California Regional Water Quality Control Board

Lahontan Region

Linda S. Adams
Acting Secretary for
Environmental Protection

Edmund G. Brown, Jr
Governor

Victorville Office

14440 Civic Drive, Suite 200, Victorville, California 92392
(760) 241-6583 • Fax (760) 241-7308
http://www.waterboards.ca.gov/lahontan

February 22, 2011

To Interested Parties:

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD MEETING, March 9, 2011 IN BARSTOW, CALIFORNIA

RESOLUTION NO. R6V-2011-(PROPOSED), AUTHORIZING THE EXECUTIVE OFFICER TO SIGN THE RECORD OF DECISION FOR OPERABLE UNIT 7, SITE 3, MAIN BASE INACTIVE LANDFILL, EDWARDS AIR FORCE BASE, KERN COUNTY

Enclosed for your information is a copy of the proposed agenda item for your review. The Regional Board will consider adoption of the proposed order during its **March 9, 2011**, meeting in Barstow, California.

If you need further information regarding this meeting, please contact our office.

Sincerely,

Rebecca Phillips
Office Technician

Enclosures: Item No. 7
Agenda Announcement

MAILING LIST
EAFB SOUTH AFRL TI WAIVER/CONTAINMENT ZONE

Vicki Lake Staff Environmental Scientist CA Dept of Fish and Game OSPR	Ray Sugiura AECOM, Inc.	Richard Caulkins Senior Engineer
Richard Haberman P.E. Supervising Sanitary Engineer Dept. of Health Services Drinking Water Field Operations	Sarah Grossi AECOM, Inc.	Russell Fuller General Manager Antelope Valley East Kern Water Agency
Ai Duong 95th ABW/ CEVR		Andy Gordus Cal State Dept. of Fish & Game
Patrice Hallman 95th ABW/CEVR	Adam Ariki, Assist. Division Engineer L.A. County Waterworks District	Gretchen Guitierrez Antelope Valley Building Industry Assn
Joe Healy USEPA REGION 9	Sutida Bergquist, Associate Engineer CDHS	John Jones, President Lake Los Angeles Town Council
Kevin Depies Cal EPA/DTSC	Tracie Billington Dept. of Water Resources	
	Laura Blank, Executive Director LA County Farm Bureau	Lorelei H. Oviatt Supervising Planner Kern County Planning Department
Peter Zorba	Richard Campbell, Director Antelope Valley Resource Conservation District	Matthew Park, Executive Director Kern County Farm Bureau

MAILING LIST
EAFB SOUTH AFRL TI WAIVER/CONTAINMENT ZONE

Michael Anderson TYBRIN Corp.	Cheryl Casdorph Supervising Planner Kern County Planning Dept.	Chad Reed, General Manager Quartz Hill Water District
Jim Schroeter, City Engineer City of California City	David Newman	Victor Yaw
Gemma Fregoso	Wendy Reed, Director Antelope Valley Conservancy	Todd Thompson SWRCB
Claude Seal, Staff Engineer Rosamond Community Services District	Randy Williams Director of Public Works City of Lancaster	Barbara Houghton Kern County DEHS
Annette Tenneboe Environmental Scientist Dept. of Fish & Game	Pete Lopez Boron CSD	John Ukkestad, President AV United Water Purveyors
Ray Tremblay, Division Engineer LACSD	Dean Baker	Bob Smith
Carolyn Coe	Mayor Henry Hearns City of Lancaster	William Brandweiner
Brenda Weems-Hunter	Michelle Tucker	Leslie Uhazy

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MEETING OF MARCH 9 - 10, 2011
BARSTOW, CALIFORNIA

ITEM: 7

SUBJECT: **RESOLUTION AUTHORIZING THE EXECUTIVE OFFICER TO SIGN THE RECORD OF DECISION FOR OPERABLE UNIT 7, SITE 3, MAIN BASE INACTIVE LANDFILL, EDWARDS AIR FORCE BASE, KERN COUNTY**

CHRONOLOGY: This is a new item.

ISSUE: Should the Water Board concur with the remedial action proposed by the Air Force and authorize the Executive Officer to sign the Record of Decision? The Board is asked to evaluate whether the proposed action complies with State requirements based on information presented with this item.

DISCUSSION: Edwards Air Force Base (EAFB) has submitted a Draft Final Record of Decision (ROD) for a proposed remedial action at Operable Unit 7, Site 3 (Site 3). Site 3 consists of an inactive landfill that is being closed. The Air Force's preferred remedy consists of limited waste consolidation, an evapotranspiration final cover, post-closure maintenance, monitored natural attenuation until groundwater cleanup goals are achieved, storm water controls, and land use controls.

Contaminated groundwater is encountered in fractured granitic bedrock approximately 80 feet below ground surface. It is currently infeasible to actively remediate the groundwater below the site through known in situ or ex situ remedial technologies. This conclusion is based on pilot studies and attempts to install treatment systems in the fractured bedrock at other locations on EAFB.

Groundwater beneath the inactive landfill EAFB contains the dissolved chlorinated solvents, perchloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE) and vinyl chloride. Natural attenuation processes will reduce the concentrations of these contaminants and limit contaminant migration. Groundwater modeling performed by the Air Force estimates that PCE and TCE concentrations will be degraded to below maximum contaminant levels in 13 years and the degradation of all organic contaminants, including the breakdown product vinyl chloride, will be reduced to background in approximately 84 years. Groundwater impacted by PCE and TCE at Site 3 has an areal extent of approximately 30 acres of which 17 acres exceed the primary MCL of 5.0 µg/L for TCE.

As part of the proposed remedy, management measures including land use controls and groundwater monitoring will be implemented to prevent human exposure to polluted groundwater and vapors, and to track contaminant degradation over time. These measures will minimize the health risks to satisfy regulatory requirements.

The Air Force will monitor the polluted groundwater and compare the results with modeled predictions. Progress of contaminant degradation will be reviewed in the Five-Year Reviews of the remedy's performance as required by CERCLA.

The Air Force does not agree that certain California State requirements such as the Basin Plan's Water Quality Objectives for secondary drinking water standards, State Water Board Resolution 68-16 or portions of State Water Board Resolution 92-49 are applicable or relevant requirements. However, the Air Force has complied with these requirements from a technical perspective in the proposed action. The ROD includes "agree-to-disagree" language that preserves each party's legal rights and allows the Air Force to implement the remedial action. Water Board staff has evaluated the proposed remedial action and finds that it complies with the State's groundwater cleanup requirements. The proposed remedy provides a feasible, cost effective method to manage contaminants in groundwater at the site and is appropriate in this case.

RECOMMENDATION: Adoption of Resolution as proposed.

Enclosures:
1. Proposed Resolution
2. Staff Report

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ENCLOSURE 1

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

RESOLUTION NO. R6V-2011-(PROPOSED)

AUTHORIZING THE EXECUTIVE OFFICER TO SIGN
THE RECORD OF DECISION
FOR OPERABLE UNIT 7, MAIN BASE INACTIVE LANDFILL,
EDWARDS AIR FORCE BASE

Kern County

WHEREAS, the California Regional Water Quality Control Board, Lahontan Region, (Water Board) finds:

1. In November 2010, the United States Air Force submitted a Draft Final Record of Decision for Operable Unit 7, Site 3, Main Base Inactive Landfill at Edwards Air Force Base. The Air Force's preferred remedy consists of an evapotranspiration final cover, institutional controls, monitored natural attenuation for groundwater, performance monitoring until groundwater cleanup goals are achieved, limited waste consolidation, storm water controls, and land use controls.

2. The Air Force and Water Board "agree-to-disagree" over whether certain State requirements are Applicable or Relevant and Appropriate Requirements for purposes of the remedial action. This language avoids the dispute resolution process and allows the Air Force to move forward with remedy implementation.

