PART II

Decision Summary

Introduction

This Decision Summary includes the findings, evaluations, decisionmaking process, and selected remedial actions for the West/Annexes/Basewide Operable Unit Soil Record of Decision (WABOU Soil ROD). This Summary consists of the following sections:

- **Section 1.0**—Describes the physical and ecological setting of Travis Air Force Base (AFB or Base).
- **Section 2.0**—Provides an overview of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and non-CERCLA environmental programs at Travis AFB.
- **Section 3.0**—Summarizes the nature and extent of soil contamination as presented in the WABOU Remedial Investigation (RI) report (CH2M HILL, 1997).
- **Section 4.0**—Presents the remedial alternatives that were considered and the comparison of the alternatives to the criteria set forth in the National Contingency Plan (NCP) as presented in the WABOU Feasibility Study (FS) (CH2M HILL, 1998).
- **Section 5.0**—Identifies the selected soil cleanup levels and remedies and the rationale for their selection.
- **Section 6.0**—Presents the applicable or relevant and appropriate requirements (ARARs) and performance standards for the actions.
- **Section 7.0**—Is the list of references.

1.0 Travis AFB Description

Travis AFB is located midway between San Francisco and Sacramento, California, about 3 miles east of downtown Fairfield in Solano County. The Base occupies about 6,383 acres. In addition, the Base maintains ownership of or administrative control over 11 annexes at off-base locations. Approximately 17,000 military and civilian personnel are present daily on the Base (Weston, 1993). Figure II-1-1 presents maps of the regional location of Travis AFB and its annexes.

Travis AFB is currently part of the Air Mobility Command (AMC) and is host to the 60th Air Mobility Wing (AMW). The AMW operates C-5 Galaxy cargo aircraft and KC-10 Extender refueling aircraft. The primary missions of Travis AFB since its establishment have been strategic reconnaissance and airlift of freight and troops.

1.1 Physical Description

Travis AFB has a gently sloping to nearly flat topography with variations in topographic relief of up to 50 feet. Elevations at Travis AFB range from over 100 feet above mean sea level (msl) near the northern boundary to less than 20 feet above msl near the South Gate. The ground surface generally slopes to the south or southeast at about 30 feet per mile. Areas surrounding Travis AFB have a varied topography.

Within the WABOU, the ground surface elevation ranges from more than 100 feet above msl in the northwest to less than 30 feet above msl in the southern area.

The Travis AFB area has a Mediterranean climate, with wet winters and dry summers. The Base is located near the Carquinez Straits, which is the major break in the Coast Range. Travis AFB usually experiences mild temperatures because of its proximity to the Carquinez Straits and the coast. The mean annual temperature is 60° F. The lowest temperatures occur in January, with a mean of 46° F. The highest temperatures occur in July and August, with a mean of 72° F. Monthly mean relative humidity typically ranges from a low of 50 percent in June to a high of 77 percent in January. The mean annual relative humidity is 60.5 percent.

Travis AFB averages 17.5 inches of rain annually. Approximately 84 percent of the annual precipitation falls during the winter season of November through March. January is the wettest month, averaging 3.7 inches of precipitation; July is the driest month averaging 0.02 inch of precipitation.

Evapotranspiration ranges from about 50 to 75 inches per year. However, because most precipitation occurs in the winter, and most evaporation takes place in the summer, this apparent "net annual negative precipitation" has little impact on water infiltration through the soil column or on groundwater recharge.

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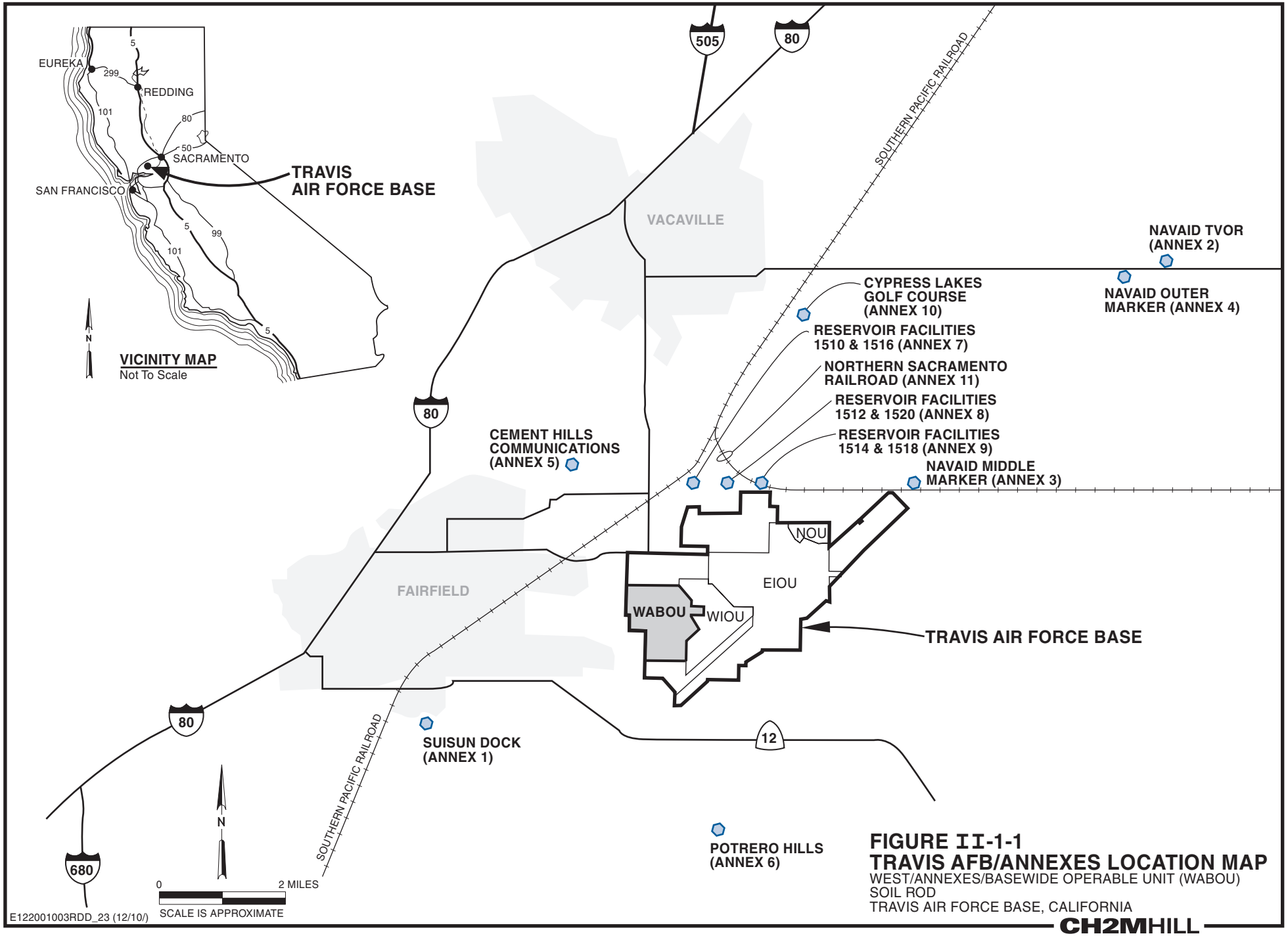

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FIGURE II-1-1
TRAVIS AFB/ANNEXES LOCATION MAP
WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

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Travis AFB experiences sea breezes during the summer because of its proximity to the Carquinez Straits. The average annual wind speed is 8 knots, with a winter average of 5 to 6 knots and a summer average of 12 knots. The predominant wind directions are from the southwest and west-southwest.

1.2 Land Use

Travis AFB occupies about 6,383 acres of land near the center of Solano County, California, and is located approximately 3 miles east of downtown Fairfield and 8 miles south of downtown Vacaville (see Figure II-1-1). Solano County's population in 1990 was 340,421 (U.S. Department of Commerce/U.S. Bureau of the Census; 1990). This population was estimated to have grown to 373,923 by 1994 (State of California, Department of Finance, 1994). During the 1980s, the population of Solano County increased nearly 45 percent (U.S. Department of Commerce/U.S. Bureau of the Census, 1990). However, the rate of growth has declined since 1990. The projected population growth between 1990 and 2000 is 47.4 percent for the City of Fairfield and 33.6 percent for Solano County overall (Association of Bay Area Governments, 1990).

According to the Travis AFB Office of Public Affairs, Travis AFB currently employs about 7,750 active military personnel and 3,323 reservists. Approximately 5,613 people live in 3,466 on-base housing units. There are 3,006 civilians employed at Travis AFB. Approximately 17,000 people are on-base on a daily basis.

The land use areas of Travis AFB are grouped into eight functional categories:

- **Mission**—Uses are closely associated with the airfield and include facilities such as maintenance hangars and docks, avionics facilities, and other maintenance facilities. Aircraft operations facilities include control towers, Base operations, flight simulators, and other instructional facilities.
- **Administrative**—Uses include personnel, headquarters, legal, and other support functions.
- **Community**—Uses include both commercial and service activities. Examples of commercial uses include the Base Exchange, dining halls, service station, and clubs; service uses include the schools, chapel, library, and the family support center.
- **Housing**—Uses include both accompanied housing for families and unaccompanied housing for singles, temporary personnel, and visitors.
- **Base Support/Industrial**—Uses are for the storage of supplies and maintenance of Base facilities and utility systems.
- **Medical**—Uses include facilities for medical support, including the David Grant Medical Center.
- **Outdoor Recreation**—Uses include ball fields, golf course, equestrian center, swimming pools, and other recreational activities.

- **Open Space**—Used as buffers between Base facilities and to preserve environmentally sensitive areas.

The lands surrounding Travis AFB on the northeast and east are primarily used for ranching and grazing. Areas to the south are a combination of agricultural and marshland. A few commercial/light industrial areas are present to the north of the Base. The area west of Travis AFB is predominantly residential.

Land use within the WABOU consists of open grasslands, light industrial support areas, administrative areas, personnel training areas, ammunition storage, and service/storage areas. Land use at and surrounding the annexes component of the WABOU varies.

1.3 Ecology

Travis AFB has a variety of terrestrial and aquatic/wetland habitats and wildlife that are typical of the region. The information used in identifying biological resources was taken from field studies and reports produced by Biosystems (1993a, b; 1994), CH2M HILL (1995; 1996), Jacobs Engineering Group (1994a, b), Radian (1994), and Weston (1995a, b).

