MCCLELLAN AFB
CALIFORNIA

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 7327

DEPARTMENT OF THE AIR FORCE
AIR FORCE REAL PROPERTY AGENCY

JUN 2 7 2011

MEMORANDUM FOR SEE DISTRIBUTION

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

SUBJECT: Final SR401 Skeet Range Record of Decision (DSR #2059-5)

1. Please find the attached Final (Signed) SR401 Skeet Range Record of Decision (ROD) for your records. It has an assigned McClellan Deliverable Status Report (DSR) #2059-5, is categorized as a primary document, and is due on 21 June 2011. The effective date of this ROD is 7 June 2011, corresponding to the date the ROD was signed by the U.S. Environmental Protection Agency, Region 9.

2. If you have any questions concerning this deliverable, please contact Molly Enloe at (916) 643-0830 ext 231.

STEVEN K. MAYER, P.E.
BRAC Environmental Coordinator

Attachment:
Final (Signed) SR401 Skeet Range Record of Decision

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Final

SR401 Skeet Range Record of Decision

Former McClellan Air Force Base
Air Force Real Property Agency

McClellan, California

June 2011

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Acronyms and Abbreviations

AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AFRPA	Air Force Real Property Agency
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
Central Valley Water Board	California Regional Water Quality Control Board, Central Valley Region
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COC	contaminant of concern
CSM	conceptual site model
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
FFA	Federal Facilities Agreement
FS	feasibility study
ft	foot
HI	hazard index
HQ	hazard quotient
IC	institutional control
ITRC	Interstate Technology and Regulatory Council
McClellan	former McClellan Air Force Base
mg/kg	milligram(s) per kilogram
MMRP	Military Munitions Response Program
NCP	National Oil and Hazardous Substance Pollution Contingency Plan

NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PRL	Potential Release Location
RAB	Restoration Advisory Board
RAO	remedial action objective
RBSL	risk-based screening level
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SLERA	screening level ecological risk assessment
SLHHRA	screening level human health risk assessment
SLUC	State Land Use Covenant
SRT	Sustainable Remediation Tool
STLC	Soluble Threshold Limit Concentration
TCLP	Toxicity Characteristic Leaching Procedure
TTLC	Total Threshold Limit Concentration
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound

SECTION 1

Declaration

1.1 Site Name and Location

This Record of Decision (ROD) is for the SR401 Skeet Range, located at the former McClellan Air Force Base (AFB) in Sacramento, California (see Figure 1).

Department of the Air Force
Air Force Real Property Agency (AFRPA)/Western Region Execution Center
3411 Olson Street
McClellan, California 95652-1003
CERCLIS Identification Number CA 4570024337
Superfund Site ID Number 0902759

The Air Force and state and federal regulatory agencies work as a team to investigate and clean up McClellan. The Air Force is the lead agency for environmental cleanup activities at McClellan. The primary regulatory agencies overseeing the McClellan cleanup are the U.S. Environmental Protection Agency (EPA) and the California Environmental Protection Agency (Cal/EPA), represented by the Department of Toxic Substances Control (DTSC) and the California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) (collectively, the "State"). In accordance with 42 U.S. Code (USC) Section 9620(e)(4), the Air Force and EPA co-select the remedy, with concurrence from the State.

1.2 Statement of Basis and Purpose

This ROD documents the selected remedy for the SR401 Skeet Range and addresses public comments to the *Proposed Plan for the SR401 Skeet Range* (Proposed Plan) (CH2M HILL, 2010a). The Air Force issued a Proposed Plan as part of its Military Munitions Response Program (MMRP). Contamination at MMRP sites is addressed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, and the Federal Facilities Agreement (FFA). Section 117 of CERCLA (42 USC Section 9717) requires public involvement in decisions related to the cleanup and closure of the site. The Proposed Plan and subsequent ROD address the community involvement requirements of CERCLA.

This ROD addresses elemental lead (Pb) and polycyclic aromatic hydrocarbons (PAHs) in soil and sediment that present a threat to human health or the environment. The Air Force and the EPA selected the remedial action for the SR401 Skeet Range in accordance with the CERCLA process, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) 42 USC Section 9601 et seq., and to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300. This decision is based on the Administrative Record, and in particular the *SR401 Skeet Range Remedial Investigation/Feasibility Study* (RI/FS) (CH2M HILL, 2010b),

which is part of the Administrative Record file for this site. The Administrative Record is available for review at the AFRPA office located at 3411 Olson Street, McClellan, California. The State concurs with the selected remedy.

1.3 Assessment of the Site

The SR401 Skeet Range became a site of concern because of the known use of this site as a skeet and trap range. Shooting from six former stations (four skeet and two trap stations) at the SR401 Skeet Range released shot pellets and clay shards to the environment. The lead associated with shot pellets and PAHs associated with shards of broken clay pigeons have leached into soil and sediment. Concentrations of lead and PAHs were detected at greater than the industrial use, ecological, and surface water screening levels in sediment and soil samples. No potential impacts to groundwater quality were identified at the site.

As a result of past activities at the SR401 Skeet Range, hazardous substances are present in soil and sediment. Actual or potential releases of hazardous substances from the SR401 Skeet Range present a potential threat to public health and welfare, and the environment, if not addressed by implementing the response action selected in this ROD.

1.4 Description of Selected Remedy

The selected remedy presented in this ROD is Excavation, Disposal, Revegetation, and Institutional Controls (Restricted Land Use) to protect public health. Soil and sediment contaminated with lead and PAHs will be excavated, and Taxiway 7611 will be swept to capture and remove shot pellets remaining on the surface of the pavement. If shot is also visually observed in surface soil immediately adjacent to the side of the taxiway, surface soil may be scraped to remove the shot, except within or immediately adjacent to vernal pools. The type of equipment used will depend on the volume and areal extent of shot observed on or immediately adjacent to the taxiway. Approximately 9,500 cubic yards of contaminated soil will be removed. The excavated soil and shot will then be transported to an offbase landfill for disposal. Treatment of the contaminated soil will occur as needed at the offsite disposal facility prior to placement in the facility's engineered cell. The site will be backfilled using clean fill, graded, and then revegetated to stabilize the soil and reduce erosion.

The selected remedy uses cleanup goals for restricted land use (i.e., industrial land use, which is the current and reasonably anticipated future use). Soil and sediment containing concentrations of contaminants of concern (COCs) greater than industrial cleanup goals will be removed. Excavation activities will have direct adverse effects on vernal pools located within the target excavation areas. The adverse effects on vernal pools will require mitigation, as the pools have been determined to be jurisdictional wetlands and provide potential habitat for the federally threatened vernal pool fairy shrimp. Because the affected vernal pools are located in an area planned for future industrial use, the Air Force will not restore the vernal pools directly impacted by excavation activities. Vernal pools 355, 357, and 745 with an approximate total area of 0.05 acre will be permanently removed. Vernal pools adjacent to excavation areas will be protected during construction. Vernal pools directly impacted by excavation and backfilling will be mitigated through the purchase of mitigation credits (typically consisting of creation credits at a ratio of 1 to 1 and/or

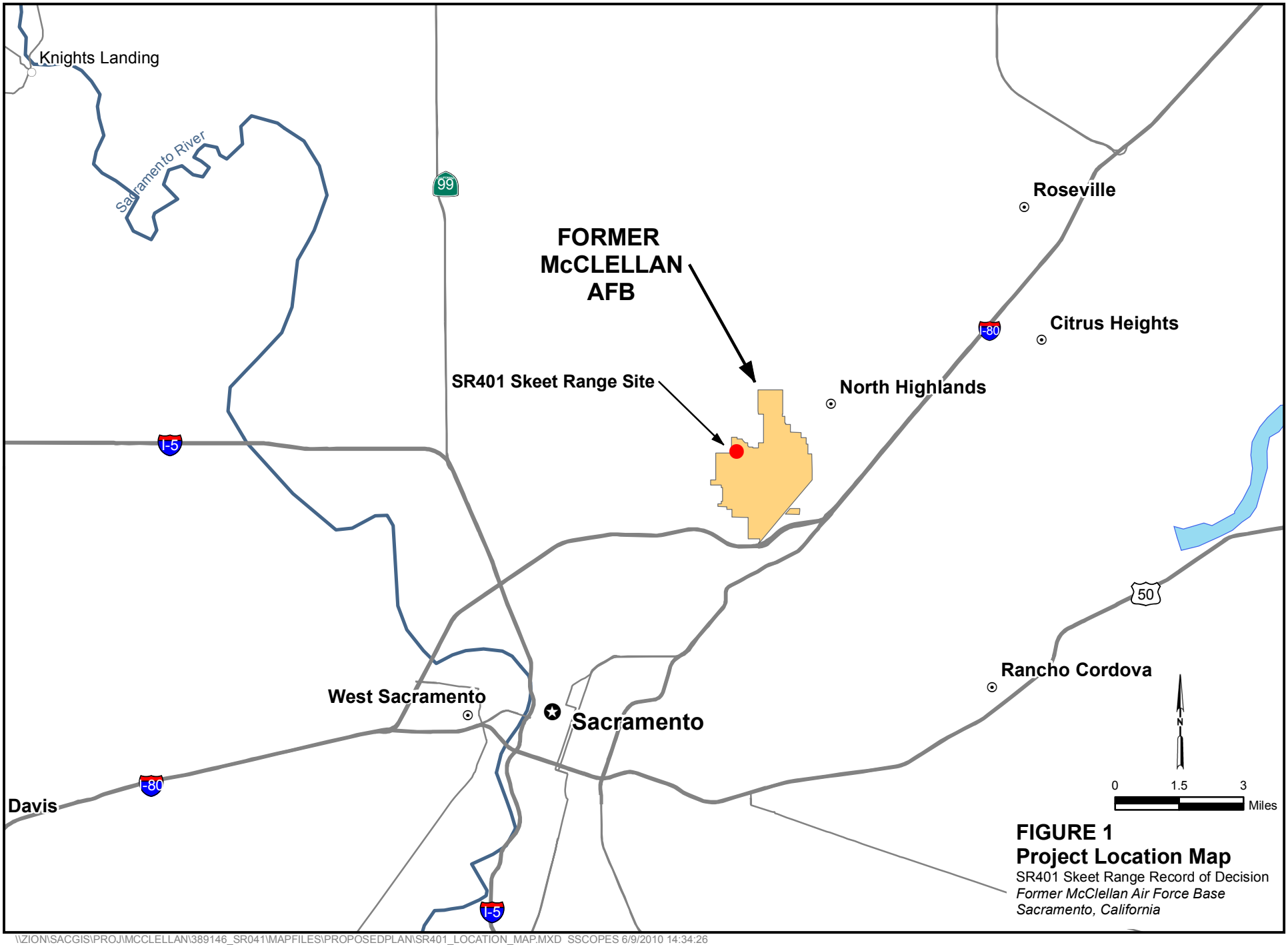

FIGURE 1
Project Location Map
SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California

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preservation credits at a ratio of 2 to 1) in a habitat mitigation bank approved by the U.S. Fish and Wildlife Service (USFWS) and U.S. Army Corps of Engineers (USACE) and/or payment of mitigation fees (i.e., to contribute to the long-term management of vernal pools in McClellan's West Nature Area). The specifics of the mitigation are being negotiated with the USFWS and the USACE. The mitigation plan will be further addressed in the Remedial Design document for the SR401 Skeet Range cleanup.

Under the selected remedy, the resulting land use is restricted, and institutional controls (ICs) will be implemented via deed restrictions to prohibit sensitive uses such as residences, daycare centers, healthcare centers, or schools in the portion of the property where the SR401 Skeet Range is located.

The Air Force has determined that the selected remedy for the SR401 Skeet Range is protective of human health and the environment given the current and reasonably anticipated future land use (industrial/commercial) and that the proposed IC measures are necessary to protect public health from the residual contaminants at the site. The Air Force will incorporate the ICs in the deed at the time of property transfer. The signed deed will include the specific land use restrictions, and the transfer documents will stipulate that a State Land Use Covenant (SLUC) be executed and recorded within 10 days of transfer.

1.5 Statutory Determinations

The Air Force has selected a remedy for the SR401 Skeet Range that is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements (ARARs) for the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Soil that is classified as hazardous waste and which exceeds Land Disposal Restrictions must be treated prior to disposal at an offsite facility. Therefore, the statutory preference for treatment as a principal element will be met. The hazardous substances at SR401 Skeet Range are not considered principle threat wastes and therefore do not trigger the NCP expectation for treatment of principal threat wastes.

Because the selected remedy will result in hazardous substances remaining onsite above levels that allow for unrestricted uses and unlimited exposures, reviews will be required every 5 years to determine if the remedy remains effective and protective of human health and the environment.

1.6 Data Certification Checklist

The following information is included in Section 2 of this ROD (additional information can be found in the Administrative Record):

- Site location and description (Section 2.1)
- COCs and respective concentrations (Section 2.5 and Figures 3 and 4)
- Risks associated with the COCs (Section 2.5 and Figures 5 through 8)
- Cleanup levels established for the COCs (Table 1)
- How source materials constituting principle threats are addressed (Section 2.6)
- Current and reasonably anticipated future land and resource use assumptions (Sections 2.5 and 2.10)
- Potential land use that will be available at the site as a result of the Selected Remedy (Section 2.10)
- Key factor(s) that led to selecting the remedy (Section 2.9 and Figure 10)
- Estimated annual and present worth costs, discount rate, and number of years over which the remedy cost estimate is projected (Sections 2.10 and 2.11.3)

This document was prepared, voluntarily by the Air Force, consistent with guidance published by the EPA for preparation of RODs (EPA, 1999).

1.7 Authorizing Signatures

This is the signature sheet for the SR401 Skeet Range ROD. EPA and the State had an opportunity to review and comment on the SR401 Skeet Range ROD, and all concerns have been addressed.

MAY 1 1 2011

JEFFREY P. DOMM
Deputy Director, Air Force Real Property Agency
U.S. Air Force

Date

June 7, 2011

MICHAEL M. MONTGOMERY
Acting Assistant Director, Federal Facilities and Site Cleanup Branch
Region 9, U.S. Environmental Protection Agency

Date

Concur with the Selected Remedy:

6/14/11

CHARLES RIDENOUR
Performance Manager
Sacramento Office Brownfields and Environmental Restoration Program
Department of Toxic Substances Control
California Environmental Protection Agency

Date

SECTION 2

Decision Summary

2.1 Site Name and Location

McClellan, which encompasses about 3,000 acres, is located 7 miles northeast of downtown Sacramento, California (CERCLIS Identification Number CA 4570024337 and Superfund Site ID Number 0902759). McClellan is surrounded by the City of Sacramento to the west and southwest, unincorporated areas of Antelope on the north, Rio Linda on the northwest, and North Highlands on the east (see Figure 1).

The SR401 Skeet Range is located in the northwestern corner of McClellan. Several buildings and a baseball field are present on the property and were built on top of the former SR401 Skeet Range. Buildings 1080 and 1093 are currently used as commercial/industrial properties, and the anticipated future use of the site is industrial or commercial/industrial. The baseball field and adjacent open-sided shade structure are not maintained and are no longer in use. Seven vernal pools and one unlined drainage ditch are present at the site (see Figure 2). Three of the vernal pools (355, 357, and 745) have been impacted by site-related COCs. The Operable Unit (OU) D cap, a former disposal area that was capped in 1986, is located on and immediately adjacent to the northwestern boundary of the skeet range. Taxiway 7611 lies along the northeastern portion of the site and is not currently in use.

The Air Force is the lead agency for environmental cleanup activities at McClellan. The primary supporting agencies are the EPA, DTSC, and Central Valley Water Board. Funding of cleanup activities is provided by the Air Force Environmental Restoration Account.

2.2 Site History and Background

2.2.1 Site History

Founded in 1936, McClellan AFB was an aircraft repair depot and supply base. McClellan's mission was to provide logistics and maintenance support for aircraft, communications, and electronic systems. In 1995, the federal government decided to close McClellan under the Base Realignment and Closure Act, and it was officially closed in July 2001.

The SR401 Skeet Range was in use from 1971 until no later than 1985. It consisted of six former shooting stations (four skeet and two trap stations). The investigation area is approximately 50 acres, including paved and unpaved areas. The sampling area (unpaved areas) is approximately 20 acres.

2.2.2 Previous Investigations

During a visual site inspection in October 2008 (AFRPA, 2008), shot pellets were found at several locations within a 900-foot radius of the former shooting stations. A field investigation was conducted at the SR401 Skeet Range in 2009. Results of the field investigation are provided in Section 2.5 (Summary of Site Characteristics and Risks).

Additional details on the contaminants identified for the SR401 Skeet Range can be found in the *SR401 Skeet Range Remedial Investigation/Feasibility Study* (RI/FS) (CH2M HILL, 2010b).

2.2.3 Enforcement Activities

On October 15, 1984, the EPA proposed listing McClellan as a candidate site for inclusion on the National Priorities List (NPL) also known as the Federal Superfund List. McClellan was formally placed on the NPL on July 22, 1987. In 1989, the Air Force, EPA Region 9, and the California Department of Health Services (currently, DTSC) signed an agreement regarding the cleanup process known as an FFA. The FFA was executed in 1990.

2.3 Community Participation

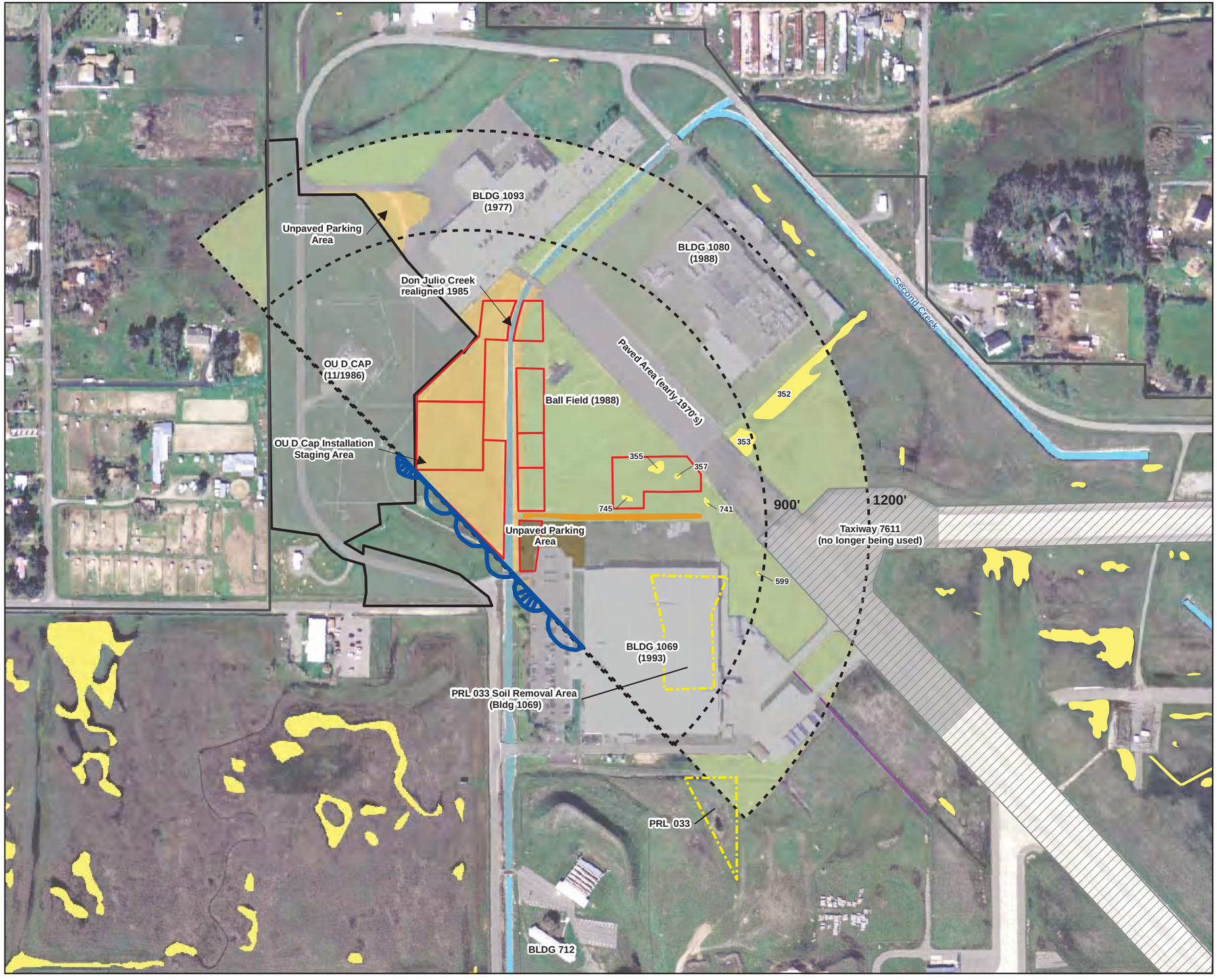
McClellan has had an active community relations/public participation program since the beginning of restoration activities in the early 1980s. The purpose of the program is to help community members understand McClellan's cleanup program and learn how to become involved in the cleanup decision-making process.

Highlights of the community relations activities undertaken by McClellan are as follows:

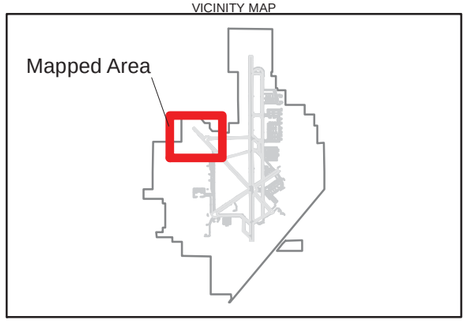
- **Restoration Advisory Board (RAB).** In 1995, a RAB was formed to increase communication between the Air Force and the neighboring community. Through open communication and the exchange of ideas, interests, and concerns, the RAB supports the search for safe, timely, and effective cleanup solutions so that McClellan may be transferred from Air Force ownership to public/private ownership. RAB meetings are held quarterly. These public meetings include discussions of the RAB's advice on particular issues, information on cleanup actions or public interest items, and updates on the status of the cleanup program. The Air Force provides seminars to RAB members to aid in their review of documents and cleanup actions. In addition, the Technical Assistance for Public Participation program is available to provide funds to retain an independent contractor to assist the community members in their reviews.

- **Administrative Record.** McClellan established the Administrative Record at the beginning of its environmental investigation to store all information that supports cleanup decisions at McClellan. An Information Repository was also set up to make all of the information, reports, and reference materials available for public review. More than 20 years of documentation is available for review by the public. This repository is located at the AFRPA office, 3411 Olson Street, McClellan, California 95652. Documents related to the cleanup efforts at McClellan also are available for review at DTSC, Central Valley Water Board, and EPA Region 9 offices.

- **Community Relations Plan**. The first McClellan Community Relations Plan was approved in August 1985. The Community Relations Plan was last updated in 2009. The Community Relations Plan identifies the community's issues, needs, and concerns, and specifies activities, outreach products, or programs used to address the community concerns and expectations. The plan also explains how the community will be involved in site cleanup.



VICINITY MAP



LEGEND

- Industrial Use Target Area
- Former Location of Skeet Station
- Former Location of Trap Station
- Developed in 1985
- Developed in 2001
- Grassy Area
- 900' and 1200' Estimated Shotfall Areas
- Controlled Flightline Area (Taxiway 7611)
- Paved Area
- Unlined Drainage Ditch (358)
- Creeks
- Jurisdictional Ditch
- Vernal Pool
- PRL 033 Soil Removal Area (Bldg 1069)
- OU D
- Base Boundary

Notes:
BUILDING CONSTRUCTION DATES

OU D Cap - Nov. 1986 (completed)
Building 1093 - 1977
Building 1080 - 1988 (estimated)
Building 1069 - 1993

1) Used aerial photos from
1978, 1985, 1988, 1991 and 2001
2) Aerial background from 2006

N

0 150 300
Feet

FIGURE 2
SR401 Skeet Range
SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California

- **Mailing List.** A mailing list of all interested parties in the community is maintained by the Air Force and updated regularly. In 2002, blanket mailings to all residents in the vicinity of McClellan were conducted in an effort to add new/interested parties to the mailing list. Since then, the mailing list has been updated repeatedly.
- **Newsletters.** Since May 1984, McClellan's quarterly newsletter, the *Environmental Action Update*, has been distributed to interested individuals and organizations. The newsletter includes articles on the status of the Installation Restoration Program, meeting announcements, listings of recently issued documents, and names of individuals to contact for more information. The newsletter is mailed to more than 2,500 neighbors of the Base, community leaders, businesses, environmental organizations, civic clubs, and the news media.
- **Web Site.** The Air Force has established a Web site to support communication about its environmental program (http://www.safie.hq.af.mil/afrpa/index.asp). The following information is available on the Web site:
  - A search feature identifying the documents stored in the Administrative Record
  - Announcements for upcoming public meetings and RAB meetings
  - RAB information and meeting minutes
  - Copies of newsletters and fact sheets
- **Fact Sheets.** Since May 1990, the Air Force has published fact sheets to help explain specific topics. Topics have included descriptions of new cleanup technologies, cleanup milestones, and descriptions of removal action plans. Fact sheets are also provided to increase the community's knowledge of technologies or the science of cleanup at McClellan.
- **Public Comment Periods and Public Meetings.** Public comment periods give the community an opportunity to review documents and provide comments verbally or in writing. Public meetings are held to solicit public comment on documents or actions and to address areas of public concern or interest. The final Proposed Plan (CH2M HILL, 2010a) and a summary Proposed Plan Fact Sheet for the SR401 Skeet Range were issued on July 7, 2010, and an associated public comment period was held from July 8 through August 9, 2010, to provide the community an opportunity to comment on the proposed action and anticipated future land use at this site. A public meeting was also held on July 15, 2010, to solicit public input on the proposed action at the SR401 Skeet Range and anticipated future land use at this site, and to provide the community an additional opportunity to provide comments. The Air Force prepared a written response to the five public comments pertaining to the Proposed Plan. The responses to the public comments are included in the Responsiveness Summary section of this ROD. This ROD will be available in the Administrative Record upon publication. The public participation requirements of CERCLA and the NCP were met for the remedy selection process.

2.4 Scope and Role of the SR401 Skeet Range Response Actions

For environmental management purposes for implementation of the cleanup under CERCLA, McClellan was subdivided into the following 11 OUs: A, B, B1, C, C1, D, E, F, G, H, and the Groundwater OU, which encompasses the entire Base. The SR401 Skeet Range is an MMRP site, but the Air Force is implementing cleanup of the site using the CERCLA process because the site contains COCs.

This ROD addresses hazardous substances in soil and sediment at the SR401 Skeet Range, which is located within OU D.

The Air Force plans to transfer the property described within the SR401 Skeet Range ROD to other parties. The Air Force will ensure through the property transfer process that the deed for this property will include the ICs selected in this ROD.

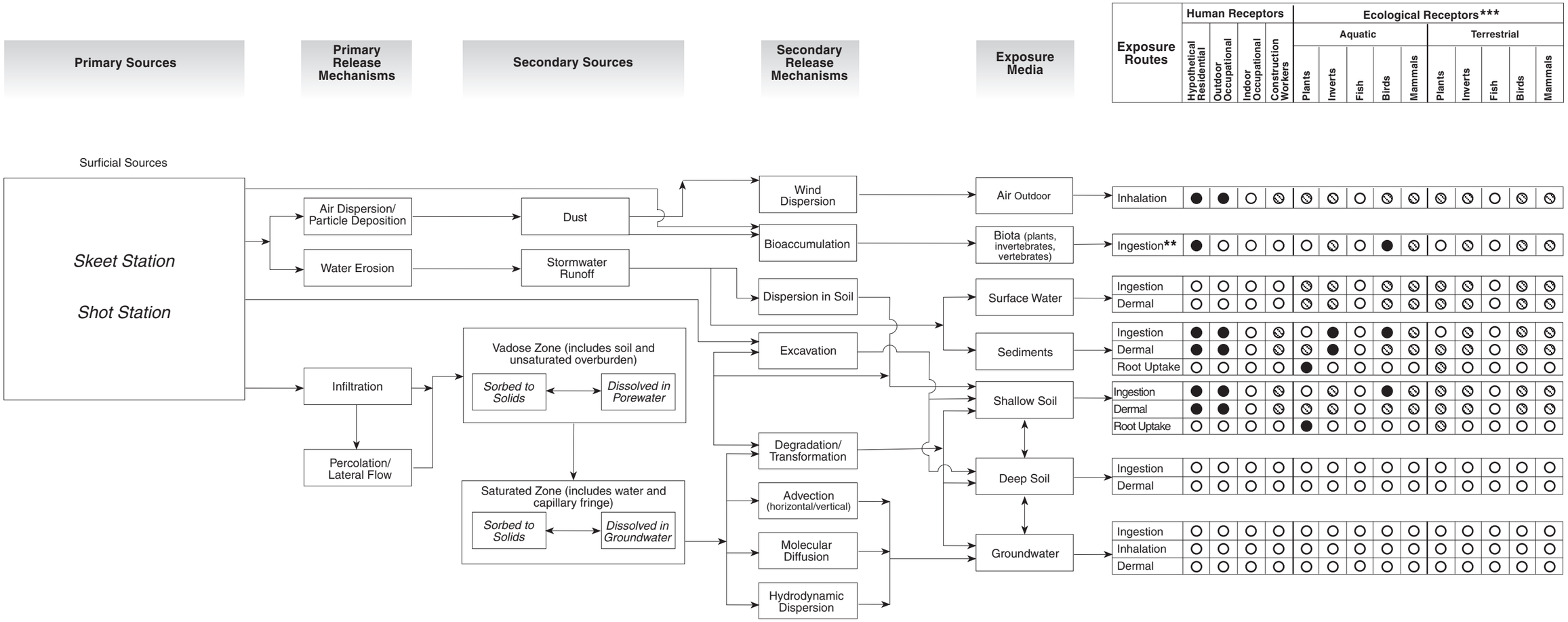
2.5 Summary of Site Characteristics and Risks

2.5.1 Site Characteristics

The former Skeet Range consists of approximately 50 acres, including paved and unpaved areas. Several buildings and a baseball field are present on the property and were built on top of the former Skeet Range. The baseball field and adjacent open-sided shade structure are no longer in use and are not maintained. Buildings 1080 and 1093 are currently used as commercial/industrial properties, and the anticipated future use of the site is commercial/industrial. The OU D cap, a former disposal area that was capped in 1986, is located on and immediately adjacent to the northwestern boundary of the skeet range. Taxiway 7611 is present along the northeastern portion of the site and is not currently in use. Several vernal pools and an unlined drainage ditch north of Building 1069 are present at the site. There is also a jurisdictional drainage ditch (under the authority of USACE and subject to provisions of the Clean Water Act) located southeast of Building 1069, which is outside the area of contamination.

Soil removal was conducted in October 1989 within the southern portion of the site during construction of Building 1069 (northern portion of Potential Release Location [PRL] 033). Confirmation samples collected from the excavated area were analyzed for metals and PAHs, and concentrations were below the site-specific designated screening levels (CH2M HILL, 2009).

