RESOURCE CONSERVATION AND RECOVERY ACT
INTERIM STATUS
DRAFT CLOSURE PLAN

OPEN BURNING/OPEN DETONATION UNITS

AT

SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

JULY 2007

prepared by

Tetra Tech NUS, Inc.

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ºF	degrees Fahrenheit
µg/kg	micrograms per kilogram
µg/g	micrograms per gram
µg/L	micrograms per liter
µg/dL	micrograms per deciliter
µm	micrometers
ADA	Active Demolition Area
AOI	Area of Interest
bgs	below ground surface
BLM	Bureau of Land Management
BLU	bomb loaded unit
BRAC	Base Realignment and Closure Process
B&R Environmental	Brown and Root Environmental
BTTN	Butanetriol trinitrate
CADs	cartridge actuated devices
Cal EPA	California Environmental Protection Agency
Cal-Wet	California Waste Extraction Test
CBU	cluster bomb unit
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CITE	Centers of Industrial and Technical Excellence
COC	chemicals of concern
COE	Corps of Engineers
COPC	chemical of potential concern
Cr III	trivalent chromium
Cr VI	hexavalent chromium
CRWQCB	California Regional Water Quality Control Board
CSM	Conceptual Site Model
CTC	Cost-to-complete
DA	Department of the Army
DATB	1,3-Diamino-2,4,6-trinitrobenzene
DBP	Dibutylphthalate
DDESB	DoD Explosive Safety Board
DDNP	Diazodinitrophenol
DEGN	Diethyleneglycol dinitrate

dEIR	draft Environmental Impact Report
DMM	discarded military munitions
-DNT	2,6-dinitrotoluene
DoD	Department of Defense
DPA	Diphenylamine
DTSC	Department of Toxic Substance Control
EOD	Explosive Ordnance Disposal
EEDN	Ethylamine dinitrate
EP	Extraction Procedure
FFSRA	Federal Facility Site Remediation Agreement
FS	Feasibility Study
FSP	field sampling plan
gpm	gallons per minute
GPS	Global Positioning System
HBX	High Blast Explosive
HC	Hazard Class
HC/D	Hazard Class/Division
HE	High Explosive
HEI	High Explosive Incendiary
HERD	Health and Ecological Risk Division
HHRA	human health risk assessment
HI	hazard index
HNAB	Hexanitroazobenzene
HNUS	Halliburton NUS
HQ	Hazard Quotient
HRA	Health Risk Assessment
IAP	Installation Action Plan
ICBM	intercontinental ballistic missiles
ICM	improved conventional munitions
ICM/CBU	improved conventional munitions/cluster bomb units
KDNBF	Potassium dinitrobenzofuroxane
km	kilometer
km^2	square kilometer
LBA	Lower Burning Area
LBG	Lower Burning Ground
LMNR	Lead mononitroresorcinate
LUC	Land Use Control

MC	Munitions Constituent
MCL	Maximum Containment Level
MEC	Munitions and Explosives of Concern
mg/L	milligrams per liter
MHE	material handling equipment
MIDAS	Munitions Items Disposition Action System
MLRS	multiple launch rocket system
MMRP	Military Munitions Response Program
mph	miles per hour
MPPEH	Material Potentially Presenting an Explosive Hazard
msl	mean sea level
NATO	North Atlantic Treaty Organization
NC	Nitrocellulose
NEW	net explosive weight
NFA	no further action
NG	nitroglycerine
NOAA	National Oceanic and Atmospheric Administration
NQ	nitroquanidine
NS	nitrostarch
OB	Open Burning
OD	Open Detonation
ODA	Open Detonation Area
PADs	propellant actuated devices
PBX	plastic bonded explosive
PETN	pentaerythiol tetranitrate
ppm	parts per million
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylenetrinitramine
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SI	Site Investigation
SIAD	Sierra Army Depot
SLBM	submarine launched ballistic missile
STLC	Soluble Threshold Limiting Concentration
SWMUs	solid waste management units

TATB	triamino trinitrobenzene
TC	Toxicity Characteristic
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TEGDN	triethylene glycol dinitrate
TNT	trinitrotoluene
TMETN	1,1,1-trimethylamine trinitrate
TTLC	Total Threshold Limit Concentration
TtNUS	Tetra Tech NUS, Inc.
U.S.	United States
UBA	Upper Burning Area
UBG	Upper Burning Grounds
UCL	Upper Confidence Limit
UNO	United Nations Organization
USACE	United States Army Corps of Engineers
USAEHA	United States Army Environmental Health Agency
USDA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency
USGS	United States Geological Society
UXO	unexploded ordnance
VOCs	volatile organic compounds
WET	waste extraction test

EXECUTIVE SUMMARY

Sierra Army Depot (SIAD) operated as a resource Conservation and Recovery Act (RCRA) hazardous waste treatment facility with open burning (OB) and open detonation (OD) Units for the treatment of hazardous waste military munitions. The OB/OD Units operated under an interim status permit, which was issued by the California Environmental Protection Agency Department of Toxics Substances Control (DTSC). SIAD had requested a Permit for operation of the OB/OD Units as permitted hazardous waste treatment facility. During 1999 DTSC had issued a draft permit and a draft Environmental Impact Report for public comment. The permitting process was delayed due to a lawsuit against SIAD. SIAD withdrew the application for the OB/OD treatment operations in a letter dated May 19, 2003. Only emergency treatment operations have occurred since the application was withdrawn. DTSC published a notice on November 25, 2003 that interim status would be terminated for the SIAD OB/OD Units. Interim status was terminated by DTSC on January 10, 2004. The initial draft closure plan for the interim status SIAD OB/OD Units was submitted to DTSC on January 23, 2004. DTSC reviewed the draft Closure Plan and requested additional information. SIAD provided DTSC with the requested information through subsequent drafts, concluding with this final Draft Phase I Closure Plan (Closure Plan) submitted in July 2007.

Closure of hazardous waste units is required to address any contamination within the boundary of the hazardous waste units as well as any releases beyond the treatment unit boundaries. This Closure Plan addresses contamination within the boundaries of the OB/OD units and does not address releases beyond the boundaries. Under the authority of this Closure Plan, releases beyond the OB/OD Unit boundaries are being addressed, by the Department of Defense (DoD) Military Munitions Response Program.

The contents of this Closure Plan meet the requirements described in 22 CCR 66265 Article 7 for closure of interim status units. Closure of the OB/OD Units will take place in two phases. Phase I will consist of the environmental investigations which are necessary to determine the nature and extent of contamination. These environmental investigations are anticipated to take place in two or more rounds. Phase II will consist of the evaluation of the need for remedial measures and, if necessary, the development and implementation of remedial measures.

This is the Phase I Closure Plan. Descriptive information is provided on the types of military munitions that were treated in the OB/OD units and on environmental investigations that were previously conducted at the OB/OD Units. The plan for the collection of samples during Round 1 at the OB/OD Units is described. The description includes the locations of the samples that will be collected and the analysis that will be conducted. Once this Closure Plan is approved by DTSC, SIAD will implement the Round I fieldwork. The results will be evaluated by DTSC to determine whether additional rounds of fieldwork are required. If additional fieldwork is necessary, SIAD will prepare and submit a Work Plan for Round II fieldwork.

Once all of the Phase I fieldwork has been completed and approved by DTSC, SIAD will prepare and submit the Phase II Closure Plan. Corrective measures, if necessary, will be implemented once DTSC approves the Phase II Closure Plan.

1.0 BACKGROUND INFORMATION - 22 CCR 66265 ARTICLE 7

This document is the Phase I Closure Plan (Closure Plan) for the Sierra Army Depot (SIAD) Open Burn (OB)/Open Detonation (OD) treatment units (OB/OD Units). The OB/OD Units became subject to the Resource Conservation and Recovery Act (RCRA) interim status and permitting requirements for hazardous waste treatment units on November 28, 1980. Numerous steps were taken during the permitting process including the following:

- November 1988 submittal of an initial Part B Permit Application as required to continue hazardous waste OB/OD treatment operations.

- March 1994 submittal of a Part B Permit Application to the Department of Toxic Substances Control (DTSC) for the operation of the deactivation furnace.

- May 1995 hazardous waste treatment certification closure for the deactivation furnace (e.g., incinerator).

- 1997 submittal of various permit application modifications including the addition of storage facilities for hazardous waste munitions.

- October 1999 presentation to the DTSC that resulted in a draft permit and a draft Environmental Impact Report (dEIR) for public comment.

- 2001/2002 permitting process delays due to a lawsuit against SIAD and the subsequent settlement between the parties.

SIAD withdrew the application for the OB/OD storage and incineration facilities in a letter dated May 19, 2003. DTSC published a notice on November 25, 2003 that interim status would be terminated for the SIAD OB/OD Units. DTSC hazardous waste regulations require that OB/OD Units submit a closure plan within 15 days of the date on which interim status is terminated. Interim status was terminated by DTSC on January 10, 2004 for the OB/OD Units. The closure plan for the interim status SIAD OB/OD Units was submitted to DTSC on January 23, 2004. Because the storage and incineration units were classified as new units and never operated as hazardous waste management units, they are not subject to RCRA closure requirements. DTSC reviewed the initial Closure Plan and requested additional information. During 2004 and 2005, various discussions and meetings took place to resolve various issues regarding boundary descriptions, scope of the program, and funding. SIAD submitted a revised Closure Plan in December 2005, and DTSC provided comments in July 2006. Resolution of DTSC's comments and finalization of the details took place during the period from July 2006 to July 2007. This document constitutes the revised Closure Plan for the SIAD OB/OD Units to address the DTSC request for additional information.

The closure process for the SIAD OB/OD Units will consist of two major phases. The first phase will consist of field investigations to determine whether releases of hazardous waste [unexploded ordnance (UXO)] or constituents (metals or explosives) have resulted in conditions that would require remedial actions. The second phase will consist of determination and implementation of remedial actions. If UXO is located during Phase 1, remedial actions may also take place. Any treatment will necessitate obtaining an emergency permit from DTSC.

The Upper Burning Grounds (UBG), which is where the OB/OD Units are located, is large and complex. The size of the UBG is over 3,900 acres. Several solid waste management units (SWMUs) are also located within the UBG. The Army has conducted a Historical Records Review (Draft Historical Records Review: Upper Burning Ground, Sierra Army Depot, Herlong, California; Tech Law; March 2006) as part of the Military Munitions Response Program (MMRP) process. Areas of Interest (AOIs) including SWMUs that were identified in this report. A summary of the AOIs identified in the Historical Records Review follows.

The 2002 Installation Action Plan (IAP) identified six past activity sub-areas (Hansen's Hole, Old Demolition Area, Open Trenches and Ash Pit, the north and south extensions of the Upper Burn Area, and the Lower Burn Area) within the UBG. Work at these six sub-areas is presented in the 1992 Group II Remedial Investigation/Feasibility Study (RI/FS), Final Investigation RI Report, which began in 1990. The 2002 IAP also noted that ongoing activities at two active sub-areas (the Demolition Area and Lower Burning Area) were under RCRA interim status as treatment facilities during the RCRA Part B Permit Application process. These are the OB/OD areas that are the subject of this Closure Plan. The UBG encompasses the following seven SWMUs, some of which are the same as the sites listed in the 2002 IAP:

SWMU Number	SWMU Name
1	Upper Detonation Grounds
2	Upper Burning Grounds
3	Lower Burning Grounds
4	Hansen's Hole
5	Explosive Ordnance Disposal (EOD) Training Area
6	Lower Burning Trenches
7	Building 349-Satellite Drum Accumulation Pad

The 1992 RI also included the following seven areas in which burning, demolition, and other disposal operations have occurred since the 1940s as identified in the 1998 Master Environmental Plan for SIAD.

- Demolition Area
- Old Demolition Area
- Upper Burning Area
- Hansen’s Hole
- Lower Burning Area
- Trenches or Dunnage Pits
- Ash Pile
- Area Immediately North of the Upper Burning Area

The Lower Burning Ground, Hansen's Hole, and the Ash Pit are being remediated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) through the Three Sites Record of Decision (ROD).

Table 1-1 provides a list of the AOIs discussed in the Historical Records Review, and their corresponding SWMU numbers and other names, where applicable. Additional details can be obtained in the Historical Records Review.

No environmental investigations to determine the nature and extent of contamination resulting from OB/OD treatment operations have taken place at the UBG. Investigations were conducted within the OD Unit for waste classification and within the OB Unit to determine the nature and extent of contamination. However, these investigations were incomplete for purposes of closure.

As noted above, the closure process for the SIAD OB/OD Units will take place in two phases. The initial phase, investigation, will consist of one or more rounds of field investigations. The second phase will consist of remedial actions, if necessary. It is anticipated that the closure investigation and remedial process as authorized by this Closure Plan will be completed first for the lower portions of the UBG near the OB Unit because data are available from environmental investigations that have already taken place within the unit and, unlike the OD Unit, UXO was not ejected from the OB Unit. Sections 7.0, 8.0, and 9.0 provide surface water/sediment, soil, and groundwater sampling/investigation plans, respectively. The field work plan will be modified, as each round of investigation and phase of closure is completed, to describe the actions to be taken in the subsequent investigation round or phase, until the final closure activities are determined.

This plan has been developed in accordance with the applicable requirements of 22 California Code of Regulations (CCR) 66265 Article 7 pertaining to Closure and Post-Closure Care for interim status units. SIAD intends to conduct a risk-based closure of the OB/OD Units. Therefore, this Closure Plan describes the general approach for collecting information necessary to conduct the risk-based closure. Section 1.0 provides general information on SIAD, the OB/OD Units that are the subject of this Closure Plan, and the general environmental setting for SIAD and the OB/OD Units. The remainder of the Closure Plan describes the approach for conducting risk assessments (Section 2.0), meeting interim status closure requirements (Sections 3.0, 4.0, 5.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, and 19.0), and conducting the environmental investigation (Sections 6.0, 7.0, 8.0, 9.0, 10.0, and 11.0).

1.1 PURPOSE OF CLOSURE

The purpose of this Closure Plan is to describe the steps that will be taken to permanently close the SIAD OB/OD Units.

1.2 GENERAL INFORMATION FOR SIERRA ARMY DEPOT

SIAD is located near the Town of Herlong in the Honey Lake Valley of Lassen County in northeast California at the base of the foothills on the eastern side of the Sierra Nevada Mountains, approximately 55 miles [89 kilometers (km)] northwest of Reno, Nevada. Figure 1-1 shows the general location of SIAD.

SIAD's current mission is as follows:

Provide world-wide Expeditionary Logistics Support for the Defenders of our nation as strategic power projection support platform providing support in the form of long-term storage, maintenance, care of supplies in storage, reset, and container management, Center of Industrial Technical Excellence (CITE) for Reverse Osmosis Water Purification Units (ROWPUs), critical Operational Project Systems including Deployable Medical Systems, Petroleum and Water Systems, Force Provider, and other items as directed.

Until 2001, SIAD received, stored, issued, maintained, and demilitarized munitions/explosives from both onsite and offsite military sources. Demilitarization of waste military munitions/explosives was conducted by OB in pits and pans and OD in pits. Waste military munitions/explosives are classified as hazardous waste for the reactivity characteristic under federal and state regulations. Hazardous waste treatment facilities are required to obtain a RCRA Permit. Existing facilities are subject to interim status requirements for hazardous waste treatment facilities until a permit is issued. SIAD had submitted a RCRA permit application to DTSC for operation of the OB/OD treatment facilities as permitted hazardous waste treatment units. However, SIAD has withdrawn the Permit Application and will close the OB/OD

Units currently under interim status regulations. This document constitutes the Closure Plan that is required by 22 CCR 66265.112.

SIAD formerly operated as a military maintenance and storage facility for munitions/explosives classified as both product and hazardous waste. As part of SIAD's former mission, the following functions were performed:

- Received and stored conventional ammunition, propellants, explosives, war reserve material, general supply items, and personal property.

- Maintained, renovated, and modified conventional ammunition and guided missiles.

- Received, inspected, classified, and maintained returned conventional ammunition.

- Packed small arms.

- Observed, inspected, tested, studied, and classified conventional ammunition/explosives and guided missiles in movement, storage, and use with respect to serviceability, hazard, and rate of deterioration.

- Demilitarized obsolete, unserviceable, and unrepairable conventional ammunition and general supplies.

In addition to the OB/OD Units, SIAD had an incinerator that was used for demilitarization. The incinerator was closed as an Interim Status unit during 1995. After 1995 the incinerator was used to treat waste munitions of 50 caliber or less that were not regulated by DTSC as hazardous wastes. The incinerator operated under an air permit issued by the Lassen County Air Pollution Control Department.

1.3 DESIGN AND DIMENSIONS OF THE OB/OD UNITS

This section contains a description of operating procedures and physical characteristics of the OB/OD Units. Section 1.6 contains a description of the military munitions wastes that were treated and a list of hazardous constituents that may have been released. SIAD utilized several techniques for the demilitarization of hazardous waste munitions/explosives at the OB/OD Units. Following is a list of these treatment techniques:

- OB of propellants in pans

- OD of munitions/explosives in pits
- OB of rocket motors in pits

OB in pans took place in the OB Unit. OD and OB of large rocket motors both took place in the OD pits. Figure 1-2 shows the general of the location of OB/OD Units in relation to the Upper Burning Ground. Figure 1-3 is an aerial of the Upper Burning Grounds with the coordinates of the open detonation pits and Lower Burning Grounds. A discussion of the design and dimensions of each treatment unit is contained below.

No munitions or explosives that were to be treated were stored at the OB/OD Units. All munitions and explosives were stored on the Main Depot. Munitions and explosives were transported, primarily via government trucks, directly from the storage units to the OB or OD Unit area. Only the amount scheduled for treatment on a day was transported to the OB/OD Units. The number of truckloads of material delivered to each of the operations per day ranged from 1 to 30 depending on the nature and quantity of the material scheduled for treatment.

1.3.1 OB in Pans

OB operations have taken place since the 1950s. The materials that were burned generally consisted of solid propellants. Initially the OB operations took place directly on the ground surface. Sometime in the 1980s, treatment directly on the ground surface was stopped, and all further OB operations took place in containment devices (pans).

OB operations consisted of the burning of solid propellants and black powder within containment pans. The OB Unit at SIAD consisted of 40 burn pans. Each burn pan held up to 1,000 pounds net explosive weight (NEW) of propellant. The OB pans were located in the center of a pad area that comprises approximately 18 acres.

OB operations were conducted in pans structurally adequate to withstand temperature extremes and collect ash/residue. Typically, solid propellant was poured into the containment pan to a depth of a few inches, primed, and then initiated with a time fuse and igniters. The burn pan dimensions ranged from 4 to 8 feet wide and 15 to 18 feet long. The pans were made of ¼-inch-thick or thicker steel, which was able to withstand the high temperature burns. Pans were supported by ¼-inch-thick or thicker steel I-beams spaced 4 feet apart. The support beams raised the containment pan bottoms approximately 6 to 8 inches above the ground surface. Metal covers were placed over the pans when they were not in use to keep precipitation and dirt from depositing in the pans. Covers were equipped for removal by material handling equipment (MHE) (i.e., forklifts) and were designed with edges to maintain a secure seal. There was no lining within the pans or below the pans on the ground surface (graded dirt surface) due to the potential for damage during burning. However, the areas surrounding the pan were inspected for ejected material after each OB operation.

Burn durations were relatively short, with burning typically completed in less than 2 minutes. The ash generated from the treatment of wastes was managed under generator requirements described in 22 CCR 66262. No ash material remained in pans at the OB Unit. The open burn pans have been removed from service at SIAD. See Section 4.2 for details regarding their removal from service.

1.3.2 OD in Pits

The OD Unit consists of 14 pits dug into the foothills of the Amedee Mountains. The NEW limits for the pits ranged from 5,000 to 10,000 pounds per pit. The OD Unit spans an area of about 35 acres. The pits are dug with sides ranging from a few feet to more than 30 feet (9 meters) at the pit backwall. The pits are sloped inward from the entrance toward the back of the pits to control run-on/runoff. No liners or structures were used in the pits. Figure 1-4 shows the dimension of the OD pits.

1.3.3 OB of Large Rocket Motors in Pits

The OD pits were also used to treat large rocket motors by OB. One to 14 pits were used, depending on the number and size of the rocket motors being treated. The rocket motors were placed into one or more detonation pits using MHE (e.g., rough terrain forklift, rough terrain lift, crane, bulldozer, etc.). The NEW of the rockets being treated ranged from a few hundred to 140,000 pounds. Crack and burn techniques were the primary method used to treat the rocket motors. Explosive charges were placed along the length of the rocket motor and then were detonated to split open the casing and initiate the subsequent burn along the entire length of the propellant contained within the casing. After each rocket motor treatment event, residues (casing and non-combustible rocket motor components) were collected and placed into rolloff boxes for disposal as solid waste. All residual materials were inspected and certified as explosive-free prior to transportation from the OD pits. No trays, pads, nor liners were used because they would have been damaged by the high temperatures of the OB process and because of the size of the rocket motors. Rocket motor propellant was not placed directly on the ground surface, and all of the propellant was contained within the casing.

1.3.4 Closure and Corrective Actions Requirements

The OB and OD Units are directly subject to RCRA closure requirements for interim status facilities. Releases beyond the unit boundary (e.g. UXO, waste constituents, and waste residues) are subject to RCRA Corrective Action requirements. A Federal Facility Site Remediation Agreement (FFSRA) is in effect between the State of California and SIAD for the investigation and possible remedial/corrective action at SWMUs. The FFSRA was signed between the Army, the State of California Environmental Protection Agency (CALEPA) DTSC, and CALEPA Regional Water Quality Control Board (CRWQCB). The FFSRA outlines the overall investigation and remediation process for units subject to Corrective Action. This Closure Plan addresses both the RCRA Unit (hazardous waste management unit) and releases beyond the boundary of the RCRA units.

SIAD requested DTSC concurrence of the OB and OD Units' boundary designations in a letter that was dated November 6, 2004. DTSC responded in a letter dated February 11, 2005 that they agreed to the boundary designations subject to the following conditions:

1. SIAD must fully delineate the unit boundaries in the revised Closure Plan using Global Positioning System (GPS) coordinates.

2. SIAD must include in the revised Closure Plan a scaled map(s) of sufficient size to clearly show the OB/OD Units.

3. Any contamination found outside of the OB/OD Unit boundaries that has resulted from or emanated from the operation of the OB/OD Units will be subject to the Corrective Action process required of the OB/OD Units, instead of being addressed under the FFSRA.

4. If it is necessary for SIAD to utilize the OB/OD Units for emergency treatment purposes, any resulting contamination in or outside the unit boundaries will be subject to the Corrective Action process required of the OB/OD Units, instead of being addressed under the FFSRA.

SIAD concurred with DTSC’s condition in a letter dated April 11, 2005. Copies of these letters are included as Appendix A.

This Closure Plan is consistent with technical requirements in the FFSRA for the investigation and evaluation process. However, per the agreement with DTSC, any contamination found outside the OB/OD Unit boundaries that has resulted from or emanated from the operation of the OB/OD Units will be subject to the RCRA Corrective Action process, instead of being addressed under the FFSRA.

The DoD is conducting investigations of closed ranges under the MMRP. Key elements of the MMRP include the following:

- Preliminary Assessments
- Site Investigations

- RIs
- Feasibility Studies/Engineering Evaluations
- Remedial/Removal Actions

The areas beyond the RCRA Unit boundaries have been deemed eligible for the MMRP. Under authority of this Closure Plan, investigation and remediation of releases beyond the boundaries of the RCRA Units will be conducted as part of the MMRP. However, RCRA Corrective Action requirements must be met, and DTSC oversight will ensure compliance. If any elements of the MMRP fail to meet RCRA Corrective Action requirements, DTSC may issue a Corrective Action order for compliance.

California hazardous waste regulations contain definitions that are directly applicable to determining the boundaries of the RCRA Units. 22 CCR 66260.10 defines a hazardous waste management unit as follows:

"Hazardous waste management unit is a contiguous area of land on or in which hazardous waste is placed, or the larger area in which there is significant likelihood of mixing hazardous waste constituents in the same area. Examples of hazardous waste management units include a surface impoundment, a waste pile, a land treatment area, a landfill cell, a waste transfer area, an incinerator, a tank and its associated piping, an underlying containment system and a container storage area. A container alone does not constitute a unit; the unit includes containers and the land or pad upon which they are placed."

