5.0 Selected Soil Remedial Actions

The Air Force evaluated and selected soil remedial actions for the 10 WABOU soil sites. Each of the selected remedies will be protective of human health and the environment and will comply with ARARs. They are effective at reducing contaminant exposure, are implementable and cost-effective, and are acceptable to the public and the State of California. The Air Force based the selection of these remedial actions on environmental and land use considerations and the nature and extent of contamination found at each site. U.S. EPA guidance and criteria evaluations and available technology were additional factors used in the selection process.

The Air Force is responsible for implementing, maintaining, and monitoring the remedial actions identified herein for the duration of the remedies selected in this Record of Decision. It will exercise this responsibility in accordance with CERCLA and the National Contingency Plan (NCP).

Meeting remedial action objectives shall be the primary and fundamental indicator of performance, the ultimate aim of which is protecting human health and the environment. Performance measures for Land Use Controls are defined herein as the remedial action objectives plus the required actions to achieve the defined objectives. It is anticipated that successful implementation, operation, maintenance, and completion of these measures will achieve protective and legally compliant remedies.

The following subsections present the selected action at each site and the soil cleanup levels for the sites that require active remedial actions and the rationale for the selection. Figures showing conceptual designs for the selected soil remedial actions are located at the end of the section.

5.1 Description of Selected Remedial Alternatives

5.1.1 Alternative S2—Land Use and Access Restrictions

Alternative S2 involves the application of additional physical and/or administrative land use restrictions to a site to ensure that human health and the environment is protected from potential exposure to chemicals that are present at the site. This remedial alternative is the selected remedial action for four soil sites (DP039, SD043, LF044, and SS046). It will also be applied to those soil sites where the residual soil concentration of each contaminant after the completion of excavation exceeds the 10^{-6} residential risk value. Table II-4-1 provides a description of this alternative, and Section 5.4 (Land Use Controls) describes the rationale for applying this alternative to excavated sites that exceed residential risk values.

5.1.2 Alternative S4—Excavation/Treatment/On-base Consolidation

Alternative S4 involves the excavation and treatment of contaminated soil prior to its placement in a CAMU. Section 4.2 (Corrective Action Management Unit) provides a detailed description of the CAMU. This alternative is appropriate for those sites that meet the following conditions:

- The chemical concentrations of contaminants in a significant amount of soil from the site exceed the CAMU acceptance levels. The calculations for the acceptance levels are based on the results of the field sampling and analysis using the California Waste Extraction Test with deionized water. The *Travis AFB Leachate Assessment Report* (Radian, 2000) presents a more detailed description of the leachate assessment and its results.
- There is a physical or chemical stabilization process that would prevent the leaching of contaminants from the soil and would allow the placement of soil with higher contaminant concentrations in the CAMU. The most likely treatment option for most of the soil contaminants is soil stabilization using Portland cement. Prior to using this stabilization process, the Air Force would have to demonstrate through a treatability study that the process successfully prevents the leaching of contaminants from the local soil.
- The cost of the soil stabilization process would not exceed the cost of transporting and disposing the soil in an appropriate off-base landfill. The amount of soil that requires treatment is an important consideration of determining the cost effectiveness of the stabilization process.

Since it is not possible to select this remedial alternative until the above conditions are met, the decision to use a soil stabilization process would occur after the excavation at the WABOU soil sites is complete and the amount of soil to be treated is known. The stabilization and placement of this soil would take place prior to the construction of the protective cap over the contaminated soil.

5.1.3 Alternative S5—Excavation/Off-base Disposal

Alternative S5 involves the excavation of contaminated soil and its disposal in an appropriate off-base landfill. This is the selected alternative for sites with contaminated soil that cannot be placed in the CAMU, including low-level radioactive waste and contaminated soil from an off-base annex. This is also the selected contingency alternative for the contaminated soil that exceeds the CAMU acceptance limits. The off-base disposal facilities that are available to receive contaminated soil and waste include Class I and Class II hazardous waste landfills and low-level radioactive waste repositories.

5.1.4 Alternative S6—Excavation/On-base Consolidation

Alternative S6 is the remedial alternative that involves the excavation of contaminated soil and its placement in a CAMU. This is the selected alternative for sites with contaminated soil that meets the CAMU acceptance criteria. Section 4.2 provides a detailed description of the CAMU. Sections 5.1.2 and 5.1.3 present the remedial alternatives for contaminated soil that exceed the CAMU acceptance criteria.

The Air Force will build the CAMU within a former landfill (LF007) to consolidate contaminated soil from Travis AFB IRP sites. LF007 is a closed landfill within the NEWIOU. The contaminated soil will be covered with an engineered cap.

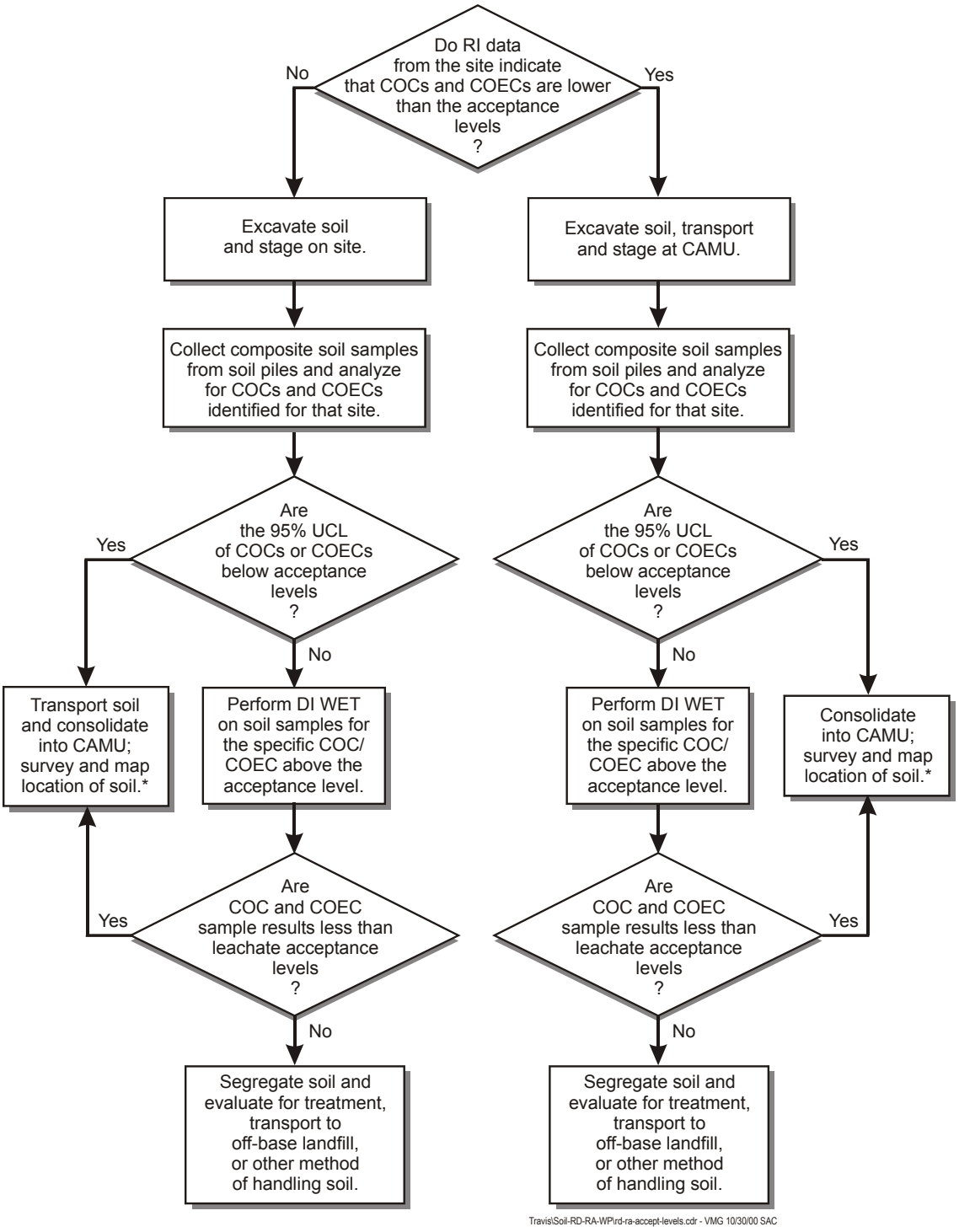
The Air Force will build the CAMU in phases. Initially, a relatively flat compacted soil pad for the CAMU will be constructed at a portion of LF007 using grading and compacted fill. Subsequently, a module will be built for each year that the excavation and consolidation of suitable soil from Travis AFB soil sites is scheduled. By the end of the construction season

(normally May through October), the module of consolidated soil will be covered with a final cap. Each module will have an intermediate cover on the side where future modules will be attached. The phased approach is necessary, because the selection of remedial alternatives for the Travis AFB soil sites will take place in the WABOU and NEWIOU Soil RODs, which are on two different schedules. Also, the soil remedial actions on Travis AFB are funded over several years so that they fit within the projected IRP budget.

The Air Force will design the CAMU to be protective of human health and the environment and to comply with all ARARs. One of the design objectives for the landfill cover and CAMU cap is to prevent the CAMU waste from coming into contact with groundwater and to ensure that potential leachate from the CAMU will not cause groundwater underlying the waste to exceed beneficial use objectives. The Air Force, with guidance from the San Francisco Bay Regional Water Quality Control Board, has developed the soil acceptance requirements shown in Table II-5-9 to determine the contaminant types and soil concentrations that can be safely placed in the CAMU. The SESOIL modeling, the initial review of the RI data, the de-ionized waste extraction test (DI WET) results and the proposed CAMU design support the establishment of soil acceptance levels. Soil acceptance levels represent chemical concentrations in the soil that may result in leachate concentrations greater than the maximum contaminant level (MCL) by a factor of 100 but are predicted to attenuate by a factor of 100 as the leachate migrates to the water table below the CAMU. Soil samples from representative soil sites at Travis AFB were collected and analyzed using the DI WET to provide site-specific data on the potential leaching of contaminants from soils. The conclusion of this sample analysis is that the leachate acceptance levels that exceed the MCL by a factor of 100 are protective of groundwater beneficial use objectives for a CAMU without a liner or leachate collection and recovery system (LCRS). The *Corrective Action Management Unit Soil Acceptance Criteria* (Radian, 2001) provides a more detailed description of the development and protectiveness of the CAMU acceptance levels.

Acceptance of contaminated soil to the CAMU will be based on a comparison of the soil acceptance level of a COC to the site-specific soil concentration data. Excavated soil that has soil concentrations below the soil acceptance level for each contaminant at the site will be placed into the CAMU. For excavated soil whose soil concentrations exceed the soil acceptance levels, placement into the CAMU is allowable if the leachate results from soil samples that are collected from the excavated site and analyzed using the DI WET method do not exceed the leachate acceptance levels presented in Table II-5-9. The CAMU will receive post-closure inspections and maintenance to ensure the cap continues to perform as designed. The *LF007 Soil Remedial Action Design Report and Post-Closure Maintenance Plan* (CH2M HILL, 2002) describes the CAMU design, postclosure inspections, and maintenance.

Figure II-5-1 (figures located at the back of this section) presents the acceptance level sampling process that supports the placement of soil in the CAMU. Section 5.6 (RD/RA Implementation and Schedule) describes the RD/RA activities related to the CAMU. Section 6 (List of Applicable or Relevant and Appropriate Requirements and Performance Standards) presents the CAMU ARARs.



* Soil that is acceptable for consolidation to the CAMU may still be transported for off-base disposal

Figure II-5-1. Acceptance Level Sampling Process

5.2 Criteria Used to Determine Soil Cleanup Levels

The selected soil cleanup levels for COCs at each site represent the residual site-specific contaminant concentrations that can remain after completion of a remedial action and are protective of human health and the environment. Since no chemical-specific ARARs that establish soil cleanup levels exist, the following subsections present the criteria that provide the basis for the cleanup levels at the WABOU soil sites.

5.2.1 Residential/Industrial Exposure Scenarios

When reviewing text or tables that address cleanup concentrations and associated risk values, it is important to consider the criteria used in the calculation of the risk values. At Travis AFB, the residential and the industrial exposure scenarios provided the two sets of criteria used in risk calculations.

The residential exposure scenario, the more conservative of the two, assumes that the site is available for any possible use. For example, the property could be in the middle of a residential housing area or adjacent to a day care center. In this scenario, the risk assessor makes assumptions about the amount of potential chemical exposure that a resident (such as a gardener or a barefoot child) may receive. Since the assumptions for this scenario represent the maximum potential exposure, the residential risk calculations usually result in high values.

The industrial exposure scenario assumes that the site is available for industrial use only. In this scenario, the risk assessor makes assumptions about the amount of potential chemical exposure that a site worker may receive. The assumptions for this scenario are appropriate for a healthy adult at the site during normal working hours in minimal protective clothing and represent a lower potential exposure. The industrial risk calculations usually result in lower values.

The Air Force reviewed the U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-30 (page 5) to select the appropriate exposure scenario for Travis AFB:

> "The preamble to the NCP states that U.S. EPA will consider future land use as residential in many cases. In general, residential areas should be assumed to remain residential; and undeveloped areas can be assumed to be residential in the future unless sites are in areas where residential land use is unreasonable. Often the exposure scenarios based on potential future residential land use provide the greatest risk estimates (e.g., reasonable maximum exposure scenario) and are important considerations in deciding whether to take action (55 Fed. Reg. at 8710).
>
> However, the NCP also states that 'the assumption of future residential land use may not be justifiable if the probability that the site will support residential use in the future is small.' Sites that are adjacent to operating industrial facilities can be assumed to remain as industrial areas unless there is an indication that this is not appropriate. Other land uses, such as recreational or agricultural, may be used, if appropriate. When exposures based on reasonable future land use are used to estimate risk, the NCP preamble states that

> the ROD 'should include a qualitative assessment of the likelihood that the assumed future land use will occur' (55 Fed. Reg. at 8710)."

Travis AFB is host to the largest airlift organization in the Air Force, with a versatile fleet of C-5 Galaxy cargo aircraft and KC-10 Extender refueling aircraft to support its strategic airlift mission. This Base is also the west coast terminus for aeromedical aircraft returning sick or incapacitated military personnel from the Pacific and is a west coast port of embarkation for military personnel. Travis AFB is in the middle of an extensive construction program that is replacing aging inefficient buildings with new facilities as well as upgrading existing structures to better conform to their function. The recent acquisition of land to the north of the Base supports the construction of additional family housing units needed for the additional personnel to be assigned to Travis AFB under the Base Realignment and Closure (BRAC) Act.

There is a large geographical separation between the northern residential housing areas and the southern industrial areas on Travis AFB. All of the WABOU soil sites are located within or adjacent to industrial facilities. Also, there are currently no Base closure initiatives scheduled for the next few years, and there is no indication that Congress will enact legislation to change the status of open Bases.

In summary, the physical size, the number of personnel and units, and the assigned mission responsibilities at Travis AFB are growing. The present land use near all WABOU sites is industrial in nature, and there are no indications that this condition will change in the near future. Therefore, the use of industrial criteria in deriving cleanup levels is appropriate for the WABOU soil sites. Also, residential criteria are the basis for deriving more stringent cleanup goals for these sites.

Since the Air Force is selecting industrial cleanup levels at all WABOU soil sites, existing and additional land use controls will be implemented, monitored, maintained, and enforced as described in section 5.4 (Land Use Controls).

5.2.2 Risk Management

Risk management is the process of making decisions concerning a site, taking into account the potential risk posed by contaminants, the cost of cleaning up the contaminants, the present and future use of the land, and other site conditions. The following subsections describe risk management decisions that were applied to the WABOU soil sites.

5.2.2.1 Risk Management Range

The Air Force has selected soil cleanup levels that equate to an acceptable exposure level. The rationale for deciding on an acceptable exposure level at a site is based on 40 CFR 300.430(e)(2)(i)(A)(2) of the NCP:

"For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response."

Consistent with this language, the Air Force will ensure that any residual soil contaminants after completion of a remedial action will fall within or below the 10^{-4} to 10^{-6} risk range. For

each site, the specific cleanup level within that range must be determined based upon site-specific factors. The NCP at 40 CFR 300.430(e)(2)(i)(A)(2) further states that:

"The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure."

Therefore, the 10^{-6} risk level and the industrial exposure scenario are the basis for cleanup concentrations at WABOU soil sites. These concentrations provide a margin of safety for workers, since Travis AFB is an industrial facility as described in Section 5.2.1 (Residential/ Industrial Exposure Scenarios), and conservative exposure assumptions were used in the risk calculations.

5.2.2.2 Point of Departure

As a military facility, Travis AFB uses a number of self-imposed land use restrictions to maintain security and ensure safety for site workers. These restrictions also serve as potential mitigating factors to depart from the 10^{-6} risk level at sites within certain portions of the Base. After a review of these factors and their locations in relation to the WABOU soil sites, only Landfill 3 (LF008) was found to warrant a departure from the 10^{-6} risk level. Table II-5-3C presents the existing land use restrictions in the vicinity of LF008 and the rationale for their use in deciding upon an appropriate risk level. Section 5.3.5 [Landfill 3 (LF008)] discusses the use of these factors in the selection of cleanup levels in more detail.

5.2.2.3 Depth Considerations

Contaminants located at different depths pose different amounts of potential risk to receptors. For example, a site worker has a greater chance of being exposed to chemicals in surface soil [0 to 0.25 feet below ground surface (bgs)] than chemicals in soil that is 10 feet bgs. Also, the soil horizon for ecological receptors is considered to be 0 to 4 feet bgs, so chemicals below 4 feet bgs are not considered to pose a potential risk to ecological receptors.