A conceptual site model (CSM) is used to develop an understanding of a site and to evaluate potential risks to human health and the environment. The preliminary CSM developed for this site was based on the known use of this site as a skeet and trap range; field observations; and review and evaluation of historical documents, historical aerial photographs, and skeet range literature (Figure 3).



NOTES

- ● Potentially significant exposure pathways addressed in this report.
- ⊘ Potentially complete pathway, but not addressed in this report.
- ○ Incomplete pathway for this scenario.
- ** Plants may take up contaminants and hypothetical residents may be exposed through ingestion of homegrown produce affected by contaminants.
- *** There is no significant terrestrial ecological habitat; therefore, terrestrial receptors were not evaluated.

FIGURE 3
Conceptual Site Model
SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California

The depth of soil potentially impacted by shot pellets and/or clay shards was expected to vary across the site because of various grading, disking, and development activities that disturbed the soil during the operation and after the closure of the Skeet Range. These development activities included construction of buildings, paved areas, and the OU D soil cap, disking and/or grading of the ball field and unpaved parking areas, and realignment and construction of the gunite-lined Don Julio Creek. It was conservatively assumed that normal site preparation activities to support construction of buildings, parking areas, the ball field, and landscaped areas could potentially disturb soil to a depth of 3 feet below ground surface (bgs). Grassy undeveloped areas, with the exception of the ball field and landscaped areas around the buildings, were expected to consist of undisturbed or disked soil, so only surface soil (above 1 foot bgs) was expected to be impacted by shot pellets and/or clay shards.

Work conducted at other skeet and trap ranges indicates that typical lead shot may travel up to an average distance of 680 feet from the shooter at a skeet range and 770 feet from the shooter at a trap range (Interstate Technology and Regulatory Council [ITRC], 2003). The typical maximum shot range is approximately 900 feet on native surfaces. Native surfaces include undisturbed, unpaved, or undeveloped grassy areas. Sections of pavement, such as those found at the site, may cause shot to travel further and concentrate in the down-range direction along the edge of pavement. Considering the reference literature and that lead shot had only been observed at a maximum distance of approximately 800 feet from the shooting stations (October 2, 2008, site inspection), it was anticipated that a 900-foot radius from the shooter would encompass the vast majority of shot pellets and/or clay shards (range debris) encountered. Clay shards were expected to be found closer to the skeet/trap stations than the shot pellets. A 1,200-foot radius was conservatively set as the maximum extent of the investigation to ensure that contamination was adequately delineated.

The reviewed literature indicated that the metals lead, arsenic, antimony, copper, iron, and zinc may be associated with shot pellets, and PAHs were anticipated to be associated with shards of broken clay pigeons.

Based on the use of the site, site-specific features, and the reviewed literature, the preliminary CSM focused on metals and PAHs in shallow soil and sediment (0 to 3 feet bgs). Using the preliminary CSM, a field sampling plan was developed (CH2M HILL, 2009a), and accordingly a field investigation was conducted at the SR401 Skeet Range in 2009.

The field investigation included visual inspection of the area, collection of soil and sediment samples from surface to a depth of 3 feet bgs, separation of the shot pellets and clay shards (range debris) from the soil or sediment samples, and sample analysis. Shot pellets and clay shards were identified mostly in surface samples (0- to 0.5-foot depth) collected within the 900-foot estimated shot-fall area and in soil samples at depths of up to 3 feet bgs in areas of disturbed soil (Figures 4 and 5). Shot pellets were identified in soil samples outside the 900-foot estimated shot-fall area in two locations from 0 to 0.5 foot bgs and from 1 to 1.5 feet bgs. Clay shards were identified at one location at or beyond the 900-foot estimated shot-fall area from 0 to 0.5 foot bgs.

The analytical results were compared with site-specific screening levels for protection of human health, ecological receptors, surface water quality, and groundwater (Appendix A). Samples containing PAHs and lead at concentrations greater than human and/or

ecological screening levels are shown on Figures 6 to 9. Lead and PAH concentrations at various locations also exceeded screening levels for protection of surface water quality (i.e., concentrations in surface soil and sediment that could affect surface water quality due to runoff). Based on a comparison of contaminant concentrations with screening levels protective of groundwater quality, no potential impacts to groundwater were identified.

As a result of the comparison with the initial screening levels, the following chemicals were identified as COCs at the SR401 Skeet Range: lead and PAHs, including acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene.

2.5.2 Current and Potential Future Land and Resource Uses

The current use of the site is primarily industrial/commercial, and the reasonably anticipated future use of the site is also industrial/commercial. The designated beneficial use of groundwater in the aquifers beneath the site is domestic or municipal water supply. However, there is no current use of groundwater as municipal drinking water. Surface water features at the site include an ephemeral unlined drainage ditch and a concrete-lined creek that provide limited habitat value for aquatic wildlife.

2.5.3 Summary of Human Health Risk Assessment

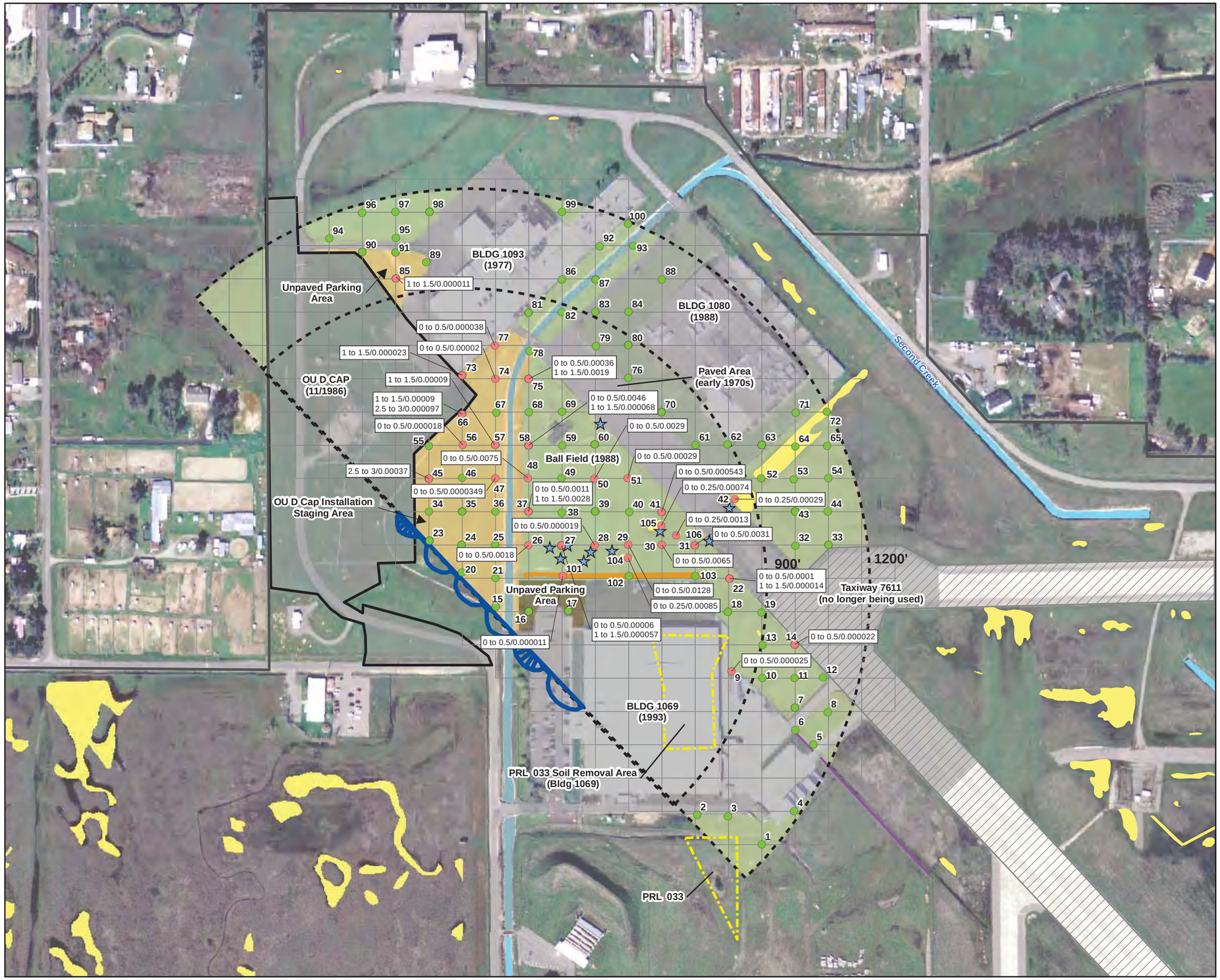
Potential human health concerns were evaluated by conducting a screening level human health risk assessment (SLHHRA).[1] A copy of the SLHHRA is provided in Appendix B.

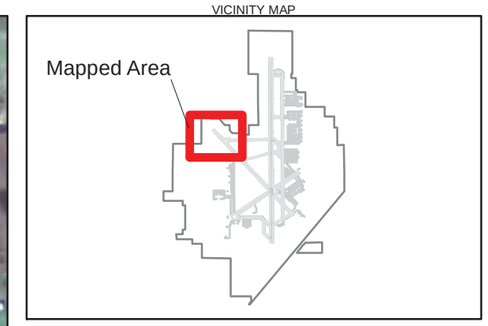
The SLHHRA identifies and characterizes the current and potential threats to human health from the concentrations of metals and PAHs detected in soil and sediment at the site. Cumulative cancer risks and non-cancer hazard indexes (HIs) were calculated by summing the cancer risks or non-cancer hazard quotients (HQs) for each COC. Health effects of lead were evaluated separately by comparing the exposure point concentrations (EPCs) with the human health risk-based screening levels (RBSLs) for residents and industrial use receptors (i.e., occupational workers).

Risks greater than the target risk range (one-in-a-million to one-in-ten-thousand for added cancer risks and/or HI greater than 1) are unacceptable, and require action. For risks that fall within the target risk range, a risk management decision is made and considers information including potential land use and the nature of the contamination. No actions are required for excess cancer risk values less than one-in-a-million, or an HI value less than 1 (Figures 6 and 7).[2]

[1] The Air Force's use of a SLHHRA for the site is not a precedent for any other site or OU at McClellan or any other Air Force installation/facility in or outside of California, nor does it prejudice any later decision by the Air Force to do a site-specific baseline risk assessment. The same applies to all related appendices.

[2] The Air Force's election respecting this ROD for this site to consider only excess cancer risks less than one-in-a million as representing acceptable risk and therefore not requiring action is limited solely to this site and ROD, and does not set a precedent for, nor prejudice its right to make different decisions respecting, any other site or OU at McClellan or at any other installation/facility. The same applies to the analysis in Appendix C and all other related appendices.





LEGEND

0 to 0.5/0.000011 **Shot Pellet Results - (Sample Depth[a]/ Shot Density[b])**

- > 0% Shot
- 0% Shot
- Locations where lead shot was found during site inspection of 10/2/08
- Former Location of Trap Station
- Former Location of Skeet Station
- Developed in 1985
- Developed in 2001
- Grassy Area
- 900' and 1200' Estimated Shotfall Areas
- 100' x 100' Sample Grid
- Controlled Flightline Area (Taxiway 7611)
- Paved Area
- Unlined Drainage Ditch
- Creeks
- Jurisdictional Ditch
- Vernal Pool
- PRL 033 Soil Removal Area (Bldg 1069)
- OU D
- Base Boundary

Notes:
a. Feet below ground surface (ft bgs)

b. Shot Density = $\frac{\text{Weight of Shot}}{\text{Weight of Soil Sample}}$

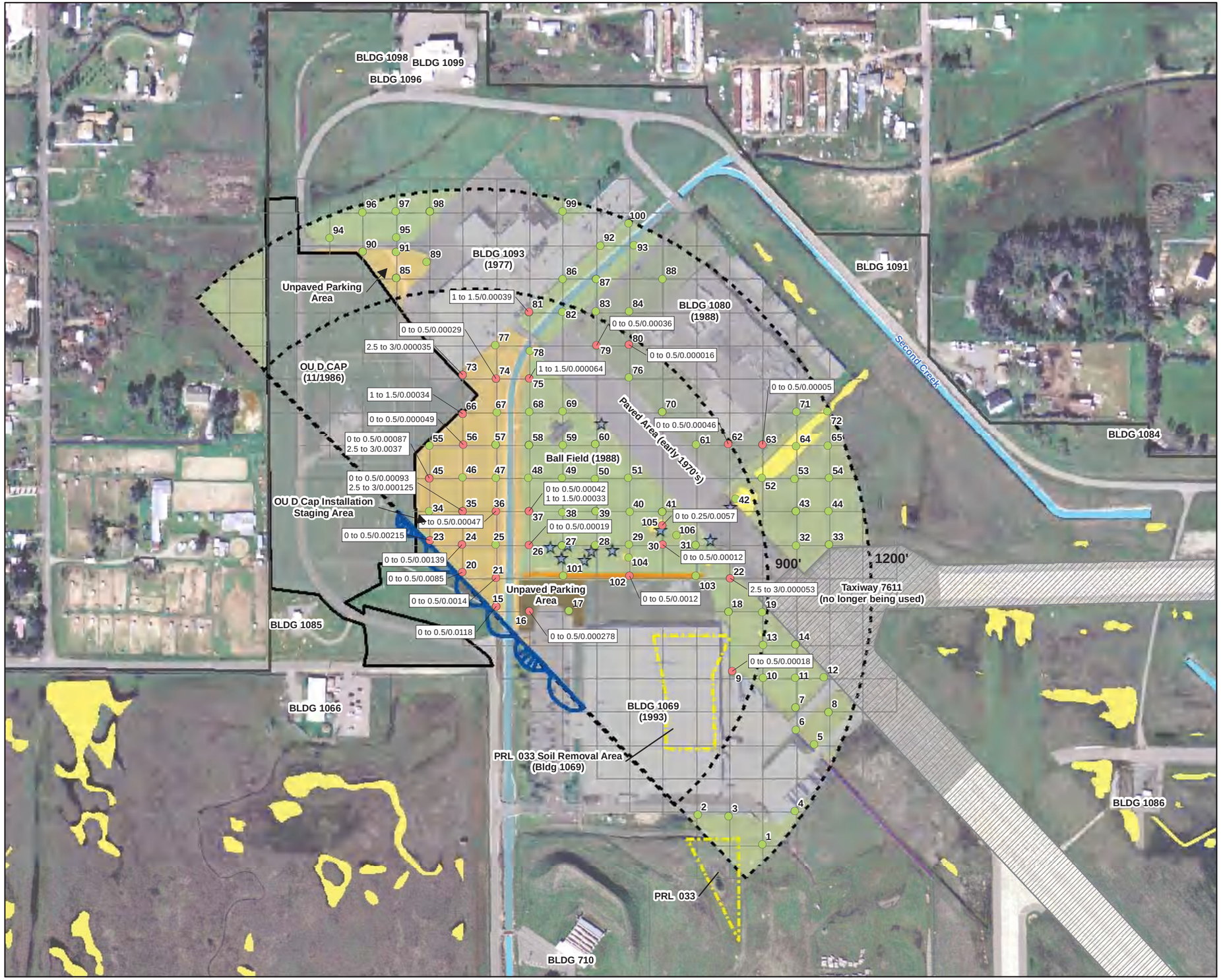
BUILDING CONSTRUCTION DATES

OU D Cap - Nov. 1986 (completed)
Building 1093 - 1977
Building 1080 - 1988 (estimated)
Building 1069 - 1993

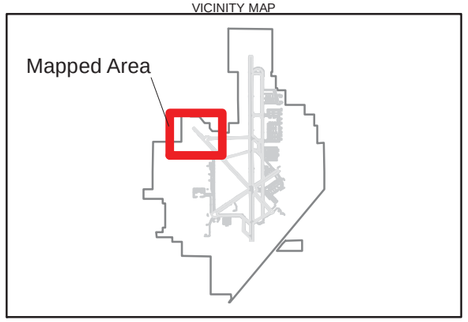
N

0 150 300
Feet

FIGURE 4
Shot Pellet Density and Distribution Results
SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California



VICINITY MAP



LEGEND

0 to 0.5/0.000011 **Clay Shard Sample Results = (Sample Depth[a]/ Shard Density[b])**

- > 0% Shard
- 0% Shard
- Locations where lead shot was found during site inspection of 10/2/08
- Former Location of Trap Station
- Former Location of Skeet Station
- Developed in 1985
- Developed in 2001
- Grassy Area
- 900' and 1200' Estimated Shotfall Areas
- 100' x 100' Sample Grid
- Controlled Flightline Area (Taxiway 7611)
- Paved Area
- Unlined Drainage Ditch
- Creeks
- Jurisdictional Ditch
- Vernal Pool
- PRL 033 Soil Removal Area (Bldg 1069)
- OU D
- Base Boundary

Notes:
a. Feet below ground surface (ft bgs)

b. Shard Density = Weight of Shard / Weight of Soil Sample

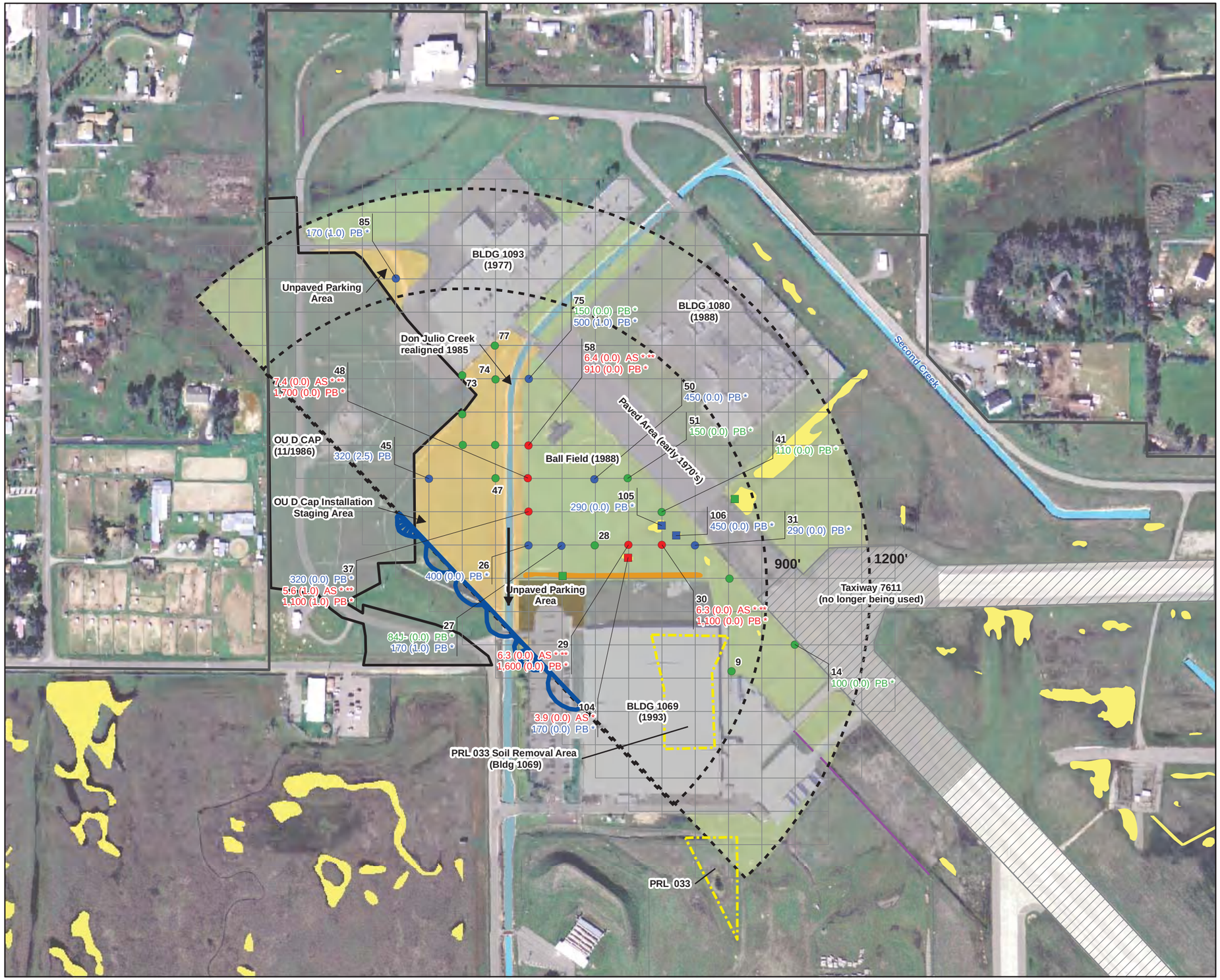
BUILDING CONSTRUCTION DATES

OU D Cap - Nov. 1986 (completed)
Building 1093 - 1977
Building 1080 - 1988 (estimated)
Building 1069 - 1993

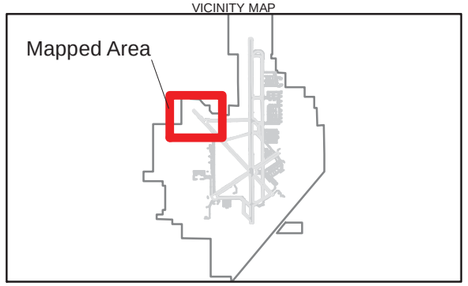
N

0 150 300
Feet

FIGURE 5
Clay Shard Density and Distribution Results
SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California



VICINITY MAP



LEGEND

- Soil Sampling Locations
- Sediment Sampling Locations
- Former Location of Skeet Station
- Former Location of Trap Station
- Developed in 1985
- Developed in 2001
- Grassy Area
- 900' and 1200' Estimated Shotfall Areas
- 100' x 100' Sample Grid
- Controlled Flightline Area (Taxiway 7611)
- Paved Area
- Unlined Drainage Ditch
- Creeks
- Jurisdictional Ditch
- Vernal Pool
- PRL 033 Soil Removal Area (Bldg 1069)
- OU D
- Base Boundary
- Surface water flow direction

SAMPLE LOCATION
CONCENTRATION (TOP DEPTH [feet below ground surface]) ANALYTE

Notes:
Concentrations are in mg/kg.

AS = Arsenic
PB = Lead

J = Estimated
Results with a ** are greater than screening levels for the protection of groundwater.
Results with a * are greater than screening levels for the protection of surface water.

Results shown in green are less than or equal to screening levels.
Results shown in blue are greater than background and unrestricted use screening levels.
Results shown in red are greater than background and industrial use screening levels.

Background screening levels were selected in accordance with the McClellan site screening process.

BUILDING CONSTRUCTION DATES

OU D Cap - Nov. 1986 (completed)
Building 1093 - 1977
Building 1080 - 1988 (estimated)
Building 1069 - 1993

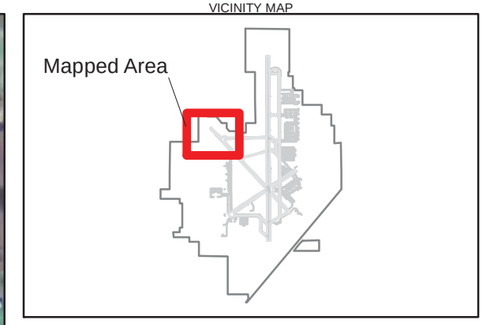
Notes:
1) Used aerial photos from 1978, 1985, 1988, 1991 and 2001
2) Aerial background from 2006
3) Sediment samples were collected at three locations within the unlined drainage ditch and within select vernal pools.

N
0 150 300
Feet

FIGURE 6
Metals in Soil and Sediment Exceeding Background and Human Health Screening Levels

SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California

VICINITY MAP



LEGEND

- Soil Sampling Locations
- Sediment Sampling Locations; Sediment Sampling
- Former Location of Skeet Station
- Former Location of Trap Station
- Developed in 1985
- Developed in 2001
- Grassy Area
- 900' and 1200' Estimated Shotfall Areas
- 100' x 100' Sample Grid
- Controlled Flightline Area (Taxiway 7611)
- Paved Area
- Unlined Drainage Ditch
- Creeks
- Jurisdictional Ditch
- Vernal Pool
- PRL 033 Soil Removal Area (Bldg 1069)
- OU D
- Base Boundary
- Surface water flow direction

SAMPLE LOCATION
CONCENTRATION (TOP DEPTH [feet below ground surface]) ANALYTE
Notes:
Concentrations are in mg/kg.

BZAA = Benzo(a)anthracene
BZAP = Benzo(a)pyrene
BZBF = Benzo(b)fluoranthene
BZKF = Benzo(k)fluoranthene
CHRYSENE = Chrysene
DBAHA = Dibenzo(a,h)anthracene
INP123 = Indeno(1,2,3-c,d)pyrene

J = Estimated
Results with a ** are greater than screening levels for the protection of groundwater.
Results with a * are greater than screening levels for the protection of surface water.

Results shown in green are less than screening levels.
Results shown in blue are greater than unrestricted use screening levels.
Results shown in red are greater than industrial use screening levels.

BUILDING CONSTRUCTION DATES

OU D Cap - Nov. 1986 (completed)
Building 1093 - 1977
Building 1080 - 1988 (estimated)
Building 1069 - 1993

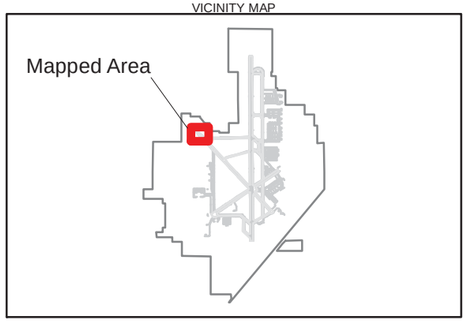
N
0 150 300
Feet

1) Used aerial photos from 1978, 1985, 1988, 1991 and 2001
2) Aerial background from 2006
3) Sediment samples were collected at three locations within the unlined drainage ditch and within select vernal pools.

FIGURE 7
PAHs in Soil and Sediment Exceeding Human Health Screening Levels

SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California

VICINITY MAP



LEGEND

- Soil Sampling Locations
- Sediment Sampling Locations
- Former Location of Skeet Station
- Former Location of Trap Station
- Developed in 1985
- Developed in 2001
- Grassy Area
- 900' and 1200' Estimated Shotfall Areas
- 100' x 100' Sample Grid
- Paved Area
- Unlined Drainage Ditch
- Creeks
- Vernal Pool
- PRL 033 Soil Removal Area (Bldg 1069)
- Base Boundary

SAMPLE LOCATION
CONCENTRATION (DEPTH) ANALYTE

Notes:
Concentrations are in mg/kg.

PB = Lead

J = Estimated

Results shown in green are less than screening levels.
Results shown in red are greater than background and ecological screening levels.

+ Lead at this location does not exceed the preliminary cleanup goal for ecological receptors.

Background screening levels were selected in accordance with the McClellan site screening process.

BUILDING CONSTRUCTION DATES

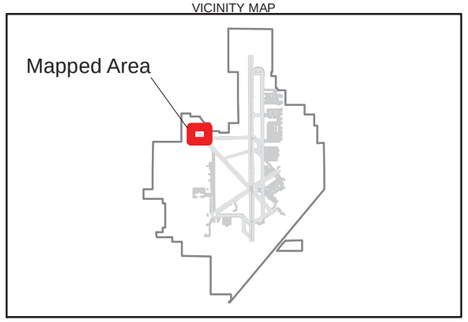
OU D Cap - Nov. 1986 (completed)
Building 1093 - 1977
Building 1080 - 1988 (estimated)
Building 1069 - 1993

N

0 50 100
Feet

FIGURE 8
Metals in Soil and Sediment Exceeding Background and Ecological Screening Levels
SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California

VICINITY MAP



LEGEND

- Soil Sampling Location
- Sediment Sampling Location
- Former Location of Skeet Station
- Former Location of Trap Station
- Developed in 1985
- Developed in 2001
- Grassy Area
- 900' and 1200' Estimated Shotfall Areas
- 100' x 100' Sample Grid
- Paved Area
- Unlined Drainage Ditch
- Creeks
- Vernal Pool
- PRL 033 Soil Removal Area (Bldg 1069)
- Base Boundary

SAMPLE LOCATION
CONCENTRATION (TOP DEPTH [feet below ground surface]) ANALYTE

Notes:
Concentrations are in mg/kg.

ACNP = Acenaphthene
ANTH = Anthracene
BZAA = Benzo(a)anthracene
BZAP = Benzo(a)pyrene
BZGHIP = Benzo(g,h,i)peryle
BZKF = Benzo(k)fluoranthene
CHRYSENE = Chrysene
DBAHA = Dibenzo(a,h)anthracene
FLA = Fluoranthene
INP123 = Indeno(1,2,3-c,d)pyrene
PHAN = Phenanthrene
PYR = Pyrene

Results shown in green are less than screening levels.
Results shown in red are greater than ecological screening levels.

BUILDING CONSTRUCTION DATES

OU D Cap - Nov. 1986 (completed)
Building 1093 - 1977
Building 1080 - 1988 (estimated)
Building 1069 - 1993

N

0 50 100
Feet

FIGURE 9
PAHs in Soil and Sediment Exceeding Ecological Screening Levels

SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California

Risks for the occupational worker scenario and hypothetical residential scenario are as follows:

- For the occupational worker scenario, the SR401 Skeet Range has a potential cancer risk of 4 in 10,000 (or 4×10^{-4}), which exceeds the target risk range and is therefore unacceptable. The main risk driver for the carcinogenic risk is benzo(a)pyrene. The SR401 Skeet Range has an HI of less than 1 for the occupational worker scenario.
- For the hypothetical residential scenario, the SR401 Skeet Range has a potential cancer risk of 3 in 1,000 (or 3×10^{-3}), which also exceeds the target risk range and is therefore unacceptable. The main risk driver for the carcinogenic risk is benzo(a)pyrene. The HI for the SR401 Skeet Range is equal to 1 for the residential scenario. Arsenic accounts for the majority of the non-carcinogenic HI; however, arsenic concentrations at the site were determined to be representative of background.

Health effects of lead were evaluated separately. Based on the maximum site concentration as the EPC (1,700 mg/kg), concentrations of lead detected at the SR401 Skeet Range exceed levels that are protective of both residents (150 mg/kg) and occupational workers (800 mg/kg).

2.5.4 Summary of Ecological Risk Assessment

A screening level ecological risk assessment (SLERA) was also conducted for the SR401 Skeet Range (Appendix C).

The SLERA identifies and characterizes the current and potential threats to ecological receptors from metals and PAHs detected in sediment and soil within and adjacent to seven vernal pools (352, 353, 355, 357, 599, 741, and 745) and the unlined drainage ditch (ditch 358). The ditch is considered to provide low value aquatic habitat because it contains water only seasonally and is characterized by upland vegetation. Because a federally listed species associated with vernal pools (e.g., federally threatened vernal pool fairy shrimp) is known to occur at McClellan, vernal pools are the primary features of concern for ecological receptors.

