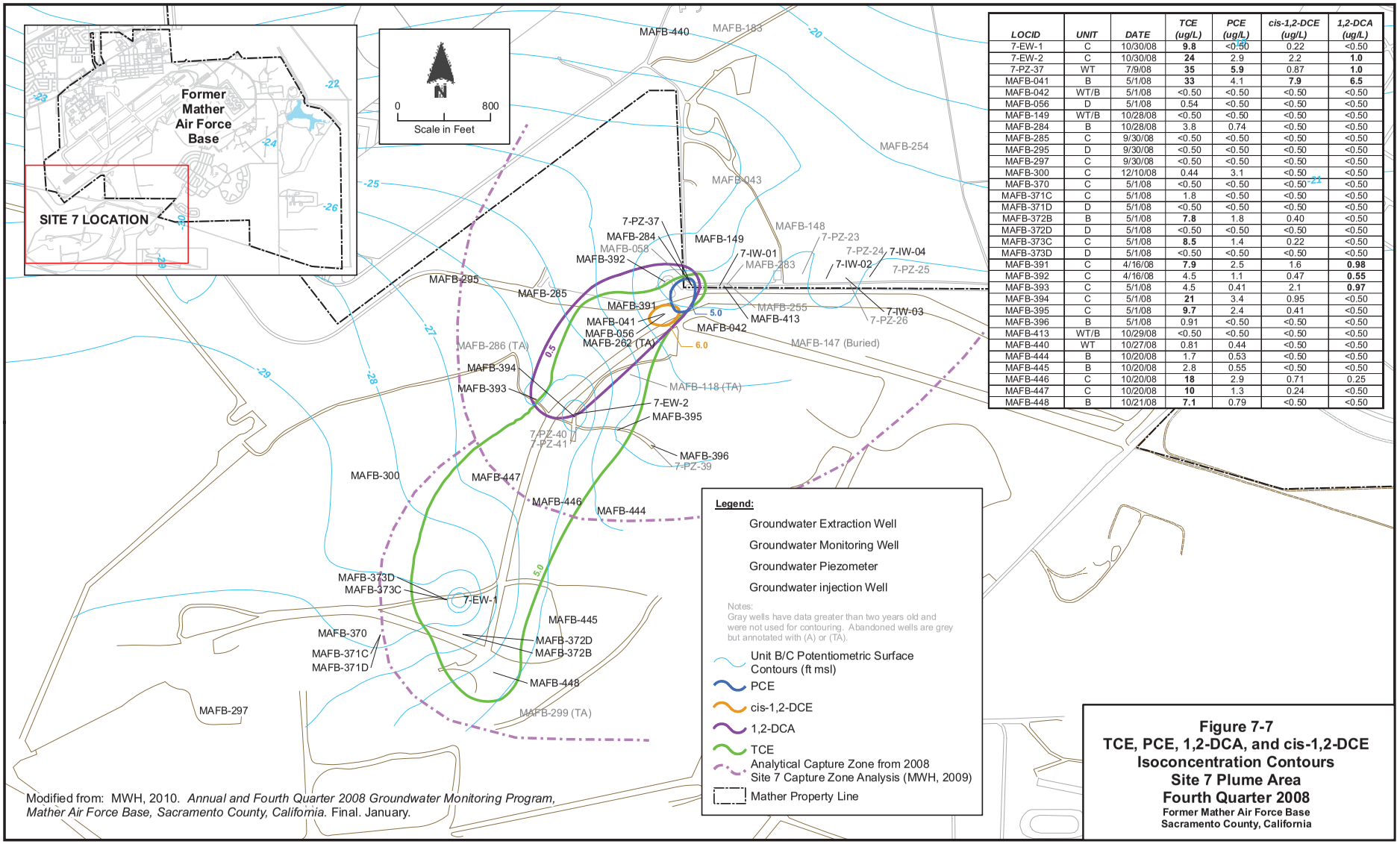

LOCID	UNIT	DATE	TCE (ug/L)	PCE (ug/L)	cis-1,2-DCE (ug/L)	1,2-DCA (ug/L)
7-EW-1	C	10/30/08	**9.8**	<0.50	0.22	<0.50
7-EW-2	C	10/30/08	**24**	2.9	2.2	**1.0**
7-PZ-37	WT	7/9/08	**35**	**5.9**	0.87	**1.0**
MAFB-041	B	5/1/08	**33**	4.1	**7.9**	**6.5**
MAFB-042	WT/B	5/1/08	<0.50	<0.50	<0.50	<0.50
MAFB-056	D	5/1/08	0.54	<0.50	<0.50	<0.50
MAFB-149	WT/B	10/28/08	<0.50	<0.50	<0.50	<0.50
MAFB-284	B	10/28/08	3.8	0.74	<0.50	<0.50
MAFB-285	C	9/30/08	<0.50	<0.50	<0.50	<0.50
MAFB-295	D	9/30/08	<0.50	<0.50	<0.50	<0.50
MAFB-297	C	9/30/08	<0.50	<0.50	<0.50	<0.50
MAFB-300	C	12/10/08	0.44	3.1	<0.50	<0.50
MAFB-370	C	5/1/08	<0.50	<0.50	<0.50	<0.50
MAFB-371C	C	5/1/08	1.8	<0.50	<0.50	<0.50
MAFB-371D	D	5/1/08	<0.50	<0.50	<0.50	<0.50
MAFB-372B	B	5/1/08	**7.8**	1.8	0.40	<0.50
MAFB-372D	D	5/1/08	<0.50	<0.50	<0.50	<0.50
MAFB-373C	C	5/1/08	**8.5**	1.4	0.22	<0.50
MAFB-373D	D	5/1/08	<0.50	<0.50	<0.50	<0.50
MAFB-391	C	4/16/08	**7.9**	2.5	1.6	**0.98**
MAFB-392	C	4/16/08	4.5	1.1	0.47	**0.55**
MAFB-393	C	5/1/08	4.5	0.41	2.1	**0.97**
MAFB-394	C	5/1/08	**21**	3.4	0.95	<0.50
MAFB-395	C	5/1/08	**9.7**	2.4	0.41	<0.50
MAFB-396	B	5/1/08	0.91	<0.50	<0.50	<0.50
MAFB-413	WT/B	10/29/08	<0.50	<0.50	<0.50	<0.50
MAFB-440	WT	10/27/08	0.81	0.44	<0.50	<0.50
MAFB-444	B	10/20/08	1.7	0.53	<0.50	<0.50
MAFB-445	B	10/20/08	2.8	0.55	<0.50	<0.50
MAFB-446	C	10/20/08	**18**	2.9	0.71	0.25
MAFB-447	C	10/20/08	**10**	1.3	0.24	<0.50
MAFB-448	B	10/21/08	**7.1**	0.79	<0.50	<0.50

Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 7-7
TCE, PCE, 1,2-DCA, and cis-1,2-DCE Isoconcentration Contours
Site 7 Plume Area
Fourth Quarter 2008
Former Mather Air Force Base
Sacramento County, California

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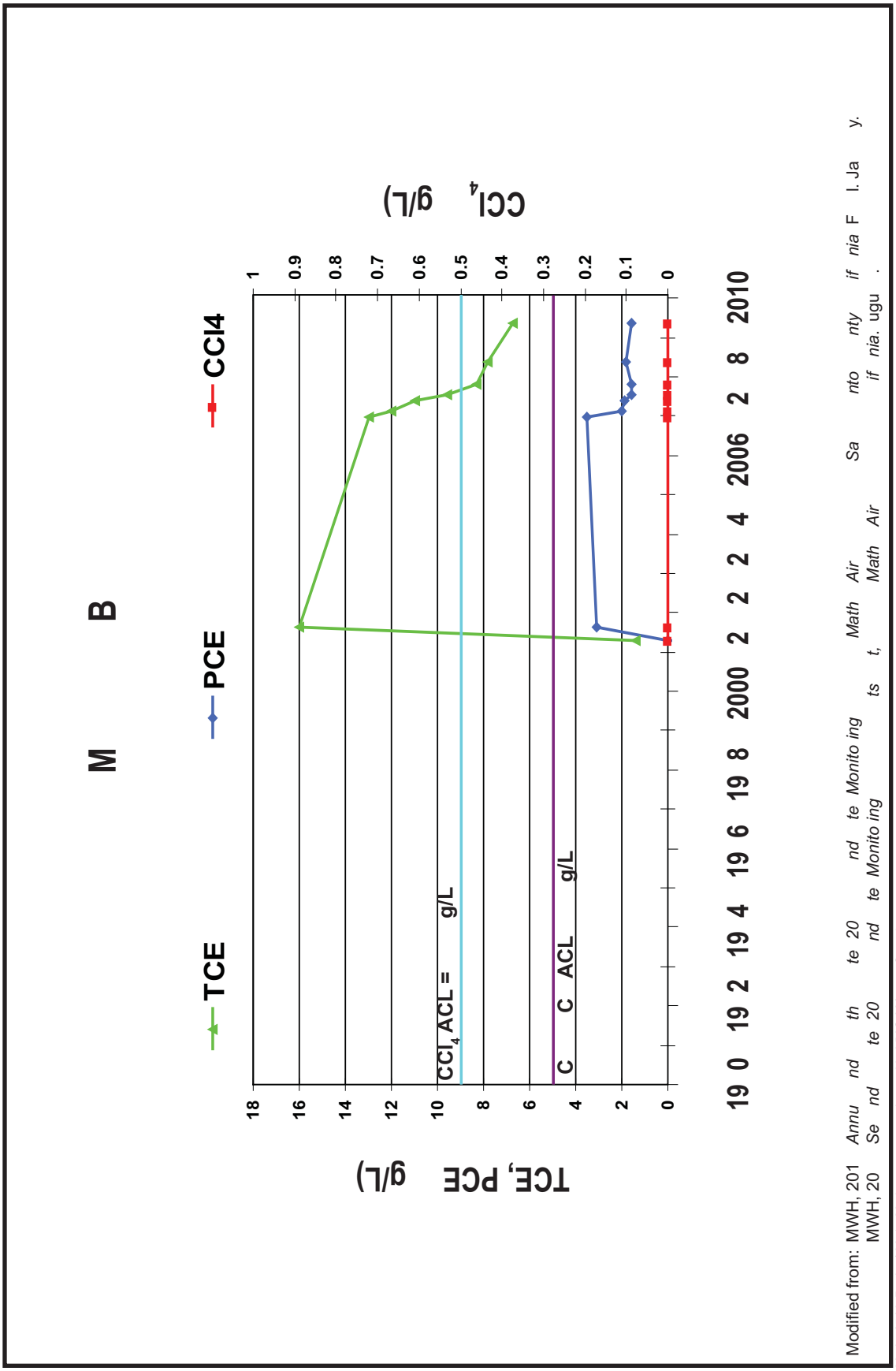
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TCE
PCE
CCl4
TCE, PCE g/L)
CCl4 g/L)
CCl4 ACL = g/L
C C ACL g/L
0
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4
6
8
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16
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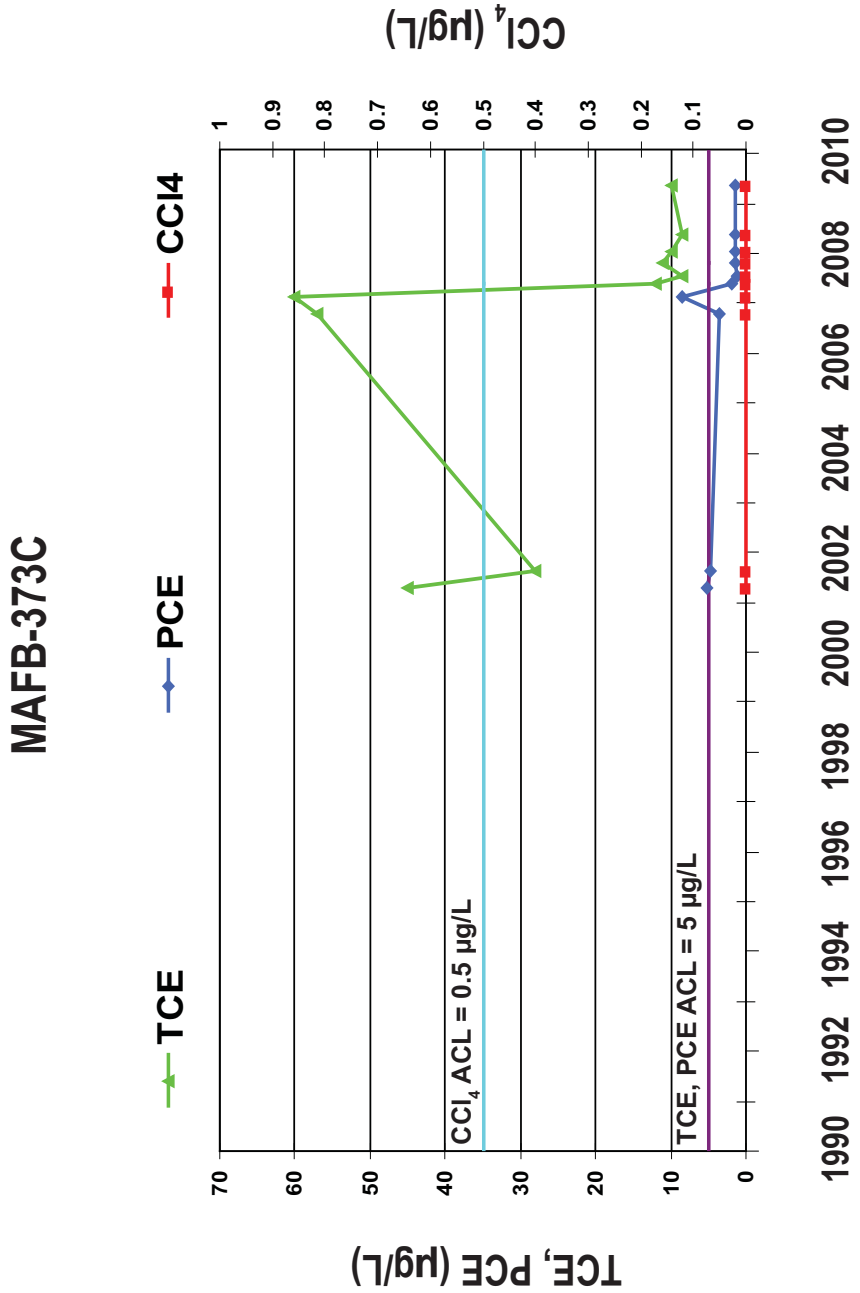
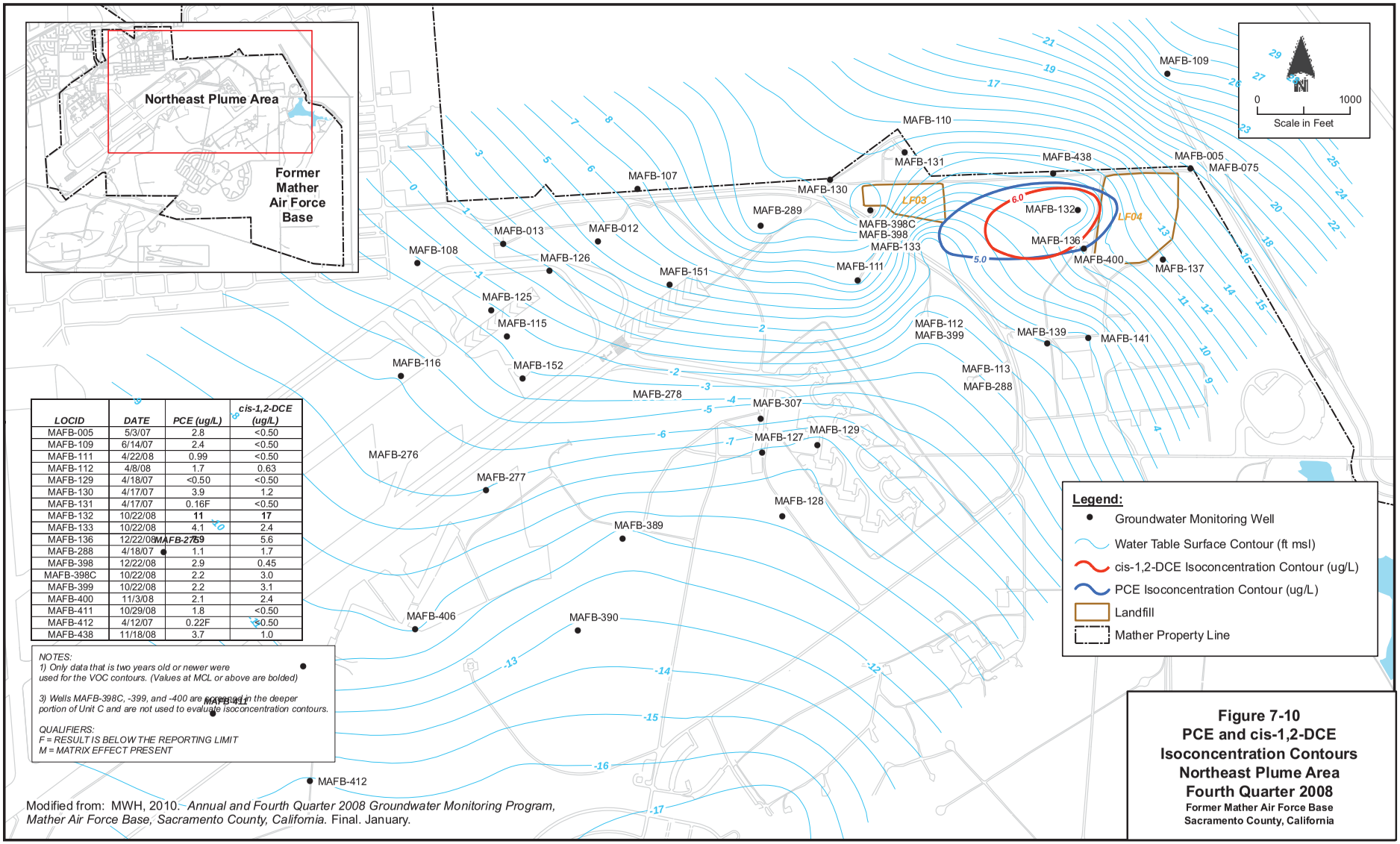


Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.
MWH, 2009. *Second Quarter 2009 Groundwater Monitoring Program Factsheet, Former Mather Air Force Base, California*. August.

Mather\5-Yr Review\08-10-Mather-time-conc-plots.indd - VMG 08/09/10 SAC 5

Figure 7-9. Time-Concentration Plot, MAFB-373C, Site 7 Plume, Former Mather Air Force Base, Sacramento County, California



LOCID	DATE	PCE (ug/L)	cis-1,2-DCE (ug/L)
MAFB-005	5/3/07	2.8	<0.50
MAFB-109	6/14/07	2.4	<0.50
MAFB-111	4/22/08	0.99	<0.50
MAFB-112	4/8/08	1.7	0.63
MAFB-129	4/18/07	<0.50	<0.50
MAFB-130	4/17/07	3.9	1.2
MAFB-131	4/17/07	0.16F	<0.50
MAFB-132	10/22/08	**11**	**17**
MAFB-133	10/22/08	4.1	2.4
MAFB-136	12/22/08	**59**	5.6
MAFB-288	4/18/07	1.1	1.7
MAFB-398	12/22/08	2.9	0.45
MAFB-398C	10/22/08	2.2	3.0
MAFB-399	10/22/08	2.2	3.1
MAFB-400	11/3/08	2.1	2.4
MAFB-411	10/29/08	1.8	<0.50
MAFB-412	4/12/07	0.22F	<0.50
MAFB-438	11/18/08	3.7	1.0

NOTES:
1) Only data that is two years old or newer were used for the VOC contours. (Values at MCL or above are bolded)

3) Wells MAFB-398C, -399, and -400 are screened in the deeper portion of Unit C and are not used to evaluate isoconcentration contours.

QUALIFIERS:
F = RESULT IS BELOW THE REPORTING LIMIT
M = MATRIX EFFECT PRESENT

Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California.* Final. January.

Figure 7-10
PCE and cis-1,2-DCE Isoconcentration Contours
Northeast Plume Area
Fourth Quarter 2008
Former Mather Air Force Base
Sacramento County, California