3. The remedy complies technically with State law, plans, and policies and is protective of water quality.

THEREFORE BE IT RESOLVED:

That the Lahontan Water Board authorizes the Executive Officer to:

1. Concur with proposed actions as documented in the OU 7, Site 3 Main Base Inactive Landfill Draft Final Record of Decision; and

2. Sign the Final Record of Decision when it is submitted provided there are no significant changes to the intent of the Record of Decision from that described in the February 18, 2011 Water Board Staff Report.

I Harold J. Singer, Executive Officer, do herby certify that the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Control Board, Lahontan Region, on March 9, 2011.

HAROLD J. SINGER
EXECUTIVE OFFICER

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ENCLOSURE 2

STAFF REPORT

RECORD OF DECISION

OPERABLE UNIT 7

SITE 3 – MAIN BASE INACTIVE LANDFILL

at

EDWARDS AIR FORCE BASE

February 2011

California Regional Water Quality Control Board, Lahontan Region
14440 Civic Drive, Suite 200
Victorville, CA 92392

Prepared by: Tim E. Post, P.G., Engineering Geologist

Reviewed by: Cindi M. Mitton, P.E., Senior Engineer

STAFF REPORT
Record of Decision
Operable Unit 7
Site 3 – Main Base Inactive Landfill
Edwards Air Force Base
February 18, 2011

1. Introduction

This report provides supporting information for a staff recommendation that the Water Board concur with the remedial alternative proposed for the Edwards Air Force Base (EAFB), Operable Unit 7, Site 3, Main Base Inactive Landfill. The landfill is located on land owned by the Air Force. A Draft Final Record of Decision (ROD), dated November 2010, has been prepared documenting the remedy proposed by the Air Force to address contaminants on site and to protect human health and the environment.

The proposed remedy for Site 3 includes waste consolidation, construction of an engineered evapotranspiration cover over the landfill, storm water controls, natural attenuation of the contaminant mass, and performance monitoring of the remedy. Land use controls will be used to prevent human exposure to polluted groundwater or organic vapors. The proposed remedy meets state requirements and is a feasible and cost effective method to restore groundwater quality.

The proposed remedy addresses groundwater at the site that is polluted with perchloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride. The groundwater occurs in fractured granitic bedrock approximately 80 feet below ground surface. The most recent data indicate the polluted zone is not expanding, that steady-state conditions have been reached, and natural attenuation processes are reducing contaminant concentrations. Computer modeling performed by the Air Force indicates that PCE and TCE concentrations will degrade to drinking water standards in 5 and 13 years, respectively. The contaminants will reach background concentrations in approximately 84 years, a reasonable time period given the current and expected land use.

The Air Force proposes the primary maximum contaminant levels (MCLs) as the risk-based cleanup levels. The Air Force does not agree that certain California groundwater cleanup requirements, such as the Water Quality Control Plan for the Lahontan Region (Basin Plan) Water Quality Objectives for Secondary MCLs, State Board Resolution 68-16, and portions of State Board Resolution 92-49 are Applicable or Relevant and Appropriate Requirements (ARARs). The ROD includes "agree-to-disagree" language

concerning these issues and thus avoids dispute resolution and allows the Air Force to move forward with remedy implementation. The Air Force prepared a Technical and Economic Feasibility Analysis with information showing the proposed remedy complies with Water Board requirements and ARARs.

The Air Force will ensure that waste constituents in groundwater will be remediated beneath the entire site. Water Board staff have evaluated the proposed remedy and finds that it complies with California state groundwater cleanup requirements. Water Board staff finds the proposed remedy is a feasible, cost effective method to prevent further leaching of landfill constituents from rainwater infiltration and to restore groundwater quality at the site.

2. EAFB Cleanup Approach Under CERCLA

EAFB is located in the western portion of the Mojave Desert. The Base covers portions of Kern, Los Angeles, and San Bernardino counties (See Figure 1).

Pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act, EAFB was listed on the U.S. Environmental Protection Agency's (USEPA) National Priorities List on August 30, 1990, because of the presence of soil and groundwater contamination. EAFB then entered into a Federal Facilities Agreement with USEPA-Region IX, California Department of Toxic Substances Control (DTSC) and the Lahontan Water Board in September 1990. The agreement provides a process for involving federal and state regulators and the public in developing and implementing cleanup decisions. It also provides a process, if necessary, for formal and informal dispute resolution.

After conducting a site investigation and feasibility study, the Air Force is proposing a remedy for Site 3 as documented in the ROD.

3. Site 3 Operational History and Groundwater Contaminants

The former landfill is located in the northwest portion of EAFB (see Figure 2). The landfill was used as EAFB's solid waste landfill from the mid-1960s until 1976. The landfill has been inactive since 1976. While in operation the cut and cover method (disposal trenches of various lengths approximately 12 feet wide and 15 feet deep constructed with a bulldozer) of waste disposal was utilized. Based on the size and orientation of the suspected landfill cells, the Air Force estimates that approximately 526,000 cubic yards of wastes are contained in the 67-acre landfill area. From the site investigation, which

included 25 test pits, no military munitions or hazardous wastes were identified in the buried wastes. Figure 3 shows the Site 3 boundary, suspected landfill cells, and monitoring wells. The site is bordered by undeveloped desert on the north and east, an active municipal waste landfill to the west, and horse stables to the south.

4. Site 3 Contaminant Source Areas

Affected groundwater at Site 3, which underlies two main areas on site, has a total areal extent of approximately 30 acres, of which 17 acres exceed TCE's primary MCL of 5.0 micrograms per liter (µg/L). The maximum concentration of TCE detected beneath the site is 29 µg/L. Table 1 is a list of chemicals of concern in groundwater at Site 3. This table lists the maximum concentrations of these chemicals from the most recent sampling at the site and relevant federal or state primary MCLs for drinking water.

Figure 4 illustrates the areal extent of four of the contaminants of concern at concentrations greater than their respective MCLs. The organic contaminants PCE and TCE have been detected approximately 50 feet beyond the site boundary; nitrate has also been detected above background concentrations and its MCL near the southeast boundary of the landfill. Nitrate is not addressed in this ROD; however, the Air Force is addressing it separately in a Base-wide nitrate investigation. The estimated volume of groundwater impacted by organic contaminant concentrations above background (based on a 30-acre extent, 50-foot thick contaminated zone, and 5% fracture volume) is 75-acre feet.

5. Site 3 Hydrogeology and Existing Groundwater Water Quality

Bedrock beneath the site is composed of quartz monzonite (a type of granite). Competent and weathered fractured bedrock is overlain by a veneer of unconsolidated alluvium. Groundwater occurs under unconfined conditions in both the weathered and fractured bedrock. Depth to the static water level ranges from 75 to 85 feet below ground surface. Groundwater flow beneath Site 3 is generally to the south-southeast toward the Mojave Creek drainage and then east to Rogers Dry Lake.

Groundwater yield in the fractured bedrock is generally low with an average sustained yield from 2-inch diameter wells of 0.3 gallons per minute (gpm). About half of the monitoring wells on site do not produce the minimum sustained yield of 0.14 gpm, or 200 gallons per day, to be considered a drinking water source under State Board Resolution 88-63. This is not surprising however given the typical short screens and small diameter of a monitoring well. Larger diameter wells with longer screens would likely meet this minimum requirement.

A groundwater mound has formed beneath the highest density of landfill cells toward the eastern portion of the site (see Figure 5, conceptual site model). This mound may be indicative of increased storm water infiltration through the disturbed surface cover and into the landfill cells. The disturbed material and landfilled materials would tend to collect, and be more transmissive to, storm water than the undisturbed native material surrounding the landfill cells.

Groundwater quality in the fractured bedrock is generally good. Poor quality groundwater is present in the area of the groundwater mound that has been affected by leachate from the landfill cells. Total dissolved solids concentrations in monitoring wells outside the influence of the landfill (i.e., background concentrations) average 674 mg/L. The monitoring wells affected by leachate located closest to the landfill cells average 2,170 mg/L for total dissolved solids.

No groundwater production wells are present or anticipated in the Site 3 area. Currently, groundwater is being extracted for domestic use from the Main Base Well Field approximately seven miles to the southeast of Site 3.