22 CCR 66265.95 defines the point of compliance for determining where the groundwater protection standard applies and at which monitoring must be conducted, and states the following.

Monitoring Points and the Point of Compliance

"(a) For each regulated unit, the owner or operator shall specify in the water quality sampling and analysis plan the point of compliance at which the groundwater protection standard of Section 66265.92 applies and at which monitoring must be conducted. The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated unit. For each regulated unit, the owner or operator shall specify monitoring points at the point of compliance and additional monitoring points at locations determined pursuant to Section 66265.97 at which the water quality protection standard under section 66265.92 applies and at which monitoring shall be conducted.

(b) The waste management area is the limit projected in the horizontal plane of the area on which waste will be placed during the active life of a regulated unit.

(1) The waste management area includes horizontal space taken up by any liner, dike, or other barrier designed to contain waste in a regulated unit.

(2) If the facility contains contiguous regulated units and monitoring along a shared boundary would impair the integrity of a containment or structural feature of any of the units, the waste management area may be described by an imaginary line along the outer boundary of the contiguous regulated units if the water quality monitoring program for each unit will enable the earliest possible detection of a release from that regulated unit. This provision only applies to contiguous regulated units that have operated or have received all permits necessary for construction and operation before July 1, 1991."

These regulations provide the basis for defining the boundaries of the RCRA Units.

Open Detonation Area Boundary

Hazardous waste treatment took place within pits in the OD Unit. The OD RCRA Unit (hazardous waste management unit) is described by a line starting at the back (back wall) of Pit No. 1 and proceeding along the back of Pits 2, 3, 4, 5, 6, 7, 8, 9, and 10. From the back of Pit 10, the line then proceeds along the fronts of Pits 11, 12, 13 and 14. From the front of Pit 14, the line proceeds to the front of Pit 6 and then proceeds to the fronts of Pits 5, 4, 3, 2, and 1. At Pit 1, the line proceeds along the side of Pit 1 to the starting point at the back of Pit 1 (see Figure 1-3 for details).

Open Burning Area Boundary

Hazardous waste treatment at the OB Unit took place on the ground and later in OB pans in the same general area. The OB RCRA Unit (hazardous waste management unit) is described by a line along the outer edges of the locations where OB took place.

1.4 OPERATIONAL HISTORY

SIAD has a long history of management of munitions/explosives. SIAD began operations by storing reserved supplies and inert materials belonging to the U.S. Treasury Department. The mission of receipt, storage, and issuance of munitions/explosives was assigned to the depot in the early 1950s upon completion of the large igloo Storage Area. OB/OD operations were initiated in 1950 and continued until 2001. In 1954, the receipt, storage, and issuance of guided missiles and propellant fuels were added to the SIAD mission. SIAD has operated as a hazardous waste treatment facility since November 1980 under interim status granted by the DTSC. The federal RCRA became effective on November 28, 1980, and all existing hazardous waste facilities that intended to keep operating had to submit a RCRA Part A

Permit Application for interim status by November 28, 1980 or cease hazardous waste operations on that date.

SIAD submitted an initial RCRA Part B Permit Application on November 28, 1988 to the United States Environmental Protection Agency (US EPA) for operation of the OB/OD facilities as permitted hazardous waste treatment units. After the application was submitted, DTSC was granted primacy for the federal hazardous waste program. Several subsequent RCRA Permit Application modifications were made to DTSC during the 1990s in response to various agency comments and the addition of military munitions storage facilities at SIAD. DTSC approved the application, pending completion of the public comment process.

In 2002, the U.S. Department of the Army settled a lawsuit regarding OB and OD operations conducted at SIAD. Under the settlement agreement, SIAD could not conduct OB/OD of munitions or propellants (including rocket motors) at SIAD, unless necessary for purposes of national security or to address emergency situations. SIAD was required to submit an amendment to the RCRA Part B Permit Application to ensure that the application did not seek permission to conduct OB/OD that was inconsistent with these conditions. This amendment was submitted on June 11, 2002. Since this permit amendment submittal, SIAD has withdrawn the RCRA Part B Permit Application. Because OB/OD treatment operations no longer take place and the permit never was in effect, SIAD is closing the OB/OD Units under interim status regulations.

1.5 MAXIMUM INVENTORY

The maximum inventory of hazardous waste military munitions/explosives ever present at the OB/OD Units was the quantity scheduled for treatment on that day. Hazardous waste military munitions/explosives were not stored at the OB/OD Units. No inventory of waste military munitions/explosives remains at the OB/OD Units.

However, as a result of the Base Realignment and Closure (BRAC) decision, SIAD will no longer store or handle military munitions. Product military munitions are still stored at SIAD. The Army is in the process of reducing the inventory stored by transporting this inventory of product munitions to other DoD facilities. Future shipments of munitions are dependent on funding and cannot be forecasted. However, the BRAC legislation does require all BRAC actions to be completed by 2011.

In the future, one or more lots of the munitions stored on the Main Depot may become unstable or be reclassified as wastes and require emergency OB or OD treatment. Emergency treatment of unstable munitions may be required in the future. However, it is not possible to predict whether any emergency treatments will be required or, if required, the types and quantities of munitions that would require treatment. An emergency permit issued by DTSC will be required for any emergency treatments.

1.6 DESCRIPTION OF MATERIALS TREATED AND HAZARDOUS CONSTITUENTS

The chemical and physical characteristics of hazardous waste munitions/explosives containing energetics (propellants, explosives, and pyrotechnics) are described in this section.

Chemistry of Energetics

Energetic materials are chemical compounds or mixtures of chemical compounds and are divided into three classes according to use: (1) propellants; (2) explosives; and (3) pyrotechnics. Explosives and propellants, when initiated, evolve large quantities of gas in a short time. The difference between explosives and propellants is the rate at which the reactions proceed. For explosives, a fast reaction produces a very high pressure in the surrounding medium; this pressure is capable of significant destruction. In propellants, a slower reaction produces lower pressure over a longer period of time. This lower sustained pressure is used to propel objects. Pyrotechnics evolve large amounts of heat but much less gas than propellants or explosives.

Propellants cannot be distinguished from explosives by chemical composition or by chemical reaction rate alone, although propellants characteristically react (burn) at a rate much lower than the detonation rate of explosives. Propellants are characterized by the ability to be made to burn at reproducible, controllable, and predetermined rates. When confined to the breech and barrel of a gun, the evolved gases produce high pressures, that provide propulsion for the projectile. Under certain conditions, however, propellants can be made to detonate, and conversely, explosives that characteristically detonate may simply burn if the proper conditions of confinement, dimensions, degree of consolidation, and other factors are chosen. For example, explosives will burn if not confined and the depth of the explosives is less than 4 inches. Table 1-2 provides information on the general chemical composition of typical energetic materials (propellants, explosives, pyrotechnics) that are present in munitions/explosives stored at the SIAD storage facilities.

<u>Propellants</u>

Gun propellants are grouped into the following five classes:

- Single-base propellant compositions are used in cannons, small arms, and grenades. These compositions contain the propellant nitrocellulose as their chief ingredient. In addition to containing a stabilizer, they may also contain inorganic nitrates, nitro-compounds, and non-explosive materials such as metallic salts, metals, carbohydrates, and dyes.

- Double-base propellant compositions are used in cannons, small arms, mortars, rockets, and jet propulsion units. This term generally applies to compositions containing both nitrocellulose and nitroglycerine. They can also be defined as propellants containing nitrocellulose and liquid organic nitrates that will gelatinize nitrocellulose. Additives are frequently used in addition to a stabilizer.

- Triple-base propellant compositions are used in cannon units. This term is applied to propellants containing three explosive ingredients, with nitroguanidine as the major ingredient and the other two usually nitroglycerine and nitrocellulose.

- Mixed nitrate esters are propellant compositions developed to replace the triple-base composition during times of nitroguanidine shortages. As an example, the XM35 composition contains 1,1,1-trimethylolethane trinitrate (TMETN), triethylene glycol dinitrate (TEGDN), and diethylene glycol dinitrate (DEGN). As another example, the XM34 composition contains nitrocellulose, 1,2,4-butanetriol trinitrate (BTTN), TMETN, and TEGDN.

- Composite propellants contain neither nitrocellulose nor an organic nitrate. They are usually physical mixtures of a fuel such as metallic aluminum, a binder (normally a synthetic rubber that is also a fuel), and an inorganic oxidizing agent such as ammonium perchlorate. Composite propellants are used primarily in rocket assemblies and jet propellant propulsion units.

Explosives

Explosives are grouped into the following two classes:

- Small quantities of primary explosives are often used in ordnance items to initiate an explosive reaction. Primary explosives are very sensitive and relatively easy to detonate by heat, impact, or friction. These primary explosives include the following:

    - Lead azide
    - diazodinitrophenol (DDNP)
    - Lead styphnate
    - Tetracene
    - potassium dinitrobenzofuroxane (KDNBF)
    - lead mononitroresorcinate (LMNR)

Primary explosives are used in combination with fuels and oxidizers in ordnance.

- Several classes of secondary explosives are less sensitive than primary explosives. These consist of the following:

  - Aliphatic nitrate esters
  - Nitramines
  - Nitroaromatics
  - Ammonium nitrate
  - Compositions
  - Plastic-bonded explosives

Pyrotechnics

Pyrotechnics involves the technology of using exothermic chemical reactions that are non-explosive, relatively slow, self-sustaining, and self-contained. All pyrotechnic compositions contain oxidizers and fuels. Additional ingredients present in most compositions may include binding agents, retardants, and waterproofing agents. Some compositions may contain smoke dyes and color intensifiers. Pyrotechnics evolve large amounts of heat, noise, smoke, light, or infrared radiation, but much less pressure than propellants or explosives.

Energetic Materials

Energetic materials contained in munitions/explosives may contain both energetic and non-energetic components compounds. The energetic compounds consist of propellants, explosives, and pyrotechnics such as those described above. The non-energetic compounds in energetic materials typically serve as binders and stabilizers. Examples of these additives are ethyl cellulose, graphite, carbon black, calcium carbonate, cellulose acetate, and charcoal.

Classification System for Munitions/Explosives

Information is provided in this section on the classification system used by DoD for all munitions/explosives including hazardous waste munitions/explosives. DoD uses the international system of classification devised by the United Nations Organization (UNO). The UNO classification system consists of nine hazard classes, two of which (Classes 1 and 6) are applicable to ammunition and explosives. No Class 6 materials were treated at the OB/OD Unit.

UNO Class 1 material hazard divisions are as follows:

1.1 Munitions items that will detonate almost instantly when only a single item is subjected to fire or initiation.

1.2 Munitions items that will not mass detonate when a single item or package in a stack is initiated. The items will burn or explode progressively a few items at a time, with blast effects limited to the immediate vicinity. The major hazard to exposed sites would be ejected fragments. Within this hazard division are four subdivisions based on potential distances to which shrapnel might travel.

1.3 Items that burn vigorously with explosions limited to rupture of containers with no shock waves.

1.4 Items with fire hazard but no blast hazard.

1.5 Items that are very insensitive explosives.

1.6 Items that are extremely insensitive ammunition.

UNO Class 6 material includes the following two hazard divisions:

6.1 Poisonous materials. SIAD only stored incapacitating agents such as tear gas. These materials were not treated by OB/OD at SIAD.

6.2 Etiologic agents. SIAD has not stored etiologic agents; and none were treated by OB/OD.

Munitions/Explosives Families

Munitions/explosives can be grouped into families as follows:

High Explosive (HE) Components/Devices: HE detonators, boosters, or bursting charges that are not part of an ammunition item. Typically HE components/devices have a hazard class/division (HC/D) of 1.1 or 1.2.

HE Bombs: HE-filled bombs. These items are typically air dropped, and the explosives within the HE bombs are usually tritonal, 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-8-triazine (HBX), or H-6 HE.

HE Cartridges: Complete artillery or Navy gun ammunition with an HE projectile and propellant charge. Examples are 90MM, 3 inch/50 cal., 81MM mortar, 30MM fuzed or unfuzed cartridges, and fuzed 20MM cartridges.

Bulk HE: Bulk high explosives such as TNT, composition A, composition B, composition C-4, PBX and RDX.

HE Grenades; Hand or rifle grenades that contain HE fillers.

HE Depth Charges and Underwater Munitions: HE-filled marine depth charges and underwater mines.

HE Improved Conventional Munitions/Cluster Bomb Units (ICM/CBU) and Sub Munitions: Variety of improved conventional munitions types containing sub munitions. Items may be air-dropped cluster bomb units, projectiles, or warheads containing sub munitions such as anti-tank mines, anti-personnel/material grenades, or bomb loaded units (BLUs) and Multiple Launch Rocket System (MLRS) rockets.

Missiles: Complete rounds of missile ammunition configured with an explosive or practice warhead, rocket motor, and guidance system.

HE Projectiles and Warheads: All projectiles, warheads, mortars or similar items that do not have a cartridge case, propellant, or rocket motor and that contain HE filler.

HE Rockets: Complete rounds of rocket ammunition containing warhead, fuze, and rocket motor.

Torpedoes: Underwater torpedoes that contain HE.

Demolition Material: Demolition charges such as TNT, C-4, flexible sheet explosives, cratering charges, shaped charges, and detonating cord.

HE Land Mines: HE-filled land mines emplaced by hand or disbursing devices. This family also includes scatterable mines when they are packed separately from the disbursing unit (e.g., a dispenser, projectile body, or other system).

Large Rocket Motor: Solid propellant Inter-Continental Ballistic Missiles (ICBM), Submarine Launch Ballistic Missiles (SLBM), space launch booster motors or tactical motors greater than 20 inches in diameter.

Bulk Propellants and Black Powder: Propellants and black powder in bulk form that are not assembled or configured to an ammunition item. Material is normally packaged in drums or metal-lined wooden or fiber containers.

Propellant Charges and Increments: Packaged propelling charges and propellant increments.

Propellant Munitions/Components: Rocket motors, cartridge-actuated devices (CADs), propellant-actuated devices (PADs), blank ammunition of more than 20MM, and expelling charges. This family also typically includes HC/D 1.3 components or munitions that do not fit into any other family.

Small Caliber Ammunition: Small caliber ammunition cartridges up to 20MM with energetic filler(s). Excluded are fuzed HE or high-explosive incendiary (HEI) loaded 20MM cartridges that are assigned to family HC, and DUMMY small caliber ammunition.

Incinerable Munitions and Components: Munitions and components assigned HC/D 1.4 that do not fit any other family. Items are relatively small and are typically capable of being demilitarized in deactivation furnaces or by other incineration methods.

Fuzes: All types of fuzes related to munitions. Examples include artillery ammunition/Navy gun fuzes, bomb fuzes, rocket fuzes, or grenade fuzes packaged separately from the munitions.

Hazardous Waste Codes

The hazardous waste munitions/explosives treated at SIAD were all classified as RCRA reactive (D003) because of the energetic constituents (propellants, explosives, and pyrotechnics) contained in these items. The specific reactivity subcategories applicable to munitions/explosives are those defined as follows: CCR 66261.23(a)(6) (it is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if it is heated under confinement); and CCR 66262.23(a)(8) [it is a forbidden explosive as defined in 49 Code of Federal Regulation (CFR) section 173.51 (as amended April 20, 1987), or a Class A explosive as defined in 49 CFR section 173.53 (as amended April 5, 1967), or a Class B explosive as defined in 49 CFR section 173.88 (as amended May 19, 1980)].

Some of the waste munitions/explosives that were treated were potentially toxicity characteristic (TC) wastes because of metals content (arsenic, barium, cadmium, chromium, lead, mercury, selenium) and/or organic content [hexachlorobenzene and 2,4-dinitrotoluene (DNT)]. All of the wastes munitions/explosives stored contain energetic material. The only listed wastes treated at SIAD were K044 and K045 wastes. K044 wastes are defined in CCR 66261.32 as wastewater treatment sludges from the manufacturing and processing of explosives. K045 wastes are defined as spent carbon from the treatment of wastewaters. With minor exceptions, all components of munitions/explosives are solids. The RCRA codes, characteristics, and contaminants for items stored at the munitions/explosives storage facilities at SIAD are presented in Table 1-3. The two listed wastes treated at SIAD, K044 and K045, are listed because of the reactive properties of the explosives contained in these wastes.

Munitions/explosives treated at SIAD also possessed the California codes of 181 (other inorganic wastes) and 352 (other organic solids). These wastes could have exceeded Soluble Toxicity Leaching Concentration (STLC) or Total Threshold Limiting Concentrations (TTLCs) for any of the following inorganic and organic compounds; antimony, arsenic, barium, beryllium, cadmium, chromium III, chromium VI, copper, lead, manganese, mercury, nickel, selenium, zinc, or for organic lead compounds. the California codes, characteristics, and contaminants for items stored at the munitions/explosives storage facilities at SIAD are also presented in Table 1-3. Table 1-4 provides a listing of the hazardous waste constituents that were present in the hazardous waste munitions and explosives treated by OB/OD at SIAD.

Prohibited Wastes

Certain types of military materials were not treated in the interim status OB/OD Units. These included chemical warfare agents and related compounds or materials contaminated with chemical warfare agents. Radioactive materials, including depleted uranium, were not treated at the interim status OB/OD Units at SIAD. Rounds containing depleted uranium were stored as product munitions. SIAD did not have the equipment necessary to process these rounds for demilitarization; therefore, no demilitarization of depleted uranium rounds took place at SIAD.

1.6.1 OB Unit

Following are the general families of munitions/explosives that were treated by OB in pans during interim status operations at SIAD.

- Bulk propellant and black powder
- Propellant charges and increments

1.6.2 OD Unit

Following are the general families of munitions/explosives that were treated by OD in pits during interim status operations at SIAD.

- HE components and devices

- HE bombs
- HE cartridges
- Bulk HEs
- HE grenades
- HE depth charges and underwater munitions
- HE ICM/CBU and sub munitions
- Missiles
- HE projectiles and warheads
- HE rockets
- Torpedoes
- Demolition material
- HE land mines
- Large rocket motors
- Propellant munitions/components
- Fuzes

1.6.3 OB in Pits

Large rocket motors were treated by OB in pits at SIAD:

1.7 ENVIRONMENTAL SETTING

This section provides a general overview of the environmental setting in the general area of SIAD and the OB/OD Units. Information is provided on land uses, population, climate and ambient air conditions, surface characteristics, surface water features, and groundwater in the Honey Lake Valley.

1.7.1 Land Use

This section describes land uses in the area potentially impacted by the SIAD OB/OD Units.

1.7.1.1 Honey Lake Valley

SIAD is located near the Town of Herlong in the Honey Lake Valley of Lassen County in northeastern California. SIAD is located at the base of the foothills on the eastern side of the Sierra Nevada Mountains, approximately 55 miles (89 km) northwest of Reno, Nevada. Figure 1-1 shows the general location of SIAD. Susanville lies approximately 45 miles (73 km) northwest of SIAD.

The major land uses in the Honey Lake Valley are military, ranching, and public lands. Land to the south of SIAD is privately owned, with ranching as the primary use. The two ranches closest to SIAD are Skedaddle Ranch, which is located approximately 1.2 miles (2 km) from the OB Unit and approximately 2.4 miles (4 km) from the OD Unit, and High Rock Ranch which is located approximately 4.7 miles (7.5 km) from the OB Unit and approximately 3.1 miles (5 km) from the OD unit. Land to the east, north, and northeast of SIAD is publicly owned. The Pyramid Lake Paiute Indian Reservation (Wendel) lies to the east of SIAD, several miles inside the Nevada border. Wendel is located approximately 9.3 miles (14.9 km) from the OB Unit and approximately 9.8 miles (15.8 km) from the OD unit.

1.7.1.2 Military Land Uses

SIAD is a U.S. Military Reservation. The entire depot comprises 37,937 acres of land divided into two sites: the Main Depot and the Upper Burning and Demolition Area. Honey Lake has recently been turned over to the Honey Lake Conservation Team.

The used portion of the depot is divided into two fenced areas:

Restricted Area - This area constitutes the bulk of the active portion of SIAD's property and covers approximately 35,300 acres. The UBG, immediately north of the Main Depot, constitutes approximately 5,350 of this 35,300-acre total. Included in the Restricted Area are facilities to support ammunition storage, maintenance, and demolition; test sites; rail classification and holding facilities; Amedee Army Airfield; open land; and the General Supply (warehouse) Area. Access to this area is restricted to employees and those persons securing permission for special entry into the area.

Cantonment Area - The cantonment includes the family and unit quarters areas, housing, the administrative area (Headquarters Area); morale, welfare, and recreation (MWR) activities; the Industrial Area; and the rifle and skeet ranges. This portion of the depot encompasses approximately 1,301 acres of the 35,300-acre total and includes open areas that have been set aside or could be used for future development.

1.7.1.3 Nonmilitary Land Uses

SIAD is zoned as a U.S. Military Reservation. The county land extending beyond SIAD boundaries for 1 mile (1.6 km) is zoned A-1 (General Agriculture) with a "Public Safety" restriction. The Public Safety designation requires that a use permit be secured prior to the building of a house in this area.

The Pyramid Lake Paiute Tribe Reservation is located approximately 26 miles (42 km) east of the OB/OD Units.

Land uses in the unincorporated areas (outside this safety zone) surrounding the SIAD include ranching (hay crops and grazing) in Lassen County, California, and Washoe County, Nevada. The Plumas National Forest is the principal land use in that portion of Plumas County immediately south and southwest of the depot. The Plumas National Forest is managed for multiple uses (e.g., forestry, recreation, wildlife, watershed, grazing, etc.). A Wilderness Area in Plumas National Forest is proposed nearby at the Skedaddle Mountains, the closest boundary of which is about 2 miles (3.2 km) north of the OD pits.

Land use control (LUC) throughout Lassen County is maintained by the establishment of four zoning districts that are quite broad in application. However, control is established within each district because the land is not available for use until a permit has been secured. The four existing zoning districts include the following:

A-1 - General Agricultural Districts. Chapter 18.12, Lassen County Code. This is the zoning with the widest applicability within the county, allowing residential development, airports, flammable materials storage, mining and manufacturing, and industrial processing plants. This zoning completely surrounds the depot, except as noted below. The depot-associated community of Herlong (i.e., Title IX housing and other off-depot structures and the airfield) is included in this category.

A-E - Exclusive Agricultural Districts. Chapter 18.20, Lassen County Code. This district classification is intended to be applied to land areas that are used or are suitable for intensive agricultural purposes, having fertile soils and other favorable agricultural applications, and to preserve such areas and protect them from encroachment of incompatible uses. Examples of this zoning are evidenced along the shores of Honey Lake and several miles south of the depot adjacent to country roads A-25 and A-26.

U-C - Upland Conservation Districts. Chapter 18.22, Lassen County Code. This classification is intended to be applied in the mountain and upland foothill areas of the county in which forestry, mining, grazing, and noncommercial recreational activities are natural and desirable uses; in which protection of the watershed lands from wildfire, erosion, pollution and other detrimental effects is essential to the general welfare; and in which land divisions will be regulated to ensure compatibility with primary uses. Lands in this category are also suitable for establishment as agricultural preserves. Permitted uses include single family dwellings, farm buildings, logging, greenhouses, public parks, public schools, private airports, and retail sales of products produced on the premises. Uses requiring use permits include: hospitals, churches, sawmills, wineries, commercial airports, and cemeteries. In the proximity of the depot, several of these zoning districts are found to the north and east and several miles south in the Diamond Mountains.

P-S - Public Safety Districts. Chapter 18.48, Lassen County Code. The regulation of this chapter is applied to protect life and property in areas that may be unsafe for human habitation because of natural conditions such as rough topography, possible inundation or fire hazard, because of the close proximity to places where storage of explosives or inflammable material occurs (including highways or other roads giving access to such places of storage), or because of other hazardous conditions. "Close proximity" means any area within a radius of 1 mile (1.6 km) outside any point or the boundary line of such places where the storage of explosives or inflammable materials occurs, or 1 mile (1.6 km) from any point on the centerline of such highways or other roads giving access to such storage places. All depot land and surrounding land is given this classification in combination with one of the other three previously outlined designations. At SIAD all depot lands and those surrounding it are zoned A-1-P-S.