1.3.1 Terrestrial Habitats

The terrestrial habitats at Travis AFB and adjacent areas consist of herbaceous-dominated habitats (annual grassland, pasture, and early ruderal habitat) and urban habitat (industrial areas, lawns, and ornamental plants) according to the California Department of Fish and Game (CDFG) classification system (Mayer and Laudenslayer, 1988). Aquatic/wetland habitats at Travis AFB include riverine (Union Creek) and riparian habitat, lacustrine (Duck Pond), and herbaceous-dominated wetlands marshes, and vernal pools.

In general, annual grassland habitat is dominated by non-native plant species such as slender wild oat (*Avena fatua*), fescues (*Festuca)*, soft chess (*Bromus hordeaceus*), field bindweed (*Convolvulus arvensis*), and yellow star-thistle (*Centaurea solstitialis*). Some native plants, such as bunchgrass (*F. viridula)* and johnny-tuck (*Triphysaria eriantha*) may also be found, usually associated with undisturbed areas.

Mowed/disced grassland is generally composed of soft chess, Italian ryegrass (*Lolium multiflorum*), and wild oats. Pasture grassland can contain varying frequencies of filaree (*Erodium* sp.), ripgut brome (*Bromus diandrus*), soft chess, Italian ryegrass, and yellow star-thistle. Ruderal grasslands, on the other hand, contain higher numbers of perennial species and, in some areas, woody species such as coyote brush (*Baccharis pilularis*), eucalyptus (*Eucalyptus* sp.), Peruvian pepper-tree (*Schinus molle*), and black locust (*Robinia pseudoacacia*).

The urban habitat on-base contains maintained lawns as well as trees and shrubs such as eucalyptus, Fremont cottonwood (*Populus fremontii*), arroyo willow (*Salix lasiolepis*), and coyote brush. Most isolated stands of shrubs or trees are located within or near urban areas, permanent water sources, or near artificial surface mounds (for example, rail lines, blast protection, and building/road foundations).

1.3.2 Aquatic/Wetland Habitats

Herbaceous wetland vegetation is found along the permanent (natural or artificial) drainages on-base and can also occur seasonally within vernal pools, swales, and ditches. Native species include salt grass (*Distichlis spicata*); non-native species include meadow fescue (*Festuca elatior*), sickle grass (*Parapholis incurva*), and cattails (*Typha* sp.). Vernally inundated areas support seasonal vegetation such as non-native Mediterranean barley (*Hordeum murinum* ssp. *leporinum*) and brass buttons (*Cotula coronopifolia*) and native plants such as downingia (*Downingia* sp.) and toad rush (*Juncus bufonius*).

Vernal pools are shallow depressions or small, shallow pools that fill with water during the winter rainy season, then dry out during the spring and become completely dry during the summer. The vernal pools at Travis AFB contain indicator species such as goldfields (*Lasthenia fremontii*), coyote thistle (*Eryngium vaseyi*), dwarf woolly-heads (*Psilocarphus brevissimum*), water pygmy-weed (*Crassula aquatica*); and one or more species of downingia and popcornflower (*Plagiobothrys* sp.).

Although a few willows and coyote brush can be found along Union Creek, the dominant plant species found in the riparian zone of Union Creek are mainly herbaceous and consist of beardless wild rye (*Leymus triticoides*), broad-leaved pepperwort (*Lepidium latifolium*), Harding grass (*Phalaris aquatica*), and saltgrass. Hydrophytes such as cattails and rushes are also common.

1.3.3 Wildlife

Terrestrial vertebrates associated with non-native annual grasslands are commonly found on-base. Typical avian species include ring-necked pheasant (*Phasianus colchicus*), American kestrel (*Falco sparvarius*), American robin (*Turdus migratorius*), and the western meadowlark (*Sturnella neglecta*). Reptiles observed, or potentially occurring, at the Base include the western fence lizard (*Sceloporus occidentalis*), gopher snake (*Pituophis melanoleucus*), and California red-sided garter snake (*Thamnophis sirtalis* ssp. *infernalis*). Common mammals identified include deer mouse (*Peromyscus maniculatus*), California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), black-tailed hare (*Lepus californicus*), and red fox (*Vulpes vulpes*).

Permanent wetlands and seasonally wet areas support aquatic invertebrates, fish, amphibians, reptiles, birds, and mammals. Some aquatic invertebrate species observed in herbaceous wetlands and vernal pools at Travis AFB include vernal pool fairy shrimp (*Branchinecta lynchi*), damselflies, crayfish, and aquatic snails. Amphibian species identified include bullfrog (*Rana catesbeiana*), Pacific tree frog (*Hyla regilla*), and California tiger salamander (*Ambystoma californiense tigrinum*). Aquatic birds observed on or near the Base include mallard (*Anas platyrhynchos*), great egret (*Casmerodiuis albus*), and great blue heron (*Ardea herodias*).

Because wildlife use riverine and riparian habitat somewhat similarly, these habitats are discussed together. Many aquatic invertebrates and amphibians are the same as those discussed above in herbaceous wetlands and vernal pools. These include damselflies, crayfish, aquatic snail, bullfrog, Pacific tree frog, and California tiger salamander. Fish species include mosquitofish (*Gambusia affinis*), fathead minnow (*Pimephales promelas*), threespine stickleback (*Gasterosteus aculeatus*), and bluegill (*Lepomis macrochirus*).

Riverine/riparian habitats are also used extensively by birds and terrestrial mammals for forage, shelter, and as a source of water. These include red-winged blackbird (*Agelaius phoenicus*), raccoon (*Procyon lotor*), muskrat (*Ondatra zibethicus*), and beaver (*Castor canadensis*).

Habitats that support special-status species are considered sensitive habitats. Sensitive aquatic/ wetland areas include vernal pools, swales, and ditches that can support special-status plants and animals. Urban environments, scattered throughout the Base, can also support special-status species. For example, burrowing owls (*Speotyto cunicularia*) may use man-made culverts, perches, and bare earth areas that contain burrows provided by ground squirrels. Loggerhead shrikes (*Lanius ludovicianus*) may nest on antenna wires and forage in grasslands. Both owls and shrikes are typical species of the grassland habitats on-base. Also, vernal pool fairy shrimp have been found in artificially created depressions that seasonally fill with water.

1.4 Geology and Hydrogeology

This section provides a discussion of the regional geologic setting near Travis AFB, as well as specific geologic conditions in the WABOU.

1.4.1 Geology

Travis AFB is located on the western edge of the Sacramento Valley segment of the Great Valley Geomorphic Province. This province is a sediment-filled synclinal basin with a northwest-to-southeast-oriented axis. The Coast Range Geomorphic Province, which consists of folded and uplifted bedrock mountains, lies just to the west of Travis AFB (Thomasson et al., 1960; Olmsted and Davis, 1961).

The WABOU is located on the western flank of the truncated anticline that traverses Travis AFB in a northwesterly to southeasterly direction. The axis of the anticline runs through the East Industrial Operable Unit (EIOU) near Facility 363, about 2 miles east of the WABOU boundary. Early Eocene Epoch Domengine Sandstone, which is the oldest sedimentary unit exposed at the Base, is exposed along the axis of the anticline.

Bedrock units that outcrop in the vicinity of Travis AFB include (from oldest to youngest) the Domengine Sandstone, the Nortonville Shale, the Markley Sandstone, the Neroly Sandstone, and the Tehama Formation, as shown on Figure II-1-2. Bedrock at the North/East/West Industrial Operable Unit (NEWIOU) has been defined as consisting of consolidated to semi-consolidated sedimentary rock. It has been distinguished from the overlying unconsolidated sediment by such criteria as fissility, cementation, bedding, blow counts, color, texture, and gradation into competent rock (Weston, 1995a). Because of its lower permeability relative to the unconsolidated alluvium that overlies it, the bedrock may form a boundary for groundwater flow and therefore influence the migration of contaminants in groundwater. Table II-1-1 is a stratigraphic column that summarizes the lithology and age of the geologic units in the area.

KIRBY HILLS FAULT

VACA FAULT

LEGEND

- Qal-YOUNGER ALLUVIUM
- Qbm-BAY MUD
- Qoal-OLDER ALLUVIUM
- Tpth-TEHAMA FORMATION
- Tem-MARKLEY SANDSTONE
- Ten-NORTONVILLE SHALE
- Ted-DOMENGINE SANDSTONE
- Tpu-UNNAMED FORMATION
- Kfo-FORBES FORMATION
- Kg-GUINDA FORMATION

N

0 1500 3000 FEET

SCALE IS APPROXIMATE

FIGURE II-1-2
GEOLOGIC MAP OF
TRAVIS AFB AND VICINITY
WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

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TABLE II-1-1
Stratigraphic Column of Geologic Units at Travis AFB
WABOU Soil ROD
Travis AFB, California

Million Years Ago	Era	Period	Epoch	Geologic Unit	Lithologic Description	Possible Range of Thickness
1.8	Cenozoic	Quaternary	Pleistocene and Recent	Younger Alluvium	Interbedded clays, silts, sands and gravels, continental	0-70 feet
				Older Alluvium	Interbedded clays, silts, sands, and gravel, continental	0-100 feet
				Bay Mud	Interbedded clays, silts, sands and gravel, continental	
5			Pliocene	Tehama Formation	Interbedded gravels, sands, silts and clays, partially consolidated, occasional volcaniclastic sediments; continental	
					Unconformity	
27.5		Tertiary	Miocene	Neroly Sandstone (San Pablo Group)	Interbedded sandstone, siltstone, and shale, distinctive bluish color; marine	0-60 feet
					Unconformity	
38			Oligocene			
55			Eocene	Markley Sandstone	Massive micaceous, arkosic sandstone, interbeds of siltstone and shale, marine	0-60 feet
				Nortonville Shale	Predominantly dark gray marine shale and siltstone, minor sandstone, coal and glauconitic sandstone unit	80 feet
				Domengine Sandstone	Coarse-grained sandstone, minor siltstone and shale interbeds, gray to brown, marine (in outcrop only as mapped by Sims et al., 1973).	50 feet
			Paleocene	Unnamed Formation (?)	Interbedded shale, siltstone, and thinly laminated friable sandstone, marine (as mapped by Sims et al., 1973)	

Source: Sims et al., 1973.

