EPA/ROD/R09-92/084
1992

# EPA Superfund Record of Decision:

**SACRAMENTO ARMY DEPOT**
**EPA ID: CA0210020780**
**OU 04**
**SACRAMENTO, CA**
**09/30/1992**

**SUPERFUND RECORD OF DECISION:**

**SACRAMENTO ARMY DEPOT**
**OXIDATION LAGOONS**
**OPERABLE UNIT**

SACRAMENTO, CALIFORNIA

September 15, 1992

**RECORD OF DECISION**

**I. DECLARATION**

**SITE NAME AND LOCATION**

Oxidation Lagoons Operable Unit
Sacramento Army Depot (SAAD)
8350 Fruitridge Road
Sacramento, California

**STATEMENT OF BASIS AND PURPOSE**

This decision document presents the selected remedial action for the Oxidation Lagoons Operable Unit at the SAAD facility in Sacramento, California, which was chosen in accordance with The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by The Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The basis for this decision is documented in the administrative record for this site, which includes, among other documents:

- The Oxidation Lagoons Operable Unit Feasibility Study (OUFS) which contains site investigation data, the Public Health Evaluation, and an analysis of remedial alternatives,

- The Proposed Plan (PP), dated April 1992, which summarizes the preferred cleanup alternative, compares the preferred alternative with several other alternatives, and invites public participation,

- Summaries of public comments on the OUFS and the PP, including the Army's response to comments.

The purpose of this Record of Decision (ROD) is to set forth the remedial action to be conducted at SAAD to remedy soil contamination associated with the Oxidation Lagoons. This is the third of several potential remedial actions addressing soil and groundwater contamination that may be conducted at SAAD. Subsequent RODs will address other potential threats posed by the site, both on and off site. A final comprehensive ROD will address the entire SAAD facility prior to SAAD's closure in 1997.

The U.S. Environmental Protection Agency Region IX (EPA IX) and the State of California [California EPA: Department of Toxic Substances Control (DTSC) and Central Valley Regional Water Quality Control Board (CVRWQCB)] concur with the selected remedy.

**ASSESSMENT OF THE SITE**

The Oxidation Lagoons Operable Unit includes four Oxidation Lagoons, the Drainage Ditches, and a portion of Old Morrison Creek. An investigation by the U.S. Army showed that soils in the Oxidation Lagoons Operable Unit have been contaminated by metals. Metals identified at concentrations above background levels are antimony, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, silver, and zinc.

Contamination in the lagoons appears to extend laterally to the intermediate level of the berms which surround each lagoon. The lateral extent of contamination in the Drainage Ditches is approximately 6 feet wide, and the total length of the ditches. The lateral extent of contamination in Old Morrison Creek is about 30 feet wide, and extends from approximately 50 feet east of the eastern Drainage Ditch to Caroline Drive. The vertical extent of contamination is about 2 feet in the lagoons, and about 3 feet in the ditches and the creek.

The Oxidation Lagoons Operable Unit does not include groundwater. Comparison of soil contaminants with the types of contaminants present in groundwater indicates that the Oxidation Lagoons Unit is not currently a source of groundwater contamination found at SAAD.

A baseline health risk assessment was conducted to evaluate the current and potential future risks posed by the contamination at the Oxidation Lagoons Operable Unit if no cleanup occurs. The health risk assessment found that arsenic, cadmium and lead pose the greatest potential threat to human health, due to their toxicity and concentrations. Cleanup levels based on potential health risks and on protection of groundwater were then established for arsenic, cadmium and lead. The cleanup levels were determined based on additive risk and Applicable or Relevant and Appropriate Requirements.

Actual or threatened released of hazardous substances from this site, if not addressed by implementing the response action presented in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

**DESCRIPTION OF THE SELECTED REMEDY**

The Army intends to clean up the Oxidation Lagoons Operable Unit so that the public is not exposed to toxic chemicals from the site. This ROD addresses the principal threat at the Oxidation Lagoons site by removing the contaminants present in the soil. Removal of contaminants in the soil will reduce the potential for: future migration of contamination from the soil to groundwater; public exposure to contamination from inhalation or ingestion of fugitive dust containing contaminants; and public exposure to contamination due to direct contact or ingestion of contaminated soil. These pathways represent the primary potential present and future risks to public health. Inhalation or ingestion of fugitive dust by the nearest off-site business and residence is presently a potential risk. Exposure to contamination due to groundwater ingestion, or direct contact or ingestion of contaminated soil are potential future risks.

The selected remedy for cleaning up the soil at the Oxidation Lagoons Operable Unit is composed of: excavating contaminated soil; treating soil in an on-site washing unit; backfilling the excavation with remediated soil; treating the soil-wash rinsate on site to precipitate metals; and reclamation of metals from the de-watered sludge or off-site disposal of the sludge. The selected remedy includes:

- Excavating soil that contains levels of arsenic, cadmium, and/or lead above cleanup levels.

- Removing metals from the soil by mixing it with a washing reagent for a selected reaction time.

- Sampling the washed soil to assess the effectiveness of the cleanup. Remediated soil then will be used to backfill the excavation.

- Treating the soil-wash rinsate on site using a chemical precipitant.

- De-watering the sludge containing the precipitated metals on site, and disposing of it at an off-site facility permitted to receive hazardous waste or recovering the precipitated metals at an offsite metal reclamation unit. Although reclamation of the sludge is preferred to off-site disposal, the decision will be based on the cost, the concentration of metals in the sludge, the total quantity of sludge, and the availability of a market for metals recycling.

- Sampling the treated rinsate to assess its quality. Treated rinsate will be discharged to the sanitary sewer.

- Completing the excavation and treatment within six to nine months after contractor selection.

**STATUTORY DETERMINATIONS**

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies, to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Because the remedial action will not leave hazardous residuals on site above health-based levels and will be completed after approximately six to nine months of operation, the five-year review will not apply to this action.

**RECORD OF DECISION**
**II. DECISION SUMMARY**
**SAAD - OXIDATION LAGOONS OPERABLE UNIT**

**TABLE OF CONTENTS**

FIGURES



TABLES



APPENDICES

# 1 SITE NAME, LOCATION, AND DESCRIPTION

## 1.1 Location

The Oxidation Lagoons Operable Unit is part of the Sacramento Army Depot (SAAD) military facility owned by the U.S. Army. The SAAD facility is located at 8350 Fruitridge Road, in the City and County of Sacramento, California. SAAD lies approximately 7 miles southeast of downtown Sacramento (Figure 1), and is bound by Fruitridge Road on the north, Florin-Perkins Road on the east, Elder Creek Road on the south, and the Southern Pacific Railroad tracks on the west. The facility encompasses an area of 485 acres.

The four Oxidation Lagoons, each covering approximately 0.5 to 0.75 acres, are located in the southwest quadrant of the SAAD facility, north of the Burn Pits and east of Caroline Drive. North of the lagoons are the Drainage Ditches and Old Morrison Creek. The Operable Unit includes the four lagoons, the Drainages Ditches, and a portion of Old Morrison Creek. A site map of the SAAD facility, showing the location of the Oxidation Lagoons Operable Unit with respect to the other Operable Units and site features, is shown on Figure 2.

## 1.2 Site Description

Past and present activities conducted at SAAD include electro-optics equipment repair, the emergency manufacture of parts, shelter repair, metal plating and treatment, and painting. The metal plating and painting operations are likely the primary on-site waste generating activities.

In addition to the Oxidation Lagoons, past and present surface and subsurface storage units and other structures at the site include: several underground and above-ground storage tanks; unlined burn pits; a battery disposal area; areas where pesticides were mixed or pesticide rinse water may have been discharged to the ground surface; and an area used for firefighter training, where flammable hydrocarbons were reportedly burned on the ground surface. Several of these areas have released contaminants into the soil and/or groundwater at SAAD, and are being investigated and cleaned up as separate Operable Units. Areas where contaminants have been found at SAAD are discussed in more detail in Section 2.

## 1.3 Demography

In 1987, 76 people were living on the SAAD facility, and 56,398 people were living off site, within 2 to 3 miles of SAAD. Data for the working populations on and around SAAD in 1987 are not available. In 1984, 3,430 people worked on the SAAD facility and 20,710 worked off site, within 2 to 3 miles of SAAD.

## 1.4 Land Use

SAAD is surrounded on all sides by land currently zoned as commercial/light industrial property. Within 2 to 3 miles of SAAD, the areas that are primarily low to medium density residential are northwest, west, and southwest of the site. The areas south, east, and north of SAAD are primarily industrial.