As a conservative measure, the concentrations that equate to a 10^{-6} risk level under industrial conditions will apply to the top six inches of surface soil at each site, unless there is a human health or ecological cleanup value that is lower. The rationale for using a depth of six inches involves the existing land use controls on Travis AFB. To conduct a soil excavation in excess of six inches, the excavator must obtain a signed digging permit from the Base. The Base environmental office reviews all digging permits to ensure that site workers are not exposed to contaminants or that appropriate personal protection is required as a condition of proceeding with the excavation. It is conservative, because the WABOU human health risk assessment applied conservative surface soil assumptions to calculate potential risk for the top three inches of soil. Section 5.4 (Land Use Controls) describes the land use controls on Travis AFB.

The concentrations that are protective of ecological receptors and the local groundwater will apply to soil beneath the top six inches at each site as long as they are within or below the 10^{-4} to 10^{-6} risk range. The assumptions used to calculate potential risk for the soil below 3 inches are less conservative, since they apply to trench workers. As a result, this approach protects site workers by preventing potential chemical exposure at a site.

As a result of this consideration, several sites have multiple soil cleanup tables, each one applying to a different range of soil depths.

5.2.2.4 Consideration of Site Conditions

Initially, the Air Force used an initial screening approach that used only numerical risk values to determine whether a soil site required a cleanup action. However, in working with the regulatory agencies to resolve legal and technical issues, the Air Force elected to apply a risk management strategy described in OSWER Directive 9355.0-30, the *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (U.S. EPA, 1991) to several WABOU soil sites. This strategy uses the risk assessment and site conditions to develop cleanup alternatives and to support risk management decisions. This strategy allows the Air Force to focus its cleanup efforts on high-risk soil sites and monitor the low-risk soil sites.

As a result, the Air Force found that Alternative S2 (Land Use and Access Restrictions) provided an adequate measure of protection for site workers at low-risk soil sites, negating the need for an active remedial action. Section 5.8.2 [Railhead Munitions Staging Area (SS046)] presents an example of the application of this strategy at the Railhead Munitions Staging Area (SS046).

5.2.3 Human Health Exposure for Carcinogens

The WABOU Human Health Risk Assessment evaluated potential threats to human health from chemicals found at WABOU soil sites in the absence of any remedial action. This information was used to determine the need for remedial action at each site. Section 3.2.1 (Human Health Risk Assessment) presents a brief summary of the WABOU Human Health Risk Assessment.

The Air Force accepted the regulatory agency recommendation to use the 1 October 2002 U.S. EPA Preliminary Remediation Goals (PRG) as the soil cleanup levels for carcinogenic chemicals that equate to a fixed level of risk (1×10^{-6}). U.S. EPA estimated the PRG using current U.S. EPA toxicity values with "standard" exposure factors to ensure that the resulting concentrations are protective of humans, including sensitive groups, over a lifetime.

The 1 October 2002 U.S. EPA Region IX PRG Table contains concentrations for both residential and industrial use. Since Travis AFB is an industrial facility as described in Section 5.2.1 (Residential/Industrial Exposure Scenarios), the soil cleanup levels for each site are based on the industrial PRG. The soil cleanup table for each site contains a column of the current residential PRGs and a column of the current industrial PRGs that equate to a potential 10^{-6} cancer risk.

5.2.4 Human Health Exposure for Non-carcinogens

The WABOU Human Health Risk Assessment evaluated potential lead exposures by calculating the blood-lead level associated with lead in soil, using the lead spreadsheet model developed by the CAL-EPA. A lead concentration in the soil that results in a blood-lead level greater than 10 μg/dL warrants a cleanup action at a lead-contaminated site.

The Air Force accepted the regulatory agency recommendation to use the 1 October 2002 U.S. EPA PRGs as the soil cleanup levels for non-carcinogenic chemicals that equate to a fixed level of risk (Hazard Index of 1). The Hazard Index is a ratio of a chemical concen-

tration compared to the chemical's corresponding U.S. EPA PRG. U.S. EPA estimated the PRG using current U.S. EPA toxicity values with "standard" exposure factors to ensure that the resulting concentrations are protective of humans, including sensitive groups, over a lifetime. As described in Section 5.2.3 (Human Health Exposure for Carcinogens), the soil cleanup levels for each site are based on the industrial PRG. The soil cleanup table for each site contains a column of the current residential PRGs for a residential hazard index of 1 and a column of the current industrial PRGs for an industrial hazard index of 1.

5.2.5 Ecological Exposure

During the WABOU RI, an ERA was conducted for the WABOU soil sites (CH2M HILL, 1997b). The ERA was conducted in accordance with the protocol for conducting risk assessments at Travis AFB (JEG, 1994a) as well as applicable state and federal guidance documents available at that time (e.g., U.S. EPA, 1989a; U.S. EPA, 1989b; U.S. EPA, 1992; DTSC, 1996), and is described in Section 3.2.2 (Ecological Risk Assessment). Although additional guidance documents have been published subsequently (e.g., U.S. EPA, 1997; U.S. EPA, 1998), they do not contain substantive changes in the approach toward conducting ERAs at sites such as Travis AFB.

One of the key components of the ERA was the identification of ecological resources that were valued (termed "assessment endpoints"); the goal of the ERA was to evaluate potential risks of contaminant exposures to these endpoints. The following assessment endpoints were used for sites in terrestrial habitats:

- Plants – maintain grassland productivity or plant species composition
- Animals – maintain the prey species (e.g., invertebrates and herbivorous mammals and birds) available to secondary consumers; maintain the population of avian and mammalian consumers; and protect individual special-status bird species likely to nest or forage in grassland habitat.

To conduct the ERA, a special-status bird species (the burrowing owl, *Athene cunicularia*), several common bird and mammal species that are representative of animals found at the sites, along with plants and terrestrial invertebrates, were selected for evaluation.

Risk characterizations were based on HQs in which exposure levels were compared to potential effect levels. The HQs in the ERA generally were based on comparisons of exposure point concentrations to NOECs or NOAELs, or to similar values (rather than comparing to the lowest observed effect concentrations [LOECs] or LOAELs).

The LOECs and LOAELs are typically about ten times the NOECs and NOAELs, and an uncertainty factor of 10 was used in the ERA to estimate the NOEC or NOAEL when the referenced study reported only the lowest effect levels. Thus, concentrations up to ten times the NOECs or NOAELs that were used (consistent with conservative ERA assumptions and practice) could represent acceptable levels of contamination for chemicals at the various sites, especially for population-level endpoints and common species. Using both the NOEC/NOAEL and the LOEC/LOAEL provides a range of values that can be considered in risk management decisionmaking.

Site use factors (i.e., proportion of time receptors are likely to spend on-site) were conservatively assumed to be one for the ERA, even though most of the birds and mammals selected as target receptors have foraging ranges that are larger than the affected areas at the terrestrial sites. This is particularly true for the burrowing owl, which typically has a foraging range of about 300 acres (Gervais, 2000). This foraging range was identified in a recent study conducted at Lemoore Air Field, which is an ecological setting similar to that at Travis AFB.

The risk management decision for the terrestrial sites focused primarily on protection of special-status species individuals (i.e., the burrowing owl, which was the special-status species selected for the ERA because it is known to occur on some of the sites and can be expected to forage on any of the sites). Setting the cleanup levels to be protective of the burrowing owl (and basing the cleanup levels on NOAELs for this species) will result in reduction of risk to other ecological receptors at the terrestrial sites.

When the combined consideration of LOECs or LOAELs for the common species, potentially limited use of on-site habitats by those receptors (as well as the burrowing owl), and the goal of protecting populations (rather than individuals) of the common species were taken into account, it was concluded that there will be no potential unacceptable ecological risk remaining at the soil sites. This is particularly true because the soil sites are small in relation to the amount of available similar habitat on-base and in the surrounding region, and any residual (post-remediation) contamination will not adversely impact populations of these species.

The *Evaluation of Ecological Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001b) presents the risk evaluations that led to the ecological input to the soil cleanup levels. Section 5.3 (Site-Specific Remedial Actions) summarizes the results of the ERA for each site from the WABOU RI Report (CH2M HILL, 1997) and presents the rationale for the selected cleanup levels.

5.2.6 Groundwater Protection

It is important that the residual soil contamination at each site does not serve as a continuing source of groundwater contamination. There are two groups of WABOU soil sites based on this criterion: those without contaminated groundwater and those with contaminated groundwater.

5.2.6.1 Sites without Groundwater Contamination

The WABOU RI investigated contamination in the soil and groundwater at each WABOU site. At several sites, the WABOU RI concluded that there was no groundwater contamination present, using either the significant reduction of soil contaminant concentrations in the vadose zone with depth or the results of groundwater sample analysis. The WABOU RI report review also evaluated site histories to determine the approximate date of the initial release and to determine if sufficient time had elapsed for a groundwater impact to be observed in the closest down-gradient monitoring location. For those sites where the release took place more than 10 years ago, it was determined that current groundwater data would serve as a suitable indicator of whether a groundwater impact was likely to occur now or in the future. For those sites where groundwater has not yet been impacted by the release, it

was decided that the cleanup level based on human health and ecological protection would also provide sufficient protection of the groundwater resource.

The WABOU RI did not evaluate the groundwater conditions at several soil sites due to considerations of the insoluble nature of the contaminants. At these sites the Base collected groundwater samples at locations immediately downgradient of the highest contaminant concentrations. The purpose of this sampling effort was to collect the empirical evidence needed to prove that the soil contaminants are not leaching into the groundwater. The results of the sample analyses demonstrated that there is no leachate generation at these sites. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) presents the results of these analyses.

5.2.6.2 Sites with Groundwater Contamination

At several WABOU sites, groundwater contamination is present and is undergoing treatment in a separate groundwater remedial action. For those sites where groundwater has already been impacted, it was necessary to determine whether residual contaminant concentrations less than the selected cleanup level could potentially serve as a continuing source of groundwater pollution. To demonstrate that the cleanup levels at a soil site with groundwater contamination are protective of groundwater beneficial use objectives, the Base collected soil samples in the most highly contaminated portions of the site and analyzed them, using the landfill assessment approach for determining the CAMU acceptance levels. The *Corrective Action Management Unit Soil Acceptance Criteria* (Radian, 2001) provides a more detailed description of the approach for developing the CAMU acceptance levels. This approach takes into account the low permeability of the underlying soil strata and the distance between the contaminant source area and the water table. This approach takes the concentration of the contaminants and compares them to the amount of contaminant that leached from the sample when subjected to a modified California Waste Extraction Test modified to use deionized water as an extractant. A site-specific dissociation constant was then calculated by dividing the leachate concentration by the total soil concentration. The analyses resulted in the identification of chemical concentrations that are protective of groundwater beneficial use objectives. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) presents the rationale for the application of this methodology to the evaluation of groundwater protection and the results of these analyses.

5.2.7 Former Small Arms Range Remedial Action Plan

The former small arms range (SD045) was the subject of an Air Force Center for Environmental Excellence (AFCEE)-funded demonstration project that is part of a nationwide Air Force initiative to develop a standardized approach for the streamlined assessment of remedial requirements at Air Force small arms ranges. The purpose of the initiative is to establish a technically sound, unified approach to firing range site investigation, risk evaluation, and remediation that is cost effective. AFCEE plans to use the information acquired during the application of the risk-based approach to prepare a technical protocol document for use by remedial project mangers and their subcontractors to cost-effectively mitigate potential environmental hazards associated with Air Force firing ranges. The Air Force published the risk-based approach in the *Work Plan for the Demonstration of a Risk-Based*

Approach To Determine Remedial Requirements at the Former Small Arms Firing Range (SAR1), Travis AFB, California (Parsons, 1998).

The risk-based approach consists of four major tasks:

1. Estimate of Lead Absorption by the Human Body – This estimate was made using the following measurements:
    - Particle Size – Soil samples were sieved and analyzed chemically to determine the particle size of the metal contaminants.
    - Chemistry – An electron microprobe was used to determine the forms of lead (oxides, sulfates, etc.) that are present in the soil. This information is important, because different lead compounds are absorbed into people, plants and animals at different rates.
    - Lead Absorption Analysis – The study used the U.S. EPA Technical Review Workgroup Adult Blood Lead Model to evaluate potential risks to on-base industrial workers from site contaminants.
2. Evaluation of Ecological Risk – The study evaluated the potential risks of site contaminants on terrestrial plants and invertebrates, the burrowing owl, the western meadowlark, and the deer mouse. It took into consideration the disruption of cattle grazing and firebreak disking on the ecological habitat. Once the potential risks were characterized, risk-based remediation goals were calculated.
3. Treatability Testing – Three treatment technologies (gravity separation, acid leaching, and stabilization with Portland cement) were tested to determine their effectiveness under existing site conditions.
4. Feasibility Study - A focused feasibility study was performed to evaluate remedial alternatives to reduce risks associated with antimony, copper, and lead concentrations in soil at the site. The five remedial alternatives were land use restrictions, a soil cap, excavation and on-site treatment (acid leaching), excavation and placement in an on-base CAMU, and excavation and off-base disposal.

After the completion of the field activities that were described in the above work plan, the Air Force published the *Remedial Action Plan for the Former Small Arms Range (SAR1), Travis AFB, California* (RAP) (Parsons, 2000). The RAP summarizes the findings of the risk-based investigation of SD045, recommends a preferred remedial alternative to address the metals contamination in the soil, and presents soil remediation goals that are protective of current and future workers, plants and animals. The Air Force used the RAP to select cleanup levels for this site.

5.2.8 WABOU Reference Concentrations

The WABOU RI evaluated the inorganic chemicals found at WABOU sites to determine whether inorganic constituents detected in samples are naturally occurring or are the result of contamination from past activities. The end product of this evaluation was a table of WABOU maximum reference concentrations for all media. Section 3.5 (Inorganic Constituent Evaluation) of the WABOU RI report summarizes the approach used to evaluate the

WABOU inorganic data set. Appendix H1 of the WABOU RI report provides a more detailed discussion of the WABOU inorganic constituent evaluation.

Barium at SD042 is the only chemical that required the application of WABOU maximum reference concentrations in the selection of soil cleanup levels.

5.3 Site-Specific Remedial Actions

The following subsections present a brief description of the 10 WABOU soil sites; the selected remedial action for each site; and descriptions of the protectiveness of the remedial action to human health, the ecological receptors, and groundwater beneficial use objectives.

Tables II-5-1 through II-5-8 present the soil cleanup levels for the sites that require active remedial action in accordance with the NCP. The shaded cells in the risk columns of these tables indicate the concentration (cancer, non-cancer, ecological, or groundwater protection) that led to the soil cleanup level.

The following subsections also provide the rationale for the selection of cleanup levels for each site. These soil cleanup levels take into account the site-specific conditions, comply with CERCLA, and are protective of human health and the environment.

For clarification purposes, the WABOU RI report used the term "hazard index" to refer to a measure of non-carcinogenic risk to humans and the term "hazard quotient" to refer to a measure of ecological risk. This ROD describes the hazard index in section 3.2.1 (Human Health Risk Assessment) and the hazard quotient in section 3.2.2 (Ecological Risk Assessment).

The WABOU RI report (CH2M HILL, 1997) is the source of the risk values listed below.

5.3.1 Building 755 (DP039)

Site Description— Building 755 is the Base battery and electric shop. The past practice for disposing of used battery acid was to pour it into a battery neutralization sump. The Base dismantled the sump in 1993. The area immediately surrounding the former sump area contains lead, possibly left behind from the sump removal action.

Selected Remedial Alternative(s)— Alternative S2 (Land Use and Access Restrictions) is the selected remedial action for this site. The Air Force will restrict the use of this small area to industrial activities only. Administrative controls will be sufficient to enforce the restriction, so no physical barriers (i.e., fences) will be necessary. The Travis AFB General Plan will document the presence of lead in the surface soil and enforce the land use restriction, particularly on the use of the contaminated area for playground or other play activities.

The objective of this remedial action is to document the location of the contaminants and apply land use controls to prevent the site from being used for residential purposes. This is the most cost-effective remedy available, since it avoids the cost of an active remedial action, such as excavation and disposal. Also, the selection of an active remedial action would still not allow the site to be used for residential purposes, primarily due to its location within an existing explosive safety clear zone associated with a nearby ammunition handling facility.

Protection of Human Health— Lead is the soil COC at this site. There is no estimated excess lifetime cancer risk; however, lead is regulated based on developmental toxicity. The lead concentrations at the former sump area range from 56.5 mg/kg to 7,040 mg/kg (830 mg/kg average), which equates to a potential non-cancer residential hazard index of 11. The average value reflects 'hot spot' concentrations only (biased high); the estimated industrial hazard index is less than 1, and the calculated blood-lead level for the site (6 μg/dL) is lower than the threshold level of 10 μg/dL. The site does not pose an unacceptable potential risk to site workers, and the selected remedy is protective of human health by preventing the residential use of the property, including day care center activities. Section 4.1.7 of the WABOU RI presents the results of the human health risk assessment for this site.

Protection of Ecological Receptors— The small area of lead contamination results in a low exposure potential for ecological receptors, so lead is not a chemical of ecological concern at this site. Section 4.1.8 of the WABOU RI report presents the results of the ecological risk assessment for this site.

Protection of Groundwater— The WABOU RI detected lead in the local groundwater at concentrations below the U.S. EPA MCL. Lead is not a groundwater chemical of concern at this site, so the selected remedial alternative is protective of groundwater beneficial use objectives. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2000a) technical memorandum presents a more detailed discussion on the groundwater evaluation of this site.