Ecological risks were evaluated for surface soil (0 to 1 foot bgs), subsurface soil (1 to 4 feet bgs), and sediment (0 to 0.5 feet bgs) for birds, plants, and benthic invertebrates. For four of the vernal pools (352, 353, 599, and 741), site contaminants do not present an unacceptable risk to any ecological receptors. Lead presents a potential risk to ecological receptors at vernal pools 357 and 745, and lead and PAHs present a potential risk to ecological receptors at vernal pool 355 (Figures 8 and 9).

2.5.5 Basis for Action

Based on the results of the field investigation, screening process, and SLHHRA and SLERA, lead and benzo(a)pyrene were retained as COCs because they were the primary risk drivers for residential and industrial use human health risk scenarios and posed a risk to surface water quality and ecological receptors. The remaining PAHs that exceeded screening levels co-occur with lead and benzo(a)pyrene, and therefore will be addressed by cleanup of the selected COCs. Table 1 identifies the industrial use cleanup levels, which are protective of human health under an industrial use scenario. Unrestricted use levels are also provided in Table 1 as a point of reference for when land use restrictions are required. As described in

Section 2.7, cleanup to the industrial standards shown in Table 1 is expected to result in an average site concentration of lead that is below background for surface soils and removal of PAHs at all locations where they occur above screening levels for the protection of surface water quality and ecological receptors. Sensitive ecological habitats impacted by site COCs would be removed as part of the cleanup action and mitigated at an offsite mitigation bank (see Section 2.7). Therefore, the selected remedy is expected to be protective of human health, ecological receptors, and surface water quality.

TABLE 1
Cleanup Levels for COCs Based on Potential Risk to Human Health
SR401 Skeet Range Record of Decision, Former McClellan Air Force Base, Sacramento, California

COC	Restricted Use (Industrial)	Unrestricted Use (Residential)
Lead*	800 mg/kg	150 mg/kg
Benzo(a)pyrene*	0.14 mg/kg	0.018 mg/kg

* Calculated risk-based values. See Footnotes 3 and 4 below for lead and benzo(a)pyrene, respectively.

Note:

mg/kg = milligram per kilogram

2.6 Principal Threat Wastes

The NCP establishes an expectation that the EPA will use treatment to address principal threat wastes wherever practicable. Principal threat wastes consist of materials that are highly mobile or toxic, cannot be reliably controlled in place, or present a significant risk to human health or the environment should exposure occur. Contaminants in soil at the SR401 Skeet Range have been determined through risk assessments to pose a threat to human health and the environment; however, principal threat wastes are not present at the site. Should exposure occur, risks under the reasonable future land use scenario (industrial) are near the acceptable risk range. In addition, the COCs in soil (PAHs and lead) have not and are not expected to migrate through air or groundwater. While concentrations of contaminants in soil exceeded screening levels for protection of surface water, contaminants have not migrated in surface water to the adjacent drainage ditch. Therefore, the NCP expectation for treatment of principle threat wastes is not applicable to the site.

[3] The Unrestricted Use (Residential) value is based on the DTSC Leadspread 7 model. This value is protective of noncancer health effects (i.e., elevated blood-lead levels in children) and is based on a residential scenario that includes the following exposure routes: soil ingestion, inhalation, dermal contact, and homegrown produce ingestion. Leadspread 7 default values were used except for a McClellan-specific air concentration. The Air Force's decision to utilize this value of 150 mg/kg for residents vs. EPAs regional screening level of 400 mg/kg is limited solely to this site and ROD, and does not set any precedent, nor prejudice its right to determine at any other site/OU at McClellan or any other Air Force installation/facility a different concentration. The Restricted Use (Industrial) Cleanup Level for lead is the EPA RSL for lead. The EPA RSL is intended to be protective of a fetus that may be carried by a pregnant female worker. It is assumed that a cleanup goal that is protective of a fetus will also afford protection for male or female adult workers.

[4] The Restricted Use (Industrial) Cleanup Level for benzo(a)pyrene corresponds to a 1×10^{-6} excess lifetime cancer risk based on exposure via ingestion of soil/sediment, inhalation, and dermal contact. The Unrestricted Use (Residential) Cleanup Level corresponds to a 1×10^{-6} excess lifetime cancer risk based on exposure via ingestion of soil/sediment, ingestion of homegrown produce, inhalation, and dermal contact.

2.7 Remedial Action Objectives

Remedial action objectives (RAOs) define the extent to which the site will require cleanup to meet the objectives of protecting human health and the environment. The RAOs reflect the COCs, exposure routes and receptors, and acceptable concentrations or range of concentrations for contaminants in soil and sediment.

The RAO for the SR401 Skeet Range is to reduce risks to human health and the environment to acceptable levels for the current and reasonably anticipated land use. The cleanup levels established to attain this RAO are based on reducing the excess cancer risk to one-in-a-million to support industrial land use. The RAO will be attained if the concentration of each COC in surface and subsurface soil is less than or equal to the restricted use (industrial) cleanup levels identified in Table 1, and use restrictions are imposed to limit future uses of the site to industrial.

Based on the results of the SLERA, lead and PAHs in sediment and soil pose a potential risk to ecological receptors at vernal pools 355, 357, and 745. Because COCs in these three vernal pools also exceed the industrial use cleanup levels for human health, excavation of soil and sediment to attain the industrial cleanup levels in Table 1 will result in the removal of these vernal pools. The Air Force will mitigate the loss of these vernal pools but will not restore the vernal pools because the site is intended for industrial use. To mitigate the loss, the Air Force will purchase mitigation credits (typically consisting of creation credits at a ratio of 1 to 1 and/or preservation credits at a ratio of 2 to 1) at a habitat mitigation bank approved by the USFWS and USACE. The approximate area of excavation includes nine industrial use target areas where cleanup will occur. The cleanup target areas and approximate volumes of soil to be excavated from each area are shown on Figure 10.

Cleanup to industrial standards is expected to result in an average site concentration of lead that is below background for surface soils (i.e., 137 mg/kg), as the excavation areas will be backfilled predominantly with subsurface soil, which has significantly lower background lead concentrations (15.9 mg/kg). For PAHs, all impacted soil will be removed and backfilled with clean soil with the exception of one location, where two PAHs were detected at concentrations below screening levels for the protection of surface water quality and ecological receptors. Confirmation sampling will be performed to ensure the cleanup levels are attained, and additional soil would be excavated from the site as needed to meet the cleanup levels. Therefore, the Air Force has determined that cleanup to the industrial standards shown in Table 1, with deed restrictions to limit future use of the site to industrial, will be protective of human health and the environment.

2.8 Description of Alternatives

The Air Force evaluated cleanup alternatives to address hazardous substances in soil and sediment at the site in the RI/FS (CH2M HILL, 2010b). Under Alternatives 2, 3, and 4, there are two options available: cleanup to restricted land use (Alternatives 2a, 3a, and 4a), or cleanup to unrestricted land use (Alternatives 2b, 3b, and 4b). The alternatives for the site are described in detail in the RI/FS and are summarized below.

2.8.1 Alternative 1 – No Action

No remedial activities for PAHs or lead would be implemented under this alternative. Evaluation of the No Action Alternative is required by the NCP to serve as a baseline for comparison with other alternatives. No cost is associated with this alternative.

2.8.2 Alternative 2 – Excavation, Disposal, and Revegetation

Under Alternative 2, paved Taxiway 7611 would be swept, and soil and sediment would be excavated and transported to an offbase landfill for disposal. The site would be backfilled using onsite clean fill, graded, and then revegetated to stabilize the soil and reduce erosion.

Alternative 2a uses cleanup levels for restricted land use (i.e., industrial land use). Soil containing concentrations of COCs greater than industrial cleanup levels would be removed, and ICs would be implemented. Alternative 2b uses cleanup levels for unrestricted land use (residential land use). Soil containing concentrations of COCs greater than residential cleanup levels would be removed, and no restrictions would be placed on the land after cleanup.

Excavation and backfilling performed under either Alternative 2a or 2b would result in the removal of vernal pools 355, 357, and 745. These vernal pools will be mitigated through the purchase of mitigation credits in a habitat mitigation bank and/or payment of mitigation fees.

Sweeping of the Paved Taxiway

Shot visually observed on Taxiway 7611 will be swept to capture and remove shot pellets remaining on the surface of the pavement. If shot is also visually observed in surface soil immediately adjacent to the side of the taxiway surface soil may be scraped or vacuumed to remove the shot, except within or immediately adjacent to vernal pools. The type of equipment used would depend on the volume and areal extent of shot observed on or immediately adjacent to the taxiway.

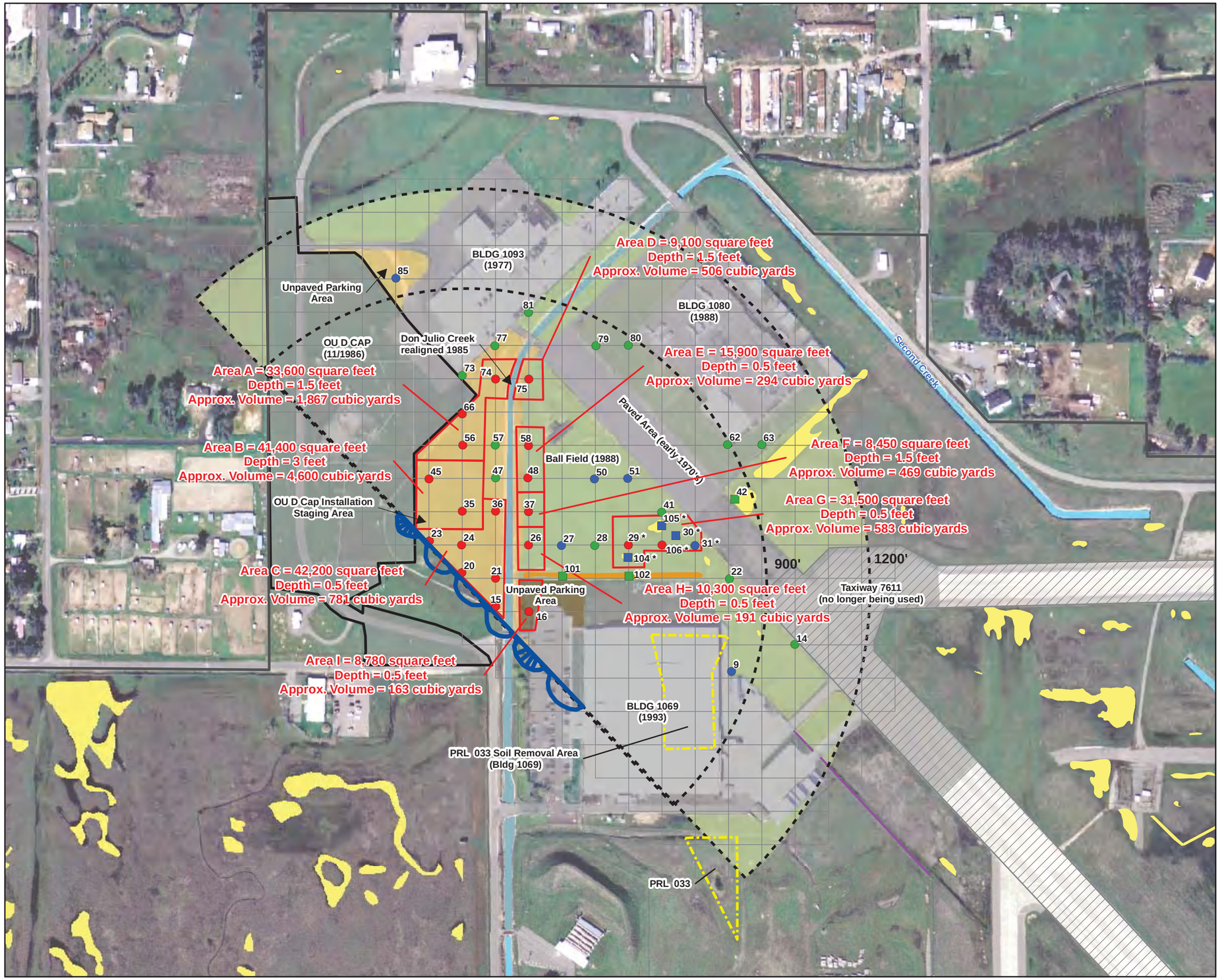
Excavation

Soil with concentrations of COCs exceeding cleanup levels would be physically excavated using conventional earthmoving equipment. The type and quantity of equipment used would depend on the depth, areal extent, and volume of soil requiring removal.

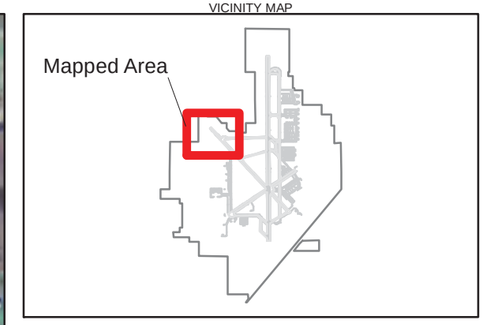
Site controls such as fencing, signage, and security would be implemented as necessary during the remedial action. Following initial excavation, confirmation sampling would be conducted to verify that cleanup levels have been achieved. If the analytical results indicate that contamination has been adequately removed, then the excavation void would be backfilled with clean soil and graded. Otherwise, excavation would continue until cleanup levels are satisfied.

Disposal

Soil excavated and shot removed from the site may include hazardous waste and designated waste. Therefore, offbase disposal might be at a Class I or II landfill (or some combination of these), as appropriate, with approval under the CERCLA Off-Site Rule (OSR) under 40 CFR 300.440. Waste stream profile sampling of the excavated materials would be conducted to determine whether the material meets the waste acceptance criteria at the receiving landfill. Contaminated soil will be treated at the Class I facility as necessary prior to final placement.



VICINITY MAP



LEGEND

- Soil Sampling Locations
- Sediment Sampling Locations
- Industrial Use Target Area
- Former Location of Skeet Station
- Former Location of Trap Station
- Developed in 1985
- Developed in 2001
- Grassy Area
- 900' and 1200' Estimated Shotfall Areas
- 100' x 100' Sample Grid
- Controlled Flightline Area (Taxiway 7611)
- Paved Area
- Unlined Drainage Ditch
- Creeks
- Jurisdictional Ditch
- Vernal Pool
- PRL 033 Soil Removal Area (Bldg 1069)
- OU D
- Base Boundary

Notes:
Sample locations shown in green are below the PCGs for ecological receptors and unrestricted use.
Sample locations shown in blue are above the PCG for unrestricted use.
Sample locations shown in red are above the PCG for industrial use.

* Sample locations are above PCGs for the protection of ecological receptors.

BUILDING CONSTRUCTION DATES

OU D Cap - Nov. 1986 (completed)
Building 1093 - 1977
Building 1080 - 1988 (estimated)
Building 1069 - 1993

1) Used aerial photos from 1978, 1985, 1988, 1991 and 2001
2) Aerial background from 2006
3) Sediment samples were collected at three locations within the unlined drainage ditch and within select vernal pools.

N

0 150 300
Feet

FIGURE 10
Industrial Use Target Areas
SR401 Skeet Range Record of Decision
Former McClellan Air Force Base
Sacramento, California

For cost estimating purposes, it is conservatively assumed that 65 percent of the excavated soil under Alternative 2a and 75 percent under Alternative 2b would require disposal at a Class I landfill, and the remaining soil would be disposed of at a Class II landfill.

Backfilling, Grading, and Revegetation

The excavated area would be backfilled and graded, or just graded, depending on excavation depth and surface drainage requirements. The backfill would consist of clean fill imported from the McClellan Clean Soils Holding Area (soil from unimpacted areas at McClellan) or other available sources of clean soil. The backfilled area would be compacted appropriately during the grading process. The excavated area, and other areas of the site impacted by excavation activities, would be graded to approximate original conditions with positive drainage and without low spots or areas of ponding. Soil would then be seeded and fertilized to establish vegetation. The vegetative cover would stabilize the soil, limit erosion, and reduce the amount of water leaching through the soil. Surface water monitoring will be performed for the first five-year review to demonstrate that the remedy is protective of surface water quality.

Vernal Pool Mitigation

Construction activities (excavation, backfilling, and grading) associated with Alternative 2 will impact vernal pools. It is anticipated that vernal pools 355, 357, and 745 will be removed completely because COCs in these three vernal pools exceed the industrial use cleanup levels for human health. It is assumed that mitigation (purchase of credits in a habitat mitigation bank approved by the USFWS and the USACE or payment of mitigation fees as compensation) would be required for impacted vernal pools. Typically, mitigation consists of creation credits purchased at a rate of 1 to 1 and/or preservation credits purchased at a rate of 2 to 1. The specifics of the mitigation are being negotiated with the USFWS and the USACE. The mitigation plan will be further addressed in the Remedial Design document for the SR401 Skeet Range cleanup. Costs are included for mitigating impacts to the vernal pools.

Institutional Controls

Under Alternative 2a, ICs would be used to eliminate exposure pathways for COCs to sensitive human receptors by prohibiting residential, school, day care, or hospital uses. After Alternative 2a is implemented, excavation and other site work could be allowed if environmental and worker safety control measures involving proper soil handling and management were implemented. ICs would remain in effect until such time as all COCs are reduced to levels that are safe for unrestricted use and unlimited exposure.

The responsibilities of the various parties are listed below, with more detailed descriptions of the IC components provided in the following subsections.

Lease restrictions (Department of the Air Force, 1998) are in place and operational at this time 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. SLUCs provide the State with the authority to implement, monitor, and enforce protective restrictions.

Deed Restrictions and Reservation of Access. The federal deed(s) for any property including the SR401 Skeet Range will include a description of the residual contamination on the property, consistent with the Air Force's obligations under CERCLA Section 120(h) and the specific restrictions set forth in this section. The federal deeds may require additional specific restrictions from RODs addressing other residual contamination on the property. ICs, in the form of deed restrictions, are "environmental restrictions" under California Civil Code Section 1471 (Section 1471). The deeds will include a legal description of the property to which the ICs apply and will contain the provisions required by Section 1471 to qualify the ICs as "environmental restrictions" so that they run with the land and are binding on all subsequent transferees.

The Air Force and regulatory agencies may conduct inspections of the ICs and the affected property. The deeds or associated transaction documents will also contain a reservation of access to the property for the Air Force, the EPA, and the State of California, and their respective officials, agents, employees, contractors, and subcontractors for purposes consistent with this ROD, CERCLA, the Air Force Installation Restoration Program, or the Federal Facilities Agreement. The Air Force will provide such access to regulatory agencies prior to transfer.

The environmental restrictions are the basis for part of the CERCLA 120(h)(3) covenant that the United States is required to include in the deed for any property that has had hazardous substances stored for 1 year or more or known to have been released or disposed of on the property.

For any deed (non-federal entity) or letter of transfer (federal entity) transferring all or part of any parcel including the SR401 Skeet Range, ICs, in the form of land use restrictions, will be incorporated in the deed as a grantee covenant, in substantially the following language:

- Grantee covenants and agrees that it will not use the Site for residential purposes, hospitals for human care, public or private schools for persons under 18 years of age, or day-care centers for children.

Notice of Institutional Controls. The Air Force will include the specific deed restriction language set forth in the ROD in the deed for any parcel including the SR401 Skeet Range, and will provide a copy of the deed or other transfer documentation containing the use restrictions to the regulatory agencies as soon as practicable after transfer of fee title. The Air Force will inform the property owner(s) of the necessary ICs and deed restrictions in the draft deed. The signed deed and/or transfer document(s) are legally binding between the Air Force and the transferee will include the land use restrictions as well as a condition that the transferee execute and record a 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 letter of transfer (to a federal entity) will include a condition that future deeds to a non-federal entity include this requirement. The Air Force will ensure that the transferee has met this condition. Concurrent with the transfer of fee title from the Air Force to the transferee, the Finding of Suitability for Transfer (if cleanup actions have been completed) or the Finding of Suitability for Early Transfer (if cleanup actions have not yet been completed) and the location of the Administrative Record file will be communicated in writing to the property owners and to appropriate state and local agencies (with a copy to EPA) with authority regarding any of the activities or entities addressed in the controls to

ensure that such agencies can factor the information into their oversight, approval, and decision-making activities regarding the property.

Prior to conveyance of any Air Force property including the SR401 Skeet Range, EPA and DTSC representatives will be given reasonable opportunity to review and comment on the applicable deed language described in this section and associated rights of entry for purposes of IC oversight and enforcement.

The Air Force will provide notice to EPA and DTSC at least 6 months prior to any transfer or sale of property. If it is not possible for the facility to notify EPA and DTSC at least 6 months prior to any transfer or sale, then the facility will notify EPA and DTSC as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to ICs. Additionally, the Air Force further agrees to provide EPA and DTSC with similar notice, within the same timeframes, as to federal-to-federal transfers of property.

Annual Evaluations/Monitoring. Prior to property transfer, the Air Force will conduct annual monitoring, provide annual reports describing whether property use has conformed to ICs or use restrictions, and undertake prompt action to address activity that is inconsistent with the IC objectives or use restrictions, or any action that may interfere with the effectiveness of the ICs. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and will be provided to EPA and DTSC. The annual monitoring reports will be used in preparation of the five-year review to evaluate the effectiveness of the remedy. Prior to transfer, the annual monitoring report submitted to the regulatory agencies by the Air Force will evaluate the status of the ICs and how any IC deficiencies or inconsistent uses, if any, have been addressed.

Upon the effective date of property conveyance, the transferee (or other entity accepting such obligations [which may include, without limitation, subsequent transferees]) or subsequent property owner(s) will conduct annual physical inspections of property including the SR401 Skeet Range to confirm continued compliance with all IC objectives unless and until the ICs at the site are terminated. The transferee or subsequent property owner(s) will provide to the Air Force, EPA, and DTSC an annual monitoring report on the status of the ICs and how any IC deficiency or inconsistent uses have been addressed, whether use restrictions and controls were communicated in the deed(s) for any property transferred in the reporting period, and whether use of the property encompassing the area subject to ICs has conformed to such restrictions and controls. The Air Force will place these transferee obligations in the deed or other transfer documentation.

If a transferee fails to provide an annual monitoring report as described above to the Air Force, the Air Force will notify EPA and DTSC as soon as practicable. If EPA or DTSC does not receive the annual monitoring report from the transferee, it will notify the Air Force as soon as practicable. Within 30 days of the report's due date, the Air Force will take steps to determine whether ICs are effective and remain in place and advise the regulators of its efforts. In any event, within 90 days of the report's due date, the Air Force shall determine the status of ICs and provide its written findings, with supporting evidence sufficient to confirm the reported status, based on the use restrictions/ICs and site conditions, to EPA and DTSC unless either EPA or DTSC, in its sole discretion, acts to confirm the status of the ICs independently.

The five-year reviews conducted by the Air Force will also 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. Five-year reviews will make recommendations on the continuation, modification, or elimination of annual reports and IC monitoring frequencies. Reviews are submitted by the Air Force to the regulatory agencies for review and comment every 5 years.

Although the Air Force is transferring procedural responsibilities to the transferee and its successors by provisions to be included in the deed(s) transferring title to the property including the SR401 Skeet Range 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 remedy.

Response to Violations. Prior to property transfer, the Air Force will notify EPA and DTSC as soon as practicable but no longer than 10 days after discovery of any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the ICs. The Air Force will notify EPA and DTSC regarding how the Air Force has addressed or will address the breach within 10 days of sending EPA and DTSC notification of the breach.

The deed will require that post-transfer, the transferee will notify the Air Force, EPA, and DTSC of any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the ICs, and will address such activity or condition as soon as practicable, but in no case will the process be initiated later than 10 days after the transferee becomes aware of the breach. Post-transfer, if the transferee fails to satisfy its obligations pursuant to the SLUC, DTSC may enforce such obligations against the transferee. If there is failure of the selected remedy or a violation of selected remedy obligations (for example, an activity inconsistent with IC objectives or use restrictions, or any action that may interfere with the effectiveness of the ICs), DTSC will notify the Air Force and EPA in writing of such failure as soon as practicable (but no longer than 14 days) upon discovery of the inconsistent activity or action that interferes with the effectiveness of the IC, and initially seek corrective action or other recourse from the transferee. If, after diligent efforts, DTSC is unable to enforce the obligations of the SLUC or remedy obligations against the transferee, within 21 days following DTSC's notification, the parties shall confer to discuss re-implementation of the selected remedy or other necessary remedial actions to address the breach of the IC. Once DTSC reports that the transferee is unwilling or unable to undertake the remedial actions, the Air Force will within 10 days inform the other Parties of measures it will take to address the breach.

Approval of Land Use Modification. Prior to transfer, the Air Force shall not modify or terminate ICs or implementation actions, or modify use restrictions that are part of the selected remedy without approval by EPA and DTSC. The Air Force shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the ICs or any action that may alter or negate the need for ICs.

Any grantee of property constrained by the ICs imposed through their transfer document(s) may request modification or termination of an IC. Modification or termination of an IC, except the SLUC (discussed below), requires Air Force, EPA, and DTSC approval.

State Land Use Covenant Modification. Any modification or termination of the SLUC must be undertaken in accordance with State law and will be the responsibility of the transferee or then-current owner or operator.

2.8.3 Alternative 3 – Excavation, Soil Washing, Disposal, and Revegetation

Under Alternative 3, paved Taxiway 7611 would be swept, soil and sediment would be excavated, and impacts to vernal pools within the site would be mitigated. The excavated soil would be treated via soil washing to remove shot and shards and then transported to an offbase landfill for disposal. The site would be revegetated to stabilize the soil and reduce erosion.

Alternative 3a uses cleanup levels for restricted land use (i.e., industrial land use) and ICs would be implemented. Alternative 3b uses cleanup levels for unrestricted land use (residential land use), and no restrictions would be placed on the land after cleanup.

Sweeping of the Paved Taxiway

Sweeping of the paved taxiway would be implemented in the same manner as described in Alternative 2.

Excavation

Soil excavation would be implemented in the same manner as described in Alternative 2.

Soil Washing

Following excavation, soils would be treated via soil washing to remove shot and shards from the bulk soil using equipment typically used in the aggregate industry to separate sand and gravel. A basic leaching agent, surfactant, or chelating agent may be added to the wash water to help remove organics and heavy metals. If necessary, multiple washing stages may be used. This treatment process, if successful, would reduce/remove contaminants in soil thereby reducing the volume of soil that would require disposal at a Class I landfill.

During 2001, McClellan conducted a soil washing and stabilization treatability study. For metals-contaminated soil collected from a similar site (the Small Arms Firing Range), the washing process was partially effective but did not consistently attain the cleanup standard for lead for industrial use. Soil washing of PAH-contaminated soil was also not successful, and in many cases, the industrial cleanup levels were not achieved. Therefore, the effectiveness for treatment of soil from the SR401 Skeet Range is uncertain.

Disposal

Soil disposal would be implemented as described for Alternative 2. Liquids generated during the soil washing process would be disposed of appropriately; the disposal method will be dictated by analytical testing results. For cost estimating purposes, it is assumed that the soil washing treatment will result in an 80 percent reduction in the soil volume requiring disposal at a Class I landfill.

Backfilling, Grading, and Revegetation

Areas disturbed by excavation would be backfilled and/or graded and revegetated in the same manner as described for Alternative 2.

Vernal Pool Restoration and Mitigation

Mitigation for direct impacts to vernal pools during construction activities would be implemented in the same manner as described for Alternative 2.

Institutional Controls

Under Alternative 3a, ICs would be implemented in the same manner as described for Alternative 2.

2.8.4 Alternative 4 – Excavation, Solidification/Stabilization, Disposal, and Revegetation

Under Alternative 4, paved Taxiway 7611 would be swept, soil and sediment would be excavated, and impacts to vernal pools within the site would be mitigated. The excavated soil would be treated via solidification/stabilization to demobilize COCs and then transported to an offbase landfill for disposal. The site would then be revegetated to stabilize the soil and reduce erosion.

As with Alternatives 2a and 3a, Alternative 4a uses cleanup levels for restricted land use (i.e., industrial land use), and ICs would be implemented. Alternative 4b uses cleanup levels for unrestricted land use (residential land use), and no restrictions would be placed on the land after cleanup.

Sweeping of the Paved Taxiway

Sweeping of the paved taxiway would be implemented in the same manner as described in Alternative 2.

Excavation

Soil excavation would be implemented in the same manner as described for Alternative 2.

Solidification/Stabilization

Following excavation, the contaminated soil would be mixed with lime, cement, or pozzolan materials using earth-moving equipment, conveyor systems, pug mills, batch plants, or grout mixing equipment, as appropriate. This treatment process would reduce contaminant mobility by physically binding contaminants within a stabilized mass (solidification) or through chemical reactions between the stabilizing agent and the contaminants (stabilization). This treatment process would reduce the volume of soil that would require disposal at a Class I landfill but would increase the total volume requiring disposal. It is assumed that, if successful, all soil would meet the disposal requirements of a Class II landfill following the solidification/ stabilization process.

In 2003, a soil stabilization treatability study was conducted for McClellan. The application of several stabilization products and combinations of products was evaluated in the study. Treated soils from a similar site (the Small Arms Firing Range) failed to meet state or federal requirements for disposal at a Class II landfill because of high lead concentrations and

presence of lead fragments in the material. Therefore, the effectiveness for treatment of soil from the SR401 Skeet Range is uncertain.

Disposal

Prior to treatment, some segregation of the waste and debris is anticipated to meet landfill requirements and minimize disposal costs. It is assumed that soil that has been treated via solidification/stabilization will be disposed of at a Class II landfill. However, waste stream profile sampling of the treated soil would be conducted following solidification/stabilization to determine whether the material meets the waste acceptance criteria at the receiving landfill.

Backfilling, Grading, and Revegetation

Areas disturbed by excavation would be backfilled and/or graded and revegetated in the same manner as described for Alternative 2.

Vernal Pool Restoration and Mitigation

Mitigation for direct impacts to vernal pools during construction activities would be implemented in the same manner as described for Alternative 2.

Institutional Controls

Under Alternative 4, ICs would be implemented in the same manner as described for Alternative 2.

2.9 Comparative Analysis of Alternatives

The Air Force evaluated and compared the alternatives against nine criteria. These nine criteria are part of the CERCLA process established to provide a format for selecting appropriate remedial alternatives. The first two criteria, overall protection of human health and the environment and compliance with state and federal environmental requirements, are called threshold criteria. These two criteria must be met in order for the alternative to be eligible for selection. The remaining seven criteria, called modifying and balancing criteria, are used to compare the eligible alternatives and help in the selection of the Preferred Alternative. The Air Force and the support agencies (i.e., EPA and State) have reached consensus on the selected remedy. The last criterion, Community Acceptance, was evaluated through the Proposed Plan and associated public comments. The Air Force describes community acceptance in the Responsiveness Summary section of this ROD.