The Tehama Formation consists of poorly sorted deposits of clay, silt, clayey silt, sandy silt and clay, and silty sand, containing generally thin lenses of gravel and sand. In areas of outcrop, it consists chiefly of siltstone, sandstone, and conglomerate. The Tehama Formation is widespread in the northern, northwestern, and western Sacramento Valley, and averages about 2,000 feet in thickness (Page, 1986). However, the thickness of the formation beneath the WABOU is unknown. Travis AFB is located on the northeastern margin of the Fairfield-Suisun Basin astride the Vaca Fault. The Vaca Fault is aligned northwest-southwest and is mapped as a fault with late Quaternary (during the past 700,000 years) activity (Jennings, 1994). No historic activity has occurred on this fault. Travis AFB lies on alluvial fans that extend from the Vaca Mountains to the Suisun Marsh. These fans were deposited by the

Ulatis, Union, Alamo, Laurel, and Suisun Creeks. Most of the alluvial material was deposited prior to the last period of glaciation during the Pleistocene Epoch, and is referred to as Older Alluvium. The parent rocks for the alluvium at Travis AFB include metasediments, serpentinites, ultramafic rocks, and the Sonoma Volcanics (Olmsted and Davis, 1961; Wagner, 1982). The drainages cut through the alluvial fans during the last glaciation, in response to the global lowering of the sea level. As the sea level has risen during the last 15,000 years, the drainages have filled again with alluvium. This material is referred to as Younger Alluvium. At Travis AFB, the overall thickness of the alluvium ranges from 0 to approximately 70 feet, but is generally less than 50 feet. West of Travis AFB, the thickness of the alluvium increases to over 200 feet (Thomasson et al., 1960). Some topographic relief in the form of very low ridges is provided by outcrops of sedimentary rocks characterized as bedrock in the Travis AFB area.

The younger and older deposits are distinguished at the surface by the difference in maturity of their soil profiles. The portion of the alluvium near the ground surface has been altered, or weathered over time by physical, chemical, and biological actions. The Younger Alluvium generally has an immature soil profile; the Older Alluvium generally has a well-developed, mature soil profile. Most of the sediment encountered at Travis AFB consists of Older Alluvium. The Younger Alluvium overlies the Older Alluvium and is found only in the northeastern portion of the Base.

Soil develops within geologic material exposed at the Earth's surface as the material is altered through physical, chemical, and biological processes. The nature of a soil is in part a function of climate, surface slope, time of exposure at the surface, and the type of original (parent) material. Soils in the vicinity of Travis AFB are classified as alfisols, which are primarily silt and clay loams that exhibit low permeabilities and poor drainage characteristics.

The majority of the Base, including the WABOU, is covered with soils derived from Pleistocene Epoch Older Alluvium designated as the Antioch-San Ysidro Complex. This complex comprises about 45 to 50 percent Antioch soil series and 35 to 45 percent San Ysidro soil series, with the remaining percentage composed of the Solano soil series and Pescadero soil series. The soils are old and are characterized by a well-developed soil profile.

1.4.2 Hydrogeology

Travis AFB is located along the eastern edge of the Fairfield-Suisun Hydrogeologic Basin. The Fairfield-Suisun Basin is a hydrogeologically distinct structural depression adjacent to the Sacramento Valley segment of the Central Valley Province. The basin is bordered to the north by the Vaca Mountains and to the east by the ridge that runs along the eastern portion of the North Operable Unit (NOU) and EIOU. The basin slopes south toward the Suisun Marsh; consequently, groundwater and surface water at Travis AFB tend to flow south to Suisun Marsh (California Department of Water Resources, 1994).

The primary water-bearing deposits in the region surrounding Travis AFB are the coarse-grained sediments (sand and gravel) within the Older Alluvium and Younger Alluvium. The bedrock units generally do not yield groundwater of usable quantity or quality in the Fairfield-Suisun Basin (Thomasson et al., 1960).

1.4.3 Groundwater Use

Intensive extraction of groundwater generally occurs only to the west of Travis AFB and Fairfield where the alluvium is thicker and contains a greater abundance of coarse-grained sediment. Groundwater wells in the area of Travis AFB are limited to domestic, stock-watering, and irrigation wells with typical screened depths of within 100 feet of ground surface (Weston, 1995b). Domestic wells, several of which are downgradient from Travis AFB, are used typically for households and gardens (Weston, 1993). Solano County does not supply water to the residences surrounding Travis AFB. The two nearest domestic wells are within 1700 feet of the south boundary of Travis AFB.

No on-base wells are used for potable water production. However, several wells located 4 miles north of Travis AFB, at the Cypress Lakes Golf Course (Annex 10), produce 400 to 500 million gallons of water per year. This well water is mixed with surface water purchased from the City of Vallejo to supply potable water to Travis AFB. The Fairfield public water supply field is located approximately 3 miles west of Travis AFB. The large production wells at the golf course and in Fairfield tend to be deeper than the nearby domestic wells, ranging up to 1,000 feet in depth.

1.5 Surface Water

Travis AFB is located in the northeastern portion of the Fairfield-Suisun Hydrologic Basin. Within the basin, water generally flows south to southeast toward Suisun Marsh, an 85,000-acre tidal marsh that is the largest contiguous estuarine marsh as well as the largest wetland in the continental United States. Suisun Marsh drains into Grizzly and Suisun Bays. Water from these bays flows through the Carquinez Straits to San Pablo Bay and San Francisco Bay, and ultimately discharges into the Pacific Ocean near the City of San Francisco.

Union Creek is the primary surface water pathway for runoff at Travis AFB. The head-waters of Union Creek are located approximately 1 mile north of the Base, near the Vaca Mountains, where the creek is an intermittent stream. Union Creek splits into two branches north of the Base, with the main (eastern) branch being impounded into a recreational pond designated as the Duck Pond. At the exit from the Duck Pond, the creek is routed through a storm sewer to the southeastern Base boundary, where it empties into open creek channel.

The West Branch of Union Creek flows south and enters the northwestern border of Travis AFB east of the David Grant Medical Center in an excavated channel. This channel flows south to the northeast corner of the WABOU. The channel forms the boundary between the WIOU and the WABOU and parallels Ragsdale Street for about 4,000 feet. Flow in the channel is then directed to a culvert under the runway and discharges to the main channel of Union Creek at Outfall II. From Outfall II, Union Creek flows southwest, and discharges into Hill Slough, a wetland located 1.6 miles from the Base boundary. Surface water from Hill Slough flows into Suisun Marsh.

Local drainage patterns have been substantially altered within the Base by the rerouting of Union Creek, the construction of the aircraft runway and apron, the installation of storm sewers and ditches, and general development (e.g., the Base Exchange, industrial shops, maintenance yards, roads, housing, and other facilities). Surface water is collected in a

network of underground pipes, culverts, and open drainage ditches. The surface water collection system divides the Base into eight independent drainage areas. The eastern portion of the Base is served by one of the drainage systems that collects runoff from along the runway and the inactive sewage treatment plant area and directs it to Denverton Creek and Denverton Slough. Denverton Creek is an intermittent stream in the vicinity of the Base. The northwestern portion of the WABOU drains to the west toward the McCoy Creek drainage area. McCoy Creek is also an intermittent stream in the vicinity of the Base. With the exception of these drainages, the remaining six drainage areas at the Base empty into Union Creek.

Travis AFB has limited topographic relief and the clayey soils prevent rapid drainage. This swale topography leads to the formation of vernal pools. The annual cycle of vernal pools includes standing water during the winter and spring, and desiccation during the summer and fall. During the time that the vernal pools contain water, biotic communities develop over relatively restricted areas. In the larger areas, grasslands form; in more confined, deeper areas, wetlands form. The vernal wetlands are concentrated along the western, southern, and southeastern boundaries of the Base. All of the surface water bodies on and in the vicinity of the Base empty into the Suisun Marsh. No springs have been recorded within the confines of Travis AFB.

Surface water pathways as defined in this WABOU Soil ROD include Union Creek, drainage channels, the storm and sanitary sewer system and the backfill material surrounding underground sewer lines. Surface water samples were collected at all surface water pathways adjacent to the nine WABOU soil sites. No surface water contamination was detected.

2.0 Overview of Travis AFB Environmental Programs

The Travis AFB Environmental Management Office is divided into three branches: Compliance, Restoration, and Pollution Prevention. This section describes each branch and the programs that are designed to comply with current federal and state environmental regulations.

2.1 Compliance Branch

Travis AFB maintains several active environmental compliance programs, which are described below.

2.1.1 Air Force Regulations

The Air Force has developed a parallel set of environmental regulations to the federal environmental regulations. These Air Force regulations are designed to ensure that federal requirements are implemented in an appropriate manner at Air Force installations. Air Force Regulation AFI 32-7005 sets up an Environmental Protection Committee to oversee management of all environmental programs at each installation.

The Air Force environmental compliance regulations that parallel the federal environmental regulations are divided into the following subject areas:

- Air Quality Compliance
- Water Quality Compliance
- Solid and Hazardous Waste Compliance
- Storage Tank Compliance
- Environmental Impact Analysis Process
- Integrated Natural Resource Management
- Cultural Resource Management

2.1.2 Management Action Plan and Base General Plan

The Travis AFB Management Action Plan (MAP) summarizes the current status of the Travis AFB environmental compliance, restoration, and pollution prevention programs, and presents a comprehensive strategy for implementing response actions necessary to protect human health and the environment. Travis AFB produced the most recent version of the MAP in January 1997. Travis AFB environmental staff and Air Force headquarters use the MAP to direct and monitor environmental response actions and to schedule activities needed to resolve technical, administrative, and operational issues.

The Travis AFB Base General Plan, known as the Base Comprehensive Plan, a companion document to the MAP, provides an organized, systematic, and comprehensive approach to current and future planning and development. The Base General Plan is a tool that addresses a multitude of installation requirements and assists in the long-range growth of the Base, including natural resources, environmental protection, land use, airfield operation, utilities, transportation, and architectural compatibility. Of particular importance is its role in environmental protection. The Base General Plan addresses proper hazardous waste

management and recognizes CERCLA-related activities through proper land use at Travis AFB. The Travis AFB Community Planner maintains the Base General Plan. Section 5.4 (Land Use Controls) addresses the incorporation of land use restrictions into the Base General Plan based on CERCLA-related activities.