1.7.2 Climate

The climate in the Honey Lake Valley, in the vicinity of SIAD and western Nevada, is arid and characterized by low relative humidity, low rainfall, and high excesses of evaporation over precipitation. The average precipitation in the Honey Lake Valley is approximately 5 to 6 inches per year, with approximately half falling as snow during the winter months. Total annual precipitation is approximately 6 inches at Nixon, Nevada, 7 inches at Sand Pass and Reno, Nevada, and 13 inches at Cedarville, California. The bulk of the precipitation falls between October and March.

The daily summer temperature at SIAD ranges between 64 and 100 degrees Fahrenheit (°F). The winter months of December, January, and February commonly bring below-freezing temperatures. In winter months, the average temperature is 33°F (SCS, 1996). The record high and low temperatures are 104 and -20°F, respectively.

The Climatic Atlas of the United States, published by the National Oceanic and Atmospheric Administration (NOAA), contains data on mean pan and lake evaporation rates for the continental U.S. The mean Class A pan evaporation rate for the SIAD area is approximately 52 to 54 inches per year, and the mean lake evaporation rate is approximately 40 inches per year. At a rainfall rate of 5 inches per year, the evaporation rate exceeds the precipitation rate by at least 35 inches per year (NOAA, 1983).

1.7.2.1 Wind Rose

Prevailing daytime winds are generally westerly, although nighttime winds have a tendency to shift to the south-southwest. The average wind speeds are reported to be about 6 miles (9.7 km) per hour (mph), but winds may gust above 30 mph.

Figure 1-5 is a wind rose showing the distribution of wind direction and speed obtained from an onsite meteorological monitoring station at the UBG, where the OB/OD Units are located. This wind rose represents a typical year. The meteorological data for this wind rose were obtained during the period of November 1995 through November 1996. The figure shows a pronounced prevailing wind direction from the west with a second common wind direction from the west-northwest. This wind direction pattern is indicative of the channeling effects of Honey Lake Valley on the wind direction in the area.

1.7.3 Surface Characteristic/Surface Water Features

1.7.3.1 Regional

SIAD is located in the Honey Lake Valley, which is situated in the Basin Physiographic Region of northwest Nevada and northeast California. The Honey Lake Valley is oriented from southeast to northwest and is topographically closed. The area is characterized by northwest-trending mountains that rise 2,000 to 3,000 feet above the valley floor. The valley is bordered by the Fort Sage Mountains to the southeast, Skedaddle and Amedee Mountains to the northeast, Diamond Mountains to the southwest, and Shaffer Mountains to the north. The Amedee, Diamond, and Fort Sage Mountains are closest to SIAD. The Main Depot is fairly flat and varies in elevation from 3,986 to approximately 4,134 feet above mean sea level (msl) at Herlong, California. The UBG, where the OB/OD Units are located, is on the edge of the Amedee Mountains, in rugged terrain. Elevations at the UBG range from 4,039 feet to 5,480 feet above msl.

The SIAD OB/OD Units are located along the eastern side of Honey Lake Valley. Although Honey Lake Valley has a mean elevation of about 4,200 feet above msl, mountains rise 7,000 feet above msl to the north, east, and west of the valley.

Honey Lake Valley is a closed basin with an internal drainage system. This means that waters do not flow out of the basin because of the hills and mountains surrounding the valley. Water from the surrounding hills and mountains flows inward toward Honey Lake.

More than 40 streams flow from the Diamond, Fort Sage, and Virginia Mountains and the northern volcanic uplands toward Honey Lake. Most of the streams are intermittent and reach the valley floor only in years when precipitation is above normal. The largest two streams in the basin are the Susan River and Baxter Creek, which enter the valley from the northwest, and Long Valley Creek, which enters the valley from the southeast. The most prominent surface water feature in the basin is Honey Lake, which fluctuates greatly in area and volume. On average, the lake has a surface area of about 47,000 acres and contains about 120,000 acre-feet of water. The water is derived from a combination of lake-surface precipitation, stream inflow (mostly from the Susan River), and groundwater inflow. Water accumulates in

Honey Lake during periods of rapid snow melt, but most stream flow is diverted for irrigation or seeps into alluvial fan deposits before it reaches the valley floor and the lake (Handman, et al., 1990). Honey Lake typically has a depth of 4 feet or less. Because of a combination of drought and increasing diversions of water from the Susan River, until 1995, Honey Lake was dry except for the portion near the Susan River. Heavy rainfalls in 1996 and 1997 resulted in a relatively large volume of water in Honey Lake. However, the recent drought has resulted in Honey Lake once again becoming mostly dry except for the portion near the Susan River.

The major surface water feature in Nevada is Pyramid Lake, which is located approximately 23 miles (37 km) to the east of the OB/OD Units. Pyramid Lake is a terminal lake that is not drained by any streams. Pyramid Lake is not located within the drainage basin of SIAD.

1.7.3.2 Surface Water Quality

The major factor influencing the water quality of Honey Lake is the fact that the lake is a terminal lake (i.e., there are no perennial streams draining into Honey Lake). Therefore, the lake level is directly related to the balance between inflow from the Susan River and evaporation. As water evaporates, total and dissolved solids are left behind as a salt crust on the dry lake bed. When the lake refills during wet periods, these salts redissolve. The repeated cycles of evaporation and refill lead to a gradual increase in the salinity of Honey Lake.

Chemical composition information was not available for Honey Lake. However, except for the Susan River and immediately adjacent areas, it would be expected that the water would be slightly saline, highly alkaline, and high in sodium and chloride content.

1.7.3.3 OB/OD Area Surface Water Features

The UBG is drained by Spencer Creek and two unnamed, intermittent creeks adjacent to and west of Spencer Creek. Spencer Creek has a total drainage area of approximately 67,540 acres, which includes approximately 2,560 acres of the Demolition Area. Unnamed Creek No. 1 (Number 1 Creek) has a total drainage area of approximately 1,650 acres, including 1,400 acres of the Upper Burning/Demolition Area. Unnamed Creek No. 2 has a total drainage area of approximately 1,980 acres, including 650 acres of the Upper Burning/Demolition Area. The land slope and hydraulic gradients for all three watersheds are greater than 5 percent.

In general, soils in the upper portion of the UBG area restrict infiltration and promote runoff. However, above 4,400 feet above msl, soil thickness is not uniform and basaltic rock outcroppings occur. Because of the relatively permeable nature of the basaltic rock, recharge potential can be high. However, the recharge potential for the localized areas of basaltic outcroppings is minimized because of locally steep slope conditions (up to 30 percent). The runoff potential for portions of the Upper Burning/Demolition Area above the 4,400-foot contour is considered high because most of the area is covered with soil. Scattered portions of the area may have low runoff potential (and therefore high recharge potential) if exposed basaltic rock outcroppings occur in areas with relatively gentle slopes and soil cover. The OD pits were contoured to minimize precipitation run-on/runoff.

1.7.4 Groundwater Features and Characteristics

1.7.4.1 Hydrogeology

The following information on Honey Lake groundwater was taken primarily from a Master of Science thesis (Varian, 1997) in which environmental isotopes were used to investigate groundwater movement in the Honey Lake Valley. Incorporated into this thesis was information from other groundwater studies conducted in the Honey Lake Valley.

Honey Lake Basin is a closed basin with a total drainage area of approximately 5,700 square kilometers (km^2) [approximately 80.7 miles (130 km) long and 31 miles (50 km) wide], of which 930 square miles (1,500 km) is the valley floor. The basin is characterized by northwest-trending, block-faulted mountains and valleys and lies at the junction of three geologic provinces. The basin is located at the western edge of the Basin and Range, the northeastern edge of the Sierra Nevada, and the southeastern edge of the Modoc Plateau. The basin is bordered on the southeast by the Fort Sage and Virginia Mountains, on the northeast by the Skedaddle and Amedee Mountains, on the southwest by the Diamond Mountains, and on the north by the Shaffer Mountains. The Susan River, a few perennial streams, and several intermittent streams flow from the uplands towards Honey Lake, a terminal lake in the center of the basin. Honey Lake is a shallow lake at an elevation of approximately 4,018 feet (1,225 meters) above msl that periodically dries up during drought years.

Hydrologic, isotopic, and geochemical data indicate that water flows from the surrounding mountains toward the valley floor. In addition, water-level data indicate that a shallow groundwater divide separates the eastern and western portions of the basin. Primary recharge to the western portion of the basin originates as runoff in the Diamond Mountains, and primary recharge to the eastern portion of the basin originates in the Fort Sage, Virginia, and Skedaddle Mountains. Isotopic data indicate that modern runoff is poorly represented in northwestern basin groundwaters, and recharge may have occurred several thousand years ago. In addition, precipitation is low in the eastern portion of the basin (approximately 5 to 7 inches per year) and thus limits the amount of recharge available. Carbon-14 data indicate that residence times in both portions of the basin are long. Recharge may have occurred up to 8,000 years ago. In addition, available data suggest that groundwater in the northern portion of the basin (west of

Shaffer Mountain) is not being recharged locally and may be receiving recharge from farther north (Willow Creek Valley). Isotopic and geochemical data also indicate that the deep groundwater system (greater than 585 feet deep) has a different origin than more shallow groundwaters. Carbon-14 data suggest that deep groundwaters were recharged in a cooler, wetter climate up to 17,000 years ago when Lake Lahontan covered much of the valley floor.

Groundwaters in the western portion of the basin discharge in the center of the basin near Honey Lake. Groundwaters in the eastern portion of the basin discharge northwest of the Fish Springs playa. As groundwater discharges in the center of the basin, mixing occurs with evaporated surface water moving downward from the surface. In addition to evaporation and mixing, shallow groundwaters are affected by the dissolution of salts in basin-fill sediments.

Groundwaters may also be influenced by geologic structures. Fault zones have created impermeable barriers to lateral groundwater flow in parts of the basin. In the Herlong area, a portion of the Warm Springs fault zone in the basin-fill sediments separates older groundwater to the east from younger groundwater to the west.

Additionally, the isotopic and geochemical signatures of Honey Lake Basin groundwaters are not apparent in Sand Pass or Astor Pass. Hence, basin outflow to Smoke Creek Desert and Pyramid Lake Valley is most likely not occurring, as suggested by Handman et al. (1990).

Figure 1-6 shows Honey Lake Basin groundwater flow directions.

1.7.4.1.1 Hydrology of OB/OD Units

A total of nine monitoring wells have been installed in the silt and clay deposits along the southern side of the UBG. In addition, seven or more domestic wells are located south and southwest of the UBG. Groundwater levels show that groundwater is flowing primarily toward the south and southwest from the Amedee Mountains, beneath the UBG, and toward Honey Lake.

Any water infiltrating into the ground surface at the OB Unit will have to percolate downward about 75 feet (about 23 meters) before it reaches the water table. After it reaches the water table, lateral migration through the silt and clay deposits should be relatively slow because the hydraulic conductivity of these units is expected to be very low. The estimated depth to groundwater beneath the OD area is about 430 feet (131 meters).

Section 9.0 has additional details regarding the hydrology of the OB/OD Units.

1.7.4.2 Uses of Groundwater

There are three major users of groundwater in the region near SIAD. First, the California Fish and Game Commission pumps groundwater to supply two lakes north of Honey Lake and northwest of SIAD [more than 6 miles (9.7 km) from the OB/OD Units]. Second, there is some agricultural use; the closest location is at a farm located between the Main Depot and the OB/OD Units [about 2 miles (3.2 km) from the OB/OD Units]. Finally, there are potable water wells at Herlong to supply water to the base (California Department of Water Resources, 1963; HNUS, 1995).

The lakes managed by the Fish and Game Commission are maintained for use by migratory ducks. There are no records of how much these lakes are used by the ducks. Irrigation use in the region near SIAD was reported by the California Department of Water Resources to be 253,630 gallons per minute (gpm), assuming a 90-day growing season. Groundwater use, based on a 1980 land use inventory, was estimated to be about 57,070 gpm to irrigate about 7,600 acres of pasture and crop land.

1.7.4.3 Groundwater Quality

Groundwater quality in the Honey Lake Valley is extremely varied. Total dissolved solids (TDS) data for groundwater were assembled for the Bureau of Land Management (BLM) 1992 report. The highest TDS concentration, 50,000 parts per million (ppm), occur several miles west of the playa near Fish Springs Ranch. This area and two others, one about 4 miles (6.5 km) north on the state line and another about 6 miles (9.7 km) northeast, are the only areas where TDS values greater than 2,000 ppm in groundwater are common. In general, groundwater TDS concentrations in the California portion of the Honey Lake Valley are less than 400 ppm. At the OB/OD Units and immediately east (past the state line), values less than 200 ppm are most common.

Water withdrawn from the five existing irrigation wells at Fish Springs Ranch meets all federal primary and secondary water standards. Four of the five wells have TDS concentrations in the 165 to 230 ppm range.

Water sampled at SIAD during the 1992 RI/FS included water from the four potable supply wells at the Main Depot and five monitoring wells installed in the water-table aquifer at the southern edge of the UBG (Montgomery, 1992). Data from three of the four potable supply wells indicated quality consistent with sampling conducted annually for water quality. Anomalous high concentrations of metals were detected in one potable water supply well during the RI, but these high concentrations were not confirmed by additional sampling.

Two rounds of samples were collected during the RI from each well and analyzed for 17 metals and 8 explosives. No explosives were detected in any samples. Although arsenic, barium, copper, lead, and silver were detected, the concentrations were attributable to natural background. Average TDS concentrations ranged from 344 to 4,777 ppm (individual samples ranged from 337 to 4,900 ppm). In all samples, most of the TDS was accounted for by the concentrations of sodium, calcium, sulfate, and chloride ions. For example, for a well with the TDS concentration of 4,777 ppm, the combined average concentrations for sodium, calcium, chloride, and sulfate ions equaled 4,717 ppm. The remaining 60 ppm generally consisted of trace concentrations of metals constituents such as iron, copper, and zinc.

1.7.5 Surface/Subsurface Soil Characteristics

1.7.5.1 Surface Soils

SIAD soils range from silty clays in the basins to no soils present in the bedrock uplands. U.S. Department of Agriculture (USDA) classifications have been used to group the SIAD (Main Depot and the OB/OD Units) soils into four hydrologic soil groups (A through D) on the basis of water intake. Group A has the highest infiltration rate and Group D has the lowest. Natural infiltration rates generally range from high (A-type) in the southern portion of SIAD to very slow (D-type) in the northeastern quadrant.

The UBG where the OB/OD Units are located contains Groups B and D soils.

Group B soils have a moderate infiltration and water transmission rate. The USDA (1968) estimates that the permeability for this group ranges from 0.2 to more than 10 inches per hour. These soils have medium to coarse textures and are moderately well to well drained. The SIAD soils in Group B are Cobbly alluvial sand, Liebermann sandy loam, Liebermann loam, Liebermann-Herlong complex, and Stacy sandy loam. Group B soils are located on alluvial fans in the southern and northwestern portions of the Main Depot and occupy most of the southern half of the UBG and Demolition Area. Group B soils are located in the southern portion of the OB Unit where OB takes place.

Group D soils cover about 29 percent of SIAD and have very slow infiltration and water transmission rates. The USDA (1968) estimates that the permeability of Group D soils ranges from 0.01 to 2.5 inches per hour. These soils consist chiefly of clay or claypan near the surface and shallow soils over nearly impervious materials. This group is found largely on basins, basaltic table lands, and basaltic uplands in the northwestern and northeastern portions of the Main Depot and the northern portion of the UBG. Group D soils at SIAD are Calneva silty loam, Calneva loam-moderately alkali, Diaz-Karlo complex, Herlong loam, playas, rock land, Standish loam-moderately alkali, and Standish loam. The northern portion of the UBG area where the OD pits are located has Group D soils.

Section E-2c of the health risk assessment (HRA) (B&R Environmental, 1996b) contains additional details on surface soils at the OB/OD Units and the Main Depot.

1.7.5.2 Subsurface Soils

Honey Lake Valley is located at the western edge of the Basin and Range geologic province, the northeastern edge of the Sierra Nevada Mountains province, and the southeastern edge of the Modoc Plateau province. A northwest-trending fault system, the Walker Lane, extends from Las Vegas to Honey Lake Valley. The topography of Honey Lake Valley results from horizontal and vertical movement along the several faults included in the Walker Lane. Erosion, volcanism, and sedimentation in Honey Lake Valley also contributed to the topography of the basin.

The Honey Lake Valley is composed of granite bedrock, volcanic rocks, and unconsolidated to semi-consolidated sediments. Granite bedrock forms the lower impermeable boundary to groundwater flow and is 5,000 to 6,000 feet below ground surface. Volcanic rocks overlie granite rocks in the Diamond Mountains to the west and Fort Sage Mountains to the south. These rocks range in age from approximately 12 million years (Miocene) to 1 million years (Pleistocene) (Handman, et al., 1990). Miocene-age rocks are more than 5,000 feet thick in the Skedaddle Mountains to the north (Benioff, et al., 1990). These rocks are an important water source and provide a groundwater migration route along the entire northern side of the basin.

Unconsolidated and semi-consolidated Pliocene and Holocene basin-fill deposits lie under and over the consolidated volcanic rocks along the entire northern and northeastern margins of the Honey Lake basin. These semi-consolidated deposits consist of thick layers of volcanic tuff and ash that typically were deposited in shallow lakes along with lacustrine and fluvial deposits of clay, silt, and minor amounts of sand. Most of the basin fill consists of this unit, which has low permeability.

Honey Lake occupies part of an area previously covered by a much larger, prehistoric water body known as Lake Lahontan. Lake Lahontan water levels attained a maximum altitude of 4,365 feet above msl, almost 400 feet above the present-day level of Honey Lake. Quaternary-age sediments deposited in Lake Lahontan are an important aquifer in the western portions of Honey Lake Valley, where sands and gravels from Long Valley Creek are predominant. On the eastern side of the basin, the Quaternary-age sediments consist mainly of fine-grained silts and clay that have low hydraulic conductivity.

Alluvial fans of Quaternary age have accumulated along the base of the mountain front and consist of poorly sorted deposits ranging in size from clay to boulders. The distal portions of the fans interfinger with predominantly fine-grained deposits toward the center of the basin. These alluvial sediments have moderate to high permeability and are an important aquifer at the western edge of the valley floor.

1.7.5.3 Subsurface Soils in OB/OD Area

Information on subsurface soils in the OB/OD Units was obtained from soil borings drilled in 1992 as part of an RI conducted by James M. Montgomery Consulting Engineers. In general, subsurface soils in the OB/OD Units consist of the following soils in order of increasing depth:

- Alluvium, cobbles, silt, and sand
- Nearshore, imbedded sand, silt, and clay
- Deep water lacustrine olive silts and clays
- Deep water lacustrine dark gray silts and clays
- Volcanics

These lithologies vary in depth and thickness across the OB/OD Units. Figure 1-7 shows locations of cross sections A-A’ and B-B’ for subsurface soils. Figures 1-8 (A-A’) and 1-9 (B-B’) show the cross sections.

1.8 CONCEPTUAL SITE MODEL

A conceptual site model facilitates consistent and comprehensive evaluation of the risks to human and ecological receptors by creating a framework for identifying the pathways by which human health and ecological receptor systems may be impacted by contaminants predicted to exist at the OB/OD Units.

The conceptual site model depicts the relationships between the elements necessary to construct a complete exposure pathway, as follows:

- Sources and chemicals of potential concern (COPCs)
- Contaminant release mechanisms
- Contaminant transport pathways
- Exposure mechanisms and exposure routes
- Receptors

This section discusses the conceptual site models for the OB/OD Units.

1.8.1 <u>OB Unit</u>

OB in pans resulted in the release of particulates into air. This particulate matter would have been deposited onto the ground surface. The quantity of material deposited would be expected to vary with distance from the OB pans. The particles with the greatest density and largest mass would be deposited closer to the pans, and less dense particles with lesser mass would be deposited at greater distances from the pans. The largest mass would be expected to have been deposited in close proximity to the OB pans. Materials could also be ejected from the pans directly onto the ground surface in close proximity to the OB pans.

Particulate matter released during OB operations would have consisted primarily of inorganic constituents (primarily metals) and potentially untreated explosive materials. The ground surface could be contaminated with metals and explosives. Contaminants in surface soil could infiltrate into the subsurface during precipitation events, and subsurface contaminants could infiltrate to groundwater. Contaminated surface soil could also be eroded from the site during runoff and be deposited into streams.

Several pathways exist for a receptor to become exposed to contaminated media at the OB Unit. These pathways include inhalation resulting from wind erosion, direct contact with surface and subsurface soil, ingestion of groundwater, and indirect pathways such as the consumption of contaminated crops and livestock if the contaminated areas were used for farming.

1.8.2 OD Unit

OD in pits resulted in the release of particulates into air. This particulate matter would have been deposited onto the ground surface. The deposition pattern would be expected to vary with distance from the OD pits. The particles with the greatest density and largest mass would be deposited within the pits and in close proximity to the pits. Less dense particles with lesser mass would be deposited at greater distances from the pans. The largest mass would be expected to have been deposited in close proximity to the OD pits.

Materials could also have been ejected from the pits directly onto the ground surface in close proximity to the OD pits. Three types of material would have been ejected during OD treatment operations, including shrapnel, particulate matter, and UXO. Shrapnel consisted of solid pieces of metal (primarily ferrous and aluminum). Particulate matter consisted of primarily of metals and to a lesser extent may have contained untreated explosives. UXO consisted of complete rounds that were not detonated during the treatment operations.

Particulate matter released during OD treatment operations would have consisted primarily of inorganic constituents (primarily metals) and potentially untreated explosive materials such as RDX. The ground surface could be contaminated with metals and explosives. Contaminants in surface soil could infiltrate into the subsurface during precipitation events, and subsurface contaminants could infiltrate into groundwater. Contaminated surface soil outside the OD pits could also be eroded from the site during runoff and be deposited into streams. Overall, the highest density of contaminants from particulate matter would be expected to be found within and in close proximity to the OD pits. In general, concentrations of UXO would decrease with distance. However, UXO deposition patterns would be expected to vary for different classes of munitions/explosives treated.

Several pathways exist for a receptor to become exposed to contaminated media at the OD Unit. These pathways include inhalation of particulates resulting from wind erosion, direct contact with surface and subsurface soil, ingestion of groundwater, and indirect pathways such as the consumption of contaminated crops and livestock if the contaminated areas were used for farming. In the case of UXO, direct contact with UXO would primarily present a safety hazard.