6. Proposed Remedial Action

The Air Force developed the proposed remedy for Site 3, which includes waste consolidation, construction of an engineered evapotranspiration cover, storm water controls, natural attenuation of the contaminant mass, and performance monitoring of the remedy. Land use controls will be used to prevent human exposure to polluted groundwater or organic vapors. The purpose of the landfill cover is to promote storm water runoff and minimize further infiltration of precipitation into the waste materials.

The proposed landfill cover uses an alternative cover design from the prescriptive standard in title 27. Title 27 states that the Water Board can allow any alternative final cover design that it finds will isolate the waste at least as well as would a final cover built in accordance with the applicable prescriptive standards in title 27, and that meets the performance measures in title 27. The prescriptive landfill cover in title 27 includes a low permeability clay layer. EAFB has demonstrated through modeling and literature research, that the proposed evapotransporation cover will prevent stormwater infiltration and isolate the waste as well as the prescriptive cover and will meet the performance measures contained in title 27. Water Board staff find that the engineered alternative cover design is appropriate for Site 3 because evapotranspiration landfill covers are particularly effective in the desert environment given the desert's typically low precipitation and high evaporation rates.

The proposed remedy meets state requirements, is technically feasible and cost effective, and complies with the ARARs as explained further in Sections 11 and 12. The main components of the proposed remedy include:

- Removing surface debris and recycling or disposing the debris off site;
- Excavating waste from refuse cells on the south side of Landfill Road, northwest of the landfill, and west of the landfill and consolidating the waste into cells within the fenced area of the landfill (this will allow the construction of a smaller, 37-acre final cover);
- Installing an evapotranspiration final cover (designed as part of the post-ROD Remedial Action Work Plan) over the refuse cells;
- Construction of storm water controls (diversion ditches) to divert surface water away from the landfill surface. Constructing and grading the ET cover to promote runoff, and minimize infiltration and erosion;
- Implementing and maintaining land use controls Land Use Controls to prevent contact by humans and animals with the wastes until the concentrations of hazardous substances in the soil and groundwater are at levels allowing unrestricted use and unlimited exposure;
- Conducting monitored natural attenuation until remediation goals for groundwater are met; and.
- Conducting gas monitoring to assure explosive concentrations of landfill gases are not migrating beyond the site boundary.

The main components and physical features of the Proposed Remedial Alternative are illustrated in Figure 6.

7. Site 3 Remedial Investigation, Cleanup Actions and Pilot Tests

Remedial Investigations and sampling were performed from 1993 through 2009 and included soil gas sampling, soil borehole logging, soil sampling, monitoring well installation, groundwater monitoring, packer testing, pump testing, core sampling, fracture analyses, three-dimensional seismic reflection surveying, and borehole video logging.

To evaluate cleanup technologies, the Air Force used data from treatability studies at other locations on EAFB, which exhibit very similar geology to Site 3 (i.e., fractured granite exhibiting low groundwater yields). For example, a test was conducted at Site 37 (at the Air Force Research Laboratory) in 2004. The purpose was to create an

engineered fractured bedrock zone with explosives and thus increase the aquifer yield in order to create a zone where the polluted groundwater could collect and be more easily removed from the subsurface. The results of that pilot study indicated that aquifer yield was not increased for sites with this type of geology.

An *In-Situ* Bioremediation Treatability Study, using the hydrogen release compound CI-Out® was conducted at Site 162 in 2007. The results of this study indicated that, although the technology was effective in small, localized areas, large-scale effectiveness was unlikely due to the inability to effectively distribute the injected solutions into the bedrock fractures.

Other *in-situ* technologies have been, or are being, evaluated and tested at EAFB. Table 2 shows a summary of *in-situ* technologies that have been evaluated at EAFB that may be applicable to Site 3. Introduction of oxidants or bacteria into the subsurface requires an even distribution of solution to the contaminants which, at Site 3, would be very difficult to achieve within the fractured bedrock. None of the technologies evaluated are thought to be effective in the fractured granitic bedrock at Site 3.

8. Computer Modeling of Contaminant Transport

Computer groundwater models can be effective tools to evaluate the current and predicted movement of groundwater and contaminants. Their effectiveness in providing scientific certainty is limited by the site-specific data available to provide accurate input parameters to the model.

Granular porous media groundwater models are the most common and are generally used to represent alluvial aquifer situations. Although groundwater models for fractured bedrock are available, effectively modeling a fractured bedrock system requires an enormous amount of data, simplifying assumptions, or both, to develop a detailed description of the aquifer properties controlling flow.

To evaluate the quantity of storm water that could infiltrate the proposed landfill cover the Air Force used the computer model UNSAT-H® to evaluate the various cover designs for the remedial alternatives. Using precipitation data from the ten consecutive wettest years on record, the Air Force's modeling predicts storm water infiltration through the proposed cover of approximately 0.71 inches per year.

The Air Force used a granular porous media model MODFLOW® to evaluate groundwater flow, and the MT3D® model for contaminant fate and transport, to assess

the long-term movement of contaminants. The Air Force used the simplifying assumption that on the scale of the modeled area, the fractured bedrock mimics the characteristics of granular porous media. Obtaining the necessary data to produce a detailed fractured groundwater flow and contaminant transport model was determined to be impractical for the scale of both contaminant distribution and modeled area. The computer modeling performed provides an adequate assessment of storm water infiltration and contaminant transport at Site 3.

The computer model predicts the concentrations of the solvents PCE, TCE, and the degradation product DCE would decline to their primary MCLs in 5, 13, and 10 years, respectively. Vinyl chloride, the last degradation product in the series, is estimated to reach its primary MCL in approximately 84 years.

If pollutants are left in the subsurface, CERCLA requires a technical review of remedy's performance every five years. The purpose of these Five-Year Reviews is to determine if the remedy in place is performing as planned. The groundwater modeling for Site 3 will be updated before each Five-Year Review, using additional site-specific data and groundwater monitoring information collected during the Remedial Design/Remedial Action phase (post-ROD remedy implementation). Further refinement of the models should improve the accuracy and precision of the predicted contaminant movement and will be used to locate future groundwater monitoring wells (both lateral well placement and vertical well screen depth).

9. Conceptual Site Model

The most plausible source of groundwater contamination at the site is precipitation percolating through the thin veneer of soil and decomposing wastes contained in the landfill cells forming leachate, which percolates downward through the weathered and unweathered fractured bedrock. The decomposing wastes also produce gases that can be released to groundwater and the atmosphere. Identified exposure pathways for contaminants at the site include direct contact by humans and biota with decomposing wastes and contaminated groundwater and inhalation of organic vapors (see Figure 5). The contaminants of concern may, after reaching groundwater, decline via a number of mechanisms such as advection, dispersion, biotic or abiotic degradation, and volatilization into the unsaturated zone. There are several lines of evidence that suggest concentrations of contaminants are naturally attenuating; specifically, there is evidence that reductive dechlorination is taking place in some areas of the landfill.

These include, the presence of the breakdown products DCE and vinyl chloride, dissolved oxygen concentrations less than 0.5 mg/L, oxidation/reduction potentials less than 150 millivolts, and the presence of the bacteria known to degrade PCE and TCE.

10. Remedial Action Objectives

Remedial Action Objectives are objectives identified for the cleanup. The Remedial Action Objectives for groundwater at Site 3 were developed based upon the requirements of CERCLA, results of the Human Health Risk Assessment and Programmatic Ecological Risk Assessment, agreed-to ARARs, the site's characteristics, and an evaluation of the site's potential for groundwater restoration. The exposure pathways identified in the Risk Assessments that need to be prevented or minimized are: ingestion of or dermal contact with landfill wastes and contaminated groundwater, and inhalation of chlorinated solvent vapors from the contaminated groundwater. The specific Remedial Action Objectives for Site 3 are:

1. Protect human health and the environment by preventing direct contact with landfill wastes or contaminated soils that could potentially present physical or chemical hazards;
2. Protect the underlying groundwater by minimizing infiltration of storm water through the landfill cover into the landfill's waste thereby reducing the risk of contaminants leaching into the groundwater and reducing the concentrations of contaminants exceeding safe drinking water standards;
3. Protect groundwater by diverting storm water run on, promoting storm water runoff by preventing ponding of storm water on the landfill's cover, minimizing erosion of the landfill cover thereby reducing the risk of contaminants leaching into the groundwater;
4. Protect groundwater by preventing or minimizing migration of polluted groundwater that exceed safe drinking water standards;
5. Protect humans from ingestion of and dermal contact with contaminants in groundwater that exceed safe drinking water standards by restoring the Site's groundwater beneath the site to safe drinking water standards; and
6. Prevent future human exposure to potentially explosive concentrations of methane gas or toxic vapors generated by the decomposing landfill wastes, which could migrate into future buildings or confined spaces.