2.1.3 Resource Conservation and Recovery Act and Hazardous Waste Management Program

Travis AFB operates as a generator and facility for hazardous waste management under the Resource Conservation and Recovery Act (RCRA) and State of California hazardous waste management programs. Travis AFB received a Part B hazardous waste facility storage permit from Cal-EPA/DTSC and U.S. EPA on 5 March 1993.

2.1.4 Petroleum-only Contaminated Sites Program

The Travis AFB Petroleum-only Contaminated Sites (POCOS) program is designed to manage on-base petroleum-related contamination sites. Travis AFB and the regulatory agencies agreed to remove the POCOS from the Travis AFB IRP, because CERCLA excludes petroleum as a CERCLA contaminant. The Air Force will address petroleum contamination under CERCLA if it is commingled with CERCLA contaminants.

POCOS are typically associated with surface and subsurface releases from fuel spills, piping leaks, oil-water separators, or underground storage tanks (UST). The POCOS program includes the removal of leaking USTs and the remediation of petroleum-only contaminated soil and groundwater. An example of a POCOS that was removed from the CERCLA program by the regulatory agencies and the Air Force is the North/South Gas Station site. The San Francisco Bay RWQCB is the lead oversight agency for this program.

2.1.5 Stormwater Discharge Permit

Travis AFB monitors stormwater outfalls in compliance with its California National Pollutant Discharge Elimination System (NPDES) permit. The ongoing monitoring program was developed in 1992 and modified in 1999. The Air Force conducts surface water sampling and reporting according to the permit requirements. The San Francisco Bay RWQCB is the lead oversight agency for stormwater discharges.

2.2 Restoration Branch

The Restoration Branch manages the Travis AFB IRP that was initiated in 1983 to investigate the nature and extent of reported hazardous waste releases to the surrounding environment (Engineering-Science, 1983). On the basis of the evaluation of IRP data by the U.S. EPA, Travis AFB was placed on the NPL on November 21, 1989 (54 Federal Register 48187).

The Air Force, U.S. EPA, DTSC, and San Francisco Bay RWQCB negotiated and signed an FFA in September 1990. The FFA is a legally binding document that establishes the framework and schedules for the environmental cleanup at Travis AFB. This document also requires Air Force compliance with the NCP, CERCLA, RCRA guidance and policy, and state laws and regulations.

2.2.1 CERCLA Process

CERCLA was passed in 1980 and amended by SARA in 1986. This law established a program to remediate sites contaminated with hazardous constituents to protect public health and the environment. CERCLA established a series of steps to investigate site contamination and design and implement appropriate remedial actions at these sites. The major steps of the CERCLA process are described below.

Remedial Investigation (RI) — The RI is used to collect data to characterize site conditions, to determine the nature of the waste, and to assess risk to human health and the environment. The WABOU RI used a phased and sequenced approach to minimize collection of unnecessary data and maximize data quality. Initial data collection efforts provided a basic understanding of site characteristics. As this basic understanding was achieved, subsequent data collection efforts focused on filling identified data gaps in the conceptual site model and gathering the information necessary to support evaluations of remedial alternatives. The results and conclusions of this investigation were published in the WABOU RI report (CH2M HILL, 1997).

Feasibility Study (FS) — The FS is divided into three general phases: development of alternatives, screening of alternatives, and detailed analysis of alternatives. In the first phase the technology types and process options available to implement the general response actions for contaminated soil and groundwater were defined. A technology implementability screening was conducted that provided the basis for the selection of representative process options for soil and groundwater remediation. In the second phase the remedial alternatives were assembled using the representative process options and the site-specific conditions in the WABOU. In the last phase the alternatives were evaluated against seven of the nine CERCLA criteria. The WABOU FS provided a comparative analysis of alternatives to identify the advantages and disadvantages of each alternative to assist the decisionmaking process. The results of this study were published in the WABOU FS (CH2M HILL, 1998).

Proposed Plan (PP) — The PP presents to the public the preferred alternative for each site and the rationale for the preferences. The WABOU Soil PP (Travis AFB, 1998b) gave the public an opportunity to comment on the preferred soil alternatives during a 30-day public comment period (July 8, 1998 to August 8, 1998). All community members on the Travis AFB Community Relations list received a copy of the PP just prior to the start of the public comment period. The Air Force formally presented the preferred soil alternatives to the public at the July 23, 1998 public meeting. The Air Force also published a fact sheet in February 2000 to describe major changes to two of the soil remedial actions. The WABOU fact sheet gave the public an opportunity to comment on these changes during a 30-day public comment period (February 23, 2000 to March 24, 2000). All community members on the Travis AFB Community Relations list received a copy of the fact sheet just prior to the start of the public comment period. The Air Force formally presented the changes to the public at the March 15, 2000 public meeting.

The Air Force has also published a WABOU Groundwater PP (Travis AFB, 1998a) that presented the preferred alternatives for the WABOU groundwater sites. A separate 30-day public comment period (April 8, 1998 to May 8, 1998) and public meeting (April 23, 1998) was held to promote public participation in the decisionmaking process.

Record of Decision (ROD) — The ROD presents the selected alternative and final cleanup levels at each soil site. It summarizes all CERCLA activities at each soil site and documents that the Air Force and the regulatory agencies are in agreement as to how the cleanup is to take place. The *Groundwater Interim Record of Decision for the WABOU* (Travis AFB, June 1999) describes the remedial actions for the groundwater sites.

Remedial Design (RD) — The RD specifies the engineering design used to implement the selected alternative at each soil site.

Remedial Action (RA) — The RA is the construction and operation of the selected alternatives specified in the ROD and designed in the RD. The Air Force will submit a schedule for the Remedial Design/Remedial Action (RD/RA) activities to the regulatory agencies 21 days after the WABOU Soil ROD is signed.

2.2.2 Operable Units

Initially, Travis AFB was treated as a single entity with one associated comprehensive cleanup schedule. In May 1993, the FFA was amended and the Base was divided into the four Operable Units (OU) listed below to facilitate the overall cleanup program:

- East Industrial Operable Unit (EIOU)
- West Industrial Operable Unit (WIOU)
- North Operable Unit (NOU)
- West/Annexes/Basewide Operable Unit (WABOU)

The WABOU has three main components:

- The western portion of the installation. Eight of the soil sites are located within the western portion of the Base.
- The annexes or noncontiguous parcels of property that are under the jurisdiction of the Travis installation commander. The boundaries of each annex are defined in the official records of the Travis AFB Real Property Office. Cypress Lakes Golf Course (SS041) is an annex. As described in Part I (Declaration), the Potrero Hills Annex has been removed from the WABOU and will be addressed in a Potrero Hills Operable Unit (PHOU).
- Other sites within the installation not being addressed by the other three OUs. These sites were included to ensure that all portions of the Base had been addressed. This is the "Basewide" component of the WABOU.

Operable unit boundaries are shown in Figure II-1-1. In October 1995, the EIOU, WIOU, and NOU were combined into the North/East/West Industrial Operable Unit (NEWIOU). Currently, the three operable units on Travis AFB are the NEWIOU, the WABOU and the PHOU. Any additional sites that are identified after the finalization of the WABOU Soil ROD will be addressed in the PHOU.

2.2.3 Removal Actions

There have been two removal actions within the WABOU. In April 1993, a RCRA corrective action was conducted to close the acid neutralization sump at Building 755. This sump was identified in the WABOU RI report as the most probable source of the trichloroethene (TCE)

contamination migrating from the site. The cobblestones were decontaminated prior to disposal, and the residual liquids and solids at the bottom of the sump were sampled and analyzed for hazardous characteristics. All hazardous waste was contained, transported, and disposed of in accordance with federal, state and local environmental regulations. The concrete sump and associated piping were demolished and removed from the site. Soil samples were analyzed for hazardous constituents. A plastic liner was placed into the excavation. The excavation was lined with a plastic membrane and backfilled with clean soil. This RCRA corrective action did not meet residential cleanup standards for soil, so the Air Force selected an appropriate remedial action for this site, as described in section 5.3.1 [Building 755(DP039)].

In October 2000, a soil removal action began at the Cypress Lakes Golf Course Annex to excavate pesticide-contaminated soil from its maintenance yard. This removal action was in response to a request from the Travis AFB Restoration Advisory Board to look for ways to expedite the cleanup of soil sites. Travis AFB and the regulatory agencies agreed to conduct the remedy at this annex as a removal action. They also agreed to forego an Engineering Evaluation/Cost Analysis (EE/CA), since the WABOU RI, WABOU FS and WABOU Proposed Plan (with its public comment period) were equivalent to an EE/CA. The *Action Memorandum for the Removal Action at the Cypress Lakes Golf Course Annex* (Radian, 1999) documents the decision to conduct the removal action at the annex. The *Work Plan for the Removal Action at the Cypress Lakes Golf Course Annex* (ECC, 2000) describes the tasks needed to successfully conduct the removal action. The excavation and transport of the pesticide-contaminated soil to an approved off-base landfill was completed in January 2001. The *Cypress Lakes Golf Course Annex Removal Action Report* (ECC, 2001) describes the successful excavation, transportation and disposal of pesticide-contaminated soil from the Annex. Since this removal action met all residential cleanup standards for soil, this Annex is considered to be a No-Further-Action site, as described in section 5.3.9 [Cypress Lakes Golf Course (SS041)].

The *Travis Air Force Base Groundwater Interim Record of Decision for the NEWIOU* (Radian, 1997) describes several groundwater removal actions that had been conducted in the NEWIOU.

2.2.4 Risk Assessment

The WABOU RI included a human health risk assessment and an ecological risk assessment. Section 3.2.1 (Human Health Risk Assessment) provides a detailed description of the human health risk assessment, and section 3.2.2 (Ecological Risk Assessment) provides a detailed description of the ecological risk assessment. In addition, the potential ecological risks to plants and animals were quantified from a basewide perspective and were presented in the *Final Comprehensive Basewide Ecological Risk Assessment - Tier 2: Screening Assessment* (CH2M HILL, 1996).

2.2.5 Community Participation

Travis AFB has had a community relations program since 1990. The purpose of this program is to inform the public and involve the community in the environmental decision-making process.