TABLE 1-1

HISTORICAL AREAS OF INTEREST(1)
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

Areas of Interest(1)	Estimated Dates of Operation	Solid Waste Management Unit (SWMU) Number (SWMU Name)	Installation Restoration Program Site Names	Groups II Areas of Interest	Newly Defined Areas of Interest
Demolition Area (DA). The northern portion is also known as the Active Demolition Area	1950 - 2004	SWMU 1 (Upper Detonation Grounds at the DA)	N/A	Active Demolition Area	
Upper Burning Area (UBA): Southern Extension (SWMU 2) and Northern Extension	Southern Extension: 1940s - 1999 Northern Extension: 1954 - 1966	SWMU 2 (UBA Grounds - Note: The Northern Extension was not included as part of SWMU 2 or even identified at that time)	The North and South extensions of the UBA	Upper Burning Grounds (UBG)	
Lower Burning Area (LBA)	1940s - 2001	SWMU 3 (LBA)	LBA	LBA	
Hansen's Hole	1950s - 1970	SWMU 4 (Hansen's Hole)	Hansen's Hole	Hansen's Hole	
Explosive Ordnance Disposal (EOD) Training Area	Estimated: 1950s - 1990s	SWMU 5 (EOD Explosive Training Area at the DA)	N/A	N/A	
Buried Trench Area	1946 - 1988	SWMU 6 (Lower Burning Ground Trenches)	N/A	Buried Trenches	
Building 349 - Satellite Drum Accumulation Pad (Bldg. 349)	Building 349: Pre-1984 - Present Pad: Unknown	N/A	N/A	N/A	
Old Demolition Area (ODA)	1961 - 1981	N/A	ODA	ODA	
Open Trenches and Ash Pile	1950 - 1990s	N/A	Open Trenches and Ash Pile	Open Trenches and Ash Pit	
Bureau of Land Management (BLM) Property (located east of UBG)	Unknown	N/A	N/A	BLM - Administered Public Land	
Gravel Pit	1950s - Unknown	N/A	N/A	N/A	Gravel Pit north of Stacy, a potential open burning/open detonation (OB/OD) Area

TABLE 1-1

HISTORICAL AREAS OF INTEREST[1]
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

Areas of Interest[1]	Estimated Dates of Operation	Solid Waste Management Unit (SWMU) Number (SWMU Name)	Installation Restoration Program Site Names	Groups II Areas of Interest	Newly Defined Areas of Interest
Unnamed trenches	1954 - Unknown	N/A	N/A	N/A	Trenches/berms west of EOD Area
Hexachloroethene (HC) Smokes/Possible Demolition Area	1950s - Unknown	N/A	N/A	N/A	Possible demolition area along Demolition Road/Disturbed area east of Demolition Road
Western Area	1950s - Unknown	N/A	N/A	N/A	Area near the western boundary of the UBG, parallel with UBA
South of Hasen's Hole	1950s - Unknown	N/A	N/A	N/A	Pits, circular features east of UBG boundary
Area west of UBG	1949 - Unknown	N/A	N/A	N/A	Trenches, berms, etc. near a gravel pit west of UBG boundary
Area adjacent to south of the LBA	Unknown	N/A	N/A	N/A	Area of disturbance located south of the road bounding the LBA

1 Source: Draft Historical Records Review, Upper Burning Grounds, Sierra Army Depot. Tech Law. March 2006.

TABLE 1-2

GENERAL CHEMICAL COMPOSITION OF ENERGETICS
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

Propellants[1]	
Name	**Formula or Composition**
Nitrocellulose	$C_{12}H_{14}(ONO_2)_6O_4$
Nitroglycerine	$C_3H_5N_3O_9$
Nitroguanidine	$CH_4N_4O_2$
Primary Explosives[2]	
Lead azide	N_6Pb (71% Pb)
Diazodinitrophenol (DDNP)	$C_6H_2N_4O_5$
Lead styphnate	$C_6HN_3O_8Pb$ (44.2% Pb)
Tetracene	$C_{18}H_{12}$
Potassium dinitrobenzofuroxane (KDNBF)	$C_6H_2N_4O_6K$
Lead mononitroresorcinate (LMNR)	$C_6H_3NO_2Pb$ (57.5% Pb)
Fuels:	
Lead thiocyanate	$Pb(SCN)_2$ (64% Pb)
Antimony sulfide	Sb_2S_3
Calcium silicide	$CaSi_2$
Oxidizers:	
Potassium chlorate	$KClO_3$
Ammonium perchlorate	NH_4ClO_4
Barium nitrate	$Ba(NO_3)_2$
Calcium resinate	$Ca\ (C_{44}H_{62}O_4)_2$
Strontium peroxide	SrO_2
Barium peroxide	BaO_2
Strontium nitrate	$Sr(NO_3)_2$
Potassium perchlorate	$KClO_4$

TABLE 1-2

GENERAL CHEMICAL COMPOSITION OF ENERGETICS
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

Booster and Secondary Explosives (High Explosives)	
Name	**Formula or Composition**
Aliphatic nitrate esters:	
1,2,4-Butanetriol trinitrate (BTTN)	$C_4H_7N_3O_9$
Diethylene glycol dinitrate (DEGN)	$C_4H_8N_2O_7$
Nitroglycerine (NG)	$C_3H_5N_3O_9$
Nitrostarch (NS)	$C_6H_{10}O_5NO_2$
Pentaerythritol tetranitrate (PETN)	$C_5H_8N_4O_{12}$
Triethylene glycol dinitrate (TEGDN)	$C_6H_{12}O_4N_2O_4$
1,1,1-Trimethylolethane trinitrate (TMETN)	$C_5H_9O_9N_3$
Nitrocellulose (NC)	$C_{12}H_{14}(ONO_2)_6O_4$
Nitramines:	
Cyclotetramethylene tetranitramine (HMX)	$C_4H_8N_8O_8$
Cyclotrimethylene-trinitramine (RDX)	$C_3H_6N_6O_6$
Ethylenediamine dinitrate (EEDN, Haleite)	$C_2H_6N_4O_4$
Nitroguanidine (NQ)	$CH_4N_4O_2$
2,4,6-Trinitrophenylmethylnitramine (Tetryl)	$C_7H_5N_5O_8$
Ammonium picrate (Explosive D)	$C_6H_3N_3O_7H_3N$
1,3-Diamino-2,4,6-trinitrobenzene (DATB)	$C_6H_4N_5O_6$
2,2'4,4'6,6'-Hexanitroazobenzene (HNAB)	$C_{12}H_4N_8O_{12}$
Hexanitrostilbene (HNS)	$C_{14}H_2N_6O_{12}$
1,3,5-Triamino-2,4,6-trinitrobenzene (TATB)	$C_6H_6N_6O_6$
2,4,6-Trinitrotoluene (TNT)	$C_7H_5N_3O_6$
Ammonium nitrate	$NH_4(NO_3)$

TABLE 1-2

GENERAL CHEMICAL COMPOSITION OF ENERGETICS
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

Name	Formula or Composition
Binary mixtures:	
Amotols	ammonium nitrate + TNT
Composition A	RDX + desensitizer
Composition B	RDX + TNT
Composition C	RDX + plasticizer
Ednatols	haleite + TNT
LX-14	HMX-95.5 + estane 5702-F-1
Octols	HMX + TNT
Pentolite	PETN + TNT
Picratol	[ammonium picrate (52%) + TNT (48%)]
Tetrytols	TNT + tetryl
Ternary mixtures:	
Amatex 20	[RDX (40%) + TNT (40%) + ammonium nitrate (20%)]
Ammonels	NH_3 - NO_3 + Al + TNT, DNT a/o RDX
HBX	(high blast explosives) TNT, RDX + Al
HTA-3	HMX, TNT, AL - mixture 3
Minol-2	TNT, ammonium nitrate + aluminum
Torpex	[RDX (41.6%), TNT (39.7%), Al (18.0%) wax (0.7%)]
Quaternary mixtures:	
DBX	[TNT (4%), RDX (21%), ammonium nitrate (21%), Al (18%)]
Plastic bonded explosives (PBX):	
Basic explosive [RDX, HMX, HNT, or PETN + polymeric binder (polyester, polyurethane, nylon polystyrene, rubbers, nitrocellulose, Teflon)]	

Source: Military Explosives, Department of the Army Technical Manual, TM9-1300-214, September 1984.

(1) These three primary constituents can be used separately or in various combinations along with metals, metallic salts, and organic polymer binders.

(2) Primary composition includes a mixture of primary explosives, fuels, oxidizers, and binders (e.g., paraffin wax).

TABLE 1-3

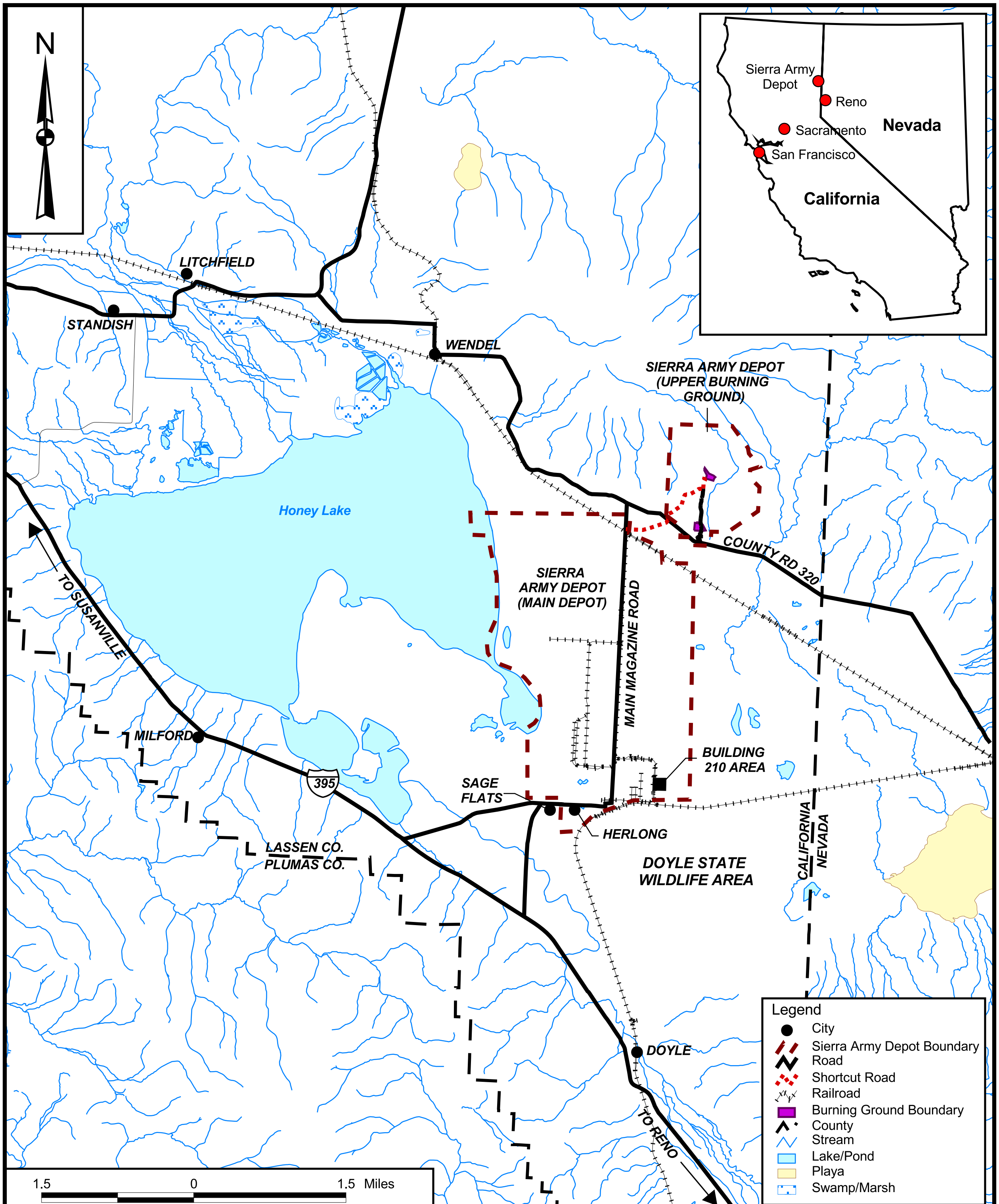
FEDERAL RCRA AND CALIFORNIA CODES FOR HAZARDOUS WASTE MUNITIONS/EXPLOSIVES TREATED BY OB/OD SIERRA ARMY DEPOT HERLONG, CALIFORNIA

RCRA Code	Characteristic	Contaminant
D001	Ignitability	Ignitable compounds
D003	Reactivity	Numerous
D004	Toxicity Characteristic	Arsenic
D005	Toxicity Characteristic	Barium
D006	Toxicity Characteristic	Cadmium
D007	Toxicity Characteristic	Chromium
D008	Toxicity Characteristic	Lead
D009	Toxicity Characteristic	Mercury
D010	Toxicity Characteristic	Selenium
D030	Toxicity Characteristic	2,4-Dinitrotoluene
D032	Toxicity Characteristic	Hexachlorobenzene
K044	Reactivity	Explosives/Propellants
California Codes		
181 (Other Inorganic Solid Wastes)	Soluble Threshold Limit Concentration and/or Total Threshold Limit Concentration	Antimony, arsenic, barium, beryllium, cadmium, chromium (III), chromium (VI), copper, lead, mercury, manganese, nickel, selenium, zinc, organic lead compounds
352 (Other Organic Solids)	Soluble Threshold Limit Concentration and/or Total Threshold Limit Concentration	Antimony, arsenic, barium, beryllium, cadmium, chromium (III), chromium (VI), copper, lead, mercury, manganese, nickel, selenium, zinc, organic lead compounds

TABLE 1-4

40 CFR 261 APPENDIX VIII HAZARDOUS CONSTITUENTS
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

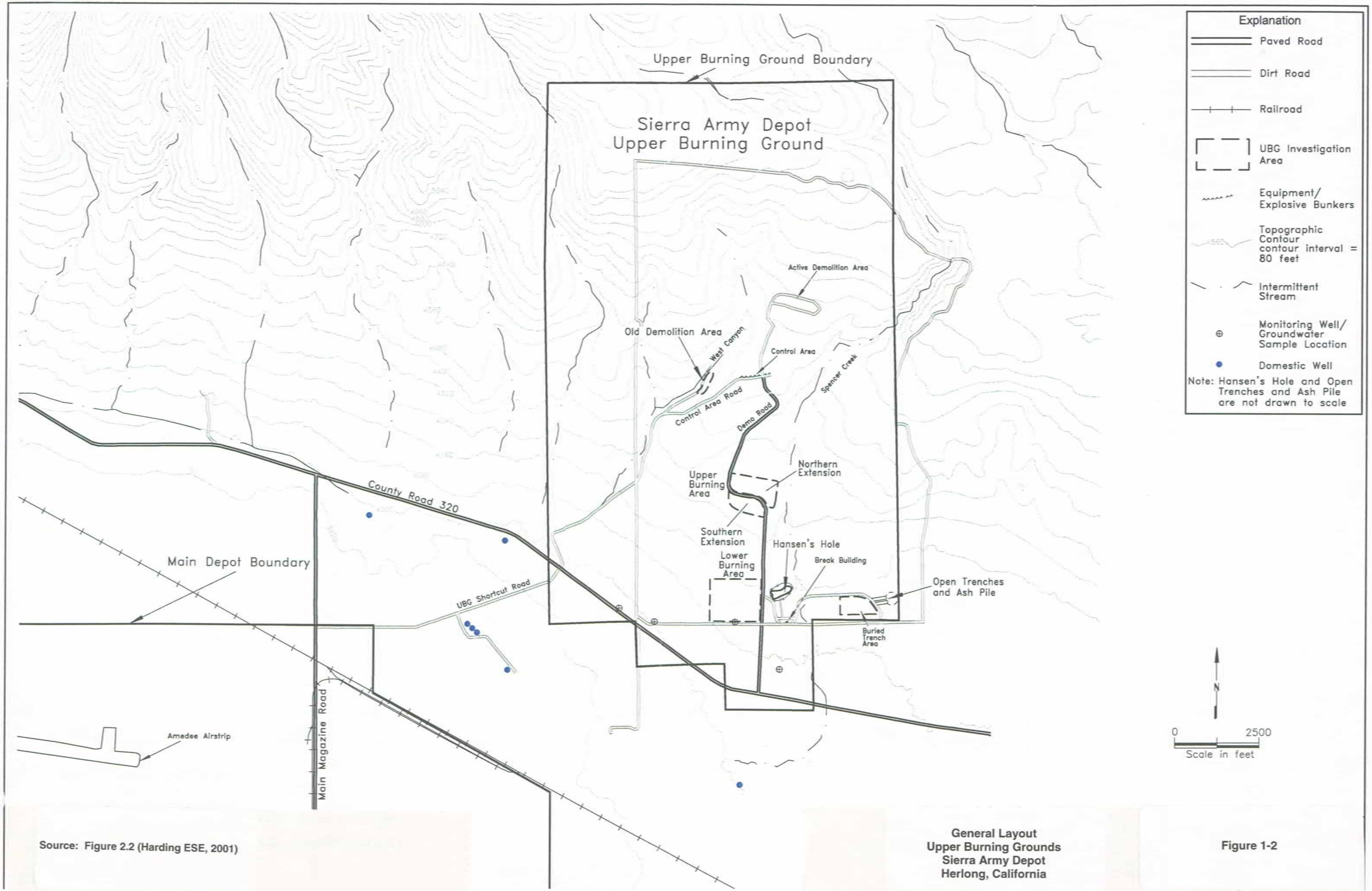
Inorganic Compounds	Organic Compounds	Organo-Metallic Compounds
Antimony sulfide	Dibutylphthalate (DBP)	Lead salicylate
Barium chromate	Diethylphthalate	Lead stearate
Barium compounds	2,4- and 2,6-dinitrotoluene (DNT)	Lead styphnate
Barium nitrate	Diphenylamine (DPA)	Lead-tribasic maleate monohydrate
Barium peroxide	Hexachlorobenzene (HCB)	N-lead-ß-resorcylate
Lead azide	Nitroglycerin	Basic lead-2-ethyl hexoate
Lead carbonate		
Lead compounds		
Lead peroxide		
Lead sulfocyanate		
Lead thiocyanate		



DRAWN BY: S. PAXTON	DATE: 7/18/07	CONTRACT NUMBER: 6123
CHECKED BY: R. BASINSKI	DATE: 7/23/07	APPROVED BY: ___ DATE: ___
COST/SCHEDULE-AREA		APPROVED BY: ___ DATE: ___
SCALE: AS NOTED		DRAWING NO.: FIGURE 1 - 1 REV: 0

LOCATION MAP
CLOSURE PLAN
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

P:\GIS\SIERRAARMYDEPOT\SAMPLING.APR LOCATION MAP LAYOUT 7/23/07 SP



Source: Figure 2.2 (Harding ESE, 2001)

General Layout
Upper Burning Grounds
Sierra Army Depot
Herlong, California

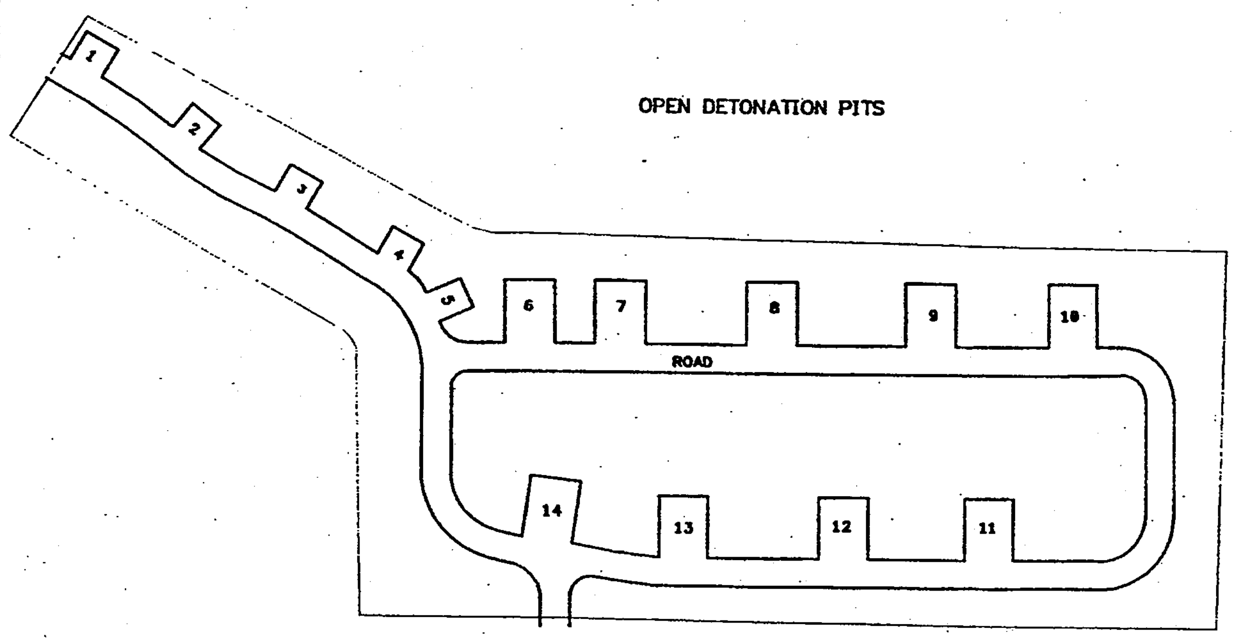
Figure 1-2

P:\GIS\SIERRAARMYDEPOT\MONITORINGAPR.APR OPEN DET PIT AND LOWER BURNING GROUNDS AERIAL LAYOUT 7/19/07 SP

DRAWN BY S. PAXTON DATE 6/25/07 CHECKED BY R. BASINSKI DATE 7/19/07 COST/SCHEDULE-AREA SCALE AS NOTED	SIERRA ARMY DEPOT PRIDE IN EXCELLENCE	OPEN DETONATION PITS AND LOWER BURNING GROUNDS AERIAL WITH COORDINATES CLOSURE PLAN SIERRA ARMY DEPOT HERLONG, CALIFORNIA	CONTRACT NUMBER 6123 APPROVED BY DATE APPROVED BY DATE DRAWING NO. FIGURE 1 - 3 REV 0

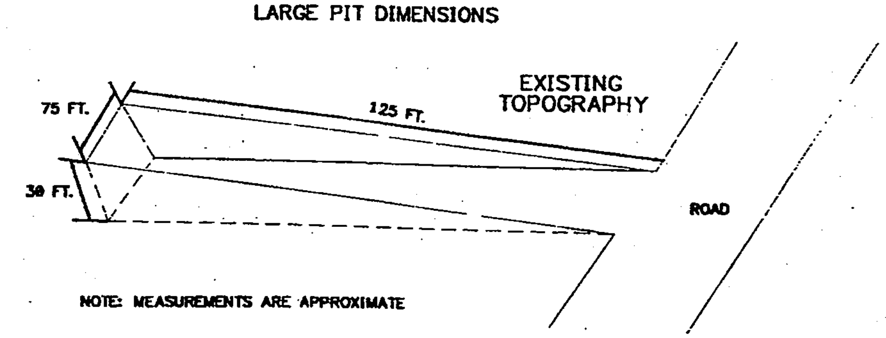
ACAD: K:\CADD\7K86\95020301.DWG 08/20/97 MF

OPEN DETONATION PITS



NOTE: DETONATION PITS 1 THROUGH 5 ARE ROUGHLY ONE HALF THE SIZE OF THE LARGER PITS NUMBERED 6 THROUGH 14

LARGE PIT DIMENSIONS



NOTE: MEASUREMENTS ARE APPROXIMATE

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 7/7/97
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

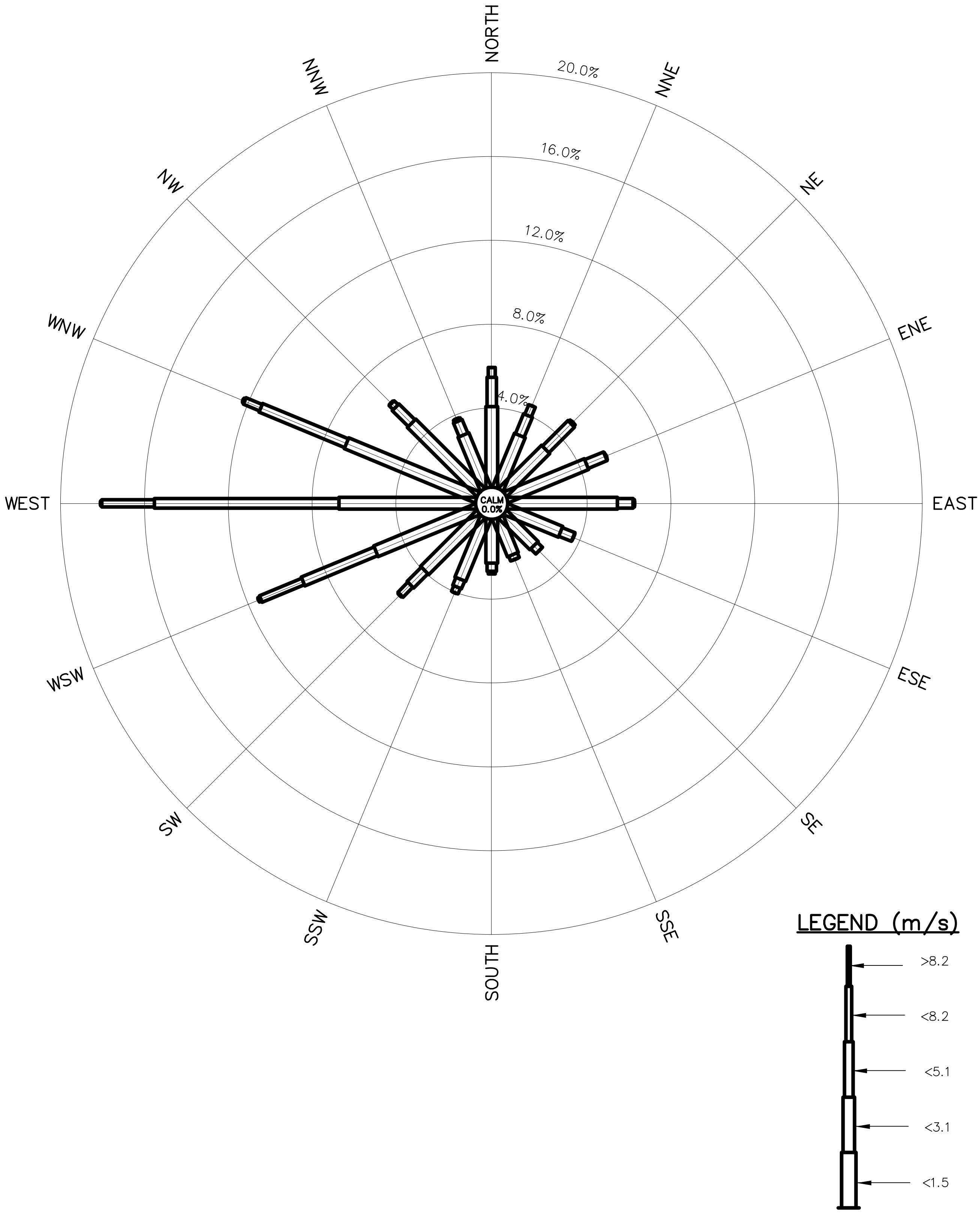
Brown & Root Environmental

OPEN DETONATION PITS
SIERRA ARMY DEPOT
HERLONG, CA

CONTRACT NO. 5A34
OWNER NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 1-4
REV. 0