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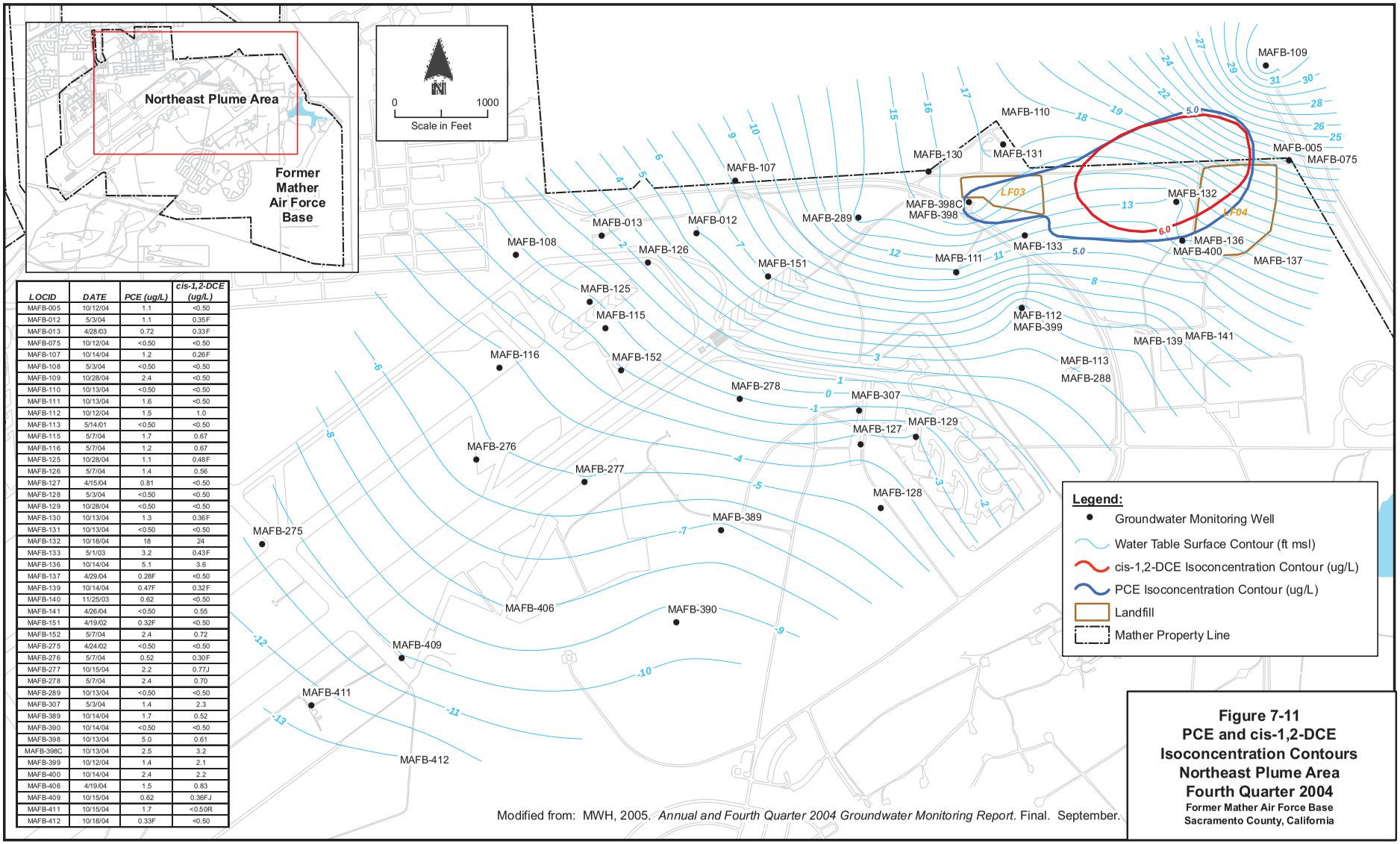
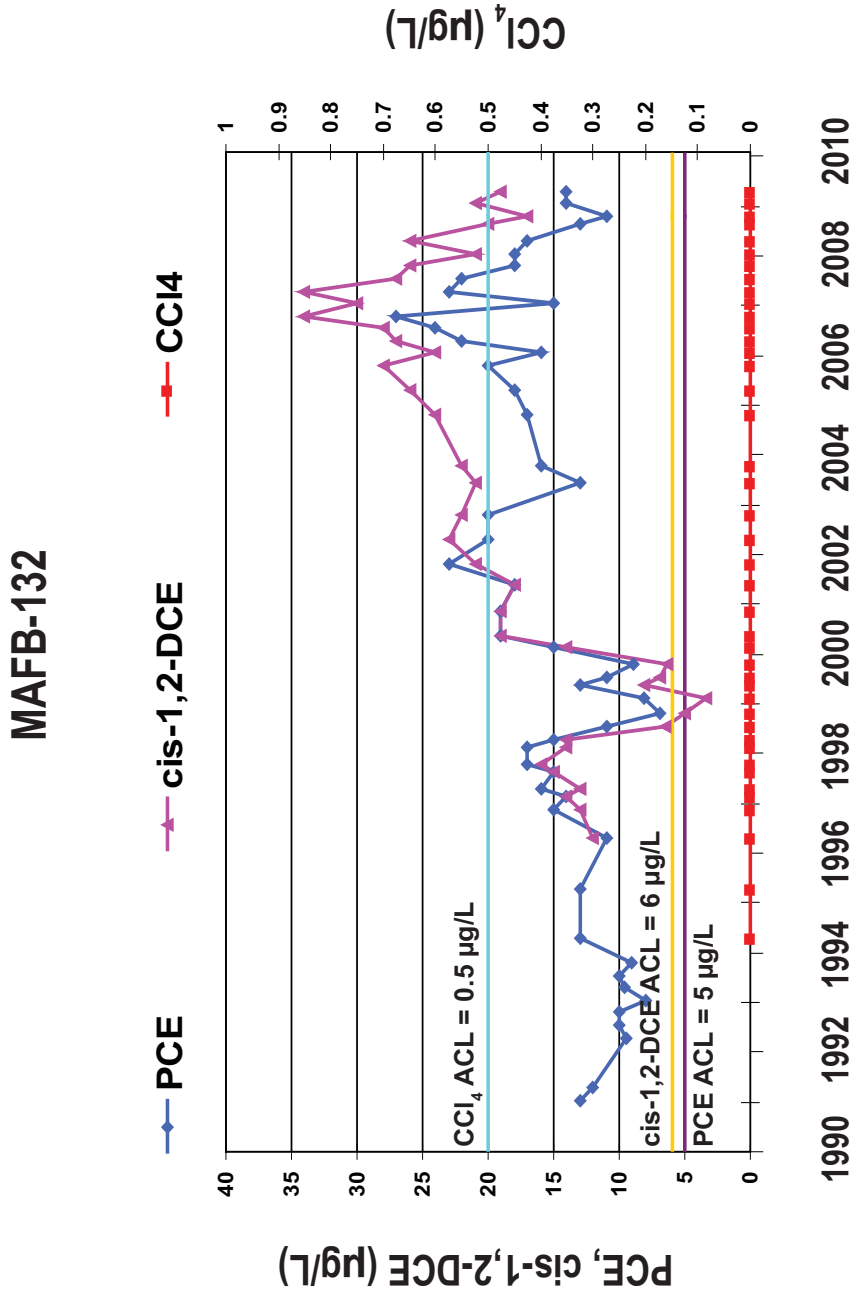


LOCID	DATE	PCE (ug/L)	cis-1,2-DCE (ug/L)
MAFB-005	10/12/04	1.1	<0.50
MAFB-012	5/3/04	1.1	0.35F
MAFB-013	4/28/03	0.72	0.33F
MAFB-075	10/12/04	<0.50	<0.50
MAFB-107	10/14/04	1.2	0.26F
MAFB-108	5/3/04	<0.50	<0.50
MAFB-109	10/28/04	2.4	<0.50
MAFB-110	10/13/04	<0.50	<0.50
MAFB-111	10/13/04	1.6	<0.50
MAFB-112	10/12/04	1.5	1.0
MAFB-113	5/14/01	<0.50	<0.50
MAFB-115	5/7/04	1.7	0.67
MAFB-116	5/7/04	1.2	0.67
MAFB-125	10/28/04	1.1	0.48F
MAFB-126	5/7/04	1.4	0.56
MAFB-127	4/15/04	0.81	<0.50
MAFB-128	5/3/04	<0.50	<0.50
MAFB-129	10/28/04	<0.50	<0.50
MAFB-130	10/13/04	1.3	0.36F
MAFB-131	10/13/04	<0.50	<0.50
MAFB-132	10/18/04	18	24
MAFB-133	5/1/03	3.2	0.43F
MAFB-136	10/14/04	5.1	3.6
MAFB-137	4/29/04	0.28F	<0.50
MAFB-139	10/14/04	0.47F	0.32F
MAFB-140	11/25/03	0.62	<0.50
MAFB-141	4/26/04	<0.50	0.55
MAFB-151	4/19/02	0.32F	<0.50
MAFB-152	5/7/04	2.4	0.72
MAFB-275	4/24/02	<0.50	<0.50
MAFB-276	5/7/04	0.52	0.30F
MAFB-277	10/15/04	2.2	0.77J
MAFB-278	5/7/04	2.4	0.70
MAFB-289	10/13/04	<0.50	<0.50
MAFB-307	5/3/04	1.4	2.3
MAFB-389	10/14/04	1.7	0.52
MAFB-390	10/14/04	<0.50	<0.50
MAFB-398	10/13/04	5.0	0.61
MAFB-398C	10/13/04	2.5	3.2
MAFB-399	10/12/04	1.4	2.1
MAFB-400	10/14/04	2.4	2.2
MAFB-406	4/19/04	1.5	0.83
MAFB-409	10/15/04	0.62	0.36F,J
MAFB-411	10/15/04	1.7	<0.50R
MAFB-412	10/18/04	0.33F	<0.50

Modified from: MWH, 2005. *Annual and Fourth Quarter 2004 Groundwater Monitoring Report*. Final. September.

Figure 7-11
PCE and cis-1,2-DCE Isoconcentration Contours
Northeast Plume Area
Fourth Quarter 2004
Former Mather Air Force Base
Sacramento County, California

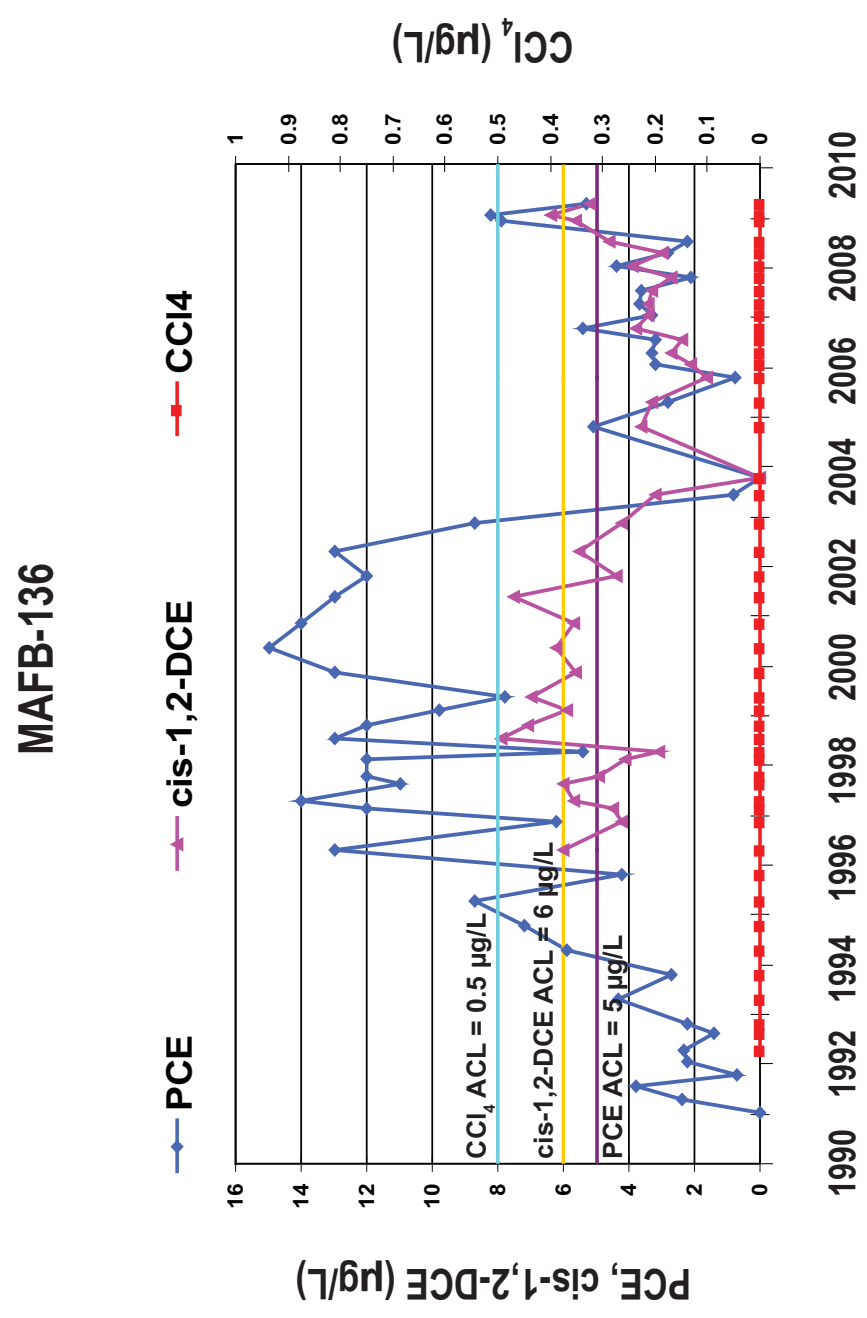
L:\Projects\MAFB\Five_Year_Review\ArcMaps\NE_area_GW_Plumes_4Q04.mxd RK 07.29.10 SAC



Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.
MWH, 2009. *Second Quarter 2009 Groundwater Monitoring Program Factsheet, Former Mather Air Force Base, California*. August.

Mather\5-Yr Review\08-10-Mather-time-conc-plots.indd - VMG 08/10/10 SAC 1

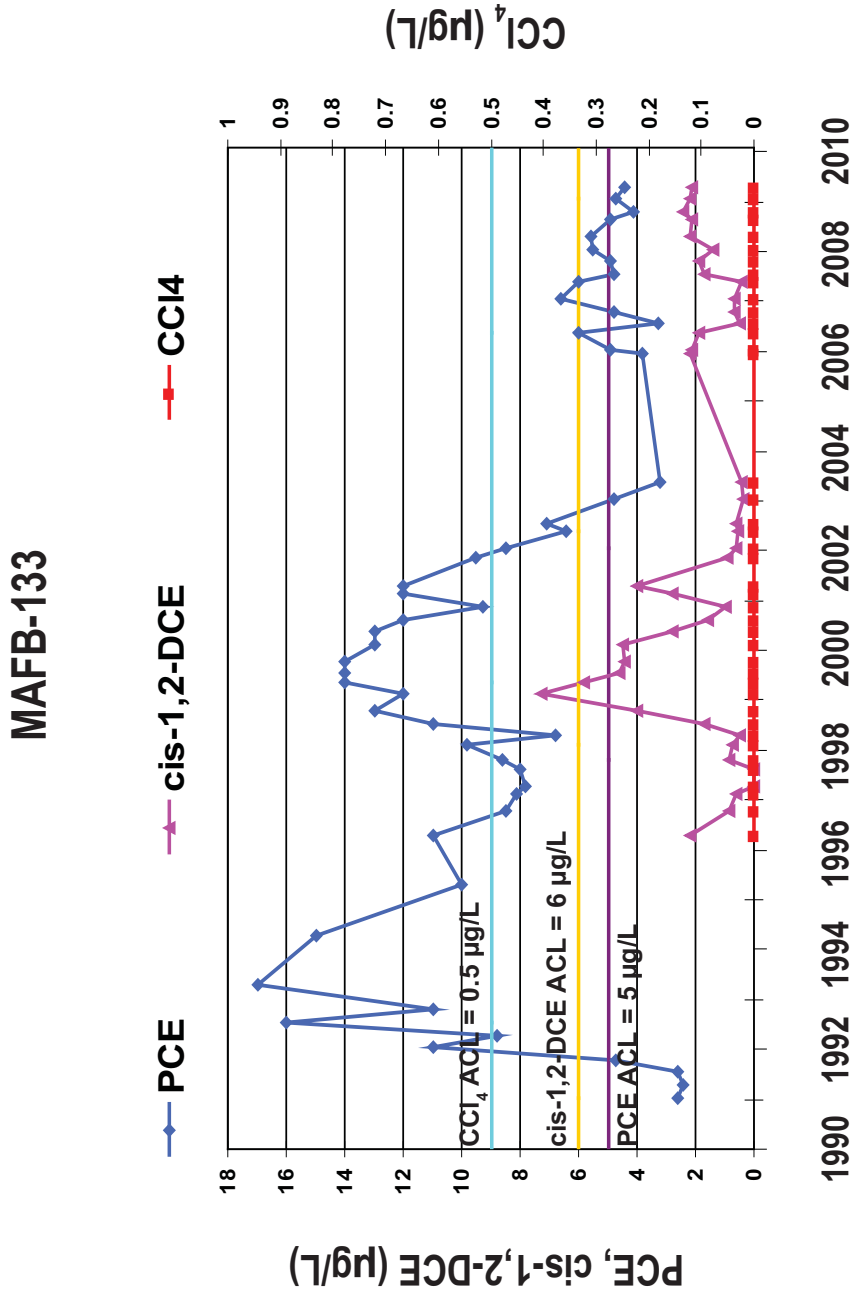
Figure 7-12. Time-Concentration Plot, MAFB-132, Northeast Plume, Former Mather Air Force Base, Sacramento County, California



Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.
MWH, 2009. *Second Quarter 2009 Groundwater Monitoring Program Factsheet, Former Mather Air Force Base, California*. August.

Mather\5-Yr Review\08-10-Mather-time-conc-plots.indd - VMG 08/09/10 SAC 3

Figure 7-13. Time-Concentration Plot, MAFB-136, Northeast Plume, Former Mather Air Force Base, Sacramento County, California



Modified from: MWH, 2010. *Annual and Fourth Quarter 2008 Groundwater Monitoring Program, Mather Air Force Base, Sacramento County, California*. Final. January.
MWH, 2009. *Second Quarter 2009 Groundwater Monitoring Program Factsheet, Former Mather Air Force Base, California*. August.

Mather\5-Yr Review\08-10-Mather-time-conc-plots.indd - VMG 08/09/10 SAC 2

Figure 7-14. Time-Concentration Plot, MAFB-133, Northeast Plume, Former Mather Air Force Base, Sacramento County, California

8.0 ISSUES IDENTIFIED DURING FIVE-YEAR REVIEW

This section summarizes issues that arose because of the technical assessment or because of concerns raised by the regulatory agencies. No issues were identified for Sites WP-07/FT-11 and SD-59 in the Soil OU; Sites LF-03 and LF-04 in the Landfill OU; or Sites FT-10C/ST-68, LF-18, OT-23C, and OT-87 in the Basewide OU.

8.1 AC&W OU

Boeing extraction well EX-2 is located northeast, regionally upgradient, of the AC&W Plume and is completed in Unit D, in the horizon just below Unit C that contains the AC&W Plume. The well began operating in 2006 to remove perchlorate not associated with Mather or the AC&W Plume. Upward vertical gradients induced by pumping for the AC&W remedial action have helped to limit or prevent downward transport of TCE into Unit D. Vertical gradient analysis conducted in 2006 showed that upward vertical gradients in the western and central portions of the AC&W Plume do not appear affected by pumping in EX-2. However, vertical gradients in the eastern (upgradient) portions of the plume may have been reversed or weakened by pumping from the EX-2 well (MWH, 2010b). Groundwater samples collected from monitoring wells completed in Unit D in the eastern portions of the plume area did not have any detections of TCE in 2007 and 2008.

All the operating extraction wells and most monitoring wells at the AC&W Site have shown decreasing TCE concentration trends in response to the remedial action since 1997. These trends have generally continued during the last five years with two of the extraction wells exhibiting asymptotic concentrations. One extraction well has had TCE concentrations less than the ACL since the second quarter of 2006, and another well had a TCE concentration less than the ACL starting in the second quarter of 2008. Trends in monitoring and extraction wells along the center axis of the plume show TCE concentrations have been stable to decreasing over the last two years (MWH, 2010b). The extraction wells with TCE concentrations less than ACLs should be considered for rebound testing and evaluated against the decision logic for shutting down extraction wells (Figure 4-7). Information from the rebound testing may be used to optimize the system and used in modeling to predict time frames for full remediation of the plume.

8.2 Groundwater OU

Main Base/SAC Area Plume. The interpreted extent of CCl_4 greater than the MCL in Unit B increased in an area near Happy Lane in 2008 (MWH, 2010b). This increase was due to recent CCl_4 detections in existing monitoring wells and newly installed well MAFB-451 (Figure 7-4), and reinterpretation of the Unit B portion of the plume. This resulted in a CCl_4 plume interpretation in this area that is more continuous than previous interpretations. Information from the Southwest Lobe CZA suggests the eastern portions of the plume in this area may be captured by new extraction well MBS EW-13BuB (MWH, 2009k). The western portions of this plume area may be captured by pumping from the Juvenile Hall water-supply wells. However, continued monitoring and analysis may be warranted to evaluate concentration trends and confirm capture of this portion of the plume.

Sampling results from the new monitoring wells generally define the extent of the Southwest Lobe of the Main Base/SAC Area Plume to ACLs or near ACLs. Evaluations conducted for the Southwest Lobe CZA show that extraction well MBS EW-13BuB (brought online in April 2008) captures much of the Southwest Lobe (MWH, 2009k). However, the conclusions regarding definition and capture of the lobe are based on only a few rounds of sampling. In addition, samples collected in 2009 from off-base well OFB-72 had detectable concentrations of TCE at 3.8 and 3.6 µg/L. OFB-72 is located approximately 2,700 feet southwest of monitoring wells MAFB-457Bs and MAFB-458Bd. Wells MAFB-457Bs and MAFB-458Bd have had TCE concentrations greater than the ACL. Two dual completion monitoring

wells (MAFB-460Bs/Bd and MAFB-461Bs/Bd) were installed in late 2009 in the area of OFB-72 to better define the extent of the Southwest Lobe and collect potentiometric data in the vicinity of the leading edge of the plume (MWH, 2010c). MAFB-460Bs/Bd is located approximately 700 feet northeast of OFB-72 and approximately 2,050 feet southwest of MAFB-458Bs/Bd and MAFB-457Bs/Bd. Initial sample results from MAFB-460Bs/Bd were less than the ACL for TCE. TCE was not detected in the initial samples collected from MAFB-461Bs/Bd (located approximately 1,150 feet west and slightly south of MAFB-460Bs/Bd). Additional monitoring of these new wells will aid in confirming this definition of the extent of the Southwest Lobe.

The Air Force installed a wellhead treatment system at the Moonbeam Drive water-supply well (Figure 4-5) in 1997 and has maintained the GAC system since in compliance with the Contingency Plan. The well has had more than six consecutive monthly samples with concentrations of COCs less than one-half MCLs. A six-month advance notice of termination of wellhead treatment maintenance at the Moonbeam Drive supply well was submitted to Cal Am (AFRPA, 2009f). The memorandum states that the Air Force plans to terminate the maintenance of the system (six months from 9 March 2009) in accordance with the Contingency Plan. Termination of maintenance would take place on or after 9 September 2009.

Several extraction wells were offline for a portion of 2008 due to decreasing capacity at the injection wells. Two injection wells (MBS IW-502 and MBS IW-503) were redeveloped to help restore the capacity of the treatment system (MWH, 2010b). MBS IW-502 was taken offline for redevelopment in May 2008 and was returned to service in September 2008; the operating injection capacity increased from approximately 300 gpm to 900 gpm. MBS IW-503 was taken offline in September 2008 and was returned to service in October 2008; the operating injection capacity increased from approximately 450 gpm to greater than 1,000 gpm. Extraction wells were returned to service as injection capacity allowed. Redevelopment of the two injection wells has provided the necessary capacity to operate all extraction wells in the system at their target flow rates. However, it is anticipated that the operational capacity of the injection wells will once again decrease. During the redevelopment of the injection wells, supplemental surface discharge to the West Ditch was planned. The outfall structure was constructed during 2009, and startup testing occurred in September 2009. However, concurrence has not yet been received from the RPMs for routine operation.

Site 7 Plume. Performance monitoring of the Site 7 Plume remedial action since the system was restarted in December 2006 has demonstrated COC removal from groundwater. Evaluation of 2007 monitoring data and a more detailed CZA for Site 7 conducted in 2009 suggest a majority of the plume is being captured by the extraction system (MWH, 2010b). Continued monitoring is warranted to evaluate concentration trends and confirm capture of the plume.

Northeast Plume. The area of the plume exceeding the ACLs has decreased over time since groundwater monitoring began. Well MAFB-132 has the highest concentration of PCE and cis-1,2-DCE in the plume. From approximately 2003 until the fourth quarter of 2006, the well had increasing PCE and cis-1,2-DCE concentration trends. Subsequently, there has been an overall decreasing trend in concentrations of these constituents through the second quarter of 2009. If the decreasing trend in PCE and cis-1,2-DCE concentrations at MAFB-132 persist at the current rate, concentrations less than the ACLs may be attained within the next five years. PCE concentrations at MAFB-136 since 2006 had been less than the ACL until an increase greater the ACL occurred in the fourth quarter of 2008. The concentration decreased to just above the ACL in the second quarter of 2009.

The Groundwater OU ROD included a commitment to perform modeling prior to the first five-year review, to predict how much time will be required for the contaminant concentrations to decrease to less than the ACLs. The modeling was not accomplished for that review. However, an evaluation of the

Northeast Plume was conducted in 2001 and 2002 (AFBCA, 2002). Inspection of the wells with contaminant detections revealed that the concentrations exhibited sporadic patterns that did not allow confident predictions of future concentrations. The report recommended continued monitoring of the Northeast Plume as opposed to initiating active remediation. It also recommended a similar evaluation be conducted periodically as monitoring data warrant, but no less frequently than the five-year reviews.

The second five-year review stated that future predictive modeling was potentially viable based on the evident initial decreasing contaminant concentration trends observed within that time period. The forecast would be dominated by predictions based on results from well MAFB-132, which was the only well with concentrations significantly greater than ACLs. The report recommended that the annual groundwater monitoring reports provide projections and an assessment of trends in the wells with the highest concentrations that may indicate when ACLs might be reached.