The highlights of the community relations activities taken by Travis AFB are presented below:

- **Federal Facilities Agreement (FFA).** The Air Force, U.S. EPA, Cal-EPA/DTSC, and San Francisco Bay RWQCB have negotiated an interagency agreement that includes requirements for community relations activities based on provisions in federal (and where applicable, state) statutes, regulations, and guidelines.
- **Restoration Advisory Board (RAB).** In 1994, Travis AFB established a RAB comprising representatives of the community and the regulatory agencies. Through its quarterly meetings and its focus groups, the RAB has provided valuable input about community concerns regarding the Restoration Program. The Technical Document Review focus group has reviewed and commented on the draft version of every major report. The Relative Risk focus group has provided input on the project prioritization, and the Community Relations focus group is working to reach out to all community members. The RAB replaced the Technical Review Committee, which met periodically to review program progress.
- **Administrative Record/Information Repository.** The Air Force established an Administrative Record to support Air Force decisions related to the Travis AFB IRP. In addition, the Air Force established a public information repository for the relevant portion of the Administrative Record at the Vacaville Public Library. Copies of RI reports, FS reports, Proposed Plans, and decision documents for both OUs are available for public review.
- **Community Relations Plan (CRP).** The Air Force implemented the first Travis AFB CRP in 1991. The Air Force revised the CRP in 1998. The Travis AFB Remedial Project Manager (RPM) is currently implementing the CRP.
- **Mailing List.** A mailing list of all interested parties in the community is maintained by Travis AFB and updated regularly. The mailing list currently totals more than 1,300 names.
- **Fact Sheets and Newsletters.** The Air Force has been publishing fact sheets describing activities and milestones in the restoration program occasionally since 1993. Since 1995 the Air Force has published and mailed quarterly newsletters to everyone on the mailing list. The newsletters contain information about public participation, issues of potential concern to the public, and program updates. The RAB co-chairs also write columns in each newsletter.
- **Proposed Plans.** The Air Force has mailed copies of NEWIOU and WABOU Soils Proposed Plans and the WABOU fact sheet to all parties on the Travis AFB mailing list, government officials, representatives of interested community groups, and members of the media. Copies are available at three Solano County libraries for public review.
- **Public Meetings.** The Air Force held a 30-day public comment period for the WABOU Soil Proposed Plan (July 8, 1998 to August 8, 1998). The Air Force held a public meeting on the evening of July 23, 1998 to present the proposed remedial alternatives for WABOU soil sites. The Air Force also held a 30-day public comment period for the WABOU fact sheet (February 23, 2000 to March 24, 2000). The Air Force held a public

meeting on the evening of March 15, 2000 to present major changes to two of the proposed remedial alternatives. At both meetings, representatives from the Air Force, Cal-EPA/DTSC, San Francisco Bay RWQCB, and U.S. EPA were present to answer questions about the soil contamination. Questions and comments from the public and responses are included in Part III, the Responsiveness Summary.

2.2.6 Remedial Design/Remedial Action

The RD/RA will include the design and implementation of all actions specified in this WABOU Soil ROD. The regulatory agencies will be involved in the approval and oversight of the design and construction of the remedial actions.

The Air Force will submit the RD/RA schedule for implementing the ROD 21 days after signing the ROD in accordance with the FFA. The regulatory agencies will review and approve the RD/RA schedule, as well as all reports and actions specified in the RD/RA schedule. The Air Force has prepared a *Basewide Soil RD/RA Plan* that covers the general approach for implementing the remedies at all Travis AFB soil sites. The Soil RD/RA Plan will include a copy of the RD/RA schedule. In addition, the Air Force will also prepare an attachment to the Soil RD/RA Plan for each Travis AFB soil site and for the CAMU that will provide the detailed approach for the selected remedy at each site.

2.3 Pollution Prevention Branch

Travis AFB has an active Pollution Prevention Program that strives to reduce the generation of wastes through a hierarchy of actions. The actions range from the most preferred choice of source reduction, to recycling, treatment, and finally disposal as a last resort. The Pollution Prevention Management Action Plan (P2 MAP) defines the framework to accomplish these actions. The P2 MAP analyzes all processes that generate hazardous waste streams and performs opportunity assessments of potential pollution prevention options to reduce the volume and/or toxicity of generated wastes. This program includes minimizing wastes generated by sampling activities in the IRP.

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3.0 WABOU Remedial Investigation Summary

The primary objectives of the WABOU RI were to evaluate the nature and extent of contamination in the WABOU and assess the potential risks to human health and the environment posed by the contamination. Following the RI field activities and data evaluation, each site received a human health and ecological risk assessment. A quantitative human health risk assessment (HHRA) resulted in the identification of chemicals of concern (COC) for each site and the calculation of site-related excess lifetime cancer risks, as well as Hazard Indexes (for non-cancer-causing chemicals) for each COC. Similarly, the ecological risk assessment (ERA) resulted in the identification of chemicals of ecological concern (COEC) for each site and the calculation of Hazard Quotients (HQ) for various ecological receptors (selected indicator species of plants and animals) for each COEC.

3.1 Nature and Extent of Contamination

Nine of the 41 WABOU sites require a soil remedial action. Originally Buildings 929/931 and Building 940 were separate sites but now have the same site designation, because the contamination from both sites migrated into the same drainage ditch. Building 905 and Cypress Lakes Golf Course also share a site designation (SS041) but are presented separately. The Cypress Lakes Golf Course does not require a remedial action, as is described in section 5.3.9 [Cypress Lakes Golf Course (SS041)]. Table II-3-1 presents a brief description of each WABOU soil site. Section 3.3 presents a detailed description of each site. Figure II-3-1 shows the locations of the nine WABOU soil sites and the extent of contamination. Figures in Section 5 show each site in more detail.

There were three types of soil sampling used in the WABOU RI. Surface soil sampling using a hand trowel or shovel supported the assessment of contamination at or near the ground surface and applied to a depth of 0 to 3 inches. Shallow soil boring using a hand auger consisted of surface (0 to 3 inches) and subsurface (3 inches to 4 feet) soil sample pairs. Soil boring sampling using a hollow-stem auger reached depths greater than 10 feet.

Surface soil samples (0 to 3 inches) and shallow soil borings (0 to 4 feet) provided data for the HHRA and the ERA. Soil boring samples between 4 and 10 feet provided data for the HHRA. Soil boring samples from greater than 10 feet below ground surface provided data to assess the vertical extent of soil contamination and the migration of contaminants to the water table.

3.2 Risks Assessments

As part of the RI, each site received an HHRA and an ERA.

TABLE II-3-1
WABOU Soil Site Descriptions
WABOU Soil ROD
Travis AFB, California

Site Name	Site Designation	Site Description
Building 755	DP039	Building 755 is the Battery and Electric Shop. A former battery neutralization sump was used to dispose of lead-acid solutions. This practice was discontinued in 1978, and the sump was removed in 1993. Lead in the surface soil around the edges of the former sump area does not present an unacceptable risk to local workers or the environment.
Building 905	SS041	Building 905 is the Entomology Shop used to mix and store pesticides and herbicides. An outdoor concrete wash facility was used to wash pesticide residue off pesticide applicator vehicles. The topsoil surrounding the wash facility contains a variety of chlorinated pesticides. These pesticides may be a source of potential human health risk.
Building 916	SD043	Building 916 is an emergency electric power facility. At least one electrical transformer on a concrete pad adjacent to the building leaked cooling oil containing a Polychlorinated Biphenyl (PCB) into the surface soil. The concentration of PCBs does not present an unacceptable risk to either local workers or the environment.
Buildings 929/931/940	SD042	Building 929 is a storage shed near a former Hazardous Waste Accumulation Area. Building 931 is a maintenance facility for portable electrical generators. Both facilities drain into an adjacent drainage ditch. Sediment within the ditch is contaminated with Semivolatile Organic Compounds (SVOCs) and metals. These compounds may be a source of potential human health and ecological risk. Building 940 is a former paint-drying facility located within the former Fairfield Air Force Station, an Atomic Energy Commission facility that stored and maintained nuclear weapons. No elevated radioactive residue was found. A sediment sump near the building and a connecting ditch are contaminated with various metals associated with the painting operations. These metals may be a source of potential ecological risk.
Landfill 3	LF008	Landfill 3 consists of a series of small, unlined trenches that were used to dispose of expired pesticide containers. Several chlorinated pesticides are present in the waste material and soil surrounding the trenches. These pesticides may be a source of potential human health and ecological risk.
Landfill X	LF044	Landfill X is not a landfill but is actually an equipment training area and a stockpiling area for construction debris that contained metals and SVOCs. These compounds may be a source of potential human health and ecological risk.
Former Small Arms Range	SD045	The former small arms range is an open field near the south gate historically used for small arms training. Lead was detected in the soil and may be a source of potential human health and ecological risk.
Railhead Munitions Staging Area	SS046	Railroad operations deposited metals and SVOCs into the surface soil. These compounds do not present an unacceptable risk to either local workers or the environment.
Cypress Lakes Golf Course	SS041	A portion of the golf course maintenance yard had historically been used for the mixing of chlorinated pesticides. Section 2.2.3 describes the removal action that Travis AFB used to remove these pesticides from the maintenance yard.
Radioactive Burial Site 2/ Dry Waste Landfill	RW013	This dry waste landfill is a fenced backfilled trench that was part of the former Fairfield Air Force Station, an Atomic Energy Commission facility that stored and maintained nuclear weapons. Low-level radioactive waste from the maintenance of the nuclear components was buried in the trench and may be a source of potential human health risk.