## 1.5 Climatology

Climate at SAAD is classified as "Mediterranean", hot summer (Koppen System), with mean temperatures of 30 to 40 degrees Fahrenheit in January, and 90 to 100 degrees in July. Average relative humidity in January ranges from 80 to 90 percent, and from 50 to 60 percent in July. Generally, 85 to 95 percent of the annual precipitation occurs in winter. The estimated mean annual precipitation at the site is 17 inches, and the estimated mean evaporation is 73 inches.

## 1.6 Regional Topography

SAAD is located in the Central Valley of California, a broad, flat valley that lies between the Sierra Nevada to the east and the Coast Ranges to the west. The youngest sediments (as old as 5 million years) underlying SAAD were deposited by the American River as its course meandered across the valley floor, and, to a lesser extent, by Morrison Creek. Consequently, the topography at SAAD is relatively flat. The slope of the land surface is approximately 0.13

percent to the west, with ground surface elevations ranging from 36 to 42 feet above mean sea level.

### 1.7 Surface Water Hydrology

SAAD is situated within the Morrison Creek drainage basin. Morrison Creek originally flowed from east to west through the land now occupied by the SAAD facility. When SAAD was constructed, the Army re-routed Morrison Creek so that it flowed along the facility boundary around the south side of the facility, rather than through it. The floodplain for the re-routed Morrison Creek extended approximately half a mile north of the creek, onto the SAAD facility. The creek discharges into two overflow basins of the Sacramento and American Rivers, and ultimately empties into the Sacramento River.

In 1958, 7,900 linear feet of flood-control dikes were constructed along the re-routed portion of Morrison Creek, and in 1986, the new channel was widened and deepened. The re-routed portion of Morrison Creek is currently capable of handling 100-year flood events, so SAAD is not considered to be on the floodplain at this time. The old channel of Morrison Creek is currently dry during most of the year. This channel bisects the facility from east to west and is referred to as "Old Morrison Creek".

Drainage of the SAAD facility is mainly overland flow to Morrison Creek and man-made diversion structures. Morrison Creek also receives surface runoff from other industrial and agricultural sites which are located along its course, and permitted discharges from industries.

A study of the SAAD facility indicates that 0.52 acres of wetlands currently exist within the Oxidation Lagoons Operable Unit, along Old Morrison Creek.

### 1.8 Geology

SAAD is located in the Great Valley of California, a broad asymmetric trough filled with a thick assemblage of flat-lying marine and non-marine sediments. The most recent formations deposited in the Great Valley are nonmarine sediments derived from the Sierra Nevada foothills and mountains on the west side of the valley and from the Coast Ranges on the east side of the valley. The sediments are carried out of the mountains and deposited by a series of large and small rivers. Sediments under SAAD have been largely derived from the Sierra Nevadas, and have been deposited by the American River as it has meandered back and forth across the valley floor.

The upper 250 feet of sediments under SAAD is comprised of interbedded sands, silts and clays, with some coarse gravels underlying the north side of the facility at an approximate depth of 40 feet. The identification of horizontal and vertical boundaries of formation is extremely difficult in alluvial environments such as that encountered at SAAD. Older buried stream channels exist at various locations and depths in the area. These streams have deposited materials ranging in size from gravel down to clay as they meandered back and forth. Multiple discontinuous hardpans (cemented clays), representing buried ancient soil horizons, exist throughout the site.

### 1.9 Hydrogeology

SAAD is underlain by a series of alluvial aquifers which provide water to residences, industries, and agricultural properties in Sacramento County. The California Department of Water Resources has divided the groundwater in the area into two hydraulically isolated sections, the superjacent (upper) series located form approximately 80 to 250 feet in depth under the site and the subjacent (lower) series located deeper than approximately 250 feet under the site. The primary water-producing aquifers are in the subjacent series, although many wells in the surrounding area draw water from the superjacent series. Groundwater contamination under the SAAD facility has been found in three discrete, relatively thin, strata located within the upper portion of the superjacent series, approximately 80 to 200 feet below ground surface. Groundwater contamination extends off site to the southwest of the SAAD facility. The lateral extent of groundwater contamination is currently being investigated, but appears to extend approximately 1,000 feet southwest of SAAD. Industries and residences in this area use City water from municipal wells located at least 3/4 mile from SAAD.

### 1.10 Natural Resources

Except for groundwater, which is an extremely important resource throughout the Central Valley, other natural resources on the site are minimal. The Army Corps of Engineers does not consider the wetlands at SAAD to be high quality wetlands because they provide minimal wetland functions and habitat values. The Army plans to restore the wetlands areas following remediation by restoring the relict channel of Morrison Creek to its original grade and by revegetating the impacted wetland areas with seed source material from areas of old Morrison Creek that are currently jurisdictional wetlands. It is expected that there will be an overall benefit to environmental quality by eliminating a source of contamination to species in the area.

## 2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Remedial Investigations conducted at SAAD are a part of the U.S. Army Installation Restoration Program (IRP). The Army is the owner of the site and the lead agency for implementing the environmental response actions.

In the late 1970s, the U.S. Army Depot Systems Command recommended that SAAD be included in the Installation Restoration Program (IRP). Consequently, in 1978 and 1979 the U.S. Army Toxic and Hazardous Materials Agency (USATHMA) conducted a review of historical data to assess SAAD with regard to the use, storage, treatment, and disposal of toxic and hazardous materials. USATHMA identified several areas of concern where further investigation was warranted.

In early 1981, the Army initiated an on-site investigation of soil and groundwater in the areas of concern identified by USATHMA, including the Oxidation Lagoons, Burn Pits, Pesticide Mix Area, Morrison Creek, and Old Morrison Creek. Groundwater samples collected during this investigation indicated that volatile organic chemicals (VOCs) were present in groundwater under the southwest corner of SAAD. Based on the location of the VOCs in groundwater, the Burn Pits appeared to be one of the main sources of groundwater contamination in this area. The Oxidation Lagoons were identified as an area contaminated with metals.

In late 1981, the Central Valley Regional Water Quality Control Board (CVRWQCB) sampled off-site wells near the southwest corner of SAAD. VOCs were reported in some of the wells closest to SAAD, and the Army began working with the CVRWQCB to assess the source and extent of groundwater contamination. The U.S. EPA and California Department of Health Services (DHS) subsequently becameinvolved in the investigation of contamination at SAAD, and SAAD was placed on the National Priorities List (NPL), effective August 21, 1987 (52 Fed. Reg. 27620; July 22, 1987).

In December 1988, the U.S. Army, the U.S. EPA, and the State of California signed a Federal Facility Agreement (FFA) under CERCLA Section 120 agreeing to address the entire facility, including the contaminated groundwater and seven other areas of suspected contamination on the SAAD facility:

- Tank 2
- Oxidation Lagoons
- Burn Pits
- Building 320 Leach Field
- Pesticide Mix Area
- Firefighter Training Area
- Battery Disposal Well

The FFA also calls for a rigorous RCRA Facility Assessment to identify other specific Solid Waste Management Units that need further characterization and cleanup. To expedite investigation and cleanup of the individual sites, the seven areas listed above and the on-site groundwater are each being treated as individual Operable Units. These seven Operable Units are shown on Figure 2. Groundwater was the first Operable Unit investigated, and is currently being cleaned up under a ROD signed in 1989. Contaminated soil at the Tank 2 Operable Unit is scheduled to be cleaned up next, under the provisions of a ROD that was signed in December 1991.

Built in 1950, the Oxidation Lagoons received most of the industrial and domestic wastewater generated at SAAD until 1972. Domestic wastewater was treated in the sewage treatment plant prior to discharge to the lagoons. Concentrated, untreated rinse water generated by metal plating operations was diluted with large volumes of water and then directed to the lagoons. Until 1968, this water was supplied by two on-site wells. In 1968, the wells were abandoned and SAAD was connected to the City of Sacramento municipal water supply.

Currently, the four Oxidation Lagoons are not in use, and are dry. Vegetation is present in three of the lagoons. The bottom of the southwest Oxidation Lagoon is void of vegetation, apparently due to hardpan soil exposed at the surface.

As part of the IRP, the U.S. Army conducted additional soil assessments at the Oxidation Lagoons in 1985, 1986 and 1990 through 1991. In 1991, the U.S. Army prepared a Remedial Investigation/ Feasibility Study (RI/FS) workplan in accordance with the FFA. The RI/FS evaluated the seven Operable Units. Based upon the RI/FS findings, four of these, including the Oxidation Lagoons, were recommended for operable unit feasibility studies (OUFS).