FORM CADD NO. SOUTH_BH.DGN - REV 0 - 02/11/97

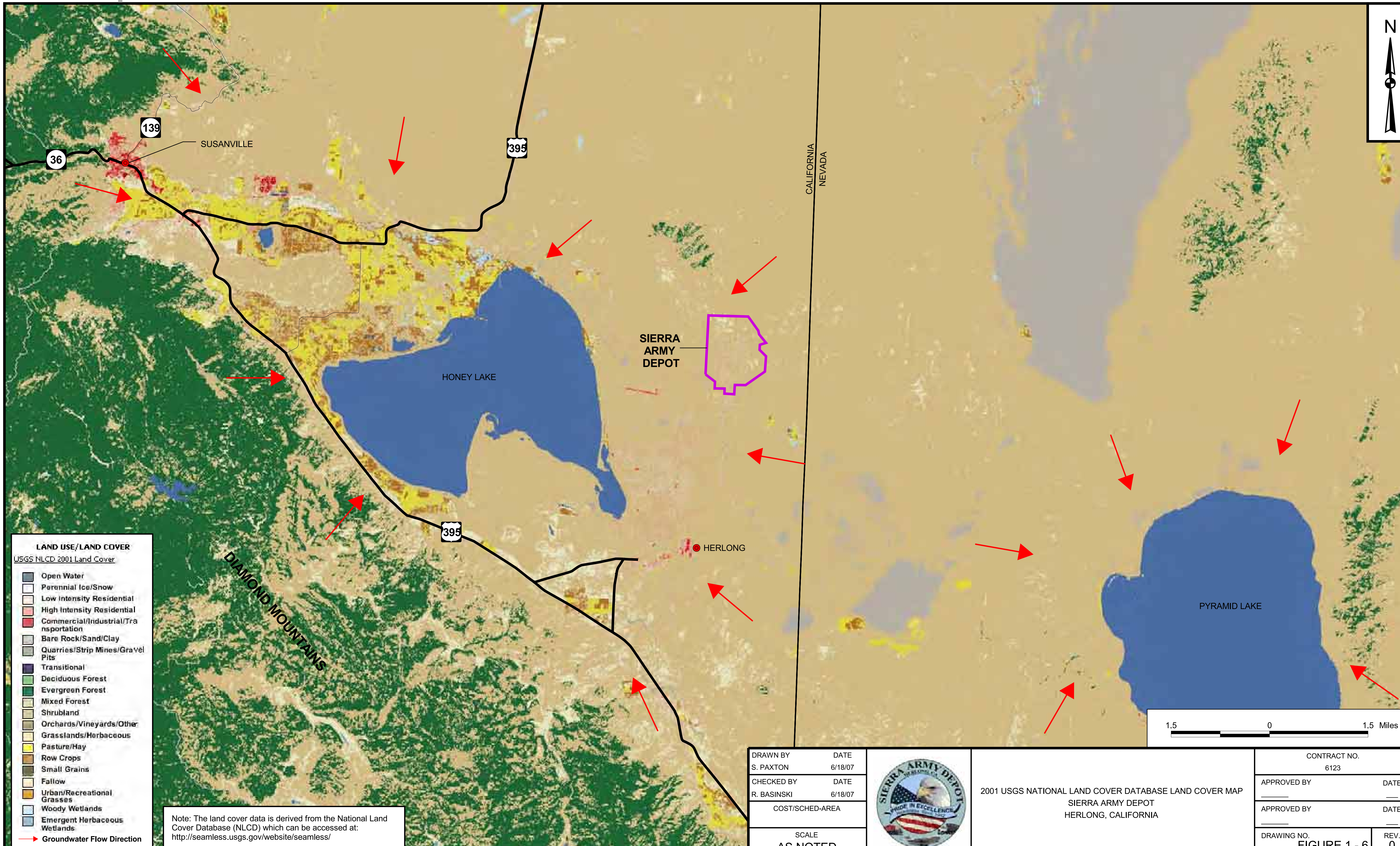
ACAD: 0724km01.dwg 01/09/07 HJB PIT



DRAWN BY HJB — DATE 1/9/06	Tetra Tech NUS, Inc.	ANNUAL WIND ROSE 1996 METEROLOGICAL DATA FROM OB/OD BREAK SHACK METEOROLOGICAL STATION CLOSURE PLAN SIERRA ARMY DEPOT HERLONG, CALIFORNIA	CONTRACT NO. 0724
CHECKED BY — DATE			OWNER NO.
REVISED BY — DATE			APPROVED BY — DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-5 — REV. 0

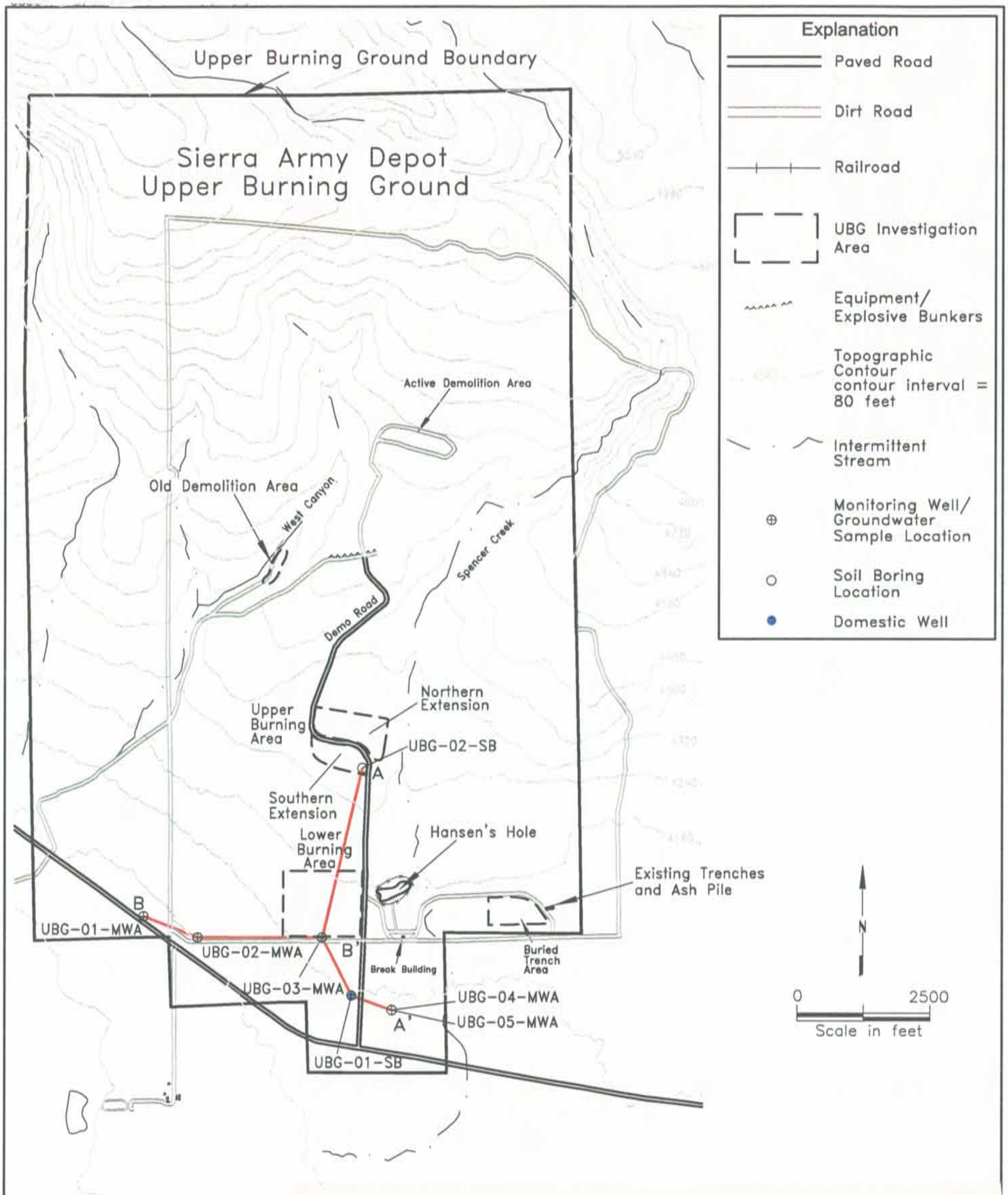
FORM CADD NO. TTNUS-AV.DWG - REV 1 -9/10/98

P:\GIS\SIERRAARMYDEPOT\LAND_USE.APR 2001 LAND USE LAYOUT 6/18/07 SP



Note: The land cover data is derived from the National Land Cover Database (NLCD) which can be accessed at: http://seamless.usgs.gov/website/seamless/

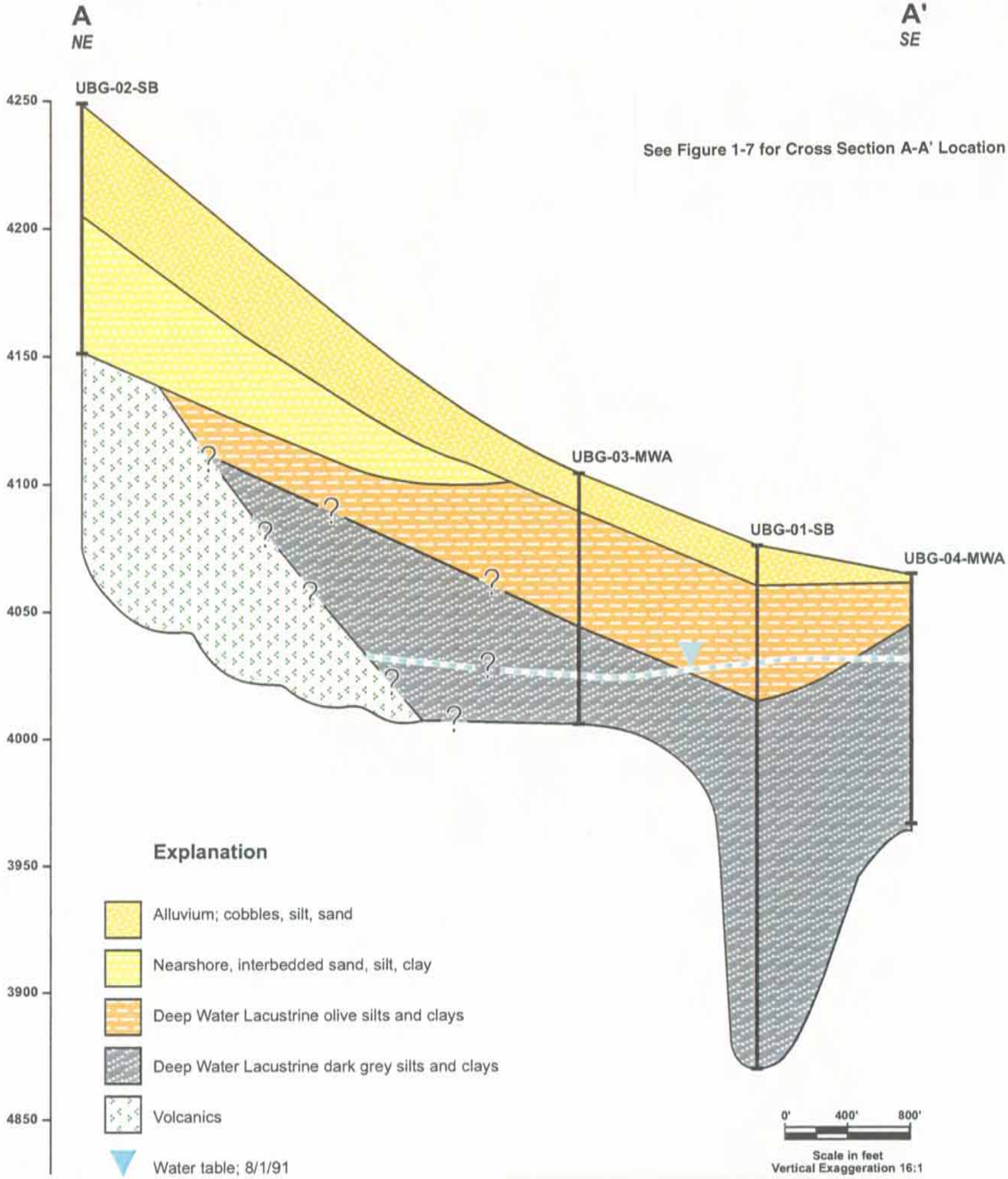
DRAWN BY	DATE		2001 USGS NATIONAL LAND COVER DATABASE LAND COVER MAP SIERRA ARMY DEPOT HERLONG, CALIFORNIA	CONTRACT NO. 6123	
S. PAXTON	6/18/07			APPROVED BY	DATE
CHECKED BY	DATE			APPROVED BY	DATE
R. BASINSKI	6/18/07				
COST/SCHED-AREA				DRAWING NO. FIGURE 1 - 6	REV. 0
SCALE AS NOTED					



Source: Figure 2.6 (Harding ESE, 2001)

Cross Section Locations
Upper Burning Grounds
Sierra Army Depot
Herlong, California

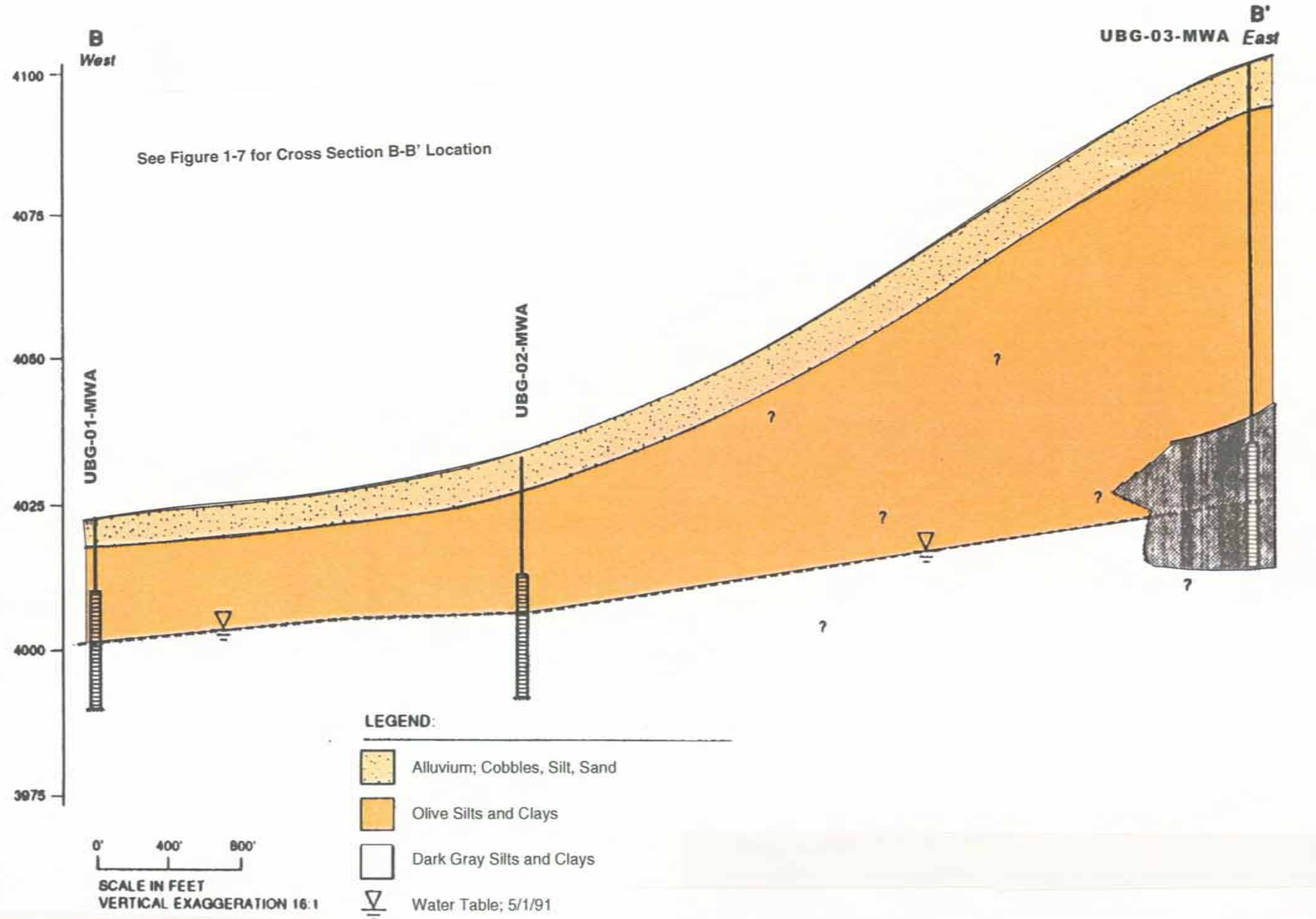
Figure 1-7



Source: Figure 2.7 (Harding ESE, 2001)

Cross Section A-A'
Upper Burning Grounds
Sierra Army Depot
Herlong, California

Figure 1-8



Source: Figure 2.8 (Harding ESE, 2001)

Cross Section B-B'
Upper Burning Grounds
Sierra Army Depot
Herlong, California

Figure 1-9

2.0 CLOSURE PERFORMANCE STANDARD - 22 CCR 66265.111

The closure performance standard for the SIAD OB/OD Units addresses munitions and explosives of concern (MEC). The DoD defines MEC as consisting of unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) present in concentrations potentially causing an explosive hazard. MC may also be present in concentrations which do not cause an explosive hazard, but present risks to human and/or ecological receptors. MC constituents include explosive (RDX HMX, TNT, etc.) and non-explosive constituents (metals) of military munitions. MEC and MC may be present at the SIAD OD Unit, and MC may be present at the SIAD OB Unit as a result of interim status treatment operations. DMM is not present because no military munitions were discarded.

In general, MEC and MC-contaminated soil will be removed from the OB/OD Units to the extent necessary to attain designated uses. If decontamination of soil cannot be achieved at a given OB/OD Unit or subunit during closure, additional closure activities will be conducted at that unit to protect human health and the environment. If SIAD is unable to certify that all or parts of the treatment areas are MEC-free, restrictions will be placed on land use in these areas where safety impacts to humans could result. In addition, the contingent Post-Closure Plan will be implemented for any unit if clean closure cannot be attained. In the event that SIAD cannot attain clean closure for any unit, this Closure Plan will be modified and a detailed Post-Closure Plan developed and submitted to DTSC.

Cleanup goals for soil will include removal of MEC and MC (from the OD area) to the depth necessary for the final end use or as required by DTSC and to attain background levels and/or risk-based concentrations for metals and energetics (SW 846 Method 8330 list). These cleanup goals will be established through a series of screening steps and detailed evaluations. The evaluation procedure that will be used to establish soil cleanup goals is outlined in the following narrative.

2.1 MEC

Searches will be made for MEC. Any MEC will either be removed or detonated in place if the MEC is unsafe to move. In the event that treatment is required an emergency permit must be obtained from DTSC. If MEC is not of concern (i.e., the OB pan area) or for areas that can be certified as free of MEC to the DTSC-approved designated depth, the area will be considered to be MEC clean. Section 6 provides information on the characterization of the OB/OD Units for MEC.

2.2 MUNITIONS CONSTITUENTS

2.2.1 Background Comparison

The purpose of the background comparison is to determine which metallic munitions constituents detected in soil or groundwater (OB Unit only) are present at concentrations that represent contamination due to OB/OD treatment activities. This will be done by comparing concentrations of metals to background data representative of local conditions unaffected by site-related activities. Metals present at concentrations elevated with respect to background well or soil concentrations will be retained for evaluation as COPCs for human health and ecological risk assessments. Separate background evaluations will be conduced for the OB Unit and the OD Unit.

Section 1.6 contains details on the MC that were present in the waste military munitions and explosives treated by OB/OD at SIAD. These major constituents, explosives and metals, were determined from information obtained from Army manuals and the Munitions Items Disposition Action System (MIDAS) database. Table 2-1 lists the explosives and metals that were the primary MC at the OB/OD Units.

CALEPA has published a final policy for hazardous waste sites titled Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities, dated February 1997. This policy requires the use of the comparison to background method and will serve as the basis for the initial identification of metallic munitions constituents as COPCs. This is the simplest method and involves comparisons of the maximum concentrations detected at the site to concentrations representing the upper range of ambient/background conditions. However, this technique results in increasing Type I errors (false positives) as the number of samples being compared increases. The policy also allows the use of the Wilcoxon rank sum test. The background comparison will be made in accordance with this CALEPA Policy.

If background values are not exceeded for any munitions constituent and UXO is not of concern, soil at the OB/OD Units will be considered clean, and no further evaluation will be conducted. If background values are exceeded, a quantitative risk analysis using site-specific sampling results will be conducted.

Because organics (explosives) are not naturally occurring, any detections will be considered to be greater than background.

2.3 QUANTITATIVE RISK ASSESSMENT – HUMAN HEALTH

Health risk will be assessed separately at the OB Unit and OD Unit. Quantitative risk estimates will be developed for carcinogenic and noncarcinogenic constituents that exceed background levels. Two documents will be used as guidance in the preparation of the human health risk assessment (HHRA):

- The US EPA guidance document titled Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) 1989.

- Supplemental guidance prepared by the CALEPA DTSC titled Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste and Permitted Facilities dated August 1996.

The following is an outline of the quantitative HHRA process.

Chemicals detected in excess of background levels will be compared to screening levels established by US EPA and CALEPA. Any chemical detected at concentrations exceeding background levels and screening levels will be considered as a COPC in the HHRA.

The following human receptors will be evaluated in the HHRA:

Resident: Most of the UBG is very unlikely to be developed for residential land use because the Army will retain control of the entire OB/OD area for the indefinite future. However, hypothetical future residential land use will be evaluated to provide baseline risk estimates and to identify no further action (NFA) areas to be released for general uses. These areas are most likely to include places around the locations where OB took place and away from the OD pits. Soil in these areas will be evaluated to a depth of 10 feet.

Site Worker: The former "industrial use" of the UBG was as an OB/OD facility. However, this use will no longer take place. The most likely industrial use of the UBG would be for military training purposes.

The following exposure pathways will be considered in the HHRA:

- Ingestion of contaminated soil
- Dermal contact with contaminated soil
- Inhalation of contaminated airborne soil particulates
- Ingestion of contaminated drinking water

- Ingestion of contaminated fruits and vegetables
- Dermal contact with contaminated water
- Ingestion of contaminated meat, eggs, or dairy products
- Ingestion of breast milk by nursing infants

The following pathways will not be considered:

- Inhalation of contaminated vapors – None of the materials handled at the OB Unit and OD Unit contained volatile organic chemicals (VOCs). See Section 1.6 for details. Explosive donor materials used at the OD pits did not contain volatiles. The RCRA Facility Investigation (RFI) activities conducted at the OB Unit did not identify the presence of any VOCs in soil, sediment, or groundwater.