5.3.2 Building 905 (SS041)

Site Description— Building 905 is the Base entomology shop. The surface soil within this fenced facility contains various pesticides from the past washing of pesticide-applicator vehicles on a concrete washrack.

Selected Remedial Alternative(s)— Alternative S6 (Excavation/On-base Consolidation) is the selected remedial action for this site. Table II-5-1 presents the soil cleanup levels for the chemicals of concern at the site. Alternative S5 (Excavation/Off-base Disposal) is the selected contingency remedial action for soil that exceeds the CAMU acceptance levels.

TABLE II-5-1
Cleanup Levels for Soil COCs at Building 905 (SS041)
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	Soil Cleanup Level (mg/kg)	Residential (mg/kg)		Industrial (mg/kg)		HQ=1 (mg/kg)	Potential for Groundwater Impact?
		10^{-6} Cancer Risk	Chronic HI=1	10^{-6} Cancer Risk	Chronic HI=1		
chlordane	6.5	1.6	35	6.5	670	NA [a]	No
heptachlor epoxide	0.19	0.053	0.79	0.19	11	NA	Yes [b]
toxaphene	1.6	0.44	NA	1.6	NA	NA	No

[a] NA = Not Applicable

[b] The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum describes the confirmatory analyses for verification that the cleanup level for this compound is protective of groundwater beneficial use objectives.

If some of the excavated soil does not meet the CAMU acceptance criteria, the Air Force will determine whether the soil needs to be sent to an off-base landfill or whether a soil treatment can stabilize the contaminants sufficiently for placement in the CAMU. Alternative S4 (Excavation/ Treatment/On-base Consolidation) is the selected contingency remedial action if it proves to be a cost-effective improvement over Alternative S5.

Alternative S2 (Land Use and Access Restrictions) is also a selected remedial action for the site. However, it will not be implemented if Alternative S6 achieves the residential cleanup values as presented in Table II-5-1. Administrative controls will be sufficient to enforce future restrictions at this site, because a fence is already in place around the site. The Travis AFB General Plan will document the presence of pesticides in the soil and enforce the land use restrictions, including the prohibition on day care center activities.

The basis for selecting an active remedial action at this site is the protection of groundwater beneficial use objectives. The Air Force will excavate the pesticide-contaminated soil surrounding the concrete washrack and transport it to the CAMU. The estimated volume of excavated soil is approximately 100 cubic yards. The excavation will be backfilled with clean soil. This approach has minimal impact on entomology shop operations. The estimated cost for Alternative S6 is $32,000; the estimated cost for Alternative S5 is $57,000, and the estimated cost for Alternative S4 is $90,600. This is the most cost-effective remedy that meets the remedial action objective of removing as much of the soil contaminants as needed to improve the effectiveness of the existing groundwater extraction and treatment remedy at this site. Figure II-5-2 shows the areal extent of contamination and the approximate limits of excavation.

Protection of Human Health— Chlordane, heptachlor epoxide, and toxaphene are the chemicals of concern at this site. The estimated excess lifetime cancer risk for potential future worker exposure is 4×10^{-5} for surface soil, based on existing contaminant concentrations. The estimated hazard index for potential industrial exposure is 0.4 for surface soil. For subsurface soil the estimated excess lifetime cancer risk for all personnel is below 1×10^{-6}, and the estimated hazard index for residential exposure is below 1. Even though the basis of the selected remedial action is protection of groundwater beneficial use objectives, the cleanup levels will reduce the estimated excess lifetime cancer risk for potential future worker exposure to 1×10^{-6} for each contaminant.

Protection of Ecological Receptors— There is no ecological habitat, and therefore no chemicals of ecological concern, at the site. Section 4.2.8 of the WABOU RI report presents the results of the ecological risk assessment for this site.

Protection of Groundwater— The local groundwater also contains heptachlor epoxide, and a separate groundwater remedial action (groundwater extraction and treatment) is removing this contaminant from the groundwater. Although this pesticide does not readily dissolve in groundwater, the soil remedial action will remove the source of groundwater contamination. The other two soil COCs (chlordane and toxaphene) are not groundwater COCs, so their concentrations prior to an active soil remedial action are already protective of the groundwater beneficial use objectives. However, the selected remedial action will reduce the potential of the soil COCs to leach into the local groundwater.

The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2000a) technical memorandum describes the field analysis that was used to calculate contaminant concentrations in the soil that are protective of groundwater beneficial use objectives. Groundwater monitoring associated with the groundwater remedial action will verify the effectiveness of the soil and groundwater remedial actions at the site.

5.3.3 Building 916 (SD043)

Site Description— This site is an electric power facility. At least one electrical transformer on a concrete pad adjacent to the building leaked PCB-laden oil into the surface soil.

Selected Remedial Alternative(s)— Alternative S2 (Land Use and Access Restrictions) is the selected remedial action for this site. The Air Force will restrict the use of this small area to industrial activities only. Administrative controls will be sufficient to enforce the restriction, so no physical barriers (i.e., fences) will be necessary. The Travis AFB General Plan will document the presence of this compound and enforce the land use restriction.

Section 5.8.1 [Building 916 (SD043)] describes the change made to the proposed remedial alternative. The residential cleanup value for PCB-1254 is 0.22mg/kg.

Protection of Human Health— PCB-1254 is the chemical of concern at this site. The remaining PCB-1254 concentrations at the former transformer area range from 0.051 mg/kg to 2.0 mg/kg (0.58 mg/kg average), which equates to a potential residential cancer risk of 2.6×10^{-6}. The estimated excess lifetime cancer risk for potential future worker exposure is below 1×10^{-6} for surface soil (based on the screening human health risk assessment) and is 6×10^{-8} for subsurface soil. The estimated non-cancer risk value for potential industrial exposure is below 0.1 for surface soil (based on the screening human health risk assessment) and is 0.1 for subsurface soil. The site does not pose an unacceptable potential risk to site workers, and the selected remedy is protective of human health by maintaining the industrial use of the property. Section 4.3.7 of the WABOU RI report presents the results of the human health risk assessment for this site.

Protection of Ecological Receptors— There are no chemicals of ecological concern associated with this site. Section 4.3.8 of the WABOU RI report presents the results of the ecological risk assessment for this site.

Protection of Groundwater— The WABOU RI detected PCB-1254 in an unfiltered groundwater sample taken directly under the leak area. Additional groundwater samples taken from sampling points approximately 15 feet and 30 feet from the leak area contained no PCBs. Since the leak occurred over eight years ago, this sampling effort demonstrates that the low PCBs concentrations in the soil are not contaminating the local groundwater. The *Reevaluation of Soil and Groundwater Contamination at Building 916 (SD043)* Technical Memorandum (CH2M HILL, 2000) presents a detailed discussion on this groundwater sampling effort.

Even though the additional fieldwork described above demonstrated that the PCBs are not migrating from the source area, the Air Force will collect and analyze a set of groundwater samples from the three groundwater monitoring points located downgradient of the PCB leak area. This field effort will take place within the Travis AFB Groundwater Sampling and Analysis Program (GSAP) after all WABOU soil actions are complete and will provide addi-

tional verification that PCBs are not migrating from the source area. If the GSAP demonstrates that PCBs are consistently present in the groundwater at concentrations greater than MCLs, then the Air Force will evaluate the available remediation technologies and implement an appropriate contingency remedial action.

5.3.4 Building 929/931/940 (SD042)

Site Description— Building 929 is a storage shed, building 931 is maintenance facility for portable electrical generators, and building 940 was a former paint-drying facility. The ditch adjacent to these buildings received metals and SVOC contaminants from past industrial activities.

Selected Remedial Alternative(s)— Alternative S6 (Excavation/On-base Consolidation) is the selected remedial action for this site. Tables II-5-2A and II-5-2B present the soil cleanup levels for the chemicals of concern at the site. Alternative S5 (Excavation/Off-base Disposal) is the selected contingency remedial action for soil that exceeds the CAMU acceptance levels.

TABLE II-5-2A
Cleanup Levels for Surface Soil COCs and COECs at Buildings 929/931/940 (SD042)
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	Soil Cleanup Level (mg/kg) [a]	Residential (mg/kg) 10^{-6} Cancer Risk	Residential (mg/kg) Chronic HI=1	Industrial (mg/kg) 10^{-6} Cancer Risk	Industrial (mg/kg) Chronic HI=1	HQ=1 (mg/kg)	Potential for Groundwater Impact?
Benzo(a) pyrene	0.21	0.062	NA [b]	0.21	NA	59	No
Dibenz(a,h) anthracene	0.0092	0.062	NA	0.21	NA	0.0092	No
Benzo(b) fluoranthene	2.1	0.62	NA	2.1	NA	61	No
Indeno(1,2,3-c,d) pyrene	2.1	0.62	NA	2.1	NA	110	No
Fluoranthene	850	NA	2,300	NA	22,000	850	No
Barium	860 [c]	NA	5,400	NA	67,000	91	No
Cadmium	47	1,400	37	3,000	450	47	No
Total Chromium	450	210	NA	450	NA	2,900	No
Lead	380	NA	400	NA	750	380	No
Nickel	520	NA	1,600	NA	20,000	520	No
Zinc	6,900	NA	23,000	NA	100,000	6,900	No

a These cleanup levels apply to soil within a depth of 6 inches below ground surface (bgs) at Buildings 929/931/940.
b NA = Not Applicable
c The cleanup level for Barium is based on the WABOU maximum reference concentration. Section 5.2.8 (WABOU Reference Concentrations) addresses the derivation of this value.

If some of the excavated soil does not meet the CAMU acceptance criteria, the Air Force will determine whether the soil needs to be sent to an off-base landfill or whether a soil treatment can stabilize the contaminants sufficiently for placement in the CAMU. Alternative S4 (Excavation/Treatment/On-base Consolidation) is the selected contingency remedial action if it proves to be a cost-effective improvement over Alternative S5.

TABLE II-5-2B
Cleanup Levels for Subsurface Soil COCs and COECs at Buildings 929/931/940 (SD042)
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	Soil Cleanup Level (mg/kg) [d]	Residential (mg/kg)		Industrial (mg/kg)		HQ=1 (mg/kg)	Potential for Groundwater Impact?
		10^{-6} Cancer Risk	Chronic HI=1	10^{-6} Cancer Risk	Chronic HI=1		
Benzo(a) pyrene	59	0.062	NA [b]	0.21	NA	59	No
Dibenz(a,h) anthracene	0.0092	0.062	NA	0.21	NA	0.0092	No
Benzo(b) fluoranthene	61	0.62	NA	2.1	NA	61	No
Indeno(1,2,3-c,d) pyrene	110	0.62	NA	2.1	NA	110	No
Fluoranthene	850	NA	2,300	NA	22,000	850	No
Barium	860 [c]	NA	5,400	NA	67,000	91	No
Cadmium	47	1,400	37	3,000	450	47	No
Total Chromium	2,900	210	NA	450	NA	2,900	No
Lead	380	NA	400	NA	750	380	No
Nickel	520	NA	1,600	NA	20,000	520	No
Zinc	6,900	NA	23,000	NA	100,000	6,900	No

[d] These cleanup levels apply to soil greater than a depth of 6 inches below ground surface (bgs) at Buildings 929/931/940.

The basis for the selected alternative is the protection of ecological receptors. The Air Force will excavate soil contaminated with metals and SVOCs from the drainage ditch adjacent to Buildings 929/931/940 and transport it to the CAMU. The estimated volume of contaminated soil is approximately 295 cubic yards. The excavation may be backfilled with clean soil, depending on the volume of soil that is removed from the ditch. The estimated cost for Alternative S6 is $86,000; the estimated cost for Alternative S5 is $176,000, and the estimated cost for Alternative S4 is $197,600. This is the most cost-effective remedy that meets the remedial action objective of cleaning up the site to levels that are protective of individual burrowing owls and populations of other ecological receptors. Figure II-5-3 shows the areal extent of contamination and the approximate limits of excavation.

Alternative S2 (Land Use and Access Restrictions) is also a selected remedial action for the site. However, it will not be implemented if Alternative S6 achieves the residential cleanup values as presented in Tables II-5-2A and II-5-2B. Administrative controls will be sufficient to enforce this action, so no physical barriers (i.e., fences) will be necessary. The Travis AFB General Plan will document the presence of metals and SVOCs in the surface soil and enforce the restriction on residential land use, including day care center activities.

Protection of Human Health— Benzo(a)pyrene, , benzo(b)fluoranthene, cadmium, and dibenz(a,h)anthracene are the chemicals of concern for this site. The estimated excess life-time cancer risk for potential future worker exposure is 1 x 10^{-5} for surface soil, based on existing contaminant concentrations. The estimated hazard index for potential industrial

exposure is 0.4 for surface soil. Even though the basis of the selected remedial action is protection of ecological receptors, the cleanup levels will reduce the estimated excess lifetime cancer risk for potential future worker exposure. As described in section 5.2.2 (Risk Management), the soil cleanup levels for the top six inches of soil equate to a 10^{-6} risk level under industrial conditions. The subsurface soil contained no chemicals of concern, so the soil cleanup levels below six inches below ground surface equate to a hazard quotient of one for the burrowing owl, since this is the basis for conducting a remedial action at this site. Section 4.4.7 of the WABOU RI report presents the results of the human health risk assessment for this site.

Protection of Ecological Receptors— Barium, cadmium, chromium, lead, nickel, zinc, benzo(a)pyrene, dibenz(a,h)anthracene, fluoranthene, and indeno(1,2,3-c,d)pyrene are the chemicals of ecological concern for this site. Ecological risks were evaluated for plants, terrestrial invertebrates, deer mice (*Peromyscus maniculatus)*, ornate shrews (*Sorex ornatus*), western meadowlarks (*Sturnella neglecta*), and burrowing owls at this site. Sensitivity of the various receptors differed among the COECs identified at the site, with deer mice and shrews generally being most sensitive, especially to cadmium and benzo(a)pyrene exposure.

Cleanup levels were selected to protect individual burrowing owls and populations of the other ecological receptors. They took into account the assumption that an owl would feed consistently at the contaminated portion (less than 0.5 acres) of the site, even though it represents only about 0.2 percent of the typical foraging range for an owl. The evaluations conducted for other ecological receptors indicate that remediation of soil to the degree necessary for protection of the burrowing owl will be reasonably protective for plants, invertebrates, and common species of birds and mammals at the site. This is particularly true because the site represents a very small fraction of the similar habitat on-base and in the surrounding area, and the goal for other receptors is to protect populations rather than individuals of those receptors. When the combined consideration of LOECs or LOAELs for the common species, potentially limited use of on-site habitats by those receptors (as well as the burrowing owl), and the goal of protecting populations (rather than individuals) of the common species were taken into account, it was concluded that there will be no potential unacceptable ecological risk remaining at this site. The *Evaluation of Ecological Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001b) presents a more detailed description of this ecological evaluation.

Protection of Groundwater— The WABOU RI did not evaluate the presence of contaminants in the local groundwater, because the soil contaminant concentrations decreased significantly with depth. However, the Base collected and analyzed groundwater samples immediately downgradient of the highest surface soil concentrations to determine whether the chemicals of concern were present in the groundwater. The results of the groundwater analysis demonstrate that the current concentrations of the chemicals of concern in the soil do not have an adverse impact on the local groundwater. Therefore, the soil cleanup levels are also protective of groundwater beneficial use objectives. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum presents a more detailed description of this field investigation.

5.3.5 Landfill 3 (LF008)

Site Description— Landfill 3 consists of trenches used for the past disposal of pesticide containers.

Selected Remedial Alternative(s)— Alternative S5 (Excavation/Off-base Disposal) is the selected remedial action for this site. Tables II-5-3A and II-5-3B present the soil cleanup levels for the chemicals of concern at the site. Alternative S6 (Excavation/On-base Consolidation) is the selected contingency remedial action for soil that does not exceed the CAMU acceptance levels. Alternative S2 (Land Use and Access Restrictions) is also a selected remedial action for the site. However, it will not be implemented if Alternative S5 achieves the residential cleanup values as presented in Tables II-5-3A and II-5-3B. The Travis AFB General Plan will document the presence of pesticides in the soil and enforce the land use restrictions, including the prohibition on day care center activities.

TABLE II-5-3A
Cleanup Levels for Surface Soil COCs and COECs at Landfill 3 (LF008)
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	Soil Cleanup Level (mg/kg) [a]	Residential (mg/kg)		Industrial (mg/kg)		HQ=1 (mg/kg)	Potential for Groundwater Impact?
		10^{-6} Cancer Risk	Chronic HI=1	10^{-6} Cancer Risk	Chronic HI=1		
chlordane	0.9	1.6	35	6.5	670	0.9	No
dieldrin	0.11	0.03	3.1	0.11	44	0.29	No
endosulfan	7.5	NA	370	NA	3,700	7.5	No
heptachlor	0.38	0.11	31	0.38	440	0.97	No
heptachlor epoxide	0.037	0.053	0.79	0.19	11	0.037	No
methoxychlor	3,100	NA	310	NA	3,100	5,300	No

[a] These cleanup levels apply to soil within a depth of 4 feet below ground surface (bgs) at Landfill 3.

TABLE II-5-3B
Cleanup Levels for Subsurface Soil COCs and COECs at Landfill 3 (LF008)
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	Soil Cleanup Level (mg/kg) [b]	Residential (mg/kg)		Industrial (mg/kg)		HQ=1 (mg/kg)	Potential for Groundwater Impact?
		10^{-6} Cancer Risk	Chronic HI=1	10^{-5} Cancer Risk	Chronic HI=1		
chlordane	65	1.6	35	65	670	NA	Yes [c]
dieldrin	1.1	0.03	3.1	1.1	44	NA	Yes
endosulfan	3,700	NA	370	NA	3,700	NA	No
heptachlor	3.8	0.11	31	3.8	440	NA	Yes
heptachlor epoxide	1.9	0.053	0.79	1.9	11	NA	Yes
methoxychlor	3,100	NA	310	NA	3,100	NA	No

[b] These cleanup levels apply to soil greater than a depth of 4 feet bgs at Landfill 3.