The Oxidation Lagoons were recommended for an OUFS because: 1) heavy metals are present in the near surface, and pose a threat for airborne migration or migration in surface water runoff; and 2) the Toxic Pits Cleanup Act (TPCA) is an Applicable or Relevant and Appropriate Requirement (ARAR). TPCA requires that surface impoundments be closed as soon as feasible.

An OUFS for the Oxidation Lagoons was prepared in 1991, and was revised March 13, 1992. As part of the OUFS, the Army prepared a baseline Public Health Evaluation (PHE) to estimate potential health and environmental risks that could results if no action was taken at the site. The PHE indicated potential cancer and non-cancer health effects to an on-site resident from metals in Oxidation Lagoons soils. Details of the PHE are summarized in Section 6.

## 3 HIGHLIGHTS OF COMMUNITY INVOLVEMENT

In June 1988, the Army prepared a Community Relations Plan. In August, 1991, the U.S. Army issued a Proposed Plan (PP) for the Oxidation Lagoons Operable Unit. The plan consists of a 10-page fact sheet that was mailed to residents in the surrounding community. The plan describes the site background, presents a summary of site contamination, and discusses health risks, cleanup levels, and remedial alternatives. The plan also includes a list of individuals who may be contacted for additional information, lists the addresses of the information repositories, and announces the public comment period. The Army also placed notices in two local daily newspapers, the Sacramento Bee and the Sacramento Union, for five days prior to the public comment period to outline the preferred remedial alternative and to announce the availability of the OUFS and PP, as part of the Administrative Record, for review and comment. The SAAD Administrative Record was located at the following local repositories: SAAD Visitor Control Center and the California State University, Sacramento, Library. The OUFS and PP were also available for public review at the Sacramento office of the Department of Toxic Substances Control (DTSC) and at EPA headquarters in San Francisco.

A public comment period was held from August 20 through September 18, 1991. A public meeting was held on August 20, 1991. Thirty-nine people, including community members and representatives from the Army, U.S. EPA, DTSC, and CVRWQCB attended the public meeting. Seven oral questions were received at the meeting. In April 1992, the U.S. Army revised and reissued the PP for the Oxidation Lagoons Operable Unit in order to include additional information on compliance with Land Disposal Regulations that are applicable to the site. A second public comment period was held from May 9 through June 8, 1992. A second public meeting was held on May 27, 1992. No written comments were received during either public comment period.

Details of community involvement activities and responses to official public comments on the PP are presented in the Responsiveness Summary, which is in Part III of this ROD.

In addition, the DTSC adopted a Negative Declaration fulfilling the requirements found under the California Environmental Quality Act.

## 4 SCOPE AND ROLE OF OPERABLE UNIT WITHIN SITE STRATEGY

Since the Army began investigating possible contamination at SAAD, eight Operable Units have been identified that may require remediation (see Section 2, above). Four of the units, the Oxidation Lagoons, Tank 2, the Burn Pits, and On-site Groundwater, were recommended for OUFS. The other four units will be addressed in the overall site Feasibility Study as the important site characterization information becomes available.

The Groundwater OUFS was completed on May 19, 1989, and on-site groundwater is currently being remediated under a ROD signed on September 29, 1989. The OUFS for Tank 2 was finalized on October 1, 1991. A ROD for Tank 2 was signed in December 1991, and remedial activities at Tank 2 are scheduled to begin in 1992. The OUFS for the Oxidation Lagoons was finalized on March 13, 1992. The OUFS for the Burn Pits is scheduled to be completed in 1992. Subsequent RODs will address other potential threats posed by the site. Also, there will be a final ROD that will comprehensively address all of the contaminated areas at SAAD.

The remedy selected in this ROD will address metals contamination in soils at the Oxidation Lagoons operable unit. These metals pose the principle risk through ingestion of, or contact with, the contaminated soil.

## 5 SUMMARY OF SITE CHARACTERISTICS

### 5.1 Contamination Sources

Soil from the ground surface to depths of approximately 18 to 36 inches beneath the Oxidation Lagoons Operable Unit (consisting of the four lagoons, the Drainage Ditches, and Old Morrison Creek) contain 11 heavy metals at concentrations that exceed site background concentrations. The source of these metals appears to be waste water that was discharged to the Oxidation Lagoons and, subsequently, to the three Drainage Ditches and Old Morrison Creek. Most of the waste water appears to have been generated by electroplating operations at the Depot. These electroplating wastes are listed as F006 wastes under the Resource Conservation and Recovery Act (RCRA) (40 CFR 261.31).

### 5.2 Evaluation of Primary Contaminants

Soil sample analytical results indicate that heavy metals are present in surficial soils of the Oxidation Lagoons. Seventeen metals were detected in at least one sample of the Oxidation Lagoons soils; each of these plus five additional metals were detected in at least one sample from the Drainage Ditches and Old Morrison Creek. The estimated volume of affected soil at the Oxidation Lagoons is approximately 12,000 in-place cubic yards (cy). The estimated volume of affected soil at the Drainage Ditches and Old Morrison Creek is 3,500 in-place cy. The 22 metals detected are:

Many of these metals are naturally occurring in the soils at SAAD. Therefore, the area around the Oxidation Lagoons Operable Unit was studied to establish the normal (background) concentration of each metal. Eleven of the detected metals were identified above background levels: antimony, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, silver, and zinc. A list of these metals, the percentage of times each was detected, the range of concentrations reported by the analytical laboratory, the range of background concentrations, the relative mobility of each metal, and its classification as a carcinogen or non-carcinogen, are presented in Table 1.

### 5.3 Location of Contaminants and Potential Routes of Migration

The estimated lateral extent of contamination in the Oxidation Lagoons is shown in Figure 3. The extent was estimated based upon the postulated maximum operating water levels in the lagoons, as approximated from topographic surveys. Contamination appears to extend laterally to the intermediate level of the berms which surround each lagoon. The lateral extent of contamination in the Drainage Ditches is approximately 6 feet wide, and extends along the total length of the ditches. The lateral extent of contamination in Old Morrison Creek is about 30 feet wide, and extends from approximately 50 feet east of the east Drainage Ditch to Caroline Drive. Based upon soil sample analytical results, metals contamination in the lagoons is concentrated in the upper 2 feet of soil (Figure 4). The vertical extent of contamination in the Drainage Ditches and Old Morrison Creek is about 3 feet.

Since metals are present in surface soils, airborne migration could occur in windblown dust.

Individuals on site could be exposed via inhalation of the dust, or by directly contacting surface soil during outdoor activities. Individuals off site could be exposed to windblown dust.

Groundwater, which is at a depth of about 80 feet beneath the unit, has not been affected by metals from the Oxidation Lagoons. In the future, the metals could dissolve in infiltrating rainwater and migrate downward to the underlying groundwater, and a resident or business having a well downgradient of the unit could be exposed. However, contaminants have only been detected in the top 18 to 36 inches of soil, which suggests that the potential for mobility into groundwater is low. A numerical mobility assessment was performed to estimate future movement of metals at the site. This assessment indicated that the contaminants will move approximately 2 to 6 feet vertically downward over the next 100 years.

## 6 SUMMARY OF SITE RISKS

### 6.1 Human Health Risks

As part of the OUFS, the Army prepared a baseline PHE. This PHE was prepared to estimate, in the absence of remedial action (i.e., the "No Action" alternative), the potential future risks to human health by contaminants remaining in soil or leaching through soil, migrating in groundwater, or released to the air. Table 2 presents definitions of key risk terms from the PHE that are used in this section of the ROD.

#### 6.1.1 Contaminants of Concern

The risk assessment provides a list of contaminants based on the results of the RI that were found above detection limits or above natural background levels. Eleven metals of potential concern were identified above background levels and appeared to originate from the Oxidation Lagoons, Drainage Ditches, and Old Morrison Creek. The PHE estimated the risk posed by all 11 metals. The following three metals are the primary chemicals of concern based on the estimated health risks and on the frequency of detection:

- Arsenic: Classified as a Group A carcinogen (known human carcinogen)
- Cadmium: Classified as a Group B1 carcinogen (probable human carcinogen, limited human data)
- Lead: classified as a Group B2 carcinogen (probable human carcinogen, no human data). The most notable effect of lead exposure is decreased neurological development in children.

#### 6.1.2 Exposure Assessment

Four exposure points were considered for the PHE:

- a hypothetical residence constructed on site at the Oxidation Lagoons following closure of SAAD;
- a hypothetical residence constructed on site at the Drainage Ditches and Old Morrison Creek following closure of SAAD;
- the nearest off-site business downgradient from the Oxidation Lagoons operable unit which has a well; and
- the nearest off-site residence downgradient from the Oxidation Lagoons operable unit which has a well.