The recommendation in the last five-year review remains valid. It appears that decreasing PCE and/or cis-1,2-DCE concentration trends at MAFB-132 from 2006 through 2009 allow the projection of concentrations of these analytes to at or less than the ACLs. Trend extrapolation was conducted for PCE and cis-1,2-DCE data from MAFB-132. The extrapolation suggests that if the trends through 2009 continue, ACLs would be reached in 2012 (extrapolation of a best-fit linear trend line) or 2025 (extrapolation of a best-fit exponential trend line). The trend analysis was conducted using standard curve-fitting formulas found in Microsoft Excel 2007. If the assumption that the area near MAFB-132 will require the longest time to achieve ACLs holds true (MAFB-132 has had the highest concentrations of PCE and cis-1,2-DCE), and the trends observed from 2006 through 2009 continue, the Northeast Plume will meet ACLs around 2025. However, the prediction is not intended to be relied upon with any great certainty, but rather to indicate whether at this time modeling indicates that the contaminants will not meet the ACLs within a reasonable time, or at least forty years from the date of the ROD. It is too early to determine whether the recent concentration decreases at MAFB-136 indicate a consistent trend.

8.3 Soil OU

Site 37/39/54. Residual contaminants adsorbed to fine-grained, high moisture content soils are difficult to remediate and are prolonging achievement of the RAOs for Site ST-37/ST-39/SS-54. Performing status quo SVE may not be adequate because SVE readily becomes diffusion-limited and is inefficient.

Site 57. Concentrations of TCE have generally decreased across the site to concentrations less than 1 ppmv. Only two locations (57-MPMP-11/57-PZ-11 and 57-MPMP-12/57-PZ-12) in the deep vadose zone at the site exhibit TCE vapor concentrations of approximately 2 ppmv, and the contaminants are contained within the moist smear zone just above the water table at the transition between the vadose zone and the saturated zone. Removal of contaminants in these conditions through SVE is not likely to be technically achievable or cost effective.

8.4 Institutional Controls

Sites WP-12 (AC&W Site) and OT-89. The Air Force is required to conduct annual monitoring, provide annual reports and undertake prompt action to address activity that is inconsistent with the IC objective or use restrictions, or any action that may interfere with IC effectiveness. The requirements for annual monitoring reports were instituted in 2006 for the Basewide OU Site OT-89 (AFRPA, 2006) and in 2008 for Site WP-12 (the AC&W Site) (AFRPA, 2008a). Through 2008, annual monitoring reports on the status of ICs for Sites OT-89 and WP-12 have not been completed. These annual monitoring reports are also necessary in the preparation of five-year reviews to evaluate the effectiveness of the ICs.

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

This section provides recommendations and follow-up actions to address issues identified in the technical assessment as described in Section 8.0. No recommendations or follow-up actions were identified for Sites WP-07/FT-11 and SD-59 in the Soil OU; Sites LF-03 and LF-04 in the Landfill OU; or Sites FT 10C/ST-68, LF-18, OT-23C, and OT-87 in the Basewide OU.

9.1 AC&W OU

Continue sampling of the Unit D monitoring wells in the eastern portion of the plume area near Boeing extraction well EX-2 to help confirm pumping from the extraction well is not causing migration of TCE into Unit D.

Implement plans to shut down extraction wells with TCE concentrations less than ACLs and monitor for potential rebound while maintaining plume capture. Continued progress of the remedy has been evident during the last five years with two extraction wells exhibiting asymptotic levels. One extraction well has also had TCE concentrations less than the ACL since the second quarter of 2006, and another well had a TCE concentration less than the ACL in the second quarter of 2008. The plume appears to be shrinking in size and trends in monitoring and extraction wells along the center axis of the plume show TCE concentrations have been stable to decreasing over the last two years. Data collected from the rebound monitoring may be used to optimize the system and to predict (via modeling) when ACLs may be achieved.

9.2 Groundwater OU

Main Base/SAC Area Plume. Continue monitoring and evaluation of sample results from Unit B wells in the area near Happy Lane. The interpreted extent of CCl_4 greater than the MCL in Unit B increased in the area near Happy Lane in 2008. Data evaluation and the Southwest Lobe CZA suggest this area of the plume is captured by extraction well MBS EW-13BuB and the Juvenile Hall supply wells. The sampling results will be used to assess concentration trends and confirm capture of this portion of the plume.

Continue monitoring of newly installed monitoring wells MAFB-460Bs/Bd and MAFB-461Bs/Bd in the area of OFB-72. Initial sampling of these wells defined the extent of the Southwest Lobe to ACLs. Additional monitoring will aid in confirming this definition of the extent of the Southwest Lobe and the extent of capture by extraction well MBS EW-13BuB. In addition, continue monitoring the off-site private wells in the area of the Southwest Lobe to confirm the wells are not impacted.

Implement the termination of wellhead treatment maintenance at the Moonbeam Drive supply well. The well has had six consecutive monthly samples with concentrations of COCs less than one-half MCLs. A memorandum to Cal Am (AFRPA, 2009f) states that the Air Force plans to terminate the maintenance of the system (six months from 9 March 2009) in accordance with the Contingency Plan. The well will continue to be sampled as part of the off-base water-supply well monitoring program.

Site 7 Plume. Continue monitoring and evaluate results relative to the detailed CZA of the Site 7 Plume conducted in 2009. The 2009 CZA incorporated data not available during the earlier capture analysis that used data through 2007. The results of future monitoring may be used to evaluate future system performance, demonstrate capture of the plume, and show progress of the remedy toward achieving objectives.

Northeast Plume. Continue to monitor and evaluate concentration trends at monitoring wells MAFB-132, MAFB-133, and MAFB-136. ACLs are currently predicted to be achieved by approximately

2025 at MAFB-132, which is assumed to require the longest time to achieve ACLs in the Northeast Plume. It is too early to determine whether the recent concentration decreases at MAFB-136 indicate a consistent trend. Predictions of time to achieve ACLs should be updated periodically (e.g., as part of each five-year review) to incorporate future monitoring results.

9.3 Soil OU

Site 37/39/54. Evaluate alternative remediation approaches (e.g., excavation of shallow soils) or enhancements/modifications (e.g., fracturing or thermal enhancement technologies) to the SVE remedy that are capable of expediting cleanup of residual contamination adsorbed to low-permeability soil.

Site 57. As previously recommended in SVE semiannual reports (e.g., MWH, 2008d), conduct vadose zone modeling at Site 57 to determine whether the residual contaminant concentrations in the deep vadose zone just above the water table will result in sufficient mass flux to groundwater to result in aqueous concentrations that exceed ACLs. If contaminant concentrations will impact groundwater, conduct a cost-benefit analysis to assess the need for additional deep SVE wells versus allowing concentrations to persist and be remediated by the Main Base/SAC Area Plume groundwater treatment system.

9.4 Institutional Controls

Sites WP-12 (AC&W Site) and OT-89. Ensure that the ICs established in the RODs, ESDs, and the Landfill OU memorandum of post-ROD changes, are monitored on an annual basis, as required, and establish an ICs checklist and monitoring program. In addition, following signature on the Soil OU and Groundwater OU ESD and Basewide OU ESD, annual IC monitoring will be required at the sites noted in those documents.

10.0 PROTECTIVENESS STATEMENT

The following statements address the protectiveness of the remedial actions taken at Mather for each OU.

10.1 AC&W OU

The remedy for the AC&W OU is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

10.2 Groundwater OU

The remedies for the Groundwater OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Soil OU and Groundwater OU ESD that is pending authorizing signatures.

10.3 Soil OU

The remedies for the Soil OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Soil OU and Groundwater OU ESD that is pending authorizing signatures.

10.4 Landfill OU

The remedies for the Landfill OU are protective of human health and the environment.

10.5 Basewide OU

The remedies for the Basewide OU currently protect human health and the environment in the short term. However, in order for the remedies to be protective in the long term, ICs must be implemented per the Basewide OU ESD that is pending authorizing signatures.

10.6 Supplemental Basewide OU

The remedy for the Supplemental Basewide OU is protective of human health and the environment.

10.7 Comprehensive Protectiveness Statement for Mather

The remedial actions at the AC&W OU, Landfill OU, and Supplemental Basewide OU are protective. However, because the remedial actions at the Groundwater, Soil, and Basewide OUs are not protective in the long term, the site is not protective of human health and the environment at this time. The remedial actions at these OUs are not protective because ICs are not in place. To ensure protectiveness, ICs need to be implemented per the Soil OU and Groundwater OU ESD and Basewide OU ESD that are pending authorizing signatures.

AUTHORIZING SIGNATURES

Robert Moore, Director
Air Force Real Property Agency
U.S. Air Force

Date

Michael Montgomery, Assistant Director
Federal Facilities and Site Cleanup Branch
Region 9
U.S. Environmental Protection Agency

Date

Allen Wolfenden, Performance Manager
Brownsfield and Environmental Restoration
Sacramento Cleanup Branch
Department of Toxic Substances Control
California Environmental Protection Agency

Date

11.0 NEXT FIVE-YEAR REVIEW

The fourth five-year review for Mather will span the time period from 2009 through 2013 and is required to be completed no later than five years from the date of this third five-year review. Actions taken in response to recommendations in this third five-year review and any future optimization of or modifications to the remedies selected in the five RODs will be evaluated in the fourth five-year review to ensure that the remedies continue to be protective of human health and the environment.

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APPENDIX A

Operational and Remedial Histories of the SVE/Bioventing Systems

(Source: MWH, 2009. *2008 Soil Vapor Extraction/Bioventing Annual Monitoring Reports for Sites 7/11, 10C/68, 18, 23C, 29/71, 37/39/54, 57, and 59*)

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OPERATIONAL AND REMEDIAL HISTORY,
SITE 7/11
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
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	Event	Start Date	End Date
1)	Construction Bids and Procurement	15-Jul-97	3-Oct-97
2)	SVE System Procurement	28-Jul-97	3-Oct-97
3)	Well Drilling and Installation	29-Aug-97	1-Jan-98
4)	Perched Zone Dewatering	1-Jan-98	1-Apr-98
5)	SVE Pilot Test	1-Apr-98	1-Jun-98
6)	SVE System Installation	29-Jun-98	28-Sep-98
7)	SVE System Startup and Proveout	21-Sep-98	19-Feb-99
8)	SVE System Operation (Catalytic Mode)	4-Mar-99	13-May-99
9)	SVE System Shut Down and Aboveground Piping Removed During Construction of Engineered Landfill Cap	14-May-99	25-Oct-99
10)	Aboveground Piping Reinstallation	26-Oct-99	17-Dec-99
11)	Rotary Lobe Blower Repair	26-Nov-99	1-Jan-00
12)	SVE System was Restarted for Compliance and Wellhead Sampling, then Shut Down	4-Feb-00	8-Feb-00
13)	SVE System was Restarted for Compliance and Wellhead Sampling, then Shut Down	28-Feb-00	8-Mar-00
14)	SVE System was Restarted and Optimized	31-Mar-00	18-Apr-00
15)	SVE System was Shut Down for Rebound Test	19-Apr-00	15-May-00
16)	Catalyst was Removed and SVE System Operated in Thermal Mode	16-May-00	22-May-00
17)	SVE System was Shut Down for Respiration Test	23-May-00	12-Jun-00
18)	SVE System Operation (Thermal Mode)	13-Jun-00	28-Jun-00
19)	SVE System was Shut Down for Rebound Test	29-Jun-00	7-Jul-00
20)	SVE System Operation (Thermal Mode)	7-Jul-00	11-Aug-00
21)	SVE System was Shut Down for Weekly Cycling and Repairs to Pressure Switch	11-Aug-00	29-Aug-00

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OPERATIONAL AND REMEDIAL HISTORY,
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MATHER AIR FORCE BASE
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	Event	Start Date	End Date
22)	SVE System Operation Cycled (4 days on, 3 days off)	29-Aug-00	30-Nov-00
23)	SVE System was Shut Down for Rebound Test	30-Nov-00	14-Dec-00
24)	SVE System Operation (Thermal Mode)	14-Dec-00	22-Dec-00
25)	SVE System was Shut Down for Rebound Test	22-Dec-00	3-Jan-01
26)	SVE System Operation (Thermal Mode)	3-Jan-01	1-Feb-01
27)	SVE System was Shut Down for Rebound Test	1-Feb-01	6-Mar-01
28)	SVE System Operation (Thermal Mode)	6-Mar-01	4-Sep-01
29)	SVE System was Shut Down for Gas Migration Sampling at Landfill Site 7	4-Sep-01	13-Sep-01
30)	SVE System was Restarted for Compliance Sampling	13-Sep-01	14-Sep-01
31)	SVE System was Shut Down for Gas Migration Sampling at Landfill Site 7	14-Sep-01	28-Sep-01
32)	SVE System Operation (Thermal Mode)	28-Sep-01	1-Oct-01
33)	SVE System was Shut Down Due to Propane Refueling Issues (heightened airport security)	1-Oct-01	10-Oct-01
34)	SVE System Operation Cycled (4 days off, 3 days on)	10-Oct-01	5-Nov-01
35)	SVE System was Shut Down Due to Propane Refueling Issues (Heightened Airport Security)	5-Nov-01	14-Nov-01
36)	SVE System Operation Cycled (4 days off, 3 days on)	14-Nov-01	8-Mar-02
37)	SVE System was Shut Down for Rebound Test	8-Mar-02	1-Apr-02
38)	SVE System Operation Cycled (4 days off, 3 days on)	1-Apr-02	18-Jun-02
39)	SVE System was Shut Down for Rebound Test	18-Jun-02	3-Jul-02
40)	SVE System Operation Cycled (4 days off, 3 days on)	3-Jul-02	23-Aug-02
41)	SVE System was Shut Down for Rebound Test	23-Aug-02	4-Sep-02
42)	SVE System Operation Cycled (4 days off, 3 days on)	4-Sep-02	7-Oct-02

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OPERATIONAL AND REMEDIAL HISTORY,
SITE 7/11
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
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	Event	Start Date	End Date
43)	Installation of Horizontal Extraction Well 7-HBV-16	20-Sep-02	20-Sep-02
44)	Aspiration Test at 7-MP-5	17-Sep-02	22-Oct-02
45)	SVE System was Shut Down for Rebound Test	7-Oct-02	22-Oct-02
46)	SVE System Operation Cycled (4 days off, 3 days on)	22-Oct-02	21-Nov-02
47)	Shut Down for SMAQMD Substantive Requirement Compliance Issue	5-Nov-02	6-Nov-02
48)	SVE System was Shut Down for Rebound Test	21-Nov-02	11-Dec-02
49)	SVE System Operation Cycled (4 days off, 3 days on)	11-Dec-02	6-Jan-03
50)	SVE System Operation Cycled (4 days on 3 days off)	6-Jan-03	7-Mar-03
51)	SVE System was Shut Down for Quarterly Landfill Monitoring	7-Mar-03	20-Mar-03
52)	SVE System Operation Cycled (4 days off, 3 days on)	20-Mar-03	23-May-03
53)	SVE System was Shut Down for Rebound Test and Quarterly Landfill Monitoring	23-May-03	30-Jun-03
54)	SVE System Operation Cycled (4 days off, 3 days on)	30-Jun-03	2-Aug-03
55)	SVE System Shut Down for Quarterly Landfill Monitoring	2-Aug-03	13-Aug-03
56)	SVE System Operation Cycled (4 days off, 3 days on)	13-Aug-03	26-Aug-03
57)	SVE System Operation on Continuous Schedule	26-Aug-03	18-Nov-03
58)	SVE System Shut Down for Rebound Test, Quarterly Landfill Monitoring, and Blower Motor Repairs	18-Nov-03	13-Apr-04
59)	SVE System Operation on Continuous Schedule	13-Apr-04	11-May-04
60)	SVE System Shut Down Due to System Vibrations	11-May-04	19-May-04
61)	SVE System Operation on Continuous Schedule	19-May-04	11-Jun-04
62)	SVE System Shut Down for Rebound Testing	11-Jun-04	13-Jul-04
63)	SVE System Operational on Continuous Schedule	13-Jul-04	13-Aug-04

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OPERATIONAL AND REMEDIAL HISTORY,
SITE 7/11
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Event	Start Date	End Date
64) SVE System Shut Down for Rebound Testing at Site 11, Site 7 Third and Fourth Quarter Landfill Monitoring, and to Evaluate Conversion to Bioventing at Site 7/11	13-Aug-04	28-Dec-04
65) SVE System Diagonosed with Faulty Thermal Couple, Motor Conductor, Secondary Thermal Couple. Repairs Being Performed	28-Dec-04	25-Jan-05
66) Optimal Operating Schedule Testing Being Performed	25-Jan-05	8-Mar-05
67) SVE System Operation Cycled (4 days off, 3 days on)	8-Mar-05	8-Jun-05
68) SVE System Shut Down for Respiration Testing	8-Jun-05	6-Jul-05
69) SVE System Operation Cycled (4 days off, 3 days on)	6-Jul-05	25-Aug-05
70) SVE System Shut Down for 3rd Quarter Landfill Monitoring	25-Aug-05	8-Sep-05
71) SVE System Operation Cycled (4 days off, 3 days on)	8-Sep-05	13-Sep-05
72) SVE System Shut Down for Respiration Testing	13-Sep-05	26-Sep-05
73) SVE System Operation Cycled (4 days off, 3 days on)	26-Sep-05	4-Nov-05
74) SVE System Shut Down for 4th Quarter Landfill Monitoring	4-Nov-05	14-Nov-05
75) SVE System Operation Cycled (4 days off, 3 days on)	14-Nov-05	30-Dec-05
76) SVE System Shut Down for Rebound Testing	30-Dec-05	6-Feb-06
77) SVE System Operation Cycled (4 days off, 3 days on)	6-Feb-06	16-Mar-06
78) SVE System Shut Down for System Evaluation (Evaluation samples collected Oct-06)	16-Mar-06	31-Dec-06
79) SVE System Shut Down for System Evaluation and Biovent System Maintenance (Maintenance performed 6-Apr-07)	31-Dec-06	10-Apr-07
80) Biovent System Operation Begins (1,200-cfm blower)	10-Apr-07	8-May-07
81) Biovent System Shut Down for Well Network Reconfiguration	8-May-07	15-May-07
82) Biovent System Operational	15-May-07	23-May-07
83) Biovent System Shut Down due to Clogged Air Filters	23-May-07	1-Jun-07
84) Biovent System Operational	1-Jun-07	3-Jul-07

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OPERATIONAL AND REMEDIAL HISTORY,
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	Event	Start Date	End Date
85)	Biovent System Shut Down for Rebound, Blower Maintenance	3-Jul-07	13-Jul-07
86)	Biovent System Operational	13-Jul-07	22-Jul-07
87)	Biovent System Shut Down for High Vacuum Alarm	22-Jul-07	26-Jul-07
88)	Biovent System Operational	26-Jul-07	3-Aug-07
89)	Biovent System Shut Down for Rebound Testing	3-Aug-07	8-Aug-07
90)	Biovent System Operational	8-Aug-07	23-Aug-07
91)	Biovent System Shut Down due to Leaky Gasket	23-Aug-07	6-Sep-07
92)	Replaced Gasket, System not Restarted	6-Sep-07	11-Sep-07
93)	Biovent System Operational	11-Sep-07	27-Sep-07
94)	Biovent System Shut Down for Rebound, Drilling Activities, and Landfill Cap Regrading	27-Sep-07	12-Feb-08
95)	Biovent System Operational	12-Feb-08	30-May-08
96)	Biovent System Shut Down for Blower Maintenance	30-May-08	2-Jun-08
97)	Biovent System Operational	2-Jun-08	8-Aug-08
98)	Biovent System Shut Down for Rebound Testing	8-Aug-08	4-Nov-08
99)	Biovent System Operational	4-Nov-08	8-Dec-08
100)	Biovent System Shut Down for Maintenance Repairs	8-Dec-08	10-Dec-08
101)	Biovent System Operations	10-Dec-08	31-Dec-08

Notes:
SVE - Soil Vapor Extraction
SMAQMD - Sacramento Metropolitan Air Quality Managment District

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OPERATIONAL AND REMEDIAL HISTORY
SITE 10C/68 SVE/BIOVENTING SYSTEM
MATHER AIR FORCE BASE
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	Event	Start Date	End Date
1)	Mobilization of Equipment	16-Sep-96	24-Jan-97
2)	Notice to Proceed	30-Sep-96	-----
3)	Well Drilling Program	6-Jan-97	6-Mar-97
4)	Shallow SVE Pilot Test	7-Apr-97	8-Apr-97
5)	Catalytic Oxidizer Shallow SVE System Installation	1-May-97	5-Aug-97
6)	Catalytic Oxidizer Shallow SVE System Startup and Proveout	15-Aug-97	21-Sep-97
7)	Catalytic Oxidizer Shallow SVE System Operation	15-Aug-97	3-Dec-97
8)	Catalytic Oxidizer Shallow SVE System Shut Down for Rebound Testing and GAC System Installation	3-Dec-97	19-Jun-98
9)	Shallow SVE/Bioventing System Installation	3-Dec-97	19-Jun-98
10)	Rebound Sampling and Analysis	25-Feb-98	26-Feb-98
11)	Bioventing Pilot Testing	19-Jun-98	12-Jul-98
12)	Respiration Test for Shallow Bioventing System	13-Jul-98	15-Jul-98
13)	Shallow SVE Pilot Testing and Data Analysis	16-Jul-98	11-Aug-98
14)	Shallow Bioventing System Startup	12-Aug-98	10-Sep-98
15)	Respiration Test	11-Sep-98	15-Oct-98
16)	Shallow Bioventing System Shut Down, Rebound Period	21-Dec-98	22-Jan-99
17)	Deep SVE Pilot Testing	23-Jan-99	8-Feb-99
18)	Shallow Bioventing System Operation	15-Feb-99	23-Jun-99
19)	Pressure Transducer Deep SVE Extraction Test	31-Mar-99	31-Mar-99
20)	Compliance Source Testing of the Deep SVE System	23-Jun-99	23-Jun-99
21)	Operation of the Deep SVE System	28-Jun-99	19-Aug-99
22)	Deep SVE System Shut Down for Test Soil Vapor Sampling	19-Aug-99	26-Aug-99
23)	Operation of the Deep SVE System	26-Aug-99	22-Oct-99
24)	Deep SVE Shut Down Test for Groundwater Sampling	22-Oct-99	4-Nov-99
25)	Operation of the Deep SVE System	4-Nov-99	18-Nov-99
26)	Barometric/Subsurface Pressure Testing	18-Nov-99	22-Nov-99
27)	Operation of the Deep SVE System	22-Nov-99	2-Dec-99
28)	Shallow SVE Performance Sampling	2-Dec-99	23-Dec-99