[c] The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum describes the confirmatory analyses for verification that the cleanup level for this compound is protective of groundwater beneficial use objectives.

NA = Not Applicable

The rationale for this selection is that there may be intact containers of liquid pesticides in the trenches at Landfill 3. If these containers were to break during excavation and transport to the CAMU, the contents would potentially be incompatible with other CAMU waste. The liquid pesticides could also percolate through the soil and have an impact on groundwater beneath the CAMU. The containers and contaminated soil present a potential risk to human health but does not present a risk to ecological receptors, based on the depth at which the contamination is found.

The Air Force will begin the remedial action by excavating the soil above the trenches. Any contaminated portion of this soil will be placed into the CAMU only if it meets the established CAMU acceptance levels. Then the Air Force will remove the containers and highly pesticide-contaminated soil and transport them to an appropriate offsite disposal facility. The excavation and transport of contaminated soil to either the CAMU or to the offsite facility (depending on the ability of the soil to meet CAMU acceptance levels) will continue until the cleanup levels are achieved or a maximum depth of 15 feet is reached. This is the depth that a typical excavator can reach. At this point, the excavation will stop, and the pit will be backfilled with clean soil. Since this soil remedial action will remove most of the source of the groundwater contamination from the subsurface, the Air Force will then rely on the existing groundwater extraction and treatment system to contain and remove the residual contaminants from the site.

The total estimated volume of contaminated soil is 11,110 cubic yards. The estimated cost of this action is $4,162,000, based on the off-base disposal of the entire estimated soil volume. The placement of soil into the CAMU as described above will reduce the overall cost of this remedial action and still allow Travis AFB to meet the remedial action objective of removing as much of the soil contaminants as needed to improve the effectiveness of the existing groundwater extraction and treatment remedy at this site. Figure II-5-4 shows the areal extent of contamination and the approximate limits of excavation.

Table II-5-3A presents the LF008 cleanup levels for the soil within a depth of 4 feet below ground surface (bgs). The 0 to 4 foot depth is the reasonable limit of potential exposure to contaminants by burrowing animals and most plant roots, so the cleanup levels in Table II-5-3A take into account the protection of ecological receptors. Table II-5-3B presents the LF008 cleanup levels for the soil greater than 4 feet bgs. Since there is a negligible exposure pathway between ecological receptors and contaminants from soil that exceeds the 4-foot depth, the cleanup levels in Table II-5-3B do not use the ecological protection values in their calculations.

Specific site conditions provide the basis for any departure from the 10^{-6} cancer risk value. A review of these risk-reducing site conditions was part of the determination of whether a site warrants a departure from the starting point. When applying these factors to a specific site, the qualitative and quantitative value of the factors present justifies and supports departure from the 10^{-6} limit toward the protective and authorized 10^{-4} limit. Table II-5-3C presents the mitigating factors that are present at LF008. An excess lifetime cancer risk level for future industrial exposure of 1×10^{-5} is justified, because the presence of these mitigating factors greatly diminishes the time an industrial worker spends on-site and the resulting potential industrial exposure to the contaminated soil beneath buried waste. This time-spent-on-site is far below the assumed exposure time used to calculate industrial risk. Present and future exposure is minimal due to site conditions and the low level of industrial activity at the site.

TABLE II-5-3C
Specific Factors Justifying Departure from 10^{-6} Risk Level for Landfill 3 (LF008)
WABOU Soil ROD
Travis AFB, California

No.	Description	Rationale
1	Installation Boundary Fence	A boundary fence surrounds Travis AFB. This fence limits Base access to personnel who reside, work or conduct business at Travis AFB. Personnel can only enter the installation through four manned gates.
2	Site Fence	Landfill 3 has an additional fence to allow site access to authorized personnel only. The activities at this site are sensitive in nature and require a greater level of control over property use. LF008 is enclosed in the fence that protects A bunker, an ammunition storage facility.
3	Clear Zones	Landfill 3 is located in restricted explosive safety, quantity-distance clear zones due to its proximity to ammunition storage and handling facilities. The Wing Safety Office closely monitors the land use within a safety clear zone and restricts its use to activities that involve a maximum of 25 persons at one time. For example, office building construction does not take place inside clear zones. In essence, the explosive safety clear zone is a restricted area for industrial and construction activities. Permitted activities within the zone, such as landscape maintenance, are not routine and of short duration.
4	Noise Level Restrictions	The area surrounding the runways at Travis AFB is called the Air Installation Compatible Use Zone (AICUZ). The dimensions of the noise contours within the zone are based on the level of noise that is generated by aircraft operations. High noise levels can have an adverse effect on personnel, so the Base discourages development in areas within this zone both on- and off-base.
5	Security Forces	Security forces regularly patrol Travis AFB for unauthorized activities. This monitoring enforces the land use restrictions that are in place.
6	Escort Requirements	Certain portions of the installation are official restricted areas and require a qualified Base escort to obtain site access. Taxiways and ammunition storage and handling areas are examples of restricted areas. Site access is limited to individuals with a specific need to enter. This consideration applies to LF008, which is located in an ammunition storage facility. A Base representative trained in ammunition safety must escort personnel who enter this facility. This factor decreases worker time on-site compared to the standard assumption for time on-site and the resulting potential exposure.
7	Segregation of Residential/ Industrial Areas	Residential housing areas at Travis AFB are physically separate and geographically remote from all WABOU sites. The closest site, LF008, is approximately 2/3 mile from a residential complex.
8	Transient Work Force	The majority of workers at Travis AFB are transient military members, thereby limiting their period of potential exposure. All Travis AFB residents are military members and their dependents. Due to the frequency of transfers, the average length of assignment to Travis AFB is approximately three years, which limits their potential lifetime exposure.

Protection of Human Health—Chlordane, dieldrin, heptachlor, and heptachlor epoxide are the chemicals of concern for this site. The estimated excess lifetime cancer risk for potential future industrial exposure to surface soil is 5×10^{-6} and to subsurface soil is 2×10^{-4}, based on existing contaminant concentrations. The estimated hazard index for potential industrial exposure is 3 for subsurface soil.

Protection of Ecological Receptors—Chlordane, dieldrin, endosulfan, heptachlor epoxide, and methoxychlor are the chemicals of ecological concern at this site. Ecological risks were evaluated for plants, terrestrial invertebrates, deer mice, ornate shrews, western meadowlarks, and burrowing owls at this site. Sensitivity of the various receptors differed

among the pesticides identified at the site, with birds generally being more sensitive than the mammals.

Cleanup levels were selected to protect individual burrowing owls and populations of the other ecological receptors. They took into account the assumption that an owl would feed consistently at the contaminated portion (about 0.7 acre) of this site, even though it represents about 0.2 percent of the typical foraging range for an owl. The evaluations conducted for other ecological receptors indicate that remediation of soil to the degree necessary for protection of the burrowing owl will be reasonably protective for plants, invertebrates, and common species of birds and mammals at the site. This is particularly true because the site represents a very small fraction of the similar habitat on-base and in the surrounding area, and the goal for other receptors is to protect populations rather than individuals of those receptors. When the combined consideration of LOECs or LOAELs for the common species, potentially limited use of on-site habitats by those receptors (as well as burrowing owls), and the goal of protecting populations (rather than individuals) of the common species were taken into account, it was concluded that populations of those species would not be affected by any potential impacts attributable to COECs remaining at this site. The *Evaluation of Ecological Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001b) presents a more detailed description of this ecological evaluation.

Protection of Groundwater—The local groundwater contains chlordane, heptachlor and heptachlor epoxide; a separate groundwater remedial action will treat this contaminated groundwater in accordance with the *Groundwater Interim Record of Decision for the WABOU* (Travis AFB, 1999). Although the pesticides do not readily dissolve in groundwater, the buried waste may be acting as a potential source of groundwater contamination.

Two of the soil COCs, methoxychlor and endosulfan, are not groundwater COCs, so the current concentrations of these compounds are protective of groundwater beneficial use objectives.

The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum describes the field analysis that was used to calculate contaminant concentrations in the soil that are protective of groundwater beneficial use objectives. Groundwater monitoring associated with the groundwater remedial action will verify the effectiveness of the soil and groundwater remedial actions at the site.

5.3.6 Landfill X (LF044)

Site Description—Landfill X is located in an area used as a stockpile for construction debris, such as concrete and asphalt, and a heavy equipment training area.

Selected Remedial Alternative(s)—Alternative S2 (Land Use and Access Restrictions) is the selected remedial alternative for this site. Landfill X is not actually a landfill, but rather it is in an area used by the Base to train heavy equipment operators and to stockpile construction materials, such as asphalt and concrete. The metals and SVOCs found in the soil are constituents of these construction materials. The Air Force will install a fence around the contaminated area and the training and stockpile area. It is protective of human health, in that it will restrict personnel access to the site but will still allow the area to meet worker safety training and construction needs. Workers involved with safety training use adequate

noise and breathing protection equipment, when needed, in accordance with Occupational Safety and Health Administration (OSHA) regulations. Protective berms constructed within the fenced area will provide environmental protection by preventing soil contaminants from flowing during rain events into nearby vernal pools. The estimated cost of this action is $139,000. Figure II-5-5 shows the areal extent of contamination and the proposed fence location. Table II-5-4 presents a comparison of the chemical concentrations in the soil with potential risk criteria.

TABLE II-5-4
Comparison of Soil COCs and COECs at Landfill X (LF044) to Potential Risk Criteria
WABOU Soil ROD
Travis AFB, California

		Residential (mg/kg)		Industrial (mg/kg)			
Chemical of Concern	Average Concentration (mg/kg) [a]	10^{-6} Cancer Risk	Chronic HI=1	10^{-6} Cancer Risk	Chronic HI=1	HQ=1 [b] (mg/kg)	Potential for Groundwater Impact?
Cadmium	0.704	1,400	37	3,000	450	47	No
Lead	16.94	NA	400	NA	750	380	No
Silver	0.686	NA	390	NA	5,100	230	No
Acenaphthene	0.205	NA	3,700	NA	29,000	1,200	No
Anthracene	0.494	NA	22,000	NA	100,000	5,100	No
Benzo(a) anthracene	2.09	0.62	NA	2.1	NA	3.1	No
Benzo(a) pyrene	2.67	0.062	NA	0.21	NA	59	No
Benzo(b) fluoranthene	2.16	0.62	NA	2.1	NA	61	No
Benzo(g,h,I) perylene	1.35	NA	56	NA	190	NA	No
Benzo(k) fluoranthene	2.39	6.2	NA	21	NA	110	No
Bis(2-ethylhexyl) phthalate	42.48	35	1,200	180	18,000	15,000	No
Chrysene	2.60	62	NA	210	NA	150	No
Dibenz(a,h) anthracene	0.652	0.062	NA	0.21	NA	0.0092	No
Fluoranthene	4.44	NA	2,300	NA	22,000	850	No
Indeno(1,2,3-cd) pyrene	1.47	0.62	NA	2.1	NA	110	No
Phenanthrene	1.79	NA	56	NA	190	510	No
Pyrene	3.84	NA	2,300	NA	29,000	850	No

[a] mg/kg = milligrams per kilogram

[b] Based on the protection of the burrowing owl

[c] NA = Not Applicable

The objective of this remedial action is to document the location of the contaminants and apply land use controls to prevent the site from being used for residential purposes. This is the most cost-effective remedy available, as shown in Table II-4-6 (Relative Performance of Soil Alternatives – by Cost). Also, the selection of an active remedial action would still not

allow the site to be used for residential purposes, primarily due to its location within an existing explosive safety clear zone associated with a nearby ammunition handling facility.

The Travis AFB General Plan will describe all land use controls associated with the site, which will include compliance with any applicable personnel notification or other OSHA regulations that pertain to personnel access to the site.

If the Air Force decides to close the site in the future, a follow-on remedial action will be selected, based on the nature of the revised future land use. Until that time, the Travis AFB General Plan will restrict use of this site to industrial use with protective clothing.

Protection of Human Health— Benzo(a)pyrene, benzo(a)anthracene, dibenz(a,h)anthracene, and benzo(k)fluoranthene are the chemicals of concern at this site. The estimated excess lifetime cancer risk for potential future worker exposure is 2×10^{-5} for both surface and subsurface soil, based on existing contaminant concentrations, which is within the risk management range for carcinogens. The estimated hazard index for potential industrial exposure is 0.007 for subsurface soil. The chemicals are attributed to the asphalt and concrete that is stockpiled in the area. This is an active industrial facility, and all site workers wear appropriate personal protection equipment in accordance with OSHA regulations. Also, the area investigated during the WABOU RI is located in a little-used portion of the facility, so the potential exposure of chemicals to the site workers is low. Therefore, the selected remedial alternative is protective of the site workers.

Protection of Ecological Receptors— Benzo(a)pyrene, benzo(a)anthracene, dibenz(a,h)anthracene, fluoranthene, benzo(k)fluoranthene, pyrene, benzo(g,h,I)perylene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, indeno(1,2,3-c,d)pyrene, phenanthrene, cadmium, lead, silver, acenaphthene, and anthracene are the chemicals of ecological concern at this site. Ecological risks were evaluated for plants, terrestrial invertebrates, deer mice, ornate shrews, western meadowlarks, and burrowing owls at this site. Sensitivity of the various receptors differed among the three metals, a phthalate, and 13 polyaromatic hydrocarbons (PAH) identified at the site, with birds and mammals generally being about equally sensitive. Exceptions were mainly cadmium and benzo(a)pyrene, to which the mammals were more sensitive. Plants and terrestrial invertebrates are considered most sensitive to bis(2-ethylhexyl)phthalate, which was found in the subsurface soil at the site.

Concentrations of COECs in surface soils are substantially lower than those in subsurface soils (which are less likely than surface soils to be an exposure source for most species). The only HQ that was very high for the burrowing owl was for dibenz(a,h)anthracene. There is considerable uncertainty associated with that HQ, because it was based on results of a study with mammals that were extrapolated to birds. Based on the results of a feeding study with mallards (*Anas platyrhynchos*) reported by Patton and Dieter (1980), the NOAEL-based acceptable level (i.e., the CTV) for dibenz(a,h)anthracene in the soil is 877 mg/kg. This indicates that this COEC realistically should pose minimal risk to the burrowing owl at this site.

This site is actively used by the Air Force as a heavy equipment training area. Ongoing site activities frequently alter the terrain as mounds of excavated soil and concrete rubble are moved during the training activities. The frequent site activities would routinely displace wildlife and make it unlikely that they would be able to permanently establish a residence.

This disturbance causes much of the site to provide sub-optimal habitat for wildlife. Birds and mammals are more likely to only occasionally use the site, preferring to use the less disturbed surrounding areas that provide higher-quality habitat.

The contaminated portion of this site is less than 7 acres, which represents less than 2 percent of the typical foraging range for a burrowing owl. When the combined consideration of LOECs or LOAELs for the common species, potentially limited use of on-site habitats by those receptors (as well as burrowing owls) due to the nature of site activities and the small size of the site compared to typical home ranges, and the goal of protecting populations (rather than individuals) of the common species were taken into account, it was concluded that populations of those species would not be affected by any potential impacts attributable to COECs at this site. This is particularly true because the site represents a very small fraction of the similar habitat on-base and in the surrounding area, and the goal for other receptors is to protect populations rather than individuals of those receptors. The *Evaluation of Ecological Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001b) presents a more detailed description of this ecological evaluation.

Protection of Groundwater—The WABOU RI concluded that there are no groundwater COCs at this site. Therefore, the current concentrations of chemicals found in the soil are protective of groundwater beneficial use objectives. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum presents a more detailed discussion of the groundwater investigation conducted during the WABOU RI.

5.3.7 Former Small Arms Range (SD045)

Site Description—This site was a former small arms training facility. Reduction of potential adverse human health and ecological impacts is the basis for establishing cleanup levels.

Selected Remedial Alternative(s)—Alternative S6 (Excavation/On-base Consolidation) is the selected remedial action for this site. Table II-5-5 presents the soil cleanup levels for the chemicals of concern at the site. Alternative S5 (Excavation/Off-base Disposal) is the selected contingency remedial action for soil that exceeds the CAMU acceptance levels.

If a portion of the excavated soil does not meet the CAMU acceptance criteria, the Air Force will determine whether the soil needs to be sent to an off-base landfill or whether a soil treatment can stabilize the contaminants sufficiently for placement in the CAMU. Alternative S4 (Excavation/ Treatment/On-base Consolidation) is the selected contingency remedial action if it proves to be a cost-effective improvement over Alternative S5.

Alternative S2 (Land Use and Access Restrictions) is also a selected remedial action for the site. However, it will not be implemented if Alternative S6 achieves the residential cleanup values as presented in Table II-5-5. Administrative controls will be sufficient to enforce the restriction, so no physical barriers (i.e., fences) will be necessary. The Travis AFB General Plan will document the presence of lead in the soil and enforce the restriction on residential land use, including day care center activities and for playground and other play activities.