11. Description of Remedial Alternatives

To accomplish the identified Remedial Action Objectives, the Air Force identified and evaluated numerous remedial alternatives in the *Site 3 Focused Feasibility Study*, dated December 2009, for their ability to satisfy the nine CERCLA criteria. The criteria are:

1. Overall protectiveness;
2. Compliance with state and federal requirements;
3. Long-term effectiveness and permanence;
4. Reduction of toxicity, mobility, or volume;
5. Short-term effectiveness;
6. Implementability;
7. Cost;
8. Regulatory agency acceptance; and
9. Community acceptance.

Four remedial alternatives were identified and evaluated by the Air Force, these are:

- ***Alternative 1 – No Action***. Consideration of a No Action Alternative is required as a baseline against which the other remedial alternatives are compared. Alternative 1 does not meet the identified ARARs and is not protective of human health and the environment. There is no cost to implement this Alternative.
- ***Alternative 2 – Land Use Controls and Monitored Natural Attenuation***. The existing landfill cover material would be used to contain the waste, land use controls would minimize site access and preclude use of the groundwater at the site, and groundwater and landfill gas monitoring would be performed to track the reduction in contaminant concentrations. It is estimated the cleanup goals for PCE, TCE and their degradation products will be reached in approximately 140 years. This alternative was not selected because the existing landfill cover may not be adequate to preclude storm water infiltration into the landfill and it took the longest time of the alternatives evaluated to cleanup the groundwater. The total cost for this Alternative is estimated to be $7,363,000.
- ***Alternative 3 – Waste Consolidation, Evapotranspiration Cover, Storm Water Controls, Land Use Controls, and Monitored Natural Attenuation.*** This alternative includes the land use controls, groundwater and landfill gas monitoring listed in Alternative 2 with the addition of removing the surface debris from the site, consolidating waste from three peripheral waste cells into the main landfill area,

and construction of an engineered 32.7-acre evapotranspiration cover. Storm water would be controlled by diversion structures and grading the cover to minimize storm water run on, promote storm water runoff and minimize erosion and infiltration. Groundwater cleanup will be accomplished through monitored natural attenuation. It is estimated the MCL for PCE will be reached in 5 years, for TCE in 13 years, for DCE in 10 years, and the cleanup goals for all organic contaminants at the site will be reached in approximately 84 years. Because the cleanup goal for vinyl chloride is near the current detection limit, it is expected that TCE, PCE, DCE and vinyl chloride will reach current background concentrations within the 84-year cleanup timeframe. The total cost for this Alternative is estimated to be $14,511,000.

- ***Alternative 4 - Waste Consolidation, Enhanced Evapotranspiration Cover, Storm Water Controls, Land Use Controls, and Monitored Natural Attenuation***. This alternative includes the land use controls, groundwater and landfill gas monitoring, and surface debris removal listed in Alternatives 2 and 3 with only limited waste consolidation and construction of a 56.2-acre cover. The enhancement to the Evapotranspiration cover would be the installation of a passive landfill gas venting system below the cover. It is estimated the cleanup goals for all organic contaminants at the site will be reached in approximately 23 years. The total cost for this Alternative is estimated to be $23,006,000.

Alternatives 1 and 2 are easily implementable. Costs escalate from Alternative 2 through 4. Community response to the proposed remedy identified in the ROD during the public comment period indicates that Alternative 3 is acceptable to the public. To achieve the listed remedial action objectives, and based on the detailed evaluation of the potential remedial alternatives, the Air Force proposes Alternative 3 as the remedial action. The Air Force selected Alternative 3 over the other alternatives by comparing implementability, effectiveness, ability to protect human health and the environment, community acceptance and cost.

The proposed remedy must under federal law, at a minimum, protect human health and the environment and comply with the identified ARARs (the two "Threshold Criteria"). CERCLA does not create new cleanup standards, but rather requires site cleanups to conform to existing federal and state cleanup standards. These cleanup standards, called ARARs, must be identified during the CERCLA process and are listed in the ROD.

State cleanup standards become ARARs when they are: promulgated, legally enforceable, of statewide applicability and, are more stringent than federal standards. Water Board staff have consistently identified State Water Board Resolutions 68-16, 88-63, and 92-49 (see Table 3) as ARARs; however, the Air Force does not agree that all portions of these Resolutions are ARARs.

The dispute resolution process in the FFA may be used to resolve disagreement over what particular state standards are ARARs. Alternatively, both parties may disagree over what standards are ARARs, but find technical agreement on the proposed remedy. In this case, the parties "agree-to-disagree" over specific ARARs, thus avoiding dispute resolution, and allowing the Air Force to move forward with remedy implementation.

Water Board staff agree that the proposed remedial alternative is an appropriate remedy for the site given its remote location on EAFB and therefore minimal human and environmental receptors, low concentrations of contaminants, and evidence that contaminant concentrations are being bioremediated and reduced over time. With the addition of the engineered alternative landfill cover, storm water infiltration through the waste materials will be greatly reduced, the mechanisms to transport contaminants from the waste materials to groundwater will be minimized, and the groundwater mounds beneath the contaminated zones will collapse restoring the groundwater flow regime to pre-landfill conditions. The land use controls proposed by the Air Force will also preclude exposure of humans or biota to contaminants by contact with the waste materials, groundwater or vapors.

In the unlikely case of remedy failure where contaminants migrate or are predicted to migrate beyond the Site 3 boundary, the ROD would be reopened. A focused feasibility study would then be prepared to identify and develop an effective remedial alternative for the site.

Water Board staff has determined that the proposed remedy complies with State requirements, specifically protecting and restoring beneficial uses and requiring cleanup to background levels of the constituents, and that cleanup will occur in a reasonable time frame under the proposed remedy.

12. Compliance with Water Board Requirements

The following California state laws, policies and regulations apply to groundwater cleanup:

- State Water Board Resolution 68-16 (*Statement of Policy with Respect to Maintaining High Quality of Waters in California*)
- State Water Board Resolution 88-63 (*Sources of Drinking Water Policy*)
- State Water Board Resolution 92-49 (*Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304*)
- California Water Code (*Porter-Cologne Water Quality Control Act*)
- Basin Plan *(Water Quality Control Plan for the Lahontan Region*)

In accordance with State Water Board Resolution No. 68-16 and the Basin Plan, water degradation may be allowed if the following conditions are met: 1) any change in water quality must be consistent with the maximum benefit to the people of the State; 2) will not unreasonably affect present and anticipated beneficial uses; 3) will not result in water quality less than prescribed in the Basin Plan; and 4) dischargers must use the best practicable treatment of control to avoid pollution or nuisance and maintain the highest water quality consistent with the maximum benefit to the people of the State.

Degradation of water quality is confined to a limited area within the site boundaries and will occur for a limited time. The long-term benefit of the proposed remedy is reduction in the concentrations of PCE, TCE and degradation products in groundwater and restoring the groundwater quality to background levels.

The Basin Plan designates groundwater at Site 3 for a Municipal Use. State Water Board Resolution 88-63 states that groundwaters with excessive salinity, contaminants that cannot be reasonably treated, or that exhibit a low sustained yield should not be classified as a source of drinking water. These exceptions do not apply to Site 3 because there has not been a sufficient demonstration that the sustained yield from wells at the site would not meet the minimum sustained yield of 0.17 gallons per minute. Even if such a showing can be made, the groundwater at the site would have to undergo a formal de-designation process before it could be exempt from the requirements of 88-63. However, for the foreseeable future, groundwater within the fractured bedrock is not likely to be used for drinking water.