The first two exposure scenarios were selected because SAAD is scheduled to close in the future and the site could be re-zoned and used for residential development. Future residential development is considered unlikely, but is a health-conservation assumption. The latter two exposure points presently exist. The approximate locations of the current off-site receptors are shown on Figure 2.

**TABLE 2**
**DEFINITIONS OF RISK TERMS**

Carcinogen: A substance that, with long term exposure, may increase the incidence of cancer.

Chronic Daily Intake (CDI): The average amount of chemical in contact with an individual on a daily basis over a substantial portion of a lifetime.

Chronic Exposure: A persistent, recurring, or long-term exposure. Chronic exposure may result in health effects (such as cancer) that are delayed in onset, occurring long after exposure ceased.

Exposure: The opportunity to receive a dose through direct contact with a chemical or medium containing a chemical.

Exposure Assessment: The process of describing, for a population at risk, the amounts of chemicals to which individuals are exposed, or the distribution of exposures within a population, or the average exposure of an entire population.

Health Hazard Index (HHI): An EPA method used to assess the potential noncarcinogenic risk. The ratio of the CDI to the chronic RfD (or other suitable toxicity value for noncarcinogens) is calculated. If it is less than one, then the exposure represented by the CDI is judged unlikely to produce an adverse noncarcinogenic effect. A cumulative, endpoint-specific HHI can also be calculated to evaluate the risks posed by exposure to more than one chemical by summing the CDI/RfD ratios for all the chemicals of interest that exert a similar effect on a particular organ. This approach assumes that multiple subthreshold exposures could result in an adverse effect on a particular organ and that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures. If the cumulative HHI is greater than one, then there my be concern for public health risk.

Reference Dose (RfD): An estimate, with uncertainty spanning an order of magnitude, of a daily exposure level for human population that is likely to be without an appreciable risk of deleterious effects.

Risk: The nature and probability of occurrence of an unwanted, adverse effect on human life, health, or on the environment.

Risk Assessment or Health Evaluation: The characterization of the potential adverse effect on human life, health, or on the environment. According to the National Research Council's Committee on the Institutional Means for Assessment of Health Risk, human health risk assessment includes: (1) description on the potential adverse health effects based on an evaluation of results of epidemiologic, clinical, toxicologic, and environmental research; (2) extrapolation from those results to predict the types and estimate the extent of health effect in humans under given conditions of exposure; (3) judgements as to the number and characteristics of persons exposed at various intensities and durations; (4) summary judgements on the existence and overall magnitude of the public-health program; and (5) characterization of the uncertainties inherent in the process of inferring risk.

Slope Factor: A plausible upper-bound estimate (set at 95%) of the probability of a response per unit intake of a chemical over a lifetime.

Metals from the Oxidation Lagoons do not appear to have impacted groundwater quality to date. For the PHE, however, the assumptions were made that: metals may migrate into the underlying groundwater as components of leachate at some time in the future; metals present in surface soils may enter the atmosphere in windblown dust; and individuals located on site may directly contact soil. Thus, the following potential exposure pathways were considered: soil ingestion, dermal absorption, drinking water ingestion, and inhalation of dust for on-site individuals; and ingestion of drinking water and inhalation of dust for off-site individuals.

Metals detected in the top six inches of soil were assumed to pose a potential risk because the concentrations are greatest near the soil surface. Analytical results for soil samples collected within the four Oxidation Lagoons and along the Drainage Ditches and Old Morrison Creek were used to calculate average and upper-bound concentrations for each of the metals found above background concentrations. The calculated upperbound concentration for each metal is the 95% Upper Confidence Limit concentration, calculated by finding the arithmetic mean and adding two times the standard deviation. Upper-bound soil concentrations were used for calculating exposure point concentrations for direct contact with contaminated soil, and inhalation of dust. Estimated exposure point concentrations of the three primary metals of concern in soil and in fugitive dust are shown on Table 3.

Upper-bound groundwater exposure point concentrations were estimated based upon soil concentrations, physical and chemical properties of the metals, physical characteristics of the uppermost water-bearing zone, and net precipitation infiltration at the site. Upper-bound metal concentrations in the contaminated soil were input to a vadose zone model to derive upperbound leachate concentrations. It was assumed that the source concentrations stayed constant

over time (i.e., leaching of metals does not deplete the source). The calculated leachate concentrations were then used to estimate the on-site upper-bound groundwater concentrations directly beneath the lagoons, the Drainage Ditches, and Old Morrison Creek. These groundwater concentrations were assumed to remain constant over a 70-year exposure period. A groundwater transport computer model was used to estimate upper-bound groundwater exposure concentrations off site. Estimated upper-bound exposure point concentrations of the three primary metals of concern in groundwater are shown on Table 3.

The contaminant intake equations and values chosen for various intake parameters were derived from the standard intake equations and data presented in EPA guidance documents. Chronic Daily Intake (CDI), the amount of each chemical that could be inhaled, ingested, or adsorbed, were estimated in the PHE. The estimated CDIs are shown on Tables 4 and 5. The CDIs were then multiplied by chemical-specific slope factors (SF) to calculate carcinogenic risk. The SF represents the 95 percent upper confidence limit (UCL) value of the probability of a carcinogenic response per unit intake of a contaminant over a lifetime (70 years for the analysis in the PHE). SF values for arsenic and cadmium are presented in Table 4. No SF has been established for lead. Therefore, lead is not included on Table 4.

To calculate the Health Hazard Index (HHI) for non-carcinogenic risks, the CDIs were multiplied by chemical-specific Reference Dose (RfD) values. The RfD values for a substance represent a level of intake which is unlikely to result in adverse non-carcinogenic health effects in individuals exposed for an extended period of time (70 years for the analysis in the PHE). RfDs for the arsenic and cadmium are shown on Table 5. U.S. EPA Health Criteria are not available for lead at this time so lead is not included on Table 5.

**6.1.3 Summary of PHE Results**

The PHE estimated the potential non-carcinogenic and carcinogenic risks posed by each of the 11 metals of concern at the Oxidation Lagoons Operable Unit to Future On-site Residents, and to the nearest Off-site Residence and Business. (Dose-response criteria are not available for two of the metals, cobalt and lead. These metals were evaluated separately).

Carcinogenic risks were estimated for arsenic and cadmium by multiplying the CDI of each metal by its SF. The carcinogenic risks for arsenic and cadmium, expressed as the "potential excess cancer risk", for each exposure pathway are shown on Table 4. As a National goal, the EPA's target risk range is 10[-4] to 10[-6], or one additional incidence of cancer per 10,000 people to one additional incidence of cancer per 1,000,000 people. The aggregate (total) estimated carcinogenic risks from arsenic and cadmium due to the combined effects of all pathways are:

- Approximately 2.4 excess cancers per 10,000 people for Hypothetical Future Oxidation Lagoons Residents;

- Approximately one excess cancer per 10,000 people for Hypothetical Future Drainage Ditches and Old Morrison Creek Residents;

- Less than one excess cancer per one million people for off-site businesses and off-site residents.

Thus, the baseline risk estimated for Future Oxidation Lagoon Residents is higher than the target range. The baseline risks for the other exposure scenarios are within or less than the target range.

The non-carcinogenic risks posed by contaminants were estimated by computing the HHI for each chemical in accordance with procedures established by EPA. An HHI greater than 1.0 indicates a potential health threat. The noncarcinogenic risks posed by arsenic and cadmium are shown on Table 5. The aggregate estimated HHIs from arsenic and cadmium due to the combined effects of all pathways are:

- 5.8 for Future Oxidation Lagoons Residents;

- 2.1 for Future Drainage Ditches and Old Morrison Creek Residents;

- Less than 1.0 for the Nearest Off-site Business and Nearest Off-site Resident.

For lead, which may cause decreased neurological development in children, the U.S. EPA has developed a biokinetic model for evaluating lead exposures on a site-specific basis. Using the model, potential blood lead levels in children can be calculated and then evaluated by comparing them to the level which the U.S. EPA estimates will cause adverse effects in children [10 micrograms per deciliter (ug/dl)] (U.S. EPA, 1990c).

Based upon a calculated upper-bound surface soil lead concentration of 194 milligrams per kilogram (equal to the 95 percent upper confidence limit of the mean), the geometric mean blood level in children (0 to 6 years old) that reside at the Oxidation Lagoons would be 4.88 ug/dl due to soil ingestion. Additionally, the blood lead level in 98.12 percent of the population would be less than the suggested U.S. EPA criterion of 10 ug/dl. These results indicate that lead in surface soils at the Oxidation Lagoons Operable Unit is a low concern with respect to human health.