TABLE II-5-5
Cleanup Levels for Soil COCs and COECs at the Former Small Arms Range (SD045)
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	Soil Cleanup Level (mg/kg) [a]	Residential (mg/kg)		Industrial (mg/kg)		HQ=1 (mg/kg)	Potential for Groundwater Impact?
		10^{-6} Cancer Risk	Chronic HI=1	10^{-6} Cancer Risk	Chronic HI=1		
Antimony	6	NA	31	NA	410	0.54	No
Copper	250	NA	3,100	NA	41,000	1,400	No
Lead	1,000	NA	400	NA	750	380	No

NA = Not Applicable

[a] The rationale for the selection of soil cleanup levels for this site is presented in the Remedial Action Plan for the Former Small Arms Range SAR1 (Parsons ES, 2000). Section 5.2.7 (Former Small Arms Range Remedial Action Plan) presents a summary of the Remedial Action Plan.

Surface soil within a former small arms range contains lead residue from past small arms training activities. The estimated volume of contaminated soil is approximately 5,755 cubic yards. The Air Force will excavate lead-contaminated soil and transport it to the CAMU. The excavation will be backfilled with clean soil. The estimated cost for Alternative S6 is $186,000; the estimated cost for Alternative S5 is $2,255,000, and the estimated cost for Alternative S4 is $833,000. This is the most cost-effective remedy that meets the remedial action objective of cleaning up the site to levels that allow for industrial use and are protective of individual burrowing owls and populations of other ecological receptors that can live within a grazing management unit. Figure II-5-6 shows the areal extent of contamination and the approximate limits of excavation.

Protection of Human Health— Lead is the chemical of concern at this site. There is no estimated excess lifetime cancer risk; however, lead is regulated based on developmental toxicity. The estimated hazard index for industrial exposure to surface soil is 0.2, and the estimated blood lead level for lead exposure in surface soil is 19 µg/dL and in subsurface soil is 52 µg/dL, based on existing contaminant concentrations. Both values exceed the threshold value of 10 µg/dL. The remedial action will reduce the lead concentrations in the soil to a protective level. The *Remedial Action Plan for the Former Small Arms Range (SAR1), Travis AFB, California* (Parsons, 2000) presents the risk calculations that demonstrate the protectiveness of the cleanup levels under site-specific conditions to human health.

Protection of Ecological Receptors— Antimony, copper, and lead are the chemicals of ecological concern at this site. Ecological risks were evaluated for plants, terrestrial invertebrates, deer mice, ornate shrews, western meadowlarks, and burrowing owls at this site. Birds and mammals were identified as the most sensitive receptors for antimony and lead, based on NOECs/NOAELs. Plants were the most sensitive receptors for copper.

Cattle graze on the site under the Base's lease program and, in addition, portions are disked as part of the Base's fire control program. The combined effects of grazing and disking make the site suboptimal habitat for most avian and mammalian wildlife.

Two other factors influenced the derivation of cleanup levels for lead. The first factor was the small size of the site (3.8 acres) compared to the foraging range for a burrowing owl. The original ERA (CH2M HILL, 1997) assumed that an owl (as well as other avian and mammalian receptors) would forage consistently on-site, but the site represents only about 1 percent of the expected foraging range for a burrowing owl. The second factor was the relative bioavailability of lead at this site (Parsons, 2000). Further study (Parsons, 2000) was conducted at the site toward development of risk-based remediation goals for the COECs identified in the ERA. In this study, the previously developed preliminary cleanup goals for the site were revised based on additional ecological and contaminant characterization data. Relative in-vitro bioavailability of lead in soil from the site ranged from 75 to 96 percent, with an average of 85.2 percent. This bioavailability fraction and an assumed absorbable fraction of 50 percent were used to derive a lower site-specific BAF of 43 percent for lead, in contrast to the assumed 100 percent during the ERA. Due to a lack of site-specific information on the bioavailability of antimony and copper, the default value of 100-percent bioavailability was retained for those metals. The ecological input to the cleanup levels reflect the results of the studies conducted at this site. They provide a substantial margin of safety for exposures of the burrowing owl to metals at the site. The *Remedial Action Plan for the Former Small Arms Range (SAR1), Travis AFB, California* (Parsons, 2000) presents the rationale for demonstrating the protectiveness of the soil cleanup levels under site-specific conditions to ecological receptors. Section 5.2.7 (Former Small Arms Range Remedial Action Plan) describes the subsequent Parsons study in more detail.

Excavation of soil to the degree necessary for protection of the burrowing owl will be reasonably protective for populations of other ecological receptors at the site. When the combined consideration of LOECs or LOAELs for the common species, potentially limited use of on-site habitats by those receptors (as well as the burrowing owl), and the goal of protecting populations (rather than individuals) of the common species were taken into account, it was concluded that there will be no potential unacceptable ecological risk remaining at this site. This is particularly true because the site is small in relation to the amount of available similar habitat on-base and in the surrounding region, and any residual contamination will not adversely impact populations of these species. The *Evaluation of Ecological Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001b) presents a more detailed description of this ecological evaluation.

Protection of Groundwater— The WABOU RI did not evaluate the presence of contaminants in the local groundwater, because the soil contaminant concentrations decreased significantly with depth. However, the Base collected and analyzed groundwater samples immediately downgradient of the highest surface soil concentrations to determine whether the chemicals of concern were present in the groundwater. The results of the groundwater analysis demonstrate that the current concentrations of the chemicals of concern in the soil do not have an adverse impact on the local groundwater. Therefore, the soil cleanup levels are also protective of groundwater beneficial use objectives. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum presents a more detailed description of this field investigation.

5.3.8 Railhead Munitions Staging Area (SS046)

Site Description— This site consists of a railroad track and concrete pad that formerly served as a railhead for a spur off the Northern Sacramento Railroad line.

Selected Remedial Alternative(s)— Alternative S2 (Land Use and Access Restrictions) is the selected remedial action for this site. The objective of this remedial action is to document the location of the contaminants and apply land use controls to prevent the site from being used for residential purposes. This is the most cost effective remedy available, as shown in Table II-4-6 (Relative Performance of Soil Alternatives – by Cost). Administrative controls will be sufficient to enforce the restriction, because the site is located within the explosive safety clear zones that surround an adjacent ammunition storage facility (A Bunker) and Building 759 (Ammunition Maintenance). The clear zones already restrict property use and new construction at SS046. Therefore, physical barriers (i.e., fences) would provide no additional protection and will not be necessary. The Travis AFB General Plan will document the presence of chemicals and enforce the land use restriction at this site.

Section 5.8.2 [Railhead Munitions Staging Area (SS046)] describes the change that was made to the original selected remedial action for this site. Table II-5-6 presents a comparison of the chemical concentrations in the soil with potential risk criteria.

TABLE II-5-6
Comparison of Soil COCs and COECs at the Railhead Munitions Staging Area (SS046) to Potential Risk Criteria
WABOU Soil ROD
Travis AFB, California

		Residential (mg/kg)		Industrial (mg/kg)			
Chemical of Concern	Average Concentration (mg/kg) [a]	10^{-6} Cancer Risk	Chronic HI=1	10^{-6} Cancer Risk	Chronic HI=1	HQ=1 [b] (mg/kg)	Potential for Groundwater Impact?
Benzo(a) pyrene	0.126	0.062	NA	0.21	NA	59	No
Benzo(b) fluoranthene	0.431	0.62	NA	2.1	NA	61	No
Benzo(a) anthracene	0.404	0.62	NA	2.1	NA	3.1	No
Benzo(k) fluoranthene	0.429	6.2	NA	21	NA	110	No
Fluoranthene	2.24	NA	2,300	NA	22,000	850	No
Pentachlorophenol	0.664	3.0	1,400	9	14,000	1.2	No
Phenanthrene	1.20	NA	56	NA	190	510	No
Pyrene	1.69	NA	2,300	NA	29,000	850	No
Cadmium	4.23	1,400	37	3,000	450	47	No
Lead	112.41	NA	400	NA	750	380	No

[a] mg/kg = milligrams per kilogram

[b] Based on the protection of the burrowing owl

[c] NA = Not Applicable

Protection of Human Health— Benzo(a)pyrene, benzo(B)fluoranthene, benzo(a)anthracene, and benzo(k)fluoranthene are the chemicals of concern at this site. The estimated excess lifetime cancer risk for potential future worker exposure is 1×10^{-5} for surface soil, based on existing contaminant concentrations, which is within the risk management range for

carcinogens. The estimated hazard index for potential industrial exposure is 0.03 for surface soil. Since the chemicals are located beneath the railroad tracks adjacent to the concrete pad, there is a low probability of exposure to future workers. Therefore, the selected remedial alternative is protective of human health.

Protection of Ecological Receptors—Cadmium, lead, benzo(a)pyrene, benzo(k)fluoranthene, fluoranthene, pentachlorophenol phenanthrene, and pyrene are the chemicals of ecological concern for this site. Ecological risks were evaluated for plants, terrestrial invertebrates, deer mice, ornate shrews, western meadowlarks, and burrowing owls at this site. HQs for birds were less than ten for all chemicals, but those for cadmium and benzo(a)pyrene in mammals were higher. Plants were considered the most sensitive receptors for pentachlorophenol.

The contaminated portion of the site is about 0.07 acre, which represents less than 0.02 percent of the typical foraging range for a burrowing owl. When the combined consideration of LOECs or LOAELs for the common species, potentially limited use of on-site habitats by those receptors (as well as the burrowing owl), and the goal of protecting populations (rather than individuals) of the common species were taken into account, it was concluded that there is no potential unacceptable ecological risk at this site. This is particularly true, because the site is small in relation to the amount of available similar habitat on-base and in the surrounding region, and the COECs will not adversely affect populations of these species. The *Evaluation of Ecological Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001b) presents a more detailed description of this ecological evaluation.

Protection of Groundwater—The WABOU RI concluded that there are no groundwater COCs at this site. Therefore, the current concentrations of chemicals found in the soil are protective of groundwater beneficial use objectives. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum presents a more detailed discussion of the groundwater investigation conducted during the WABOU RI.

5.3.9 Cypress Lakes Golf Course (SS041)

Site Description—The maintenance yard of the Cypress Lakes Golf Course contains an administrative building, garages, and storage areas. The equipment in the maintenance yard is used for pesticide application and landscaping activities at the golf course.

Selected Remedial Alternative(s)—No further action is required at the Cypress Lakes Golf Course, because Alternative S5 (Excavation/Off-base Disposal) was completed in January 2001 as a removal action. Table II-5-7 presents the soil cleanup levels that the removal action had to achieve at the site. Environmental Chemical Corporation (ECC) excavated approximately 160 cubic yards of pesticide-contaminated soil and transported it to Kettleman Hills landfill for disposal. Section 2.2.3 (Removal Actions) provides a description of the removal action in the maintenance yard. The *Cypress Lakes Golf Course Annex Removal Action Report* (ECC, 2001) describes the successful implementation of Alternative S5. This report concluded that the removal action achieved the targeted cleanup levels as presented in the *Work Plan for the Removal Action at the Cypress Lakes Golf Course Annex* (ECC, 2000). Since the targeted cleanup levels are identical to the soil cleanup levels in Table II-5-7, the

removal action meets the requirements of the Alternative S5 remedial action. The DI WET analyses that were performed during the removal action demonstrated that the residual pesticide concentrations are protective of groundwater beneficial use objectives. Figure II-5-7 shows the extent of the actual excavated area.

TABLE II-5-7
Cleanup Levels for Soil COCs and COECs at the Cypress Lakes Golf Course (SS041)
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	Soil Cleanup Level (mg/kg)	Residential (mg/kg)		Industrial (mg/kg)		HQ=1 (mg/kg)	Potential for Groundwater Impact?
		10^{-6} Cancer Risk	Chronic HI=1	10^{-6} Cancer Risk	Chronic HI=1		
chlordane	1.45	1.6	35	6.5	670	1.45	No
DDE	7.0	1.7	NA	7.0	NA	7.8	No
DDT	3.4	1.7	36	7.0	730	3.4	No
dieldrin	0.11 [a]	0.03	3.1	0.11	44	0.29	Yes [b]
endosulfan	7.5	NA [c]	370	NA	3,700	7.5	No

[a] This cleanup level for dieldrin applies to soil within a depth of 6 inches below ground surface (bgs) at the Cypress Lakes Golf Course. A cleanup level of 0.29 mg/kg for dieldrin (associated with a hazard quotient of 1) applies to soil in excess of a depth of 6 inches bgs at this site.

[b] The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum describes the confirmatory analyses for verification that the cleanup level for this compound is protective of groundwater beneficial use objectives.

c NA = Not Applicable

The report also concluded that the removal action achieved the residential cleanup levels that are presented in Table II-5-7. As a result, the Cypress Lakes Golf Course Annex is clear for unrestricted land use, and the Air Force does not need to select Alternative S2 (Land Use and Access Restrictions) for this site. This annex requires no further action and is considered a closed site.

Protection of Human Health—Dieldrin and DDE were the chemicals of concern at this site prior to the removal action. The estimated excess lifetime cancer risk for potential future worker exposure to surface soil was 6×10^{-6}. The estimated hazard index for potential industrial exposure was 0.03 for surface soil. The selected remedial action reduced the potential risk posed by these chemicals to a protective level.

Protection of Ecological Receptors—Chlordane, DDE, DDT, dieldrin, and endosulfan were the chemicals of ecological concern at this site prior to the removal action. Ecological risks were evaluated for plants, terrestrial invertebrates, deer mice, ornate shrews, American robins (*Turdus migratorius)*, western meadowlarks, and burrowing owls at this site. All of the pesticide HQs for birds and mammals were less than five. HQs for plants and invertebrates were higher, especially for invertebrate exposure to endosulfan.

Excavation of soil to the degree necessary for protection of the burrowing owl is reasonably protective for populations of other ecological receptors at the site. When the combined consideration of LOECs or LOAELs for the common species, potentially limited use of on-site habitats by those receptors (as well as the burrowing owl), and the goal of protecting populations (rather than individuals) of the common species were taken into account, it was

concluded that there is no unacceptable risk remaining at this site. This is particularly true because the site is small in relation to the amount of available similar habitat on-base and in the surrounding region, and any residual (post-remediation) contamination will not adversely impact populations of these species.

Cleanup levels were selected to protect individual burrowing owls and populations of other ecological receptors. They took into account the assumption that an owl would feed consistently at the contaminated portion (about 0.1 acres) of the site, even though it represents less than 0.03 percent of the typical foraging range for an owl. The evaluations conducted for other ecological receptors indicated that remediation of soil to the degree necessary for protection of the burrowing owl would be reasonably protective for plants, invertebrates, and common species of birds and mammals at the site. This is particularly true because the site represents a very small fraction of the similar habitat on-base and in the surrounding area, and the goal for other receptors is to protect populations rather than individuals of those receptors. When the combined consideration of LOECs or LOAELs for the common species, potentially limited use of on-site habitats by those receptors (as well as burrowing owls), and the goal of protecting populations (rather than individuals) of the common species were taken into account, it was concluded that populations of those species would not be affected by any potential impacts attributable to COECs remaining at this site. The *Evaluation of Ecological Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001b) presents a more detailed description of this ecological evaluation.

Protection of Groundwater— The WABOU RI detected dieldrin in one unfiltered hydropunch sample that was attributed to an artifact associated with sediment carry-over introduced during sampling. A subsequent filtered sample immediately downgradient of the highest dieldrin concentration detected in the soil had a lower detection. An evaluation of this data concluded that the soil cleanup levels are protective of groundwater beneficial use objectives. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum presents a more detailed description of this field investigation.

5.3.10 Radioactive Burial Site 2/Dry Waste Landfill (RW013)

Site Description— This fenced burial site is a single trench that contains low-level radioactive waste from former nuclear weapons maintenance.

Selected Remedial Alternative(s)— Alternative S5 (Excavation/Off-base Disposal) is the selected remedy for this site. Table II-5-8 presents the soil cleanup levels for the chemicals of concern at the site. The Air Force will excavate the waste and soil and transport them in specially designed containers to an off-base low-level radioactive waste repository. The total estimated volume of excavated material is 60 cubic yards. The excavation will be backfilled with clean soil. The estimated cost of this action is $131,000. As shown in Table II-4-6 (Relative Performance of Soil Alternatives – by Cost), this is the most cost-effective remedy that meets the remedial action objective of cleaning up the site to levels that allow for

TABLE II-5-8
Cleanup Levels for Subsurface Soil COCs at Radioactive Burial Site 2 (RW013)
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	Soil Cleanup Level (pCi/g) [a]	Residential (pCi/g)		Industrial (pCi/g)		HQ=1 (pCi/g)	Potential for Groundwater Impact?
		10^{-5} Cancer Risk	Chronic HI=1	10^{-5} Cancer Risk	Chronic HI=1		
Uranium-234	690	180	NA	690	NA	NA	No
Uranium-235	8	2	NA	8	NA	NA	No

NA = Not Applicable

[a] The soil cleanup levels for U-234 and U-235 represent a 10^{-5} industrial cancer risk rather than the more conservative 10-6 industrial cancer risk values at other sites. Concentrations at the 10^{-6} level are below the practical quantitation limits for these compounds, using standard laboratory test equipment, which justifies the departure from the 10^{-6} level, as described in the Travis AFB e-mail, sent 21 December 2001 at 8:37 PM, titled "Resolution of the Soil Cleanup Levels Selection for RW013". Travis AFB and the regulatory agencies agree that the selected cleanup levels are protective, because they are within the 10^{-4} to 10^{-6} risk range as described in the National Contingency Plan. Also, there is no complete exposure pathway, because residual contaminants remaining at the bottom of the excavation will be buried below at least 6 feet of clean soil backfill. Land use controls will be implemented at the site if the residential cleanup levels are not achieved.

industrial use. Figure II-5-8 shows the areal extent of contamination and the approximate limits of excavation.

Alternative S2 (Land Use and Access Restrictions) is the selected remedial action for the site if Alternative S5 does not achieve the residential cleanup values as presented in Table II-5-8. The Travis AFB General Plan will document the presence of uranium in the subsurface soil and enforce the restriction on residential land use, including prohibiting day care center activities.