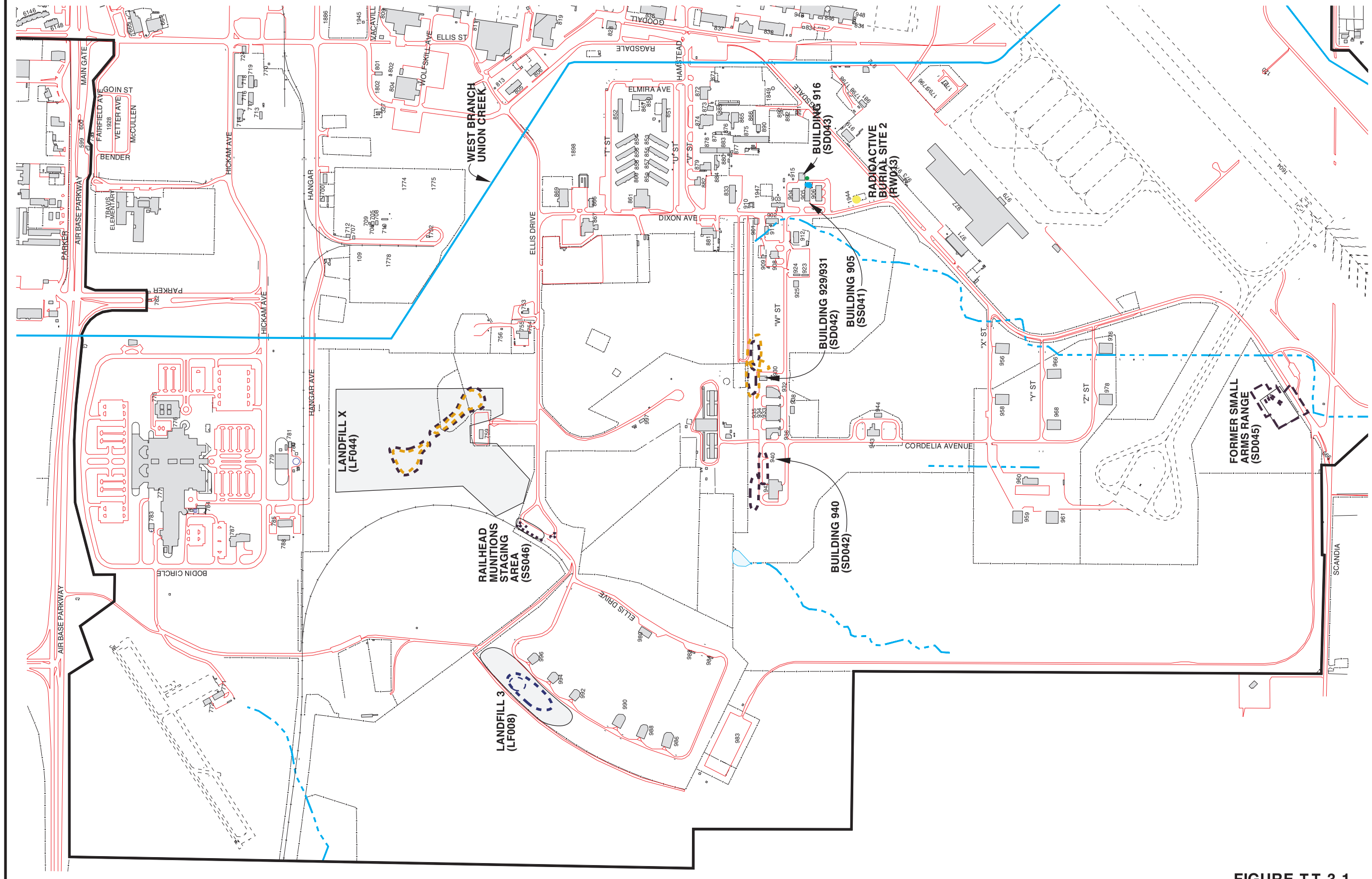

FIGURE II-3-1
EXTENT OF SOIL CONTAMINATION IN THE WABOU
WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_899 (12/10/01)

CH2MHILL

3.2.1 Human Health Risk Assessment

An HHRA is a baseline assessment that evaluates potential threats to human health in the absence of any remedial action. The HHRA begins by evaluating the chemicals of potential concern (COPC) and concludes with identification of the COCs. Section 3.7 of the WABOU RI report presents a detailed discussion of the HHRA at WABOU sites.

The following steps summarize the evaluation process:

Identification of Chemicals of Potential Concern (COPC)— Identifies the chemicals evaluated in the HHRAs.

Exposure Assessment— Identifies potential pathways by which exposure could occur; characterizes the potentially exposed populations; and estimates the magnitude, frequency, and duration of exposure.

Toxicity Assessment— Summarizes the toxicity of the COPC and the relationship between magnitude of exposure and adverse health effects.

Risk Characterization— Integrates the toxicity and exposure assessments to estimate the potential risks to human health from exposure to site chemicals. Chemicals that exceed risk factors in surface soil/dry sediment, subsurface soil or groundwater are identified as COCs. The potential risk posed by a carcinogenic compound is expressed as a probability value (i.e., 1×10^{-6}). The potential risk posed by a non-carcinogenic compound is expressed as a ratio, known as a Hazard Index, of the estimated intake of a chemical divided by its reference dose. The hazard index takes into account multiple routes of exposure (i.e., inhalation, ingestion, etc.).

Highlights of the HHRA within the WABOU RI report are as follows:

- Section 3.7.2 (Screening HHRA) describes the first step of the HHRA that involved the identification of No Further Action sites based on chemical exposure under residential conditions.
- Section 3.7.3 (Quantitative HHRA) describes the evaluation of site-specific exposure scenarios. The commercial/industrial worker exposure scenario applies to most sites, based on the current and anticipated future site use.

3.2.2 Ecological Risk Assessment

The overall purpose of an ERA is to provide a qualitative and quantitative evaluation of the actual or potential effects of contaminants on plants and animals (other than humans and domesticated species). The WABOU ERA (CH2M HILL, 1997) evaluated potential threats to the environment in the absence of any remedial action. The ERA identifies and characterizes the toxicity of the chemicals of potential ecological concern (COPEC), possible exposure pathways, potential ecological receptors, assessment and measurement endpoints, and the upper boundary of possible risks under the conditions defined for the various WABOU sites. One result of the ERA is the identification of COECs for each site.

The ERA used a tiered approach to support the investigation of, and the remedial action decisions for, the WABOU soil sites. The Tier 1 assessment was qualitative in nature and

identified the chemicals, habitats and potential ecological receptors at each soil site. The Tier 2 assessment was a screening process that quantified potential risks to ecological receptors by comparing Exposure Point Concentrations (EPC) to Critical Toxicity Values (CTV) for each target species. The EPC is a chemical concentration to which a target species may be exposed at a site. The calculation of the EPC takes into account the number and chemical concentration of samples collected at the site. The CTV is a chemical- and receptor-specific value that is derived from a selected exposure medium and pathway. It is based on Reference Toxicity Values (RTVs) for plants and animals reported in toxicological databases, wildlife toxicological reviews, or scientific literature, as well as results of site-specific bioassays. CTVs are expressed as a chemical concentration in soil. CTVs are derived from the target species RTVs, bioaccumulation factors, species-specific exposure factors, and dietary compositions of target species. The CTVs are conservative values, because they assume animals will be resident within the area of each soil site, although the sites often are smaller than the home range (which is especially true for birds). The Tier 3 assessment validated the results of the Tier 2 assessment, using bioassays, to better define the potential risks and reduce uncertainties. Section 3.8 of the WABOU RI report (CH2M HILL, 1997) presents a detailed description of the tiered approach used for the ERA and the results of the Tier 3 ERA at WABOU sites; relevant portions for soil sites are summarized below.

Travis AFB has two primary terrestrial habitats that are typical of the region and are described as herbaceous-dominated habitats (annual grassland, pasture, and early succession ruderal habitat) and urban habitats (industrial areas, lawns, and ornamental plants). Terrestrial vertebrates associated with non-native annual grasslands are commonly found on base. Typical avian species include ring-necked pheasant (*Phasianus colchicus*), American kestrel (*Falco sparverius*), American robin (*Turdus migratorius*), and the western meadowlark (*Sturnella neglecta*). Reptiles observed, or potentially occurring, at the Base include the western fence lizard (*Sceloporus occidentalis*), gopher snake (*Pituophis melanoleucus*), and California red-sided garter snake (*Thamnophis sirtalis infernalis*). Common mammals identified include deer mouse (*Peromyscus maniculatus*), California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), black-tailed hare (*Lepus californicus*), and red fox (*Vulpes vulpes*). Tables 2-6 through 2-10 in the WABOU RI (CH2M HILL, 1997) list the individual plant, invertebrate, amphibian, bird, and mammal species associated with the habitats found on Travis AFB. Table 2-11 (CH2M HILL, 1997) lists several special-status species observed on base, including the burrowing owl (*Athene cunicularia*).

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.

Selection of Assessment and Measurement Endpoints is described more fully in Section 3.8.2.5 of the WABOU RI report (CH2M HILL, 1997).

Another crucial component of the ERA is to develop a Conceptual Site Model (CSM) that describes the different pathways by which ecological receptors may be exposed to contaminant sources. The CSM also denotes which types of receptors are likely to have a potential risk of exposure for each pathway. This model is described in detail in Section 3.8.2.6 of the WABOU RI report (CH2M HILL, 1997). Briefly, contaminants at Travis AFB may be released from their primary sources via two mechanisms: (1) surface dispersion to surface soils, and (2) infiltration/percolation to subsurface soils and groundwater. Surface soil contaminants may be subsequently transported via stormwater runoff to surface water, sediments, or other surface soils. These contaminants may also be released and transported by air as either volatile emissions or dust. Subsurface contaminated soil represents a direct pathway of exposure to plants and to animal receptors that live or burrow in the soil. Groundwater in the WABOU is more than 5 feet bgs; therefore, discharge to surface water and completion of this exposure pathway is not likely. Potential exposure routes include root or foliar uptake (plants only), direct ingestion, dermal contact, and inhalation or secondary ingestion through consumption of contaminated forage or prey.

The number of different habitats and species present at any site makes it impractical to evaluate the potential ecological risks to each individual species. Therefore, a subset of potential receptors, called target species, was selected for evaluation in the ERA. Selection of target species is important because it allows for extrapolation of effects from a small subset of species to those in a larger group and potentially to the community as a whole. To effectively make such extrapolations, target species were selected that fulfill as many of the following criteria as possible:

- Species that are known to occur or are likely to occur at the site
- Species that relate to the assessment endpoints selected
- Species that are likely to be maximally exposed to COPECs or are especially sensitive to them
- Sedentary species or species with a small home range
- Species that are known to play an integral role in the ecological community structure at the site
- Species that are known or likely to be especially sensitive to contaminants, and therefore are an indicator of ecological change
- Species that are representative of the foraging guild or that serve as food items for higher trophic levels.

To conduct the ERA, a special-status bird species (the burrowing owl), several common bird (American robin and western meadowlark) and mammal (deer mouse and ornate shrew) species that are representative of animals found at the sites, along with plants and terrestrial invertebrates, were selected for evaluation. Section 3.8.3.1 of the WABOU RI report (CH2M HILL, 1997) presents full descriptions of each of these species.