Therefore, the baseline risk assessment indicates a potential noncarcinogenic health threat to Hypothetical Future On-Site Residents due to the metals at the site, but no non-carcinogenic health threat to the Nearest Off-Site Business or Residents.

Health risk assessment provides a means of quantifying potential risks posed by chemicals present in the environment. However, a great deal of uncertainty exists in the estimation process. In addition to uncertainties common to the risk assessment process, sources of uncertainty in the PHE conducted for the Oxidation Lagoons Operable Unit include:

Site Characterization -- Chemicals may exist in localized "hotspots" where samples were not collected, or chemicals may exist at the site but may not have been detected by the selected analytical methods. This could result in an underestimation of risk.

Estimation of Exposure Point Concentrations -- These may be overestimated since (1) chemicals reported as "non-detects" are assigned a value of one-half the detection limit for the purpose of calculating site concentrations, and (2) the PHE assumes that chemical concentrations in soil and groundwater remain constant over the 70-year exposure period, rather than decreasing as expected due to leaching. This could result in overestimating the risk.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

### 6.2 Environmental Evaluation

The SAAD site is primarily a disturbed annual grassland ecosystem. No threatened plant or animal species inhabit the site. Several sensitive species have been observed, including the burrowing owl, black-shouldered kite, and American kestrel.

Remediation activities at the Oxidation Lagoon Operable Unit will disrupt the existing habitat, including riparian vegetation present on the perimeters of the lagoons. The riparian habitat developed as a result of the wastewater formerly stored in the lagoons. In the opinion of a retired California Fish and Game representative who investigated the site, the lagoons are only a passage way for animals, except for ground squirrels. Ingestion of the squirrels by foxes and great horned owls could result in their exposure to heavy metals. This could result in death and deformity of young, and health problems for adults. Remediation, therefore, would favor wildlife and appears to warrant disruption of the existing habitat.

A study of plants and soils was conducted at the Sacramento Army Depot on September 6, 1991. The objective of the study was to evaluate historically wet areas to determine if they fit the criteria for jurisdictional wetlands, as regulated by Section 404 of the Clean Water Act. The assessment was based on the Corps of Engineers' criteria for wetland delineation: hydric soils, hydrophytic vegetation, and wetland hydrology.

The wetlands delineation indicated that Old Morrison Creek and a small bathtub-like feature north of the Oxidation Lagoons display the hydric soils, hydrophytic plants, and hydrology needed to qualify as jurisdictional wetlands. The total area of jurisdictional wetlands amounts to approximately 0.52 acre. These seasonal wetlands are isolated from other waterbodies. The Corps of Engineers has concluded that these wetlands are not high quality and provide minimal wetland functions and habitat value. In addition, field surveys conducted at the time of this study and on two other occasions, November/December 1991 and April/May 1992, indicated there are no threatened or endangered species inhabiting the area.

The following requirements are ARARs for all alternatives:

Section 404 of the Clean Water Act, 33 U.S.C. Section 1344, requires permits for the discharge of dredged or fill material into waters of the United States, including wetlands. The 404(b)(1) regulations (40 CFR Part 230) and Executive Order 11990, "Protection of Wetlands", dated May 24, 1977, require Federal agencies to avoid adversely impacting wetlands wherever possible, and to preserve the functional values of wetlands. The nationwide permits (NWP) program, set forth in 33 CFR Part 330 and administered by the Army Corps of Engineers, is designed to regulate with little, if any, delay or paperwork certain activities having minimal impacts. The types of NWPs and conditions under which a permit is granted are given in Appendix A to Part 330.

Because the wetlands at SAAD exhibit low wetland functional values, the Army Corps of Engineers has determined that the proposed fill activities-- replacement of excavated soil into the wetlands area of the Oxidation Lagoons-would result in minimal adverse impacts and is work of a nature specifically authorized under both NWPs 26 and 38. Although CERCLA Sec. 121(e) provides that permits are not required for activities conducted entirely on-site, the Army Corps of Engineers has determined that the replacement of the excavated soil is properly authorized under the terms of NWP 26, "Headwaters and Isolated Waters Discharges". The wetland area proposed to be impacted at SAAD qualifies as an "isolated water", defined as non-tidal waters of the United States that are: (1) Not part of a surface tributary system to interstate or navigable waters of the United States; and (2) Not adjacent to such tributary waterbodies. Following remediation, the Army plans to restore the impacted wetland area by regrading and revegetating, as described in Section 1.10.

**6.3 Cleanup Levels**

Based upon the results of the PHE, cleanup levels were established for the three primary metals of concern: arsenic, cadmium, and lead.

Arsenic and cadmium are the primary metals of concern due to potential carcinogenic effects. Arsenic poses a risk as a potential carcinogen via soil ingestion, dermal absorption, and groundwater ingestion. Cadmium poses a risk as a potential carcinogen via dust inhalation. Cadmium also poses a risk for noncarcinogenic effects via dermal absorption and groundwater ingestion. Specific risk numbers were not developed in the PHE for lead. However, lead is a metal of concern primarily because it poses risks as a reproductive toxin and can effect the central nervous system in children.

One other metal assessed in the PHE, antimony poses a risk for noncarcinogenic effects via groundwater ingestion. Antimony was only detected in 3 of 62 samples analyzed. Therefore, it does not appear to exist throughout the site. However, the health risk assessment assumed that antimony is present throughout the site at an upper-bound concentration of 28 mg/kg. This concentration is less than the Federally proposed action level of 30 mg/kg. Exceeding the proposed action level could indicate that further assessment is warranted. Since this proposed action level is not exceeded and since antimony was detected in less than 5 percent of samples analyzed, a specific cleanup level was not established. Some cleanup of antimony will be achieved in the process of cleaning up other metals of concern.

Specific soil cleanup levels for other metals found above background levels were not developed. Based upon results of the PHE, the concentrations of these metals in soil do not pose unacceptable health risks.

The selected cleanup levels will reduce contaminant levels in soil. A list of Comparative Criteria is provided on Table A-1, Appendix A. The cleanup levels are shown in Table 6, and are discussed below.

### 6.3.1 Non-Carcinogens

Of the three primary metals of concern, only cadmium exceeds the acceptable HHI of 1.0. A cleanup level was developed for cadmium. Additionally, a cleanup level was established for lead for the reasons described above. The cleanup levels will result in reductions of risk by 91 percent for cadmium, and by 10 percent for lead.

### 6.3.2 Carcinogens

Of the three primary metals of concern, arsenic and cadmium are carcinogens. The proposed soil cleanup level for arsenic would result in a risk reduction of 50 percent. As stated above, the proposed cleanup level for cadmium would result in a 91 percent risk reduction.

## 7 DESCRIPTION OF ALTERNATIVES

An OUFS was conducted to develop and evaluate remedial alternatives for the Oxidation Lagoons Operable Unit. Fourteen remedial alternatives were assembled from applicable remedial technology process options, and were initially evaluated for effectiveness, institutional implementability, and cost. Five alternatives for cleaning up soil at the Oxidation Lagoons passed this initial screening and were then considered in detail by comparing them to the nine criteria required by the NCP. The remedial alternatives emphasize the use of technologies which reduce toxicity, mobility, or volume of contaminants, and which provide a permanent solution. In addition to the remedial alternatives, the NCP and CERCLA require that a no-action alternative be considered at every site. The no-action alternative serves primarily as a point-of-comparison for other alternatives. The five alternatives evaluated are:

- Alternative 1: No Action
- Alternative 2: Excavation, On-Site Soil Washing, On-Site Treatment of Wash Liquid, and Backfill with Washed Soil
- Alternative 3: Excavation, On-Site Soil Washing, Off-Site Disposal of Wash Liquid, and Backfill with Washed Soil
- Alternative 4: Excavation, Stabilization, and Backfill with Stabilized Soil
- Alternative 5: Excavation, Stabilization, Backfill with Stabilized Soil, and Cap

Each alternative would be applied to remediate approximately 15,500 cy of soil that contain the contaminants detected at the site at concentrations exceeding cleanup levels. The location and configuration of the 15,500 cy are shown in Figures 3 and 4. Each alternative is expected to attain the treatment levels (cleanup levels) described in Section 6.3. Each alternative can be implemented, subject to the difficulties and considerations described in Section 8.6. During implementation of each alternative, controls will be exercised to reduce the disruption to wildlife in the area, including removal of trees prior to nesting season to encourage nesting activity in alternative locations. The five alternatives are described in more detail in the following sections.

## 7.1 Alternative 1: No Action

Under this alternative, the Army would take no further action to control the source of contamination. However, long-term monitoring of the site would be necessary to monitor contaminant migration. Since periodic groundwater monitoring is presently being conducted, it is assumed that the current monitoring program would be continued under this alternative.