- Ingestion of contaminated fish or shellfish – All of the streams in the OB/OD area are ephemeral and do not support permanent fish populations.

- Ingestion of contaminated water while swimming – None of the streams in the vicinity of the OB Unit and OD Unit are deep enough for swimming.

The de minimus threshold for cancer risk is 1 X 10^{-6}; any risk greater than 1 X 10^{-6} will be considered on a risk management basis. In the event that the cancer risk estimates summed for all carcinogenic chemicals detected in excess of background in an environmental medium do not exceed 1 X 10^{-6}, NFA will be considered appropriate for that environmental medium. If the cancer risk exceeds 1 X 10^{-6}, the medium will be considered potentially contaminated. The extent of contamination will be determined, and the need for a Corrective Measures Study will be evaluated.

In the event that the cumulative hazard index (HI) summed for all noncarcinogenic chemicals detected in excess of background in an environmental medium does not exceed 1.0, no further analysis of potential systemic toxicants will be conducted, and NFA will be considered appropriate for that environmental medium. If the HI does exceed 1.0, additional analysis will be completed to determine the HI based on the toxicity endpoints of the potential chemicals of concern (COCs). Under these circumstances, it is likely that several cumulative HIs for chemicals with similar endpoints will be determined. If cumulative HIs based on toxicity endpoints do not exceed 1.0, NFA will be considered appropriate for the environmental medium. Otherwise, the extent of contamination will be determined, and the need for a Corrective Measures Study will be evaluated.

2.4 ECOLOGICAL RISK ASSESSMENT

The Ecological Risk Assessment (ERA) will be conducted in accordance with the CALEPA guidance titled Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities dated July 4, 1996 and updates found on the CALEPA website (http:/www.dtsc.ca.gov/AssessingRisk/eco.cfm).

Initially, a scoping-level assessment will be conducted that will consist of chemical, physical, and biological characterizations of the OB Unit and OD Unit, and evaluations of the potential for complete exposure pathways. The purpose of this investigation is to determine the potential for contact between ecological receptors and COCs. Soil will be evaluated to a depth of 2 to 6 feet. The results of this qualitative assessment will be used to determine the need for and extent of further assessments. If no organic chemicals (explosives) of ecological concern are present or concentrations of inorganic elements are at or less than background concentrations, the OB Unit, OD Unit, or portions of the units will not be further evaluated for ecological risk. A minimal Scoping Assessment Report detailing these findings, the areas to which they apply, and conclusions will be prepared and submitted to DTSC. If potentially MC-contaminated media are identified at concentrations that may adversely impact wildlife or their habitats, the Scoping Assessment Report will recommend that a Phase 1 predictive assessment be conducted. If remediation is required to address any human health risks, the Scoping Assessment Report will include an evaluation of the potential impacts on biota or habitat. Figure 2-1 provides a flow chart for the ecological scoping assessment. Following is a discussion of key elements of the ecological scoping assessment and how each element will be addressed. Separate ecological scoping assessments will be conducted for the OB Unit and OD Unit.

2.4.1 Site Characterization

Chemical and physical characterization of OB and OD Units for MC is described in Section 7.0 (Surface Water and Sediment Sampling Plan), Section 8.0 (Soil Sampling Plan), and Section 11.0 (Analytical Program). In the case of inorganic MC (metals), only metals present at concentrations greater than background concentrations will be retained for evaluation as COPCs. Section 2.2.1 describes how the background comparison will be conducted to identify which metals will be considered as COPCs for the ERA.

2.4.2 Biological Characterization

The purpose of the biological characterization of the OB Unit and OD Unit will be to determine biological assets to be protected. The following elements will be considered during biological characterization of the OB and OD Units:

- Identification of each distinct habitat found at each site, and each offsite habitat that has the potential to be impacted by OB- or OD-related contaminants.

- Identification of the species and types of communities present or potentially present.

- Identification of species considered to be essential to, or indicative of, the normal functioning of the ecosystem or community.

- Identification of special species and their habitats at or near the OB and OD Units in addition to identification of the more common site-receptors.

2.4.3 Pathway Assessment

The purpose of the pathway assessment will be to identify the potential for contact between environmental receptors and COCs in environmental media by any exposure route. The media to be considered will include soil, air, sediment, surface water, and biota. Surface water will be considered, although it is not likely to be identified as a medium of concern because of the lack of permanent water bodies at the OB and OD Units. Honey Lake, which is the only permanent water body, is located over 5 miles from the OB and OD Units. Both direct (e.g., dermal contact with soil) and indirect (e.g., via food sources) pathways will be considered. The physical and chemical properties of the MC will be considered. Pathways will be considered complete unless the MC will not enter into the environmental medium or the receptor will not contact the environmental medium, either directly or indirectly.

2.4.4 Scoping Assessment Report

The objective of the Scoping Assessment Report will be to describe the approach, calculation, and documentation of the scientifically based estimation of adverse effect(s) on wildlife and wildlife habitats from exposure to MC in environmental media at the OB and OD Units. The following elements will be contained in the Scoping Assessment Report:

- Characterizations of the OB and OD Units including location, ecological region, physical description, climate, and site history, including MC managed on the individual units.

- A description of potential problem including MC contamination of environmental media, chemical migration pathways, ecological resources, and exposure pathways. Media concentrations that are predictive of adverse effects on biota will be identified.

- A draft proposal for a Phase 1 Predictive Assessment Work Plan will be developed. The fully developed Phase I Predictive Assessment Work Plan would be developed in consultation with the DTSC Health and Ecological Risk Division (HERD). The draft proposal would include the following elements:

  - Preliminary Conceptual Site Model
  - Preliminary list of potential receptors to be evaluated in detail
  - Preliminary list of potential pathways for each receptor to be evaluated
  - Field validation of preliminary facility-specific habitats maps
  - Assessment endpoints to be evaluated
  - Measure endpoints to be measured
  - Proposed data quality objectives
  - Proposed hypotheses for any statistical testing

2.5 REMEDIATION

If the threshold levels for protection or human health and/or ecological receptors are not satisfied, corrective measures will be considered to meet the human health cleanup goals (incremental cancer risk less than 1×10^{-6} and HI less than or equal to 1.0). Remediation may also be required if impacts to ecological concerns are identified that do not require remediation for human health risks. The areas where remediation is required to meet the closure performance standard will be based on analytical results from soil and groundwater sampling and risk analysis described above. Verification sampling will be conducted as required to verify that the closure standard has been met.

The evaluation of corrective measures may result in a determination that clean closure is not feasible in parts of the OB or OD Units because of technical or economic considerations. For example, the OD area has been operated since the 1950s. As a result of these long-term operations, it is likely that UXO has been ejected from the pits and has been deposited over a large area consisting of several thousand acres. Surface sweeps for UXO will be conducted; however, in many cases, potential UXO may be hidden by vegetation or may be buried. Existing technologies are not adequate to allow complete detection of buried UXO. Utilization of hand techniques to dig up several thousand acres would be prohibitively expensive. Therefore, it may not be possible to certify large portions of the OB/OD area as free of UXO. In this case, institutional controls (fencing and land use restrictions) may be the only feasible alternative.

2.6 DATA QUALITY OBJECTIVES PLANNING PROCESS

Various planning meetings have been held among SIAD, DTSC and Tetra Tech NUS, Inc. to determine scope of Phase I fieldwork for the OB and OD Units. Following is a description of the results of the planning meetings.

2.6.1 OB Unit Data Quality Objectives Planning Process Summary

PROBLEM DEFINITION - STEP 1

The following is the problem definition:

- MC may be present in surface and subsurface soil.
- If present in soil, MC may have migrated into groundwater
- Historical data are available for MC; however, there are data gaps.
- The Conceptual Site Model (CSM) indicates potentially complete pathways between human and ecological receptors under both current land uses and potential future land uses.
- If present in significant concentrations in soil, groundwater, surface water, or sediment, MC could present significant risks to human and ecological receptors.

DECISIONS TO BE MADE - STEP 2

The primary goal of the OB Unit Phase I investigation is to obtain environmental data for use in making the following decisions:

- Determine whether MC is present within the study area in quantities or concentrations that present excess risk to human receptors
- Determine whether MC is present within the study area in quantities or concentrations that present excess risk to ecological receptors
- Determine whether MC or MEC is present within the study area in quantities or concentrations that require LUCs. If they are, consider imposing LUCs; otherwise, impose no LUCs.

The secondary goal of the Phase I investigation is to collect information to improve the cost-to-complete (CTC) estimate.

INPUTS REQUIRED TO MAKE THE DECISION - STEP 3

Data and information required to make the decisions(s) listed above include the following:

- Concentrations in surface soil of SW 846 Method 8330 explosives (primarily RDX, HMX, and TNT) and perchlorate.

- Concentrations in surface soil of SW 846 metals to determine if metals are present in soil in excess of background and screening levels.

    - Identification of soil types
    - Background metals data in similar soil types

- Concentrations in subsurface soil of SW 846 Method 8330 explosives (primarily RDX, HMX, and TNT) and perchlorate.

- Concentrations in subsurface soil of SW 846 metals to determine if metals (primarily lead, barium, strontium, and lithium) are present in soil in excess of background and screening levels.

    - Identification of soil types
    - Background metals data in similar soil types

- Concentrations in perched water and groundwater of explosives, perchlorates, and metals.

- Screening levels for explosives, perchlorates, and metals to conduct the human and ecological risk assessments.

- Method detection limits that meet screening levels.

DELINEATION OF STUDY BOUNDARY - STEP 4

- The horizontal boundary is defined as the hazardous waste management unit. Figure 1-3 shows the coordinates of the OB Unit boundary.

- All media within the OB Unit boundary that are contaminated with MC are of interest. This includes surface and subsurface soil, perched water, and groundwater.

- Lateral (horizontal) expansion of the study area will not occur because release beyond the unit boundary will be addressed in the MMRP Site Inspection (SI).

- Vertical expansion of the study area during Phase II fieldwork to deeper subsurface soil may be necessary if MC is present in the deepest subsurface soil sampled during Phase I.

DEFINITION OF RULES FOR DECISION MAKING - STEP 5

- If MC is detected at concentrations in soil or groundwater that present excess human health risk, consider proceeding to the Phase II Closure Plan if adequate data are available. Otherwise proceed to Round II fieldwork.

- If MC is detected at concentrations in soil that present excess ecological risk, proceed to the Phase II Closure Plan if adequate data are available. Otherwise proceed to Phase II fieldwork.

PERFORMANCE CRITERIA - STEP 6

Performance criteria for new analytical data are normal laboratory quality assurance (QA) limits and meeting pre-established detection limits.

PLAN FOR OBTAINING THE DATA - STEP 7

The sampling and analysis plan for collecting the MC data from the OB Unit is described in Section 7.0 of this Closure Plan.

2.6.2 OD Unit Data Quality Objectives Planning Process Summary

PROBLEM DEFINITION - STEP 1

The following is the problem definition:

- MC may be present in surface and subsurface soil at the OD Unit.

- If present in soil, MC may have migrated into groundwater.

- MEC may be present in surface and subsurface soil at the OD Unit. If present, MEC may present an explosive hazard.

- The CSM indicates potentially complete pathways between human and ecological receptors under both current land uses and potential future land uses.

- If present in significant concentrations in soil or groundwater, MC could present significant risks to human and ecological receptors.

DECISIONS TO BE MADE - STEP 2

The primary goal of the OD Phase 1 site investigation is to obtain environmental data for use in making the following decisions:

- Determine whether MC or MEC is present within the OD hazardous waste management unit in quantities or concentrations that require proceeding to the Round II field site investigation Phase II of the Closure Plan. If they are, proceed to the Round II fieldwork or Phase II of the Closure Plan; otherwise, do not investigate further.

- Determine whether MC or MEC is present within the study area in quantities or concentrations that require and immediate response. If they are, initiate the appropriate response; otherwise, take no immediate action.

- Determine whether MC or MEC is present within the study area in quantities or concentrations that require LUCs without further study. If they are, consider imposing LUCs; otherwise, impose no LUCs.

The secondary goal of the Phase I investigation is to collect information to improve the CTC estimate.

INPUTS REQUIRED TO MAKE THE DECISION - STEP 3

Data and information required to make the decisions listed above include the following:

- Presence of MEC on the ground surface and in the subsurface.

- Concentrations in surface soil of SW 846 Method 8330 explosives (primarily RDX, HMX, and TNT).

- Concentrations in surface soil of SW 846 metals to determine if metals (primarily lead, barium, strontium, and lithium) are present in soil in excess of background and screening levels.

- Identification of soil types
- Background metals data in similar soil types

- Screening levels for explosives and metals to determine if it is necessary to proceed to Phase II fieldwork and complete the human health and ecological risk assessments.

- Method detection limits that meet screening levels.

DELINEATION OF STUDY BOUNDARY - STEP 4

- The horizontal boundary is defined as the hazardous waste management unit. Figure 1-3 shows the coordinates of the OD Unit boundary.

- All media potentially contaminated with MC are of interest, including surface and subsurface soil.

- Lateral (horizontal) expansion of the study area will not occur because release beyond the unit boundary will be addressed in the MMRP.

- Vertical expansion of the study area during a Phase II investigation may be necessary if MC or MEC is present in the surface soil.

DEFINITION OF RULES FOR DECISION MAKING - STEP 5

- If sufficient data have been collected to complete the human and ecological risk assessments and/or FS, proceed to Phase II of the Closure Plan.

- If MC is detected at concentrations in soil greater than screening values, consider proceeding to Round II fieldwork if additional data are necessary to conduct the human health or ecological risk assessments.

- If MC is observed at concentrations in soil greater than action levels at the vertical boundaries of sampling, proceed to Round II fieldwork.

PERFRMANCE CRITERIA - STEP 6

Performance criteria for new analytical data are normal laboratory QA limits and meeting pre-established detection limits.

PLAN FOR OBTAINING THE DATA - STEP 7

The sampling and analysis plan for collecting the MC data from the OD pits is described in Section 8.0 of this Closure Plan. The plan for collection of data on surface MEC is presented in Section 6.0 of this Closure Plan.

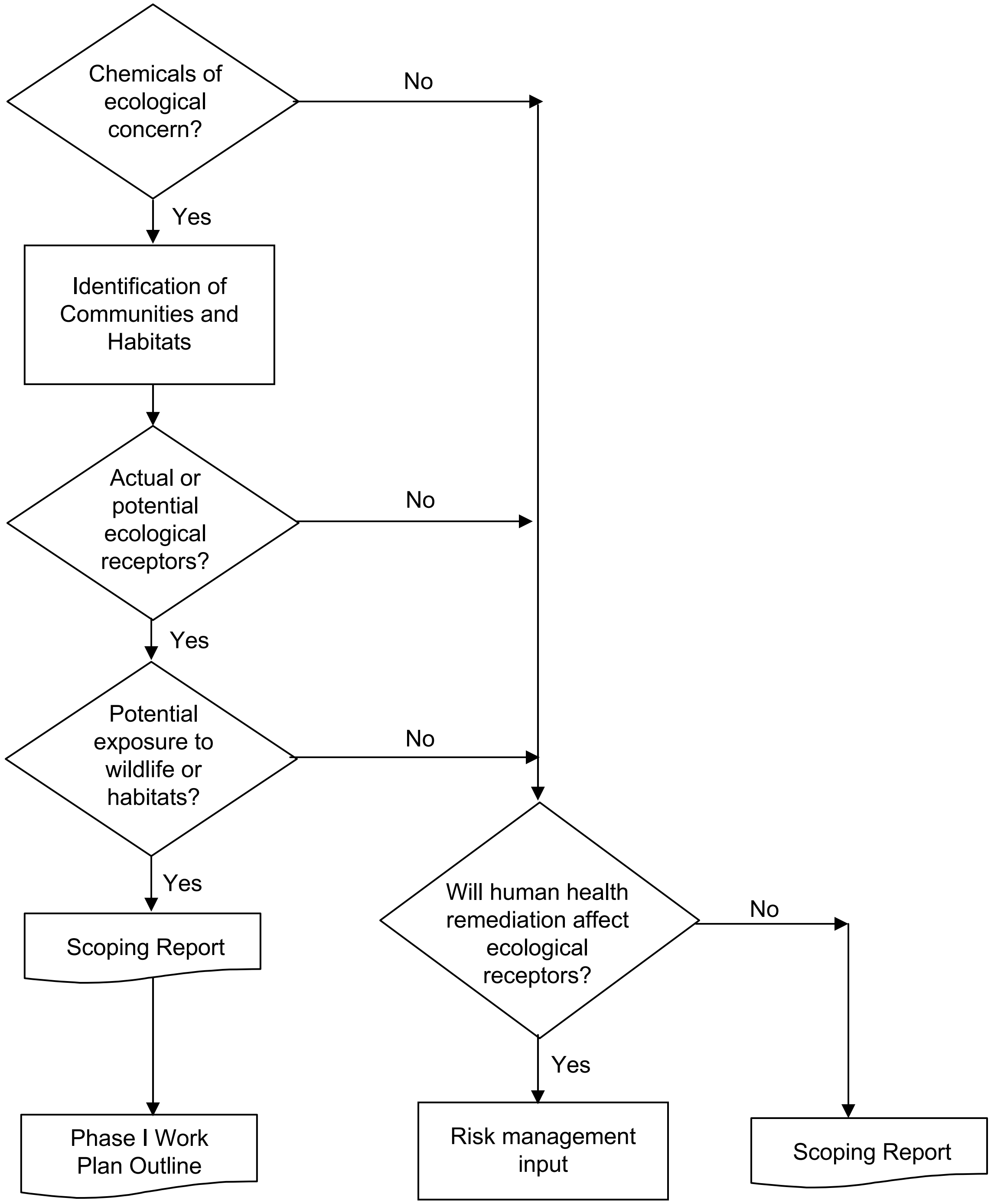
TABLE 2-1

MUNITIONS CONSTITUENTS
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

Munitions Constituents	
Metals	
Aluminum	Magnesium
Antimony	Manganese
Arsenic	Mercury (7000 series method)
Barium	Molybdenum
Beryllium	Nickel
Cadmium	Potassium
Calcium	Selenium
Chromium	Silver
Cobalt	Sodium
Copper	Thallium
Iron	Vanadium
Lead	Zinc
Explosives	
2-Am-DNT	2-Nitrotoluene
4-Am-DNT	3-Nitrotoluene
1,3-DNB	4-Nitrotoluene
2,4-DNT	RDX
2,6-DNT	Tetryl
HMX	1,3,5-TNB
Nitrobenzene	2,4,6-TNT
Miscellaneous	
Perchlorate	Asbestos

FIGURE 2-1

SCOPING ASSESSMENT
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA



Source: Guidance for Ecological Risk Assessments at Hazardous Waste Sites and Permitted Facilities, State of California Environmental Protection Agency, Department of Toxic Substances Control, Human and Ecological Risk Division July 4, 1996.

3.0 PARTIAL CLOSURE ACTIVITIES - 22 CCR 66265.112(B)(1)

3.1 OPEN BURNING UNIT

The OB Unit will be closed in its entirety. Therefore, there will be no partial closure activities at the OB Unit.

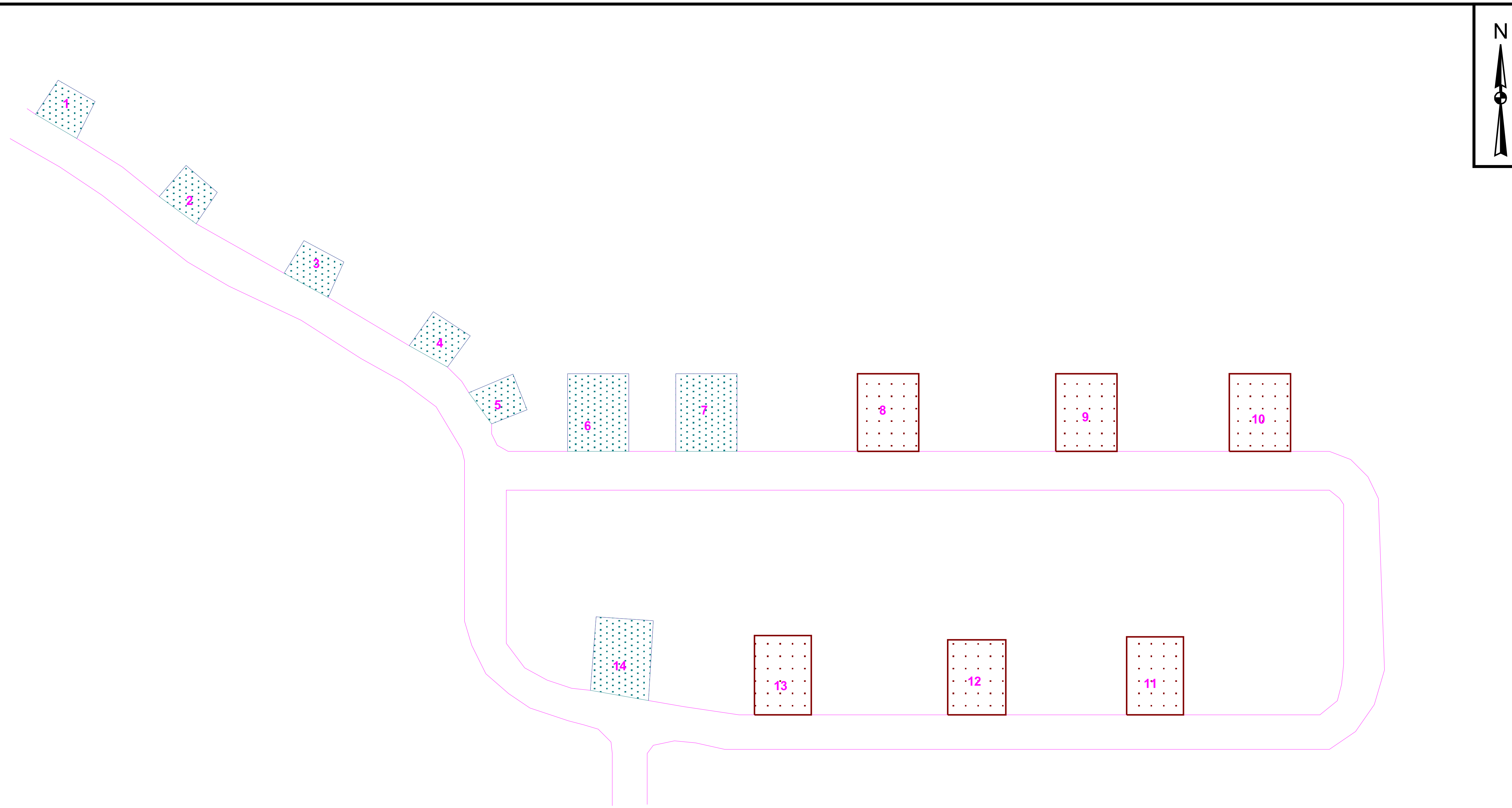
3.2 OPEN DETONATION UNIT

SIAD is currently storing military munitions. As a result of the 2005 BRAC process, these munitions will be moved to other Army depots. The Department of Defense (DoD) is in the process of moving munitions from SIAD to other storage facilities; however, this process will take several years to complete. SIAD does not control the movement of the existing munitions inventory. Funding, which is necessary to move the munitions, is controlled by the Congressional budgeting process, and the allocation of funds is controlled by the Department of Army. Therefore, it is not possible for SIAD to develop a refined approximation of the number of years before the last of the existing munitions inventory has been removed. However, under the federal law governing the BRAC process, all BRAC activities must be completed by 2011. Therefore, this is the latest year in which the existing inventory of munitions should be removed. On occasion, some items may become unsafe to store or found to be unsafe for transportation when removed from their current storage area for transportation to other storage sites. In these cases, it will be necessary to remove these unsafe items from storage and conduct emergency treatments. As long as military munitions are in storage at SIAD, the potential exists that emergency OD treatments may be required. Closure activities will include searches for MEC, which includes UXO. Any suspect MEC that is safe to move will be re-located to a central location for treatment under emergency conditions. Emergency detonation will take place at SIAD only if the items cannot be shipped to an approved treatment facility and there are no other onsite alternatives.