The comparative analysis of the alternatives against the nine criteria is summarized in Figure 11. All of the alternatives, except the No Action alternative, are protective of human health and the environment, are compliant with ARARs, are effective in the long-term, and are implementable. Alternative 2 is more effective in the short-term since it can be quickly implemented to protect human health. All of the alternatives, with the exception of No Action, provide for a reduction of toxicity, mobility, or volume through treatment, either treatment at the offsite landfill prior to disposal or treatment at the site prior to disposal by soil washing or solidification/stabilization. Alternative 2a (restricted land use) has the lowest costs. The costs for Alternatives 2b, 3 (soil washing), and 4 (solidification/stabilization) are higher, with Alternative 3 having the highest costs.

Additionally, a sustainability evaluation of the alternatives was completed using the Air Force Sustainable Remediation Tool (SRT) to incorporate sustainability concepts into the remediation selection process. The SRT is not a legal requirement of CERCLA or the NCP but an internal Air Force tool used to assess sustainability issues. The sustainability evaluation compared the alternatives against three metrics:

- Air emissions from vehicles and equipment used during the remedial activities, including the production of carbon dioxide, sulfur oxides, nitrogen oxides, and particulate matter.
- Risk of accident and lost time impacts associated with the worker and public risks.
- Non-renewable resource use such as fuel and/or electricity.

Calculations, assumptions, and sources used to evaluate the sustainability metrics for each alternative are included in Appendix D. Alternative 1 (No Action) was not evaluated and is assumed to have no impact.

Results of the sustainability evaluation indicate that Alternative 4 has about 40 percent lower energy consumption and air emission impacts compared with Alternatives 2 and 3. A major factor in the calculations is the disposal location. Under Alternative 4, all soil is disposed of at a Class II landfill that is located closer to McClellan than the Class I landfill used for a portion of the soil under Alternatives 2 and 3. However, the SRT does not consider the significant energy consumption and air emissions associated with manufacturing of the cement used for treatment. Because of the reduced hauling distance, Alternative 4 also has a lower risk of accidents over the other alternatives.

Based on input received from the public during the Proposed Plan stage, the community (with one exception) accepts Alternative 2a (Excavation, Disposal, Revegetation, and Institutional Controls [Restricted Land Use]) and believes that this alternative provides good use of the property with reasonable cost considerations.

2.10 Selected Remedy

The Air Force's selected remedy for the SR401 Skeet Range is Alternative 2a (Excavation, Disposal, Revegetation, and Institutional Controls [Restricted Land Use]). This cleanup alternative was presented in the Proposed Plan, and the Air Force has determined that the selected remedy is protective of human health and the environment given the current and reasonably anticipated future land use at the SR401 Skeet Range (i.e., industrial or industrial/commercial). The proposed IC measures are necessary to protect public health and the environment from the residual contaminants at the site. Annual costs for ICs assume a 30-year project life, but will need to be carried out in perpetuity or until such time as all COCs are reduced to levels that are safe for unrestricted use and unlimited exposure. The selected remedy complies with ARARs (i.e., state and federal environmental requirements), is cost effective, and utilizes permanent solutions to the maximum extent possible. The selected remedy is expected to provide the best balance with respect to the modifying and balancing criteria.

National Contingency Plan Criteria	Alternative 1 No Action	Alternative 2a Excavation, Disposal, Revegetation and ICs (Restricted Land Use)	Alternative 2b Excavation, Disposal, and Revegetation (Unrestricted Land Use)	Alternative 3a Excavation, Soil Washing, Disposal, Revegetation and ICs (Restricted Land Use)	Alternative 3b Excavation, Soil Washing, Disposal, and Revegetation (Unrestricted Land Use)	Alternative 4a Excavation, Solidification/ Stabilization, Disposal, Revegetation and ICs (Restricted Land Use)	Alternative 4b Excavation, Solidification/ Stabilization, Disposal, and Revegetation (Unrestricted Land Use)
1 **Overall Protectiveness of Human Health and the Environment** Determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.	No	Good - Protective for industrial use	Better - Protective for unrestricted use	Good - Protective for industrial use	Better - Protective for unrestricted use	Good - Protective for industrial use	Better - Protective for unrestricted use
2 **Compliance with State and Federal Environmental Requirements** Evaluates alternatives for compliance with environmental protection requirements.	No	Yes	Yes	Yes	Yes	Yes	Yes
3 **Long-term Effectiveness** Considers an alternative's ability to maintain reliable protection of human health and the environment after implementation.	No	Good - ICs required to monitor land use restrictions	Better	Good - ICs required to monitor land use restrictions	Better	Good - ICs required to monitor land use restrictions	Better
4 **Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment** Evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.	No	Mobility is reduced by treatment at landfill for hazardous waste.	Mobility is reduced by treatment at landfill for hazardous waste.	Reduces toxicity and/or volume of COCs in soil through soil washing but generates a liquid waste stream requiring treatment and/or disposal. Meets the statutory preference for treatment.	Reduces toxicity and/or volume of COCs in soil through soil washing but generates a liquid waste stream requiring treatment and/or disposal. Meets the statutory preference for treatment.	Reduces the mobility of COCs in the soil through solidification/stabilization, but increases the volume of soil requiring disposal. Meets the statutory preference for treatment.	Reduces the mobility of COCs in the soil through solidification/stabilization, but increases the volume of soil requiring disposal. Meets the statutory preference for treatment.
5 **Cost+** Weighs the benefits of a particular alternative against the cost of implementation.	$0	$3,064,000*	$3,390,000–$4,460,000*	$5,388,000*	$5,674,000–$8,175,000*	$3,128,000*	$3,254,000–$4,868,000*
6 **Short-term Effectiveness** Addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.	No	Yes, risks during excavation and construction can be managed effectively since the alternative can be quickly implemented to protect human health. Loss of existing vernal pools will be mitigated.	Yes, risks during excavation and construction can be managed effectively since the alternative can be quickly implemented to protect human health. Loss of existing vernal pools will be mitigated.	Yes, however, soil washing will increase the amount of waste (liquid) and the level of effort. As with other options risks during excavation can be managed effectively. Loss of existing vernal pools will be mitigated.	Yes, however, soil washing will increase the amount of waste (liquid) and the level of effort. As with other options risks during excavation can be managed effectively. Loss of existing vernal pools will be mitigated.	Yes, however, solidification/stabilization increases the amount of waste for disposal and increases the level of effort. As with other options, risks during excavation can be managed effectively. Loss of existing vernal pools will be mitigated.	Yes, however, solidification/stabilization increases the amount of waste for disposal and increases the level of effort. As with other options, risks during excavation can be managed effectively. Loss of existing vernal pools will be mitigated.
7 **Implementability** Refers to the technical and administrative feasibility of the alternative, including the availability of materials and services needed to implement a particular option.	Easily implementable	Easily implementable	Easily implementable	More difficult to implement. Studies at McClellan indicate treatment may not be effective.	More difficult to implement. Studies at McClellan indicate treatment may not be effective.	More difficult to implement. Studies at McClellan indicate treatment may not be effective.	More difficult to implement. Studies at McClellan indicate treatment may not be effective.
8 **State Acceptance** Considers whether the state favors or objects to any of the alternatives based on the available information.	No	Yes	Yes	Yes	Yes	Yes	Yes
9 **Community Acceptance** Indicates whether community concerns are addressed by the alternative and whether the community has a preference for an alternative. Although public comment is an important part of the final decision, the Air Force must balance community concerns with all the previously mentioned criteria.	No	Yes	No	No	No	No	No

* The cost for Institutional Controls is based on a 30-year timeframe.

+ Cost ranges reflect uncertainty in the target volumes for the unrestricted use alternatives, because the cleanup level (150 mg/kg) is approximately equivalent to background for lead in surface soil. It is assumed that pre-removal or confirmation sampling could identify additional locations above 150 mg/kg, as lead concentrations in the background data set for surface soil range up to 265 mg/kg. The upper cost in the ranges assumes an additional 3,925 cubic yards of soil within the central portion of the shotfall area would require excavation and disposal in a Class II landfill.

FIGURE 11
NATIONAL CONTINGENCY PLAN CRITERIA FOR EVALUATING REMEDIAL ALTERNATIVES AND HOW THE ALTERNATIVES FOR SR401 SKEET RANGE MEET THE CRITERIA
SR401 SKEET RANGE RECORD OF DECISION
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

The costs associated with the selected remedy are as follows:

- ICs – capital costs ($1,000)
- ICs – annual costs ($130,200) – based on 30 years
- Excavation ($864,600)
- Hauling and offbase disposal ($2,013,900)
- Reports – capital cost ($75,000)
- Mitigation fees for directly impacted vernal pools (without restoration) – capital cost ($21,600)
- Total cost for selected remedy ($3,106,300)

The expected outcome of the selected remedy for the SR401 Skeet Range is potential future commercial and/or industrial use. The industrial use target volumes are shown on Figure 10.

Because the selected remedy will result in hazardous substances remaining onsite above levels that allow for unrestricted uses and unlimited exposures, reviews will be required every 5 years to determine if the remedy remains effective and protective of human health and the environment.

2.11 Statutory Determinations

The Air Force is issuing this ROD as part of its MMRP. Contamination at MMRP sites is addressed in accordance with CERCLA and the Federal Facilities Agreement.

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Remedies that employ treatment as a principal element to permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants are preferred. The offsite requirements of CERCLA 121(b)(1) and 40 CFR Section 300.440 require that the offsite disposal of hazardous or contaminated media without treatment is the least preferred alternative when practicable treatment technologies are available. The following sections discuss how the selected remedy meets the requirements of CERCLA Section 121 and the NCP.

It is noted that there is disagreement between the Air Force and the California Department of Fish and Game (DFG) regarding the relevance and appropriateness of California Fish and Game Code (F&GC) Section 3005. The DFG has requested that the following language be included: "The Air Force has determined that F&GC Section 3005 is not a State ARAR because it is not applicable or relevant and appropriate. DFG-OSPR asserts that F&GC Section 3005 is a State ARAR because it is relevant and appropriate. Whereas the Air Force and DFG agree to disagree upon whether F&GC Section 3005 is an ARAR, this paragraph of the ROD documents each party's agree-to-disagree position on the statute."

F&GC Section 3005 prohibits the "take of birds or mammals with any net, pound, cage, trap, set line or wire, or poisonous substance." The Air Force has determined that Section 3005 is not relevant and appropriate, in that the Selected Remedy does not involve activities (i.e., taking via a net, pound, cage, trap, set line or wire, or poisonous substance) or circumstances sufficiently similar to those regulated by the statute. In addition, inclusion of Section 3005 as an ARAR would not drive an RAO or response option that is more protective than the Selected Remedy. Therefore, F&GC Section 3005 has not been included as an ARAR.

2.11.1 Protection of Human Health and the Environment

The selected remedy would provide protection to human health (for industrial land use) and the environment because contaminants at concentrations exceeding the industrial use cleanup levels would be physically removed. The contaminated soil would be removed from the site and disposed of at an approved offbase landfill where appropriate measures would be taken to protect human health and the environment near the facility, either by treatment at the landfill before disposal and/or by disposing of the soil within an engineered containment system to prevent offsite contaminant migration. Under the selected remedy, contamination would remain at levels acceptable for commercial/ industrial use. Therefore, use restrictions and ICs would be implemented to protect human health by prohibiting residential and other sensitive uses at the site. Once the remedial action is complete and ICs are implemented, there would be a minimal likelihood of risk to human health or to ecological receptors.

2.11.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA states that remedial actions on CERCLA sites must attain (or justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be ARARs. Applicable requirements are those cleanup standards, criteria, or limitations promulgated under federal or state law that specifically extend to the situation at a CERCLA site. A requirement is applicable if the jurisdictional prerequisites of the environmental standard show a direct correspondence when objectively compared with the conditions at the site. Relevant and appropriate requirements are federal or state cleanup standards, requirements, criteria, or limitations that, while not "applicable" to a hazardous substance, action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those found at the site that their use is well suited to the particular site. The selected remedy complies with ARARs for protection of human health and the environment. ARARs are presented in Table 2.

TABLE 2
State and Federal ARARs
SR401 Skeet Range Record of Decision, Former McClellan Air Force Base, Sacramento, California

Location/Action	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description	Comment
Location-specific ARARs				
California Toxics Rule	40 CFR Part 131	Relevant and Appropriate	Establishes criteria for surface water quality and aquatic life for priority toxic pollutants. This regulation addresses inland surface waters, bays, and estuaries in California.	Used to determine discharge requirements that are protective of surface water.
Endangered Species	50 CFR 222, 226, 227, and 402 Substantive portions of the Federal and California Endangered Species Act Substantive portions of the Native Plant Protection Act	Applicable	The remedial actions at McClellan are presumed to impact endangered or threatened species. All procedures must ensure that substantive regulatory requirements are followed to avoid or mitigate impacts.	Federally endangered/threatened wildlife species associated with vernal pools (e.g., fairy shrimp) are presumed to be present at the site, and compensatory mitigation will be provided for impacted vernal pools. No state-listed plant or wildlife species are known to occur at the site; however, preconstruction surveys will be conducted to verify absence.
Wetlands	Subsection C, Appendix A to Part 330, 33 CFR 330	Applicable	The following conditions/practices must be followed: any structure or fill shall be maintained, including maintenance to ensure public safety; erosion and siltation controls must be used and maintained during construction and all fills must be permanently stabilized at the earliest practicable date; heavy equipment working in wetlands must be placed on mats or other measures must be taken to minimize soil disturbances; no activity conducted under a nationwide permit must jeopardize the continued existence of a threatened or endangered species or a species proposed for designation.	Vernal pools, seasonal depressional wetlands, lie within the site addressed in this ROD. Threatened or endangered wildlife species associated with vernal pools (e.g., fairy shrimp) are presumed to be present at the site.

TABLE 2
State and Federal ARARs
SR401 Skeet Range Record of Decision, Former McClellan Air Force Base, Sacramento, California

Location/Action	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description	Comment
Wetlands	Protection of Wetlands (40 CFR 6.302(a); 40 CFR Part 6, Appendix A)	Applicable	Requires federal agencies to take action to avoid adversely affecting wetlands, to minimize wetlands destruction, and to preserve the value of wetlands.	Vernal pools present at the site would be avoided to the extent possible; compensatory mitigation will be provided for impacted vernal pools.
Skeet Range	Migratory Bird Treaty Act, 50 CFR 10 and 20; California Fish and Game Code Section 3511; Title 14 CCR Section 460	Potentially Relevant and Appropriate	The Migratory Bird Treaty Act and California law and regulation prohibiting the "take" of certain species are of unquantified relevance to this action.	Pre-construction surveys will be conducted to determine whether species of concern are present and what actions will need to be taken to reduce the probability of adverse impact on individuals or species.
Waters of the United States	Clean Water Act (Section 404)—Dredge or Fill Requirements (33 USC 1251-1376; 40 CFR 230)	Applicable	Establishes requirements that limit the discharge of dredged or fill material into waters of the United States, including wetlands. EPA guidelines for discharge of dredged or fill materials in 40 CFR 230 specify consideration of alternatives that have fewer adverse impacts and prohibit discharges that would result in exceedance of surface water quality standards, exceedance of toxic effluent standards, or jeopardy of threatened or endangered species.	Vernal pools present at the site have been determined to be jurisdictional wetlands under authority of the Clean Water Act.
Action-specific ARARs				
Control of Air Emissions	Rule 403, Fugitive Dusts	Relevant and Appropriate	Limits visible particulate emissions to the property line.	Relevant and appropriate because the remedial actions may result in the production of fugitive dust. Substantive requirements will be met to control emissions of fugitive dust.

TABLE 2
State and Federal ARARs
SR401 Skeet Range Record of Decision, Former McClellan Air Force Base, Sacramento, California

Location/Action	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description	Comment
Hazardous Waste Determination	22 CCR 66261.3(a)(2)(C) and (F)	Applicable to Resource Conservation and Recovery Act (RCRA) or California hazardous waste	Provides specifications for determining whether a waste is a hazardous waste.	Hazardous waste determination will be made prior to transporting waste offsite for disposal.
California Hazardous Waste Control Law Hazardous Waste Determination	22 CCR 66261.21, 66261.22(a)(1), 66261.22(a)(2), 66261.23, and 66261.24(a)(1) or Article 4, Chapter 11	Applicable to RCRA or California hazardous waste	Specifies that a solid waste is considered a hazardous waste if it exhibits any of the characteristics of ignitability, corrosivity, reactivity, or toxicity, if it is listed as a hazardous waste.	Toxicity Characteristic Leaching Procedure (TCLP) limits will be used to determine whether excavated soil is hazardous.
California Hazardous Waste Determination	22 CCR 66261.24(a)(2)	Applicable to California hazardous waste	Specifies that wastes can be classified as non-RCRA, State-only hazardous wastes if they exceed the Soluble Threshold Limit Concentration (STLC) or Total Threshold Limit Concentration (TTLC) values. California hazardous wastes previously released into the environment are considered hazardous substances under California law. New California hazardous wastes generated in the course of the response action must be properly managed as hazardous wastes.	TCLP limits will be used to determine whether excavated soil is hazardous.
RCRA Hazardous Waste Determination	22 CCR 66261.100 and 66261.101(a)(1) and (a)(2)	Applicable to RCRA hazardous waste	Provides specifications for determining whether a waste is a RCRA hazardous or RCRA non-hazardous waste.	

TABLE 2
State and Federal ARARs
SR401 Skeet Range Record of Decision, Former McClellan Air Force Base, Sacramento, California

Location/Action	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description	Comment
Discharges of Storm Water from Industrial or Construction Areas	40 CFR Parts 122, 123, 124, National Pollutant Discharge Elimination System (NPDES), substantive portions of California Storm Water Permits for Construction and Industrial Activities, State Water Resources Control Board Orders 92-08-DWQ and 97-03-DWQ	Applicable	Regulates pollutants in discharge of storm water associated with hazardous waste treatment, storage, and disposal facilities; wastewater treatment plants; landfills; land application sites; and open dumps; and construction activity (clearing, grading, or excavation) involving the disturbance of 1 acre or more. Requirements to ensure storm water discharges do not contribute to a violation of surface water quality standards. Includes measures to minimize and/or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance.	The CERCLA permit exemption applies to all discharges that are related to response actions and are “onsite,” as that term is defined in the NCP. Remedies will meet the substantive requirements of the NPDES Program.
Surface Water Monitoring	23 CCR 2550.6 and 2550.7(c)	Relevant and Appropriate	Specifies requirements for surface water monitoring such as compliance periods for detection and corrective action monitoring.	Develop technically appropriate surface water monitoring parameters, locations, frequencies, and durations.
Land Use Covenant	Title 22 CCR Section 67391.1(a), (b), (d), and (e)	Relevant and Appropriate	When waste is left in place above standards for unrestricted use, an appropriate land use covenant must be recorded.	Relevant and appropriate at the point of transfer to a non-federal entity. DTSC asserts that the entire regulation is ARAR. EPA Region 9 believes that subsections a, d, and e are ARARs.
	CA Civil Code Section 1471(a) and (b)	Relevant and Appropriate	Environmental covenants must contain specified elements if they are to run with the land.	Relevant and appropriate at the point of transfer to a non-federal entity.

2.11.3 Cost Effectiveness

In the Air Force's judgment, the selected remedy for the SR401 Skeet Range (Excavation, Disposal, Revegetation, and Institutional Controls [Restricted Land Use]) is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (NCP 300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., protective of human health and the environment and ARAR compliant). Overall effectiveness was further evaluated by assessing the balancing criteria (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; short-term effectiveness; and implementability). Overall effectiveness was then compared with costs to determine cost effectiveness.

The present-worth cost for 30 years is $3,064,000. A detailed cost analysis for the selected remedy is presented in the RI/FS, Appendix F (CH2M HILL, 2010b). Costs were estimated in accordance with EPA guidelines (EPA, 2000). Per the guidelines, the discount rate used for the calculations was 2.7 percent and was taken from Appendix C of the Office of Management and Budget Circular A-94 (January 2008) for real discount rates over a 30-year period.

Figure 11 summarizes the costs and provides the information needed to evaluate the cost effectiveness of the selected remedy. For each alternative, information is presented on the threshold and balancing criteria.

2.11.4 Use of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies

The selected remedy would provide permanent and long-term effectiveness in protecting human health and the environment to the extent that the COCs are physically removed. The Air Force has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies or resource recovery technologies can be used in a practicable manner at the SR401 Skeet Range. The selected remedy for the SR401 Skeet Range provides the best balance of trade-offs in terms of the five balancing criteria and State and community acceptance.

2.11.5 Preference for Treatment as a Principal Element

Remedies that employ treatment as a principal element to permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants are preferred. The offsite requirements of CERCLA 121(b)(1) require that the offsite disposal of hazardous or contaminated media without treatment is the least preferred alternative when practicable treatment technologies are available. The statutory preference for treatment is met, in that treatment of contaminated soil will occur as needed at the offsite disposal facility. Alternatives with treatment applied at the site were either not effective or not cost-effective.

2.11.6 Five-year Review Requirements

Because the selected remedy will result in hazardous substances remaining onsite above levels that allow for unrestricted uses and unlimited exposures, reviews will be required every 5 years to determine if the remedy remains effective and protective of human health and the environment. Typical information recorded during the review process will include the status of the ICs, any changes in the land use, any changes to the site, and how the changes were addressed. Reviews will continue until all COCs are reduced to levels that are safe for unrestricted use and unlimited exposure. The next basewide five-year review is scheduled to be conducted no later than September 29, 2014.

2.12 Documentation of Significant Changes

The Selected Remedy does not include significant changes from the Preferred Alternative presented in the Proposed Plan for the SR401 Skeet Range.

SECTION 3

Responsiveness Summary

3.1 Background of Community Involvement

A proposed plan and public comment period are key parts of the decision-making process because the Air Force uses community input when making cleanup decisions. The proposed plan for this ROD was available for review during a public comment period from July 7 through August 9, 2010. A public notice announced the start of the public comment period.

The Proposed Plan was available for review at the McClellan Information Repository, on the AFRPA online Administrative Record, and at the North Highland-Antelope Public Library. In addition, a public meeting was held on July 15, 2010, to explain the Proposed Plan and to solicit comments from the public. Prior to the meeting, a fact sheet summarizing the Proposed Plan and announcing the public comment period and meeting was distributed to the entire mailing list. The public was encouraged to review the document and provide comments, either orally or in writing, about the cleanup alternatives presented in the Proposed Plan.

3.2 Summary of Significant Comments Received

The Air Force received five comments from members of the public during the public comment period. Their comments and the Air Force responses are provided below. Two people commented at the public meeting and three provided written comments during the public comment period. Specific comments and Air Force responses are provided below. The public comments did not result in modification of the preferred cleanup alternatives presented in the Proposed Plan.

3.2.1 Significant Comments Received during the July 15, 2010, Public Meeting and Air Force Responses

Mr. Burl Taylor: I think it's pretty well summed up in there on the site. I was concerned about the ammo dump. And I think – Is the ammo dump part of this area?

Note: This comment was preceded by a question from Mr. Taylor regarding the cleanup of the former shooting range at Camp Kohler in what is now Rosario Park. He asked if it could be investigated further as part of the Skeet Range investigation and cleanup program.

Air Force Response: The former ammunitions dump is not part of the Skeet Range site.

Regarding Camp Kohler, the USACE is responsible for the site and the DTSC is actively engaged in the USACE's actions there.

Mr. Glenn Jorgensen: Okay. Regarding the mitigation for the vernal pools. I know you have said tonight that you are going to propose doing some mitigation over in the West Nature Area. I would just like to request that those mitigation plans and whatever cost or monies deposited with the Army Corps of Engineers or whatever be outlined in the Record of Decision so that it's available to the public. Thank you.

Air Force Response: The specifics of the mitigation are being negotiated with the USACE and the USFWS; however, the ROD identifies that mitigation will be accomplished through the purchase of habitat mitigation credits in a mitigation bank approved by the USFWS and the USACE. The mitigation plan will be further addressed in the Remedial Design document for the SR401 Skeet Range cleanup. In addition, the USFWS will issue a Biological Opinion on the mitigation. Both documents will be available to the public.

3.2.2 Written Comments Received during the Public Comment Period and Air Force Responses

Anonymous: Who is auditing the distribution of all monies for this purpose?

Air Force Response: The SR401 Skeet Range cleanup will be accomplished through a competitive firm-fixed-price contract from the Air Force Center for Engineering and the Environment (AFCEE). Payments will be milestone-based, overseen by the AFCEE contracting officer and his or her technical representative. In general, AFCEE contracts are subject to audits by, but not limited to, the Air Force Audit Agency, the Air Force Inspector General, the Department of Defense Inspector General, and the Government Accountability Office.

Mr. Clarence Howard: I agree that the McClellan Skeet Range should be cleaned up, and I also agree with the Air Force Proposed Plan. I believe the cleanup should be accomplished at the lowest cost.

Air Force Response: Thank you for your input.

Kit Rodden, President and CEO, Battery M.D., Inc.: Battery M.D. (Bldg 1093 tenant) votes for Option 2B. Battery M.D. has express interest in past in buying land/building but will only do that if land is clean/unrestricted and does not need future monitoring or cleanup efforts.

Air Force Response: Only a small portion of the southwestern corner of the Building 1093 lot would be impacted by the proposed ICs. The proposed ICs would restrict current and future land use to industrial, which is the current and future zoning for the area. Under the selected remedy, there would not be a need for future cleanup beyond what is described. Monitoring would be part of the 5-year monitoring as required by CERCLA to verify that the ICs are being enforced and are effective. In addition, the transferee or subsequent property owner(s) will be responsible for conducting annual physical inspections of the SR401 Skeet Range to confirm continued compliance with all IC objectives and will also be responsible for providing to the Air Force, EPA, and DTSC an annual monitoring report on the status of the ICs.

The Air Force still believes that the selected remedy is the appropriate cleanup action for the SR401 Skeet Range site. Given the current and anticipated future industrial land use, this remedy is protective of human health and the environment and complies with state and federal laws.

SECTION 4

Works Cited

Air Force Real Property Agency (AFRPA). 2008. *Former McClellan Air Force Base Visual Site Inspection Report, Skeet Range.* October.

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Appendix A
Screening Levels and Background Levels for Soil and Sediment

APPENDIX A

Screening Levels and Background Levels for Soil and Sediment

This appendix contains material published in the *Final SR401 Skeet Range Remedial Investigation/Feasibility Study, Former McClellan Air Force Base, California* (CH2M HILL, 2010).

TABLE C1-13
Screening Levels for Soil/Sediment
SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

	Screening Levels for Protection of						
	Human Health		Groundwater	Surface Water	Ecological Receptors		
Contaminant	Unrestricted Use Surface and Shallow Soils (0 to 15 ft bgs)	Industrial Use Surface and Shallow Soils (0 to 15 ft bgs)	Surface, Shallow, and Deep Soils (0 to 30 ft bgs)	Surface Soils (0 to 1 ft bgs)	Plants Surface and Shallow Soils (0 to 4 ft bgs)	Avian Surface Soils (0 to 1 ft bgs)	Benthic Invertebrates Sediment (0 to 0.25 ft
Inorganics (mg/kg)							
Antimony[c,e]	1.4E+01	3.7E+02	6.0E+02	1.9E+02	5	--	3
Arsenic[d,f]	9.3E-02	1.4E+00	3.3E+00	5.8E-01	18	43	9.79
Copper[d,f]	1.4E+03	3.7E+04	2.5E+05	1.3E+02	70	28	31.6
Iron[a,g]	2.4E+04	6.4E+05	9.1E+04	9.6E+03	--	--	20000
Lead[d,f]	1.5E+02	8.0E+02	4.3E+03	2.9E+01	120	11	35.8
Zinc[a,d,f]	3.1E+03	2.8E+05	1.4E+05	1.7E+03	160	46	121
PAHs (mg/kg)							
Acenaphthene[b,c,h]	2.9E+02	1.6E+04	1.6E+04	6.4E+02	20	--	0.00671
Acenaphthylene[h]	--	--	--	--	--	--	0.00587
Anthracene[a,b,f]	2.3E+03	1.0E+05	1.0E+05	3.1E+05	--	--	0.0572
Benzo(a)anthracene[j]	8.8E-02	8.8E-01	2.1E+01	1.4E-01	--	--	0.0748
Benzo(a)pyrene[f]	1.8E-02	1.4E-01	3.7E+01	1.4E-01	--	--	0.15
Benzo(b)fluoranthene	1.1E-01	8.8E-01	4.0E+01	1.4E-01	--	--	--
Benzo(g,h,i)perylene[g]	7.5E+02	1.1E+04	1.1E+04	--	--	--	0.17
Benzo(k)fluoranthene[i]	1.1E-01	8.8E-01	1.3E+01	1.4E-01	--	--	0.0272
Chrysene[b,f]	8.8E-01	8.7E+00	2.5E+01	1.4E-01	--	--	0.166
Dibenzo(a,h)anthracene[i]	3.8E-02	2.6E-01	7.8E+00	1.4E-01	--	--	0.1
Fluoranthene[f]	4.9E+02	1.5E+04	1.5E+04	9.6E+03	--	--	0.423
Fluorene[b,f]	2.4E+02	1.3E+04	1.3E+04	4.2E+04	--	--	0.0774
Indeno(1,2,3-cd)pyrene[i]	1.2E-01	8.8E-01	2.2E+01	1.4E-01	--	--	0.01732
Naphthalene[f]	2.4E+00	5.1E+00	5.1E+00	6.7E+02	--	--	0.176
Phenanthrene[f]	2.6E+03	1.1E+05	1.1E+05	--	--	--	0.204
Pyrene[b,f]	3.5E+02	1.1E+04	1.1E+04	3.1E+04			0.195
Total PAHs[g]	--	--	--	--	--	--	1.61

[a] EPA Region 9 recommends that a "ceiling limit" of 1E+05 be used when the risk-based value is higher. Documentation accompanying the PRGs also acknowledges that this recommendation is not a universally accepted approach.

[b] The listed risk-based concentrations exceed the soil saturation concentration (EPA Region 9 default soil properties for PRGs) for acenapthene (1.3E+02 mg/kg), anthracene (6.1E+00 mg/kg), chrysene (3.8E+00 mg/kg), fluorene (1.6E+02 mg/kg), and pyrene (8.5E+01 mg/kg).

[c] Source of ecological screening level is *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision* (Efroymson et al., 1997)

[d] Source of ecological screening level is EPA's Ecological Soil Screening Levels (http://www.epa.gov/ecotox/ecossl/)

[e] Upper effects threshold (UET) from the Screening Quick Reference Tables (SQuiRTs) developed by Buchman (2008) of the National Oceanic and Atmospheric Administration (NOAA)

[f] Source of threshold effect concentration (TEC) for benthic invertebrates is *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald et al., 2000)

[g] Lowest effect level (LEL) from SQuiRTs developed by Buchman (2008) of NOAA

[h] Threshold effect level (TEL) from SQuiRTs developed by Buchman (2008) of NOAA

[i] ARCS Hyalella TEL from SQuiRTs developed by Buchman (2008) of NOAA

[j] Source of effects value is EPA IV: USEPA. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated November 30, 2001 http://www.epa.gov/region4/waste/ots/ecolbul.htm.