Because this alternative would result in contaminants remaining on site, CERCLA requires that the site be reviewed every five years. If indicated by the review, remedial actions would be implemented at that time to remove or treat the wastes.

Based upon the health risk assessment, cadmium and arsenic left on site in present concentrations pose potential threats to public health and the environment. Specifically, the human health risks estimated for hypothetical future residents exceed levels normally considered acceptable. Additionally, ingestion of squirrels by foxes and great-horned owls could result in ecological exposure to heavy metals. The "No Action" alternative therefore does not meet the threshold criteria of protectiveness of human health and the environment. Alternatives which do not meet this first evaluation criterion are not acceptable remediation alternatives and further evaluation is not necessary.

## 7.2 Alternative 2: Excavation, On-site Soil Washing, On-site Treatment of Wash Liquid, and Backfill with Washed Soil

Alternative 2 consists of excavating contaminated soil and treating it in an on-site washing unit. Soil samples would be collected from the excavation to assess whether contaminated soil remains. Dust created while excavating would be controlled using water or foam sprays.

The washing unit would consist of a size segregation device, mix reactors, and a de-watering device. Oversized soil particles would be segregated using wet screens to physically remove contaminants from the larger size fraction. The segregated lower size fraction would be transferred to mix reactors, where it would be mixed with a washing reagent. Based upon treatability testing results, a combination of chelating agents and dilute acid solution with a minimum reaction time of 30 minutes would probably be used to meet the cleanup levels.

After the soil and washing reagent are mixed for a selected reaction time, the soil/reagent slurry would be de-watered. De-watering would be accomplished using a centrifuge or vacuum/pressure filters. The washed soil fraction would be recovered, and the rinsate would be stored in holding tanks for recycling. Composite samples would be collected from the washed soil to evaluate the effectiveness of the cleanup. Remediated soil would be replaced in the excavation.

The soil wash rinsate would be treated on site using a chemical precipitant. Dissolved metals would be converted to insoluble forms, and would be separated from the rinsate using a clarifier. Flocculation and settling of the metals may be further enhanced by the addition of chemical coagulants. The sludge containing precipitated metals would be de-watered on site and disposed at an off-site facility permitted to receive hazardous waste. Stabilization of the de-watered sludge may be required to minimize its leaching potential.

As an alternative, the precipitated metals could be recovered at an off-site metal reclamation unit. The decision to use reclamation will depend upon the concentration of metals in the sludge, the total amount of sludge, the cost, and the availability of a market for metals recycling.

Samples of the treated rinsate would be analyzed to assess its quality. Treated rinsate would be discharged to the sanitary sewer after demonstrating compliance with SAAD's sewer use permit conditions.

Alternative 2 would be protective of human health and the environment.  The protection is achieved by removing metals from the soil.  The heavy metals were estimated in the public health evaluation to present an unacceptable risk to a hypothetical future resident and were found in the environmental evaluation to be a potential risk to predators.

Soils would be excavated and then treated until sampling and analysis indicates that the remaining unexcavated soil as well as the treated soil contain heavy metals at either the local background levels or at the prescribed clean-up level.  Clean-up levels, as presented in Section 6.3, are soil concentrations developed for three of the heavy metals which must be met in order for the soil not to pose unacceptable risks to human health or the environment.

Alternative 2 will be conducted in full compliance with ARARs, as listed on Table A-2.  U.S. EPA has approved the State of California's application for RCRA authorization, effective August 1, 1992.  Therefore, all Federal RCRA regulations (40 CFR Parts 262 through 268) cited as ARARs in Table A-2 are now superceded by the corresponding State RCRA regulations.  The site-specific ARARs are California Health and Safety Code Sections 25208.1 and 25208.4 and Sections 2580, 2582 and 2524 of Chapter 15, Title 23, California Code of Regulations (CCR).  These ARARs address closure requirements for surface impoundments.  The Health and Safety Codes (also known as the Toxic Pits Cleanup Act or TPCA) will be met by achieving closure of these surface impoundments. The sections of 23 CCR will be met by removing the old surface impoundment structures and contaminated geologic material.  The term "contaminated" used in the regulation has been defined for this project by the development of cleanup levels.  Also, because the SESOIL Modeling demonstrates that the proposed soil cleanup and residual levels will not impact ground or surface waters, these soils can be classified as 'Inert Waste' per California's Title 23 Chapter 15, Section 2524, CCR.  However, to confirm that the actual remediated and residual soils meet the 'Inert Waste' classification, they will be sampled and analyzed (using the deionized water Waste Extraction Test) to verify the SESOIL Modeling results.

State Water Resources Control Board Resolution 68-16 (the Anti-Degradation Policy) has been incorporated into the Water Quality Control Plan for the Central Valley Regional Water Quality Control Board (Basin Plan). The CVRWQCB has identified this as an ARAR for all remedial alternatives. Compliance with this ARAR requires that the quality of the underlying groundwater must be maintained following the implementation of the soil remedy. Compliance with the soil cleanup levels set forth in Table 6 of this ROD, and with the closure and sampling and analysis requirements specified in the preceding paragraph, will constitute compliance with Resolution 68-16.

A number of action and chemical specific ARARs have been identified for this alternative.  The action specific ARARs will be achieved by the remediation contractor taking the necessary actions to comply.  Chemical specific ARARs will be met by designing the remediation system for achieving the desired result and monitoring for compliance.

The soils at the Oxidation Lagoons contain both RCRA listed F006 waste and characteristic hazardous waste (arsenic and mercury which exceed their toxic characteristic values). Replacement of the excavated soil after treatment would require compliance with RCRA ARARs for disposal of hazardous waste, including the land disposal restrictions.  The RCRA Land Disposal Restrictions (LDRs) are ARARs for all remedial alternatives.

Alternative 2 would comply with LDRs through either the treatment standards in 40 CFR 268.41 (now 22 CCR 66268.41) or a treatability variance under 40 CFR 268.44 (now 22 CCR 66268.44). Existing treatability study data do not conclusively demonstrate that the LDR treatment standards can be attained. Thus, prior to full scale implementation of the soil washing remedy, a pilot test will be conducted.  If the pilot test shows that the treatment standards (268.41) are not achievable, the alternative treatment levels shall apply through a treatability variance under 268.44.

In complying with LDRs, the following items are "to be considered":

- EPA's Superfund LDR Guide #6A, Superfund Publication 9347.3-06FS

- OSWER Memo, Lowrance to Luftig, April 6, 1990.

As set forth in the Lowrance memo, Minimum Technology Requirements (MTRs) for land disposal of

RCRA restricted waste would not be triggered by placing the treated soil back into the excavated Oxidation Lagoons area as long as there is no lateral expansion of the original areas of contamination.

### 7.3 Alternative 3: Excavation, On-Site Soil Washing, Off-Site Disposal of Wash Liquid, and Backfill

Alternative 3 consists of excavating contaminated soil and treating it in an on-site washing unit. Alternative 3 is identical to Alternative 2, except that the rinsate generated during soil washing operations would be treated off site.

Compliance with ARARs would be the same as described for Alternative 2 and as stated in Table A-2, except that the wash water will be disposed off site. As noted on Table A-2, 40 CFR 403 is applicable for Alternative No. 2 only since Alternative No. 3 would not use disposal to the regional POTW. Otherwise, Table A-2 applies to both alternatives.

The wash water would be subject to the same regulations as the heavy-metal containing sludge which is produced for offsite diposal or recycling. The wash water will be analyzed to determine the appropriate disposal methods and requirements.

### 7.4 Alternative 4: Excavation, Stabilization, and Backfill with Stabilized Soil

Alternative 4 consists of excavating and stabilizing contaminated soil. Stabilization would be accomplished using pozzolanic-based additives, such as Portland cement. Pre-determined quantities of cement, silicates, and water would be mixed and added to the soil. The mixture would be homogenized in mix drums and allowed to cure. Alternative mixing and curing procedures, including in-situ procedures, are feasible.

Stabilization depends on developing a suitable "mix design" or recipe for soil, cement, and other additives. With a proper recipe, the heavy metals are immobilized in the soil mass to meet leachability criteria. The leachability criteria, as measured by the Toxic Characteristic Leaching Procedure (TCLP), is established at levels which are protective of human health and the environment.

Compressive strength and permeability criteria are added to the engineering design to improve the permanence of the remediation and reduce maintenance requirements. The soil mass, after mixing in the additives, would be returned to the oxidation lagoons and backfilled in place. Verification testing would be used to ensure leachability and other criteria are being met at all times.