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OPERATIONAL AND REMEDIAL HISTORY
SITE 10C/68 SVE/BIOVENTING SYSTEM
MATHER AIR FORCE BASE
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Event	Start Date	End Date
29) Operation of the Deep SVE System	23-Dec-99	19-Jan-00
30) Operation of the Bioventing System	19-Jan-00	2-Feb-00
31) Respiration Testing	2-Feb-00	9-Mar-00
32) Operation of the Bioventing System	9-Mar-00	25-May-00
33) Data Gap Drilling and Investigation	25-May-00	30-May-00
34) Operation of the Bioventing System	31-May-00	13-Jul-00
35) Respiration Testing	13-Jul-00	25-Aug-00
36) Operation of the Bioventing System	25-Aug-00	13-Oct-00
37) Conducting ROI Test	13-Oct-00	25-Oct-00
38) Operation of the Bioventing System	25-Oct-00	26-Feb-01
39) Respiration Testing	26-Feb-01	15-Jul-01
40) Moved Thermal Oxidizer SVE from Site 29 to Site 10C/68	8-Mar-01	8-Mar-01
41) Performing Routine O&M	15-Jul-01	22-Aug-01
42) SVE Pilot Test	22-Aug-01	2-Oct-01
43) Operation of the SVE System	2-Oct-01	9-Jan-02
44) Conducting Rebound Test	9-Jan-02	29-Jan-02
45) Operation of SVE System	29-Jan-02	15-Mar-02
46) Conducting Rebound Test (South of Truemper Way)	15-Mar-02	3-Sep-02
47) Performing Excavation Activities (Eleven trenches excavated North of Truemper Way)	3-Sep-02	30-Oct-02
48) Performing Magnetic Gradiometer Survey (Phase 1)	2-Oct-02	3-Oct-02
49) Installing and Sampling Six Horizontal Vapor Extraction Wells and Three Monitoring Probes	30-Oct-02	27-Nov-02
50) Preparing for and Conducting Pilot Study on Newly Installed Wells with Portable SVE System	27-Nov-02	5-Dec-02
51) Conducting SVE System and Well Configuration Evaluations and Long Term Rebound Test	5-Dec-02	26-Mar-03
52) Conducting SVE Pilot Test (North of Truemper Way)	26-Mar-03	28-Mar-03
53) System Shutdown for Rebound Testing and Determining Substantive Requirements	28-Mar-03	27-Jun-03
54) Performing Magnetic Gradiometer Survey (Phase 2)	14-May-03	15-May-03
55) Operation of the SVE System	27-Jun-03	5-Dec-03

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OPERATIONAL AND REMEDIAL HISTORY
SITE 10C/68 SVE/BIOVENTING SYSTEM
MATHER AIR FORCE BASE
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	Event	Start Date	End Date
56)	Field Investigation Performed to Verify Three Anomalies Discovered During the Magnetic Gradiometer Survey (Phase 2)	4-Aug-03	8-Aug-03
57)	System Shut Down for Rebound Testing and Compliance Issue	5-Dec-03	17-Mar-04
58)	Optimal Scheduling Testing being Conducted on SVE System	17-Mar-04	26-Mar-04
59)	Operation of SVE System	26-Mar-04	23-Apr-04
60)	System Shut Down for System Diagnosis and Tuning	23-Apr-04	26-May-04
61)	Operation of SVE System	26-May-04	8-Jun-04
62)	System Shut Down for Compliance Issue and Rebound Testing	8-Jun-04	12-Aug-04
63)	Performing Pilot Study	12-Aug-04	19-Aug-04
64)	System Shut Down to Perform Risk Calculation	19-Aug-04	8-Oct-04
65)	System Operating on a Continuous Basis	8-Oct-04	1-Nov-04
66)	System Shut Down to Repair System Blower and Modify System	1-Nov-04	18-Mar-05
67)	System Off-line Evaluation of Shallow Perched Zone	18-Mar-05	12-May-05
68)	New 650-scfm Rated SVE System in Operation	12-May-05	12-May-05
69)	Optimization Testing	12-May-05	2-Jun-05
70)	System Operating on a Continuous Basis	2-Jun-05	14-Jun-05
71)	System Shut Down for Respiration Testing	14-Jun-05	28-Jun-05
72)	System Operating on a Continuous Basis	28-Jun-05	1-Nov-05
73)	System Shut Down due to Heat Exchanger Fan Failure	1-Nov-05	11-Nov-05
74)	System Operating on a Continuous Basis	11-Nov-05	6-Jan-06
75)	System Shut Down due to Low Flow Conditions	6-Jan-06	6-Feb-06
76)	System Operating on a Continuous Basis	6-Feb-06	19-Apr-06
77)	System Shut Down for Rebound and System Evaluation	19-Apr-06	17-Dec-06
78)	System Shut Down for ROI Testing	18-Dec-06	21-Dec-06
79)	System Shut Down for System Evaluation	22-Dec-06	31-Dec-06
80)	System Shut Down for Rebound	31-Dec-06	3-Jan-07
81)	System Operating on a Continuous Basis	3-Jan-07	30-Jun-07
82)	System Shut Down for ROI Testing	16-Jul-07	25-Jul-07
83)	System Operating on a Continuous Basis	25-Jul-07	7-Aug-07
84)	System Shut Down for ROI Testing	7-Aug-07	8-Aug-07

TABLE 3-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 10C/68 SVE/BIOVENTING SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 4 of 4)

	Event	Start Date	End Date
85)	System Operating on a Continuous Basis	8-Aug-07	8-Oct-07
86)	System Shut Down for Additional Well Installations	8-Oct-07	18-Feb-08
87)	System Operating on a Continuous Basis	18-Feb-08	3-Jul-08
88)	System Shut Down for Maintenance Repairs	3-Jul-08	23-Jul-08
89)	System Operating on a Continuous Basis	23-Jul-08	28-Jul-08
90)	System Shut Down for Rebound and Closure Evaluations	28-Jul-08	31-Dec-08

Notes:
GAC - Granular Activated Carbon
O&M - Operations and Maintenance
ROI - Radius of Influence
SVE - Soil Vaper Extraction

TABLE 4-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 18 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 1 of 3)

Event	Start Date	End Date
1) First Phase Drilling Program	21-Sep-98	5-Dec-98
2) Second Phase Well Drilling Program	14-May-99	8-Jul-99
3) SVE System Installation	12-Oct-99	28-Oct-99
4) Catalytic Oxidizer System Startup and Operation	8-Feb-00	15-Jun-00
5) GAC System Startup and Proveout	15-Jun-00	7-Jul-00
6) SVE System Operation	7-Jul-00	24-Jul-00
7) SVE System Shutdown for Warranty Repairs	24-Jul-00	18-Oct-00
8) SVE System Operation	18-Oct-00	5-Dec-00
9) SVE System Shutdown for Repairs	5-Dec-00	14-Dec-00
10) SVE System Operatition	14-Dec-00	27-Feb-01
11) SVE System Shutdown for Repairs	27-Feb-01	30-Mar-01
12) SVE System Operation	30-Mar-01	1-Apr-01
13) SVE System Shutdown for Warranty Repairs	1-Apr-01	4-Apr-01
14) SVE System Operation	4-Apr-01	16-Apr-01
15) SVE System Shutdown for Warranty Repairs	16-Apr-01	23-Apr-01
16) SVE System Operation	23-Apr-01	1-May-01
17) SVE System Shutdown for Repairs to Blower and to conduct a long-term rebound test	1-May-01	26-Oct-01
18) Catalytic Oxidizer Removed from Service	2-Aug-01	2-Aug-01
19) SVE System Operation (GAC Mode)	26-Oct-01	19-Nov-01
20) SVE System Shutdown due to AWS high water level alarm	19-Nov-01	4-Dec-01
21) SVE System Operation (GAC Mode)	4-Dec-01	11-Dec-01
22) SVE System Shutdown due to AWS high water level alarm	11-Dec-01	18-Dec-01

TABLE 4-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 18 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 2 of 3)

Event	Start Date	End Date
23) SVE System Operation (GAC Mode)	18-Dec-01	8-Feb-02
24) SVE System Operation (GAC Mode) cycled (4 days on, 3 days off)	8-Feb-02	18-Jun-02
25) SVE System Shutdown for Rebound Test	18-Jun-02	28-Jun-02
26) SVE System Operation (GAC Mode) cycled (4 days on, 3 days off)	28-Jun-02	16-Nov-02
27) SVE System Shutdown for Rebound Test	16-Nov-02	2-Dec-02
28) SVE System Operation (GAC Mode) cycled (4 days on, 3 days off)	2-Dec-02	27-Dec-03
29) SVE System Operation (GAC Mode) cycled (3 days on, 4 days off)	31-Dec-02	23-May-03
30) SVE System Shutdown for Rebound Test	23-May-03	30-Jun-03
31) SVE System Operation (GAC Mode) cycled (3 days on, 4 days off)	30-Jun-03	18-Jul-03
32) SVE System Shutdown for Rebound Test	18-Jul-03	22-Aug-03
33) SVE System Operation (GAC Mode) Continuous	22-Aug-03	5-Dec-03
34) SVE System Shutdown for Rebound Test	5-Dec-03	9-Mar-04
35) SVE System Operation Continuous	9-Mar-04	23-Mar-04
36) SVE System Shut Down To Repair Blower	23-Mar-04	31-Mar-04
37) SVE System Operation Continuous	31-Mar-04	2-Apr-04
38) SVE System Shut Down Due to System Electrical Problem	2-Apr-04	8-Apr-04
39) SVE System Operation Continuous	8-Apr-04	16-Apr-04
40) SVE System Shut Down to Perform Pilot Study at Site 59, Addition of MAFB-105	16-Apr-04	19-Apr-04
41) SVE System Operation Continuous	19-Apr-04	17-May-04
42) SVE System Shut Down for Site Closure Evaluation	17-May-04	15-Mar-07

TABLE 4-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 18 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 3 of 3)

	Event	Start Date	End Date
43)	Site 18 Additional characterization Activities - One SVE and one Multi-probe Monitoring Well Installed	19-Apr-05	21-Apr-05
44)	SVE System Operational on Continuous Schedule	15-Mar-07	8-Oct-07
45)	SVE System Shut Down for Rebound and Drilling Activities at Site 59	8-Oct-07	9-Apr-08
47)	SVE System Operational on Continuous Schedule	9-Apr-08	5-Jun-08
48)	SVE System Shut Down for Utility Service Interruption	5-Jun-08	9-Jun-08
49)	SVE System Operational on Continuous Schedule	9-Jun-08	4-Aug-08
50)	Performed Pilot Vacuum Extraction Test at Site 59. Not Operating at Site 18.	4-Aug-08	11-Aug-08
51)	SVE System Operational on Continuous Schedule	11-Aug-08	15-Aug-08
52)	SVE System Shut Down for Rebound	15-Aug-08	1-Oct-08
53)	SVE System Operational on Continuous Schedule - Only Operating SVE-18-ES	1-Oct-08	12-Nov-08
54)	SVE System Shut Down for AWS Pump and Heat Exchanger Replacement - Site 18 Closure Evaluation	12-Nov-08	31-Dec-08

Notes:
AWS - Air Water Separator
GAC - Granular Activated Compound
SVE - Soil Vapor Extraction

TABLE 5-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 23C SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 1 of 4)

	Event	Start Date	End Date
1)	First Phase SVMP Drilling Program	19-Oct-98	13-Nov-98
2)	First Phase SVE Well Drilling Program	4-Jan-99	12-Jan-99
3)	Second Phase SVE Well & SVMP Drilling Program	23-Jun-99	20-Jul-99
4)	SVE System Installation	25-Oct-99	25-Feb-00
5)	Utility Installation	28-Feb-00	29-Mar-00
6)	CAT-OX System Startup and Proveout	12-Apr-00	28-Aug-00
7)	SVE System Operation	28-Aug-00	28-Nov-00
8)	System Shut Down Due to Water Accumulation in the Conveyance Piping	28-Nov-00	23-Jan-01
9)	SVE System Operation	23-Jan-01	18-Mar-01
10)	SVE Shut Down Due to Mechanical Problems	18-Mar-01	26-Mar-01
11)	SVE System Operation	26-Mar-01	1-Apr-01
12)	SVE Shut Down for Sound Insulation Installation	1-Apr-01	5-Apr-01
13)	SVE System Operation	5-Apr-01	24-Apr-01
14)	SVE Shut Down Due to pH Controller Problems	24-Apr-01	15-May-01
15)	SVE System Operation	15-May-01	31-May-01
16)	SVE Shut Down Due to Recirculation Pump Problems	31-May-01	11-Jun-01
17)	SVE System Operation	11-Jun-01	14-Jun-01
18)	SVE Shut Down Due to pH Problems	14-Jun-01	6-Jul-01
19)	SVE Shut Down for Rebound Testing	6-Jul-01	27-Aug-01
20)	SVE System Operation	27-Aug-01	2-Sep-01
21)	SVE Shut Down Due to Throwing Blower Drive Belt	2-Sep-01	26-Sep-01
22)	SVE System Operation	26-Sep-01	8-Oct-01
23)	SVE Shut Down Due to Recirculation Pump Problems	8-Oct-01	25-Oct-01
24)	SVE System Operation	25-Oct-01	11-Nov-01

TABLE 5-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 23C SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 2 of 4)

	Event	Start Date	End Date
25)	SVE Shut Down Due to Scrubber Problem	11-Nov-01	15-Nov-01
26)	SVE System Operation	15-Nov-01	19-Nov-01
27)	SVE Shut Down Due to Sight Glass Fouling	19-Nov-01	28-Nov-01
28)	SVE System Operation	28-Nov-01	1-Dec-01
29)	SVE Shut Down Due to Flame out problem and to clean combustion chamber	1-Dec-01	6-Dec-01
30)	SVE System Operation	6-Dec-01	24-Dec-01
31)	SVE Shut Down Due to Flame out problem and to clean UV sensor.	24-Dec-01	31-Dec-01
32)	SVE System Operation	31-Dec-01	28-Jan-02
33)	System Shut Down due to system conversion to GAC mode	28-Jan-02	13-Feb-02
34)	SVE System Operation	13-Feb-02	15-Mar-02
35)	SVE System Shut Down for Rebound Testing	15-Mar-02	23-Apr-02
36)	SVE System Operation	23-Apr-02	26-Mar-03
37)	SVE System Shut Down for Carbon Changeout	26-Mar-03	26-Mar-03
38)	SVE System Operation	26-Mar-03	9-Jun-03
39)	SVE Shut Down for Rebound Testing	9-Jun-03	24-Jun-03
40)	SVE System Operation	24-Jun-03	30-Jun-03
41)	SVE System Operation	30-Jun-03	26-Nov-03
42)	SVE Shut Down due to SMAQMD Compliance Issue and for Rebound Testing	26-Nov-03	7-Jan-04
43)	SVE System Operation	7-Jan-04	17-Jun-04
44)	SVE System Shut Down for Rebound Testing	17-Jun-04	1-Jul-04
45)	SVE System Operation	1-Jul-04	17-Nov-04
46)	SVE System Shut Down for Rebound Testing	17-Nov-04	8-Dec-04
47)	SVE System Operation	8-Dec-04	2-Jun-05

TABLE 5-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 23C SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 3 of 4)

	Event	Start Date	End Date
48)	SVE System Shut Down for Carbon Changeout	13-Jan-05	13-Jan-05
49)	SVE System Shut Down for Rebound Testing	2-Jun-05	22-Jun-05
50)	SVE System Operation	22-Jun-05	5-Aug-05
51)	Soil Gas Survey Performed	27-Oct-05	27-Oct-05
52)	SVE System Shut Down for Long-Term Rebound Testing and for the Soil and Soil Gas Survey	5-Aug-05	4-Jan-06
53)	SVE System Operation	4-Jan-06	16-Jan-06
54)	SVE System Shut Down for System Evaluation	16-Jan-06	26-Jan-06
55)	SVE System Operation	26-Jan-06	3-Feb-06
56)	SVE System Shut Down for Carbon Changeout	3-Feb-06	3-Feb-06
57)	SVE System Operation	3-Feb-06	4-Apr-06
58)	SVE System Shut Down for System Evaluation	4-Apr-06	20-Apr-06
59)	SVE System Operation	20-Apr-06	5-Oct-06
60)	SVE Sytem Shut Down for Rebound Testing	5-Oct-06	21-Dec-06
61)	SVE System Restarted for Radius of Influence Testing	22-Dec-06	27-Dec-06
62)	SVE Sytem Shut Down for System Evaluation	28-Dec-06	31-Dec-06
63)	SVE Sytem Shut Down for System Evaluation	31-Dec-06	2-Feb-07
64)	SVE System Operation	2-Feb-07	8-Oct-07

TABLE 5-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 23C SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 4 of 4)

	Event	Start Date	End Date
65)	SVE System Shut Down for Rebound and Drilling Activities	8-Oct-07	2-Apr-08
66)	SVE System Operational	2-Apr-08	21-Apr-08
67)	SVE System Shut Down	21-Apr-08	1-May-08
68)	SVE System Operational	1-May-08	15-Aug-08
69)	SVE System Shut Down for Rebound	15-Aug-08	1-Oct-08
70)	SVE System Operational	1-Oct-08	25-Dec-08
71)	SVE System Shut Down for AWS Maintenance	25-Dec-08	31-Dec-08

Notes:
AWS - Air Water Seperator
CAT-OX - catalytic oxidizer
GAC - Granular Activated Compound
pH - potential hydrogen
SMAQMD - Sacramento Metropolitan Air Quality Management District
SVE - Soil Vapor Extraction
SVMP - Soil Vapor Monitoring Point
UV - ultraviolet

TABLE 7-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 37/39/54 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 1 of 4)

	Event	Start Date	End Date
1)	Construction Bids and Procurement	15-Sep-97	3-Oct-97
2)	Well Drilling and Installation	20-Oct-97	2-Feb-98
3)	SVE System Pilot Test	16-Feb-98	31-Mar-98
4)	Mobilization of Equipment	29-Jun-98	29-Jun-98
5)	SVE System Installation	20-Jul-98	9-Dec-98
6)	SVE System Startup and Testing	9-Dec-98	28-May-99
7)	SVE System Operation	29-May-99	15-Sep-99
8)	SVE System Temporary Shutdown	16-Sep-99	14-Nov-99
9)	SVE System Operation	15-Nov-99	7-Dec-99
10)	SVE System Shut Down for Pulsing Test	8-Dec-99	12-Dec-99
11)	SVE System Operation	13-Dec-99	3-Mar-00
12)	SVE System Shut Down for Blower Motor Repair	3-Mar-00	30-Apr-00
13)	SVE System Operation	1-May-00	2-May-00
14)	SVE System Shut Down to Conduct Rebound Testing	3-May-00	22-May-00
15)	SVE System Operation	23-May-00	27-Jun-00
16)	SVE System Shut Down to Support Site 35/36 Respiration Test	28-Jun-00	12-Jul-00
17)	SVE System Operation	12-Jul-00	18-Jul-00
18)	SVE System Shut Down to Evaluate Cycling Schedule	18-Jul-00	31-Jul-00
19)	SVE System Operation Cycled (4 days on, 3 days off)	31-Jul-00	5-Dec-00
20)	SVE System Shut Down to Conduct Rebound Testing	5-Dec-00	19-Dec-00
21)	SVE System Operation Cycled (4 days on, 3 days off)	19-Dec-00	15-Jan-01
22)	SVE System Shut Down for Long-Term Rebound Testing	15-Jan-01	16-Mar-01
23)	SVE System Continuous Operation (4 days on, 3 days off)	16-Mar-01	27-Sep-01
24)	SVE System Shut Down for SMAQMD Substantive Requirement	27-Sep-01	14-Nov-01
25)	SVE System Operation Cycled (4 days on, 3 days off)	14-Nov-01	26-Feb-02
26)	SVE System Shut Down for SMAQMD Substantive Requirement Compliance Issue (Rebound test Conducted)	26-Feb-02	18-Mar-02
27)	SMAQMD Grants MWH Permission to Restart SVE System	8-Mar-02	8-Mar-02
28)	SVE System Operation Cycled (4 days on, 3 days off)	18-Mar-02	29-Mar-02
29)	SVE System Shut Down to Conduct Rebound Testing	29-Mar-02	28-Jun-02

TABLE 7-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 37/39/54 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 2 of 4)

	Event	Start Date	End Date
30)	SMAQMD Amended the Original Substantive Requirement on April 10, 2002, to Include New Air Emission Requirements of Less Than 10 lbs/day of ROC or Controlled by 95% or Greater Destruction Efficiency.	10-Apr-02	10-Apr-02
31)	SVE System Operation Cycled (4 days on, 3 days off)	28-Jun-02	6-Sep-02
32)	SVE System Shut Down for SMAQMD Substantive Requirement Compliance Issue	6-Sep-02	13-Sep-02
33)	SVE System Operation Cycled (4 days on, 3 days off)	13-Sep-02	7-Oct-02
34)	SVE System Shut Down to Conduct Rebound Testing	7-Oct-02	22-Oct-02
35)	SVE System Operation Cycled (4 days on, 3 days off)	22-Oct-02	8-Nov-02
36)	SVE System Shut Down to Conduct Rebound Test	8-Nov-02	12-Dec-02
37)	SVE System Operation Cycled (4 days on, 3 days off)	12-Dec-02	6-Jan-03
38)	SVE System Operation Cycle Changed (3 days on, 4 days off)	6-Jan-03	23-May-03
39)	SVE System Shut Down to Conduct Rebound Testing	23-May-03	30-Jun-03
40)	SVE System Operation Cycle Changed (3 days on, 4 days off)	30-Jun-03	25-Aug-03
41)	SVE System Operating on Continuous Schedule	25-Aug-03	17-Oct-03
42)	SVE System Shut Down to Perform System Blower and Motor Repairs and for Rebound Testing	17-Oct-03	23-Mar-04
43)	SVE System Operating on Continuous Schedule	23-Mar-04	5-Apr-04
44)	SVE System Shut Down to Perform System Adjustments and Tuning	5-Apr-04	9-Apr-04
45)	SVE System Operating on Continuous Schedule	9-Apr-04	15-Jun-04
46)	SVE System Shut Down to Conduct Rebound Testing	15-Jun-04	22-Jul-04
47)	SVE System Operational on Continuous Schedule	22-Jul-04	4-Aug-04
48)	System Shut Down Due to July Compliance Results	4-Aug-04	16-Aug-04
49)	SVE System Operational on Continuous Schedule	16-Aug-04	5-Oct-04
50)	System Shut Down Due to September Compliance Results and for Rebound Testing	5-Oct-04	3-Dec-04
51)	SVE System Operational on Continuous Schedule	3-Dec-04	21-Jan-05
52)	SVE System Shut Down for System Troubleshooting	21-Jan-05	28-Jan-05
53)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	28-Jan-05	13-Mar-05
54)	SVE System Shut Down to Conduct Rebound Testing	13-Mar-05	4-Apr-05
55)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	4-Apr-05	27-May-05

TABLE 7-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 37/39/54 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 3 of 4)

	Event	Start Date	End Date
56)	SVE System Shut Down to Conduct Rebound Testing	27-May-05	20-Jun-05
57)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	20-Jun-05	27-Jul-05
58)	SVE System Shut Down due to a Failed Gas Valve	27-Jul-05	1-Aug-05
59)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	1-Aug-05	5-Aug-05
60)	System Shut Down for Long-Term Rebound Testing and for the Soil and Soil Gas Survey	5-Aug-05	7-Dec-05
61)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	7-Dec-05	12-Dec-05
62)	SVE System Shut Down due to AWS Tank Pump Failure	12-Dec-05	15-Dec-05
63)	SVE System Operating Continuously for Testing at Site 29/71	15-Dec-05	30-Dec-05
64)	SVE System Operating on Cycled Schedule (4 days on, 3 days off)	30-Dec-05	13-Jan-06
65)	SVE System Shut Down Due to Poor Destruction Efficiency (New system purchased third quarter 2006, which arrived December 2006)	13-Jan-06	31-Dec-06
66)	SVE System Shut Down - New Soil Therm SVE System Set up	31-Dec-06	12-Feb-07
67)	SVE System Operating (500-scfm thermal oxidizer)	12-Feb-07	18-Mar-07
68)	SVE System Operating Intermittently due to Gas Pressure Adjustments	18-Mar-07	23-Mar-07
69)	SVE System Operational	23-Mar-07	27-Mar-07
70)	SVE System Shut Down for Maintence	27-Mar-07	28-Apr-07
71)	SVE System Operational	28-Apr-07	3-Jul-07
72)	SVE System Shut Down for Maintence	3-Jul-07	16-Jul-07
73)	SVE System Operating Intermittently due to a Leak in the Natural Gas Line	16-Jul-07	19-Jul-07
74)	SVE System Operational	19-Jul-07	29-Aug-07
75)	SVE System Shut Down for Modification and Replacement of the Sytem's Exhaust Stack	29-Aug-07	31-Aug-07
76)	SVE System Operational	31-Aug-07	27-Dec-07
77)	SVE System Shut Down for Rebound and Drilling Activities	27-Dec-07	11-Mar-08
78)	Vacuum Pressure Influence Testing Performed at Site 29/71 SVE Wells (29-PW-04, -05, -06)	11-Mar-08	12-Mar-08
79)	SVE System Shut Down after Vacuum Pressure Influence Testing at Site 29/71	12-Mar-08	20-Mar-08
80)	Vacuum Pressure Influence Testing Performed on Shallow SVE Wells (29-PW-04, -05, -06)	20-Mar-08	20-Mar-08