The Basin Plan requires polluted groundwater to be restored in compliance with State Water Board Resolution No. 92-49. Water Board staff agree the Air Force's proposed remedy complies with the Basin Plan and State Water Resolution 92-49 because cleanup alternatives have been appropriately evaluated and the timeframe to restore groundwater to background concentrations is reasonable. The proposed remedy

complies with State Water Board Resolution No. 92-49 because it is consistent with maximum benefit to the people of the state; does not unreasonably affect present and anticipated beneficial use of such water; and will not result in water quality less than that prescribed in the Basin Plan and Policies adopted by the State and Regional Water Boards.

Section 13304 of the California Water Code requires dischargers that have polluted groundwater to clean it up. Water Board staff agree that the proposed remedy to cleanup groundwater satisfies the requirements of Section 13304.

The Air Force's position is that only State Water Board Resolution 88-63 and the State and Federal Primary MCLs, which are water quality objectives identified in the Basin Plan, are ARARs. The Air Force does not consider secondary MCLs, State Water Board Resolution 68-16 or portions of State Water Board Resolution 92-49 to be ARARs. The ROD includes language indicating the State and Air Force "agree-to-disagree" whether these items are ARARs. Nonetheless, the Water Board staff have reviewed the proposed remedy for compliance with Water Board requirements and determined that it meets technical compliance with these requirements. This analysis is summarized in Table 3 and finds that the same processes, including natural attenuation, that are being proposed to clean up the groundwater to MCLs will continue to degrade the contaminants to background concentrations. The time it will take natural attenuation to occur at the site is reasonable because the contamination at the site is localized beneath the site, not migrating, there are land use controls in place to limit exposure to contaminants, including prohibiting the use of groundwater from the site; and further ground water impacts will be limited by reducing storm water infiltration into the site by constructing an engineered evapotranspiration cover and minimizing ponding of storm water at the site.

13. Conclusions

Water Board staff has reviewed the ROD and other available data and information for Site 3, EAFB Operable Unit 7, and believes the proposed Remedial Alternative 3 is an appropriate way to address the groundwater contaminants at the site. The remedy complies with requirements and policies administered by the Water Board.

14. Recommendation

The Air Force has prepared the ROD with an acceptable cleanup proposal. The Water Board is party to the Federal Facility Agreement for the EAFB and is now asked to sign the ROD indicating it concurs with the actions proposed in the ROD. Staff recommends the Board adopt the Proposed Resolution enclosed with this Water Board meeting item authorizing the Executive Officer to sign the ROD.

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TABLE 1. Contaminants of Concern in Site 3 Groundwater

Analyte	Most Recently Detected Concentration[a]	Maximum Detected Concentration	Location of Maximum Concentration	Federal ARAR/TBC Primary[b] MCLs	State of California ARAR/TBC Primary[c] MCLs
benzene	1.5	5.9	3-MW07	5.0	**1.0**
1,4 - dichlorobenzene	7.9	7.9	3-MW07	5.0	**0.5**
cis-1,2-dichloroethene (DCE)	12.0	12.0	3-MW07	7.0	**6.0**
methylene chloride	18.0	220.0	3-MW07	5.0	**5.0**
tetrachloroethene (PCE)	19.0	21.5	3-MW06	**5.0**	5.0
trichloroethene (TCE)	29.0	32.0	3-MW07	**5.0**	5.0
vinyl chloride	15.0	16.0	3-MW07	2.0	**0.5**
nitrate	26.9 J[e]	41.0	3-MW10	**10**[e]	10[e]/45[f]

Notes:

This table shows the chemicals of concern (CoCs) in the groundwater at Site 3.

Concentrations of organic compounds micrograms per liter (µg/L, or approximately parts per billion). Nitrate concentrations are in milligrams per liter (mg/L, (or approximately parts per million)).

[a] Includes monitoring data through November 2008.
[b] Source: U.S. Environmental Protection Agency (2006).
[c] Source: California Department of Public Health (2009).
[d] Source: California Department of Public Health (2007).
[e] Nitrate reported as nitrogen.
[f] Nitrate reported as nitrate.

ARAR	applicable or relevant and appropriate requirement
COC	contaminant of concern
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
TBC	to-be-considered criterion.

Laboratory–Assigned Data Qualifiers:

J Result is an estimated value of a detection below the reporting limit.

TABLE 2. Summary of Some In-Situ Technologies Tested at EAFB

OU	Site	Technology	Result	Applicability to Site 3
1	19	Bio-enhanced In-well Stripping	Rebound occurred at lower concentrations.	Limited to shallow alluvial aquifer material.
1	19	Bioremediation - Whey Powder	TCE reduction to DCE.	Effectiveness in deep bedrock unlikely due to inability to apply in fractures.
2	5	Aerobic Bioremediation - PHOSter®	Free product petroleum thickness reduced. Dissolved phase petroleum hydrocarbon and TCE concentrations reduced.	Effectiveness in bedrock unlikely due to inability to apply in fractures. No petroleum hydrocarbons present for electron donor source.
4/9	37	Explosive fracturing of bedrock via a series of closely-spaced boreholes creating a high porosity zone/cutoff wall.	No increase in fracture hydraulic conductivity observed.	Effectiveness at AFRL unlikely due to constraints on volume of explosives allowed (to protect site infrastructure).
4/9	162	Hydrogen Release Compound CI-Out®. PCE and TCE reduced to DCE.	May be effective in small, localized areas.	Large-scale effectiveness in fractured bedrock unlikely due to the inability to effectively distribute the injected solutions into the fractures.
5/10	207(N3)	Chemical Oxidation – Fenton's Reagent and Persulfate	Decrease in TCE – still above MCL.	Effectiveness in deep bedrock unlikely due to inability to apply in fractures.
5/10	211(N7)	Chemical Oxidation – Potassium Permanganate	VOCs reduced to less than detection with rebound occurring.	Effectiveness in deep bedrock unlikely due to inability to apply in fractures.
5/10	282	Nano-Scale Zero-Valent Iron	Effective reduction of VOCs within a limited radius of influence	Effectiveness in deep bedrock unlikely due to inability to apply in fractures.
8	25	Hydraulic Fracturing	New fractures relatively shallow. Minimal improvement in hydraulic conductivity.	Effectiveness in deep bedrock unlikely.
8	25	*In Situ* Chemical Oxidation. Introduction of permanganate solutions via infiltration trenches to degrade solvents.	Field scale pilot test started in Spring 2010.	Preliminary data from this pilot test also indicate the technology is only effective within a very limited radius of influence from the injection points.

TABLE 3. CALIFORNIA STATE GROUNDWATER CLEANUP REQUIREMENTS APPLICABLE TO SITE 3

Citation	Major Requirement	Analysis
State Board Resolution 68-16	Maintain high water quality unless change is demonstrated to be consistent with maximum benefit of the people, will not unreasonably affect beneficial uses, and not result in water quality less than policies. For any change, apply best practicable treatment of control of the discharge.	If contaminants, at any level, are predicted to migrate beyond the Site boundary, it would indicate the remedy in place has failed and other more effective measures must be implemented.
State Board Resolution 88-63	All surface and groundwaters of the State are considered to be suitable, or potentially suitable, for municipal or domestic water supply.	The groundwater at the site does not meet any of the exceptions listed in State Board Resolution 88-63 for not designating the groundwater at the site as a [potential] source of drinking water.
State Board Resolution 92-49 & Section 13304 of the California Water Code	State Board Resolution 92-49 applies to cleanup actions under CWC Section 13304 which authorizes the Regional Board to order cleanup and abatement where a person has discharged waste into the waters of State in violation of WDRs or other orders and prohibitions issued by the Regional Board.	The Air Force and Water Board disagree whether State Board Resolution 92-49, which requires cleanup to background concentrations, is an ARAR. The Air Force will only agree to cleanup levels set at the MCL. However, the same attenuation processes that will clean up the groundwater to the MCL concentrations will continue to degrade the contaminants to background (nondetect) concentrations.
California Water Code	Cleanup must conform to the Porter Cologne Water Quality Control Act, the Basin Plan and State Plans and Policies.	Exceptions to this requirement are discussed at various places in the Staff Report.
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Water quality objectives must be attained to protect designated beneficial uses of groundwater within the Antelope Valley groundwater basin.	The Air Force and Water Board disagree whether the secondary MCLs are applicable as cleanup levels at the site; however, it is anticipated that secondary MCLs will be attained before the primary MCLs. Waste constituents, at any concentration, are not expected to migrate beyond the site boundary.