Utilization of areas where OD has not previously been conducted could result in the contamination of areas that are not currently contaminated. Therefore, existing OD units, which have been historically used for OB/OD, will also be utilized for emergency OD treatments. If required, 6 of the 14 OD pits may be utilized for emergency treatments of military munitions and UXO. The remainder of eight pits will be closed. Figure 3-1 shows the location of the pits that will be used for emergency OD treatments.

Because of the need to use existing pits for emergency detonations, the closure of the OD pits will be conducted in a phased manner. Pits 1, 2, 3, 4, 5, 6, 7 and 14 will be sampled during the first phase of fieldwork. Corrective actions will be based on the results of the sampling. Emergency detonations may take place in Pits 9, 10, 11, and 12 when munitions become unstable. Pits 8, 9, 10, 11, 12, and 13 will be

P:\GIS\SIERRAARMYDEPOT\SAMPLING.APR DETONATIONPITS 12/7/05 CS



(red dotted box)	Emergency Detonation Pits Phase II Closure
(green dotted box)	Phase I Closure

DRAWN BY: K. PEILA	DATE: 5/3/05	EMERGENCY OPEN DETONATION PITS RCRA INTERIM STATUS DRAFT CLOSURE PLAN OPEN BURNING/OPEN DETONATION UNIT SIERRA ARMY DEPOT HERLONG, CALIFORNIA	CONTRACT NO. 6123
CHECKED BY: V. PLACHY	DATE: 5/3/05		APPROVED BY / DATE
COST/SCHED-AREA			APPROVED BY / DATE
SCALE: AS NOTED			DRAWING NO. FIGURE 3-1 / REV. 0

sampled during a later round of fieldwork. Pits 8 and 13 will not be sampled until this later phase because they are located adjacent to the pits where emergency treatments may take place, and potential kick out may occur into these pits. The later sampling rounds will occur after the BRAC process has been completed and all stored munitions have been removed from storage and transported to other sites. Section 13.0 contains the closure schedule.

4.0 DECONTAMINATION PROCEDURES FOR STRUCTURES, BUILDINGS, AND EQUIPMENT - 22 CCR 66265.112(B)(4)

4.1 STRUCTURES AND BUILDINGS

Structures and buildings associated with the SIAD OB/OD Units include the following:

- Break House, including field office, lunch room, detonation control tower, and bunkers
- Three storage igloos for OD materials, including donor explosives
- Two meteorological monitoring stations (upper and lower)

None of these structures are located within the areas where OB/OD activities took place. No hazardous waste explosives or donor materials were ever present at the meteorological stations. Non-containerized explosives, including donor materials, were not handled within these structures. OB/OD workers who handled the munitions did occupy the Break House or storage igloos. However, the energetic material (propellants, pyrotechnics, and explosives) present in the waste munitions was contained in shells or other types of metallic casing material, or in the case of propellants, was generally contained in bags or other types of containers. In addition, the safety techniques used during placement of munitions at the OD pits and propellants at the OB pans were designed to preclude contamination of workers or personnel protection equipment with energetic materials. Therefore, the storage igloos and Break House are not expected to be contaminated with hazardous waste or hazardous waste constituents as a result of Interim Status treatment operations. Decontamination of these structures is not expected to be necessary. However, as described in Section 5.0, confirmation sampling will be conducted to verify that no explosive residues remain in these areas.

4.2 OB UNIT EQUIPMENT

There are no structures or buildings located within the area where OB in pans took place. The only equipment was the burn pans. The burn pans were decontaminated by removing all OB residues to the bare metal, as confirmed by visual observation. The residues were placed into drums, evaluated for hazardous waste characteristics, and, as appropriate, managed as hazardous wastes. The decontaminated OB pans were shipped to Hawthorne Army Ammunition Plant on June 3, 2003 for the same use (i.e. OB of hazardous waste propellants).

4.3 OD UNIT EQUIPMENT

There is no equipment located at the OD pits; therefore, this section is not applicable.

5.0 CONFIRMATION SAMPLING PLAN FOR STRUCTURES, BUILDINGS, AND EQUIPMENT - 22 CCR 66265.112(B)(4)

Wipe sampling will be conducted of the floors and walls of the storage structures and Break House. The wipe sampling will be conduced in a later round of sampling after all product munitions have been removed from SIAD and there is no potential need for emergency treatments. There are no structures at the OD pits or OB Unit. No structures were ever located at the OD pits or the OB area. The only equipment located at the OB/OD Units requiring decontamination were the burn pans located at the OB Unit. Confirmation that the pans have been decontaminated (removal of all residues to bare metal) was provided by visual observation. Visual observations are adequate for metal surfaces because any OB treatment residues would reside on top of the metal. Collection and analysis of confirmation samples were not required. The decontaminated OB pans were shipped to Hawthorne Army Ammunition Plant for the same use (i.e., OB of hazardous waste propellants).

6.0 MUNITIONS AND EXPLOSIVES OF CONCERN

This section provides baseline information regarding the potential presence of MEC at the UBG. It also contains a description of the procedures that will be used to establish the baseline characterization of the RCRA unit (OD pits) for the presence of MEC. This Closure Plan authorizes the baseline characterization of MEC beyond the boundary of the RCRA units under the MMRP. Characterization of all releases beyond the boundary of the RCRA unit is being addressed under the MMRP.

Several unique terms are used when discussing characterization of UXO. The DoD has established definitions for these terms. Following is a listing of these terms, which are relevant to the baseline characterization, and relevant portions of the DoD definitions:

Explosive Ordnance Disposal (EOD): The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded ordnance and of other munitions that have become hazardous by damage or deterioration.

Material Potentially Presenting an Explosive Hazard (MPPEH): Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris).

Military Munitions: Military munitions means all ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the U.S. Coast Guard, the U.S. Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery munitions, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components of the above.

The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954.

Munitions and Explosives of Concern (MEC): This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded Ordnance (UXO), as defined in 10 U.S.C. 101(e)(5)(A) through (C); (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC): Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions (10 U.S.C. 2710).

Unexploded Ordnance (UXO): Military munitions that (A) have been primed, fuzed, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded either by malfunction, design, or any other cause [10 U.S.C 101(e)(5)(A) through (C)].

6.1 BACKGROUND

SIAD has demilitarized military munitions in the UBG since the early 1950s. Demilitarization was accomplished by treating military ordnance items by OD and OB.

OD in Pits: OD took place in 14 pits situated at the base of the Amedee Mountains. The types of ordnance items treated in the OD pits included the following:

- HE components and devices
- HE bombs
- HE cartridges
- Bulk HE
- HE grenades
- HE depth charges and underwater munitions
- HE ICM/CBU and sub munitions
- Missiles
- HE projectiles and warheads
- HE rockets
- Torpedoes
- Demolition material
- HE land mines
- Large rocket motors
- Bulk propellant and black powder
- Propellant charges and increments

- Propellant munitions/components
- Small caliber ammunition
- Incinerable munitions and components
- Fuzes

Military munitions that were treated by OD within the pits were solid, discrete, cased items. Liquids were rarely treated and when treated consisted of small quantities (ounces) contained in cased items. Generally, the ordnance items were laid out in item-specific configurations and donor explosives placed on top. The configurations of the items and the placement of the donor material were designed to direct the explosive force toward the items. This was done to minimize the potential for potential ordnance items to remain untreated and also to minimize the potential for ejection of MEC. However, during the course of the OD treatment operations, MPPEH, consisting of metallic shrapnel and UXO, was ejected onto the land areas surrounding the OD pits. The metallic shrapnel rarely had explosive residues and generally did not present an explosive hazard. A large amount of shrapnel has been ejected from the OD pits, with very high shrapnel densities close to the pits. Therefore, although the vast majority of shrapnel is free of explosive residues, there is a significant potential that shrapnel containing explosive residues is present due to the large amount of shrapnel. In the early 1990s, the original fence line of the Upper Burning Grounds was expanded to increase the area that was off-limits to the public because of safety hazards associated with UXO. During an OD treatment operation, UXO (CBUs) were ejected beyond the original fence line. As a result, the UBG was expanded to include additional BLM lands.

Periodically, SIAD conducted sweeps in which visual observations were made for the presence of UXO. The largest density of shrapnel and UXO were found in close proximity to the OD pits, with the density falling off rapidly within a few hundred feet from the OD pits. However, both shrapnel and UXO have been found within a few hundred feet of the fence surrounding the OB/OD Units. Depending on the direction, the fence line at the boundary of the UBG is located approximately 2.5 to 4 miles from the OD pits.

<u>OB of Rocket Motors in Pits</u>: Large rocket motors were treated in the OD pits using crack-and-burn treatment methods. The rocket motor was laid on its side, and an explosive charge was laid out along the casing. The charge split open the casing and also initiated the burning of the propellant in the rocket motor. There were no reported incidents of any rocket motor functioning (i.e., taking off). Because this was a burning operation, any ejected propellant would have fallen out in close proximity to the pits. Small plugs (finger sized) of ejected propellant have been observed within close proximity (approximately 300 yards) of the OD pits. The density of any ejected propellant would be expected to decrease rapidly with increasing distance.

OB: OB treatment operations took place in the OB Unit, which is located near the southern border of the UBG. All military munitions treated by OB were conventional munitions. No chemical munitions or chemical warfare agents were ever treated at SIAD by OB. Originally, treatment operations took place on the ground surface. Beginning in the 1980s, all treatment operations were conducted in steel burn pans. The principal ordnance items treated by OB in the OB Unit consisted of the following:

- Bulk propellant and black powder
- Propellant charges and increments
- Propellant munitions/components

The materials treated by OB were generally bulk materials and were not in closed metallic casings. The demilitarization treatment took place by burning. Any ejected untreated materials would have fallen out in the near vicinity of the locations where the burning took place and been packed up and replaced into the pans for treatment. Therefore, UXO would not have resulted from OB operations.

The presence of UXO can present a potential public safety hazard. Currently safety hazards are controlled by the fence, which prevents the public from accessing the areas that may contain UXO. Reduction of the public safety hazard requires clearance of MEC. This section describes the general procedures that will be followed during UXO clearance activities at the UBG

6.2 UXO CONCEPTUAL SITE MODEL

The OD pits were excavated into the moderately sloping hillside with side and back walls. OD Pits 6 through 14 had side walls that were approximately 125 feet long and 75 feet wide and that varied from a few feet high at the pit entrances to as high as 30 feet at the back walls. Pits 1 through 5 are roughly half the size of Pits 6 through 14. Figure 1-4 shows the approximate dimensions of a large pit and the layout of Pits 1 through 14.

OD treatment operations conducted since the 1950s at the OD pits have resulted in the ejection of MPPEH, primarily shrapnel and UXO, onto the UBG. OD treatments took place at the back of the pits near the back walls and the highest parts of the side walls. Therefore, any MPPEH exiting the pits would likely have been ejected at an angle that would have allowed it to clear the side or back walls. These angles are likely to result in most MPPEH falling out in relatively close proximity to the pits. The frequency of occurrence of metallic shrapnel can be used to approximate the potential frequency of occurrence of UXO. Based on site observations, the frequency of occurrence of shrapnel is greatest in close proximity to the OD pits and falls off rapidly within several hundred feet of the pits. The frequency of occurrence of shrapnel generally decreases with increasing the distance from the pits and decreases to zero at the fence line. The frequency of occurrence of UXO would be expected to be similar.

ICMs and CBUs are the types of munitions that, when detonated, presented the greatest probability for UXO dispersal. ICMs and CBUs consist of shells containing anywhere from tens to hundreds of sub munitions. These small sub munitions tended to disperse widely when they did not explode. CBUs were one of the munitions treated in OD pits in large quantities, especially during the 1990s.

UXO ejected from the pits would hit the ground with a velocity that could result in the UXO item penetrating the ground surface. However, the depth of penetration would be expected to be limited to shallow soil no more than several inches deep. During periods of freezing and thawing, buried munitions could resurface due to frost heaving, which occurs when soil expands upward or outward or contracts during periods of freezing and thawing.

SIAD is located in a semi-arid environment (yearly precipitation of approximately 6 inches). The semi-arid climate and alkaline soils characteristic of the SIAD area support a greasewood-saltgrass biome. A limited assortment of grasses and shrubs can be found on the UBG. Although vegetative ground cover is relatively limited, UXO may be hidden underneath the vegetative cover.

Explosive constituents (e.g., TNT, RDX, HMX, etc.) could be released into soil from UXO ejected onto the ground surface or into shallow subsurface soil. Such releases would generally be limited to soil in close proximity to the UXO location (a few feet). Soil contaminated with explosive constituents would rarely, if ever, have high enough concentrations to present an explosive hazard. Therefore, explosives-contaminated soil would not be expected to meet the definition of MEC, although it would contain MC. MC present in soils, in particular RDX, can be mobilized by precipitation. However, because SIAD is located in a semi-arid environment, there is very limited potential for mobilization of MC by precipitation.

6.3 OBJECTIVES OF MEC CHARACTERIZATION FOR OD UNIT

The full characterization of MEC at the OD Unit is expected to occur in at least two rounds. The objectives of the initial characterization round (Round 1) are as follows:

- Verify the conceptual model of UXO dispersal
- Test UXO characterization procedures
- Establish procedures for full characterization
- Establish a modified conceptual model for full characterization and clearance necessary to meet land use requirements
- Meet all applicable DoD explosives safety requirements and Huntsville Corps of Engineers (COE)
- Provide information for determining viable future uses of the UBG

To achieve these objectives, a visual survey will be conducted of the entire OD Unit. The results of Round I UXO characterization will be used to determine viable land uses and the scope of future UXO characterization and clearance activities.

6.4 DEPARTMENT OF DEFENSE SAFETY REQUIREMENTS

Any activities involving explosives, including the UXO characterization to be conducted at the OD Unit, must meet stringent DoD explosive safety standards. The DoD Explosive Safety Board (DDESB) is responsible for establishing explosive safety standards for the DoD. The specific functions of the DDESB are as follows:

- Provide impartial and objective advice to the Secretary of Defense, the Secretaries of the military departments and the Directors of the Defense Agencies on safety aspects of ammunition and explosives (including chemical agents) development, manufacturing, testing, handling, transportation, storage, maintenance, demilitarization, and disposal.

- Review and approve the explosives safety aspects of all plans for siting, construction, or modification of ammunition and explosives facilities, including nearby structures and activities.

- Provide safety surveys and evaluations of ammunition and explosives facilities and activities worldwide to determine compliance with applicable safety standards and to detect conditions endangering life or property inside or outside DoD installation boundaries.

- Establish explosives safety standards by using test results, accident data, and theoretical or analytical techniques.

- Review and approve plans for lease, transfer, or disposal of DoD real property when ammunition, explosives, or chemical agent contamination exists or is suspected.

- Represent the United States on the North Atlantic Treaty Organization (NATO) Group of Experts on the Safety Aspects of Transportation and Storage of Military Ammunition and Explosives (AC/258).

6.5 VISUAL SURVEY OF OD UNIT FOR MEC

The ground surface surrounding the OD pits has a high density of metallic scrap both on the surface and below the surface. Therefore, geophysical techniques, which are normally used in MEC surveys, are not practical. In addition, rocket motor propellants are non-metallic and their detection is not amenable to geophysical techniques.

Visual surveys will be conducted to evaluate and document suspect MEC on the ground surface. No movement or treatment (blow-in-place) of any suspect MEC item will take place. The visual surveys will be conducted by UXO Tech IIIs meeting the qualification requirements described in DDESB TP-18 Table 4-1 (Minimum Qualification Standards). One hundred percent of the OD Unit will be surveyed. At the conclusion of the visual survey, the field team will produce a field log documenting any suspect MEC items discovered and any issues encountered during the visual survey. The Item Log Sheet used in the MMRP Final Site Inspection Work Plan, Upper Burning Ground, Sierra Army Depot, dated April 2007, (MMRP SI Work Plan) will be used. The field log will also contain a sketch showing the locations of MEC items discovered. Each location will be given a unique identifier (1-1, 1-2, etc.) based on a grid system. Figure 6-2 presents an aerial view that shows the layout of the OD pits and the grids that will be used as the basis for the identifiers. Digital photographs will also be taken of each suspect MEC item. Non-suspect MEC surface debris may be removed to facilitate identification. No subsurface investigations will be conducted.

P:\GIS\SIERRAARMYDEPOT\SAMPLING.APR SURVEY GRID LAYOUT 7/19/07 SP

DRAWN BY S. PAXTON, DATE 6/25/07		SURVEY GRID FOR THE OPEN DETONATION UNIT	CONTRACT NUMBER 6123
CHECKED BY R. BASINSKI, DATE 7/19/07		RCRA INTERIM STATUS DRAFT CLOSURE REPORT	APPROVED BY — DATE —
COST/SCHEDULE-AREA		OPEN BURNING/OPEN DETONATION UNIT	APPROVED BY — DATE —
SCALE AS NOTED		SIERRA ARMY DEPOT HERLONG, CALIFORNIA	DRAWING NO. FIGURE 6 - 1, REV 0

7.0 SURFACE WATER/SEDIMENT SAMPLING PLAN - 22 CCR 66265.112(B)(4)

This section provides a general description of historical surface water and sediment sampling data from the UBG. However, as discussed below, surface water/sediment sampling is not proposed as part of this Closure Plan for the OB/OD Units.

7.1 BACKGROUND

Individual OD pits are closed depressions; therefore, surface water does not exit the pits. There are no obvious surface water drainages in the area between the pits; therefore, no surface water or sediment samples are proposed. DTSC and SIAD have agreed that the MMRP will address releases beyond the boundaries of the OB and OD Units. All surface water and sediment sample locations are beyond the boundaries of the OB and OD Units. The surface water and sediment sampling program for locations outside of the OB/OD Units is now included in the MMRP SI Work Plan. The remainder of this section provides general information on surface water drainage patterns and historical investigations of surface water/sediment that were conducted beyond the boundary of the OB and OD hazardous waste management units.

7.1.1 Surface Drainage Patterns

There is no perennial stream draining the UBG area; it is drained by two intermittent creeks. These include Spencer Creek on the northern and eastern sides of the UBG and an unnamed intermittent creek (Unnamed Creek No. 1) located on the western side of the UBG. Locations of these creeks are shown on Figure 7-1. Spencer Creek is the larger of the two creeks and has a total drainage area of approximately 67,540 acres. Spencer Creek and its two tributaries drain land areas on the northern, eastern, and southeastern sides of the UBG, which include approximately 2,560 acres of the OD area (i.e., Demolition Area, Figure 7-1). The Spencer Creek drainage area also includes the OB area (i.e., the LBA, Figure 7-1) and several solid waste management units (SWMUs) including the Buried Trench Area, Hansens Hole, Trenches and Ash Pile Area, and the Upper Burning Area. Unnamed Creek No. 1 and its two tributaries have a total drainage area of approximately 3,630 acres, including 2,050 acres of the Upper Burning Area, the Old Demolition Area pits, and the Demolition Area. The land slope and hydraulic gradients for both watersheds are greater than 5 percent.

The intermittent streams drain south to southwest off of the hillside and onto the flatter valley bottom. Any runoff in the intermittent streams travels to the flat areas (playas) south of County Road 320 and either infiltrates into the ground or evaporates.

The closest surface water body to the UBG is Honey Lake, which is located approximately 5 miles west of the locations where OB and OD activities took place. No surface water or sediment from the UBG ever reaches Honey Lake directly. As mentioned above, surface runoff and sediment are contained in playas located between County Road 320 and the northeastern corner of the Main Depot area (see Figure 7-1).

7.2 HISTORICAL INVESTIGATIONS

7.2.1 Surface Water

No surface water data were available from the RFI conducted at the UBG.

SIAD has a Storm Water Management Plan (Permit No. WDI06A181015231 dated 1998) that requires sampling of surface water runoff that emanates from the UBG during runoff events. Stormwater samples are analyzed for chemical oxygen demand (COD), conductivity, iron, lead, nitrate, nitrite, pH, phorphorous, suspended solids, total organic carbon, and zinc. Appendix B contains the 2006/2007 Annual Report.

7.2.2 Sediments

In 1991, 18 sediment samples were collected from the intermittent streams (as shown on Figure 7-1) during the RFI (James B. Montgomery, 1992). Samples were analyzed for California Title 22 metals and explosives. Analytical results are presented in Table 7-1 and Figure 7-1 includes the locations where samples were collected. Included in these samples were two designated upgradient samples (UBG-17-SD and UBG-18-SD) that were collected from the north and south branches, respectively, of Spencer Creek on the northern side of the UBG (USACE, 1992). Results for metals were detected in excess of background concentrations are shown on Figure 7-1. As noted previously, several CERCLA units exist within the UBG. Several of the sediment samples were collected at locations downgradient of CERCLA units and are not directly relevant to the OB and OD Units. The following is a general discussion of the analytical results for sediment samples.

Explosives: No explosive compounds were detected in the 18 sediment samples collected in 1991.

Metals: Samples UBG-17-SD and UBG-18-SD were collected at locations upgradient of the OD pits. Mercury was the only metal detected in excess of background levels at these upgradient locations.

Some metals were detected at concentrations greater than background concentrations (see Figure 7-1 and Table 7-1). The most exceedances of background concentrations occurred for arsenic, barium, chromium, nickel, lead, and zinc. However, these concentrations in sediments were minor and less than two to five times the background concentrations. The highest metals concentrations were detected at sampling stations UBG-07-SD and UBG-02-SD, located in the eastern branch of Unnamed Creek No. 1, just northwest of the Old Demolition Area and the OD area, respectively. The metals concentrations in Spencer Creek sediments were very low and generally less than background, except for concentrations in sample UBG-15-SD, which was collected at the far southern (downstream) end of the UBG (USACE, 1992). In most cases, metals concentrations were so low (e.g., chromium, cadmium, and mercury) that WET analyses were not performed. In no cases did metals concentrations exceed the relevant TTLCs.

Based on the available data, no other sediment samples have been collected from the two primary intermittent creeks that drain the UBG. Some samples classified as sediment were collected from ditches and drainage swales around the Old Demolition Area, the Upper Burning Area, and the Lower Burning Area during the Follow-On RI (Harding ESE, 2001). These sample analyses have only limited usefulness for evaluation of impacts to creek sediments because it is not known whether the sampled materials are actually representative of the sediment materials transported to the creeks.