TABLE 7-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 37/39/54 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA
(Page 4 of 4)

Event	Start Date	End Date
81) SVE System Shut Down after Vacuum Pressure Influence Testing at Site 29/71	20-Mar-08	4-Apr-08
82) Restart SVE System to Collect Compliance Samples	4-Apr-08	4-Apr-08
83) SVE System ShutDown after Compliance Sampling	4-Apr-08	8-Apr-08
84) SVE System Operational	8-Apr-08	1-May-08
85) SVE System Shut Down due to Flame-out Alarm (Insuffiecent Oxygen)	1-May-08	2-May-08
86) SVE System Operational	2-May-08	5-May-08
87) SVE System Shut Down due to Flame-out Alarm (Insuffiecent Oxygen)	5-May-08	7-May-08
88) SVE System Operational	7-May-08	7-May-08
89) SVE System Shut Down due to Flame-out Alarm (Insuffiecent Oxygen)	7-May-08	9-May-08
90) SVE System Operational	9-May-08	9-May-08
91) SVE System Shut Down due to Flame-out Alarm (Insuffiecent Oxygen)	9-May-08	12-May-08
92) SVE System Operational	12-May-08	15-May-08
93) SVE System Shut Down due to Flame-out Alarm (Insuffiecent Oxygen)	15-May-08	16-May-08
94) SVE System Operational	16-May-08	28-May-08
95) SVE System Shut Down due to Flame-out Alarm (Insuffiecent Oxygen)	28-May-08	2-Jun-08
96) SVE System Operational	2-Jun-08	4-Jun-08
97) SVE System Shut Down due to Flame-out Alarm (Insuffiecent Oxygen)	4-Jun-08	6-Jun-08
98) SVE System Operational	6-Jun-08	16-Jun-08
99) SVE System Shut Down for Instrument Calibrations	16-Jun-08	17-Jun-08
100) SVE System Operational	17-Jun-08	5-Jul-08
101) SVE System Shut Down for Well Field Maintenance at Site 29/71	5-Jul-08	23-Jul-08
102) SVE System Operational	23-Jul-08	24-Jul-08
103) SVE System Shut Down for Rebound	24-Jul-08	12-Nov-08
104) SVE System Operational	12-Nov-08	5-Dec-08
105) SVE System Shut Down for Vacuum Pressure Influence Testing	5-Dec-08	5-Dec-08
106) SVE System Operational	5-Dec-08	31-Dec-08

Notes:
lbs/day - pounds per day
ROC - Reactive Organic Compound
SMAQMD - Sacramento Metropolitan Air Quality Management District
SVE - Soil Vapor Extraction

TABLE 8-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 57 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

	Event	Start Date	End Date
1)	Notice to Proceed	17-Mar-97	-----
2)	Mobilization of Equipment	2-Mar-97	6-Mar-97
3)	Well Drilling Program (Phase I)	17-Mar-97	28-Mar-97
4)	Pilot Test	3-Apr-97	4-Apr-97
5)	SVE System Installation (Phase I)	7-May-97	15-Aug-97
6)	SVE System Startup and Proveout	19-Aug-97	17-Oct-97
7)	SVE System Operation (Catalytic Mode)	17-Oct-97	12-Jan-98
8)	Rebound Test Conducted	12-Jan-98	20-Feb-98
9)	Installed four Monitoring Points (Phase II): MPMP-4 through MPMP-7	11-Mar-98	1-Apr-98
10)	SVE System Shut Down when Vapor Cooling Water Backflushed into the Burner	17-Jul-98	3-Sep-98
11)	SVE System Operation (Catalytic Mode)	3-Sep-98	10-Dec-98
12)	Installed One Monitoring Point (Phase III): MPMP-8	1-Dec-98	2-Dec-98
13)	SVE System Shut Down, Electrical Problems	11-Dec-98	28-Feb-99
14)	SVE System Operation (Catalytic Mode)	1-Mar-99	15-Apr-99
15)	SVE System Shut Down, Troubleshooting	16-Apr-99	13-May-99
16)	SVE System Operation (Catalytic Mode)	14-May-99	30-Jun-99
17)	SVE System Shut Down for Operation Study by Praxis	14-Jul-99	30-Jul-99
18)	SVE System Operation (Catalytic Mode)	2-Aug-99	5-Oct-99
19)	SVE System Shut Down for Converting to GAC Mode	6-Oct-99	1-Nov-99
20)	SVE System Operation (GAC Mode)	2-Nov-99	22-Jul-00
21)	SVE System Shut Down for Rebound Study and Concurrent Warranty Repairs	22-Jul-00	1-Nov-00
22)	SVE System Operation (GAC Mode)	1-Nov-00	3-Feb-01

TABLE 8-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 57 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

	Event	Start Date	End Date
23)	SVE System Shut Down for Rebound Study and Concurrent Warranty Repairs	3-Feb-01	30-Mar-01
24)	SVE System Operation (GAC Mode)	30-Mar-01	17-Apr-01
25)	SVE System Shut Down for Sound Enclosure Construction	17-Apr-01	23-Apr-01
26)	SVE System Operation (GAC Mode)	23-Apr-01	14-Sep-01
27)	SVE System Shut Down for Dual Phase Extraction Activities	14-Sep-01	18-Sep-01
28)	SVE System Operation (GAC Mode)	18-Sep-01	27-Sep-01
29)	SVE System Shut Down for Dual Phase Extraction Activities	27-Sep-01	1-Oct-01
30)	SVE System Operation (GAC Mode)	1-Oct-01	9-Jul-03
31)	SVE System Shut Down for System Blower Repairs	9-Jul-03	20-Aug-03
32)	SVE System Operation (GAC Mode)	20-Aug-03	30-Dec-03
33)	SVE System Shut Down SMAQMD Compliance Issue and to Perform a Rebound Test	30-Dec-03	8-Mar-04
34)	SVE System Operation (GAC no longer required, permission granted by SMAQMD 19 February 2004)	8-Mar-04	14-Jun-04
35)	SVE System Shut Down for Rebound Testing	14-Jun-04	12-Jul-04
36)	System Operational on Continuous Schedule	12-Jul-04	10-Dec-04
37)	System Shut Down to Perform Rebound Testing	10-Dec-04	4-Jan-05
38)	System Operational on Continuous Schedule	4-Jan-05	20-Apr-05
39)	SVE System Shut Down for 57-SVE-7A Tie-in	20-Apr-05	21-Apr-05
40)	System Operational on Continuous Schedule	21-Apr-05	3-Aug-05
41)	Installed One Multi-probe Monitoring Well	16-May-05	17-May-05
42)	57-SVE-7A brought Online to SVE System	18-May-05	18-May-05
43)	System Shut Down to Replace Blower Belt, for Long-Term Rebound Testing, and for the Soil and Soil Gas Survey	3-Aug-05	6-Dec-05
44)	System Operational on Continuous Schedule	6-Dec-05	8-Dec-05

TABLE 8-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 57 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

	Event	Start Date	End Date
45)	System Shut Down for Compliance Issue	8-Dec-05	28-Apr-06
46)	System Operational on Continuous Schedule	28-Apr-06	24-May-06
47)	System Shut Down awating Compliance Sample Results	24-May-06	5-Jun-06
48)	System Operational on Continuous Schedule	5-Jun-06	12-Jun-06
49)	System Shut Down awating Compliance Sample Results	12-Jun-06	30-Jun-06
50)	System Operational on Continuous Schedule	30-Jun-06	5-Oct-06
51)	System Shut Down for Rebound Testing	6-Oct-06	13-Dec-06
52)	System Operational Intermittently for Radius of Influence Testing	13-Dec-06	15-Dec-06
53)	System Shut Down for System Evaluation	15-Dec-06	4-Jan-07
54)	System Restarted and Operational on Continuous Schedule	4-Jan-07	14-Jan-07
55)	System Shut Down Due to High AWS Discharge Water Levels	14-Jan-07	16-Jan-07
56)	System Restarted and Operational on Continuous Schedule	16-Jan-07	19-Jan-07
57)	System Shut Down Due to High AWS Discharge Water Levels	19-Jan-07	22-Jan-07
58)	System Restarted and Operational on Continuous Schedule	22-Jan-07	26-Jan-07
59)	System Shut Down Due to High AWS Discharge Water Levels and Waiting for Carbon	26-Jan-07	5-Mar-07
60)	System Restarted and Operational on Continuous Schedule	5-Mar-07	9-Jul-07
61)	System Shut Down Due to Blower Motor Failure	9-Jul-07	31-Jul-07
62)	System Restarted and Operational on Continuous Schedule	31-Jul-07	17-Aug-07
63)	System Shut Down Due to Low Air Flow at the System's Blower	17-Aug-07	21-Aug-07
64)	System Restarted and Operational on Continuous Schedule	21-Aug-07	8-Oct-07
65)	System Shut Down for Rebound and Drilling Activities	8-Oct-07	19-Feb-08

TABLE 8-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 57 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

	Event	Start Date	End Date
66)	System Restarted for Compliance Sampling	19-Feb-08	19-Feb-08
67)	System Shut Down after Compliance Sampling	19-Feb-08	25-Feb-08
68)	SVE System Operational	25-Feb-08	5-Aug-08
69)	System Shut Down for Rebound, Connection of 57-PW-01 and 57-PW-02 to the SVE System, and Replacement of Water-to-Air Heat Exchanger with Air-to-Air Heat Exchanger	5-Aug-08	1-Oct-08
70)	SVE System Operational with GAC	1-Oct-08	2-Dec-08
72)	System Shutdown due to Failed Blower and Motor	2-Dec-08	31-Dec-08

Notes:
AWS - Air Water Separator
GAC - Granular Activated Carbon
SMAQMD - Sacramento Metropolitan Air Quality Management District
SVE - Soil Vapor Extraction

TABLE 9-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 59 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

	Event	Start Date	End Date
1)	First Phase SVE Well & SVMP Drilling Program	14-Oct-98	6-Nov-98
2)	Pilot Test	10-Dec-98	16-Dec-98
3)	Second Phase SVE Well & SVMP Drilling Program	10-Jun-99	7-Jul-99
4)	SVE System Installation	27-Oct-99	1-Nov-99
5)	Utility Installation	2-Nov-99	21-Jan-99
6)	SVE System Startup and Proveout	8-Feb-00	16-Aug-00
7)	SVE System Operation (Catalytic Oxidation Mode)	16-Aug-00	13-Oct-00
8)	System Shut Down as a Result of Scrubber Problems	13-Oct-00	14-Dec-00
9)	SVE System Operation (Catalytic Oxidation Mode)	14-Dec-00	3-Feb-01
10)	System Shut Down as a Result of Scrubber Problems	3-Feb-01	20-Feb-01
11)	SVE System Operation (Catalytic Oxidation Mode)	20-Feb-01	18-Jun-01
12)	System Shut Down for Long-Term Rebound Test	18-Jun-01	2-Aug-01
13)	Soil Vapor Re-routed to the Site 18 SVE GAC System (Operating on cycled schedule, 4 days on, 3 days off)	2-Aug-01	16-Nov-02
14)	SVE System Shut Down for Rebound Test	16-Nov-02	2-Dec-02
15)	SVE System Operation cycled (4 days on, 3 days off)	2-Dec-02	31-Dec-02
16)	SVE System Operation Cycle Changed (3 days on, 4 days off)	1-Jan-03	23-May-03
17)	SVE Cat-OX System Removed for Use at Castle AFB	21-Mar-03	21-Mar-03
18)	SVE System Shut Down for Rebound Test	23-May-03	30-Jun-03
19)	SVE System Operation Cycle Changed (3 days on, 4 days off)	30-Jun-03	17-Jul-03
20)	SVE System Shut Down for Rebound Test	17-Jul-03	22-Aug-03
21)	SVE System Operating on Continuos Schedule	22-Aug-03	5-Dec-03
22)	SVE System Shut Down for Rebound Test	5-Dec-03	9-Mar-04
23)	SVE System Operating on Continuos Schedule	9-Mar-04	23-Mar-04
24)	SVE System Shut Down to Repair Blower	23-Mar-04	31-Mar-04
25)	SVE System Operating on Continuous Schedule	31-Mar-04	2-Apr-04

TABLE 9-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 59 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

	Event	Start Date	End Date
26)	SVE System Shut Down Due to System Electrical Problem	2-Apr-04	8-Apr-04
27)	SVE System Operating on Continuous Schedule	8-Apr-04	16-Apr-04
28)	SVE System Shut Down to Perform Pilot Study at Site 59, Addition of MAFB-105	16-Apr-04	19-Apr-04
29)	SVE System with GAC Operational on Continuous Schedule	19-Apr-04	1-Jul-04
30)	SVE System Shut Down to Perform Site 59 Rebound Testing, Tie-in Newly Installed SVE Wells to SVE System, Perform System Carbon Changeout, and Perform System Source Testing	1-Jul-04	31-Aug-04
31)	Carbon Change-out Performed on Carbon Vessels	5-Aug-04	5-Aug-04
32)	SVE System with GAC Operational on Continuous Schedule	31-Aug-04	3-Sep-04
33)	System Shut Down to Await Results from Confirmation Compliance Sample Collected on 9/3/04	3-Sep-04	13-Sep-04
34)	SVE System with no GAC Operational on Continuous Schedule. GAC removed based on substantive requirements met according to SMAQMD.	13-Sep-04	15-Oct-04
35)	System Shut Down because Field Readings from October Compliance Sample Indicated System Not Operating Properly	15-Oct-04	29-Oct-04
36)	SVE System Operational with GAC on Continuous Schedule	29-Oct-04	29-Nov-04
37)	SVE System Shut Down Due to Broken System Blower Belt	29-Nov-04	2-Dec-04
38)	SVE System Operational with GAC on Continuous Schedule	2-Dec-04	3-Dec-04
39)	SVE System to Perform Repairs to System Blower	3-Dec-04	4-Jan-05
40)	SVE System Operational with GAC on Continuous Schedule	4-Jan-05	30-Jan-05
41)	SVE System Shut Down due to High AWS Discharge Tank Level	30-Jan-05	3-Feb-05
42)	SVE System Operational with GAC on Continuous Schedule	3-Feb-05	3-Mar-05
43)	SVE System Shut Down for Rebound Test	3-Mar-05	2-May-05
44)	SVE System Operational with GAC on Continuous Schedule	2-May-05	20-Jun-05
45)	System Shut Down due to Water Line Tie-in	20-Jun-05	24-Jun-05
46)	SVE System Operational with GAC on Continuous Schedule	24-Jun-05	1-Aug-05

TABLE 9-1

OPERATIONAL AND REMEDIAL HISTORY
SITE 59 SVE SYSTEM
MATHER AIR FORCE BASE
SACRAMENTO COUNTY, CALIFORNIA

	Event	Start Date	End Date
47)	System Shut Down for Long-Term Rebound Testing and for the Soil and Soil Gas Survey	1-Aug-05	28-Feb-06
48)	SVE System Operational on Continuous Schedule; GAC Abatemen t Removed (Numerous shutdowns due to High AWS Discharge Tank)	28-Feb-06	28-Apr-06
49)	SVE System Operational	28-Apr-06	5-Oct-06
50)	SVE Shut Down for Rebound Testing	5-Oct-06	8-Dec-06
51)	SVE System Restarted for Radius of Influence Testing	8-Dec-06	11-Dec-06
52)	SVE System Shut Down for System Evaluation	11-Dec-06	1-Jan-07
53)	SVE System Operational	1-Jan-07	15-Jan-07
54)	SVE System Shut Down due to High AWS Discharge Tank Level	15-Jan-07	17-Jan-07
55)	SVE System Operational	17-Jan-07	15-Mar-07
56)	SVE System Operational; Vapor Extraction Well 18-SVE-004 Brought Online (Compliance Source Testing Performed)	15-Mar-07	17-Mar-07
57)	SVE System Operational	17-Mar-07	8-Oct-07
58)	SVE System Shut Down for Rebound and Drilling Activities at Site 59	8-Oct-07	9-Apr-08
59)	SVE System Operational	9-Apr-08	5-Jun-08
60)	SVE System Shut Down for Utility Service Interruption	5-Jun-08	9-Jun-08
61)	SVE System Operational	9-Jun-08	4-Aug-08
62)	Performed Pilot Vacuum Extraction Test at 59-PW-02	4-Aug-08	4-Aug-08
63)	SVE System Operational	4-Aug-08	15-Aug-08
64)	SVE System Shut Down for Rebound	15-Aug-08	1-Oct-08
65)	SVE System Operational	1-Oct-08	12-Nov-08
66)	SVE System Shut Down for AWS Pump and Heat Exchanger Replacement	12-Nov-08	31-Dec-08

Notes:
GAC - Granular Activated Carbon
SVE - Soil Vapor Extraction
SVMP - Soil Vapor Monitoring Point

APPENDIX B

Interview Records

Former Mather AFB – Third Five-Year Review Interview Questionnaire

Date: 14 May 2009
Name: Jill Ritzman
Title: Deputy Director
Affiliation/Organization: Regional Parks
Address and phone number: 3711 Branch Center Road, Sacramento, CA 95827; Ph: (916) 876-5134

1.) How long have you lived, worked, or been associated with the community adjacent to the former Mather AFB? What is your current role as it relates to the site (e.g., local resident, local business representative, city council member, etc.)?

Since 2001. I oversee the planning and operations designated for the Regional Park site.

2.) What is your overall impression of the environmental cleanup conducted at the site to date? (general sentiment)

It seems to be a slow process.

3.) What effects have site environmental cleanup had on the surrounding community?

There will be many extraction wells and associated pipelines that Parks will need to plan around when building the park.

4.) Are you aware of any community concerns regarding the site or its environmental cleanup and administration? If so, please give details.

No.

5.) Do you feel well informed about the site's environmental cleanup activities and progress?

Yes. I have a good rapport with Bill Hughes; he makes an extra effort to be sure that Parks is receiving information.

6.) Do you have any comments, suggestions, or recommendations regarding the site's environmental management or cleanup?

None.

Former Mather AFB – Third Five-Year Review Interview Questionnaire

Date: 13 May 2009
Name: Gregg Weissenfluh
Title: Mather Airport Manager
Affiliation/Organization: Sacramento County Airport System
Address and phone number: 3745 Whitehead Street, Mather, CA 95655

1.) How long have you lived, worked, or been associated with the community adjacent to the former Mather AFB? What is your current role as it relates to the site (e.g., local resident, local business representative, city council member, etc.)?

I am the Airport Manager, assigned to this position in March 2007.

2.) What is your overall impression of the environmental cleanup conducted at the site to date? (general sentiment).

The Air Force and Boeing do a lot of work regarding monitoring and extraction wells. Both are very good at keeping the airport informed of their activities.

3.) What effects have site environmental cleanup had on the surrounding community?

I have not received any comments from the surrounding community regarding the cleanup activities on Mather Airport. That said, I have not received any complaints either.

4.) Are you aware of any community concerns regarding the site or its environmental cleanup and administration? If so, please give details.

I'm not aware of any specific community concerns.

5.) Do you feel well informed about the site's environmental cleanup activities and progress?

As the Airport Manager, yes, I get good information.

6.) Do you have any comments, suggestions, or recommendations regarding the site's environmental management or cleanup?

No.

Former Mather AFB – Third Five-Year Review Interview Questionnaire

Date: 5 June 2009
Name: Sandra Lunceford
Title: Community Co-Chair
Affiliation/Organization: RAB
Address and phone number: 121 Kennar Way, Folsom, CA, Ph: (916) 985-8984

1.) How long have you lived, worked, or been associated with the community adjacent to the former Mather AFB? What is your current role as it relates to the site (e.g., local resident, local business representative, city council member, etc.)?

I have been involved with the RAB since 1993 as a RAB member, RAB Co-Chair, and as a contractor to the DoD.

2.) What is your overall impression of the environmental cleanup conducted at the site to date? (general sentiment).

Generally the cleanup is handled well, but I honestly feel that we have addressed environmental issues on a short term basis. I am afraid that as we develop the base and tear up asphalt, areas we have not previously addressed will have environmental issues that need continued oversight. DoD generally does not take samples under asphalt, and there are lots of old roads, parking lots, and uninvestigated area at Mather that really had no ***known*** *reason to sample. Discovery of potentially new contamination may lead to revisions of institutional controls. Nearby communities can help by providing oversight of enforcement of institutional controls during redevelopment, and identify instances that may require institutional control redress.*

For instance, when digging a trench next to a road, excavated dirt exploded into flames. I feel there MUST be some sort of continued community oversight, and most appropriately by the community most affected by the closed base. It would behoove both the regulatory agencies, as well as the Air Force, to fund and recognize the importance of oversight. Continued community oversight can decrease liability and promote safety.

It is difficult to get the nearby community involved, partially due to the length of time cleanup requires. On the community's behalf, I must say that the lack of funding for regulatory participation in RAB meetings makes it difficult to justify time spent on hearing just from the Air Force. Alternatively, why should regulatory agencies receive funding, if the community does not show interest? It is imperative to hear all aspects of the contamination cleanup at Mather and all bases.

Lastly, I feel the groundwater plume capture has been way too slow and has bored the community into complacency.

3.) What effects have site environmental cleanup had on the surrounding community?

The surrounding community is happy to have clean water flowing through the taps and reap the benefits of base redevelopment. The community also benefits from the jobs created, the new infrastructure, and potential ongoing development.

4.) Are you aware of any community concerns regarding the site or its environmental cleanup and administration? If so, please give details.

The community will continue to grow around this base, and they want growth to occur in an environmentally smart way. New development should be sensitive to the environmental constraints posed by the environmental cleanup systems and land limitations (deed restrictions and institutional controls). The community wants a safe and secure flow of clean water in their taps without shortage, responsible wetland management, regulated contamination cleanup, and a safe place for their children to play.

5.) Do you feel well informed about the site's environmental cleanup activities and progress?

I feel very informed about the cleanup activities; however, I feel that receiving and commenting on draft documents would enhance my ability to become engaged in issues that can be solved by early warning.

6.) Do you have any comments, suggestions, or recommendations regarding the site's environmental management or cleanup?

1) Continued community oversight of cleanup, particularly to facilitate enforcement and early detection of problems with institutional controls. 2) Draft document distribution to community members. 3) A concerted effort by the Air Force to educate and recruit nearby community members in the newly developed Mather housing area.

Former Mather AFB – Third Five-Year Review Interview Questionnaire

Date: 1 June 2009
Name: Arne Sampe
Title: Retired
Affiliation/Organization: RAB, MCC, Hanbit Presbyterian Church, Lord's Church
Address and phone number: 9025 El Cajon Way #1, Sacramento, CA 95826, Ph: (916) 362-9013

1.) How long have you lived, worked, or been associated with the community adjacent to the former Mather AFB? What is your current role as it relates to the site (e.g., local resident, local business representative, city council member, etc.)?