Protection of Human Health—Uranium-234 and Uranium-235 are the chemicals of concern at this site. The estimated excess lifetime cancer risk for potential future worker exposure to subsurface soil is 3×10^{-5}, based on existing contaminant concentrations. The buried waste does not pose a potential non-cancer risk. The remedial action will reduce the potential risk to future workers to a protective level.

Protection of Ecological Receptors—There are no chemicals of ecological concern at this site due to the burial depth (6 feet) of the waste materials. Therefore, the soil cleanup levels are protective of ecological receptors.

Protection of Groundwater—The WABOU RI detected no evidence of radiological or chemical contamination in the local groundwater, so the soil cleanup levels are protective of groundwater beneficial use objectives. The *Evaluation of Groundwater Protection for Remedial Actions in the WABOU Soil ROD* (CH2M HILL, 2001a) technical memorandum presents a more detailed discussion of the WABOU RI groundwater investigation.

5.4 Land Use Controls

Alternative S2 (Land Use and Access Restrictions) is included as all or part of the selected remedy at nine WABOU soil sites as described in Table I-1-4 and Section 5.1.1 (Alternative S2 – Land Use and Access Restrictions). Alternative S2 is required at the nine WABOU sites, because the selected remedial actions will clean up soil contamination to industrial cleanup levels but will allow for residual contamination to be left in place, which is greater than residential cleanup levels and therefore requires land use and access restrictions. If it is economically feasible, the Air Force may decide to clean up soil to the more conservative residential cleanup levels. If the Air Force does achieve residential cleanup levels at a site, then land use and access restrictions would not be necessary as discussed in Section 5.4.2 (Residential Cleanup Levels).

The soil remedial actions at five WABOU sites (LF008, RW013, SS041, SD042, and SD045) are required to meet industrial cleanup levels. At these five sites, Alternative S2 will also be implemented to address residual contamination above residential cleanup levels. At four sites (DP039, SD043, LF044, and SS046), no active remedial action is needed, because the contamination levels do not exceed industrial cleanup levels. However, Alternative S2 is required, because the contamination levels exceed residential cleanup levels. At one site (Cypress Lakes Golf Course Annex), the soil excavation that was performed as a removal action achieved residential cleanup levels, so Alternative S2 will not be applied there.

The remedial action objective of Alternative S2 for all nine sites is to restrict site access to prohibit residential use of the property, including use for day care, at sites where residential cleanup values are not attained. For sites where contaminated soil is not being excavated and backfilled with clean soil, an additional objective is to prevent surface-disturbing activities that could create a risk of human exposure inconsistent with the assumptions described herein. Separate controls are in place and enforced by the Air Force to prevent inappropriate soil and groundwater exposure at all Travis AFB IRP sites. The Air Force currently requires digging permits and other types of controls to restrict site access during the interim period before remedial actions are implemented.

Alternative S2 includes administrative and physical measures selected by the Air Force to restrict access and limit exposure to residual hazardous substances after remediation. These measures restrict future land use and ensure the effectiveness of the remedy at all nine sites. The Air Force will implement as performance measures at all sites with Land Use Controls the following:

-- Include in the Base General Plan any specific controls required at each site, that controls are required because of the presence of pollutants or contaminants, the current land users and uses of the site, the geographic control boundaries, and the objectives of the controls. Unless a site is cleaned up to levels appropriate for unrestricted use, the General Plan will reflect the applicable use restrictions, with all sites restricted from use for residential development, play areas, or day care facilities. Upon completion of a remedial action at a site, the Base will update the Base General Plan to include the site-specific use restrictions if needed. The section describing the specific controls will also refer the reader to the Base Environmental Office if more information is needed. The General Plan will contain a map indicating all areas where contaminated soil and groundwater are located, and what land use controls are in effect for each of those areas.

-- Notify the regulatory agencies of any Base proposals for a major land use change at a site inconsistent with the use restrictions and assumptions described herein, any anticipated action that may disrupt the effectiveness of the land use controls, any action that might alter or negate the need for the land use controls, or any anticipated transfer of the property subject to the land use controls.

-- Maintain existing administrative controls (e.g. dig permits as described in Section 5.4.1) while Land Use Controls are in place.

-- Conduct periodic monitoring (at least annually) and take prompt action to restore, repair or correct any Land Use Control deficiencies or failures identified. A different monitoring schedule may be agreed upon according to the schedule provisions of the FFA, if all parties agree and if the change reasonably reflects the risk presented by the site.

The Air Force is responsible for implementing (to the degree controls are not already in place), monitoring, maintaining, and enforcing the identified controls. If the Air Force determines that it cannot meet specific Land Use Control requirements, it is understood that the remedy may be reconsidered and that additional measures may be required to ensure the protection of human health and the environment.

In addition to the Land Use Controls described above for all sites, the following measures will be taken at some sites:

-- As mutually agreed among the RPMs for specific sites, display appropriate signs to warn site visitors of potential hazards associated with surface soil contamination.

-- At the five sites where the selected remedy involves soil excavation, the Air Force will backfill the excavation with clean soil, removing the potential exposure to surface soil contamination. These sites may have residual contamination at depth, so the digging permit process is designed to ensure that future industrial activities or construction projects either do not disturb the contaminated subsurface soil or that the Base takes other appropriate safety measures.

-- For Landfill X,

- Install a fence around the Landfill X area and the adjacent equipment training area.

- Build protective berms to prevent soil contamination from flowing during rain to nearby vernal pools.

- Comply with applicable OSHA regulations, including relevant worker notification, training, and protective measures.

In addition, to assure the regulatory agencies and the public that the Air Force will fully comply with and be accountable for the performance measures identified herein, it will timely submit to EPA and California an annual monitoring report on the status of LUCs and/or other remedial actions, including the operation and maintenance, and monitoring thereof, and how any LUC deficiencies or inconsistent uses have been addressed. The report will also be filed in the Information Repository (IR). The report would not be subject to approval and/or revision by EPA and the State.

5.4.1 Components of the Travis AFB General Plan and Existing Administrative Procedures

The first step in restricting specific types of development at a site is to revise the Travis AFB General Plan (GP) to place constraints ensuring that these sites are never used for specific tpes of land use such as residential development or day care facilities. The GP implements "zone-like" requirements at Travis AFB. Air Force installations require this comprehensive planning document for the establishment and maintenance of the institutional and engineering controls. The GP resides in the office of the Base community planner.

Travis AFB will revise several sections of the GP to establish the constraints against residential development of IRP sites. Section 5.2.2.4 (Installation Restoration Program Sites) and Section 5.4.1 (On Base Land Use) of the GP will receive the appropriate revisions needed to prohibit specific development of an IRP site. Figure 5-2B (Aboveground Storage Tanks, Underground Storage Tanks, IRP Areas, Test Wells, Air Emission Sources: Boilers, Air Emission Sources: Bulk Storage Tanks) will show the IRP sites at which specific development is prohibited. Travis AFB will enforce these constraints on specific development through administrative review procedures that are already in place.

One procedure is the Air Force Form 332 (AF332) (Base Civil Engineer Work Request). This form must be filed and approved before the start of any building project at Travis AFB. Appendix A includes a copy of this form. The approval of the AF332 involves the comparison of the building site with the constraints in the GP. The AF332 serves as the document for communicating any construction constraints to the appropriate offices. Any constraints at the site result in the disapproval of the form unless the requester makes appropriate modifications to the building plans. The Civil Engineer Squadron Chief of Operations is responsible for the final approval of building projects through the AF332 review process.

In addition to restricting specific development at IRP sites, the GP will restrict soil disturbances such as digging trenches for underground lines and excavating soil for building foundations. Travis will use 60 Air Mobility Wing Form 55 (Excavation Permit) to enforce these constraints against residential development. Appendix A includes a copy of this form. This form is also called the Base digging permit. The requester submits the permit to the Civil Engineer Squadron for any project that involves soil excavation of greater than three inches. The permit lists the environmental management and other support offices that review the excavation plans for approval. If constraints involving soil disturbance or worker safety exist at the excavation area, the permit describes the appropriate procedures that will prevent unknowing exposure to soil contamination as well as measures the workers must implement before the start of excavation. The Civil Engineer Squadron Chief of Operations is responsible for the final approval of excavation projects through the permit review process.

5.4.2 Residential Cleanup Levels

Residential cleanup levels are not legally enforceable cleanup standards under this WABOU Soil ROD but are goals that the Air Force will try to meet in order to avoid the implementation of land use controls at a site. As stated in Section 5.3, the selected soil cleanup levels take into account the site-specific conditions, comply with CERCLA, and are protective of human health and the environment. These levels are also protective of the sensitive ecologi-

cal receptors that live near the WABOU soil sites. However, these levels do not clear the sites for unrestricted (residential) use. Alternative S2 is a selected remedial alternative for all excavation sites, because the selected cleanup levels may not be protective of human health and the environment if these sites were to be reclassified in the future as recreational or residential areas. Section 5.1 describes the industrial nature of the land surrounding the WABOU soil sites. Tables II-5-1 through II-5-8 present the soil cleanup levels and the residential cleanup levels for the WABOU soil sites that require excavation.

If a soil excavation achieves the residential cleanup levels at a site, then the site is available for unrestricted access and there would be no need to establish, maintain, monitor or enforce LUCs. The regulatory agencies agree to delete requirements pursuant to Alternative S2 (Land Use and Access Restrictions) as a selected remedial alternative for a site in the event that the soil excavation achieves the residential cleanup levels for all chemicals of concern at the site.

It is impossible to calculate the concentrations of residual contamination at a soil site before the excavation of the estimated volume of soil is complete. There are three possibilities:

1. The excavation does not achieve results that meet the minimum specified cleanup standards, in which case the excavation will continue until the standards are met.
2. The excavation achieves results that meet the minimum specified cleanup standards, but the site will be protective for industrial uses only. Land use controls will be necessary.
3. The excavation achieves soil cleanup levels such that the site is protective for both industrial and residential use. Land use controls will not be necessary.

If the initial soil excavation at a site achieves the selected cleanup levels but not the residential cleanup levels (possibility 2), the Air Force will consider a number of factors in making the decision to continue the excavation in an attempt to reach the residential cleanup goals, including the:

- Amount of soil excavation completed,
- Concentrations of residual contaminants (and the residual risk remaining),
- Best estimate available for the additional amount of soil to be excavated to achieve protection for residential activities,
- Amount of time that an excavation crew can remain mobilized at the site,
- Remaining budget for the continuation of excavation activities,
- Remaining budget for the disposal of the additional volume of contaminated soil,
- Impact of adverse weather conditions on the project,
- Continued impact of the project on Base activities.

The decision-making process is qualitative in nature and takes into account the progress made at all excavation sites. For example, the selected cleanup levels are achieved at both Site A and Site B. There is a small amount of funding remaining for these two projects, and the best estimate indicates that a smaller amount of additional excavation would be needed

to reach residential cleanup levels at site A. Assuming that there are no other considerations, the decision might be made to continue the excavation activities to attempt to reach residential cleanup levels at site A and finalize the remedial action at site B with land use controls. If the review results in the decision to finalize the cleanup action before achieving the cleanup levels at a soil site, Travis AFB will notify the regulatory agencies and start the application of Alternative S2 to the site.

5.5 Statutory Determinations

This section discusses the applicability and compliance of the following statutory determinations:

- Protectiveness
- ARARs
- Cost-Effectiveness
- Use of Permanent Solutions, Alternative Treatment, or Resource Recovery Technologies
- State and Community Acceptance

5.5.1 Protectiveness

These selected remedies are protective of human health and the environment. They achieve protection by removing or isolating source areas of contamination that pose a potential risk to human health or the environment.

5.5.2 Applicable or Relevant and Appropriate Requirements

The selected remedies comply with State of California and federal ARARs. Section 6.0 presents the soil ARARs.

5.5.3 Cost-Effectiveness

The selected remedies for implementing the soil remedial actions at each site include the most cost-effective technologies that can meet the WABOU RAOs. Section 6.0 of the WABOU FS (CH2M HILL AFB, 1998) presents the details of the technology selection.

5.5.4 Use of Permanent Solutions, Alternative Treatment, or Resource Recovery Technologies

The selected remedies utilize, to the maximum extent practicable, permanent solutions to the potential threats posed by soil contamination at each site. For the WABOU soil sites, innovative technologies, such as solidification and stabilization, were considered. However, difficulties associated with implementability or excessive cost rendered less innovative technology, such as excavation and disposal, more favorable.

5.5.5 State and Community Acceptance

The State of California (DTSC and San Francisco Bay RWQCB) concurs with the Air Force and the U.S. U.S. EPA in the selection of the actions described in this section for the WABOU soil sites.

The comments received during the July 8, 1998 to August 8, 1998 public comment period and lack of comments from the February 23, 2000 to March 24, 2000 public comment period indicate that the public has no preference of alternatives. Part III (Responsiveness Summary) provides the public comments received and the Air Force responses.

5.6 RD/RA Implementation and Schedule

The Air Force will implement the RD/RA for the nine WABOU soil sites in accordance with this WABOU Soil ROD. In accordance with the Travis AFB FFA, the Air Force will present the WABOU RD/RA schedule for completing and submitting the site-specific RD planning and design documents to the regulatory agencies within 21 days of signing the WABOU Soil ROD.

The WABOU RD/RA schedule is a product of the Travis AFB IRP Priority Model and the Travis AFB Strategic Plan. The priority model and the strategic plan are planning tools used by Travis AFB to prioritize funding and schedule remedial actions for IRP sites. They take into account factors such as human health risk, off-base migration, CAMU coordination issues, ecological risk, public interest, capital cost, project execution, and projected funding levels.

The Air Force has prepared the final *Basewide Soil Remedial Design/Remedial Action Plan* (Soil RD/RA Plan) (URS, 2002) that addresses the implementation of soil remedial actions for all Travis AFB soil sites. It provides the procedures for conducting a soil excavation, transportation, and either placement in the CAMU or disposal in an off-base landfill. It addresses the following issues:

- The identification and filling of potential site characterization data gaps.
- The analytical methods and Quality Assurance/Quality Control procedures that will be used to characterize soil contaminants and confirm the attainment of cleanup levels during excavation.
- The procedures for conducting soil excavations. This includes procedures for sample collection and selection of sampling methods. This also includes the consideration of factors needed to make the site-specific decisions for continuing an excavation to attempt to reach residential cleanup goals.
- The sampling rationale for waste characterization prior to disposal. This includes the number of samples collected at each site and the methodology used for their collection. This also includes the procedures to be used to segregate heavily contaminated soil that needs to be transported off-base for disposal and the less contaminated soil that can be placed in the CAMU.
- A detailed description of the CAMU, to include the procedures for segregating soil by contaminant type, decontamination procedures, sampling protocols, and inspection and maintenance requirements.

The Soil RD/RA Plan also provides the procedures needed for those remedial actions that do not involve excavation, such as the construction of fences and berms needed for land use controls.

The Air Force will also prepare an attachment to the Soil RD/RA Plan for each Travis AFB soil site. Each attachment will present excavation requirements, precautions needed to protect nearby sensitive habitats, truck routes to enter and exit the site, and all other site-specific information needed to complete the soil remedial action. The regulatory agencies will review each site-specific attachment to the Soil RD/RA Plan for acceptance. The *LF007 Soil Remedial Action Design Report and Post-Construction Maintenance Plan* (CH2M HILL, 2002) presents the CAMU design, including the configuration and procedures for the phased placement of consolidated soil. The Air Force will provide an opportunity for public participation during the Remedial Design phase.

The attachment for the Radioactive Burial Site 2/Dry Waste Landfill (RW013) identifies the low-level radiological waste disposal facility that will receive the Radioactive Burial Site 2 waste and contaminated soil. It describes any special packaging, labeling, transportation, and Air Force coordination requirements that need to be met for radiological waste disposal.

The RD/RA phases will use the soil cleanup levels listed in Tables II-5-1 through II-5-8 to:

- Estimate the target volumes that require remediation, an important input for the remedial design.
- Verify that the analysis of the confirmation samples collected during remedial action can achieve the quantitation limits required by the appropriate Travis AFB Quality Assurance Project Plan.
- Measure the progress of the remedial action through comparison with the field analytical data and determine when the remedial action is complete.

The Air Force will monitor the progress of each soil remedial action until the soil cleanup levels are achieved. Then, the Air Force will review the results of the confirmation sample analysis and other site-specific conditions as described in Section 5.4.2 and decide whether the remedial action should continue in order to attempt to reach residential cleanup goals and avoid the need to implement land use controls. The Air Force will keep the regulatory agencies informed of these decisions.

5.7 Site Closure

Within 60 days of the final inspection of the constructed remedy, the Air Force will submit a remedial action report to the regulatory agencies for acceptance. This report will describe the remedial action and document the amount of excavated soil removed from the site, the disposition of the excavated soil (placement in the on-base CAMU or disposal in an off-base landfill), and the analytical results of the confirmation sampling. Table II-5-9 lists the soil and leachate acceptance levels for the CAMU at LF007. For soils that have been placed in the CAMU, the report will document the results of acceptance level sampling and analysis and will contain a map of the CAMU that shows the placement area for soil from a particular site. Figures will show the areal, and if necessary vertical, extent of the excavation area. For those sites that did not require excavation, the remedial action report will document the installation of fences, berms and signs and the implementation of land use controls. It will also describe the maintenance of permanent structures that are part of the remedial action.