Notes: CWC = California Water Code MCLs = Maximum Contaminant Levels WDRs = Waste Discharge Requirements

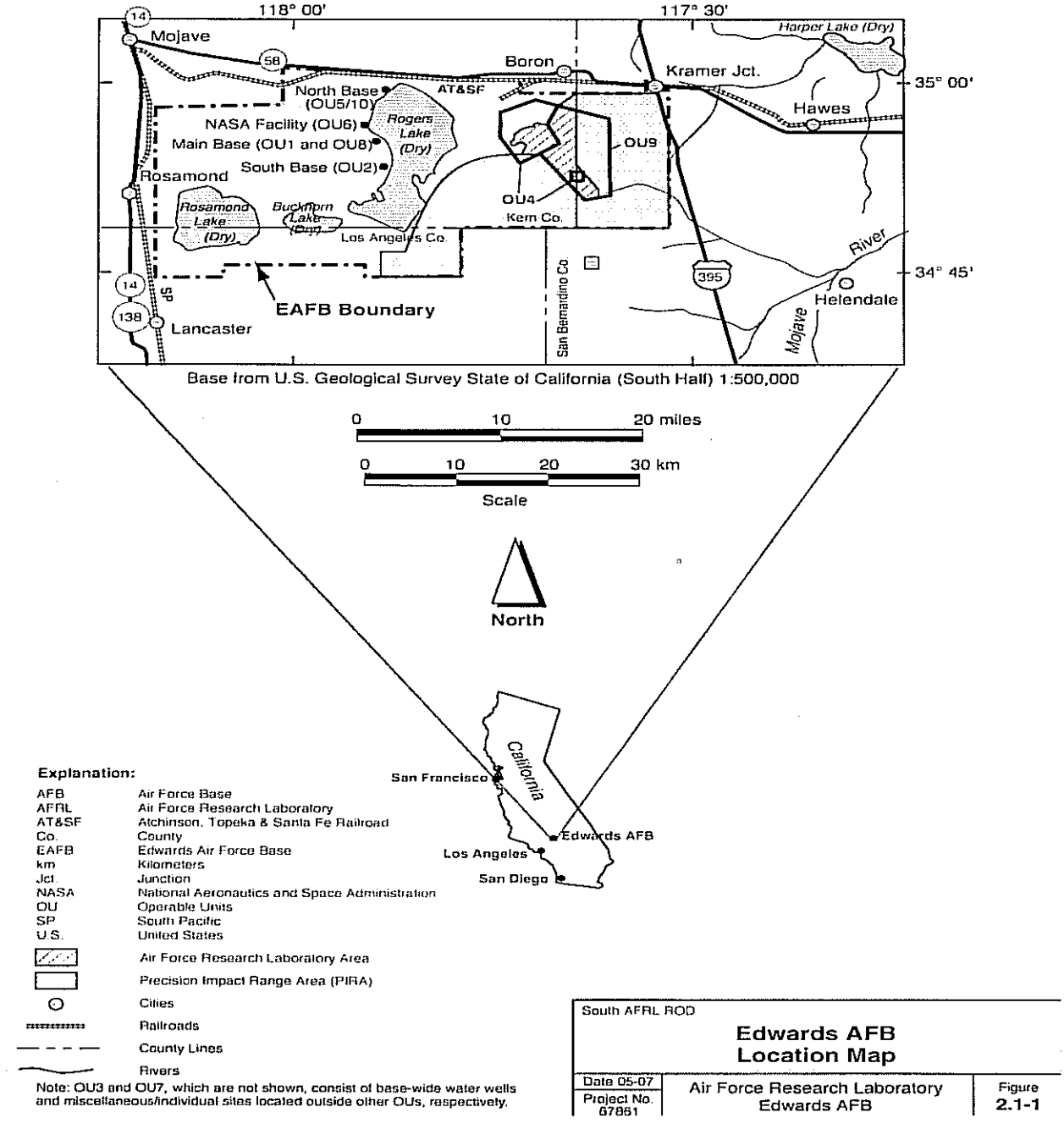

Figure 1. Edwards Air Force Base Location Map

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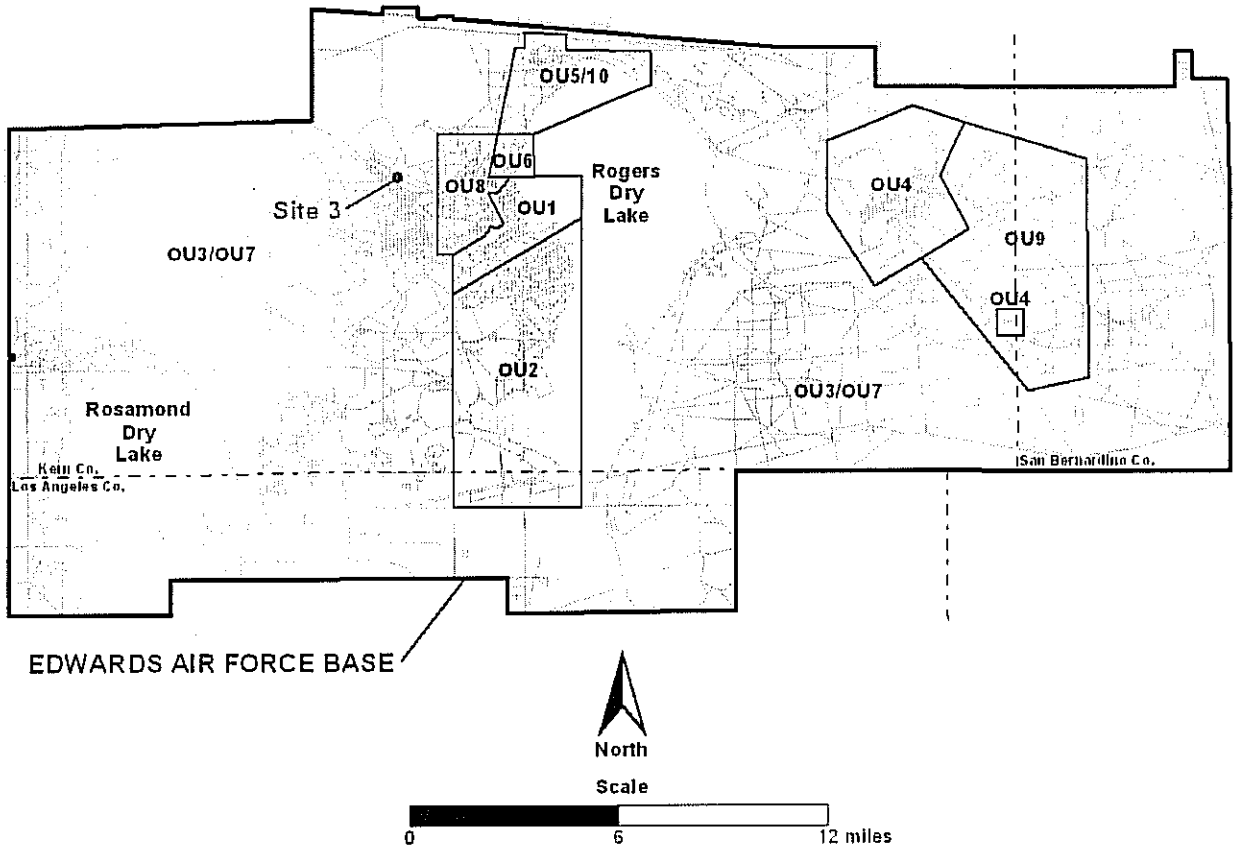