Note:

-- = a screening level was not developed

ATTACHMENT C1-1

Background Levels

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Method	Residential PRGs (mg/kg)	Surface Soils (mg/kg) (N=27)	Sediments (mg/kg) (N=15)	Silts and Clays (mg/kg) (N=69)	Sands (mg/kg) (N=51)	Combined (mg/kg) (N=162)
Antimony*	SW6010	31	10	10	20	20	10
Arsenic	SW7060	0.97 ca	5.8 (I)/2.8 (II,III,IV)	3.6	6.5	3.7	4.9
Copper	SW6010	2,900	23.6	45.4	41.4	26.7	36.5
Iron	SW6010	NE	23,597	25,529	46,293	34,759	39,695
Lead	SW7421	500	137	150	15.9	6.8	74.0
Zinc	SW6010	23,000	159.0	374	85.8	58.6	156

*Background established as reporting limit for this analyte

Notes:

Source of background levels is the Interim Basewide Report, McClellan AFB. All background levels calculated as the mean plus two times the standard deviation for the data set unless established as the reporting limit.

I, II, III, IV = background study landscape types
ca = carcinogen
n = number of samples
NE = not established
PRG = Preliminary Remediation Goal, EPA Region 9

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Appendix B
Screening Level Human Health Risk Assessment

APPENDIX B

Screening Level Human Health Risk Assessment

This appendix contains material published in the *Final SR401 Skeet Range Remedial Investigation/Feasibility Study, Former McClellan Air Force Base, California* (CH2M HILL, 2010).

Appendix C2
Screening Human Health Risk Assessment

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Attachment
C2-1 Site-specific Risk Summary Tables Based on Cal/EPA Toxicity Criteria

Tables

1 Soil Risk Summary for SR401 Skeet Range Using Cal/EPA Toxicity Criteria Hierarchy- Residential Scenario
2 Soil Risk Summary for SR401 Skeet Range Using Cal/EPA Toxicity Criteria Hierarchy – Occupational Worker Scenario

Acronyms and Abbreviations

AFCEE	Air Force Center for Engineering and the Environment
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
COPC	contaminant of potential concern
CSM	conceptual site model
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
FS	feasibility study
HEAST	Health Effects Assessment Summary Table
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
LOAEL	lowest observed adverse effects level
mg/kg	milligram(s) per kilogram
mg/kg-day	milligram(s) per kilogram per day
NCEA	National Center for Environmental Assessment
NOAEL	no observed adverse effects level
PAH	polynuclear aromatic hydrocarbon
PRG	preliminary remediation goal
RBSL	risk-based screening level
REL	reference exposure level
RfC	reference concentration
RfD	reference dose
RICS	remedial investigation characterization summaries
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure

ROD	record of decision
SLHHRA	screening-level human health risk assessment
UCL	upper confidence limit
URF	unit risk factor
USAF	U.S. Air Force
VOC	volatile organic compound

APPENDIX C2

Screening Human Health Risk Assessment

C2.1 Introduction

This appendix to the SR401 Skeet Range (Skeet Range) Remedial Investigation (RI)/ Feasibility Study (FS) report presents the screening-level human health risk assessment (SLHHRA) methods and results for the Skeet Range at the former McClellan Air Force Base (McClellan), located in Sacramento, California. The SLHHRA was completed to support the Skeet Range RI/FS.

The location of McClellan is shown on Figure 1-1 in Section 1 of the RI/FS report. The location of the Skeet Range is shown on Figure 1-2 in Section 1 of the RI/FS report.

C2.1.1 Objectives

The SLHHRA was conducted to provide risk managers with a basis for evaluating whether action is warranted to mitigate potential health effects from chemicals in soil. This screening assessment was accomplished by characterizing potential cancer risks and risks of adverse noncancer health effects associated with chemicals at the site. The SLHHRA considers baseline conditions, that is, a case in which no remedy is implemented for chemical contamination at the site.

The methodology used for this SLHHRA is generally consistent with the risk assessment procedures developed in the *McClellan Air Force Base, Operable Unit A, Part 2A – Interim Basewide Remedial Investigation Characterization Summaries* (RICS) (Jacobs, 2001). However, the risk assessment procedures used for the McClellan RI program have been revised over time in response to input from regulatory agencies, updates to state and federal risk assessment guidance, and updates to toxicity values used in the risk calculations. These updates have been incorporated, as appropriate, into the SLHHRA methodology used for McClellan. Risk-based screening levels for soil were developed for the RI/FS and have been revised, as appropriate, when updated toxicity factors are published by the U.S. Environmental Protection Agency (EPA) or California Environmental Protection Agency (Cal/EPA).

The methodology used for the SLHHRA is consistent with the risk assessment procedures presented to the regulatory agencies in a meeting on 26 June 2008. In this meeting, a streamlined, screening risk assessment approach was agreed to by the regulatory agencies. The screening risk assessment approach includes quantitative evaluation of two receptor groups, industrial workers and hypothetical future residents, using maximum detected concentrations in the 0 to 10 feet bgs depth interval for soil. Although uncertainties exist and the degree of characterization differs among sites, the use of the SLHHRA, in conjunction with risk-based screening levels (RBSLs) for this effort (see Appendix C1), provides sufficient information for the remedial project managers to identify sites with potential impacts to human health and to evaluate appropriate remedial actions.

C2.1.2 Scope

The SLHHRA provides an evaluation of potential exposure to metals (lead, arsenic, antimony, copper, iron, and zinc) from shot pellets and polynuclear aromatic hydrocarbons (PAHs) associated with clay shards (from clay pigeons) in soil and sediment at the Skeet Range. Calculations are not included for the soil gas or groundwater pathways because characterization of these media was not a part of this investigation. More information on the status and current groundwater conditions at McClellan can be found in the *Basewide VOC Groundwater Record of Decision* (CH2M HILL, 2007), the *Remedial Investigation/Feasibility Study for Non-VOCs in Groundwater* (CH2M HILL, 2008), and the Groundwater Monitoring Program quarterly reports. Groundwater use restrictions for McClellan can also be found in the VOC ROD.

C2.1.3 Guidance Documents

The methods that were used to conduct the SLHHRA are consistent with the following federal and state (i.e., EPA and DTSC) guidance documents:

- *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part A (Interim Final)* (EPA, 1989)
- *Exposure Factors Handbook, Volume I General Factors* (EPA, 1997)
- *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment) Final* (EPA, 2004a)
- *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (DTSC, 1992)
- *Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Military Facilities* (DTSC, 2005)

C2.1.4 Organization

The remainder of this appendix is organized into the following sections:

- **Section C2.2: Site Background.** Briefly summarizes the environmental investigations at the site.
- **Section C2.3: Conceptual Site Model.** Provides a description of potential chemical sources, migration pathways, and potential human receptors.
- **Section C2.4: Selection of Contaminants of Potential Concern.** Identifies the chemicals considered to be most important to the human health risk quantification process.
- **Section C2.5: Exposure Assessment.** Identifies the pathways by which potential human exposures could occur; describes how they are evaluated; and evaluates the magnitude, frequency, and duration of these exposures.
- **Section C2.6: Toxicity Assessment.** Provides a general summary of the toxicity assessment and references the toxicity value tables in Appendix C1 that were used for the risk calculations.

- **Section C2.7: Risk Characterization Methodology.** Describes the methods used to integrate the information from the exposure and toxicity assessments to characterize the risks to human health from potential exposure to chemicals in environmental media.
- **Section C2.8: Uncertainty Analysis.** Summarizes the uncertainties associated with results of the SLHHRA, as well as limitations of data and methodology.
- **Section C2.9: Human Health Risk Assessment for Skeet Range.** Presents an overall summary of the risk and hazard results.
- **Section C2.10: References.**

C2.2 Site Background

See Section 1 of the RI/FS report for site background information.

C2.3 Conceptual Site Model

This section presents a general description of the McClellan conceptual site model (CSM). The principal components of a CSM include:

- Identification and characterization of contaminant sources
- Identification of potential contaminant migration pathways
- Identification of potential receptors

Contaminant releases at McClellan have resulted primarily from routine operations and maintenance activities, aviation support operations, vehicle and facility maintenance activities, accidental spills and releases, and onsite storage or disposal of hazardous materials and other activities, including shot pellets and clay shards associated with Skeet Range activities. Examples of potential sources of contamination for McClellan include the following:

- Aboveground storage tanks
- Underground storage tanks
- Pipelines and underground fuel lines
- Aircraft, vehicle, and equipment maintenance facilities
- Waste storage facilities
- Industrial waste lines
- Surface spills and releases
- Surface drainage areas
- Oil/water separators
- Drains and sumps
- Transformers
- Fire Arm/Skeet Ranges

Details of the CSM for the Skeet Range are provided in Section 1.4 of the RI/FS report. Metals and PAHs were detected in samples collected at the site and identified as contaminants of potential concern (COPCs) for the SLHHRA. The release of these chemicals from soil may occur through wind erosion, mechanical erosion (e.g., excavation), leaching,

or stormwater runoff. These types of releases may result in emissions in air of dust (with sorbed chemicals), chemical contamination in stormwater runoff, or the movement of chemicals downward into the subsurface with infiltrating rainwater, depending on site conditions and the physical and chemical properties of the COPCs.

Based on the McClellan Reuse Plan (EDAW, 2000) and the *McClellan Park Special Planning Area* (Sacramento County Ordinance No. SZC-2002-0029), future use of the site will be for industrial and commercial purposes. Although residential land use is not planned for the Skeet Range at this time, residential exposure scenarios were evaluated in the SLHHRA to provide information for future risk management decisions. The potential receptors evaluated in the SLHHRA include outdoor commercial/industrial workers and future residents (adults and children; indoor and outdoor exposure). Specific land use restrictions will be identified in the record of decision.

C2.4 Selection of Chemicals of Potential Concern

COPCs are constituents that are included in the quantitative exposure estimation and risk characterization steps of the SLHHRA. Analytical data used to select the COPCs include those from surface and shallow soil (defined as the 0 to 3 feet below ground surface [bgs] depth interval) and surface sediment (0 to 0.5 foot bgs). All detected organic compounds were retained as COPCs. Some inorganic compounds are considered to be beneficial to human health or may be present only at naturally occurring levels. For this reason, an inorganic chemical was retained as a COPC for soil if:

- It was detected in a depth interval for which at least one exposure pathway was considered to be complete.
- It is not an essential human nutrient (EPA, 1989).
- Detected concentrations were not representative of ambient levels at McClellan.

C2.4.1 Chemicals Considered to Be Essential Human Nutrients

Elements considered to be essential human nutrients (i.e., calcium, iron, magnesium, potassium, and sodium) were eliminated as COPCs. EPA and DTSC guidance state that these elements can be deleted from the list of COPCs because of their low toxicity when detected at ambient concentrations (EPA, 1989; DTSC, 1992). Even if these constituents are present at concentrations above naturally occurring levels, they are eliminated as COPCs because they are toxic only at very high doses.

C2.4.2 Background Levels

Metals considered to be representative of background were eliminated as COPCs. Background levels in soils at McClellan have been established for 24 inorganic analytes for surface soils, and for subsurface soils by soil type (i.e., silts and clays or sands) (AFCEE, 1994). For seven inorganic analytes (antimony, cadmium, mercury, molybdenum, selenium, silver, and thallium) where the percentage of non-detects was greater than 80 percent in the background data set, the background level was established as the method reporting limit for the analyte. Background levels for the remaining analytes were established as the mean

concentration plus two deviations for the background data set. Background levels for inorganic chemicals detected at the Skeet Range are presented in Attachment C1-1 of Appendix C1.

A two-step process was used to determine if metals concentrations were significantly different from background levels. For the first step, a metal was considered to be present at background levels and was eliminated as a COPC if the maximum detected concentration was below its established background level. Site data from the 0 to 3 feet bgs depth interval were compared to the lowest of the lithology-specific background levels. If the maximum detected concentration exceeded the lowest of the lithology-specific background levels, the Mann-Whitney test was used to determine if the central tendencies of the concentrations of metals in the site data set were significantly different than the background data set (DTSC, 1997). If the Mann-Whitney test indicated that there is not a significant difference between concentrations in the site data set and background data set, the metal was eliminated as a COPC.

Comparisons of central tendency are described in numerous guidance documents (DTSC, 1997; EPA, 1998; 2001) as appropriate methods to compare site data to background data. Such comparisons include the two-sample t-test and the Mann-Whitney test (or the Wilcoxon Rank Sum Test). Although DTSC guidance discusses both, it emphasizes the Mann-Whitney test because it does not depend on a parametric (distributional) assumption, such as normality.

The Mann-Whitney test makes use of the sum of the ranks of the ordered (smallest to largest concentration for the combined two data sets) concentrations to determine whether the mean of the ranks of the site concentrations is unexpectedly larger than the mean of the ranks of the background concentrations.

A central tendency background comparison is typically performed using a one-tailed significance level of 0.20. The one-tail method determines whether site concentrations exceed ambient concentrations, not whether ambient concentrations exceed site concentrations. The significance level of 0.20 is typically the appropriate one for comparisons of background to site populations (EPA, 1992; 2001). This significance level corresponds to a one-in-five chance of falsely concluding that the site population exceeds background.

When the p-value of the Mann-Whitney test falls below 0.20, this indicates that the site population exceeds the background population. If the p-value is not less than 0.20, the conclusion that the site population does not exceed background is accepted. This p-value is the probability that the differences observed between the site and background sample concentrations would occur randomly if both populations were actually equivalent.

C2.5 Exposure Assessment

The exposure assessment component of the SLHHRA identifies the means by which individuals may contact chemicals in environmental media at the site. It addresses exposures that may result under current site conditions and from reasonably anticipated potential uses of the site and the surrounding areas in the future. In addition, for this SLHHRA, the hypothetical future residential scenario is included to provide information for future risk management decisions. The exposure assessment also identifies the populations that might be exposed; the routes by which these individuals might become exposed; and the magnitude, frequency, and duration of potential exposures.

The exposure assessment step of an SLHHRA includes the following tasks:

- Identification of potentially complete exposure pathways
- Computation of exposure point concentrations (EPCs)
- Development of exposure assumptions for potentially complete exposure pathways
- Calculation of chemical intake for COPCs

C2.5.1 Potentially Complete Exposure Pathways

This section describes the potential exposure pathways resulting from site contaminants, based on currently available site information. The conceptual exposure model is formulated according to agency guidance, with the use of professional judgment and information on contaminant sources, release mechanisms, routes of migration, potential exposure points, potential routes of exposure, and potential receptor groups associated with the site.

An exposure pathway can be described as the physical course that a COPC takes from the point of release to a receptor. Chemical intake or route of exposure is the means by which a COPC enters a receptor. For an exposure pathway to be complete, all of the following components must be present:

- A source
- A mechanism of chemical release and transport
- An environmental transport media
- An exposure point
- An exposure route
- A receptor or exposed population

In the absence of any one of these components, an exposure pathway is considered incomplete and, by definition, there is no risk or hazard.

C2.5.1.1 Contaminant Sources and Releases

The primary potential source of contamination at the Skeet Range is related to use of the site as a skeet and trap range. Potential contaminants based on the history of the site include metals and PAHs.

C2.5.1.2 Potentially Complete Human Exposure Settings

Based on the current understanding of land use conditions at and near the Skeet Range the most plausible exposure pathways that are considered for characterizing human health risks include the following:

- **Outdoor Occupational Worker Scenario.** The outdoor occupational worker scenario is considered representative of future workers at a site who spend all of their workday outdoors. The outdoor occupational worker is assumed to work 50 weeks per year (250 days per year) for 25 years. The outdoor worker may be exposed to COPCs through direct contact routes (i.e., incidental ingestion of soil, dermal contact with soil, and inhalation of particulates).

As described previously, the current reuse plans for the Skeet Range are commercial/industrial land use, and it is unlikely that the area will be developed for residential purposes in the future. However, the hypothetical future residential scenario was evaluated to provide results for an unrestricted use scenario for future risk management purposes. It is assumed that residents spend the entire day at home 7 days per week for 50 weeks per year (350 days per year) for 30 years. Evaluated routes of exposure to soil include ingestion (incidental soil and homegrown produce), dermal contact, and inhalation of dust generated from wind. Based on the agreement between the U.S. Air Force (USAF) and regulatory agencies made at the 26 June 2008, meeting, data collected from the 0 to 10 feet bgs depth interval should be evaluated in the SLHHRA. For the Skeet Range, data were only collected from 0 to 3 feet bgs, based on the distribution of shot pellets and clay shards in sediment and surface and subsurface soil at the site.

C2.5.2 Computation of Exposure Point Concentrations

EPCs are estimated chemical concentrations that a receptor might contact, and are specific to each exposure medium. The maximum detected concentrations from the soil (0 to 3 feet bgs depth interval) and sediment data sets were used as the soil EPCs. The entire Skeet Range is considered a single exposure area. An exposure area is the area in which receptors may work on a regular basis. In general, the administrative site boundaries plus soil borings used for site characterization comprise the soil exposure areas. For the incidental ingestion, dermal contact, and inhalation routes of exposure for soil/sediment, EPCs are represented by the maximum detected concentrations directly measured in soil/sediment.

C2.5.3 Human Health Exposure Assumptions

The estimation of exposure requires numerous assumptions to describe potential exposure situations. A combination of central tendency and upper-bound exposure assumptions are used to estimate reasonable maximum exposure (RME) conditions to provide a bounding estimate on exposure.

Risk and hazard were calculated by the risk ratio approach using RBSLs for commercial/industrial land use or residential land use and the EPCs (i.e., maximum detected concentrations of each COPC in soil and sediment). Details of the methodology for calculating risk and hazard are presented in Section C2.7.1. Appendix C1 presents the exposure assumptions and methodology for the derivation of the RBSLs.

C2.6 Toxicity Assessment

The toxicity assessment in an SLHHRA evaluates the relationship between the magnitude of exposure to a chemical and the likelihood of adverse health effects to potentially exposed populations. This assessment provides, where possible, a numerical estimate of the increased likelihood of adverse effects associated with chemical exposure (EPA, 1989). The toxicity assessment contains two steps: hazard characterization and dose-response evaluation. These two components are discussed in the following two subsections.

C2.6.1 Hazard Characterization

Hazard characterization identifies the types of toxic effects a chemical can exert. For the toxicity assessment, chemicals can be divided into two broad groups on the basis of their effects on human health: non-carcinogens and carcinogens. This classification has been selected because health risks are calculated differently for carcinogenic and non-carcinogenic effects, and separate toxicity values have been developed for them.

Carcinogens are those chemicals suspected of causing cancer following exposure; non-carcinogenic effects cover a wide variety of systemic effects, such as liver toxicity or developmental effects. Some chemicals (such as arsenic) are capable of eliciting both carcinogenic and non-carcinogenic responses; therefore, these carcinogens are also evaluated for systemic (non-carcinogenic) effects.

C2.6.2 Dose-response Evaluation

The magnitude of chemical toxicity depends on the dose to a receptor. Dose refers to exposure to a chemical concentration over a specified period of time. Human exposures are generally classified as acute (typically less than 2 weeks), subchronic (about 2 weeks to 7 years), or chronic (7 years to a lifetime). This SLHHRA specifically addresses chronic exposure. Acute exposures and risks are evaluated only when chronic exposure estimates pose a high risk. A dose-response curve describes the relationship between the degree of exposure (the dose) and the incidence of the adverse effects (the response) in the exposed population. EPA uses this dose-response information to establish toxicity values for particular chemicals, as described in the following paragraphs.

C2.6.3 Toxicity Values

The hierarchy of sources for toxicity values used for the derivation of the RBSLs and for calculation of cancer risk follows EPA and Air Force guidance (EPA, 2003; USAF, 2006) and is listed below in order of preference:

1. EPA IRIS online database (EPA, 2009)
2. EPA's Provisional Peer Reviewed Toxicity Values (as cited in the 2004 EPA Region 9 preliminary remediation goal (PRG) table [EPA, 2004b])
3. Cal/EPA cancer potency factors and reference exposure level (REL) online database (Cal/EPA, 2009)
4. Other EPA sources (i.e., Health Effects Assessment Summary Table [HEAST], National Center for Environmental Assessment [NCEA] provisional toxicity values,

and route-extrapolated toxicity values as cited in the 2004 EPA Region 9 PRG table [EPA, 2004b]).

In addition, risks and hazards were calculated with RBSLs that were developed using the Cal/EPA toxicity values. The risk summary tables using Cal/EPA toxicity values are provided as Attachment C2-1. Risks and hazards calculated using the Cal/EPA toxicity values were compared to those calculated using the EPA hierarchy.

C2.6.3.1 Reference Doses for Noncancer Effects

The toxicity value describing the dose-response relationship for noncancer effects is the reference dose (RfD) value. For non-carcinogenic effects, the body's protective mechanisms must be overcome before an adverse effect is manifested. If exposure is high enough and these protective mechanisms (or thresholds) are exceeded, adverse health effects can occur. EPA attempts to identify the upper bound of this tolerance range in the development of noncancer toxicity values. EPA uses the apparent toxic threshold value, in conjunction with uncertainty factors based on the strength of the toxicological evidence, to derive an RfD. EPA defines an RfD as follows:

> In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The RfD is generally expressed in units of milligrams per kilogram per day (mg/kg-day) (EPA, 1989).

The RfDs used for the derivation of the RBSLs and for the calculation of hazard are presented in Table C1-1 in Appendix C1. Some of the inhalation RfDs are derived from reference concentrations (RfC) or RELs. EPA defines an RfC as follows:

> An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark concentration, with uncertainty factors generally applied to reflect limitations of the data used (EPA, 2009).

C2.6.3.2 Slope Factors for Cancer Effects

The dose-response relationship for cancer effects is expressed as a cancer slope factor that converts estimated intake directly to excess lifetime cancer risk. Slope factors are presented in units of risk per level of exposure (or intake). The data used for estimating the dose-response relationship are taken from lifetime animal studies or human occupational or epidemiological studies where excess cancer risk has been associated with exposure to the chemical. However, because risk at low intake levels cannot be directly measured in animal or human epidemiological studies, a number of mathematical models and procedures have been developed to extrapolate from the high doses used in the studies to the low doses typically associated with environmental exposures. The model choice leads to uncertainty. EPA assumes linearity at low doses and uses the linearized multistage procedure when uncertainty exists about the mechanism of action of a carcinogen and when information suggesting nonlinearity is absent.

It is assumed, therefore, that if a cancer response occurs at the dose levels used in the study, there is some probability that a response will occur at all lower exposure levels (i.e., a dose-response relationship with no threshold is assumed). Moreover, the dose-response slope chosen is usually the upper confidence limit (UCL) on the dose-response curve observed in the laboratory studies. As a result, uncertainty and conservatism are built into the EPA risk extrapolation approach. EPA has stated that cancer risks estimated by this method produce estimates that provide a rough but plausible upper limit of risk. In other words, it is not likely that the true risk would be much more than the estimated risk, but "the true value of the risk is unknown and may be as low as zero" (EPA, 1996a). The cancer slope factors used for the RBSLs and in the SLHHRA are summarized in Table C1-1 in Appendix C1. Some of the inhalation slope factors are derived from unit risk factors (URFs). EPA defines a URF as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 $\mu g/m^3$ in air (EPA, 2009).

C2.7 Risk Characterization

This section summarizes the approach used to develop the human health risk. In this risk characterization step, quantification of risk is accomplished by the risk ratio approach (i.e., dividing the EPCs by the RBSLs to provide numerical estimates of potential health effects). The quantification approach differs for potential noncancer and cancer effects, as described in the following subsections.

Although this SLHHRA produces numerical estimates of risk, it should be recognized that these numbers might not predict actual health outcomes because they are based largely on hypothetical assumptions. Their purpose is to provide a frame of reference for risk management decision-making. Any actual risks are likely to be lower than these estimates, and may even be zero. Interpretation of the risk estimates provided should consider the nature and weight of evidence supporting these estimates, as well as the magnitude of uncertainty surrounding them.

C2.7.1 Soil Cancer and Noncancer Risk Estimation Method

For the potential soil/sediment risk calculations, the maximum detected concentrations of COPCs in soil were divided by the RBSLs presented in Appendix C1 (based on a target risk of 10^{-6}) and multiplied by 1E-06. The individual chemical risks were summed to give the cumulative potential cancer risk for each receptor. For the noncancer hazard calculations, the maximum detected concentrations of COPCs in soil/sediment were divided by the RBSLs (based on a target hazard quotient [HQ] of 1). The ratios were summed to give the hazard index (HI) for each receptor.

C2.7.2 Evaluation of Exposure to Lead

Neither EPA nor Cal/EPA publishes RfDs for lead, a COPC known to cause adverse noncancer health effects. The potential for health effects from exposure to lead may be assessed by comparing EPCs for lead to a risk-based level for the outdoor worker and residential scenarios. For the worker scenario, the EPCs for lead may be compared to the EPA Region 9 PRG for lead for commercial/industrial land use of 800 milligram(s) per kilogram (mg/kg). For the residential scenario, the EPCs for lead may be compared to

the EPA Region 9 PRG for lead for residential land use of 150 mg/kg. The values of 800 and 150 mg/kg that are shown in the Region 9 PRG Table (EPA, 2004b) for commercial/industrial and residential land use were derived using EPA's Adult Lead Model.

Background levels for lead at McClellan are as follows (Attachment C1): 137 mg/kg in surface soil; 15.9 mg/kg in subsurface soil (silts and clays); 6.8 mg/kg in subsurface soil (sands); and 74 mg/kg for the combined data set. Where the concentrations of lead in soil exceed McClellan-specific background levels, the concentrations were compared to the EPA Region 9 PRGs of 800 mg/kg for the outdoor occupational worker scenario and 150 mg/kg for the residential scenario.

C2.8 Uncertainty Analysis

Several sources of uncertainty are associated with the overall estimates of potential cancer risk and noncancer HIs as presented below and in Section 2.6.1 of the RI/FS report. The sources are generally associated with sampling and analysis, selection of COPCs, exposure assumptions, and toxicity values. Some general considerations of uncertainties are described below.

C2.8.1 Sampling and Analysis

In general, the sampling approach employed for the investigation at the Skeet Range was judgmental (i.e., soil samples were collected from locations and specific depth intervals suspected to be associated with potential contaminant sources, as indicated by site history and shot pellet and clay shard distribution. This judgmental sampling approach increases the likelihood that all site-related constituents will be characterized; however, this approach requires the additional assumption that knowledge of the site is adequate to identify all potentially contaminated locations and constituents. In general, this judgmental approach to data collection will tend to overestimate cancer risks and noncancer HIs for the Skeet Range.

The maximum detected concentrations in soil were used as the EPCs for the estimation of risk for the occupational worker and residential scenarios. Using the maximum detected concentration may overestimate overall average exposure for the various receptors and therefore, potential cancer risks and noncancer hazards may be overestimated.

C2.8.2 COPC Selection Process

The primary uncertainty associated with the COPC selection process is the possibility that a constituent may be inappropriately identified as a COPC for evaluation in the SLHHRA (i.e., a constituent detected may be inappropriately excluded or included as a COPC). The only constituents that were not designated as COPCs were constituents that were not detected in any samples, metals that were detected at or below background levels, and essential nutrients. For that reason, it is unlikely that any constituents were inappropriately excluded from the screening risk assessment. A more likely error in this screening risk assessment is the possibility that constituents were inappropriately included as COPCs. For example, the concentrations of some metals (e.g., arsenic) were found to be statistically different than background concentrations associated with McClellan based on the Mann-Whitney test, but were not necessarily greater than the background levels associated with

the site-specific lithology. These metals were carried through the SLHHRA as COPCs but concentrations may be representative of naturally occurring levels rather than site-related contamination. Therefore, by including these metals as COPCs in the SLHHRA and adding the associated risks and hazards associated with naturally occurring levels of metals in soils, the cancer risks and noncancer HIs for site-related contaminants at the Skeet Range are most likely overestimated.

C2.8.3 Exposure Assumptions

Current reuse plans for the Skeet Range are industrial/commercial and do not include residential use. Hence, the use of the residential scenario for the site is considered hypothetical at this time. The estimation of risks associated with the residential exposure scenarios were solely developed as a conservative estimate for risk management evaluation purposes. The risk and hazard estimates for the industrial/commercial scenario represent risks associated with current and anticipated future land use.

For purposes of the SLHHRA, it was assumed that exposure pathways involving contact with soil by workers are potentially complete. The construction worker scenario is a potentially complete exposure pathway. However, the construction worker scenario is not evaluated quantitatively based on agreements between the Air Force and regulatory agencies at the 26 June 2008, meeting. As several metals are more toxic by inhalation relative to other exposure routes (aluminum, barium, beryllium, boron, cadmium, total chromium and hexavalent chromium, cobalt, manganese, and nickel), the construction worker scenario was evaluated qualitatively for metals included in the risk estimates.

Considerable uncertainty is associated with the soil partition coefficients that are used to model uptake of COPCs by plants for the homegrown produce ingestion pathway. Most of the K_{ps} values used in the SLHHRA are modeled values; they are not based on empirical data. For some metals, empirical data are available, but the range of available values spans more than an order of magnitude. For example, K_{ps} values for cadmium in EPA's Soil Screening Guidance document (EPA, 1996b) range from 0.004 to 0.36 for various types of produce. For arsenic, K_{ps} values range from 0.002 to 0.036 (EPA, 1996b). In addition, the Soil Screening Guidance document only includes K_{ps} values for six metals. Other K_{ps} values are available from various literature sources but are not as well defined as the Soil Screening Guidance values.

On 7 August 2003, the regulatory agencies discussed this issue with the Air Force Real Property Agency. Given the available information, it was collectively decided that the Soil Screening Guidance values were most applicable for McClellan. Therefore, for this SLHHRA, plant root uptake of metals is only evaluated for those metals in the Soil Screening Guidance document. The rain splash component of the plant uptake was included for all metals.

Because of the factors described above, the uncertainties associated with the homegrown produce pathway input parameters result in uncertainties with the risk and hazard results for this pathway. The homegrown produce pathway is typically the main contributor to the estimated cancer risk and noncancer hazard estimates for many COPCs in many exposure areas. As described above, based on the planned reuse of the site, the likelihood of future residential use is hypothetical. However, homegrown produce ingestion is evaluated in the

SLHHRA because it may be a consideration for controlling site soils that might be removed during site development and construction activities and used elsewhere, resulting in potential offsite exposure. Therefore, in addition to the uncertainties associated with the homegrown produce calculations, the potential for a complete homegrown produce exposure pathway at McClellan is unlikely and primarily provided for risk management decision-making purposes.

C2.8.4 Toxicity Values

The toxicological database was also a source of uncertainty. EPA has outlined some of the sources of uncertainty in the *Risk Assessment Guidance for Superfund* (EPA, 1989). These sources may include or result from the extrapolation from high to low doses and from animals to humans; the species, gender, age, and strain differences in a toxin's uptake, metabolism, organ distribution, and target site susceptibility; and the human population's variability with respect to diet, environment, activity patterns, and cultural factors.