The site-specific ARARs for Alternative 4 are the same as for other alternatives. Compliance is also the same in that this remediation will close the surface impoundments. Closure will be achieved via excavation and removal of surface impoundment structures and contaminated geologic materials. The cleanup levels would guide excavation and the remaining, unexcavated soil would not pose significant human health or environmental risks.

Stabilized soil would meet the criteria of an inert waste. Stabilized soil would not be significantly leachable or pose other human health or environmental risks.

Action-specific and chemical specific ARARs will be achieved by design and contractor adherence to the ARARs. Placement of the stabilized soil back into the oxidation lagoons will not expand the area of contamination; therefore, minimum technology requirements for a landfill are not applicable.

One requirement was found to be relevant and appropriate. Future site owners and operators shall be notified of the existence of the stabilized soil mass. The Army shall develop a notification procedure.

Table A-3 provides a list of ARARs for Alternative No. 4.

### 7.5 Alternative 5: Excavation, Stabilization, Backfill with Stabilized Soil, and Cap

Alternative 5 consists of excavating and stabilizing contaminated soil. Alternative 5 is identical to Alternative 4, except that the stabilized soil would be capped after it is returned to the site. Alternative 5 would be selected if stabilized soil does not comply with leachability criteria set for cadmium.

The cap would be approximately 5 feet thick, and would consist of vegetative and drainage layers overlying a 40 millimeter-thick plastic liner and a clay layer. The cap would be sloped at approximately 3 percent.

Alternative 5 would comply with the same ARARs as Alternative No. 4 in the same manner as described above. The higher leachability of cadmium is not expected to pose a significant human health or environmental risk. However, additional State of California regulations would be applicable. These are 22 CCR 66264.301 (d) and (g) and 22 CCR 264.303 and 22 CCR 264.310. The feasibility study analysis provides sufficient demonstration that a liner is not required for placement of the stabilized soil back into the oxidation lagoons.

## 8 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The five remedial alternatives have been assessed using the nine evaluation criteria developed to address CERCLA requirements. The nine criteria are:

Threshold Criteria

1) Overall Protection of Human Health and the Environment
2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Primary Balancing Criteria

3) Long-Term Effectiveness and Permanence
4) Reduction of Toxicity, Mobility, or Volume (TMV)
5) Short-Term Effectiveness
6) Implementability
7) Cost

Modifying Criteria

8) State Acceptance
9) Community Acceptance

The following sections compare the five remedial alternatives in terms of each of the nine criteria.

### 8.1 Overall Protection of Human Health and the Environment

This criterion assesses whether the alternative meets the statutory requirement for protection of public health and the environment, and describes how risks posed through each potential exposure pathway are eliminated, reduced, or controlled through treatment, or engineering or institutional controls. This criterion is based upon the findings of three other evaluation criteria: "Compliance with ARARs", "Long-Term Effectiveness and Permanence", and "Short-Term Effectiveness".

Each of the alternatives, except Alternative 1 (no action), would provide adequate protection of human health and the environment. Potential risks due to groundwater ingestion and inhalation of dust would be reduced to levels that are acceptable to the U.S. EPA and the DTSC. Alternatives 2 through 5 would reduce risks by excavating contaminated soil. Alternatives 2 and 3 treat the soil to an inert waste by washing out the contaminants. Alternative 4 treats the soil to an inert waste by stabilization. Alternative 5 includes stabilization of soil to levels that are protective of human health and the environment.

Risks temporarily posed due to the potential of increased dust inhalation exposure would be reduced by controlling dust with water or foam sprays. Risks temporarily posed to workers due to dermal exposure during excavation activities would be reduced by the use of protective clothing. Additionally, workers would follow OSHA guidelines for working on an hazardous waste site and ambient air quality would be monitored continuously.

## 8.2 Compliance with ARARs

Compliance with ARARs was not evaluated for Alternative No. 1 since this alternative did not meet the threshold requirement of protectiveness. Alternatives 2 through 5 were each found to comply with ARARs. Compliance is achieved as discussed in Section 7 of this document. A treatability variance from land disposal restrictions is likely to be required for alternatives 2 through 5. The achievable treatment levels will be set by field pilot tests employing the selected technology.

## 8.3 Long-Term Effectiveness and Permanence

The analysis of long-term effectiveness and permanence addresses the expected residual risk, and the ability of a remedy to maintain reliable protection of human health and the environment after the remedial objectives have been attained.

Alternatives 2, 3, 4, and 5 include excavation of the chemicals of concern present at concentrations exceeding cleanup levels. Alternatives 2 and 3 include treating soil to acceptable risk levels. Alternatives 4 and 5 include stabilization of the soil to reduce contaminant mobility. Each of these alternatives affords long-term effectiveness and permanence. Alternatives 2 and 3 are more permanent than Alternatives 4 and 5, since the contaminants would be removed from the site.

## 8.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The analysis of this criterion addresses the anticipated performance of the treatment technologies the remedy may employ. The analysis considers:

- treatment process;
- volume of hazardous material to be treated;
- effectiveness in reducing toxicity, mobility, and volume of contaminant; and;
- type of quantity of treatment residual.

Alternatives 2 and 3 would remove the contaminants from the site, which would effectively reduce on-site mobility, toxicity, and volume. Alternatives 4 and 5 would decrease contaminant mobility, which would result in a reduction in toxicity. However, Alternatives 4 and 5 would also increase the volume of contaminated material on site due to the addition of cement or other stabilizers.

## 8.5 Short-Term Effectiveness

The analysis of short-term effectiveness addresses public health and environmental impacts during the construction and implementation period. The period of time required to achieve remediation objectives is also considered. The time required to complete the five alternatives are as follows:

- Alternative 1 - None
- Alternative 2 - 6 to 9 months
- Alternative 3 - 6 to 9 months
- Alternative 4 - 3 months
- Alternative 5 - 3 to 6 months

Alternative 1 is effective in the short term. The Oxidation Lagoons are secure, eliminating the possibility of soil ingestion. The majority of the site is overgrown with vegetation, limiting dust formation. Based upon absence of evidence of contaminant metals in soil below 3 feet or in groundwater, downward migration of metals does not appear to be occurring.

Alternatives 2, 3, 4, and 5 would slightly increase the potential for dust exposure during construction activities. This could result in a short-term increase in human health risks. The exposures would be controlled to acceptable levels and monitored.

**8.6 Implementability**

Implementability refers to the technical and administrative feasibility of performing the remedial alternative. The analysis also considers the availability of necessary materials and services. The following factors were considered:

- Ability to construct the technology;
- Reliability of the technology;
- Ease of interfacing additional remedial technology;
- Feasibility of monitoring;
- Ability to obtain approvals from, and coordinate with, regulatory agencies;
- Availability of treatment, storage, and disposal services; equipment and specialists; and technologies.

Alternative 1 could be readily implemented. Alternative 4 could be readily implemented, subject to preparation of a suitable mix design. Based upon results of the mix design treatability studies, modifications would be required to develop a mix which would stabilize the soil sufficiently to comply with ARARs. If an adequate mix design cannot be developed, Alternative 5 could readily be implemented, subject to approval of the cap design. Alternatives 2 and 3 rely on a process which has been proven in the laboratory and is believed to be feasible. A pilot study will be conducted at the site to demonstrate the feasibility of the process prior to full-scale implementation.

**8.7 Cost**

This criterion evaluates the capital and operation and maintenance (O&M) costs, and present worth of each alternative. The estimated costs as of August 1991 for each alternative were as follows:

| Alternative | Present Worth | Capital Cost | O&M Cost |
|---|---|---|---|
| Alternative 1 | $0 | $0 | $0 |
| Alternative 2 | $5,020,000.00 | $5,020,000.00 | $0 |
| Alternative 3 | $4,556,000.00 | $4,556,000.00 | $0 |
| Alternative 4 | $2,574,000.00 | $2,574,000.00 | $0 |
| Alternative 5 | $3,800,000.00 | $3,800,000.00 | $0 |

Since all of the alternatives require less than one year to complete, the estimated costs are capital costs. No recurring O & M costs are expected. These costs are estimates and actual contractor bids may differ from the estimates. The contractor's bid for Alternative 2, the selected remedy, is $8.9 million. The difference in cost is associated with more detailed information presented by the contractor. The Army analyzed the contractor's cost estimate and determined that it was fair and reasonable. It is anticipated that the contractor cost estimate for the other alternatives would be similarly higher.

Alternative 1 is the least expensive. Alternatives 4 and 5 would cost 25 to 50 percent less than Alternatives 2 and 3.