I moved to Sacramento from Idaho around 1966. I represent the Mather Community Campus as a volunteer at the Mather Community Campus and am a member of the Hanbit Presbyterian Church located at the old base chapel. I am a friend of the Lord's Church which is located at the back of the base. I provide all of these organizations with information obtained from the RAB meetings.

2.) What is your overall impression of the environmental cleanup conducted at the site to date? (general sentiment).

I and my dog have taken several tours of the clean up operations, which appear to be operating properly and efficiently. I remain concerned that operations may be curtailed in the future due to any number of reasons, (money, time, interest, priorities, etc.) as I believe that operations should continue.

3.) What effects have site environmental cleanup had on the surrounding community?

The efforts being made do lead to greater confidence in the community residents that their health and safety are not being compromised by the water contamination 90 and 360 feet down below the surface. Efforts to monitor surface contamination in the water supply and ground areas and wildlife are productive toward community confidence that the safety and health of the public are being addressed.

4.) Are you aware of any community concerns regarding the site or its environmental cleanup and administration? If so, please give details.

The length of time required to complete the clean up is a concern. 50 years is a long time.

5.) Do you feel well informed about the site's environmental cleanup activities and progress?

I feel that I am reasonably well informed, although some of the technical aspects are difficult to fully understand and explain. Repetition is not a bad thing in explaining these difficult matters.

6.) Do you have any comments, suggestions, or recommendations regarding the site's environmental management or cleanup?

Recruitment of community members to attend and participate in the RAB meetings remains difficult. Length of service is required and the boring technical aspects are generous. For community confidence, I think that these meetings will need to continue for at least ten more years.

Former Mather AFB – Third Five-Year Review Interview Questionnaire

Date: 2 June 2009
Name: Douglas V. Fortun
Title: BRAC Environmental Coordinator (BEC) – Circa January-May 2009
Affiliation/Organization: AFRPA WREC
Address and phone number: 3411 Olson St., McClellan, CA 95652, Ph: (916) 643-0830 x 203

1.) What is your overall impression of the remedies selected for the former Mather AFB's Installation Restoration Program (IRP) (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, institutional controls)?

The remedies selected (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, etc.) for the Mather sites are working effectively to protect human health and the environment.

2.) Are the remedies functioning as expected? Do you have any concerns regarding the function of the remedies?

The selected remedies are functioning and operating successfully as expected. I do not have any concerns regarding the functions of the remedies.

3.) Have there been unexpected operation and maintenance (O&M) difficulties or costs at the site since startup or in the last five years?

There have not been unexpected operation and maintenance (O&M) difficulties at Mather since I became the BEC.

4.) Has the site been in compliance with permitting and reporting requirements?

Since I became the BEC, there was the (March 12, 2009) Landfill 04 methane noncompliance incidents only. To prevent reoccurrence of the noncompliance, the noncompliance reporting protocol was revised to ensure that the AF BEC be included in the notification of any noncompliance the same day of the incident. However, I was informed that there were some periodic noncompliance methane and other incidents in the past.

5.) Do you have any comments, suggestions, or recommendations regarding the implementation of the IRP remedies or how the program has been conducted in general?

The remediation program at Mather is being conducted in accordance with the US EPA and State agency approved Record of Decision (ROD) and Federal Facilities Agreement.

6.) Do you have any comments on the operation of the IRP remedies related to future effectiveness or optimization of operations?

To my knowledge, the IRP remedies are operating effectively.

7.) What is your single greatest concern regarding the ongoing performance of the IRP remedies?

The single greatest concern regarding the ongoing performance of the IRP remedies is the injection well capacity of the GW treatment system. The injection well is undersized to meet the

maximum capacity GW treatment systems. A back up excess discharge plan should be in place if and when the maximum discharges capacity of the system is reached.

8.) Does the monitoring data show any trends that contaminant levels are increasing or decreasing? Have any new or emerging contaminants of concern (COCs) been identified? If so, have they impacted the effectiveness of the remedies?

The monitoring data does show that the contaminant levels are decreasing in the vadose zone and the groundwater. There has not been any new or emerging contaminants of concern (COCs) identified since I became the BEC.

9.) Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.

Yes, the GW O&M and/or monitoring sampling efforts have been optimized this year.

Former Mather AFB – Third Five-Year Review Interview Questionnaire

Date: 8 June 2009
Name: MWH Mather Program Team
Affiliation/Organization: MWH Americas, Inc.
Address and phone number: 3321 Power Inn Rd., Suite 300, Sacramento, CA 95826, Ph: (916) 924-8844

1.) What is your overall impression of the remedies selected for the former Mather AFB's Installation Restoration Program (IRP) (e.g., excavation, SVE, groundwater extraction and treatment, landfill cap, institutional controls)?

The selected remedies have achieved or are achieving their intended cleanup objectives.

2.) Are the remedies functioning as expected?

The groundwater system as designed (P&T) is functioning as prescribed to meet aquifer cleanup standards as stated in the ROD. The SVE treatment systems are functioning as designed to address high concentration removal. The landfill caps are functioning as designed.

Do you have any concerns regarding the function of the remedies?

For the groundwater and landfill programs, no concerns.

The SVE remedial systems were not necessarily designed to remediate low level contaminant concentrations, which may be a regulatory concern during the pursuit of site closure. In addition, vadose zone soil types and moisture conditions have made cleanup of residual contaminants more difficult than anticipated.

3.) Have there been unexpected operation and maintenance (O&M) difficulties or costs at the site since startup or in the last five years?

For the operation of the Site 7 groundwater extraction and treatment system, there have been system shutdowns of longer duration than expected due to mining activities of the neighboring property owners.

During the installation of the 84-inch sewer interceptor pipeline along Macready Avenue, hydrocarbons were encountered at unexpected elevated concentrations beneath the street which resulted in non-programmed costs to observe and collect soil samples for analysis, on behalf of the Air Force, to document the distribution of contaminants in the pipeline trench. Previous and current soil and/or vapor data from both sides of Macready Avenue indicated that hydrocarbon contamination did not exist. It wasn't until the County of Sacramento began excavating through Site 39 for the 84-inch sewer interceptor that the elevated hydrocarbons were detected.

During the landfill gas monitoring conducted in 2008, methane in excess of 5 percent by volume in air was detected in compliance well MW-403 along the north boundary of LF-4 (north of gas-migration control trench GV4P-8). Solar-powered fans were subsequently installed in the vent pipe in GV4P-8 to actively remove methane from this trench. Following installation and operation, methane was reported at 0% in MW-403 during 4Q08. During the 1Q09 monitoring, the solar-powered fans were observed to be inoperable and methane was detected above the 5% compliance level in MW-403. The fans were replaced and operated and the methane concentration immediately fell below the 5% compliance level.

4.) Has the site been in compliance with permitting and reporting requirements?

Yes.

5.) Do you have any comments, suggestions, or recommendations regarding the implementation of the IRP remedies or how the program has been conducted in general?

All treatment systems should continue to be operated and maintained so that optimal run-time is achieved and compliance is maintained.

6.) Do you have any comments on the operation of the IRP remedies related to future effectiveness or optimization of operations?

The groundwater treatment systems should continue to be operated with maximum up-time and to maintain compliance.

The SVE systems are operating effectively for their designed intent and have been optimized to maximize uptime and maintain compliance. Residual contaminants bound in fine-grained, high moisture content soils are very difficult to remediate.

A more permanent (active) solution to mitigate methane generation/migration at GV4P-8 at LF-4 may be necessary in the future.

7.) What is your single greatest concern regarding the ongoing performance of the IRP remedies?

Getting regulatory concurrence for SVE site closure.

8.) Does the monitoring data show any trends that contaminant levels are increasing or decreasing? Have any new or emerging contaminants of concern (COCs) been identified? If so, have they impacted the effectiveness of the remedies?

Generally, concentrations (trends) have been decreasing in groundwater. Vadose zone concentrations have decreased; mass removal rates for SVE systems are asymptotic.

Perchlorate has been detected in MB/SAC groundwater extraction wells at low concentrations well below the California MCL of 6.0 ug/L. Because the Air Force believes that the source for perchlorate is upgradient of Mather AFB, they have elected to discontinue sampling/analyzing for this compound. Limited 1,4-dioxane sampling has been conducted in the past at wells with the highest TCE concentrations.

9.) Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.

O&M and sampling have been optimized. Sampling frequencies have been reduced significantly based on the approved decision tree process between the Air Force and regulatory agencies thereby reducing significant costs to the program. Groundwater level measurements (gauging) have become more cost effective having been reduced from 4 times per year to 2. The SVE systems are operating effectively for their designed intent with focused remediation. Active SVE well head sampling has guided optimal extraction and provided estimates of time to cleanup residual contaminants.

APPENDIX C

Response to Comments

RESPONSE TO COMMENTS on the DRAFT THIRD FIVE-YEAR REVIEW REPORT, FORMER MATHER AIR FORCE BASE, CALIFORNIA (22 MARCH 2010)

Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
Specific Comments	1	EPA	John Lucey				**Summary Form, Community Involvement and ARARs:** The Draft Third Five-Year Review Report (5YR) contains good information but it does not include some of the important elements described in EPA's guidance document entitled "Comprehensive Five-Year Guidance" dated June 2001. Please revise the draft document to follow EPA's guidance. Appendix E in the guidance shows a report template and Appendix F shows a sample report. To the extent possible, please follow the report format shown in Appendix F of the guidance. The Summary Form (page F-11) Community Involvement (page 21) ARARs Appendix Summary Form - Please include the Five Year Review Summary Form within the body of the report (probably within Section 1.0) and include the Summary Form as a subsection title in the Table of Contents. The Summary Form should be completed with a summary listing for each individual operable unit (OU). The summary listing should follow the format shown on page E-18 of EPA's Five Year Review guidance (a copy of (continued)	The second page of the summary form has been completed and summarizes the information presented in Sections 8.0, 9.0, and 10.0. Protectiveness statements have been made for each OU (six total). In addition, because the former Mather AFB has reached construction completion, a comprehensive protectiveness statement for the entire site has been made per the 2001 EPA Comprehensive Five-Year Review Guidance (p. 4-13, p. E-18, and p. E-30). The summary form (continued)

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Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
	1. (cont'd)	EPA	John Lucey				(continued) page E-18 is attached to the transmittal letter for these comments). The summary listing should include specific issues, recommendations, and a comprehensive protectiveness statement that summarizes all of the remedies for the entire OU. The Summary Form should briefly summarize the information in Section 8, 9, and 10. (Note: the protectiveness statement in Section 10 is not accurate or adequate).	(continued) is now included under separate tab and precedes Section 1.0.
							Community Involvement - The 5YR should include a section to describe community involvement and outreach to the community. Appendix A of the Comprehensive 5-Year Review Guidance, EPA June 2001, provides guidelines for community involvement. Appendix F includes community involvement in Section VI. Five - Year Review Process.	Section 6.2 Community Involvement and Notification of the draft *Third Five-Year Review Report* describes community involvement activities for the former Mather AFB in general and specific to this five-year review. No changes to this section are necessary.

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Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
	1. (cont'd)	EPA	John Lucey				ARARs - The 5YR should include a section on ARARs. Please add a section or an appendix with a table showing all the COCs with the original cleanup levels, the current cleanup levels and a description of any impacts on remedial actions.	A discussion of chemical-specific ARARs is already presented in Sections 7.1.2 and 7.1.3. In addition, recodified post-closure landfill ARARs are discussed in Section 7.4.1.2 and Table 7-4. There are no new location-specific requirements that have a bearing on the protectiveness of the selected remedies. In 2003, California developed a new action-specific requirement (i.e., State Land Use Covenant) for documenting ICs in decision documents with specific emphasis on property transfers at federal facilities. Under Title 22 CCR, Section 67391.1, portions of this regulation have been included in decision documents for each of the sites that require ICs. A complete listing of all ARARs is presented in the various decision documents (i.e., RODs and ESDs – two of which are not yet signed). These RODs and ESDs are cited throughout the *Third Five-Year Review Report* and are included in the references section. COCs and original and current cleanup levels are presented in Table 3-1. There have been no changes to cleanup levels since the RODs were signed; however, two ESDs (for the Soil OU and the Basewide OU) awaiting authorizing signatures are expected to delete numeric soil cleanup values for selected petroleum constituents and apply narrative soil cleanup levels at Sites WP-07/FT-11, FT-10C/ST-68, ST-37, ST-39, SS-54, and SD-59. (continued)

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Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
	1. (cont'd)	EPA	John Lucey					(continued) Use of the narrative soil cleanup levels will adequately protect human health and the environment and do not impact the effectiveness of the SVE and/or bioventing operations.
	2	EPA	John Lucey				**Risk Assessments and Ecological Risk:** The 5YR should have a section to discuss the risk assessments performed at Mather. This section should also discuss the potential for ecological risk at each site.	Text has been added to Section 3.5 (Basis for Taking Action) that references the comprehensive baseline risk assessment (CBRA). The CBRA includes human health and ecological risk assessments for 85 IRP sites. References to risk assessments conducted for sites identified after the CBRA was completed (i.e., Sites OT-86, OT-87, and OT-89) have also been added. It should be noted that if a significant ecological risk was present, the site was remediated. A confirmatory small mammal survey is being conducted at Site OT-87.
	3	EPA	John Lucey				**Revise Table 1-1 and create a new Table 1-2:** Table 1-1 provides a good summary of all the sites at Mather AFB. The sites that are not included in the 5YR should be pulled out of this table and put in a new Table 1-2 for "Sites not included in the 5YR". Then the new title for Table 1-1 should be changed to "Sites included in the 5YR". (continued)	

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Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
	3 (cont'd)	EPA	John Lucey				(continued) The new Table 1-1 (Sites included in the 5YR) should include the following: • a column for property transfer/lease status and reference FOSTs	FOSTs/FOSETs are not relevant for determining protectiveness, as they are not decision documents and do not specify remedies. The ICs and other restrictions described in the FOSTs/FOSETs are not the final remedies for the affected sites; final remedial actions are governed by an applicable ROD or other CERCLA decision document (e.g., ESD). Although the Air Force will transfer responsibilities to the transferee and its successors by provisions to be included in the deed(s) transferring title to the property and may contractually arrange for third parties to perform any and all of the actions associated with the ICs, the Air Force is ultimately responsible for the remedies (including ICs) before and after property transfer and will exercise this responsibility in accordance with CERCLA and the NCP. Compliance with the terms of decision documents will be protective of human health and the environment. (continued)

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Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
	3 (cont'd)	EPA	John Lucey				• Add a column to describe any ICs in place or indicate if no IC's are required.	The comments column in Table 1-1 has been updated to note which sites have ICs in place and/or will have ICs implemented following signature of the Soil and Groundwater OU and Basewide OU ESDs.
							• Indicate any residual soil contamination and ICs for Industrial landuse	As noted in the previous bullet, the comments column in Table 1-1 has been updated to note which sites have ICs in place and/or will have ICs implemented following signature of the Soil and Groundwater OU and Basewide OU ESDs.
							• Reference any changes in the Base General Plan	There is no Base General Plan for the former Mather AFB.
							• Add a column for groundwater contamination above MCLs with ICs to restrict use (this would be a yes no answer).	The comments column in Table 1-1 has been updated to note that ICs are in place for the four groundwater plumes.
							• If the remedy is complete and ICs are not required this should be stated in the IC column	If a remedial action has been completed and no ICs are required, then the site would not be included in this table because no five-year review would be required.
							• a column with a short description of the current remedy	The comments column in the draft report already provided a short description of the current remedies, except for a notation of ICs, which has now been added. A more detailed description of remedial actions is provided in Section 4.0.
							• a column with a one sentence protectiveness designation (i.e. protective, short term protective, long term protective, deferred, etc.).	Protectiveness determinations have been made by OU per the 2001 EPA Comprehensive Five-Year Review Guidance and have been included in the summary form and Section 10.0.

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	3 (cont'd)	EPA	John Lucey				• a column for wetlands on-site (this would be a yes no answer).	The Air Force does not believe this information is relevant for determining protectiveness, as there are no remedies directly related to wetlands for any of the IRP sites. It should be noted that protection of any wetland ecosystems present at IRP sites was considered as part of the selection and implementation of the ROD remedies.
							• a column for ecological risk on-site (this would be a yes no answer).	The Air Force does not believe the requested column is necessary, as the only site that has a potential ecological risk and requires a five-year review is Site OT-87. The Basewide OU ROD requires small mammal monitoring to ensure that the residual levels of lead left in place at Site OT-87 do not present a hazard to small mammals. This monitoring at Site OT-87 is noted in the comments column in Table 1-1. In addition, the small mammal monitoring is discussed in Sections 2.6.4, 4.4.5, and 7.6.4 of the *Third Five-Year Review Report*. Cleanup actions have been completed without restrictions at other sites that were identified as having an ecological risk (e.g., Site SD-85).

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	3 (cont'd)	EPA	John Lucey				The new Table 1-2 (Sites not included in the 5YR) should include the following: • Describe the ROD remedy if there was one. • Describe successful completion of the ROD remedy if applicable (i.e. completed and finalized soil remedial actions). • If a site was NFA in the ROD explain why, and explain what NFA means. Describe when NFA was determined and reference the document PA/SI, RI/FS etc. • For sites that never had a remedy selected in a ROD please explain why. • Rationale why the site is not included in the FYR (i.e. remedy complete with clean closure, site not carried forward from RI etc.)	The Air Force does not believe Table 1-2 is necessary, as these sites do not require a five-year review. These sites are included in Table 1-1 simply to provide a comprehensive status of all IRP sites at the former Mather AFB. However, the Air Force has created a Table 1-2 that removes from Table 1-1 the sites that do not require a five-year review. The table includes the same columns as Table 1-1, except for the column "requirement for review – statutory/ policy," since no five-year review is required. For sites at which a ROD-required action was completed, the remedial action is already provided in the comments column. For sites that were NFA in a ROD, the ROD in which this decision was made has been noted. In addition, the introduction to Section 2.0 directs the reader to other documents (e.g., RODs, RARs, and previous five-year reviews) that can be reviewed for information on sites that do not require a five-year review. Information on how to access the Administrative Record is also provided.

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	4	EPA	John Lucey				**Include all sites with ongoing remedial actions, ICs and O&M activities** Site 69 - Please revise the 5YR Report to include the site 69.	All CERCLA actions were completed at Site OT-69, which is now part of the Military Munitions Response Program, prior to the period of this five-year review. However, temporary ICs are planned at this site to prevent potential unacceptable exposure to buried hazards while munitions debris clearance is being conducted. These ICs will be included in the Soil OU ESD that is pending signature. In addition, a land-use restriction was included in the deed when the property was transferred to the County of Sacramento in 2000. This restriction will be maintained until the munitions debris clearance at Site OT-69 is completed. The effectiveness of the ICs will be assessed in the fourth five-year review. A note about the pending ICs has been added to the comments column for Site OT-69 in Table 1-2.

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	4 (cont'd)	EPA	John Lucey				According to the comments provided for storage tank (ST)-20, site closure is still pending results of groundwater sampling for phthalates, but ST-20 is not reviewed in the 5YR Report. Please revise the 5YR Report to include the site ST-20.	All remedial actions were completed at Site ST-20 prior to the third and even the second five-year reviews. Although the RAR for Site ST-20 has not yet been finalized, the draft RAR (AFRPA, 2006) states, "No further remedial action is planned at Site 20, and there are no requirements for remedial action operation or institutional controls." The phthalate monitoring was part of Site ST-20's long-term groundwater monitoring requirement and, as such, is a post-remedial action requirement. Four quarters of phthalate monitoring were completed between 2008 and 2009 at monitoring wells MAFB-440 and MAFB-440P; phthalates were not detected in any of the groundwater samples collected. The comments column for Site ST-20 in Table 1-2 has been updated to reflect the completion of the groundwater monitoring requirement. In addition, the RAR for Site ST-20 is expected to be finalized in 2010.

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	4 (cont'd)	EPA	John Lucey				All sites with wetlands and the associated ICs should be included in the 5YR.	There are no ICs established for wetlands at any of the IRP sites in the CERCLA decision documents. However, the wetlands will be protected by a deed restriction or other agreement when property is transferred as documented in the *Supplemental Record of Decision, Final Environmental Impact Statement, Disposal and Reuse of Mather Air Force Base, California* (SROD) (AFBCA, 1994). Specifically, the SROD states "…that unless Sacramento County and the appropriate federal regulatory agencies, including but not limited to EPA Region 9, U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers, enter into agreements to protect the wetlands and endangered species prior to the conveyance by deed of SROD Parcels A and G to Sacramento County, I will attach to the deeds the following restriction: The Grantee will manage the area consistent with a management plan approved by appropriate federal and state regulatory agencies, including but not limited to the EPA Region 9, U.S. Fish and Wildlife Service, California Fish and Game, and the U.S. Army Corps of Engineers, to protect vernal pools, wetlands, and endangered species. Likewise, if the grantee desires a modification (continued)

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Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
	4 (cont'd)	EPA	John Lucey					(continued) to the management plan, it shall consult and receive the appropriate regulatory agencies' approval prior to taking any action. The grantee shall provide, in advance, copies of the management plan and any revisions to EPA Region 9. Regardless of the above agreement, the property disposal decisions reflected in this SROD do not relieve Sacramento County of its responsibility to comply with all applicable Federal, State, and local environmental laws and regulations, including, but not limited to, those related to endangered species, wetlands, vernal pools, endangered species, asbestos, landfills, and Installation Remediation Program sites."
	5	EPA	John Lucey	TOC			**Changes to the Table of Contents:** Please make the following changes to the table of contents (page i and ii) and to the report: Section 2.2 should include subsections for the sites within the AC&W OU, to be consistent with the other sections in the 5YR. If the AC&W plume is the only site within the OU then just list this site for consistency.	Site WP-12 is the only site that is part of the AC&W OU that requires a five-year review. Section 2.2 was not divided into subsections in the draft report, since there is only one site. Although at least two items are typically required to divide a section into subsections, a subsection for Site WP-12 (AC&W Plume) has now been added to be consistent with the other sections in Section 2.0.

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	5 (cont'd)	EPA	John Lucey				Section 2.7 should include a subsection for the sites within the Supplemental Basewide OU. Add site 89 and any other sites here for a consistent format with the preceding sections.	Site OT-89 is the only site that is part of the Supplemental Basewide OU that requires a five-year review. Section 2.7 was not divided into subsections in the draft report, since there is only one site. Although at least two items are typically required to divide a section into subsections, a subsection for Site OT-89 has now been added to be consistent with the other sections in Section 2.0.
							Section 5.2.3 should identify site 23C rather than 23.	The Air Force does not agree. The section addresses Subsites OT-23A, OT-23B, and OT-23D. The title of the section has been revised to, "5.2.3 In Situ Treatment at Subsites OT-23A, OT-23B, and OT-23D and Site SD-59".
							Section 8 and 9 should follow the previous format of listing each OU and each site within the OU. A separate issues and recommendations should be provided for each site. If there are no issues or recommendations for a site is should be stated as such. It may be appropriate to combine the issues and recommendation into one section so the reader does not have to flip between sections. The results should also be briefly summarized in a Table within the Summary Table in Section 1.	Text has been added to the introductory paragraphs in Sections 8.0 and 9.0 to list which sites within their respective OUs do not have any issues or recommendations/follow-up actions. Combining the two sections does not follow the 2001 EPA Comprehensive Five-Year Review Guidance. A summary of Sections 8.0 and 9.0 has been added to the summary form, which is now included under separate tab and precedes Section 1.0.