Figure 2. Site 3 Location on Edwards Air Force Base

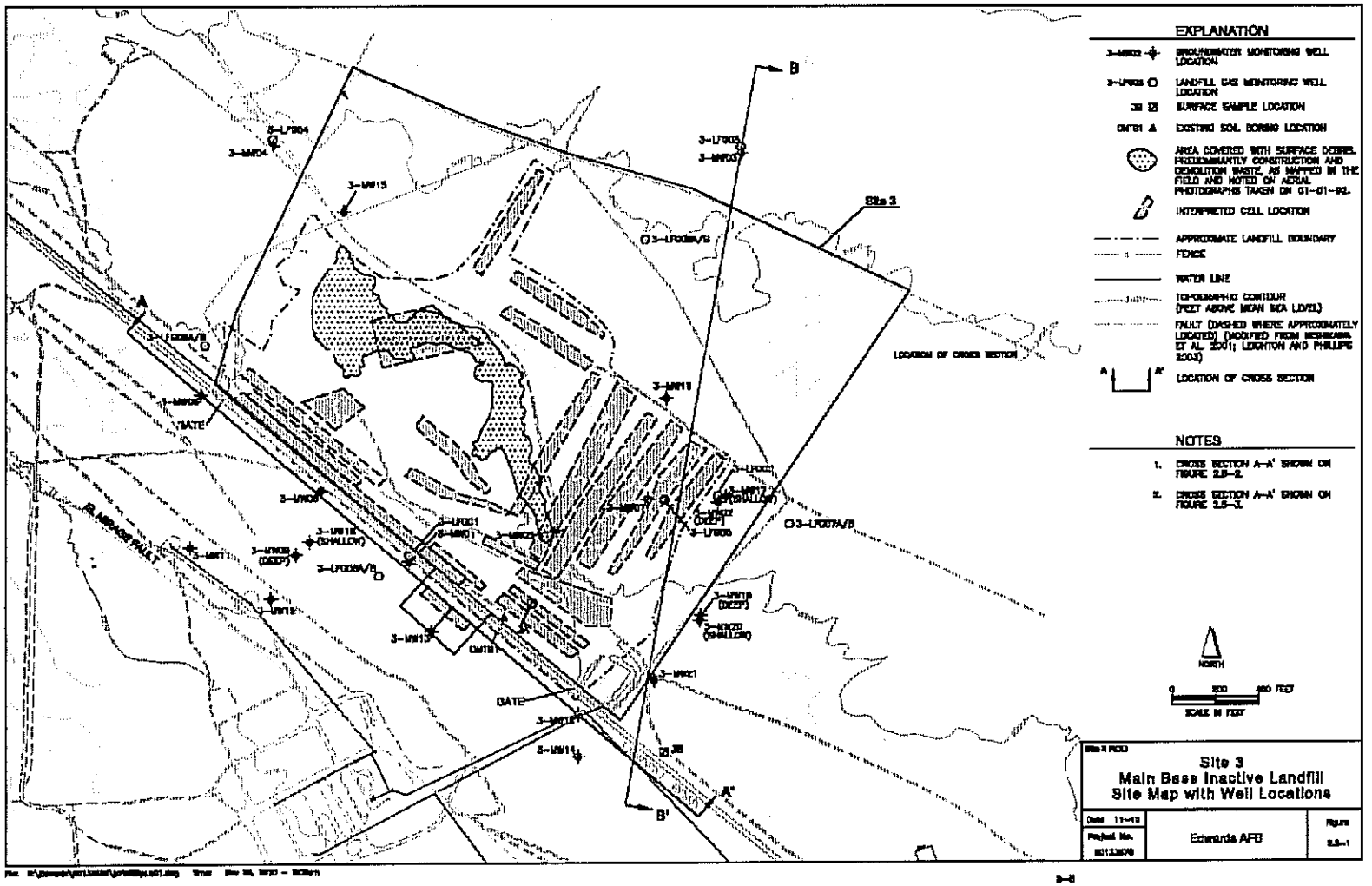

Figure 3. Site Map Showing Site Boundary, Suspected Landfill Cells, and Monitoring wells

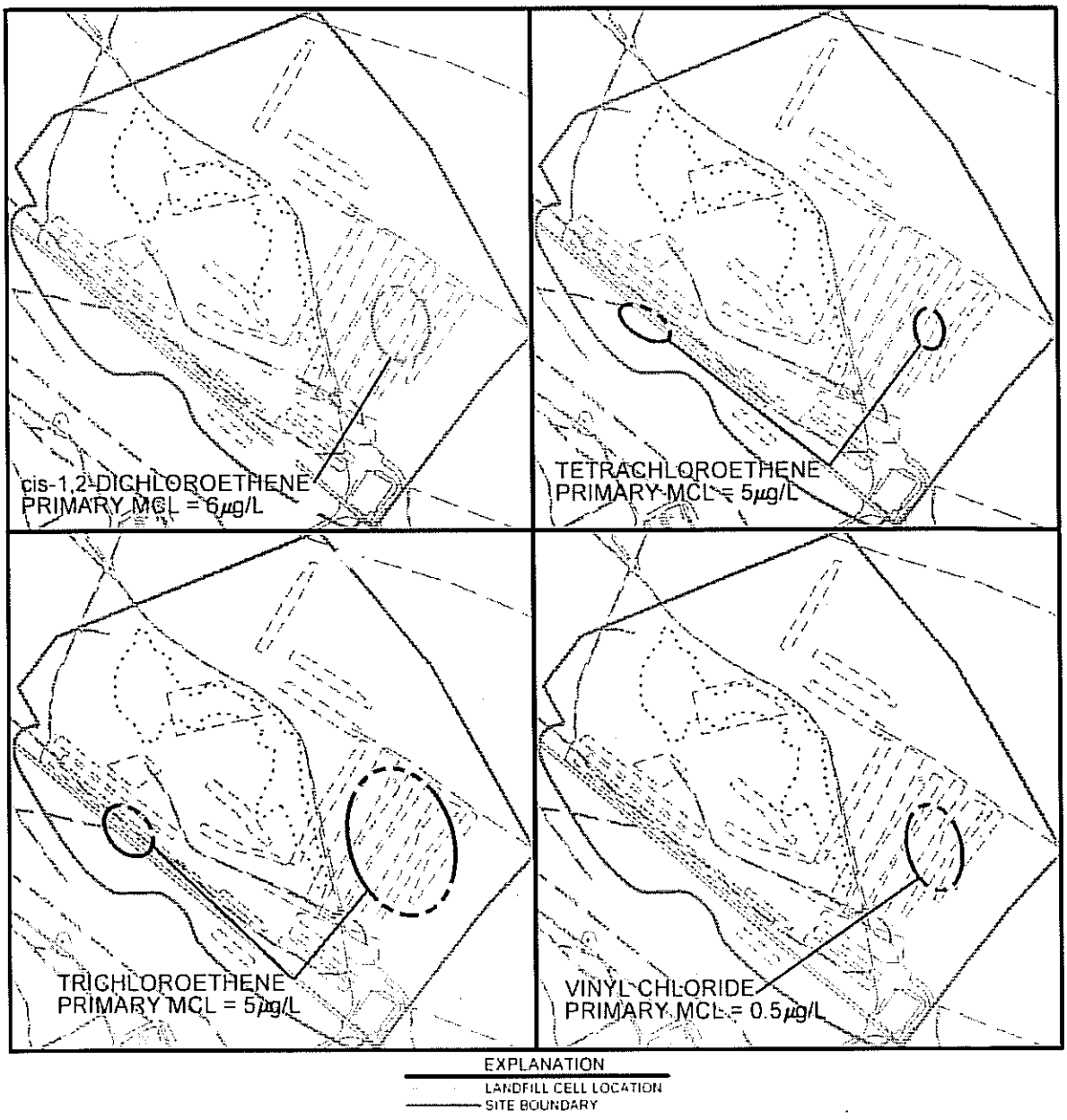

Figure 4. Site 3 Contaminants Detected in Groundwater at Concentrations Greater Than Their Respective MCLs