**8.8 State Acceptance**

The analysis of State acceptance addresses technical and administrative concerns of the U.S. EPA, the DTSC, the SMAQMD, and the RWQCB relative to implementation of the remedial alternative. The State of California has concurred with the selected alternative for the cleanup of soil at the Oxidation Lagoons. The State of California Department of Toxic Substances Control has adopted a Negative Declaration, pursuant to the California Environmental Quality Act (CEQA).

### 8.9 Community Acceptance

This criterion indicates whether the public concurs with, opposes, or has no comment on the preferred alternative. During the public meeting and two public comment periods, the public requested information on the results of the treatability testing, the use of Superfund money, the effects of the cleanup on Depot wildlife, the applicability of bioremediation, the effects of rainfall, and the feasibility of achieving a lower cleanup level for lead in soil. The public did not indicate concerns about the preferred alternative. Part III of this ROD contains the Responsiveness Summary from the public comment periods and public meeting.

## 9 SELECTED REMEDY

Alternative 2 is the remedy selected for the cleanup on the soil at the Oxidation Lagoons Operative Unit. The selection of this remedy was based upon the comparative analysis of alternatives presented above, and provides the best balance of trade-offs with respect to the nine evaluation criteria. The selected remedy consists of the following components:

- excavating contaminated soil;
- washing contaminated soil on-site to remove chemicals of concern;
- replacing washed soil into the excavation;
- treating soil-washing rinsate on-site;
- disposing treated rinsate in the sanitary sewer;
- treating and disposing of the de-watered residual sludge off-site; consisting of stabilization and disposal in a RCRA landfill, or recovery of metals at an off-site reclamation unit.

No air emissions are anticipated; dust would be controlled during excavation using water or foam sprays.

The objective of the remedial action is to reduce the toxicity, mobility, and volume of contaminants at the Oxidation Lagoons Operable Unit such that:

- remaining contaminant concentrations are in compliance with ARARs; and
- human health and the environment are protected.

The selected remedy would cost more than the other alternatives which were considered; however, it would meet the objectives of the remedial action most effectively. The total estimated cost for the selected remedy is $5,020,000.00. The itemized cost estimate is presented on Table 7. Because the remedy is expected to take six to nine months, recurring operation and maintenance costs are not expected. Therefore, Capital Cost equals the Present Worth of the alternative.

The selected remedy would provide short-term effectiveness, and is technically feasible. It would provide better short-term effectiveness than Alternative 3, because the latter would involve transporting hazardous rinsate off-site for treatment; this could temporarily increase human health and environmental risks.

The selected remedy would provide long-term effectiveness by maintaining protection of human health and the environment. The selected remedy would be more permanent than Alternatives 4 and 5, because the contaminants would be removed from the site.

The selected remedy would reduce toxicity, mobility, and volume of the contaminant through treatment more effectively than Alternatives 4 and 5. The latter two alternatives would increase the volume of contaminated material due to the addition of a soil stabilizer.

The selected remedy is expected to comply with ARARs. A treatability variance may be required in order to meet the Landban TCLP criterion. The ARARs for the selected remedy are discussed in Table A-2.

## 10 STATUTORY DETERMINATIONS

The Army's primary responsibility at this NPL site is to undertake remedial actions that achieve adequate protection of human health and the environment. Section 121 of CERCLA establishes several statutory requirements and preferences. These specify that, when complete, the selected remedy must comply with ARARs unless a statutory waiver is justified. The selected remedy must also be cost effective, and utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable. Finally, the statute expresses a preference for remedies that reduce toxicity, mobility, or volume of the hazardous waste.

**ALTERNATIVE 2 NOTES:**

1 Includes workplan preparation, sampling and analysis, soil washing tests, and report

2 Includes trees and concrete valve boxes

3 Assumes electrical connection requires a transformer and the water connection a tap to ground water treatment plant

4 Based on fence surrounding oxidation lagoons and staging area

Site improvements includes a barrier along north side of oxidation lagoons for laser protection

5 Includes hydroseeding oxidation lagoons

6 Includes site restoration, water treated on-site and disposed of in sanitary sewer

7 Based on removing and replacing 15,500 in-place c.y. soil

8 Based on 66 surface samples analyzed for EPA 6010, Cd and Pb atomic adsorption, QA/QC, report, 100% rush

9 Based on excavation verification survey

10 Soil washing system includes treatment sampling verification and wash liquid treatment Based on 15,500 in-place c.y. soil @ $155/c.y.

11 Based on 66 3'-5' borings analyzed for EPA 6010, Cd and Pb atomic adsorption, QA/QC, report, 100% rush

12 Based on 5% of construction costs excluding reports

13 Based on anticipated reports

14 Based on percentage of the construction costs

15 Based on 1991 dollars

### 10.1 Protection of Human Health and Environment

The selected remedy would protect human health and the environment by removing the contaminated material from the site. Risks posed by ingestion of contaminated soil and groundwater would be eliminated. Risks posed by fugitive dust inhalation could be temporarily increased during construction, but would be eliminated once the remediation is accomplished. To reduce inhalation risks during construction, dust would be controlled with water or foam sprays.

Because this remedy will not result in hazardous substances on site above health-based levels (providing the variance for cadmium is granted; see Section 10.2 below), the 5-year review will not apply to this action.

### 10.2 Compliance with ARARs

The selected alternative complies with ARARs as listed in Table A2. Detailed design and pilot testing of the soil washing process has not yet been completed. When completed, the design data will determine the exact method of compliance with certain regulations.

### 10.3 Cost Effectiveness

The selected remedy is cost-effective in mitigating the principle risks within a reasonable period of time. The estimated cost of the selected alternative is $5,020,000, which is slightly higher than the cost for Alternative 3 and about 25 to 50 percent higher than estimated costs for Alternatives 4 and5. The no-action alternative is not acceptable since it does not protect human health and the environment. Additionally, the selected remedy would be more effective in protecting human health and the environment, and would be more permanent than Alternatives 3, 4, and 5. Therefore, the estimated cost for the selected remedy is reasonable considering these criteria.

### 10.4 Utilization of Permanent Solutions and Alternative Treatment Resource Recovery Technologies

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner at the Oxidation Lagoons Operable Unit. Of those alternatives that are protective of human health and the environment, and comply with ARARs, the selected remedy provides the best balance of tradeoffs in terms of:

- Reduction of toxicity, mobility, and volume of contaminant through treatment: Treatment would consist of washing soil, and adding precipitants to rinsate to remove metals. Treatment of the soil and rinsate would reduce or eliminate the risk to human health and the environment posed by the contaminants of concern.

- Long-term effectiveness and permanence: Metals, in residual sludge, would be removed from the site, resulting in a permanent remedial solution. Resource recovery technologies would be utilized, if economically practicable, to salvage metals from the residual sludge.

### 10.5 Preference for Treatment as a Principle Element

The selected remedy satisfies the statutory preference for treatment as a principle element. The principle threat to human health and the environment is heavy metal contamination in soil. The selected remedy will reduce heavy metals concentrations through treatment, consisting of soil washing. Heavy metals will be removed from soil-wash rinsate through treatment, consisting of the addition of precipitants.

## 11 DOCUMENTATION OF SIGNIFICANT CHANGES

There were no significant changes from the Proposed Plan issued in April 1992.

## 12 REFERENCES CITED

California Air Pollution Control Officers Association (CAPCOA), 1987, Toxics Air Pollutant Source Assessment Manual for California Air Pollution Control Districts and Applicants for Air Pollution Control District Permits; Interagency Working Group, CAPCOA, Cameron Park, California.

United States Environmental Protection Agency, 1986, Superfund Public Health Evaluation Manual, EPA 540/1-86/060; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

---------------------------------, 1989, Risk Assessment Guidance for Superfund, Human Health Risk Assessment, U.S. EPA Recommendations; U.S. Environmental Protection Agency, Region IX, San Francisco, California.

---------------------------------, 1990a, Integrated Risk Information System (IRIS); U.S. Environmental Protection Agency, Washington, D.C.

---------------------------------, 1990b, Health Effects Assessment Summary Tables, Third Quarter FY 1990; U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

---------------------------------, 1990c, User's Guide for Lead: a PC Software Application of the Uptake/Biokinetic Model, Version 0.40; U.S. Environmental Protection Agency, Environmental Criteria and Assessment Office, Cincinnati, Ohio.

---------------------------------, 1990d, Policy Memorandum: "CERCLA Response Activities and the Land Disposal Restrictions Program's Applicability at Plattsburgh Air Force Base;" From Sylvia Lowrance, Director of Office of Solid Waste, April 6, 1990.

APPENDIX A

ANALYSIS OF ARARs