Ecological receptors may be exposed to chemicals in soil, sediment, or surface water via direct or secondary exposure pathways. Complete exposure pathways evaluated for the soil sites include root uptake (plants only), direct ingestion by terrestrial invertebrates, dermal

contact by terrestrial invertebrates, incidental ingestion by terrestrial vertebrates, inhalation of volatiles by birds (burrowing owl only), and food-chain transfer via ingestion of contaminated plants or wildlife (secondary exposure). More detail on selected exposure pathways is available in Section 3.8.3.2 of the WABOU RI report (CH2M HILL, 1997).

Contaminant exposure may cause a variety of effects in receptor species. Potential effects on plants include toxicity to target (or acceptable surrogate) species represented by adverse changes in growth rate, biomass, and reproduction (e.g., seed germination) and bioaccumulation in tissues determined by tissue residue analysis. Target prey species may exhibit toxicity through decreases in reproduction and survival, and may bioaccumulate chemicals (determined by tissue residue analysis) which can be transferred to avian and mammalian consumers. As a result of this secondary exposure, consumer species may suffer reductions in reproduction and survival. Additionally, decreases in the abundance of prey species due to toxic effects of contaminant exposure may cause adverse effects on reproduction and survival of consumer species. Effects and measurement endpoints are further discussed in Section 3.8.2.5 and Table 3-17 of the WABOU RI report (CH2M HILL, 1997).

The ecological effects assessment establishes a relationship between concentrations of COPECs and adverse effects in ecological receptors. CTVs are obtained or derived from toxicological literature, toxicity bioassays, and evaluation of bioaccumulation potential. Site-specific information and toxicological data for the identified target species were used in preference to literature sources. When toxicological information for the target species was not available, information for similar species was used and was extrapolated to the target species (mammals and birds only). In addition, toxicity information resulting from chronic studies was used in preference to acute information, unless site-specific conditions dictated use of acute information. Two upland terrestrial areas (pastural and pastural/mowed grassland habitat) were identified as reference locations, and were sampled to provide additional background information for "natural stressors" (i.e., non-contaminant factors causing unfavorable conditions) in surface soil.

The purpose of the risk characterization is to evaluate the evidence linking site contaminants with potential adverse ecological effects. This link is established by combining the exposure assessment, ecological effects assessment, toxicological data, and site chemical data through quantitative and qualitative evaluations. In the WABOU ERA, quantification of the potential ecological risk posed by a contaminant to a target species was conducted using an HQ approach. The formula for the HQ is:

HQ = EPC/CTV

The magnitude of the HQ provides a broad determination of the potential ecological toxicity/risk for a chemical. Because of the uncertainties associated with the CTV calculation process, the WABOU ERA expresses potential risk as measured by the HQ in general terms: less than 1 – no or low risk, 1 to 10 – low to medium risk, 10-100 – medium to high risk, and greater than 100 very high risk.

The results of the toxicity bioassays were used to calculate no observed effect concentrations (NOECs) for plants, terrestrial invertebrates, and aquatic organisms and bioaccumulation factors (BAFs) for plants and terrestrial invertebrates. These site-specific NOECs and BAFs were used in the derivation of the CTVs that were used in the HQ calculations. In addition,

the results of the toxicity bioassays were used to evaluate the toxicity at the locations where the samples were collected. For birds and mammals, all HQs were based on CTVs that represent no observed adverse effect levels (NOAELs) of exposure.

Qualitative evaluations focused on the reasonable potential for exposure of target species to contaminants at each site. This potential for exposure was evaluated through assessment of the magnitude of the HQ, habitat quality of the site, home range size of target species in comparison to size of site/contaminated area, frequency of detection, and use of maximum values or 95 percent upper confidence levels of the mean as EPCs. Results of these evaluations were used in conjunction with the results of the quantitative evaluations to determine if COPECs would be retained as COECs, and those COECs will be used as the basis for recommendations for evaluation of the site during the FS. (Derivation and justification of cleanup goals based on the results of the ERA are discussed below in Section 5.2.5 of this document.)

In summary, the magnitude of the HQs was used as an indication of the magnitude of potential risk, but it is not an exact estimation of risk. If a COPEC had a high HQ, but the other qualitative evaluations (i.e., habitat quality, home range, frequency of detection, and EPC) indicated that the potential for exposure to the COPEC was low, then the COPEC may not have been retained as a COEC.

Finally, uncertainties and limitations are inherent in all aspects of an ERA and include those related to problem formulation, exposure assessment, ecological effects assessment, and risk characterization. The major uncertainties and limitations associated with soil sites are presented in Section 3.8.6 of the WABOU RI report (CH2M HILL, 1997) and are summarized below:

- Problem Formulation
  - The use of duplicate samples as unique samples may under- or over-estimate potential risks because the actual sample concentrations may lie somewhere between the original sample value and the duplicate sample value.
  - The background dataset used to evaluate inorganics and organochlorine pesticides may result in an under- or over-estimation of potential risks because the inorganic dataset was limited and the organochlorine pesticide evaluation was based on historical legal applications (exact concentrations are unknown).
- Exposure Assessment
  - Plant uptake, inhalation of volatiles or particulates, and dermal contact were not quantified due to the limited toxicological information for these pathways. This may under-estimate the potential risks; however, the contribution of these pathways was expected to be minor.
  - Many species were identified as potential receptors, but habitat or other conditions may preclude these species from using the site regardless of the presence of COPECs. This may over-estimate the potential risks.

  - Assumptions regarding the exposure route (e.g., media intake, population characteristics, and exposure patterns) may not characterize exposures resulting in under- or over-estimation of potential risks.
  - Calculation of risks based on target species may under- or over-estimate potential risk because other species may have different exposure or intake than that modeled for target species.
  - Species commonly used in bioassays (e.g., earthworms, lettuce, daphnia, and amphipods) may be more or less sensitive than species found onsite resulting in over- or under-estimation, respectively, of potential risks.

- Ecological Effects Assessment
  - RTVs are subject to change, as new evidence becomes available. This may under- or over-estimate the potential risks.
  - No mathematical correlation exists to extrapolate LD50s to NOAELs; therefore, RTVs derived from LD50s or LC50s may under- or over-estimate potential risks.
  - RTVs and CTVs were derived from laboratory animal studies. Extrapolation between species from different families and classes may induce error because of differences in pharmacokinetics, target organs, and population variability. This may under- or over-estimate potential risk.
  - Toxicity values were not available for all chemicals at the site; thus, these chemicals were not addressed quantitatively. This may under-estimate the potential risks.
- Risk Characterization
  - Hazard quotients can be used as indicators of potential risk, but due to uncertainties in the derivation of CTVs, they cannot be used as an exact measurement of potential risk. This may under- or over-estimate risk.
  - Use of risk estimates for target species to characterize risks to plants and wildlife throughout the site may under- or over-estimate the potential risks because target species may be more or less sensitive to COPECs than other species.
  - Toxicity and risk were evaluated for individual chemicals. This may underestimate risks associated with exposure to multiple chemicals.

3.3 Site Descriptions

This section provides a description and history for each WABOU soil site. It identifies the COCs and COECs for surface and subsurface soil and references the appropriate sections of the WABOU RI report that pertain to the human health and ecological risk assessments.

Table II-3-2 presents the soil COCs and COECs at each site, the maximum concentrations detected, and the maximum human health risk values and ecological HQs associated with each contaminant. When reading this table, it is important to realize that the maximum contaminant concentration at a soil site does not necessarily result in the maximum

TABLE II-3-2
Chemicals of Concern, Chemicals of Ecological Concern, and Potential Risks at WABOU Soil Sites
WABOU Soil ROD
Travis AFB, California

Site Name (Designation)	Soil COC/COEC	Maximum Concentration (mg/kg) [a]	Maximum Residential Human Health Risk Value [b]	Maximum Ecological Risk Value (HQ) [c]
Building 755 (DP039)	Lead [d]	7040	**11**	34
Building 905	Chlordane	13.7	3×10^{-5}	NA [e]
(SS041)	Heptachlor epoxide	0.27	6×10^{-6}	NA
	Toxaphene	25	6×10^{-5}	NA
Building 916 (SD043)	PCB-1254	2.0	7×10^{-6}	NA
Buildings	Benzo(a)pyrene	1.2	2×10^{-5}	400
929/931/940	Benzo(b)fluoranthene	1.6	3×10^{-6}	0.49
(SD042)	Dibenzo(a,h)anthracene	0.59	1×10^{-5}	130
	Fluoranthene	3.7	**0.001**	1.1
	Indeno(1,2,3-cd)pyrene	1.0	2×10^{-6}	1.5
	Bis(2-ethylhexyl)phthalate	22	7×10^{-7}	970
	Barium	2,020	**0.2**	12
	Cadmium	280	3×10^{-6}	240
	Chromium	5,240	**0.89**	28
	Lead	14,500	**4.59**	11
	Nickel	85	1×10^{-6}	1.7
	Zinc	12,800	**0.05**	32
Landfill 3 (LF008)	Chlordane	118	3×10^{-4}	95
	Dieldrin	0.16	6×10^{-6}	1.5
	Endosulfan	0.0072	**0.0021**	54
	Heptachlor	12	1×10^{-4}	0.011
	Heptachlor epoxide	0.35	7×10^{-6}	3.7
	Methoxychlor	0.51	**0.002**	3.7
Landfill X (LF044)	Cadmium	2	9×10^{-8}	14
	Lead	107	**0.8**	2.7
	Silver	17.8	**0.001**	3.6
	Acenaphthene	2.9	**0.0008**	2.5
	Anthracene	9.1	**0.03**	1.9
	Benzo(a)anthracene	49	8×10^{-6}	33
	Benzo(a)pyrene	69	5×10^{-5}	22,000
	Benzo(b)fluoranthene	57	3×10^{-6}	9.9
	Benzo(g,h,i)perylene	38	NA	11
	Benzo(k)fluoranthene	57	4×10^{-6}	45
	Bis(2-ethylhexyl)phthalate	1,400	7×10^{-8}	16,000
Landfill X (LF044)	Chrysene	62	9×10^{-7}	11
(continued)	Dibenz(a,h)anthracene	18	6×10^{-6}	830
	Fluoranthene	100	**0.005**	31
	Indeno(1,2,3-cd)pyrene	40	2×10^{-6}	27