For some chemicals, cancer slope factors or reference doses have only been established for one exposure route in the IRIS database. However, on the basis of the *Final OU A RICS* (Jacobs, 2001), toxicity values were extrapolated across exposure routes (e.g., oral toxicity values were used to evaluate inhalation exposure) for use in calculating potential cancer risks and hazards for the SLHHRA. Uncertainties are associated with this practice because the simple extrapolation method is based on the assumption that the route of administration is irrelevant to the dose delivered to a target organ. This assumption does not account for differences in port-of-entry effects or pharmacokinetic behavior of the chemicals in the body. Consequently, the contribution from the exposure route where the extrapolated toxicity factor was used might be overestimated or underestimated.

EPA has not published dermal RfDs or slope factors; therefore, oral toxicity factors were used to estimate absorbed doses. An unadjusted toxicity factor might have resulted in an underestimation of risk that was inversely proportional to the true oral absorption of the chemical.

In general, EPA makes assumptions to derive toxicity values that are intended to result in conservative, health-protective estimates for RfDs and slope factors. RfDs typically are derived from animal studies because data from human studies generally are unavailable. Uncertainty and modifying factors are then applied to the data from animal studies to increase the confidence that RfDs are protective of human health. Slope factors used to estimate cancer risk are also typically derived from data from animal studies. The data are adapted from studies that administered high doses of a test chemical to laboratory animals, and the reported response is extrapolated to the much lower doses that humans are likely to receive. Few experimental data are available on the nature of the dose-response relationship at low doses (e.g., a threshold may or may not exist). Therefore, EPA has selected a conservative model for estimating the low-dose relationship and uses an upper-bound estimate (the 95 UCL of the slope predicted by the extrapolation model) as the slope factor. An upper-bound estimate of potential cancer risks is obtained using that factor. Use of these conservative RfDs and slope factors may result in overestimates of actual cancer risks and noncancer hazards.

C2.9 Human Health Risk Assessment for SR401 Skeet Range

In this section, a summary of SLHHRA results is presented for the Skeet Range. The SLHHRA includes potential cancer risks and noncancer HIs associated with the soil and sediment exposure pathways (direct contact). Calculations are not included for the groundwater pathways because groundwater characterization was not a part of this investigation. Currently, there is a prohibition in place on the use of groundwater for any purposes at McClellan; therefore, groundwater is not currently used. More information on the status of current groundwater conditions, potential risks associated with groundwater, and groundwater remedies at McClellan can be found in the VOC ROD (CH2M HILL, 2007), the Non-VOCs in Groundwater RI/FS (CH2M HILL, 2008), and the Groundwater Monitoring Program quarterly reports.

A summary of the potential cancer risk and noncancer HI estimates for soil and sediment for the occupational and residential scenarios is presented in Tables 1 and 2. The detailed chemical-specific cancer risk and HI results for the occupational and residential scenarios for the Skeet Range are also included in Tables 1 and 2

C2.9.1 Results

C2.9.1.1 Worker Scenarios

As shown in Table 2 and based on the maximum concentrations used as EPCs, the Skeet Range has potential cancer risks for an occupational worker scenario above the risk management range of 1E-06 to 1E-04 at 4E-04. The Skeet Range has an HI less than 1 for the occupational worker scenario.

Health effects of lead were evaluated separately by comparing the EPCs to the human health risk-based screening levels for occupational workers. The EPC for the 0 to 10 feet bgs (1700 mg/kg) soil depth interval is greater than the occupational worker risk-based level of 800 mg/kg.

C2.9.1.2 Hypothetical Residential Scenarios

As presented in Table 1 and based on the maximum concentrations used as EPCs, the Skeet Range has potential cancer risks for a residential scenario above the risk management range of 1E-06 to 1E-04 at 3E-03. The Skeet Range has an HI of equal to 1 for the hypothetical residential scenario.

Health effects of lead were evaluated separately by comparing the EPCs to the human health risk-based screening levels for residents. The EPC for the 0 to 10 feet bgs (1700 mg/kg) soil depth interval is greater than the residential risk-based level of 150 mg/kg.

C2.10 References

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Tables

TABLE 1

Soil Risk Summary for SR401 Skeet Range - Residential Scenario

SR401 Skeet Range Remedial Investigation/Feasibility Study, Former McClellan Air Force Base, Sacramento, California

Analyte	Frequency of Detects	Units	Minimum Detected Conc	Maximum Detected Conc	Combined Background Value	Exposure Point Concentration (EPC)	EPC Basis	Risk-Based Screening Levels [a]		Estimated Risk	
								Cancer Target Risk =1.0x10-6	Non-Cancer Target HI=1	Carcinogenic Risk	Non-Carcinogenic Hazard
SR401 Skeet Range - Soil (0-3 ft bgs)											
Inorganics											
Arsenic	36 / 36	mg/kg	1.1	7.4	4.9	7.4	Max Detection	1.5E-02	0.088	4.9E-04	84.1
Organics											
Acenaphthene	19 / 28	mg/kg	0.0033	3	---	3	Max Detection	---	290	---	0.01
Anthracene	19 / 28	mg/kg	0.0035	2.5	---	2.5	Max Detection	---	2300	---	<0.01
Benzo(a)anthracene	24 / 28	mg/kg	0.0011	21	---	21	Max Detection	8.8E-02	570	2.4E-04	0.04
Benzo(a)pyrene	25 / 28	mg/kg	0.0021	37	---	37	Max Detection	1.1E-02	680	3.4E-03	0.05
Benzo(b)fluoranthene	25 / 28	mg/kg	0.0034	40	---	40	Max Detection	1.1E-01	680	3.6E-04	0.06
Benzo(g,h,i)perylene	25 / 28	mg/kg	0.0022	22	---	22	Max Detection	---	750	---	0.03
Benzo(k)fluoranthene	23 / 28	mg/kg	0.001	13	---	13	Max Detection	1.1E-01	670	1.2E-04	0.02
Chrysene	25 / 28	mg/kg	0.0026	25	---	25	Max Detection	8.8E-01	570	2.8E-05	0.04
Dibenzo(a,h)anthracene	20 / 28	mg/kg	0.0019	7.8	---	7.8	Max Detection	2.1E-02	790	3.7E-04	<0.01
Fluoranthene	24 / 28	mg/kg	0.0021	30	---	30	Max Detection	---	490	---	0.06
Fluorene	14 / 28	mg/kg	0.0013	0.43	---	0.43	Max Detection	---	240	---	<0.01
Indeno(1,2,3-c,d)pyrene	24 / 28	mg/kg	0.0017	22	---	22	Max Detection	1.2E-01	760	1.8E-04	0.03
Naphthalene	12 / 28	mg/kg	0.0011	0.27	---	0.27	Max Detection	2.4E+00	25.0	1.1E-07	0.01
Phenanthrene	24 / 28	mg/kg	0.0011	10	---	10	Max Detection	---	2600	---	<0.01
Pyrene	24 / 28	mg/kg	0.0021	30	---	30	Max Detection	---	350	---	0.09
							Total Risk SR401 Skeet Range - Soil (0-3 ft bgs)			**5E-03**	**85**

Notes:

--- not available, no risk-based screening level has been established for this analyte

[a] Risk-based screening levels are presented in Appendix C1.

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TABLE 2
Soil Risk Summary for SR401 Skeet Range - Occupational Worker Scenario
SR401 Skeet Range Remedial Investigation/Feasibility Study, Former McClellan Air Force Base, Sacramento, California

Analyte	Frequency of Detects	Units	Minimum Detected Conc	Maximum Detected Conc	Combined Background Value	Exposure Point Concentration (EPC)	EPC Basis	Risk-Based Screening Levels [a]		Estimated Risk	
								Cancer Target Risk =1.0x10-6	Non-Cancer Target HI=1	Carcinogenic Risk	Non-Carcinogenic Hazard
SR401 Skeet Range - Soil (0-3 ft bgs)											
Inorganics											
Arsenic	36 / 36	mg/kg	1.1	7.4	4.9	7.4	Max Detection	1.4E+00	230	5.3E-06	0.03
Organics											
Acenaphthene	19 / 28	mg/kg	0.0033	3	---	3	Max Detection	---	16000	---	<0.01
Anthracene	19 / 28	mg/kg	0.0035	2.5	---	2.5	Max Detection	---	100000	---	<0.01
Benzo(a)anthracene	24 / 28	mg/kg	0.0011	21	---	21	Max Detection	8.8E-01	11000	2.4E-05	<0.01
Benzo(a)pyrene	25 / 28	mg/kg	0.0021	37	---	37	Max Detection	1.4E-01	11000	2.6E-04	<0.01
Benzo(b)fluoranthene	25 / 28	mg/kg	0.0034	40	---	40	Max Detection	8.8E-01	11000	4.5E-05	<0.01
Benzo(g,h,i)perylene	25 / 28	mg/kg	0.0022	22	---	22	Max Detection	---	11000	---	<0.01
Benzo(k)fluoranthene	23 / 28	mg/kg	0.001	13	---	13	Max Detection	8.8E-01	11000	1.5E-05	<0.01
Chrysene	25 / 28	mg/kg	0.0026	25	---	25	Max Detection	8.7E+00	11000	2.9E-06	<0.01
Dibenzo(a,h)anthracene	20 / 28	mg/kg	0.0019	7.8	---	7.8	Max Detection	2.6E-01	11000	3.0E-05	<0.01
Fluoranthene	24 / 28	mg/kg	0.0021	30	---	30	Max Detection	---	15000	---	<0.01
Fluorene	14 / 28	mg/kg	0.0013	0.43	---	0.43	Max Detection	---	13000	---	<0.01
Indeno(1,2,3-c,d)pyrene	24 / 28	mg/kg	0.0017	22	---	22	Max Detection	8.8E-01	11000	2.5E-05	<0.01
Naphthalene	12 / 28	mg/kg	0.0011	0.27	---	0.27	Max Detection	5.1E+00	180	5.3E-08	<0.01
Phenanthrene	24 / 28	mg/kg	0.0011	10	---	10	Max Detection	---	110000	---	<0.01
Pyrene	24 / 28	mg/kg	0.0021	30	---	30	Max Detection	---	11000	---	<0.01
							Total Risk SR401 Skeet Range - Soil (0-3 ft bgs)			**4E-04**	**0.06**

Notes:

--- not available, no risk-based screening level has been established for this analyte

[a] Risk-based screening levels are presented in Appendix C1.

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Attachment C2-1:
Site-specific Risk Summary Tables Based on Cal/EPA Toxicity Criteria

ATTACHMENT C2-1
TABLE 1
Soil Risk Summary for SR401 Skeet Range Using Cal/EPA Toxicity Criteria Hierarchy – Residential Scenario
SR401 Skeet Range Remedial Investigation/Feasibility Study, Former McClellan Air Force Base, Sacramento, California

Analyte	Frequency of Detects	Units	Minimum Detected Conc	Maximum Detected Conc	Combined Background Value	Exposure Point Concentration (EPC)	EPC Basis	Risk-Based Screening Levels [a]		Estimated Risk	
								Cancer Target Risk =1.0x10-6	Non-Cancer Target HI=1	Carcinogenic Risk	Non-Carcinogenic Hazard
SR401 Skeet Range - Soil (0-3 ft bgs)											
Inorganics											
Arsenic	36 / 36	mg/kg	1.1	7.4	4.9	7.4	Max Detection	1.5E-02	0.088	4.9E-04	84.1
Organics											
Acenaphthene	19 / 28	mg/kg	0.0033	3	---	3	Max Detection	---	290	---	0.01
Anthracene	19 / 28	mg/kg	0.0035	2.5	---	2.5	Max Detection	---	2300	---	<0.01
Benzo(a)anthracene	24 / 28	mg/kg	0.0011	21	---	21	Max Detection	8.8E-02	570	2.4E-04	0.04
Benzo(a)pyrene	25 / 28	mg/kg	0.0021	37	---	37	Max Detection	1.1E-02	680	3.4E-03	0.05
Benzo(b)fluoranthene	25 / 28	mg/kg	0.0034	40	---	40	Max Detection	1.1E-01	680	3.6E-04	0.06
Benzo(g,h,i)perylene	25 / 28	mg/kg	0.0022	22	---	22	Max Detection	---	750	---	0.03
Benzo(k)fluoranthene	23 / 28	mg/kg	0.001	13	---	13	Max Detection	1.1E-01	670	1.2E-04	0.02
Chrysene	25 / 28	mg/kg	0.0026	25	---	25	Max Detection	8.8E-01	570	2.8E-05	0.04
Dibenzo(a,h)anthracene	20 / 28	mg/kg	0.0019	7.8	---	7.8	Max Detection	2.1E-02	790	3.7E-04	<0.01
Fluoranthene	24 / 28	mg/kg	0.0021	30	---	30	Max Detection	---	490	---	0.06
Fluorene	14 / 28	mg/kg	0.0013	0.43	---	0.43	Max Detection	---	240	---	<0.01
Indeno(1,2,3-c,d)pyrene	24 / 28	mg/kg	0.0017	22	---	22	Max Detection	1.2E-01	760	1.8E-04	0.03
Naphthalene	12 / 28	mg/kg	0.0011	0.27	---	0.27	Max Detection	2.4E+00	25.0	1.1E-07	0.01
Phenanthrene	24 / 28	mg/kg	0.0011	10	---	10	Max Detection	---	2600	---	<0.01
Pyrene	24 / 28	mg/kg	0.0021	30	---	30	Max Detection	---	350	---	0.09
							Total Risk SR401 Skeet Range - Soil (0-3 ft bgs)			**5E-03**	**85**

Notes:

--- not available, no risk-based screening level has been established for this analyte

[a] Risk-based screening levels are presented in Appendix C1.

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ATTACHMENT C2-1
TABLE 2
Soil Risk Summary for SR401 Skeet Range Using Cal/EPA Toxicity Criteria Hierarchy – Occupational Worker Scenario
SR401 Skeet Range Remedial Investigation/Feasibility Study, Former McClellan Air Force Base, Sacramento, California

Analyte	Frequency of Detects	Units	Minimum Detected Conc	Maximum Detected Conc	Combined Background Value	Exposure Point Concentration (EPC)	EPC Basis	Risk-Based Screening Levels [a]		Estimated Risk	
								Cancer Target Risk =1.0x10-6	Non-Cancer Target HI=1	Carcinogenic Risk	Non-Carcinogenic Hazard
SR401 Skeet Range - Soil (0-3 ft bgs)											
Inorganics											
Arsenic	36 / 36	mg/kg	1.1	7.4	4.9	7.4	Max Detection	1.4E+00	230	5.3E-06	0.03
Organics											
Acenaphthene	19 / 28	mg/kg	0.0033	3	---	3	Max Detection	---	16000	---	<0.01
Anthracene	19 / 28	mg/kg	0.0035	2.5	---	2.5	Max Detection	---	100000	---	<0.01
Benzo(a)anthracene	24 / 28	mg/kg	0.0011	21	---	21	Max Detection	8.8E-01	11000	2.4E-05	<0.01
Benzo(a)pyrene	25 / 28	mg/kg	0.0021	37	---	37	Max Detection	1.4E-01	11000	2.6E-04	<0.01
Benzo(b)fluoranthene	25 / 28	mg/kg	0.0034	40	---	40	Max Detection	8.8E-01	11000	4.5E-05	<0.01
Benzo(g,h,i)perylene	25 / 28	mg/kg	0.0022	22	---	22	Max Detection	---	11000	---	<0.01
Benzo(k)fluoranthene	23 / 28	mg/kg	0.001	13	---	13	Max Detection	8.8E-01	11000	1.5E-05	<0.01
Chrysene	25 / 28	mg/kg	0.0026	25	---	25	Max Detection	8.7E+00	11000	2.9E-06	<0.01
Dibenzo(a,h)anthracene	20 / 28	mg/kg	0.0019	7.8	---	7.8	Max Detection	2.6E-01	11000	3.0E-05	<0.01
Fluoranthene	24 / 28	mg/kg	0.0021	30	---	30	Max Detection	---	15000	---	<0.01
Fluorene	14 / 28	mg/kg	0.0013	0.43	---	0.43	Max Detection	---	13000	---	<0.01
Indeno(1,2,3-c,d)pyrene	24 / 28	mg/kg	0.0017	22	---	22	Max Detection	8.8E-01	11000	2.5E-05	<0.01
Naphthalene	12 / 28	mg/kg	0.0011	0.27	---	0.27	Max Detection	5.1E+00	180	5.3E-08	<0.01
Phenanthrene	24 / 28	mg/kg	0.0011	10	---	10	Max Detection	---	110000	---	<0.01
Pyrene	24 / 28	mg/kg	0.0021	30	---	30	Max Detection	---	11000	---	<0.01
							Total Risk SR401 Skeet Range - Soil (0-3 ft bgs)			**4E-04**	**0.06**

Notes:

--- not available, no risk-based screening level has been established for this analyte

[a] Risk-based screening levels are presented in Appendix C1.

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Appendix C
Screening Level Ecological Risk Assessment

APPENDIX C

Screening Level Ecological Risk Assessment

This appendix contains material published in the *Final SR401 Skeet Range Remedial Investigation/Feasibility Study, Former McClellan Air Force Base, California* (CH2M HILL, 2010).

Appendix C3
Screening-level Ecological Risk Assessment

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C3.5-1 Risk Summary of Chemicals Exceeding Background Levels and Ecological Screening Values for Biota Exposed to Sediment/Soil in or Near Vernal Pools and Ditch 358 at the SR401 Skeet Range

Figure

C3.2-1 Ecological Conceptual Site Model

Acronyms and Abbreviations

Air Force	U.S. Air Force
Base	former McClellan Air Force Base
bgs	below ground surface
BI	benthic invertebrates
BL	background level
COC	contaminant of concern
COPC	chemical of potential concern
CSM	conceptual site model
DTSC	California Department of Toxic Substances Control
Eco-SSL	Ecological Soil Screening Level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESV	ecological screening value
HQ	hazard quotient
McClellan	former McClellan Air Force Base
NOAEL	no observed adverse effect level
mg/kg	milligram(s) per kilogram
RI/FS	remedial investigation/feasibility study
NOAA	National Oceanic and Atmospheric Administration
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
SLERA	screening-level ecological risk assessment
SQuiRT	Screening Quick Reference Table
TEC	threshold effect concentration
UET	upper effects threshold
WNA	West Nature Area
WRS	Wilcoxon Rank Sum

APPENDIX C3

Screening-level Ecological Risk Assessment

C3.1 Introduction

This appendix to the SR401 Skeet Range (Skeet Range) Remedial Investigation (RI)/ Feasibility Study (FS) report presents the screening-level ecological risk assessment (SLERA) methods and results for the Skeet Range at the former McClellan Air Force Base (McClellan), located in Sacramento, California. The SLERA was completed to support the Skeet Range RI/FS.

The location of McClellan is shown on Figure 1-1 in Section 1 of the RI/FS report, and the location of the Skeet Range is shown on Figure 1-2 in Section 1 of the RI/FS report. Sample locations assessed for ecological risk are shown on Figure 2-2 in Section 2 of the RI/FS report.

C3.1.1 Objectives

The SLERA was conducted to provide risk managers with a basis for evaluating whether action is warranted to mitigate potential adverse effects to ecological receptors from chemicals in sediment and soil in or near several vernal pools (352, 353, 355, 357, 599, 741, and 745) and the unlined drainage ditch (ditch 358) aquatic habitats at the site. The screening assessment characterizes potential risks to ecological receptors (benthic invertebrates, plants, and birds) from chemicals in these media at the site. Furthermore, the SLERA considers baseline conditions, that is, a case in which no remedy is implemented for chemical concentrations at the site.

C3.1.2 Scope

The technical approach for the SLERA, outlined in the SR401 Skeet Range Investigation Work Plan dated September 2009 (CH2M HILL, 2009), generally follows the U.S. Environmental Protection Agency (EPA) and California Department of Toxic Substances Control (DTSC) guidance. This section presents the salient features of the approach, and the following section lists relevant EPA guidance documents.

EPA's Ecological Risk Assessment Guidance (EPA, 1997) represents an eight-step process. The SLERA for the Skeet Range is limited to the first two of these eight steps. It includes the screening-level problem formulation and ecological effects evaluation (Step 1), and the screening-level exposure estimate and risk calculation (Step 2). The problem formulation identifies the major contaminants of concern (COCs), identifies and characterizes environmental exposure pathways, identifies potential receptors, indicator species, and endpoints, and identifies preliminary toxicity benchmarks for the site's expected COCs and receptors. These components are then used to perform a SLERA based on the existing data. The SLERA integrates conservative measures of exposure with conservative measures of effects to differentiate between analytes, receptors, and locations for which unacceptable risks are unlikely, and those that may present potential risk.

The risk assessment procedures used for the McClellan RI program have been revised over time in response to input from regulatory agencies, updates to state and federal risk assessment guidance, and updates to toxicity values used in the risk calculations. These updates have been incorporated, as appropriate, into the SLERA methodology used for McClellan. The methodology used for the Skeet Range is consistent with the risk assessment procedures presented to the regulatory agencies in a meeting on 26 June 2008. A streamlined, screening risk assessment approach was agreed to by the regulatory agencies. Although uncertainties exist and the degree of characterization differs among sites, the use of the SLERA in conjunction with risk-based screening levels developed for this effort (see Appendix C1) provides sufficient information for the remedial project managers to identify sites with potential impacts to the environment and to evaluate appropriate remedial actions.

C3.1.3 Guidance Documents

The procedures followed for conducting the SLERA at the site were consistent with those described in the following guidance provided by the DTSC and EPA:

- *Guidance For Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities* (DTSC, 1996)
- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (EPA, 1997)
- *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (EPA, 1999a)
- *U.S. Environmental Protection Agency (EPA). 1998. Final Guidelines for Ecological Risk Assessment, Risk Assessment Forum. U.S. EPA, Washington, D.C., EPA/630/R-95/002F. April.*
- *Ecological Risk Assessment and Risk Management Principles for Superfund Sites* (EPA, 1999b)
- *The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments* (EPA, 2001)

In accordance with these guidance documents, this assessment serves as a SLERA. The primary guidance utilized in completing the SLERA was the *Ecological Risk Assessment Guidance for Superfund* (EPA, 1997) and the *Final Guidelines for Ecological Risk Assessment* (EPA, 1998).

C3.1.4 Organization

The remainder of this appendix is organized into the following sections:

- Section C3.2: Problem Formulation
- Section C3.3: Analysis
- Section C3.4: Risk Characterization
- Section C3.5: Risk Conclusions
- Section C3.6: References

C3.2 Problem Formulation

The Problem Formulation integrates available information (sources, contaminants, effects, and environmental setting) to provide focus to the SLERA. This section includes a description of the site setting, identification of chemicals of potential concern (COPCs), identification of the important aspects of the site to be protected (referred to as assessment endpoints), and the means by which the assessment endpoints were evaluated (measures of exposure and effects). The end product of the problem formulation is a conceptual site model (CSM) that describes the contaminant sources and transport mechanisms, evaluates potential exposure pathways, and identifies the representative species that were used to assess potential ecological risk to those and other similar species (see Figure C3.2-1).

C3.2.1 Physical and Ecological Setting

The topography of the site is generally flat, except for several vernal pools, an unlined drainage ditch (identified as ditch 358), a gunite-lined section of Don Julio Creek, and the Operable Unit (OU) D cap. Don Julio Creek traverses the central portion of the site and receives site runoff via storm drains, overland flow, and ditch 358 in the southern portion of the site. The creek flows toward the south along Patrol Road for about 0.5-mile, where it turns toward the west and continues in an unlined channel through the West Nature Area (WNA).

The terrestrial portions of the site have no ecological habitat (parking lots, buildings, and so forth), or they provide only marginal-quality upland habitat (a non-native annual grassland that is mowed [referred to as the grassy area elsewhere], or landscaped areas around buildings). Because ecological receptors are unlikely to be exposed significantly in the terrestrial habitat, the SLERA evaluates only the potential risk of ecological receptors' exposure to vernal pools and ditch 358. Vernal pools are landscape depressions that have impervious subsoils and pond water during winter but are dry for the remainder of the year. Vernal pools are characterized by a unique assemblage of native plant species that are adapted to periodic inundation during the winter and early spring. The pools also provide seasonal aquatic habitat for invertebrates such as crustaceans and insect larvae. The federally threatened vernal pool fairy shrimp (*Branchinecta lynchi*) has been documented in vernal pools in the WNA of McClellan and may be present in other vernal pools across McClellan.

Seven vernal pools (352, 353, 355, 357, 599, 741, and 745) and ditch 358 are located within the Skeet Range. These aquatic habitats with associated sample locations are shown on Figure 2-2 in the RI/FS report. Vernal pool 352 (0.306 acre), located just southeast of Building 1080, is the largest of these topographic depressions and is characterized by wetland plants such as creeping spikerush (*Eleocharis macrostachya*), curly dock (*Rumex crispus*), and vernal pool buttercup (*Ranunculus bonariensis*) (CH2M HILL, 2008). Vernal pool 353 is the second-largest pool (a 0.093-acre shallow topographic depression), located southwest of vernal pool 352, and also has creeping spikerush and vernal pool buttercup among the wetland plants. The remaining vernal pools are shallow topographic depressions ranging from 0.003 to 0.030 acre in size and have a variety of wetland plants, including species characteristic of vernal pools. Ditch 358, located north of Building 1069, is unlined and contains water intermittently during the wet season (November through April). The ditch is a broad, shallow, excavated drainage channel characterized by upland vegetation. The ditch is considered to provide low value

aquatic habitat. Because a federally listed species associated with vernal is known to occur at McClellan, vernal pools are the primary features of concern for ecological receptors.

C3.2.2 Identification of Chemicals of Potential Concern

COPCs are constituents that are included in the quantitative exposure estimation and risk characterization steps of the SLERA. Consistent with Appendix C2, Screening Human Health Risk Assessment, metals were selected as COPCs only if (1) it was detected in a depth interval for which at least one exposure pathway was considered to be complete, (2) it was not an essential nutrient (i.e., calcium, iron, magnesium, potassium, or sodium), and (3) it was not representative of ambient metals levels at McClellan. All detected polynuclear aromatic hydrocarbons (PAHs) were retained as COPCs (i.e., non-detects were not evaluated). The selected COPCs included two metals (arsenic and lead) and 15 PAHs (acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene) present in sediments or soils at the Skeet Range. These COPCs were evaluated in the SLERA.

C3.2.3 Assessment Endpoints

Assessment endpoints are an expression of the important ecological values that should be protected at a site (Suter, 1990; 1993; EPA, 1998; Suter et al., 2000). Assessment endpoints are developed based on known information concerning the contaminants present, the study area, the ecological CSM, and risk hypotheses. There are three components to each assessment endpoint: an *entity* (e.g., birds), an *attribute* of that entity (e.g., individual survival), and a *measure* (e.g., a measurable value, such as an effect level). Measures are described following the general description of assessment endpoints (EPA, 1998; Suter et al., 2000).

The assessment endpoint entities for the site were selected based on the following principal criteria:

- Ecological relevance
- Societal relevance
- Susceptibility (or high exposure) to known or potential stressors at the site

Assessment endpoints for the site include benthic invertebrates, plants, and birds in or near the vernal pool and ditch aquatic habitats. Because a federally listed species associated with vernal pools (e.g., federally threatened vernal pool fairy shrimp) is known to occur at McClellan, vernal pools are the primary features of concern for ecological receptors. The assessment endpoints include representative receptors for specific ecological groups associated with vernal pools and seasonal aquatic habitats. For purposes of this SLERA, individual species were not identified for estimation of exposures. Instead, generic receptors (benthic invertebrates, plants, and birds) were considered the receptors of concern. Benthic invertebrates, as used in this SLERA, are considered the representative receptor for the special-status vernal pool invertebrates. The ditch is considered to provide low value aquatic habitat.

C3.2.4 Measures of Exposure and Effects

Measures are measurable attributes used to evaluate the risk hypotheses and are predictive of exposure and effects on the assessment endpoints (EPA, 1998). The three categories of measures include the following:

- Measures of exposure—used to evaluate levels at which exposures may be occurring.
- Measures of effects—used to evaluate the response of the assessment endpoints when exposed to the stressors.
- Measures of ecosystem and receptor characteristics—used to evaluate the ecosystem characteristics that influence the assessment endpoints, the distribution of stressors, and the characteristics of the assessment endpoints that may affect exposure or response to the stressor.

For this assessment, only measures of exposure and effects were used.

C3.2.4.1 Measures of Exposure

Measures of exposure can be an exposure point concentration (EPC) of a chemical in an environmental medium or food item, or a related dose estimate. For this screening assessment, detected concentrations of COPCs were used as the EPC for all receptors in a point-by-point evaluation of all COPCs. Although this is representative for immobile or nearly immobile receptors (e.g., plants and invertebrates), mobile receptors (birds) were conservatively assumed to forage exclusively onsite for this screening evaluation.

C3.2.4.2 Measures of Effects

Measures of effects include media-specific ecological screening values (ESVs). The most current ESVs were selected from a number of sources to represent threshold values above which a potential risk to ecological receptors may be present. When multiple values were available for a particular receptor type, generally a reliable or conservative value was selected. Literature-based toxicity data were used including Ecological Soil Screening Levels (Eco-SSLs) developed by EPA (EPA, 2009) as available, as were other published screening data for plants (e.g., Efroymson et al., 1997). For the aquatic environment, published screening levels for sediment (e.g., MacDonald et al., 2000, and Buchman, 2008) were also used. Avian toxicity values were Eco-SSLs extracted from EPA (2009). The measures of exposure and effects (ESVs) are provided along with the assessment endpoints (plants, benthic invertebrates, and birds) in Table C3.2-1.

C3.2.5 Conceptual Site Model

The CSM is a written and visual presentation of predicted relationships among stressors, exposure pathways, and assessment endpoints. It includes a description of the complete exposure pathways and outlines the potential routes of exposure for each assessment endpoint. A CSM diagram for ecological exposures was developed for the site and is presented on Figure C3.2-1.

The primary sources of contamination are lead shot and clay shards from the historic use of the site as a skeet and trap range. The subsequent development and clean-up activities at the site contributed to the redistribution of the lead shot and clay shards within the site.

Development activities included construction of buildings, paved areas, and the OU D soil cap; disking and/or grading of the ball field and unpaved parking areas; and realignment and construction of the gunite-lined Don Julio Creek, which resulted in lead shot and clay shards mixing into shallow soil. Primary release mechanisms include wind erosion, leaching, and runoff of contaminants from surface and shallow soils containing shot and shards to adjacent surface water, sediment, and surface and shallow soils at or near the vernal pools and ditch 358. Leaching of lead and PAHs from the primary sources into soil resulted in secondary contamination of shallow soil and sediment.