TABLE 7-1

STREAM SEDIMENT RESULTS
UPPER BURNING GROUND[1]
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA
PAGE 1 OF 3

Site	Depth (ft)	Sample Date	Compound	Concentration	Units
UBG-01-SD	0.0	03-Apr-1991	Arsenic	4.10	µg/g
		03-Apr-1991	Barium	410.00	µg/g
		03-Apr-1991	Lead	15.90	µg/g
		03-Apr-1991	Zinc	68.20	µg/g
UBG-02-SD	0.0	03-Apr-1991	Arsenic	3.90	µg/g
		03-Apr-1991	Barium	480.00	µg/g
		03-Apr-1991	Chromium	31.90	µg/g
		03-Apr-1991	Copper	108.00	µg/g
		03-Apr-1991	Nickel	35.70	µg/g
		03-Apr-1991	Lead	28.60	µg/g
		03-Apr-1991	Zinc	84.70	µg/g
UBG-03-SD	0.0	03-Apr-1991	Arsenic	4.06	µg/g
		03-Apr-1991	Barium	380.00	µg/g
		03-Apr-1991	Chromium	28.00	µg/g
		03-Apr-1991	Nickel	24.50	µg/g
		03-Apr-1991	Lead	18.10	µg/g
		03-Apr-1991	Zinc	83.90	µg/g
UBG-04-SD	0.0	03-Apr-1991	Arsenic	673.00	µg/L
		03-Apr-1991	Arsenic	95.00	µg/g
		03-Apr-1991	Barium	890.00	µg/g
		03-Apr-1991	Beryllium	3.88	µg/g
		03-Apr-1991	Chromium	26.50	µg/g
		03-Apr-1991	Lead	16.30	µg/g
		03-Apr-1991	Antimony	9.11	µg/g
		03-Apr-1991	Thallium	87.90	µg/g
		03-Apr-1991	Zinc	69.00	µg/g
		03-Apr-1991	Thallium	184.00	µg/L
UBG-05-SD	0.0	03-Apr-1991	Arsenic	20.00	µg/g
		03-Apr-1991	Barium	480.00	µg/g
		03-Apr-1991	Chromium	28.10	µg/g
		03-Apr-1991	Lead	18.10	µg/g
		03-Apr-1991	Zinc	110.00	µg/g
UBG-06-SD	0.0	03-Apr-1991	Arsenic	16.00	µg/g
		03-Apr-1991	Barium	600.00	µg/g
		03-Apr-1991	Chromium	24.50	µg/g
		03-Apr-1991	Lead	16.20	µg/g
		03-Apr-1991	Zinc	90.90	µg/g

TABLE 7-1

STREAM SEDIMENT RESULTS
UPPER BURNING GROUND[1]
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA

Site	Depth (ft)	Sample Date	Compound	Concentration	Units
UBG-07-SD	0.0	03-Apr-1991	Mercury	0.92	µg/g
		03-Apr-1991	Arsenic	14.00	µg/g
		03-Apr-1991	Barium	490.00	µg/g
		03-Apr-1991	Beryllium	7.93	µg/g
		03-Apr-1991	Cadmium	8.35	µg/g
		03-Apr-1991	Chromium	76.10	µg/g
		03-Apr-1991	Copper	331.00	µg/g
		03-Apr-1991	Nickel	108.00	µg/g
		03-Apr-1991	Lead	50.80	µg/g
		03-Apr-1991	Antimony	24.40	µg/g
		03-Apr-1991	Thallium	216.00	µg/g
		03-Apr-1991	Zinc	2610.00	µg/g
		03-Apr-1991	Beryllium	10.10	µg/L
		03-Apr-1991	Copper	2270.00	µg/L
		03-Apr-1991	Lead	740.00	µg/L
		03-Apr-1991	Thallium	709.00	µg/L
		03-Apr-1991	Zinc	36000.00	µg/L
UBG-08-SD	0.0	03-Apr-1991	Mercury	0.07	µg/g
		03-Apr-1991	Arsenic	11.00	µg/g
		03-Apr-1991	Barium	308.00	µg/g
		03-Apr-1991	Lead	11.40	µg/g
		03-Apr-1991	Zinc	74.30	µg/g
UBG-09-SD	0.0	03-Apr-1991	Mercury	0.06	µg/g
		03-Apr-1991	Arsenic	26.00	µg/g
		03-Apr-1991	Barium	570.00	µg/g
		03-Apr-1991	Chromium	26.40	µg/g
		03-Apr-1991	Lead	12.50	µg/g
		03-Apr-1991	Zinc	91.50	µg/g
UBG-10-SD	0.0	04-apr-1991	Arsenic	5.85	µg/g
		04-apr-1991	Barium	320.00	µg/g
		04-apr-1991	Nickel	23.00	µg/g
		04-apr-1991	Lead	9.70	µg/g
		04-apr-1991	Zinc	84.50	µg/g
UBG-11-SD	0.0	04-apr-1991	Arsenic	4.14	µg/g
		04-apr-1991	Barium	307.00	µg/g
		04-apr-1991	Lead	11.60	µg/g
		04-apr-1991	Zinc	63.90	µg/g
UBG-12-SD	0.0	04-apr-1991	Arsenic	4.55	µg/g
		04-apr-1991	Barium	282.00	µg/g
		04-apr-1991	Lead	16.50	µg/g
		04-apr-1991	Zinc	82.70	µg/g

TABLE 7-1

STREAM SEDIMENT RESULTS
UPPER BURNING GROUND[1]
SIERRA ARMY DEPOT
HERLONG, CALIFORNIA
PAGE 3 OF 3

Site	Depth (ft)	Sample Date	Compound	Concentration	Units
UBG-13-SD	0.0	04-apr-1991	Arsenic	2.44	µg/g
		04-apr-1991	Arsenic	5.72	µg/g
		04-apr-1991	Barium	310.00	µg/g
		04-apr-1991	Barium	310.00	µg/g
		04-apr-1991	Chromium	21.60	µg/g
		04-apr-1991	Chromium	24.70	µg/g
		04-apr-1991	Nickel	24.20	µg/g
		04-apr-1991	Lead	11.90	µg/g
		04-apr-1991	Lead	13.50	µg/g
		04-apr-1991	Zinc	81.00	µg/g
		04-apr-1991	Zinc	81.10	µg/g
UBG-14-SD	0.0	04-apr-1991	Arsenic	7.49	µg/g
		04-apr-1991	Barium	410.00	µg/g
		04-apr-1991	Lead	12.30	µg/g
		04-apr-1991	Zinc	99.20	µg/g
UBG-15-SD	0.0	04-apr-1991	Arsenic	3.80	µg/g
		04-apr-1991	Barium	252.00	µg/g
		04-apr-1991	Chromium	28.30	µg/g
		04-apr-1991	Nickel	22.50	µg/g
		04-apr-1991	Lead	13.60	µg/g
		04-apr-1991	Zinc	117.00	µg/g
UBG-16-SD	0.0	04-apr-1991	Mercury	0.17	µg/g
		04-apr-1991	Arsenic	4.65	µg/g
		04-apr-1991	Barium	320.00	µg/g
		04-apr-1991	Lead	11.70	µg/g
		04-apr-1991	Zinc	596.00	µg/g
UBG-17-SD	0.0	04-apr-1991	Mercury	0.10	µg/g
		04-apr-1991	Arsenic	2.80	µg/g
		04-apr-1991	Barium	380.00	µg/g
		04-apr-1991	Lead	12.10	µg/g
		04-apr-1991	Zinc	68.30	µg/g
UBG-18-SD	0.0	04-apr-1991	Mercury	0.06	µg/g
		04-apr-1991	Arsenic	5.11	µg/g
		04-apr-1991	Barium	304.00	µg/g
		04-apr-1991	Lead	12.70	µg/g

1 - This table is a reproduction of Table 6-26 from U.S. Army Corps of Engineers, Sierra Army Depot Group II Remediation Investigation/Feasibility Study, Lassen County, California, July 1992, Final Remedial Investigation.

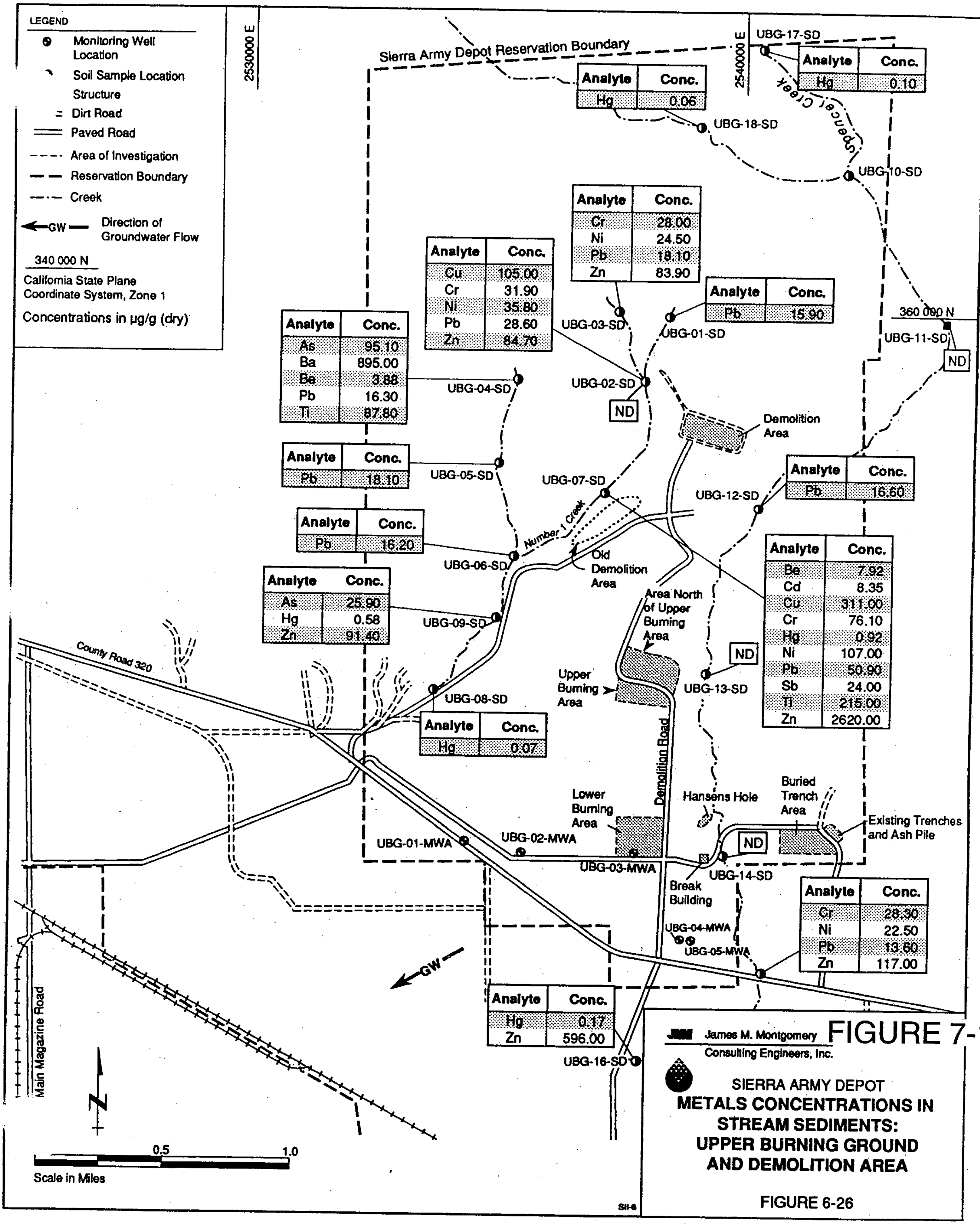


FIGURE 7-1

Source: JMM, 1992

Unit Boundary considerations.
Developed by California in conjunction with their legal team

Open Burn/Open Detonation (OB/OD) Unit Boundary Issues

Question - How should the boundary of an open burn/open detonation (OB/OD) unit be decided?

Conclusion - The unit should include only the immediate treatment area. During the life of the permit, standard operating procedures under the permit should allow for "rendering safe" those items that are discovered outside the unit in the routine verification of treatment after an event. Munition items or other hazardous waste (HW) constituents that are discovered outside the unit by another means, for example during periodic site clearance, soil sampling, or other field investigations, should be managed by interim measures under corrective action. Interim measures would be employed in the same situations that would otherwise be handled by the facility through an emergency response. At the time the OB/OD unit is closed, closure will apply only to the area within the unit boundary. Corrective action will apply to the area outside the unit, although regular monitoring with interim measures if necessary, should ensure that there are no releases outside the unit requiring cleanup at the time of closure.

Background - Treatment by both OB and OD, but especially by OD, causes releases of gases and particulates into the air, and particulate and larger pieces to the soil. The releases will extend far from the immediate area. The sources of hazardous constituents in the air are:
1) the creation and expulsion of gases and particulates by chemical reaction during the event, and
2) entrainment in the rising plume of toxic contaminants that were previously deposited on the soil.

The sources of soil contamination are:
1) deposition of particulates, and
2) fragmentation and ejection of the waste items in the blast.

Some of the fragments may escape treatment, resulting in untreated energetic HW at a distance from the blast area. In addition to untreated energetic, the detonation emits inert metal fragments.

At least three zones can be defined surrounding an OB/OD unit:

1. The smallest area is the immediate treatment area. This is the source of the releases. The source zone is where items are placed for handling and treatment and includes disturbed soil from craters, movement of trucks, grading to remove vegetation and smooth the surface, etc.

At China Lake, this area consists of six acres near the center of Burro Canyon. At Edwards, this is the graded 600 foot diameter circle.

2. Surrounding the source zone is an area that is impacted by releases of HW and hazardous constituents. Releases to the impact zone include particulates, untreated energetic, kickout of untreated intact munitions, and inert fragments. (In USEPA discussions, this area has also been described as two zones: an inner zone based on a high order detonation comprising a fast reaction, with treatment completed as planned, which is primarily particulate deposition in the immediate area; and another zone further out based on low order deposition comprising a slow reaction, possibly incomplete, which may include unreacted larger pieces.) The radius of the impact zone is the initial fragment throw range and

depends on the amount of energetic treated. To include particulate deposition, the impact zone may be extended in the direction of the prevailing wind, according to the deposition model.

At China Lake, the initial fragment throw range is 1800 feet. The area consists of approximately 233 acres (including the six acre source zone) on the floor and walls of Burro Canyon. At Edwards, this area extends considerably beyond the fenceline of the EOD units. The exact acreage involved has not been determined.

3. The largest area is the safety zone established by the Defense Department Explosive Safety Board. These areas are calculated from Explosive Safety Quantity Distances (ESQD) or arcs, and are based on such factors as thermal flux (heat), pressure from the blast, maximum fragment throw range, and/or distance where nonessential personnel are not affected. These distances usually depend on the amount of energetic treated. Areas defined by ESQD may be several miles in diameter.

Discussion - The unit boundary definition must be adaptable for all phases of RCRA: operations under the permit, corrective action, and closure/post-closure. Following are some of the concerns that must be considered when proposing the unit boundary.

1. Permit requirements definition of HWMU, see also misc. unit

a. Operations considerations

- Must be operated so as to protect workers, e.g. no buildup to hazardous waste levels in the soil.
- Must be operated so as to protect sensitive plants and animals.
- It is likely that some of the HW ejected from the detonation will present a safety hazard and will need to be retreated or “blown in place”. This may take place outside of the unit, especially if the unit is defined as the source zone. Can these events be allowed as standard operating procedures under the permit, must an emergency permit be issued for each event, or should they be handled as corrective action?

b. Maintenance considerations

- Monitoring inside the unit is required to detect and prevent buildup of soil contaminants at the surface, possibly affecting workers and ecological resources.

2. Corrective action (CA) requirements - under the munitions rule, section 266.202(d), CA can be applied to an active range *when the situation poses an imminent and substantial endangerment to health or the environment*. The imminent and substantial endangerment authority is found in HSC 25187(h). Both China Lake and Edwards OB/OD units are located on active ranges. The OB/OD unit is a HWMU, the entire contaminated area is a SWMU.

a. RFI/sampling considerations

- CA applies to “releases” from the HWMU. HW and/or constituents are not released until they leave the unit either horizontally or vertically through the underlying soil.
- At China Lake and Edwards release may be through air or soil. Neither of the units have a likely possibility of release through runoff of surface water. Because of the depth to groundwater at both facilities, release through groundwater is likely only if there is a long term release through soil.
- Since OD units have no containment, releases may occur beneath the unit. OD treatment takes place on the ground, causing the soil to become an element of the

treatment process, analogous to treatment process liquids contained in a tank. Therefore, the boundary description should include the depth that the unit extends below ground.
- Detection monitoring outside the unit is required, especially in the downwind direction to detect surface releases and below crater depth and downgradient of the unit to detect subsurface releases.
- Monitoring inside the unit may be required to detect trends.
- In addition to collecting useful and representative data, groundwater monitoring wells must be sited to meet regulatory and safety requirements. The regulations refer to point of compliance and monitoring points for regulated units. CCR Title 22 section 66264.95 requires monitoring points (groundwater monitoring wells) at the "hydraulically downgradient limit of the waste management area" for a regulated unit. (Note that miscellaneous units are not included in the definition of regulated units.) Issues to consider when determining a reasonable location for a monitoring well include:

cannot be so far from the source that detection of releases is delayed;
cannot be close enough to the detonation to be damaged by the blast;
cannot be so close to the source that the released HW and constituents are deposited downgradient of the well;
worker safety when servicing a well, e.g. possibility of encountering untreated energetic or intact munitions; and,
the purpose of the well, (detection vs. evaluation monitoring).

- All monitoring programs (permit requirement and corrective action, within and outside unit boundaries, other field investigations performed by the facility under their Integrated Natural Resources Management Plans) should be integrated to avoid duplication of effort.

b. Interim measures (IM) considerations

- IM are required to address:

worker safety concerns;
threat to plants and animals; and
threat to public health.

- For worker safety, the situations requiring IM may be defined the same as those requiring emergency/HazMat response in the facility's Contingency Plan. Following are examples of defining language:

From China Lake Spill Response Plan, Section II.2.3.3. Releases that Require an Emergency Response

"Releases of hazardous substances that pose a sufficient threat to health and safety that by their very nature, require an emergency response regardless of the circumstances of the release or the mitigating factors. The potential for an emergency must be assessed in a reasonably predictable worst-case scenario. The OSHA directive states that a good indicator of a release that involves an emergency response is if the substance cannot be contained and cleaned up by employees in the immediate vicinity and/or if evacuation of employees is needed. Situations that define an emergency response are listed in the OSHA directive and include, but not limited to, the following:

1) The response comes from outside the immediate release area

2) The release requires evacuation of employees in the area
3) The release poses, or has the potential to pose, conditions that are immediately dangerous to life and health
4) The release poses a serious threat of fire or explosion
5) The release requires immediate attention because of imminent danger
6) The release may cause high levels of exposure to toxic substances
7) An uncertainty is evident regarding the severity of handling the hazard with the available PPE and equipment (i.e. the exposure limit could be exceeded)
8) The situation is unclear or data are lacking on important factors."

From Edwards' Contingency Plan, Section 3.0 Implementation

"This Plan was also designed to minimize hazards to human health and the environment from fires, explosions, or any unplanned sudden or non-sudden release of HW or HW constituents to air, soil, or surface water…

Table 3-1. Levels of HazMat Response

I — *An incident that can be controlled, cleaned up, and disposed of by the user organizations. The incident is confined to small area. Only evacuation of the immediate area is required.*

II — *An incident beyond the user organization's capabilities involving a greater hazard or larger area which could be a potential threat to life or property and which may require a limited evacuation of the surrounding area.*

III — *An incident involving a severe hazard or large area which poses an extreme threat to life and property and will probably require a large scale evacuation; or an incident requiring the expertise or resources of county, state, federal, or private agencies/organizations."*

- It is likely that some HW ejected from the detonation will need to be "blown in place" outside of the unit. Spills or depositions may occur outside the unit which would present a hazard to workers in the vicinity or to the ecosystem and may need to be removed. Can these events be allowed as IM under CA, or should they be handled as standard operating procedures under the permit? To handle these activities under CA, some of the issues to be resolved include:

what CA steps should be required, e.g. IM Workplan, IM Operation and Maintenance Plan, IM Plans and Specifications, Health and Safety Plan, Community Profile, public participation, etc.;

can one document for typical or expected events be prepared in advance, similar to a RAP/ROD;

can IM be long term and recurring; and

how would public notice and CEQA be handled.

c. Corrective measures (CM) considerations

- CM would be required in the event that there are releases that do not require IM. Conditions requiring CM should be differentiated from those requiring

interim measures. Releases will be ongoing and CM would have to be implemented continuously throughout the period of the permit, unless CM are deferred until closure. Under these conditions, CM will not be stabilized.
- The most desirable outcome would be that regular monitoring, with interim measures if necessary, would ensure that there are no releases requiring CM.
- Areas immediately adjacent to the unit may continue to be contaminated with the same types of hazardous materials that are treated at the unit, but originate from different activities. What jurisdiction does DTSC have over an active range if there is no imminent and substantial endangerment? What would be the purpose of corrective action monitoring if there is no mandate for remediation?
- If wastes are left in place outside of the unit after the unit is closed, they would be managed in a CA management unit.

3. Closure/post-closure requirements - applies only to the horizontal area and to the depth below the surface defined by the unit boundary. Remediation of toxic contaminants and removal of munitions and ammunition of concern (UXO) may require different approaches and documentation.

a. Toxics considerations
- A miscellaneous unit is not a land disposal unit. An OB/OD unit closed with waste in place does not constitute a landfill. OB/OD units closed with waste in place are subject to post-closure care requirements, and do not require a post-closure permit.

b. UXO considerations
- Determine what RCRA guidelines apply to UXO clearance. May defer to CERCLA for cleanup if RCRA requirements for public notice are met.
- Determine whether depth of clearance coincides with unit boundary. Consider geophysical capabilities, animal burrowing depth, etc.
- If a UXO clearance effort must be undertaken, it may not be expedient to differentiate between the unit and the rest of the impacted area.

Alternatives -

1. Unit boundary encloses source zone to depth of crater plus additional feet of buffer.

Pro - - easier to delineate the unit boundary
- smaller area to manage, maintain, and close
- uses less area of active range
- soil contamination may be cleaned up sooner under CA, rather than after closure of the unit

Con - - more releases from the unit requiring CA
- releases onto active range
- wells at the limit of the unit may not capture downgradient releases
- wells at the limit of the unit may be damaged by the blast

2. Unit boundary encloses impact zone. Depth varies from below crater depth at the source zone to shallow subsurface throughout the rest of the unit.

Pro - - fewer or no releases from the unit requiring CA

- area within the unit need not be cleaned up until closure

Con - - more difficult to delineate unit boundary
- would use more area of active range
- soil contamination remains in place until closure
- wells at the limit of the unit may not detect releases soon enough for prevention or remedial measures
- more area to close

3. Unit boundary encloses DOD safety standoff zone. Depth varies throughout the unit.

Pro - - because of the large area, it is unlikely that detectable releases from the unit will occur
- no fragment releases
- area within the unit need not be cleaned up until closure

Con - - uses large area of active range
- soil contamination remains in place until closure
- wells at the limit of the unit would be too far to be useful
- requires more complex closure

Recommendation -

1. Implement Alternative 1 - Unit boundary encloses source zone to depth of crater plus additional feet of buffer.

2. Require corrective action, with interim measures only, until closure. Emergency/HazMat responses, described in the facility's Contingency Plan, define the situations requiring interim measures, including "blow in place" of items discovered during routine clearance of the impact zone (not re-treatment allowed under the permit following a detonation event, see 3. below). Additional procedures may be required for protection of ecological resources. Complete one document for expected interim measure events. The public notice and comment period for interim measures will be simultaneous with the permit.

3. Under the permit, allow re-treating of HW outside the unit (rendering safe) as standard operating procedure. The permitted treatment outside the unit must be performed by EOD personnel immediately after an event, following the required inspection of the site, except that the re-treatment may include items ejected from a previous event that were not discovered at that time.

4. Locate monitoring wells considering safety and reasonable extent of particulate deposition. In addition to downgradient direction, consider the air dispersion model results when siting the wells. The wells will be within the impact zone, outside the unit.

5. Clean close the HWMU to risk-based level for toxic contaminants. The SWMU is subject to CA. Consult CERCLA for UXO.

Where to put groundwater monitoring wells.
Wells should be placed outside the major shock wave impact from OD, and closer for OB units

VIBRATION ASSESSMENTS structural impacts

airblast damage thresholds is a corresponding incident peak Overpressure level of 7 kpa for damage to buildings. Vibrations of similar magnitude through the ground

[a]The peak overpressure levels are the levels that occur without reflections. Airblast filling a burrow can produce pressures that are 2 or 3 times these values and are sufficient to result in the effect described.

Structural Impacts

Adverse structural effects of blast noise range from low-level effects such as nondamaging vibration which is perceived or causes objects to rattle, up to high-level effects such as physica damage to structures.

No published standard exists to assess structural damage from airborne or ground impulsive waves, but a great deal of research has been conducted on the probability of damage from impulsive pressure waves. These studies have demonstrated that the peak level relates directly to the probability of damage from structural components such as windows, plaster walls and drywall,

In general, for impulsive noise, the threshold for minimal probability of the most superficial type of damage in residential structures begins when the peak sound level exceeds 134 dB. In terms of structural vibrations due to ground-borne or air-borne blast waves, the threshold of damage has been defined as a resultant peak vibrational level of 0.50 in/sec for older homes and 1.0 in/sec for modern homes.

Noise Modeling

- BNOISE (U.S. Army, May 2001):
- SHOT (U.S. Army, May 2001):
- Sound Intensity Prediction System (SIPS): SIPS is a tool developed by the U.S. Navy, and is available at http://www.nswc.navy.mil/inserts/index.html.
- Noise Assessment and Prediction System (NAPS):
- BLAST (USAF, April 1997): A blast overpressure prediction model developed by the U.S. Air Force.

Noise waves are correlated to vibration (shock waves) and are still being researched for the OD events

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John Scott (NJDEP)
Picatinny wants to declare their Subpart X confidential.
Is this a treatment unit? If it is just an OD area this is a rediculus request.

Is MIDAS information confidential? No the companion MACS database is proprietary and must be purchased. Contact Tina Ellis from DAC for more information..