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	5 (cont'd)	EPA	John Lucey				Section 10 should provide a separate protectiveness statement for each site and should be follow the previous format of listing each OU and each site within the OU. The results should be briefly summarized in Table 1-1.	Protectiveness statements have been made for each OU (six total) in Section 10.0 and in the summary form that precedes Section 1.0. In addition, because the former Mather AFB has reached construction completion, a comprehensive statement for the entire site has been made per the 2001 EPA Comprehensive Five-Year Review Guidance.
	6	EPA	John Lucey	4.0, 4.1, 4.2			**Section 4 Remedial Actions:** Please revise the outline of Section 4 as shown below. Section 4.1 will require new text as described in italics. Section 4.2 to the end of Section 4 will require a cut and paste of existing text. Each OU and each site in the OU should be described separately.	The Air Force does not believe the suggested revisions to Section 4.0 are warranted, and if the revisions are made, significant portions of text will be repeated multiple times, especially text related to ICs and O&M. The current format for Section 4.0 follows the 2001 EPA Comprehensive Five-Year Review Guidance (p. 3-6, p. E-6, and p. E-23), and the text includes a presentation of remedial action objectives, remedy selection (including ICs, if applicable), remedy implementation (including ICs, if applicable), and system operations and maintenance for each site (Note: A discussion of O&M for the Landfill OU was inadvertently not included in the draft but has been added to the draft final). Each of the items requested in the proposed outline are covered in Section 4.0 in a concise, logical manner for each site. To avoid redundancy, the O&M discussions for similar sites (e.g., Soil OU sites) or similar remedial actions (e.g., pump-and-treat for groundwater sites) are summarized together.

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	6. (cont'd)	EPA	John Lucey	4.0, 4.1, 4.2			4.0 REMEDIAL ACTIONS 4.1 Summary of Remedial Actions 4.1.1 Current Status of Remedial Actions *List the types of remedial actions at Mather (soil excavation, soil disposal & treatment, SVE, landfill actions (capping, consolidation etc), sediment actions, groundwater actions. Reference Table 1-1 which describes the current status of the remedial actions for each site.* 4.1.2 Summary of Institutional Controls *This is the place in the document to have one comprehensive discussion of ICs. Reference the site specific IC descriptions in the following subsections. Include a table listing all of the sites that have ICs. The table should include the current status of all of the ICs and should include all sites with designated wetlands. Discuss the following IC topics:* *RODs and ESDs, the annual IC report, implementation and status of ICs on AF property, implementation and status of ICs on transferred property where the current property owner is responsible for ICs, landfill ICs, wetlands ICs, groundwater ICs, soil ICs etc.*	

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	6. (cont'd)	EPA	John Lucey	4.0, 4.1, 4.2			4.1.2 Summary of Operations and Maintenance Activities *Describe all of the various monitoring reports that are generated at Mather. (Annual GWM report, treatment plants, landfills etc.)* 4.2 AC&W OU 4.2.1 AC&W Plume 4.2.1.1 Remedy Selection *(describe the remedy in the ROD and ESDs)* 4.2.1.2 Institutional Controls *(describe the ICs in the ROD and ESDs)* 4.2.1.3 Remedy Implementation 4.2.1.4 Operations and Maintenance 4.3 Groundwater OU 4.3.1 Main Base/SAC Area Plume 4.3.1.1 ROD Remedy Selection 4.3.1.2 ESD Remedy Selection and ICs 4.3.1.3 Remedy Implementation 4.3.1.4 Operations and Maintenance 4.3.2 Site 7 Plume 4.3.2.1 ROD Remedy Selection 4.3.2.2 ESD Remedy Selection and ICs 4.3.2.3 Remedy Implementation 4.3.2.4 Operations and Maintenance	

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	7	EPA	John Lucey				**Institutional Controls described in future ESDs:** We should assume that the remaining ESDs will be finalized before the 5YR is finalized and the 5YR should be written from that point of view. There has been significant work on ICs that have either been adopted (OU1 and OU6) or are currently proposed in an ESD (OU 2, OU 3, OU 4, and OU 5, AFRPA, 2009a). If institutional controls are not in place and enforceable, the remedy must be considered protective in the long term only (i.e. short term protective).	The Air Force does not concur with assuming in writing the ESDs will be finalized prior to the finalization of the *Third Five-Year Review Report*. In addition, they will not have been finalized within the period of time covered by this five-year review. The Air Force understands that the remedies for sites with ICs will not be considered protective in the long term until the ICs are in place.
	8	EPA	John Lucey				**Institutional Controls (multiple issues):** The approach to ICs for vapor intrusion is confusing. The 5YR proposes to implement ICs to prevent exposure but that these ICs will be adopted only as necessary at the time of transfer (p. 5-1, p. 7-1). The 5YR should describe the current status of ICs during the interim period before property is transferred. In addition, the 5YR should describe the status of agreements for wellhead treatment at the Moonbeam and Juvenile Hall public water supply wells (p. 5-5) that was identified as an issue in the previous 5YR.	The sites for which ICs related to potential vapor intrusion are being selected are currently leased by the Air Force. As described in the draft final Soil OU and Basewide OU ESDs, during the time between adoption of the ESDs and deeding of the property, equivalent restrictions will be implemented pursuant to the terms of the existing lease which requires the approval of the Air Force for any construction or soil disturbance activity. The lease restrictions are in place and operational and will remain in place until the property is transferred by deed. At the time of deed transfer, lease restrictions will be superseded by equivalent use restrictions to be included in the federal deed and the

(continued)

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	8 (cont'd)	EPA	John Lucey					(continued) SLUC as described in the Soil OU and Basewide OU ESDs. This information has been added to Sites FT-10C/ST-68, WP-07/FT-11, LF-18, OT-23C, ST-37/ST-39/SS-54, SD-57, and SD-59 in Section 4.0. The status of the agreements for wellhead treatment at the Moonbeam and Juvenile Hall water supply wells is described on page 5-5. An agreement is in place with Cal Am for the Moonbeam Drive well. An agreement was not reached with Sacramento County for the Juvenile Hall wells, but the Air Force operated wellhead treatment and conducted sampling in accordance with the *Off-Base Water Supply Contingency Plan* during the five-year review period and will continue to comply with the Contingency Plan.
	9	EPA	John Lucey				**Provide IC Language in an Appendix:** There should be an appendix with the most recent IC language from the RODs and ESDs including the description changes made to the base general plan. It would be helpful to have language from the FOSTs and FOSETs for the related sites in the 5YR; this could also be included as an appendix. The 5YR should include a description of how ICs have been implemented at Mather and refer to the appendix with IC language.	The Air Force considers the requested ICs and FOST/FOSET language appendix to be beyond the scope of the five-year review. IC language is presented for each site in Section 4.0 of the *Third Five-Year Review Report* and is described in the applicable RODs and ESDs (two of which are not yet signed) that are referenced throughout the report. IC language to be included in future FOSTs/FOSETs is also presented in the applicable RODs and ESDs. Implementation of ICs is discussed in Section 4.0 and their effectiveness is discussed in Section 7.0 for each site with ICs.

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Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
	10	EPA	John Lucey				**OU1 – AC&W Site:** The document does an inadequate job evaluating the VI pathway. VI is discussed in the context of a recommendation from the last 5YR (Sec. 5.2.1, p. 5-1) and mentioned in the Technical Assessment (p. 7-1). It is not clear what analysis has been performed or what protocol was followed. A complete description of the VI screening and analysis needs to be discussed as part of the 5YR. Particularly confusing is that there is no discussion of the presence of any existing buildings that could be affected by VI even though the document does indicate that OU 1 groundwater plume extends southwest to the family housing area. Until this issue is adequately addressed, the protectiveness statement for this OU must be deferred.	Vapor intrusion is not considered an issue for the AC&W Plume because of the depth to water and low concentrations of TCE (the only COC for this plume) in groundwater. In 2009, the depth to groundwater was approximately 130 feet bgs, and groundwater levels are declining. Considering this depth to ground-water (i.e., in excess of 100 feet), there is no completed pathway. (EPA, 2002). In addition, a hardpan layer is present in shallow soils over much of the AC&W area that would further impede vapor migration from the groundwater plume and completion of the VI pathway. The maximum concentration of TCE in groundwater beneath the housing area was 7.7 µg/L at ACW EW-6R, which is an operating extraction well. No monitoring wells in the housing area had a concentration of TCE greater than the ACL in 2009. The maximum concentration of TCE reported in 2009 in the AC&W Plume was 12 µg/L in two upgradient extraction wells (ACW AT-1 and ACW AT-2). Concentrations in the plume have been decreasing and will continue to decrease with operation of the system. Consequently, the remaining TCE concentrations in the AC&W Plume do not pose an unacceptable risk via the vapor intrusion pathway to any industrial or residential receptors, and the AC&W remedy is protective of human health. The text has been updated to include this information.

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	11	EPA	John Lucey				**OU2 – Groundwater OU:** The document briefly mentions recent capture zone analyses (CZA) for the Main Base/SAC Area Plume (p. 5-4), and for the Site 7 Plume (p. 5-5, 7-15) are currently under consideration. For the Main Base Plume, the document indicates that capture in the southern portion of the plume is "not clear" (p. 7-9) and that they are only able to confirm capture of "a majority of the plume" (p. 7-12). The limited contouring presented in the analysis for the Site 7 Plume (Figure 7-7) does not present a convincing case for capture. In the 5YR, the proposed follow-up actions to address these issues are indicated to be installation of additional monitoring wells (p. 8-1) and continued monitoring (p.8-2). In the absence of evidence of complete capture, and in consideration that there is no evidence of human exposure, the remedy can be considered protective in the short term only. Alternately, the protectiveness determination could be deferred until such time that the documentation demonstrating capture, currently under consideration, is approved.	For the Main Base/SAC Area Plume, the portion of the Southwest Lobe beyond depicted capture is now bounded by monitoring results below the TCE ACL. The TCE detection of 3.6 µg/L in 2Q09 at Teichert well OFB-72 (used only for dust suppression) is less than the ACL. Consequently, the remedy may be considered protective. The text has been revised to include this information. Review of analytical data through 2Q09 and the capture zone analysis for Site 7 included as Appendix N in the final 2008 groundwater monitoring report indicates the plume is now within the analytical capture zone of the extraction wells. Figure 7-7 has been modified to show the extent of the plume along with the analytical capture zones depicted in the capture zone analysis. In addition, there is no confirmed evidence of migration of the plume. The text has been revised to include this information.

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	11 (cont'd)	EPA	John Lucey				The document does an inadequate job evaluating the VI pathway. VI is discussed in the context of a recommendation from the last 5YR (Sec. 5.2.1, p. 5-1) and mentioned in the Technical Assessment (p. 7-1). It is not clear what analysis has been performed or what protocol was followed. A complete VI screening analysis needs to be presented in the 5YR. Particularly confusing is that there is no discussion of the presence of any existing buildings that could be affected by VI. Until this issue is adequately addressed, we must defer a protectiveness statement for this OU.	Generic and semi-site-specific VI risk screening analysis was conducted for the Site 7 Plume (see response to comment #38 for more details). Both the commercial and residential generic screening and semi-site-specific estimates were within the risk management range of 1E-06 to 1E-04. However, there are currently no buildings over the footprint of the Site 7 Plume. Almost the entire Site 7 Plume is off site under an area previously excavated for gravel mining, and there are no known future plans for buildings at this area. An area near the plume has been reclaimed as a seasonal wetland/ marsh, so it is unlikely that buildings will be placed near the wetlands and plume. Consequently, there is no completed commercial or residential VI exposure pathway. The Site 7 remedy is currently protective in the short term and will be protective in the long term upon completion of the groundwater extraction and treatment remedy and implementation of the ICs in the Groundwater OU ESD awaiting authorizing signatures. For the off-site portion of the Main Base/SAC Area Plume, the remedy is protective at least in the short term as discussed in detail in the response to comment #38. The text has been updated to reflect the conditions for the off-site portions of the plumes. (continued)

Comment Type	Comment No	Comment By	Commenter	Section	Page	Other	Comment	Response
	11 (cont'd)	EPA	John Lucey					(continued) Generic and semi-site-specific VI risk screening analysis was also conducted for the on-site portion of the Main Base/SAC Area Plume from two wells with the highest concentrations at the water table, i.e., MAFB-420 and MAFB-439. The commercial generic screening and semi-site-specific estimates were within the risk management range of 1E-06 to 1E-04. The residential semi-site-specific estimates reflecting more site-specific soil types are also within the risk management range. The generic residential risk estimate was just over the risk management range with a value of 2.4E-04, but the generic screening does not reflect site conditions to the degree the semi-site-specific assessment does. It should be noted that there are no residential buildings overlying this portion of the plume, and residential development at this portion of the plume is unlikely in the short term given the current use as an air field. Therefore, there is no currently completed on-site residential exposure pathway. MAFB-439 is currently in an open field and the hot spot at MAFB-420 underlies an open field, a taxiway and hangars. These facilities do not fit the typical building conditions for commercial indoor air exposure, so it is likely that this risk will be diminished. VOC concentrations have (continued)

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	11 (cont'd)	EPA	John Lucey					(continued) been decreasing in MAFB-420 since 2007. Also, the water table has been declining in this area and is now approximately 95 feet bgs. The Main Base/SAC Area Plume remedy is currently protective in the short term and will be protective in the long term upon completion of the groundwater extraction and treatment remedy and implementation of the ICs in the Groundwater OU ESD awaiting authorizing signatures. The text has been updated appropriately.
							The 5YR indicates that "The Main Base/SAC Area Plume remedial system is installed and has operated intermittently since 1998 due to gravel mining activities, and that due to gravel mining and other construction activities similar disruptions have occurred to the operation of the Site 7 groundwater remedial systems (p. 4-7). Further, operators identified as issues of concern, "longer than expected shut-down periods for the Site 7 groundwater extraction and treatment system due to mining activities off site" (p. 6-4). Nonetheless, the 5YR document (continued)	The Air Force has no control over off-site land use, so there is limited likelihood of implementing a contingency plan for the off-site portion of the plume. However, most of the mining activities that created the past delays are completed. Although some reclamation activities are being conducted by the off-site property owners, the remedial action is and will continue to operate while these activities are being conducted.

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	11 (cont'd)	EPA	John Lucey				(continued) indicates that "While the interruptions of the groundwater extraction and treatment system has been of concern and has delayed the progress of the remedial action, they have not compromised the protectiveness" (p. 7-16). Given the history of past disruptions and the effect of potential future disruptions on basic capture and control of contaminated ground water, the document should discuss contingency plans for addressing current land use in this neighboring parcel that are incompatible with the remedial project. This would appear to be a fundamental protectiveness issue for Site 7 that should be identified as such in the 5YR.	

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	11 (cont'd)	EPA	John Lucey				The previous 5YR identified as an issue the need for an ESD to incorporate MNA as the remedy for the Northeast Plume if evaluation of monitoring data supported such a remedy (p. 5-5). That 5YR suggested that the basis for this MNA approach was not supported by the 2002 study in which data obtained "did not allow for confident predictions of future concen-trations" (p. 4-8). However, the current document seems to support the case that MNA is occurring and yet comes to the conclusion that "The Air Force does not believe the existing condition of the plume warrants the development of an ESD for MNA" (p. 5-6) and that "Additional monitoring will likely be needed to confirm trends and evaluate (model) the potential time for concentrations to decrease to less than ACLs" (p. 7-20). It would appear that the issue we identified 5 years ago still stands and should be repeated here, namely, "The USAF should consider the appropriateness of monitored natural attenuation (MNA) as the remedy for the Northeast Plume through an extensive evaluation of the monitoring data; if the data support MNA as the long-term remedial action as per EPA guidance, the USAF should develop an ESD for this site."	The Air Force concurs with EPA's comment #34. This comment states the Five-Year Review should say that the Air Force and the regulatory agencies are moving forward with approval of the OPS designation and all parties agree that an ESD and MNA will not be necessary at this time. The plume appears to be stable at this time and if site conditions change in the future then alternative actions may need to be considered at that time. The text has been revised accordingly.

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	12	EPA	John Lucey				**OU3 – Soil OU:** For Site WP-07/FT-11, the document indicates that an SVE thermal oxidation (TO) system and a bioventing (BV) system are used to treat contaminated vapors from the site (p. 4-12). While the document indicates that the SVE system is in compliance with air emission ARARs (p. 7-21), the document must present and discuss the ARARs applicable to the TO and BV systems and the results of parameter sampling. The SVE off-gas treatment system for Site ST-37/ST-39/SS54 consists of a 500 scfm TO system (p. 4-13). The document must present and discuss the ARARs applicable to the TO system and the results of parameter sampling including dioxin monitoring. The report indicates that the SVE system for Site SD-57 operated from Feb 2004 through Sep 2008 without air emission treatment (p. 4-14). The document should discuss current operational requirements, ARARs, and present current emissions data if it is still operating. The report indicates that the SVE system for Site SD-59 currently operates without air emission treatment (p. 4-16). The document should discuss current operational requirements, ARARs, and present current emissions data.	The results of air emissions monitoring during the period of this five-year review can be reviewed in the semiannual (2004 through 2007) and annual (2008) SVE reports as referenced throughout the *Third Five-Year Review Report*. In Section 7.0, each Soil OU site (WP-07/FT-11, ST-37/ST-39/SS-54, SD-57, and SD-59) has a paragraph titled "SVE System Compliance", which describes the air emissions results during the period of the five-year review in general and whether the results were in compliance with the California Clean Air Act ARARs (substantive requirements of rules promulgated by SMAQMD as documented for each of the SVE systems). The Site WP-07/FT-11 SVE system did not operate after 16 March 2006; therefore, the ARARs governing air emissions were no longer applicable, and compliance samples were not collected. No dioxin monitoring was required by the Soil OU ROD for the Site ST-37/ ST 39/SS-54 system. An update on the current operational requirements for Site SD-57 has been added to Section 4.2.3. At Site SD-59, current operational requirements are presented in Section 4.2.4 and no changes to the text were made. For any system that did not or is not currently operating with air emission treatment, concurrence was obtained from SMAQMD.

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	12 (cont'd)	EPA	John Lucey				Follow-up action on a recommendation from the previous 5YR dealing with contamination at Subsites OT-23A, OT-23B, and OT-23D (p. 5-2) appears to be incomplete, and yet remedial systems have been shut down pending closure evaluation. If EPA does not concur with these evaluations, then the remedial systems must be restarted in order for the remedy to be protective.	Comment noted, although it should be noted that Subsites OT-23B and OT-23D are addressed by the Site ST-37/ST-39/SS-54 SVE system, which was still operating during the five-year review period. For Subsite OT-23A, which was combined with Site LF-18 for purposes of remediation, the final closure report was issued in May 2010 and is currently the topic of discussion between the Air Force and the regulatory agencies.
	13	EPA	John Lucey				**OU5 – Basewide OU:** The SVE systems for Sites FT-10C/ST-68 and LF-18 are currently shut down pending closure evaluation. If EPA does not concur with these evaluations, then the remedial systems must be restarted in order for the remedy to be protective.	Comment noted. The final closure reports were issued in May 2010 and are currently the topic of discussion between the Air Force and the regulatory agencies.
	14	EPA	John Lucey	2.0	2-1		**Site Chronologies:** The site chronologies section should provide a chronological list of the major site documents including, but not limited to PA/SI, RI/FS, RODs and ESDs, QAPP/SAP, and risk assessments.	A chronology of major site events (e.g., pre-ROD removal actions, RI/FS, Proposed Plans, RODs, and ESDs) is documented for each OU in the narrative text in Section 2.0. A listing of major site events is presented in the RODs for each OU.

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	15	EPA	John Lucey	3.1.2 & Fig. 3-2	3-3		**Site Geology and Groundwater Hydrology:** The last sentence of the second to last paragraph of Section 3.1.2 states "Unit D channel deposits are encountered approximately 220 to 300 feet bgs [below ground surface] and are characterized by sands and silty sands, as opposed to the coarse sands and gravels of Unit B;" however, the comparison between Unit B and the channel deposits of Unit D is confusing because Unit D consists primarily of fine overbank deposits (silt and clay) and the coarse channel deposits are only a small portion of the unit. Please explain the comparison between the coarse deposits of Unit B and the channel deposits of Unit D.	The text has been appropriately revised.

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	16	EPA	John Lucey	3.1.2 & Fig.3-2	3-3		**Site Geology and Groundwater Hydrology and Generalized Hydrogeologic Cross-Section North of Runways:** The description of the units found in the text of Section 3.1.2 does not match the visual representation shown on Figure 3-2. The text states Unit D "extends from the top of the uppermost sandy channel below Unit B to the top of the Laguna-Mehrten Transition" (i.e. Unit D underlies Unit B), while Figure 3-2 shows Unit C between Unit B and Unit D under almost the entire length of the cross-section. The descriptions of units in the text should be consistent with what is shown on the cross-section. Please revise the description found in Section 3.1.2 to match what is displayed on Figure 3-2.	The text has been revised to state that Unit D extends from the base of Unit C to the top of the Laguna-Mehrten Transition.
	17	EPA	John Lucey	3.1.2	3-3		**Site Geology and Groundwater Hydrology:** The sentence at the top of page 3-3 states the water table occurs in Unit C near sites waste pit (WP)-07, Aircraft Control and Warning (AC&W), LF-03, and LF-04, while the third full paragraph on page 3-3 states the water table occurs in Unit C near sites WP-07, AC&W, LF-03, LF-04, and LF-05. The list of sites should be the same. Please revise the text to contain the correct list of sites, and ensure the information presented within the 5YR is consistent.	The text has been revised to include LF-05 in the sentence at the top of page 3-3. This provides the correct list of sites.

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	18	EPA	John Lucey		3-7 & 3-7	Tbl. 3-1	**COCs and Cleanup Levels for Mather IRP Sites Requiring a Five-Year Review:** The list of COCs for each site has been divided based on the medium (soil, groundwater, sediment, etc.), but this division has not been done for sites ST-68, FT-10/ST-68, and SD-57. Please revise the table to include the medium subheadings for these sites.	The table has been revised as requested.
	19	EPA	John Lucey		3-6	Tbl. 3-1	**COCs and Cleanup Levels for Mather IRP Sites Requiring a Five-Year Review:** No contaminants of concern (COCs) have been listed for landfill (LF)-03 or LF-04. Please revise Table 3-1 to list the COCs provided in the Landfill Operable Unit (OU) Record of Decision (ROD).	Besides the groundwater COCs related to the Northeast Plume (Groundwater OU) and the ARARs addressing methane monitoring requirements, there are no COCs or cleanup levels for the landfills. No changes to Table 3-1 have been made.

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	20	EPA	John Lucey		3-6	Tbl. 3-1	**COCs and Cleanup Levels for Mather IRP Sites Requiring a Five-Year Review:** This table indicates the cleanup level associated with this area/action is 800 milligrams per kilogram (mg/kg), which is the screening criterion for industrial land use. This site is not associated with any institutional control limitations with respect to land transfer. Please confirm the fire training (FT)-10C/ST-68 excavation is complete and complied with a cleanup target of 151 mg/kg for lead, and if not please state whether ICs are needed.	The cleanup level for lead in soil at Site FT-10C/ST-68 as documented in the final *Explanation of Significant Difference from the Record of Decision Excavation of Shallow Soil Contaminated with Lead at Site 10C/68* is 800 mg/kg. However, it was anticipated that the excavation effort would also meet the unlimited use and unrestricted exposure threshold of concern of 151 mg/kg that was established through site-specific determinations using DTSC's LEADSPREAD model and documented in the ESD. Confirmation samples collected from the excavation indicate that the unrestricted use level (151 mg/kg) was achieved and ICs are not needed at Site FT-10C/ST-68. The results are documented in the final *Site 10C/68 Closure Report* that was issued in May 2010.
	21	EPA	John Lucey	4.0	4-1		**Remedial Actions:** While the groundwater and soil vapor extraction (SVE) sites have sections discussing operations and maintenance activities, there is no such discussion included for the landfills, LF-03 and LF-04. Long-term operations and maintenance is part of the remedy for the landfills, and therefore should be discussed in Section 4.0. Please revise Section 4.0 to include operations and maintenance discussion for the Landfill OU sites, LF-03 and LF-04.	Text describing the O&M activities for the Landfill OU was inadvertently not included in Section 4.3 and has been added as Section 4.3.3.