Potentially complete exposure pathways from contaminated surface and shallow soil, sediment, surface water, and biota to ecological receptors exist at the Skeet Range. Vernal pool plants are primarily exposed via contaminated sediment when it is present and in soil during the dry season In addition, plants may be exposed by uptake from contaminated interstitial or surface water sources or by aerial deposition onto foliage. Although benthic invertebrates may be exposed to contaminants via surface water, primary exposure is through sediment. Vernal pool fairy shrimp are primarily exposed to contaminants in surface water, aquatic vegetation, and invertebrates through preferential ingestion, and to contaminants in sediment through incidental ingestion.

Birds may be exposed directly to contaminants in surface water through ingestion and to contaminants in surface soil or sediment by incidental ingestion, dermal contact, or inhalation of wind-borne particles. Dermal exposure occurs when contaminants are absorbed directly through the skin, and inhalation exposure occurs when volatile compounds or fine particulates are inhaled into the lungs. Although methods are available for assessing these exposures, methods and data necessary to estimate dermal and inhalation exposures are poorly developed (EPA, 1993) or limited. Additionally, a wildlife receptor's exposure to contaminants by inhalation and dermal contact usually contributes little to its overall exposure. Therefore, for the purposes of this assessment, both dermal and inhalation exposure were assumed to be negligible and were not further evaluated. Birds may also receive contaminant exposure through food-web transfer of chemicals from lower trophic levels (e.g., plants to herbivores, plants and prey animals to omnivores, and so forth).

The Skeet Range consists of bare ground or regularly mowed grassy areas and provides little or no cover for small mammals. The site is also located in an industrial area and is surrounded by buildings, roads, and parking lots. Mammal burrows were not observed at the site and are not expected due to the minimal cover and significant disturbances. The limited available habitat, lack of cover, traffic, and light industry at the site make the habitat unattractive to most wildlife, and the site is most likely used by only a few species of terrestrial birds tolerant of activities in light industrial areas. Groundwater is found at 110 feet bgs and does not surface at the site; therefore, there is no direct contact with biota and the pathway of exposure is incomplete.

C3.3 Analysis

The analysis phase consists of the technical evaluation of chemical and ecological data to determine the potential for ecological exposure and adverse effects. The analysis phase includes the characterization of exposure and the characterization of effects.

C3.3.1 Exposure Characterization

The exposure characterization provides a description and quantification of the nature and magnitude of the interaction between EPCs in sediment, and surface and shallow soil to ecological receptors. EPCs for the screening estimates are the maximum detected COPC concentrations in sediment and soils (surface and shallow [Tables C3.3-1 through C3.3 7b]). These data provide a conservative measure of exposure for the ecological receptors. Surface water was not present at the time of sampling and was not evaluated.

C3.3.1.1 Benthic Invertebrates

Vernal pool invertebrates and benthic invertebrates experience exposure primarily through the medium where they live. For these receptors, exposure occurs as a consequence of living in a contaminated medium (i.e., receptors are directly exposed to COPCs). Although other exposure pathways (e.g., dietary exposure of surface water, algae, or invertebrates) may contribute to total exposure for these receptors, exposure through sediment predominates. Consequently, estimates of exposure for vernal pool invertebrates were represented as concentrations of COPCs in sediment and surface soils (milligram[s] per kilogram [mg/kg]) from 0 to 0.5 feet bgs.

C3.3.1.2 Plants

Plants experience exposure primarily through the soil/sediment in which they live. This exposure occurs as a consequence of living in a contaminated medium (i.e., receptors are directly exposed to COPCs). Although other exposure pathways (e.g., uptake from water) may contribute to total exposure for these receptors, exposure through soil/sediment predominates. Consequently, estimates of exposure for plants were represented as concentrations of COPCs in sediment and surface or shallow soils (mg/kg) from 0 to 3 feet bgs (assumes rooting depth of up to 4 feet bgs for plant exposures and sample collection to 3 feet bgs).

C3.3.1.3 Birds

Birds experience exposure through multiple pathways, including ingestion of abiotic media (surface water and sediment/soil) and biotic media (food), as well as inhalation and dermal contact. However, the screening estimate of exposure evaluated the COPC concentrations in surface soil, because the Eco-SSLs developed by the EPA (2009) include consideration of multiple exposure pathways. Avian Eco-SSLs represent soil concentrations that would result in dietary doses that do not exceed a no observed adverse effect level (NOAEL). Conservative assumptions (i.e., 100 percent bioavailability, 100 percent diet composition, 100 percent site use, and so forth) are used for the dietary dose calculations integrated into the Eco-SSLs. Estimates of exposure for birds were represented as concentrations of COPCs in sediment and surface soils from 0 to 1 foot bgs.

C3.3.2 Ecological Effects Characterization

The ecological effects assessment consists of an evaluation of available toxicity or other effects information that can be used to relate the exposures to COPCs and adverse effects in ecological receptors. Data that can be used include literature-derived or site-specific single-chemical toxicity data, site-specific ambient-media toxicity tests, and site-specific field

surveys (Suter et al., 2000). For the site, single-chemical toxicity data from literature sources were the primary effects data.

C3.3.2.1 Benthic Invertebrates

Currently, there are no EPA criteria for sediment. In general, it is difficult to predict sediment concentrations at which toxicity occurs because the type and form of the sediment and the chemistry of the overlying water affect bioavailability. However, sediment guidelines have been derived based on the relationship between the contaminant concentration in bulk sediment, the contaminant concentration in pore water, and measured biological effects (i.e., Buchman, 2008; MacDonald et al., 2000; EPA, 2001). These sediment guidelines provide an initial benchmark for predicting the potential for adverse effects due to elevated COPC concentrations in sediment. The freshwater sediment benchmarks for benthic invertebrates are shown in Table C3.2-1.

C3.3.2.2 Plants

Single-chemical screening-level toxicity values for plants have been developed for a limited number of analytes as part of the EPA Eco-SSLs (EPA, 2009). For analytes lacking Eco-SSLs, additional data were obtained from the Oak Ridge National Laboratory (ORNL) benchmark report (Efroymson et al., 1997). Soil screening values for plants are presented in Table C3.2-1.

C3.3.2.3 Birds

As described in Section C3.3.1.3, avian Eco-SSLs were used for all analytes for which they were available and are presented in Table C3.2-1.

C.3.4 Risk Characterization

In the risk characterization, exposure and effects data are integrated to draw conclusions concerning the presence, nature, and magnitude of effects that may exist at the site. This section outlines the methodology by which exposure and effects data were integrated to estimate risk in the screening-level risk characterization and presents the results.

C.3.4.1 Methodology

Data used for this SLERA were collected during the September through October 2009 sampling activity. Point-by-point ecological risks were estimated for sediment samples collected within a vernal pool, soil samples collected within 100 feet of a vernal pool, and sediment samples collected within the drainage ditch. Soil and sediment samples that had shot pellets or clay target debris (shards) were analyzed for metals or PAHs, respectively. Risk to ecological receptors was considered unlikely at locations where no shot or shard was observed. For samples with laboratory data,, the following media were evaluated in the SLERA:

- Surface soil samples collected at depths from 0 to 0.5 foot bgs in the grassy areas within the 100-foot-by-100-foot sample grid adjacent to a vernal pool

- Two shallow soil samples collected at depths of 1 to 1.5 foot and 2.5 to 3 feet at one location in the grassy area within the 100-foot-by-100-foot sample grid adjacent to vernal pool 741
- Sediment samples collected at depths of 0 to 0.25 foot bgs in vernal pools
- Sediment samples collected at depths of 0 to 0.5 foot bgs in ditch 358.

The data were selected to assess whether COPCs are likely to present risks to plants or animals in individual vernal pools or ditch 358. Risks to ecological receptors (plants, benthic invertebrates, and birds) were screened by calculating hazard quotients (HQs) for each individual sample to provide a point-by-point evaluation. The HQ was calculated by dividing the concentration of each COPC detected by the ESVs provided in Table C3.2-1. Concentrations of arsenic and lead (the only metals not considered to be representative of background for the site as a whole; see Appendix C2) in sediment and soil (both surface and shallow soil) also were compared to sediment and combined soil background levels, respectively (Tables C3.3-1 through C3.3-7b). Although arsenic and lead detected at the site were not considered in their entirety to be representative of background, some concentrations of these metals may be below background screening levels for McClellan (see Section 1.5.1 of the main report). Consistent with the site screening process (Section 1.5.1), the HQ for a representative background value was calculated to demonstrate the incremental risk from potential site contamination and to further refine the SLERA results. To be identified as a risk driver for an individual sample location, the metal concentration must exceed both the ESV and background screening levels.

HQ values less than 1.0 indicate that adverse effects associated with exposure to a given COPC are unlikely (EPA, 1997). These COPCs were not considered to present unacceptable risk. An HQ equal to or greater than 1.0 indicates data are insufficient to exclude the potential for risk, but does not necessarily indicate that risks are actually present. COPCs with HQs equal to or greater than 1.0 (and, for metals also exceeding background) were identified as potential risk drivers for the individual location. COPCs for which ESVs were unavailable or for which detection limits were insufficient were not further evaluated, but were retained as uncertainties.

C3.4.2 Results

Results are presented in this section for individual vernal pools and for Ditch 358.

C3.4.2.1 Vernal Pool 352

The comparison of PAH concentrations in surface soil collected at sample locations 62 and 63 to ESVs are presented in Table C3.3-1. ESV-based hazard quotients (ESV HQ) did not exceed 1.0 for any of the COPCs. ESVs were not available for every detected PAH for each ecological receptor. Specifically, an ESV for benzo(b)fluoranthene was not available for benthic invertebrates, only one ESV (acenaphthene) was available for plants, and no ESVs were available for birds. Therefore, these COPCs were further evaluated in the uncertainty analysis.

C3.4.2.2 Vernal Pool 353

The comparison of metal concentrations in sediment collected at sample location 42 to ESVs and sediment background levels at McClellan are presented in Table C3.3-2. Lead concentrations exceeded the ESVs for benthic invertebrates and birds; however, none of the ESV HQs exceeded 1.0 for arsenic. Both lead and arsenic concentrations were consistent with sediment background levels at McClellan. Thus, no risk drivers were identified for this vernal pool.

C3.4.2.3 Vernal Pool 355

The comparison of metal concentrations in surface soil collected at sample locations 29, 31, and 41, metal and PAH concentrations in surface soil from sample location 30, and metals and PAHs in sediment collected at sample location 105 to ESVs are presented in Table C3.3-3. Lead concentrations exceeded the ESVs for benthic invertebrates and birds at all sample locations and four out of five sample locations for plants; however, none of the ESV HQs exceeded 1.0 for arsenic. Lead concentrations in all samples exceeded the background screening levels. In sample location 105, the ESV HQs for 12 of the 14 detected PAHs, as well as total PAHs, exceeded 1.0. PAH concentrations at sample location 30 were either non-detected or below the ESV. Consequently, lead was identified as a risk driver for multiple locations and receptors and represents a potential risk from soil adjacent to the vernal pool and sediment within the vernal pool. PAHs were risk drivers at one location and represent a potential risk from soil adjacent to the vernal pool.

C3.4.2.4 Vernal Pool 357

The comparison of metal concentrations in surface soil collected at sample locations 31 and 41, metal and PAH concentrations in surface soil from sample location 30, and metal concentrations in sediment collected at sample location 106 to ESVs are presented in Table C3.3-4. Lead concentrations exceeded the ESVs for all receptors at all sample locations except for plants at sample location 41, but none of the ESV HQs exceeded 1.0 for arsenic. Lead concentrations at all locations were above background screening levels. PAH concentrations at sample location 30 were either non-detected or below the ESV. Therefore, lead was the only risk driver for this vernal pool and represents a potential risk from soil adjacent to the vernal pool and from sediment within the vernal pool.

C3.4.2.5 Vernal Pool 599

Because no shot or shards were observed in the two samples collected within the selected 100-foot assessment area for vernal pool 599, the samples were not analyzed, and no metal and/or PAH data were evaluated. The criteria for laboratory analysis of samples collected at the Skeet Range and the selection of data associated with vernal pools and ditch 358 are provided in Sections 2.1.2 and 2.6 of the RI/FS report.

C3.4.2.6 Vernal Pool 741

Lead and arsenic data collected from surface soils at sample locations 22 and 31 are presented in Table C3.3-5. In addition, a shallow soil sample collected at 1 to 1.5 feet bgs and another sample at 2.5 to 3 feet bgs from sample location 22 were analyzed for metals, and metals and PAHs, respectively. Surface soil data were compared to ESVs for benthic invertebrates, plants, and birds; shallow soil data also were compared to ESVs for plants.

Neither of the shallow soil concentrations exceeded ESVs for plants or background screening levels. Lead concentration in surface soil at sample location 31 exceeded the ESVs for all receptors and also exceeded background screening levels. The lead concentration in surface soil exceeded the ESV for birds at sample location 22 and was above background. Thus, lead in soil adjacent to this vernal pool was identified as a risk driver.

C3.4.2.7 Vernal Pool 745

The comparison of metal concentrations in surface soil collected at sample locations 28 and 29, metal and PAH concentrations in surface soil from sample location 30, and metal concentrations in sediment collected at sample location 104 to ESVs are presented in Table C3.3-6. Lead concentrations exceeded the ESVs for all receptors at all sample locations except for benthic invertebrates and plants at sample location 28; none of the ESV HQs exceeded 1.0 for arsenic. Lead concentrations at sample locations 29, 30, and 104 were above background screening levels. PAH concentrations at sample location 30 were either non-detected or below the ESV. Consequently, lead was identified as a risk driver for three of four locations at this vernal pool and represents a potential risk from soil adjacent to the vernal pool and from sediment within the vernal pool.

C3.4.2.8 Ditch 358

The comparison of metals in a sediment sample collected at location 101 and PAHs in sediment collected at sample location 102 are presented in Table C3.3-7a.

None of the ESV HQs exceeded 1.0 for arsenic, lead, or PAHs. Thus, no risk drivers were identified for the ditch.

C3.4.3 Uncertainty Analysis

Uncertainties are inherent in all risk assessments. The nature and magnitude of the uncertainties depend on the amount and quality of data available, the degree of knowledge concerning site conditions, and the assumptions made to perform the assessment. A qualitative evaluation of the major general uncertainties associated with this SLERA is outlined below in no particular order of importance.

C3.4.3.1 Selection of COPCs

The uncertainties associated with the COPC selection is provided in Appendix C-2. Although the COPCs were used to conduct the SLERA, the process was not a component of the SLERA. Therefore, the process, including the uncertainty analysis, is not included in this appendix.

C3.4.3.2 Exposure and Effects

- The ESVs are designed to ensure a conservative estimate of a toxicological effect level or endpoint. However, there is some uncertainty associated with toxicological endpoints, species, exposure duration, and site conditions. These uncertainties may lead to overestimation or underestimation of potential risks.
- There were no PAH ESVs for the avian receptor, only one PAH ESV for the plant receptor, and no benzo(b)fluoranthene ESV for benthic invertebrates to quantify ecological risks for detected PAHs. Consequently, these constituents could not be evaluated and aggregate risks at the sites may have been underestimated.

However, bioaccumulation of PAHs by birds is generally low, and the lack of ESVs for birds is not likely to significantly affect conclusions.

- The ESVs are usually based on a highly soluble and bioavailable form of the chemical. It is generally accepted that forms present in environmental media are not likely to be in a highly soluble form and, due to physical and chemical processes in the environment, are likely to be less than 100 percent bioavailable. As a consequence, risk may be overestimated.
- In samples collected within 100 feet of a vernal pool and analyzed for PAHs, even one-half the reporting limits of non-detected PAHs exceeded the associated benthic invertebrate ESV in more than half of the samples. Eliminating these non-detects before comparison to screening values may underestimate aggregate risk from PAHs.
- Analytical chemistry data collected within the exposure areas were assumed to adequately represent the exposure to wildlife, and COPCs were assumed to represent the distribution of constituents present. These assumptions could either underestimate or overestimate risk.
- In general, risks are overestimated in this SLERA through the use of conservative exposure, effects, and risk characterization assumptions described in the previous sections. In some cases, uncertainties represent potential underestimates or overestimates of risk. However, the overall quantified risks represent the best model that could be assembled given the site-specific information.

C3.5 Conclusions

A summary of the risks to ecological receptors from chemicals in sediment/soil in or near the vernal pools and ditch 358 is presented in Table C3.5-1. Although there is some uncertainty associated with the conclusions of the SLERA (e.g., avian ESVs for PAHs are unavailable), selected COPCs for the two vernal pools (352 and 353) located farthest from the former skeet station most likely do not present an unacceptable risk to any ecological receptors. PAHs are unlikely to present a risk to any receptor for vernal pools 357, 741, and 745 or ditch 358; however, lead presents a potential risk to all receptors in those vernal pools. Vernal pool 355 shows the highest level of potential risk; lead presents a potential risk to all receptors, and concentrations of 12 PAHs and total PAHs in a sediment sample collected from the vernal pool present potential risks to benthic invertebrates. Vernal pool 599 was not included in the quantitative evaluation because no shot or shards were observed in two samples collected within 100 feet of the vernal pool. Risk to ecological receptors was considered unlikely at locations where no shot or shard was observed. Conclusions of the SLERA are summarized as follows:

- COPC concentrations in sediment/soil at vernal pools 352, 353, and 599, and in the unlined ditch (358), are not likely to present an unacceptable risk to ecological receptors.
- Lead is the primary risk driver for the remaining vernal pools (355, 357, 741, and 745). Risk to vernal pool 741 is from surrounding soil only.
- Concentrations of PAHs in sediment at vernal pool 355 pose potential risks to benthic invertebrates.

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Tables

TABLE C3.2-1

Ecological Screening Values for the Protection of Ecological Receptors to Shallow Soil (0.5 to 3 feet), Surface Soil (0 to 0.5 foot), and Sediment (0 to 0.25 foot).

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

	Ecological Screening Values					
	Plants		**Avian**		**Benthic Invertebrates**	
Contaminant	**Surface and Shallow Soils (0 to 4 ft bgs)**		**Surface Soils (0 to 1 ft bgs)**		**Sediment (0 to 0.25 ft bgs)**	
Metals (mg/kg)						
Antimony	5	a	--		3	c
Arsenic	18	b	43	b	9.79	d
Copper	70	b	28	b	31.6	d
Iron	--		--		20000	e
Lead	120	b	11	b	35.8	d
Zinc[a]	160	b	46	b	121	d
Polynuclear Aromatic Hydrocarbons (mg/kg)					0	
Acenaphthene	20	a	--		0.00671	f
Anthracene[a,c]	--		--		0.0572	d
Benzo(a)anthracene	--		--		0.0748	h
Benzo(a)pyrene	--		--		0.15	d
Benzo(b)fluoranthene	--		--		--	--
Benzo(g,h,i)perylene	--		--		0.17	e
Benzo(k)fluoranthene	--		--		0.0272	g
Chrysene[c]	--		--		0.166	d
Dibenzo(a,h)anthracene	--		--		0.1	g
Fluoranthene	--		--		0.423	d
Fluorene[c]	--		--		0.0774	d
Indeno(1,2,3-cd)pyrene	--		--		0.01732	g
Naphthalene[b]	--		--		0.176	d
Phenanthrene	--		--		0.204	d
Pyrene[c]	--		--		0.195	d
Total PAHs					1.61	d

[a] Source of ecological screening level is *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision (Efroymson et al., 1997)*

[b] Source of ecological screening level is EPA's Ecological Soil Screening Levels (http://www.epa.gov/ecotox/ecossl/)

[c] Upper effects threshold (UET) from the Screening Quick Reference Tables (SQuiRTs) developed by Buchman (2008) of the National Oceanic and Atmospheric Administration (NOAA)

[d] Source of threshold effect concentration (TEC) for benthic invertebrates is *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems (MacDonald et al., 2000)*

[e] Lowest effect level (LEL) from SQuiRTs developed by Buchman (2008) of NOAA

[f] Threshold effect level (TEL) from SQuiRTs developed by Buchman (2008) of NOAA

[g] ARCS Hyalella TEL from SQuiRTs developed by Buchman (2008) of NOAA

[h] Source of effects value is EPA IV: EPA. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated November 30, 2001, http://www.epa.gov/region4/waste/ots/ecolbul.htm.

TABLE C3.3-1

Point-by-Point Hazard Quotients for Biota Exposed to Surface Soil (0 to 0.5 foot) Near Vernal Pool 352 at the SR401 Skeet Range

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Sample 62 Conc*	Sample 63 Conc*	ESV	Sample 62 HQ	Sample 63 HQ
Benthic Invertebrates			**BI ESV**		
PAHs					
Benzo(a)anthracene	ND	0.002	0.0748	ND	0.0
Benzo(a)pyrene	ND	0.004	0.15	ND	0.0
Benzo(g,h,i)perylene	ND	0.007	0.17	ND	0.0
Chrysene	ND	0.005	0.166	ND	0.0
Fluoranthene	ND	0.006	0.423	ND	0.0
Indeno(1,2,3-cd)pyrene	ND	0.004	0.0173	ND	0.3
Naphthalene	ND	0.002	0.176	ND	0.0
Phenanthrene	ND	0.004	0.204	ND	0.0
Pyrene	ND	0.005	0.195	ND	0.0
Total PAHs	ND	0.04	1.61	ND	0.0
Plants			**Plant ESV**		
PAHs					
Acenaphthene	ND	ND	20	ND	ND

*Sample was not analyzed for metals.

Notes:
Table includes detected analytes for which ESVs are available.
All units are in milligram(s) per kilogram (mg/kg) dry weight.
PAHs were analyzed by method SW8270SIM.
BI = Benthic Invertebrates
Conc = Detected concentration
ND = Not Detected

TABLE C3.3-2

Point-by-Point Hazard Quotients for Biota Exposed to Sediment (0 to 0.25 foot) in Vernal Pool 353 at the SR401 Skeet Range

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Sample 42 Conc*	ESV	Sample 42 ESV HQ	Sediment BL	Sample 42 BL HQ
Benthic Invertebrates		**BI ESV**			
Metals					
Arsenic	2.10	9.79	0.2	3.6	0.6
Lead	60.00	35.8	**1.7**	150	0.4
Plants		**Plant ESV**			
Metals					
Arsenic	2.10	18	0.1	3.6	0.6
Lead	60.00	120	0.5	150	0.4
Birds		**Avian ESV**			
Metals					
Arsenic	2.10	43	0.0	3.6	0.6
Lead	60.00	11	**5.5**	150	0.4

*Sample was not analyzed for PAHs.

Notes:
Table includes detected analytes for which ESVs and sediment background levels are available.
All units are in milligram per kilogram (mg/kg) dry weight.
Metals were analyzed by method SW6020.
HQs in bold exceed 1.
BI = Benthic Invertebrates
BL = Background Level
Conc = Detected concentration
ND = Not Detected

TABLE C3.3-3

Point-by-Point Hazard Quotients for Biota Exposed to Sediment (0 to 0.25 foot) or Surface Soil (0 to 0.5 foot) in or Near Vernal Pool 355 at the SR401 Skeet Range

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Sample 29 Conc[a]	Sample 30 Conc	Sample 31 Conc[a]	Sample 41 Conc[a]	Sample 105 Conc[b]	ESV	Sample 29 ESV HQ	Sample 30 ESV HQ	Sample 31 ESV HQ	Sample 41 ESV HQ	Sample 105 ESV HQ	CSoil BL	Sediment BL	Sample 29 BL HQ	Sample 30 BL HQ	Sample 31 BL HQ	Sample 41 BL HQ	Sample 105 BL HQ
Benthic Invertebrates						**BI ESV**												
Metals																		
Arsenic	6.3	6.3	3.1	1.9	2.4	9.79	0.6	0.6	0.3	0.2	0.2	4.9	3.6	**1.3**	**1.3**	0.6	0.4	0.7
Lead	1600	1100	290	110	290	35.8	**44.7**	**30.7**	**8.1**	**3.1**	**8.1**	74.0	150	**21.6**	**14.9**	**3.9**	**1.5**	**1.9**
PAHs																		
Acenaphthene	--	ND	--	--	0.26	0.00671	--	ND	--	--	**38.7**	--	--	--	--	--	--	--
Anthracene	--	ND	--	--	0.28	0.0572	--	ND	--	--	**4.9**	--	--	--	--	--	--	--
Benzo(a)anthracene	--	ND	--	--	2	0.0748	--	ND	--	--	**26.7**	--	--	--	--	--	--	--
Benzo(a)pyrene	--	0.06	--	--	3	0.15	--	0.4	--	--	**20.0**	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	0.06	--	--	2	0.17	--	0.3	--	--	**11.8**	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	ND	--	--	0.97	0.0272	--	ND	--	--	**35.7**	--	--	--	--	--	--	--
Chrysene	--	0.06	--	--	2.4	0.166	--	0.4	--	--	**14.5**	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	--	ND	--	--	0.52	0.1	--	ND	--	--	**5.2**	--	--	--	--	--	--	--
Fluoranthene	--	ND	--	--	2.3	0.423	--	ND	--	--	**5.4**	--	--	--	--	--	--	--
Fluorene	--	ND	--	--	0.05	0.0774	--	ND	--	--	0.6	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	ND	--	--	1.7	0.0173	--	ND	--	--	**98.3**	--	--	--	--	--	--	--
Naphthalene	--	ND	--	--	0.03	0.176	--	ND	--	--	0.2	--	--	--	--	--	--	--
Phenanthrene	--	ND	--	--	1.1	0.204	--	ND	--	--	**5.4**	--	--	--	--	--	--	--
Pyrene	--	ND	--	--	2.9	0.195	--	ND	--	--	**14.9**	--	--	--	--	--	--	--
Total PAHs	--	0.172	--	--	17.51	1.61	--	0.1	--	--	**10.9**	--	--	--	--	--	--	--
Plants						**Plant ESV**												
Metals																		
Arsenic	6.3	6.3	3.1	1.9	2.4	18	0.4	0.4	0.2	0.1	0.1	4.9	3.6	**1.3**	**1.3**	0.6	0.4	0.7
Lead	1600	1100	290	110	290	120	**13.3**	**9.2**	**2.4**	0.9	**2.4**	74.0	150	**21.6**	**14.9**	**3.9**	**1.5**	**1.9**
PAHs																		
Acenaphthene	--	ND	--	--	0.26	20	--	ND	--	--	0.0	--	--	--	--	--	--	--
Birds						**Avian ESV**												
Metals																		
Arsenic	6.3	6.3	3.1	1.9	2.4	43	0.1	0.1	0.1	0.0	0.1	4.9	3.6	**1.3**	**1.3**	0.6	0.4	0.7
Lead	1600	1100	290	110	290	11	**145.5**	**100.0**	**26.4**	**10.0**	**26.4**	74.0	150	**21.6**	**14.9**	**3.9**	**1.5**	**1.9**

[a]Sample was not analyzed for PAHs.

[b]Sediment sample, all other samples are surface soil (0 to 0.5 feet).

Notes:

Table includes detected analytes for which ESVs and surface soil or sediment (as applicable) background levels are available.

All units are in milligram per kilogram (mg/kg) dry weight.

Metals were analyzed by method SW6020 and PAHs were analyzed by method SW8270SIM.

HQs in bold exceed 1.

BI = Benthic Invertebrates

BL = Background Level

Conc = Detected concentration

CSoil = Combined Soil

ND = Not Detected

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TABLE C3.3-4

Point-by-Point Hazard Quotients for Biota Exposed to Sediment (0 to 0.25 foot) or Surface Soil (0 to 0.5 foot) in or Near Vernal Pool 357 at the SR401 Skeet Range

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Sample 30 Conc	Sample 31 Conc[a]	Sample 41 Conc[a]	Sample 106 Conc[ab]	ESV	Sample 30 ESV HQ	Sample 31 ESV HQ	Sample 41 ESV HQ	Sample 106 ESV HQ	CSoil BL	Sediment BL	Sample 30 BL HQ	Sample 31 BL HQ	Sample 41 BL HQ	Sample 106 BL HQ
Benthic Invertebrates					**BI ESV**										
Metals															
Arsenic	6.3	3.1	1.9	2.9	9.79	0.6	0.3	0.2	0.3	4.9	3.6	**1.3**	0.6	0.4	0.8
Lead	1100	290	110	450	35.8	**30.7**	**8.1**	**3.1**	**12.6**	74.0	150	**14.9**	**3.9**	**1.5**	**3.0**
PAHs															
Benzo(a)pyrene	0.06	--	--	--	0.15	0.4	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	0.06	--	--	--	0.17	0.3	--	--	--	--	--	--	--	--	--
Chrysene	0.06	--	--	--	0.166	0.4	--	--	--	--	--	--	--	--	--
Total PAHs	0.172	--	--	--	1.61	0.1	--	--	--	--	--	--	--	--	--
Plants					**Plant ESV**										
Metals															
Arsenic	6.3	3.1	1.9	2.9	18	0.4	0.2	0.1	0.2	4.9	3.6	**1.3**	0.6	0.4	0.8
Lead	1100	290	110	450	120	**9.2**	**2.4**	0.9	**3.8**	74.0	150	**14.9**	**3.9**	**1.5**	**3.0**
PAHs															
Acenaphthene	ND	--	--	--	20	ND	--	--	--	--	--	--	--	--	--
Birds					**Avian ESV**										
Metals															
Arsenic	6.3	3.1	1.9	2.9	43	0.1	0.1	0.0	0.1	4.9	3.6	**1.3**	0.6	0.4	0.8
Lead	1100	290	110	450	11	**100.0**	**26.4**	**10.0**	**40.9**	74.0	150	**14.9**	**3.9**	**1.5**	**3.0**

Notes:

Table includes detected analytes for which ESVs and surface soil or sediment (as applicable) background levels are available.

All units are in milligram(s) per kilogram (mg/kg) dry weight.

Metals were analyzed by method SW6020 and PAHs were analyzed by method SW8270SIM.

HQs in bold exceed 1.

[a]Sample was not analyzed for PAHs

[b]Sediment sample, all other samples are surface soil (0 to 0.5 foot).

BI = Benthic Invertebrates

BL = Background Level

Conc = Detected concentration

CSoil = Combined Soil

HQ = Hazard Quotient

ND = Not Detected

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TABLE C3.3-5

Point-by-Point Hazard Quotients for Biota Exposed to Surface (0 to 0.5 foot) or Shallow Soil (0.5 to 3 feet) Near Vernal Pool 741 at the SR401 Skeet Range

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Sample 22 (0-0.5') Conc[a]	Sample 22 (1-1.5') Conc[a]	Sample 22 (2.5-3') Conc[b]	Sample 31 (0-0.5') conc[a]	ESV	Sample 22 (0-0.5') ESV HQ	Sample 22 (1-1.5') ESV HQ	Sample 22 (2.5-3') ESV HQ	Sample 31 (0-0.5') ESV HQ	CSoil BL	Sample 22 (0-0.5') BL HQ	Sample 22 (1-1.5') BL HQ	Sample 22 (2.5-3') BL HQ	Sample 31 (0-0.5') BL HQ
Benthic Invertebrates					**BI ESV**									
Metals														
Arsenic	2.7	NA	--	3.1	9.79	0.3	NA	--	0.3	4.9	0.6	NA	--	0.6
Lead	33	NA	--	290	35.8	0.9	NA	--	**8.1**	74.0	0.4	NA	--	**3.9**
Plants					**Plant ESV**									
Metals														
Arsenic	2.7	2.1	--	3.1	18	0.2	0.1	--	0.2	4.9	0.6	0.4	--	0.6
Lead	33	47	--	290	120	0.3	0.4	--	**2.4**	74.0	0.4	0.6	--	**3.9**
PAHs														
Acenaphthene	--	--	ND	--	20	--	--	ND	--	--	--	--	--	--
Birds					**Avian ESV**									
Metals														
Arsenic	2.7	NA	--	3.1	43	0.1	NA	--	0.1	4.9	0.6	NA	--	0.6
Lead	33	NA	--	290	11	**3.0**	NA	--	**26.4**	74.0	0.4	NA	--	**3.9**

[a]Sample was not analyzed for PAHs.