TABLE II-5-9
CAMU Soil Acceptance Levels
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	CAMU - Soil Acceptance Level (mg/kg)	CAMU – Leachable Acceptance Level (DI-WET results µg/L)	Adsorption Coefficient - K_d (L/KG)	MCL (µg/L)	Tap Water PRG or Other Water Quality Goal (µg/L)
Aluminum	35,500	100,000	355	1000	
Antimony*	74	600	124	6	
Arsenic*	1,000	5,000	200	50	
Barium	1,096	100,000	10.96	1000	
Cadmium	7.50	500	15	5	
Chromium	840	5,000	168	50	
Copper	5,174	130,000	39.8	1300	
Lead*	854	1,500	569	15	
Mercury	64	200	322	2	
Molybdenum	360	18,000	20	NE	180
Nickel	122	10,000	12.2	100	
Selenium*	550	5,000	110	50	
Silver*	24,360	10,000	2,436	100	
Vanadium	26,000	26,000	1,000	NE	260
Zinc	6,350	500,000	12.7	5000	
Acenaphthene	1,776	37,000	48	NE	370
Alpha Chlordane* ^	38.6	10	3,856	0.1	
Anthracene	27,200	180,000	151	NE	1800
Aroclor-1254	184	50	3,674	0.5	
Aroclor-1260*	75	50	1,500	0.5	
Benzo(a)anthracene	25	10	2,484	0.1	
Benzo(a)pyrene	164	20	8,190	0.2	
Benzo(b)fluoranthene	65	9.2	7,079	NE	0.092
Benzo(k)fluoranthene	184	92	2,000	NE	0.92
Bis(2-ethylhexyl)phthalate	1,893	400	4,733	4	
Carbon Disulfide	0.52	1,000	0.52	NE	1,000
Chrysene	542	920	589	NE	9.2
4,4'-DDD*	25	28	910	NE	0.28
4,4'-DDE*	4	20	200	NE	0.2
Dibenz(a,h)anthracene	11	0.92	11,620	NE	0.0092
Dieldrin	0.030	0.420	71	NE	0.0042
Di-N-butyl phthalate	87,700	370,000	237	NE	3700
Dioxin as 2,3,7,8-TCDD*	0.034	0.0030	11,346	0.00003	
Endosulfan	0.31	220	1.4	NE	220
Endosulfan sulfate**	NE	NE	NE	NE	110
Fluoranthene	43,785	150,000	291.9	NE	1500
Fluorene	1,272	24,000	53	NE	240
Gamma Chlordane* ^	17.39	10	1,739	0.1	
Heptachlor*	2.6	1.00	2,600	0.01	
Heptachlor epoxide	0.052	1.00	51.89	0.01	
Indeno(1,2,3-cd)pyrene	15	9.20	1,600	NE	0.092
Methoxychlor	2,173	4,000	543.37	40	
Methoxone**	NE	NE	NE	NE	18

TABLE II-5-9
CAMU Soil Acceptance Levels
WABOU Soil ROD
Travis AFB, California

Chemical of Concern	CAMU - Soil Acceptance Level (mg/kg)	CAMU – Leachable Acceptance Level (DI-WET results µg/L)	Adsorption Coefficient - K_d (L/KG)	MCL (µg/L)	Tap Water PRG or Other Water Quality Goal (µg/L)
Phenanthrene	112	630	178	NE	6.3
Pyrene	4,788	18,000	266	NE	180
Toxaphene	3.17	300	10.57	3	

NE – Not Established

* Kd calculated from Travis AFB site-specific DI WET results

** Suitable Kd values have not been located or established for these compounds.

Note: The chlordane MCL was used for Alpha & Gamma Chlordane

Once all remedial actions at a site are complete, the Air Force will submit a site closure report to the regulatory agencies for acceptance. This report will document the attainment of cleanup levels, the performance of the constructed remedy, the assurance that the remedial actions are protective of human health and the environment, verification that all required land use controls is in place and are being enforced, and the description of required O&M tasks.

The Air Force and the regulatory agencies will hold a formal program review after the soil remedial actions are complete. One purpose of the program review is to confirm the implementation of land use controls on Travis AFB, where needed.

5.8 Documentation of Significant Changes

There have been two significant changes to the selected remedies since the Air Force submitted the WABOU Soil Proposed Plan for public comment on July 8, 1998.

5.8.1 Building 916 (SD043)

The first significant change involves Building 916, an emergency electric power facility on the western side of the Base. In 1995, the Base conducted a remedial investigation of this site and discovered PCB-1254 in the soil. The source of the PCB contamination was a former transformer pad next to the building that once held transformers containing PCB-laden oil. Leaks from these transformers resulted in the deposition of this chemical into the soil. The pad and transformers have been removed, but the PCB residue remains in the soil. The risk assessment for this site concluded that the PCB residue in the soil did not pose an unacceptable potential risk to site workers or the environment.

In June 1999 Travis AFB conducted a follow-on groundwater investigation at the site. The purpose of the investigation was to determine whether the PCB-1254 in the subsurface soil next to the building was acting as a source of ongoing groundwater contamination. This information was important, because the original Air Force proposal to dig up and haul away the PCB-contaminated soil was based on the possibility that the PCB residue could have an adverse impact on the local groundwater.

PCB-1254 does not readily dissolve in water, and Travis AFB wanted to confirm whether a soil cleanup action at this site was needed. So, in June 1999, the Base installed several monitoring points downgradient of the former transformer area and collected groundwater samples from them. The analysis of these samples demonstrated that the PCB-1254 in the subsurface soil was not leaching into the local groundwater.

As a result, the Air Force revises its proposed action for this site from excavation to land use controls. The objective of these controls is to document the location of the contaminants and apply land use controls to prevent the site from being used for residential purposes. Since an active remedy would still not allow the site to be used for residential purposes, due to its proximity to industrial activities and an active runway, this is the most cost-effective remedy available.

5.8.2 Railhead Munitions Staging Area (SS046)

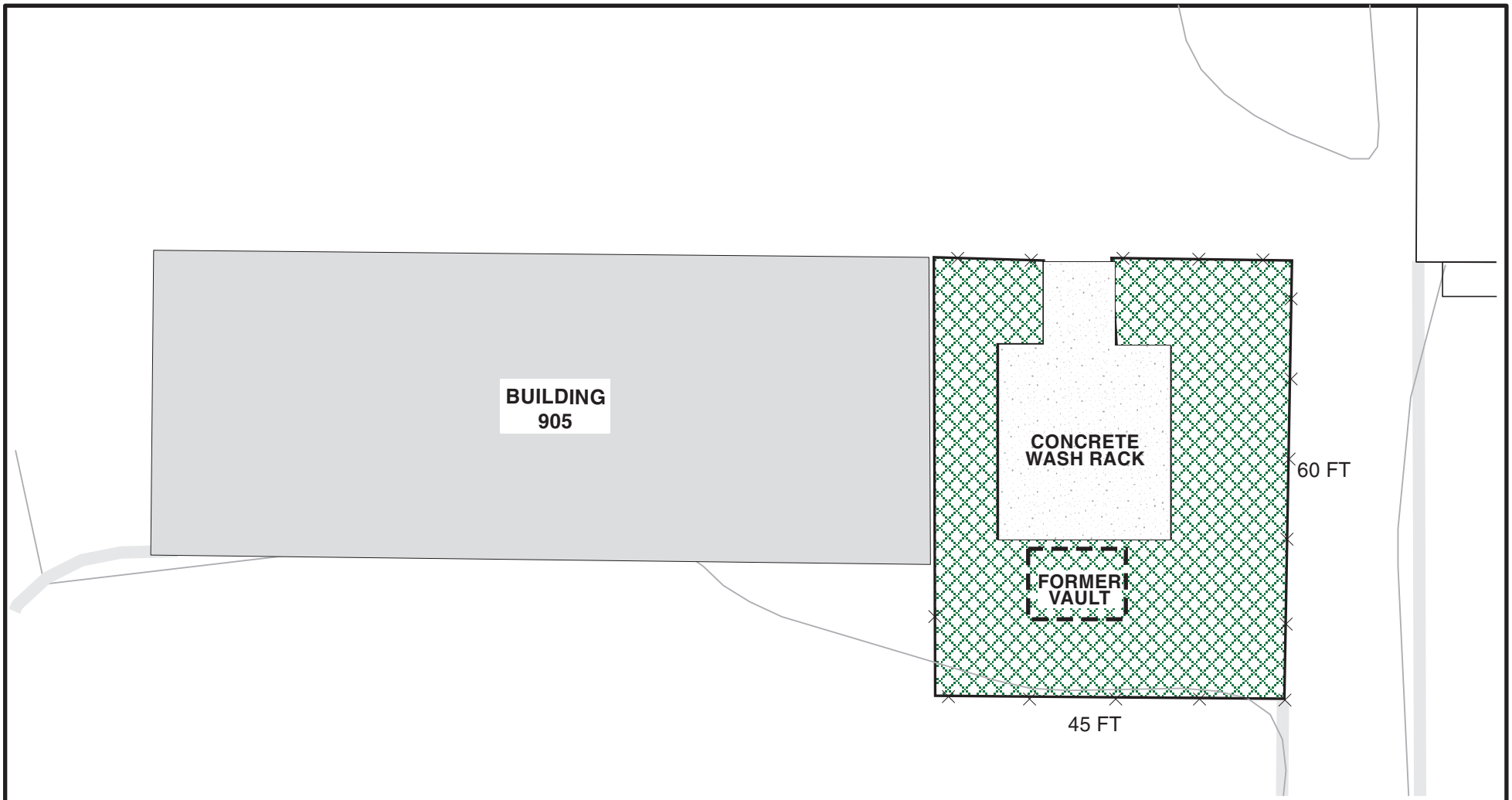
The second significant change involves the Railhead Munitions Staging Area, a concrete pad next to a set of railroad tracks on the western side of the Base. This site was part of the 1995 remedial investigation because of the possibility that cancer-causing solvents had been used on the pad during equipment-handling operations. However, the only contaminants found were metals and oil-based chemicals, related to railroad operations, in the surface soil. The original Air Force cleanup proposal for this site as presented in the *Proposed Plan for Soil Cleanup* (Travis AFB, 1998b) was to build a fence around it, dig up and haul away small quantities of surface soil around it, and administratively restrict its use to industrial purposes only.

The Air Force described changes to the original proposal in a Proposed Plan fact sheet, dated February 2000. The public reviewed this fact sheet during the February 23 to March 24 public comment period. The Air Force also presented the information in this fact sheet during the March 15, 2000 public meeting. The public did not submit comments on these significant changes. Part III (Responsiveness Summary) presents the comments received on the soil remedial actions.

The Air Force revises its proposed action for this site from fence construction and excavation to administrative land use controls. The Air Force applied the risk management strategy described in Section 5.2.2.2 (Consideration of Site Conditions) to SS046 and found that land use controls would adequately protect site workers. Land use controls would also record the presence of the contaminants until the Base changes the land use of the site and removes the railroad tracks.

This risk management decision took into account several considerations. First, the contaminants that pose a potential risk to human receptors are found beneath the railroad tracks, a location that is inaccessible to site workers. Also, the contaminants that posed a potential risk to ecological receptors are found in three isolated areas around the concrete pad adjacent to the railroad tracks. The concentrations are low and the areas are small in size, so the contaminants do not pose an unacceptable risk to the populations of plants and animals at the site. Section 5.3.8 (Railhead Munitions Staging Area) describes the protection of human and ecological receptors in more detail.

THIS PAGE INTENTIONALLY LEFT BLANK



N

0 10 20 FEET

SCALE IS APPROXIMATE

NOTE
LIMITS OF EXCAVATION SHOWN ARE APPROXIMATE, AND ARE THE BASIS FOR VOLUME ESTIMATES

LEGEND

SOIL EXCAVATION (0-0.25 FEET BGS)—HUMAN HEALTH RISK

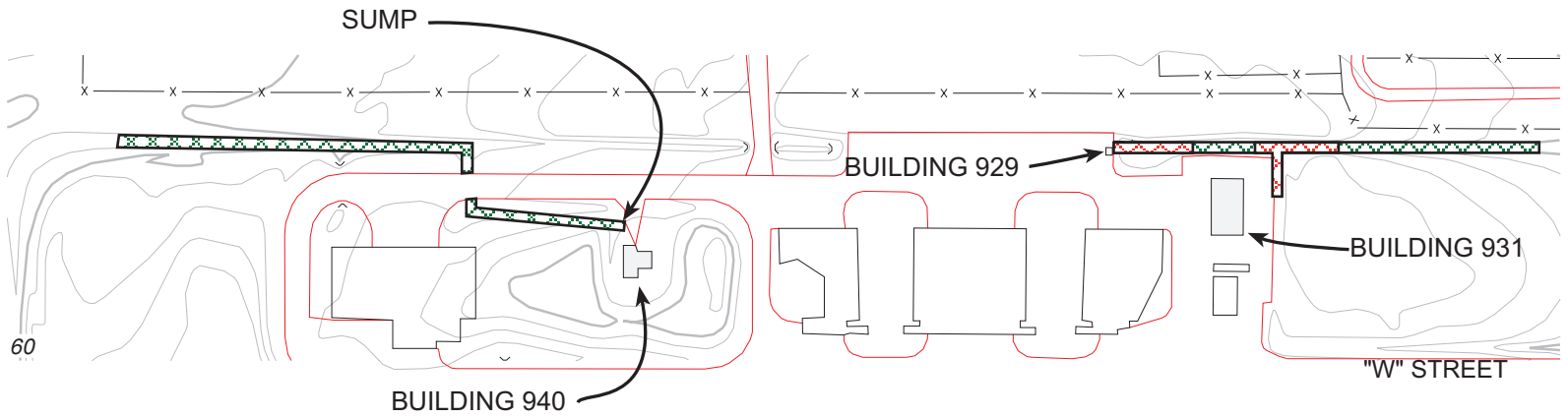
EXISTING FENCE

FIGURE II-5-2
BUILDING 905
EXCAVATION PLAN

WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_36 (12/11/01)

CH2MHILL



N

0 100 200 FEET

SCALE IS APPROXIMATE

NOTE

LIMITS OF EXCAVATION SHOWN ARE APPROXIMATE, AND ARE THE BASIS FOR VOLUME ESTIMATES

LEGEND

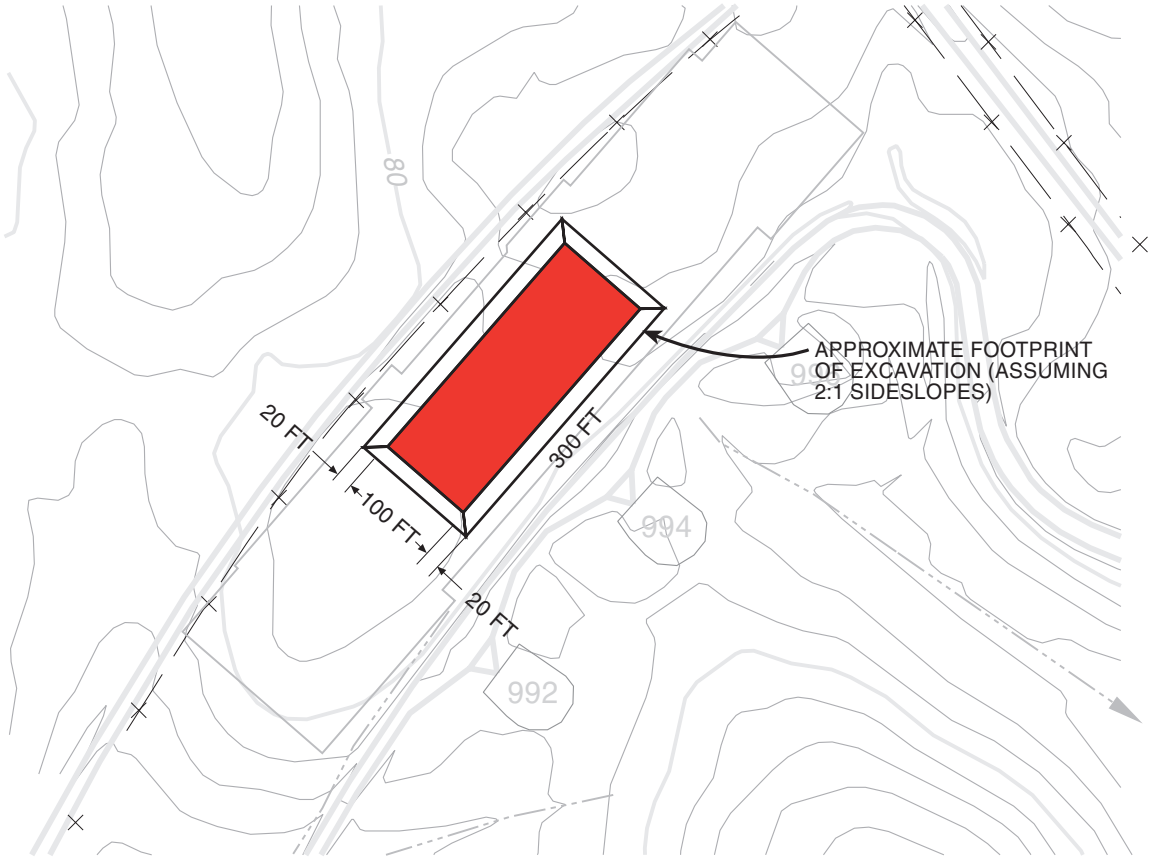
- SOIL EXCAVATION AREA (0-0.25 FEET BGS)—HUMAN HEALTH RISK
- SOIL EXCAVATION AREA (0-0.25 FEET BGS)—ECOLOGICAL RISK
- —x— EXISTING FENCE LINES
- ROADS

FIGURE II-5-3
BUILDINGS 929/931 AND 940
EXCAVATION PLAN

WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_713 (12/10/01)

CH2MHILL



N

0 150 300 FEET

SCALE IS APPROXIMATE

NOTES

1. LIMITS OF EXCAVATION SHOWN ARE APPROXIMATE, AND ARE THE BASIS FOR VOLUME ESTIMATES
2. DEPTH OF SOIL CONTAMINATION EXTENDS APPROXIMATELY 10-FT BGS.