07-5027

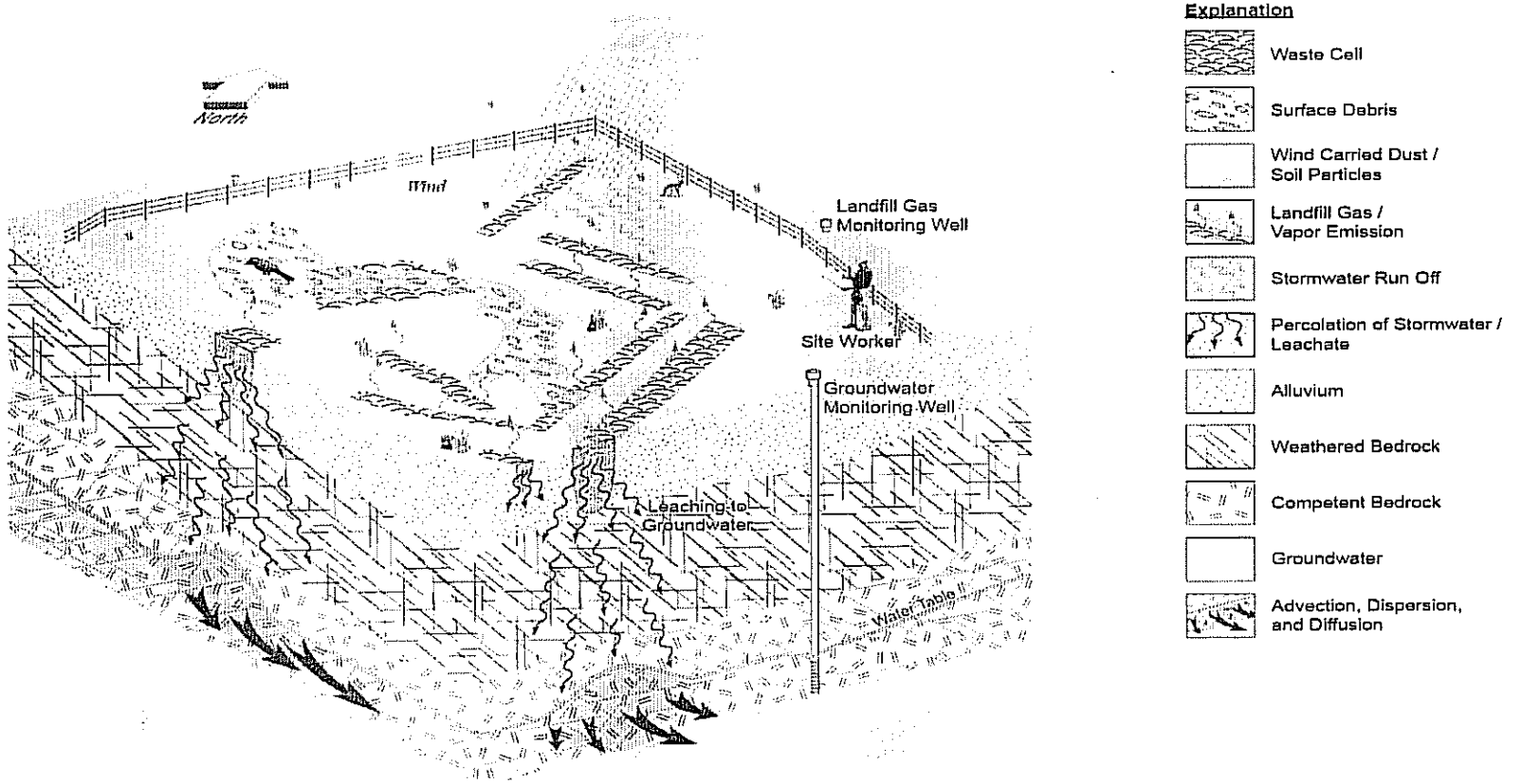

Figure 5. Site 3 Conceptual Site Model

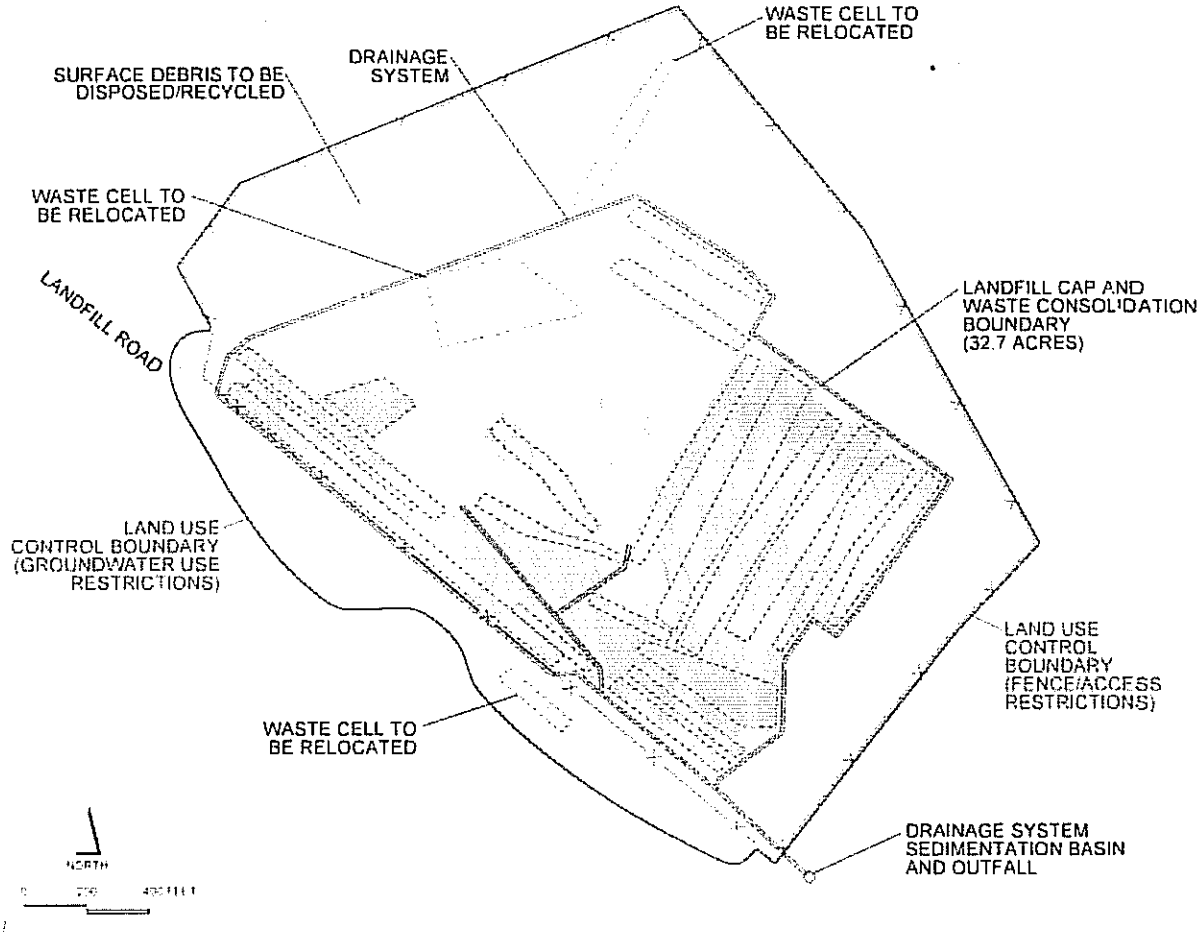

Figure 6. Conceptual Drawing of Proposed Remedial Alternative

07-0029