[b]Sample was not analyzed for metals.

Notes:
Table includes detected analytes for which ESVs and surface soil background levels are available.
All units are in milligram(s) per kilogram (mg/kg) dry weight.
Metals were analyzed by method SW6020 and PAHs were analyzed by method SW8270SIM.
HQs in bold exceed 1.
BI = Benthic Invertebrates
BL = Background Level
Conc = Detected concentration
CSoil = Combined Soil
NA = Not applicable; depth evaluated only for plants
ND = Not Detected

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TABLE C3.3-6

Point-by-Point Hazard Quotients for Biota Exposed to Sediment (0 to 0.25 foot) or Surface Soil (0 to 0.5 foot) in or Near Vernal Pool 745 at the SR401 Skeet Range

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Sample 28 Conc[a]	Sample 29 Conc[a]	Sample 30 Conc	Sample 104 Conc[ab]	ESV	Sample 28 ESV HQ	Sample 29 ESV HQ	Sample 30 ESV HQ	Sample 104 ESV HQ	CSoil BL	Sediment BL	Sample 28 BL HQ	Sample 29 BL HQ	Sample 30 BL HQ	Sample 104 BL HQ
Benthic Invertebrates					**BI ESV**										
Metals															
Arsenic	2.3	6.3	6.3	3.9	9.79	0.2	0.6	0.6	0.4	4.9	3.6	0.5	**1.3**	**1.3**	**1.1**
Lead	20	1600	1100	170	35.8	0.6	**44.7**	**30.7**	**4.7**	74.0	150	0.3	**21.6**	**14.9**	**1.1**
PAHs															
Benzo(a)pyrene	--	--	0.06	--	0.15	--	--	0.4	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	0.06	--	0.17	--	--	0.3	--	--	--	--	--	--	--
Chrysene	--	--	0.06	--	0.166	--	--	0.4	--	--	--	--	--	--	--
Total PAHs	--	--	0.172	--	1.61	--	--	0.1	--	--	--	--	--	--	--
Plants					**Plant ESV**										
Metals															
Arsenic	2.3	6.3	6.3	3.9	18	0.1	0.4	0.4	0.2	4.9	3.6	0.5	**1.3**	**1.3**	**1.1**
Lead	20	1600	1100	170	120	0.2	**13.3**	**9.2**	**1.4**	74.0	150	0.3	**21.6**	**14.9**	**1.1**
PAHs															
Acenaphthene	--	--	ND	--	20	--	--	ND	--	--	--	--	--	--	--
Birds					**Avian ESV**										
Metals															
Arsenic	2.3	6.3	6.3	3.9	43	0.1	0.1	0.1	0.1	4.9	3.6	0.5	**1.3**	**1.3**	**1.1**
Lead	20	1600	1100	170	11	**1.8**	**145.5**	**100.0**	**15.5**	74.0	150	0.3	**21.6**	**14.9**	**1.1**

[a]Sample was not analyzed for PAHs.

[b]Sediment sample, all other samples are surface soil (0 to 0.5 feet).

Notes:

Table includes detected analytes for which ESVs and surface soil or sediment (as applicable) background levels are available.

All units are in milligram(s) per kilogram (mg/kg) dry weight.

Metals were analyzed by method SW6020 and PAHs were analyzed by method SW8270SIM.

HQs in bold exceed 1.

BI = Benthic Invertebrates

BL = Background Level

Conc = Detected concentration

CSoil = Combined Soil

ND = Not Detected

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TABLE C3.3-7a
Point-by-Point Hazard Quotients Based on Ecological Screening Values for Biota Exposed to Sediment (0 to 0.25 feet) or Surface Soil (0 to 0.5 feet [except as noted]) in or Near Ditch 358 at the SR401 Skeet Range
SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Sample 101 Conc[ac]	Sample 102 Conc[bc]	ESV	Sample 101 ESV HQ	Sample 102 ESV HQ
Benthic Invertebrates			**BI ESV**		
Metals					
Arsenic	1.1	--	9.79	0.1	--
Lead	16	--	35.8	0.4	--
PAHs					
Benzo(a)anthracene	--	0.005	0.0748	--	0.1
Benzo(a)pyrene	--	0.007	0.15	--	0.0
Benzo(g,h,i)perylene	--	0.007	0.17	--	0.0
Benzo(k)fluoranthene	--	0.003	0.0272	--	0.1
Chrysene	--	0.006	0.166	--	0.0
Dibenzo(a,h)anthracene	--	0.002	0.1	--	0.0
Fluoranthene	--	0.006	0.423	--	0.0
Indeno(1,2,3-cd)pyrene	--	0.006	0.0173	--	0.3
Phenanthrene	--	0.002	0.204	--	0.0
Pyrene	--	0.007	0.195	--	0.0
Total PAHs	--	0.05	1.61	--	0.0
Plants			**Plant ESV**		
Metals					
Arsenic	1.1	--	18	0.1	--
Lead	16	--	120	0.1	--
PAHs					
Acenaphthene	--	ND	20	--	ND
Birds			**Avian ESV**		
Metals					
Arsenic	1.1	--	43	0.0	--
Lead	16	--	11	**1.5**	--

[a]Sample was not analyzed for PAHs.
[b]Sample was not analyzed for metals.
[c]Sediment sample, all other samples are soil.

Notes:
Table includes detected analytes for which ESVs and surface soil or sediment (as applicable) background levels are available.
All units are in milligram(s) per kilogram (mg/kg) dry weight.
Metals were analyzed by method SW6020 and PAHs were analyzed by method SW8270SIM.
HQs in bold exceed 1.
NA = Not Applicable
BI = Benthic Invertebrates
BL = Background Levels
Conc = Detected concentration or the 1/2 the reported limit
CSoil = Combined Soil
NA = Not applicable; depth evaluated only for plants
ND = Not Detected

TABLE C3.3-7b

Point-by-Point Hazard Quotients Based on Background Levels of metals for Biota Exposed to Sediment (0 to 0.25 foot) or Surface Soil (0 to 0.5 foot [except as noted]) in or Near Ditch 358 at the SR401 Skeet Range

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Analyte	Sample 101 Conc[b]	Sample 102 Conc[ab]	Sediment BL	Sample 101 BL HQ	Sample 102 BL HQ
Benthic Invertebrates					
Metals					
Arsenic	1.1	--	3.6	0.3	--
Lead	16	--	150	0.1	--
Plants					
Metals					
Arsenic	1.1	--	3.6	0.3	--
Lead	16	--	150	0.1	--
Birds					
Metals					
Arsenic	1.1	--	3.6	0.3	--
Lead	16	--	150	0.1	--

[a]Sample was not analyzed for metals.

[b]Sediment sample, all other samples are soil.

Notes:
Table includes detected analytes for which ESVs and surface soil or sediment (as applicable) background levels are available.
All units are in milligram(s) per kilogram (mg/kg) dry weight.

Metals were analyzed by method SW6020 and PAHs were analyzed by method SW8270SIM.
HQs in bold exceed 1.
NA = Not Applicable
BL = Background Levels
Conc = Detected concentration
CSoil = Combined Soil

TABLE C3.5-1

Risk Summary of Chemicals Exceeding Background Levels and Ecological Screening Values for Biota Exposed to Sediment/Soil in or Near Vernal Pools and Ditch 358 at the SR401 Skeet Range

SR401 Skeet Range RI/FS, Former McClellan Air Force Base, Sacramento, California

Location	Number of Samples	Background Exceedances	Benthic Invertebrates ESV Exceedances	Plants ESV Exceedances	Birds ESV Exceedances	Risk Summary
VP 352						
Metals	0	NA	Not Analyzed	Not Analyzed	Not Analyzed	Low-No Shot Observed
PAHs	2	NA	ND and No Exceedances	ND and No Exceedances	No ESVs	Unlikely Risk from PAHs
VP 353						
Metals	1	No Exceedances	Lead	No Exceedances	Lead	Low-Representative of Background
PAHs	0	NA	Not Analyzed	Not Analyzed	Not Analyzed	Low-No Shards Observed
VP 355						
Metals	5	Arsenic and Lead	Lead	Lead	Lead	Potential Risk from Lead
PAHs	2	NA	12 PAHs from VP sample	ND and No Exceedances	No ESVs	Potential Risk from PAHs to BI
VP 357						
Metals	4	Lead	Lead	Lead	Lead	Potential Risk from Lead
PAHs	1	NA	ND and No Exceedances	ND and No Exceedances	No ESVs	Unlikely Risk from PAHs
VP 599	No shot or shards were observed in 2 samples collected within 100 feet of VP 599; therefore, the VP was not evaluated.					
VP 741						
Metals	3	Lead	Lead	Lead	Lead	Potential Risk from Lead*
PAHs	1	NA	Not Analyzed	ND and No Exceedances	No ESVs	Unlikely Risk from PAHs
VP 745						
Metals	4	Arsenic and Lead	Lead	Lead	Lead	Potential Risk from Lead
PAHs	1	NA	ND and No Exceedances	ND and No Exceedances	No ESVs	Unlikely Risk from PAHs
Ditch 358						
Metals	1	No Exceedances	No Exceedances	No Exceedances	No Exceedances	Unlikely Risk from Metals
PAHs	1	NA	ND and No Exceedances	ND and No Exceedances	No ESVs	Unlikely Risk from PAHs

Notes:

* surrounding soil only

Only samples with observed shot and shards were analyzed for metals and PAHs, respectively.

BI = Benthic Invertebrates

NA = Not Applicable

ND = Not Detected

VP = Vernal Pool

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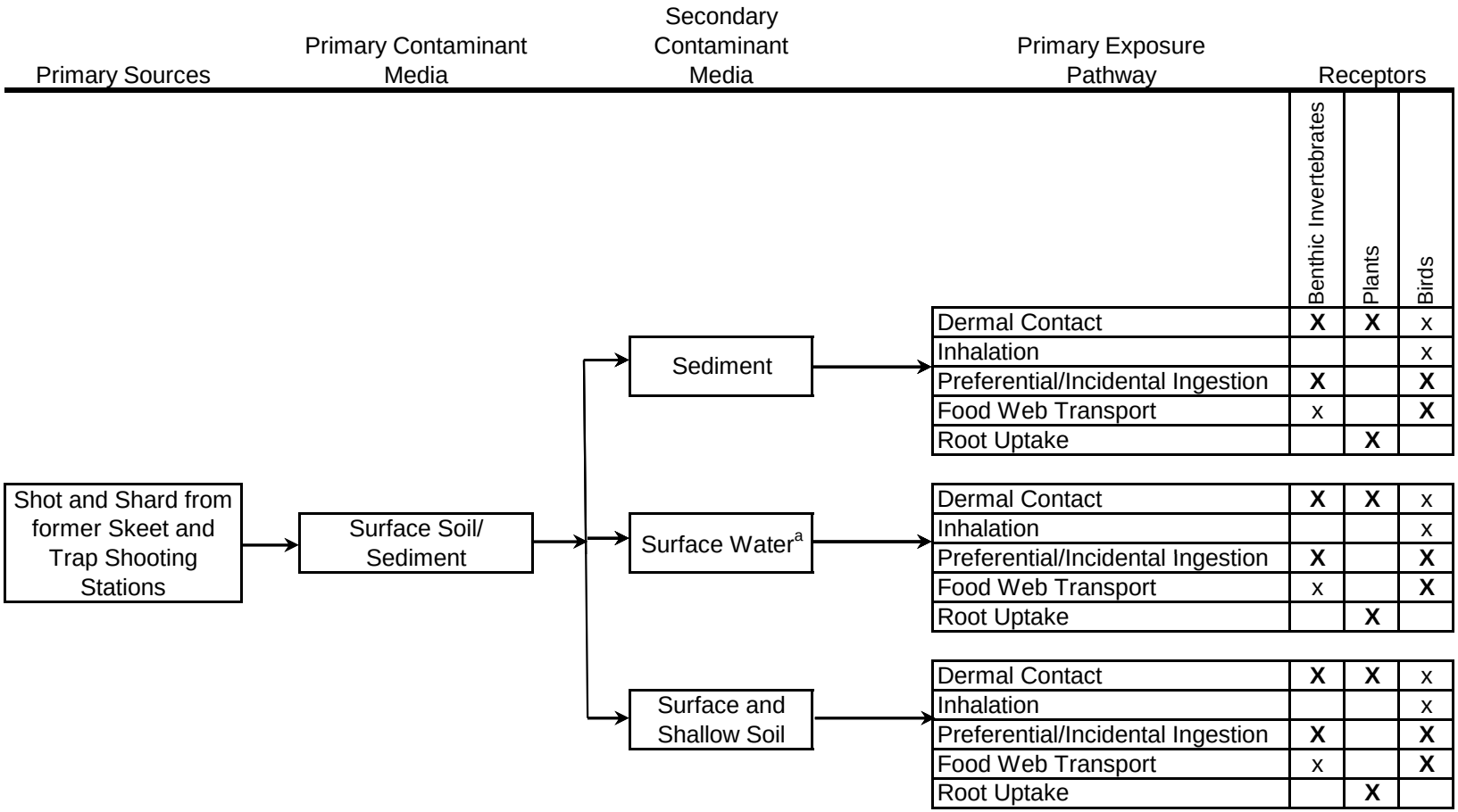
Figure

Figure C3.2-1
Ecological Conceptual Site Model
SR401 Skeet Range Remedial Investigation, Former McClellan Air Force Base, Sacramento, California



Footnotes:
X = Potentially complete pathway
x = Insignificant potentially complete pathway
Blank = Incomplete pathway
[a]Surface water was not present at time of sampling and was not evaluated.

Appendix D
Sustainability Impact Analysis

APPENDIX D

Sustainability Impact Analysis

A sustainability evaluation was completed for four alternatives at the Former McClellan Air Force Base using the Sustainable Remediation Tool (SRT). The SRT was developed for the Air Force Center for Engineering and the Environment (AFCEE) to help incorporate sustainability concepts into a remediation decision-making process for the following:

- Planning future remediation implementation
- Optimizing operating remediation system
- Comparing remediation technologies

The SRT allows users to estimate sustainability metrics for specific technologies. The current technologies in the SRT are (1) Excavation, (2) Soil Vapor Extraction, (3) Pump and Treat, (4) Enhanced Bioremediation, (5) In Situ Chemical Oxidation, (6) Permeable Reactive Barrier, (7) Monitored Natural Attenuation/Long-term Monitoring, and (8) Thermal Soil Treatment. AFCEE attends to add additional technology modules to the tool in the future.

This analysis focuses on the proposed plan for the cleanup at the SR401 Skeet Range located in the western portion of McClellan. A total of seven cleanup alternatives were evaluated. The alternatives are as follows:

- Alternative 1: No Action
- Alternative 2a: Excavation, Disposal, Revegetation, and Institutional Controls (Restricted Land Use)
- Alternative 2b: Excavation, Disposal, and Revegetation (Unrestricted Land Use)
- Alternative 3a: Excavation, Soil Washing, Disposal, Revegetation, and Institutional Controls (Restricted Land Use)
- Alternative 3b: Excavation, Soil Washing, Disposal, and Revegetation (Unrestricted Land Use)
- Alternative 4a: Excavation, Solidification/Stabilization, Disposal, Revegetation, and Institutional Controls (Restricted Land Use)
- Alternative 4b: Excavation, Solidification/Stabilization, Disposal, and Revegetation (Unrestricted Land Use)

Assumptions and sources used to calculate the sustainability metrics for each alternative are presented below.

Air Emissions

For the air emissions analysis, metrics associated with the production of carbon dioxide, sulfur oxides, nitrogen oxides, and particle matter were considered. The following primary components were evaluated for their air emission impacts:

- Light vehicle use during construction
- Heavy equipment (excavation, stockpiling, backfilling)
- Heavy-duty trucks (highway hauling)
- Fuel used for individual unit process such as soil stabilization or soils washing
- Production of Portland Cement (outside SRT)

Sustainability metrics for light vehicle use were calculated assuming 14 miles per round trip for each visit to the site. The number of site visits for each alternative varied. The SRT estimated the amount of hours to excavate the required quantity of material for each alternative. The hours required for excavation were divided by a 10-hour working day to calculate the number of trips to the site. Air emissions were calculated by the SRT by multiplying the vehicle emission factors times the total number of miles driven.

Sustainability metrics for heavy equipment were calculated assuming a certain area of affected soil that must be removed. For alternatives with Restricted Land Use controls it was assumed that 9,500 cubic yards of material would be excavated. For alternatives with Unrestricted Land Use controls, 10,000 cubic yards of material were assumed to be excavated. Using the SRT rules of thumb for excavation rates, backfill rates, equipment fuel consumption rates, and mileages, the hours of equipment operation and amounts of fuel consumed were calculated. For backfilling purposes, it was assumed that backfill was available within 0.5 mile. The landfill distances used in the calculations were 230 miles for a Class I landfill and 70 miles for a Class II landfill. Air emissions were calculated by the SRT by multiplying the appropriate vehicle emission factors times the total number of miles driven or the amount of diesel fuel used.

Sustainability metrics for soil washing activities were calculated based on the equipment required (track-mounted screen plant, dozer, articulated trucks, loaders, etc.) to wash and separate 10,000 cubic yards of soil. The estimated amount of time of operation for each piece of equipment and the fuel usage rates were used to calculate the total amount of diesel fuel consumed. It was assumed that the soil washing project would take approximately 16 days. The hours required for soil washing were calculated assuming a 10-hour working day. The amount of gallons of diesel fuel consumed by soil washing activities (~19,000) was added into the initial SRT run conducted for the excavation activities.

Sustainability metrics for stabilization/solidification activities were calculated based on the equipment required (track-mounted screen plant, dozer, articulated trucks, loaders, etc.) to mix and stabilize 10,000 cubic yards of soil with Portland Cement. The estimated amount of time of operation for each piece of equipment and the fuel usage rates were used to calculate the total amount of diesel fuel consumed. It was assumed that the project would take approximately 9 days. The hours required for solidification/stabilization was calculated assuming a 10-hour working day. The amount of gallons of diesel fuel consumed for solidification/stabilization (~7,000) was added into the initial SRT run conducted for the excavation activities. Transportation of Portland Cement to the site was also included in the

fuel consumption estimate. In addition, the emissions (CO_2 only) were calculated for the production of 1,640 tons of Portland Cement. The SRT does not have the capability to make this calculation. The emission factor for CO_2 was acquired from a freely available carbon database (Hammond and Jones, 2008). A simple calculation was performed by multiplying the emission factor and quantity of Portland Cement.

Risk of Accident and Lost Time

Impacts associated with risks to workers and the public were also evaluated for each site. Sustainability metrics for lost time resulting from hours worked and travel hours for vehicle use during construction activities were based on the total number of miles driven for the each alternative. The risk of non-fatal injuries was derived from United States Bureau of Labor statistics based on onsite worker hours. Risk of accident and lost time calculations do not take into consideration the manufacturing of Portland Cement.

Non-renewable Resource Use

The different remediation alternatives being evaluated will result in the use of different amounts of non-renewable resources such as fuel and/or electricity. Possible renewable resources were not factored in as part of the analysis. Soil washing in Alternatives 3a and 3b will use a considerable amount of water. It is estimated that 600,000 gallons of water would be required to wash 10,000 cubic yards of soil. Potable and/or palatable water is not required to perform the soil washing activities. Surface water not necessarily used for drinking water is typically used rather than water from a municipal source, if available. For this evaluation it was assumed that no surface water is readily available. When water must be purchased, a typical water usage cost of approximately $8.00/1,000 gallons equates to a water cost of $4,800.

Results of Analysis

Results show that Alternatives 2 and 3 are very similar in energy consumption and air emission impacts compared with Alternative 4. Alternatives 2a and 3a contained the lowest energy consumption and air emissions. CO_2 emissions for Alternative 4 are three times higher when compared with the other alternatives. Significant energy consumption and emissions associated with the production of Portland Cement is the main cause for the significant increases. So from a sustainability impacts perspective, there is very little difference between the alternatives with soil washing, which reduces hazardous soil disposal, and the alternatives with excavation and disposal only. Alternative 4 has a lower risk of accident because fewer heavy truck highway miles are required if stabilized soil can go to a closer Class II landfill. The risks for Alternative 4 do not include hours worked during the production of cement. The associated impacts calculated for each alternative using the SRT are included in Table D-1.

References

Air Force Center for Engineering and the Environment (AFCEE). 2010. Sustainable Remediation Tool Version 2.1. Microsoft Excel-based platform. May.

Hammond, Geoff and C. Jones. 2008. Inventory of Carbon & Energy (ICE), Version 1.6a. University of Bath, UK.

TABLE D-1
Sustainable Remediation Tool Results
SR401 Skeet Range Record of Decision, Former McClellan Air Force Base, Sacramento, California

Site	Air Emissions				Risk of Accident and Fatality		Non-renewable Resource Use		Remedial Action
	CO_2 (tons)[a]	NO_x (tons)	SO_x (tons)	PM_{10} (tons)	Lost Hours[b]	Injury Risk[c]	Total Energy Consumption[d] (megajoules)	Total Energy Consumption[d] (kWh)	
Alternative 2a									
Excavation, Disposal, Revegatation, and ICs (Restricted Land Use)	450	3.7	0.004	0.17	12.0	2.5E-01	6,000,000	1,700,000	Hazardous soils - disposal 6,175 cubic yards to Class I landfill
Excavation, Disposal, Revegatation, and ICs (Restricted Land Use)	79	0.64	0.001	0.03	2.0	4.2E-02	1,000,000	280,000	Non-hazardous soils - disposal 3,325 cubic yards to Class II landfill
Alternative 2a – TOTAL	**529**	**4.3**	**0.004**	**0.20**	**14.0**	**2.9E-01**	**7,000,000**	**1,980,000**	
Alternative 2b									
Excavation, Disposal, and Revegatation (Unrestricted Land Use)	540	4.4	0.0042	0.21	14.0	2.9E-01	7,100,000	2,000,000	Hazardous soils - disposal 7,500 cubic yards to Class I landfill
Excavation, Disposal, and Revegatation (Unrestricted Land Use)	59	0.48	0.0005	0.02	1.5	3.1E-02	780,000	220,000	Non-hazardous soils - disposal 2,500 cubic yards to Class II landfill
Alternative 2b – TOTAL	**599**	**4.9**	**0.005**	**0.23**	**15.5**	**3.2E-01**	**7,880,000**	**2,220,000**	
Alternative 3a									
Excavation, Disposal, Revegatation, and ICs (Restricted Land Use)	90	0.73	0.001	0.04	2.4	5.0E-02	1,200,000	330,000	Hazardous soils - disposal 1,235 cubic yards to Class I landfill
Excavation, Disposal, Revegatation, and ICs (Restricted Land Use)	190	1.6	0.002	0.08	4.9	1.0E-01	2,600,000	720,000	Non-hazardous soils - disposal 8,265 cubic yards to Class II landfill
Soil Washing	260	2.1	0.002	0.10	6.8	1.4E-01	3,400,000	970,000	Excavated soil treated via soil washing to remove lead shot and shards prior to offsite disposal
Alternative 3a – TOTAL	**540**	**4.4**	**0.004**	**0.21**	**14.1**	**2.9E-01**	**7,200,000**	**2,020,000**	
Alternative 3b									
Excavation, Disposal, and Revegatation (Unrestricted Land Use)	110	0.86	0.001	0.04	2.8	5.8E-02	1,400,000	390,000	Hazardous soils - disposal 1,500 cubic yards to Class I landfill
Excavation, Disposal, and Revegatation (Unrestricted Land Use)	190	1.6	0.002	0.08	4.9	1.0E-01	2,600,000	720,000	Non-hazardous soils - disposal 8,500 cubic yards to Class II landfill
Soil Washing	260	2.1	0.002	0.10	6.8	1.4E-01	3,400,000	970,000	Excavated soil treated via soil washing to remove lead shot and shards prior to offsite disposal
Alternative 3b – TOTAL	**560**	**4.5**	**0.004**	**0.21**	**14.5**	**3.0E-01**	**7,400,000**	**2,080,000**	
Alternative 4a									
Manufacturing of Portland Cement[e]	1,353	NA	NA	NA	NA	NA	6,800,000	1,900,000	Calculations based on 1,640 tons of Portland cement
Excavation, Disposal, Revegatation, and ICs (Restricted Land Use)	230	1.9	0.002	0.09	5.7	1.2E-01	3,100,000	860,000	Non-hazardous soils - disposal 9,500 cubic yards to Class II landfill
Stabilization/Solidification	90	0.7	0.001	0.03	2.7	6.0E-02	1,200,000	340,000	Excavated soil treated via solidification/stabilization to demobilize COCs prior to offsite disposal
Alternative 4a – TOTAL	**1,673**	**2.6**	**0.003**	**0.12**	**8.4**	**1.8E-01**	**11,100,000**	**3,100,000**	
Alternative 4b									
Manufacturing of Portland Cement[e]	1,353	NA	NA	NA	NA	NA	6,800,000	1,900,000	Calculations based on 1,640 tons of Portland cement
Excavation, Disposal, and Revegatation (Unrestricted Land Use)	230	1.9	0.002	0.09	5.7	1.2E-01	3,100,000	860,000	Non-hazardous soils - disposal 10,000 cubic yards to Class II landfill
Stabilization/Solidification	90	0.7	0.001	0.03	2.7	6.0E-02	1,200,000	340,000	Excavated soil treated via solidification/stabilization to demobilize COCs prior to offsite disposal
Alternative 4b – TOTAL	**1,673**	**2.6**	**0.003**	**0.12**	**8.4**	**1.8E-01**	**11,100,000**	**3,100,000**	

[a] The use of tons indicates American or short tons. One American or short ton = 2,000 pounds.
[b] Lost hours represents the number of hours of lost time due to injuries resulting from hours worked at the site and travel hours.
[c] The risk of non-fatal injuries derived from the United States Bureau of Labor (2006).
[d] Energy consumption for each technology evaluated with SRT takes into consideration all the sources of energy consumed during lifecycle of the technology. Energy sources include gasoline, diesel, electricity, and natural gas.
[e] Data to compute the energy consumption and air emissions associated with cement production from Inventory of Carbon & Energy (ICE), Version 1.6a (Hammond and Jones, 2008).

Notes:

CO_2 = carbon dioxide
kWh = kilowatt-hour
SO_x = sulfur oxides
NA = not applicable
NO_x = nitrogen oxides
PM_{10} = particulate matter (inhalable coarse particles) smaller than 10 micrometers

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Appendix E
Administrative Record Index

APPENDIX E

Administrative Record Index

TABLE E-1
Administrative Record Index

Document Date	Subject or Title	Author / Corporate Affil	AR Number
01 Apr 2000	RI, Final Report, Addenda, Vol I of V, OU-D	Radian, Corp.	3801
01 Apr 2000	Update Pages, RI Final Report, Addenda, Vol II of V, OU-D	Radian, Corp.	3802
01 Apr 2000	Update Pages, RI Final Report, Addenda, Vol III of V, OU-D	Radian, Corp.	3803
01 Apr 2000	RI, Final Report, Addenda, Vol IV of V, Appendices A-C, OU-D	Radian, Corp.	3804
01 Apr 2000	RI, Final Report, Addenda, Vol V of V, OU-D	Radian, Corp.	3805.10
01 Apr 2000	RI, Final Report, Addenda, Vol V of V, OU-D	Radian, Corp.	3805.20
01 May 2002	Final Technology Application Analysis Report, Ex Situ Thermal Desorption Treatability Study, Revision 0	URS Group, Inc.	4449
01 Jul 2002	Final Bench Scale Study Report For EX SITU Wet Oxidation Treatability Study at McClellan Air Force Base	URS	4980
01 Sept 2003	Former McClellan Air Force Base, Basewide Quality Assurance Project Plan. Revision 5, Volume 1: General Sections	URS Group	4945
25 Jun 2004	Final Addendum to the 1999 McClellan Air Force Base Basewide Volatile Organic Compound Feasibility Study (VOC FS)	Brunner, Paul G. / AFRPA	5487
22 Sep 2005	Former McClellan AFB Interim Basewide Remedial Investigation Report, Part 1, General Framework Revision 2, Final (DSR# 381-7)	Mitretek Systems, Inc.	5934
01 Nov 2006	Military Munitions Response Program (MMRP) Site Closure Criteria	AFRPA	7143
01 Aug 2007	Final Basewide VOC Record of Decision	Andy Cramer / CH2M HILL	6475
16 Oct 2007	Final Soils Data Gap Work Plan	Nick Sjaarda / CH2M HILL	6971
02 Oct 2008	Former McClellan AFB Munitions Visual Site Inspection (VSI) Report, Skeet Range, MMRP Site SR401	AFRPA	7144
01 Jan 2009	Update to the Wetlands Delineation for the former McClellan Air Force Base	CH2M HILL	7145
01 Jan 2009	Update to the Wetlands Delineation for the Former McClellan Air Force Base	CH2M HILL	7145.10
29 Apr 2009	COE Comments on the Approved Pre-Rapanos, Revised Jurisdictional Determination for a Portion of Former McClellan AFB	Michael Finan / COE	6660
30 Jul 2009	Final Soils Data Gap Remedial Investigation Characterization Summaries Addenda	Latonya Coleman / CH2M HILL	6884

TABLE E-1
Administrative Record Index

Document Date	Subject or Title	Author / Corporate Affil	AR Number
30 Jul 2009	Final Soils Data Gap Remedial Investigation Characterization Summaries Addenda	Latonya Coleman / CH2M HILL	6884.10
30 Jul 2009	Final Soils Data Gap Remedial Investigation Characterization Summaries Addenda	Latonya Coleman / CH2M HILL	6884.20
22 July 2009	Final Non-VOC Amendment to the Basewide VOC Groundwater Record of Decision	Steve Mayer / AFRPA	7055
24 Sep 2009	Final SR401 Skeet Range Investigation Work Plan	Brian Garber / CH2M HILL	7030
01 Apr 2010	Final SR401 Skeet Range Remedial Investigation/Feasibility Study	Brian Garber / CH2M HILL	7142
09 July 2010	Skeet Range Proposed Plan	CH2M HILL	7185

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