LEGEND

SOIL EXCAVATION—HUMAN HEALTH AND ECOLOGICAL RISK

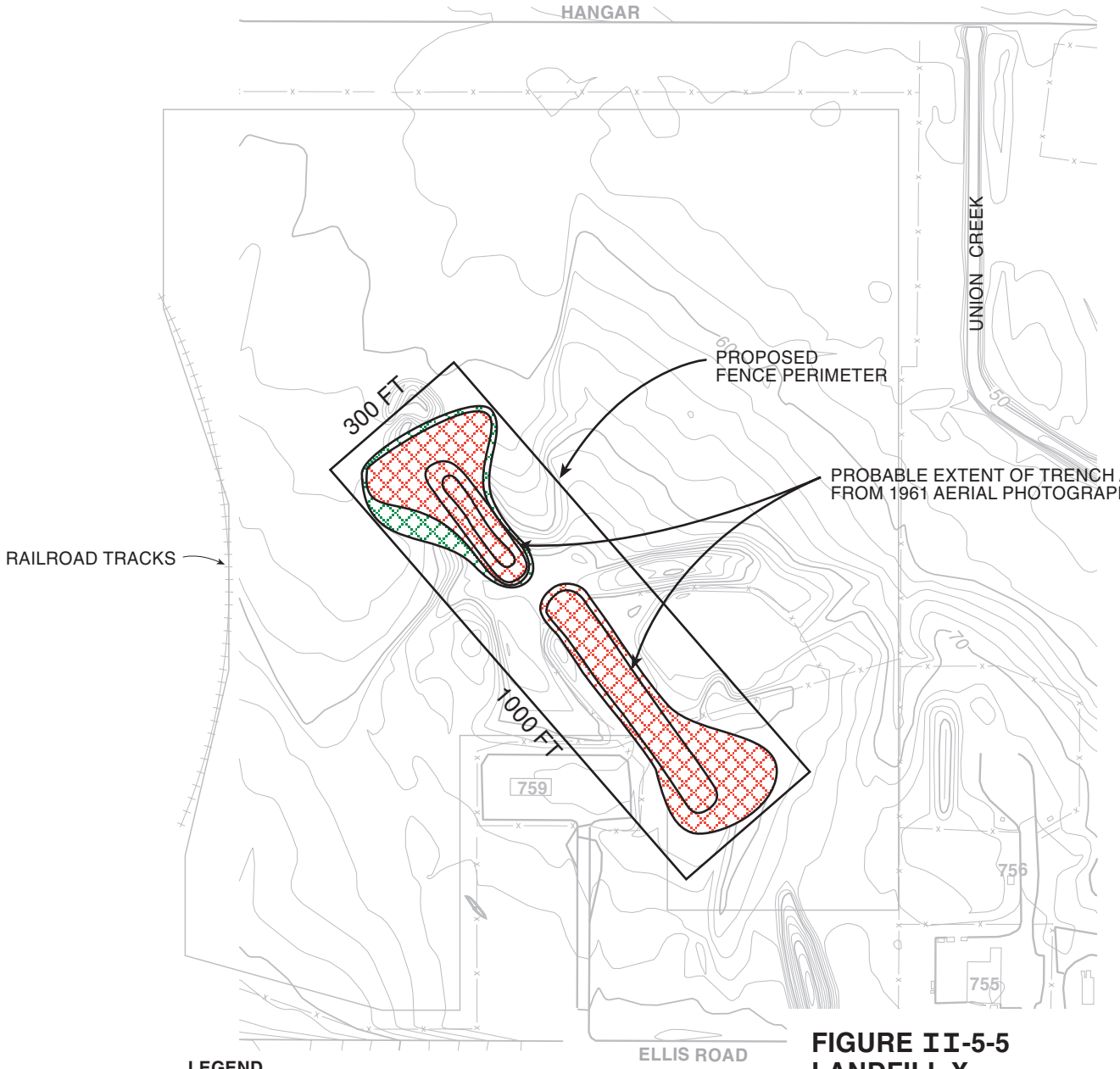
EXISTING FENCE

FIGURE II-5-4
LANDFILL 3
EXCAVATION PLAN

WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_34 (12/10/01)

CH2MHILL



NOTES

1. LIMITS OF EXCAVATION SHOWN ARE APPROXIMATE, AND ARE THE BASIS FOR VOLUME ESTIMATES
2. DEPTH OF CONTAMINATION EXTENDS APPROXIMATELY 10-FT BGS

LEGEND

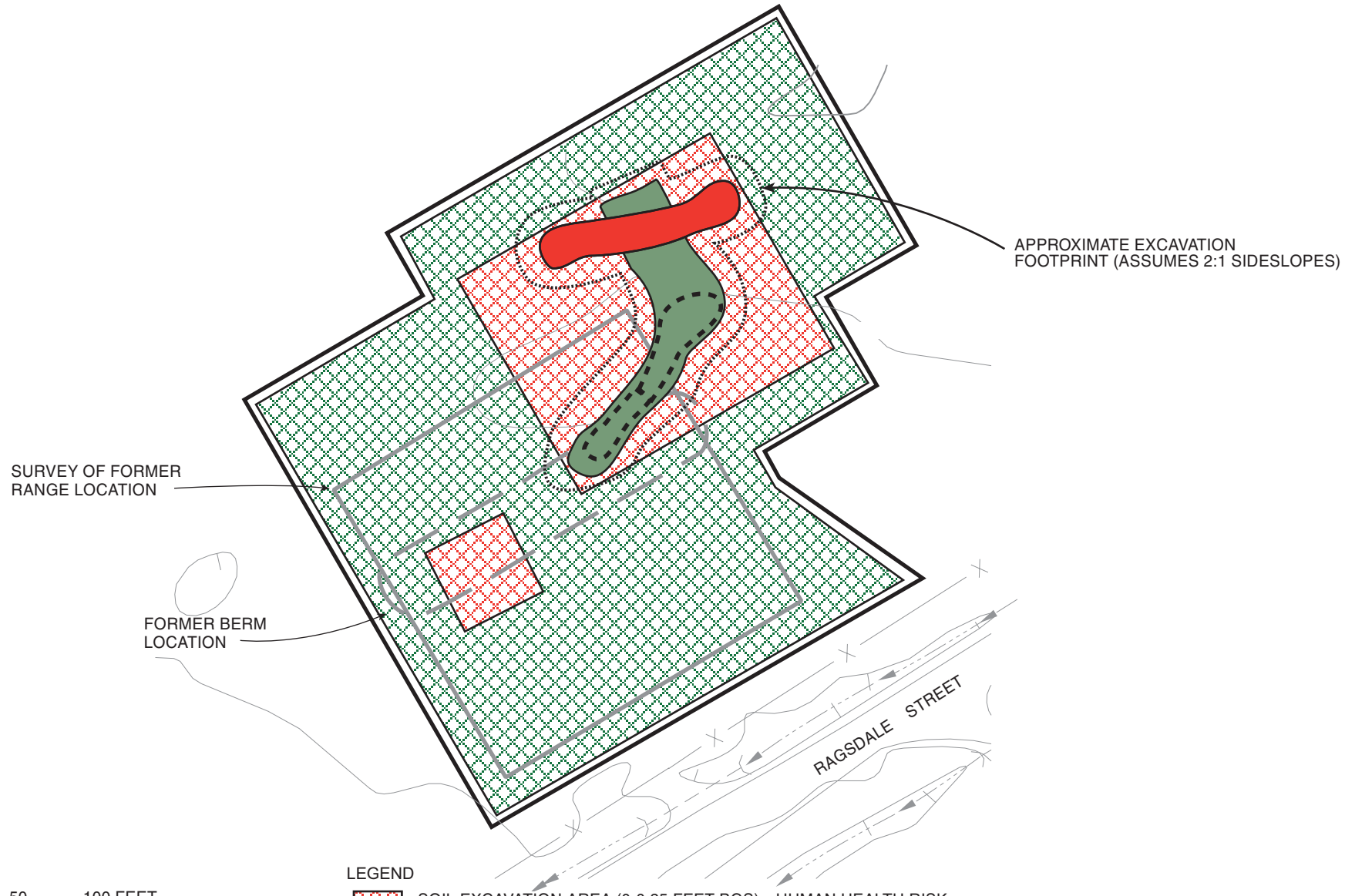
- CONTAMINATED SOIL AREA—HUMAN HEALTH RISK
- CONTAMINATED SOIL AREA—ECOLOGICAL RISK
- EXISTING FENCE

FIGURE II-5-5
LANDFILL X
FENCE LINE PLAN

WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_22 (12/11/01)

CH2MHILL

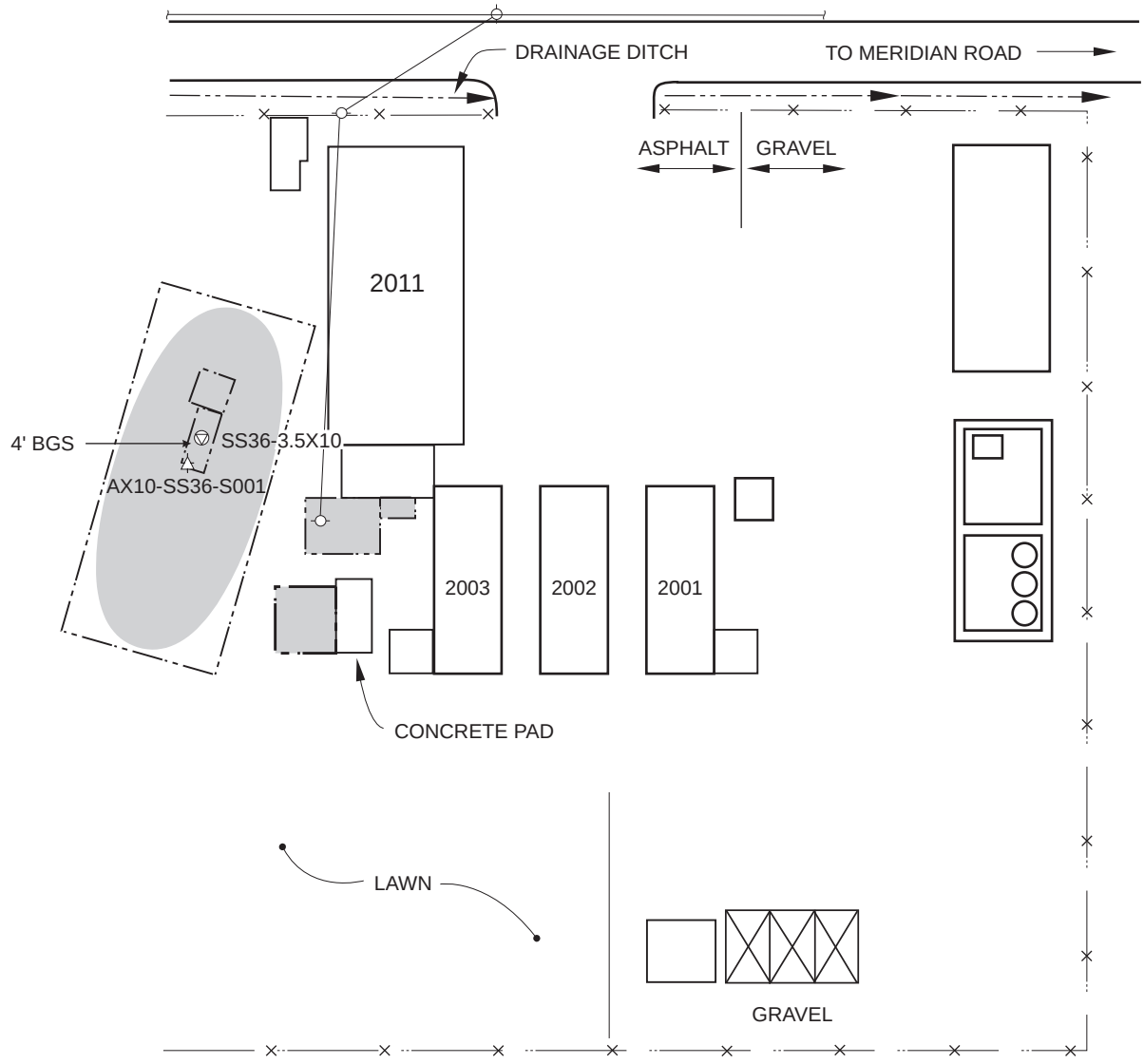


NOTE
LIMITS OF EXCAVATION SHOWN ARE APPROXIMATE, AND ARE THE BASIS FOR VOLUME ESTIMATES

FIGURE II-5-6
FORMER SMALL ARMS RANGE EXCAVATION PLAN
WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_67 (12/10/01)

CH2MHILL

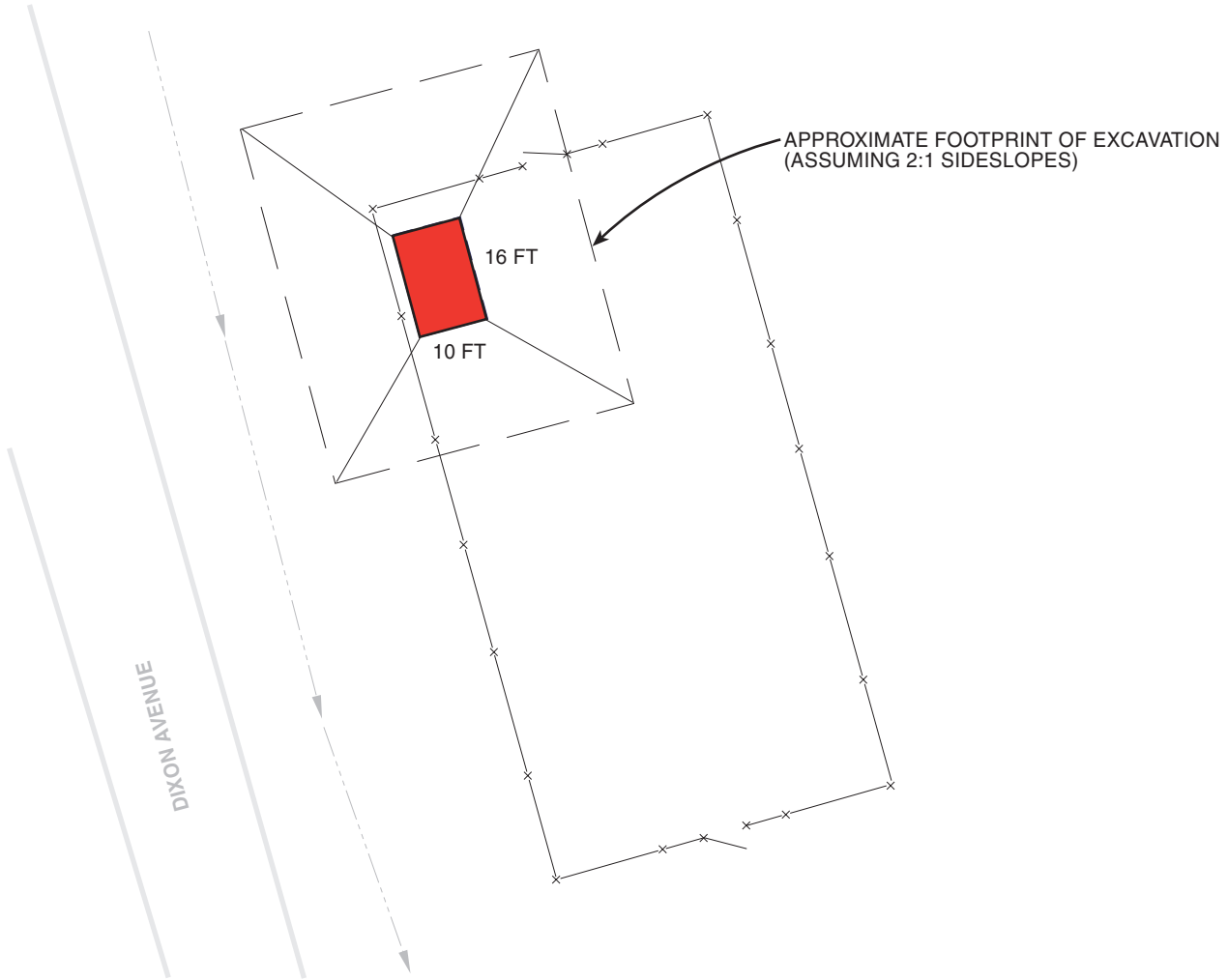


Source:
Travis\Cypress Lakes\ra-final-excavation-samples.cdr - VMG 07/13/01 SAC

FIGURE II-5-7
CYPRESS LAKES GOLF COURSE
MAINTENANCE YARD
FINAL EXTENT OF EXCAVATION
WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_42 (12/13/01)

CH2MHILL



N

0 15 30 FEET

SCALE IS APPROXIMATE

NOTE

1. LIMITS OF EXCAVATION SHOWN ARE APPROXIMATE, AND ARE THE BASIS FOR VOLUME ESTIMATES
2. DEPTH OF SOIL CONTAMINATION EXTENDS APPROXIMATELY 10-FT BGS.

LEGEND

SOIL EXCAVATION—HUMAN HEALTH RISK

EXISTING FENCE

DRAINAGE

FIGURE II-5-8
RADIOACTIVE BURIAL SITE 2 (RW13) EXCAVATION PLAN

WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_98 (12/10/01)

CH2MHILL