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	22	EPA	John Lucey	4.1.3	4-7		**Groundwater OU – Site 7 Plume:** The first paragraph discussing remedy implementation uses the wrong plume name, the Main Base/SAC Area Plume rather than the Site 7 Plume. Please revise the text to use the correct plume name, and ensure that the discussion is accurate for the Site 7 Plume.	The text has been corrected to say "Site 7 Plume." The discussion that follows applies to the Site 7 Plume.
	23	EPA	John Lucey	4.1.6 & 4.2.5	4-9 & 4-16		**Operations and Maintenance:** The Content Checklist for Five-Year Review Reports located in Appendix E of the guidance document *Comprehensive Five-Year Review Guidance* (5YR Review Guidance) states a summary of costs for system operation and maintenance should be included, but no summary of costs is presented in the 5YR. Please include a summary of the operation and maintenance costs for the sites reviewed in the 5YR.	The Mather program is managed with daily on-site presence and uses more direct indications of efficient operation than cost fluctuations. The program focus is more on effective and efficient operation of the remedial actions to meet ROD objectives than comparing costs to estimates from feasibility studies. However, cost information for the sites has been added to the O&M sections for each OU. Costs for some of the sites are combined because that is how they are funded by the Air Force.
	24	EPA	John Lucey	4.2.1	4-10		**Site WP-07/FT-11:** There is a portion of text with a line through it, so it is uncertain whether this text is intended to be in the 5YR or not. Please either remove the text from the 5YR or remove the strike-out font through the text.	The strikethrough of the italicized text was intended to show that the condition prescribed in the Soil OU ROD was deleted by the referenced ESD. The text has been revised to remove the strikethrough, and text has been added to clarify the modification of the ROD remedy by the ESD.

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	25	EPA	John Lucey		4-20 & 4-21	3rd PP & 3 PP	**Site FT-10C/ST-68:** The text refers to achieving lead cleanup levels of less than 151 mg/kg. Important to identify in the text the soil lead concentration remaining on site. There are several key EPA conclusions that are relevant to the review of lead screening value (1) young children remain the sensitive population and neurological development remains the primary health concern; (2) there are several health effects associated with the blood lead levels that are well below 10 ug/dl and we (EPA) concluded that there is now no recognized safe level of lead in children's blood. California has a revised lead residential soil level of 80 mg/kg and a revised lead industrial of 320 mg/kg.	The maximum lead concentration remaining in soil following the excavation at Site FT-10C/ST-68 is 127 mg/kg (median concentration of 19 mg/kg), which is less than the site-specific 151 mg/kg threshold of concern established in the ESD that was signed by the parties to the FFA in 2008. The 151 mg/kg threshold of concern established in the ESD is the concentration of total lead in soil compatible with unlimited use and unrestricted exposure at Site FT-10C/ST-68 as estimated using the DTSC LEADSPREAD model. In addition, 151 mg/kg is less than U.S. EPA's 400 mg/kg residential Regional Screening Level for lead. It is the Air Force's position that the California Human Health Screening Levels (CHHSLs) for lead noted in the comment are not promulgated standards, are not enforceable, and are not ARARs for Site FT-10C/ ST-68. According to Cal/EPA, the CHHSLs are non-regulatory and advisory in nature (DTSC/HERO presentation at the California CUPA conference, February 2010). It should also be noted that the area excavated at Site FT-10C/ST-68 mostly lies underneath Truemper Way and is located in an area planned for airport use. Construction of a building or other structure at this location in the future is unlikely.

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	26	EPA	John Lucey	4.0		Figs.	The site figures included in Section 4 show the current remedial systems but do not show the extent of institutional control (IC) boundaries nor the excavation boundaries for past excavation activities. Soil removal and ICs are important aspects of the remedial actions for these sites and should be shown on the figures. Please revise the site figures in Section 4 to include boundaries for ICs and soil removal actions. In addition, no site figures have been included sites other (OT)-87 and OT-89. Site figures should be included for all Installation Restoration Program (IRP) sites reviewed in the 5YR. Please also include figures for sites OT-87 and OT-89.	Site figures showing IC boundaries for Sites OT-87 and OT-89 have been added to Section 4.0. IC boundaries are also shown on Figure 4-1 for the AC&W Site. IC boundaries are not shown for other Soil, Groundwater, and Basewide OU Sites because the ESDs that define these boundaries have not yet been signed. For sites at which excavations were conducted, excavation boundaries are shown on figures presented in site closure documents/remedial action reports.

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	27	EPA	John Lucey			Fig. 4-5	There appear to still be portions of the Site 7 Plume and the Southwest Lobe of the Main Base/Strategic Air Command (SAC) Area Plume that are not defined, as shown on Figure 4-5 Groundwater Monitoring Well and Plume Location Map Fourth Quarter 2008. Plume definition is very important for establishing capture and monitoring potential migration. The portions of the Site 7 Plume and the Southwest Lobe of the Main Base/SAC Area Plume that are not defined should be discussed and any future plans regarding these areas should be summarized in the 5YR.	The Site 7 Plume is essentially defined except for a very small portion immediately upgradient (i.e., southeast) of monitoring well MAFB-448. The TCE concentrations in MAFB-448 have ranged between 7.1 and 9 µg/L during 2008 and 2009, which is just above the ACL of 5 µg/L. The cost of another monitoring well to the southeast is hard to justify relative to the rather limited additional characterization information that the well would provide. The Air Force maintains that the monitoring data show that the plume is not migrating at this time. The figure has been updated accordingly. For the Main Base/SAC Area Plume, the Southwest Lobe is now bounded by monitoring results below the ACL. The figure has been revised accordingly.

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	28	EPA	John Lucey	5.2.1			The discussion of potential risk from vapor intrusion in Section 5.2.1 of the 5YR is not well-organized. The discussion needs to discriminate between inhalation and oral toxicity values. The units of the single provided toxicity value imply a noncarcinogenic mode of action, which is not the appropriate basis for trichloroethene (TCE) screening or cleanup criteria. The groundwater screening criteria referenced within this discussion do not comply with Environmental Protection Agency (EPA) groundwater screening criteria predicated on vapor intrusion. The VI screening criterion for TCE in groundwater is equivalent to the maximum contaminant level (MCL) at 5 micrograms per liter (ug/L). The referenced screening criterion of 300 ug/L in groundwater is not in agreement with EPA's screening criterion. Even if adjustments were incorporated into the Air Force (AF) groundwater screening criteria to account for less than continuous exposures (consistent with EPA's *Risk Assessment Guidance for Superfund, Part F*; 2009), the apparent differences appear to be too significant.	

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	28 (cont'd)	EPA	John Lucey	5.2.1			(continued) • Please expand this discussion to discriminate between on- and off-site exposures.	Please see the response to comment #38 regarding the potential for off-site exposure from the Site 7 and Main Base/SAC Area plumes. There are no completed exposure pathways off site from the former Mather AFB and none are likely. There are currently no buildings and no future plans for buildings on Air Force property over the Site 7 Plume (i.e., the WP-07 Landfill). For the on-site portion of the Main Base/SAC Area Plume, health-protective screening concentrations for groundwater (from two wells with the highest concentrations at the water table, i.e., MAFB-420 and MAFB-439) were back-calculated for each analyte detected in groundwater from corresponding Regional Screening Level (RSL) and Henry's law constant (HLC) values, and either an empirical attenuation factor ("generic screening" as per EPA, 2002) or a theoretical attenuation factor ("semi-site specific screening" as per EPA, 2002), and a site-specific depth to groundwater with a subsurface soil type representative of the site. The commercial generic screening and semi-site-specific estimates were within the risk management range of 1E-06 to 1E-04. The residential semi-site-specific estimates reflecting more site-specific soil types are also within the risk management range. (continued)

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	28 (cont'd)	EPA	John Lucey	5.2.1				(continued) The generic residential risk estimate was just over the risk management range with a value of 2.4E-04, but the generic screening does not reflect site conditions to the degree the semi-site-specific assessment does. It should be noted that there are no residential buildings overlying this portion of the plume, and residential development at this portion of the plume is unlikely in the short term given the current use as an air field. Therefore, there is no currently completed on-site residential exposure pathway. Relative to commercial exposure, MAFB-439 is currently in an open field and the hot spot at MAFB-420 underlies an open field, a taxiway, and hangars. These facilities do not fit the typical building conditions for commercial indoor air exposure, so it is likely that risk will be diminished. TCE, PCE and CCl_4 concentrations have been decreasing in MAFB-420 since 2007. Also, the water table has been declining in this area and is now approximately 95 feet bgs. The Main Base/SAC Area Plume remedy is currently protective in the short term and will be protective in the long term upon completion of the groundwater extraction and treatment remedy and implementation of the ICs in the Groundwater OU ESD awaiting authorizing signatures. The text has been updated appropriately.

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	28 (cont'd)	EPA	John Lucey	5.2.1			• Please expand this discussion to address residential versus commercial/industrial exposures where the latter accounts for intermittent exposure.	There are no known current or future anticipated residential exposures for VI related to the Mather groundwater plumes. Please see the response to EPA comment #11 regarding potential commercial VI exposure from the Main Base/SAC Area Plume.
							• Please incorporate a discussion of site levels in comparison to criteria presented in Table 2C of EPA's Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soil (2002).	The Air Force understands the data used to calculate the TCE screening criteria in Table 2C of the draft guidance are outdated. Consequently, the subject criteria on Table 2C have not been used for comparison in the text.
							• Please provide a discussion presenting the soil vapor cleanup levels and the methodology utilized to develop these levels.	Narrative cleanup levels are in place (or soon will be pending signatures on the Soil OU and Basewide OU ESDs) for SVE sites, although these are for the protection of groundwater quality. As part of the closure process for the SVE/bioventing sites, the vapor intrusion pathway is evaluated. In addition, ICs to address potential vapor intrusion risk will be imposed, if necessary. If site soil gas data demonstrate that all of the soil gas concentrations for each COC are compatible with unrestricted land use, then the Air Force will not impose the ICs.

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	28 (cont'd)	EPA	John Lucey	5.2.1			• Please revise the discussion to address the CalEPA inhalation unit risk (IUR) for TCE [(2E-06 ug/m^3)$^{-1}$] and the current CalEPA oral cancer slope factor of 1.3E-02 mg/kg/day^{-1}.	As stated in previous responses, the likelihood of a completed VI pathway from the groundwater plumes at Mather is low. This is due to the significant depth to groundwater, e.g., greater than or equal to roughly 95 feet, and the relatively low concentrations of VOCs in groundwater at some of the plumes. If some form of additional exposure assessment is ever conducted for this potential pathway, then the Cal/EPA IUR and slope factor may be considered.
	29	EPA	John Lucey	5.2.3	5-2		**In Situ Treatment at Sites OT-23 and SD-59:** The discussion for subsite OT-23A does not appear to focus on this site, but instead discusses the installation of additional SVE wells at LF-18. It is understood that the LF-18 SVE system impacts subsite OT-23A, but any discussion of the LF-18 SVE system should be in terms of its impact on subsite OT-23A because that is the topic of the section. Please revise the text of Section 5.2.3 to discuss the LF-18 SVE system in terms of its affect on subsite OT-23A.	The text has been revised to discuss the impact of the Site LF-18 SVE system on Subsite OT-23A.
	30	EPA	John Lucey	5.3	5-3 to 5-6		**Issues Raised Following the Completion of the Second Five-Year Review:** This section lists a number of concerns with an associated status. Each concern and status should be numbered for easy reference.	Each concern has been numbered as requested.

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	31	EPA	John Lucey	5.3	5-4		**Issues Raised Following the Completion of the Second Five-Year Review:** The first full paragraph states the following is a list of documents with their status that "add, clarify, and/or select ICs" to be part of the remedial action. However, the bullets that follow only list the documents but do not describe whether ICs have been added or clarified.	For clarification, the text has been revised.
	32	EPA	John Lucey	5.3	5-5		**Issues Raised Following the Completion of the Second Five-Year Review:** The first full paragraph on page 5-5 states "if perchlorate levels related to the upgradient perchlorate plume(s) arrive at the Mather IRP groundwater wells, the Air Force expects the EPA and State of California to engage with the PRP(s) [potentially responsible parties] regarding additional sampling, analysis, and appropriate corrective action;" however, there is no discussion as to how the AF will monitor for the potential migration of perchlorate at former Mather Air Force Base (AFB). There is no discussion of groundwater sampling for perchlorate. Please (continued)	The Air Force is not required to monitor for perchlorate in ground-water at the former Mather AFB because the source for the perchlorate contamination in ground-water is not the result of activities at the former AFB. As noted in the status update for the concern (now identified as concern #3) regarding perchlorate in groundwater, the Air Force monitored for perchlorate in the effluent from the Main Base/SAC and AC&W GWTPs during the period of this five-year review, and perchlorate was never detected greater than the practical quantitation limit. In addition, no objections were received from the regulatory agency RPMs when the Air Force terminated groundwater sampling for perchlorate analysis in 2010 as documented in the 2010 (continued)

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	32 (cont'd)	EPA	John Lucey	5.3	5-5		(continued) discuss how the migration of perchlorate from upgradient sources will be monitored. Please include information such as the frequency of perchlorate groundwater sampling, as well as the number of wells monitored for perchlorate. Please describe more information about who the PRP for the Upgradient source. Clarify the status of regulatory concurrence to stop sampling for perchlorate.	(continued) *Groundwater Monitoring Program Sampling Plan*. The PRPs for the upgradient perchlorate sources are Aerojet-General Corporation and the Boeing Company. The perchlorate contamination in groundwater is the result of aerospace-related activities at what is known as the Inactive Rancho Cordova Test Site [IRCTS]). Aerojet cleanup activities are conducted under the Federal Superfund Program with oversight by EPA Region 9 and CVWB, and Boeing cleanup activities are overseen by DTSC and CVWB. Information about the PRPs has been added to the status update for concern #3.

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	33	EPA	John Lucey	5.3	5-5		**Issues Raised Following the Completion of the Second Five-Year Review:** The 5YR states that the AF will terminate well head treatment for the Moonbeam Drive water supply well. Clarify the status of regulatory concurrence to stop sampling for perchlorate. The discussion regarding the agreement with Sacramento County does not provide information regarding what is contained in the agreement. There is no information about the terms of the agreement that is trying to be established, and although the AF is currently operating a wellhead treatment system for the Juvenile Hall supply wells, the text does not indicate how this will continue without a signed agreement. Please summarize the scope of the desired agreement with Sacramento County and also state whether the operation of the treatment system will continue without a signed agreement.	No perchlorate sampling has been conducted or required at the Moonbeam Drive water supply well, and in June 2010, the Air Force terminated wellhead treatment at the well in accordance with the *Off-Base Water Supply Contingency Plan*. The Air Force will continue wellhead treatment at the Juvenile Hall water supply wells in accordance with the Contingency Plan regardless of whether an agreement is in place with Sacramento County.

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	34	EPA	John Lucey	5.3	5-5 & 5-6		**Issues Raised Following the Completion of the Second Five-Year Review:** Concerning the Northeast Plume OPS, the 5YR should say that the AF and the regulatory agencies are moving forward with approval of the OPS designation and all parties agree that and ESD and MNA will not be necessary at this time. The plume appears to be stable at this time and if site conditions change in the future then alternative actions may need to be considered at that time.	The Air Force agrees that an ESD and MNA are not necessary at this time.
	35	EPA	John Lucey	7.1.1	7-1		**Are the exposure assumptions used at the time of the remedy still valid?** Discussions of all associated VI issues are relevant within this section. Please also note that it appears soil vapor data will be used to make a determination regarding the need for ICs to be enacted. This may be a plausible basis for this determination if: 1) the soil vapor concentrations do not exceed the EPA Table 2C shallow soil gas screening criteria, and, 2) that underlying groundwater (continued)	Narrative cleanup levels are in place (or soon will be pending signatures on the Soil OU and Basewide OU ESDs) for SVE sites, although these are for the protection of groundwater quality. As part of the closure process for the SVE/bioventing sites, the vapor intrusion pathway is evaluated, i.e., the soil vapor data from the SVE sites would account for any potential off gassing from the groundwater plumes, if present. The VI pathway has been evaluated for the plumes, and based upon this analysis, there do not appear to be completed (continued)

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	35	EPA	John Lucey	7.1.1	7-1		(continued) concentrations also do not exceed the Table 2C groundwater screening criteria. If underlying groundwater concentrations exceed the Table 2C groundwater screening criteria, soil gas data will not be sufficient to rule out the vapor intrusion pathway. In this case, a defensible vapor intrusion assessment must be advanced, continued monitoring must be implemented to ensure levels do not rise to exceed screening criteria (in soil gas or indoor air), or another mitigation plan will need to be implemented to preclude relevant exposures under all susceptible land uses.	(continued) exposure pathways for the groundwater plumes. In addition, ICs to address potential vapor intrusion risk will be imposed, if necessary. If the site soil gas data demonstrate that all of the soil gas concentrations for each COC are compatible with unrestricted land use, then the Air Force will not impose the ICs.

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	36	EPA	John Lucey		7-1 to 7-4		**Question B exposure assumptions, etc.:** Section 7.1.2 Are the toxicity data used at the time of the remedy still valid? The lead information has changed there are several health effects associated with the blood lead levels that are well below 10 ug/dl and we (EPA) concluded that there is now no recognized safe level of lead in children's blood. California has a revised lead residential soil level of 80 mg/kg and a revised lead industrial soil level of 320 mg/kg.	Comment noted. The Air Force's position is that the CHHSLs for lead noted in the comment are not promulgated standards, are not enforceable, and are not ARARs. According to the Cal/EPA document *Use of California Human Health Screening Levels in Evaluation of Contaminated Properties,* CHHSLs are not to serve as: (1) a stand-alone decision making tool, (2) a substitute for guidance for the preparation of baseline human health risk assess-ments, (3) a rule to determine if a waste is hazardous under the state or federal regulations, (4) a rule to determine when the release of hazardous chemicals must be reported to the overseeing regulatory agency, (5) set of final cleanup or action levels to be applied at contaminated sites or (6) a guarantee that an oversight regulatory agency will determine that a project is adequately studied or agree with the conclusions of the site investigation and risk assessment report. According to Cal/EPA, CHHSLs are non-regulatory and advisory in nature; use of CHHSLs is voluntary (DTSC/HERO presentation at the California CUPA conference, February 2010).

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	37	EPA	John Lucey		7-3	Tbl. 7-1	**Groundwater Aquifer Cleanup Levels Compared to EPA Regional Screening Levels and California Public Health Goals:** Please note that the public health goal (PHG) for TCE has been revised to reflect value a of 1.7 ug/L. No revision of the Report is necessary.	The value for TCE has been corrected in Table 7-1, as it affects the calculations discussed in the text.
	38	EPA	John Lucey	7.3.1.3	7-13		**Mather Off-base Water Supply Contingency Plan:** Please update this discussion to address off-base residential and industrial exposure to contamination in groundwater via vapor intrusion.	Vapor intrusion is not considered an issue off site from the former Mather AFB, as there are no completed exposure pathways and none are likely. Off site to the west of the Main Base/SAC Area, a small TCE plume is present in groundwater at water table well MAFB-121 (Figure 7-3). This well is located to the east of Happy Lane adjacent to an open area previously mined for gravel. The most recent concentration of TCE reported at this well was 6.0 µg/L during 2Q08, and the approximate depth to groundwater was approximately 92 feet bgs. Health-protective screening concentrations for groundwater were back-calculated for each analyte detected in groundwater from corresponding RSL and HLC values, and either an empirical attenuation factor (“generic screening” as per EPA, 2002) or a theoretical attenuation factor (“semi-site-specific screening” as per EPA, 2002, and a site-specific depth to groundwater with a subsurface soil type representative of the site. The (continued)

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	38 (cont'd)	EPA	John Lucey	7.3.1.3	7-13			(continued) commercial generic screening and semi-site-specific estimates were less than 1E-06. The residential semi-site specific estimate reflecting more site-specific soil types is also less than 1E-06. The generic residential risk estimate is 3.6E-06, which is slightly above 1E-06. However, there are no residential buildings overlying this plume, and concentrations in well MAFB-121 were decreasing over the last five years prior to the well becoming dry in 4Q09 to the present. The Main Base/SAC Area Plume remedy is currently protective in the short term and will be protective in the long term upon completion of the groundwater extraction and treatment remedy and implementation of the ICs in the Groundwater OU ESD awaiting authorizing signatures. For the Site 7 Plume, health-protective screening concentrations for groundwater were also back-calculated for each analyte detected in groundwater from two wells with the highest concentrations (MAFB-041 and MAFB-446). The commercial generic screening and semi-site- specific estimates were within the risk management range of 1E-06 to 1E-04. The residential generic screening and semi-site-specific estimates were also within the risk management range. However, there are currently no (continued)

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	38 (cont'd)	EPA	John Lucey	7.3.1.3	7-13			(continued) buildings over the footprint of the Site 7 Plume. Almost the entire Site 7 Plume is off site under an area previously excavated for gravel mining, and there are no known future plans for buildings in this area. An area near the plume has been reclaimed as a seasonal wetland/ marsh, so it is unlikely that buildings will be placed near the wetlands and plume. Consequently, there is no completed residential or commercial VI exposure pathway. The Site 7 remedy is currently protective in the short term and will be protective in the long term upon completion of the groundwater extraction and treatment remedy and implementation of the ICs in the Groundwater OU ESD awaiting authorizing signatures. The text has been updated to reflect the conditions for the off-site portions of the plumes.

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	39	EPA	John Lucey	8.3	8-3		**Institutional Controls:** The text states "through 2008, annual monitoring reports on the status of ICs for Sites OT-89 and WP-12 have not been completed;" but the requirement of annual monitoring reports of OT-89 was implemented in 2006, so an explanation is needed regarding why no annual IC monitoring reports have been completed for OT-89 between 2006 and 2008. The 5YR should describe the schedule for submitting the first IC Report and preferably submit the report before the 5YR is finalized.	Although annual monitoring reports were not completed between 2006 and 2008, activities inconsistent with the ICs, and consequently the RAOs, did not occur. AFRPA and AFCEE personnel are familiar with the physical condition of the sites and remedial systems through frequent traverses of the facility. AFRPA and AFCEE personnel are also familiar with any property lease and transfer transactions. Through these personnel, remedial action contractors that are on site on a daily basis, and regulatory staff visits, the Air Force has maintained familiarity with environmental remediation activities and site conditions that could affect the performance of the ICs. No infractions of the ICs in place at Sites WP-12 and OT-89 have been observed. The Air Force is preparing a ICs monitoring report with an expected submittal date of 2010 for the draft report.

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	40	EPA	John Lucey	8.0 & 9.0	8-1 & 9-1		**Issues Identified during the Fiver-Year Review and Recommendations and Follow-Up Actions:** Not all of the sites reviewed in the 5YR have been included in Sections 8.0 and 9.0. It is understood that some sites may have no issues or recommendations; however, if that is the case then it should be explicitly stated in the text. Please revise Sections 8.0 and 9.0 to include all the sites reviewed for the 5YR, and if no issues or recommendations exist for a site then state this in the text.	Text has been added to the introductory text for Sections 8.0 and 9.0 to list which sites within their respective OUs do not have any issues or recommendations/follow-up actions.