TABLE II-3-2
Chemicals of Concern, Chemicals of Ecological Concern, and Potential Risks at WABOU Soil Sites
WABOU Soil ROD
Travis AFB, California

Site Name (Designation)	Soil COC/COEC	Maximum Concentration (mg/kg) [a]	Maximum Residential Human Health Risk Value [b]	Maximum Ecological Risk Value (HQ) [c]
	Phenanthrene	24	NA	5.1
	Pyrene	90	**0.005**	30
Former Small Arms	Antimony	77.2	**3**	290
Range (SD045)	Copper	4,930	**2**	49
	Lead	11,000	**85**	280
Railhead Munitions	Benzo(a)pyrene	0.61	1×10^{-5}	200
Staging Area	Benzo(b)fluoranthene	2.3	4×10^{-6}	0.71
(SS046)	Benzo(a)anthracene	2	3×10^{-6}	1.3
	Benzo(k)fluoranthene	2.2	4×10^{-6}	1.7
	Fluoranthene	12	**0.005**	3.7
	Pentachlorophenol	4.4	2×10^{-6}	120
	Phenanthrene	7.3	NA	1.6
	Pyrene	9.1	**0.005**	3.0
	Cadmium	18.7	2×10^{-6}	250
	Lead	298	**1**	4.6
Cypress Lakes Golf Course	Chlordane	0.54	9×10^{-7}	15.0
(SS041)	DDE	12	4×10^{-6}	9.7
	DDT	34	2×10^{-6}	4.2
	Dieldrin	0.62	2×10^{-5}	18
	Endosulfan	0.053	**0.02**	770
Radioactive Burial Site 2/Dry Waste	Uranium-234	11,160±3,500 pCi/g [f]	1.5×10^{-5}	NA
Landfill (RW013)	Uranium-235	172.1±1.70 pCi/g	8.2×10^{-5}	NA

[a] Maximum Concentration detected in either surface or subsurface soil. The maximum concentration is not necessarily the concentration associated with the Human Health or Ecological Risk Values presented in their respective columns, as described in section 3.3.

[b] A risk value in exponential notation represents an estimate of potential excess lifetime cancer risk posed by a contaminant under residential conditions. A risk value in decimal notation represents an estimate of potential non-cancer risk posed by a contaminant under residential conditions. The potential non-cancer risk values are shown in **bold** text. These values do not represent the potential risk values under current (industrial) conditions at Travis AFB. The term "NA" indicates that the contaminant does not pose a cancer or non-cancer risk to human receptors.

[c] The ecological risk value represents an estimate of potential risk posed by a contaminant to the most sensitive target species evaluated in the WABOU Ecological Risk Assessment. Section 3.2.2 describes the Hazard Quotient (HQ). The term "NA" indicates that there is no exposure pathway between the contaminant and the target ecological receptors.

[d] This chemical does not pose an unacceptable risk to current or future site workers. Therefore, it is not considered a chemical of concern.

[e] NA = Not Applicable

[f] picoCurie per gram

potential risk posed by the contaminant. For example, a high concentration of a contaminant at the bottom of a former six-foot trench would not result in a high ecological risk, because most of the ecological receptors live in the top four feet of topsoil. Using the same example, a surface soil contaminant may pose the highest potential human health risk, due to a higher probability for exposure, even though the highest contaminant concentration is found in the subsurface soil.

3.3.1 Building 755 (DP039)

Building 755 is the Travis AFB Battery and Electric Shop. The site consists of Building 755 and a former battery neutralization sump. Past operations have included the recharging and dismantling of lead-acid and nickel-cadmium batteries. Before 1978, lead acid solutions were discharged into a sink inside Building 755. The pipeline from the sink led to a rock-filled sump approximately 65 feet northwest of the building. This practice was discontinued in 1978 when the pipeline was dismantled and reconnected to the sanitary sewer system. The sump was removed in 1993.

Surface soil around the edges of the former sump area contains lead residue. Since the lead-acid solution entered the former sump through a subsurface pipe, the presence of lead in the surface soil is attributed to the deposition of small amounts of lead-contaminated subsurface soil during the 1993 sump removal action. The Building 755 HHRA and ERA concluded that the lead residue does not pose an unacceptable risk to local workers or ecological receptors. Sections 4.1.7 and 4.1.8 of the WABOU RI report present more detailed descriptions of the HHRA and ERA for Building 755, respectively

3.3.2 Building 905 (SS041)

Building 905 is the Travis AFB Entomology Shop used to prepare pesticide and herbicide mixtures from 1983 to 1992. A 3,000-square-foot fenced enclosure outside on the east side of the building contains a washrack and a storage area. The purpose of the washrack was to wash down tractors used for towing bowsers filled with pesticides and herbicides. The washrack consisted of a concrete pad with a perimeter berm (i.e., curb) and a drain that discharged to an UST. The surface soil appears to have received pesticide residue from spray generated during the washing of pesticide applicator vehicles under windy conditions or spillage during transfer of liquids from the UST to drums.

The pesticide contaminants in the surface soil at this site include the following COCs: alpha-chlordane, gamma-chlordane, heptachlor epoxide, and toxaphene. Section 4.2.7 of the WABOU RI report presents a more detailed description of the HHRA for Building 905. No COCs or COECs are present in subsurface soil. The Building 905 ERA concluded that the presence of chemicals will not adversely affect terrestrial plants or wildlife under current conditions. Section 4.2.8 of the WABOU RI report presents a more detailed description of the ERA for this site.

3.3.3 Building 916 (SD043)

Building 916 is an emergency electrical power facility. The diesel-powered generators inside the building sit above a cellar, or sump area, that also houses sump pumps. Prior to 1991, spilled diesel fuel from the generators and wash water were pumped out of the building through one of four pipes. The pipes discharged onto small concrete spillways constructed

for erosion control on the side slope of the trapezoidal drainage channel that lies east of the building. From the spillways, wastewater flowed down the side-slope and into the drainage channel. This method of sump water disposal was discontinued in 1991.

There had been a fenced and graveled electrical transformer area on the southwest corner of the building. This area contained three liquid-filled transformers on top of a concrete pad. In 1992, one of the transformers developed a leak onto the concrete pad and ground surface. The base removed the transformers and pad in 1993.

PCB-1254 was detected in soil at concentrations that do not pose an unacceptable risk to local workers or ecological receptors. Sections 4.3.7 and 4.3.8 of the WABOU RI report present detailed descriptions of the HHRA and ERA for Building 916, respectively.

PCB-1254 was detected in a groundwater sample immediately below the transformer area, and there was a possibility that PCB-1254 in subsurface soil is a source of ongoing groundwater contamination. Additional groundwater sampling in June 1999 demonstrated that there is no PCB-contaminated groundwater migrating from the site. The *Reevaluation of Soil and Groundwater Contamination at Building 916 (SD043)* Technical Memorandum (CH2M HILL, 2000) presents a detailed discussion on the groundwater sampling effort.

3.3.4 Building 929/931/940 (SD042)

Building 929 is a small storage shed, 12 feet by 12 feet, completely enclosed with a concrete floor, currently used to store paint. Building 931, a maintenance facility for portable electrical generators, is located approximately 100 feet southeast of Building 929. A former drum storage area, or Hazardous Waste Accumulation Area (HWAA), is located immediately to the west of Building 929. The HWAA stored waste materials generated at Building 931. Both buildings drain to the adjacent channel. Semivolatile organic chemicals (SVOCs) and metals have accumulated in the channel sediment.

Building 940, located approximately 400 feet southeast of Building 929, was formerly used as a painting and paint-drying area for large equipment, and possibly components of nuclear weapons from 1953 to 1962. No radiological contamination was detected in soil or sediment samples, but SVOCs and metals resulting from painting operations were detected.

COCs detected in soil and sediment samples collected from the drainage channel near Buildings 929 and 931 include benzo(a)pyrene, dibenz(a,h)anthracene, and benzo(b)fluoranthene. Sections 4.4.7 and 4.25.7 of the WABOU RI report present a detailed description of the HHRA for Buildings 929/931/940. COECs detected include cadmium, chromium, lead, nickel, zinc, benzo(a)pyrene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, and bis(2-ethylhexyl)phalate. Sections 4.4.8 and 4.25.8 of the WABOU RI report present a detailed description of the ERA for Buildings 929/931/940.

3.3.5 Landfill 3 (LF008)

Landfill 3 consists of trenches used in the 1970s for the disposal of pesticide containers. Landfill 3 is located within the Weapons Storage Area (Bunker A) in the western portion of the WABOU. Bunker A is a secured area and is surrounded by fences. This landfill comprises about 1 acre of land, as indicated by the trenches excavated during the WABOU RI. The trenches are currently covered with fill material.

Approximately 30 cubic yards of materials were reportedly buried in trenches of varying dimensions. The WABOU RI used geophysical surveys to locate these trenches, and six out of nine exploration trenches encountered buried debris. The depth of waste observed was from 5 to 8 feet, and no lining was visible beneath the waste. The excavated material included 1- and 5-gallon metal containers, plastic and paper bags, other paper and plastic debris, 1-gallon glass bottles, and two 55-gallon drums. Labels found on some of the containers indicated that the containers originally held pesticides and herbicides. There was no evidence that other contaminants were placed into these trenches.

COCs detected in surface soil include alpha-chlordane and gamma-chlordane. These contaminants are also COECs together with dieldrin, endosulfan, endosulfan II, endosulfan sulfate, heptachlor epoxide, and methoxychlor.

COCs detected in subsurface soil include alpha-chlordane, gamma-chlordane, heptachlor, and heptachlor epoxide. There were no COECs detected in subsurface soil. Sections 4.7.7 and 4.7.8 of the WABOU RI report present a detailed description of the HHRA and ERA for Landfill 3, respectively.

3.3.6 Landfill X (LF044)

Landfill X comprises approximately 25 acres of undeveloped land located within Grazing Management Unit (GMU)-2, a 126-acre parcel of land used to graze horses. Limited information regarding past activities at Landfill X is available. It was reportedly used for disposal of used aircraft tires in the early 1960s. The tires have since been removed. Construction debris is mixed with soil in one portion of the site. In 1985, horses that were grazing became ill and were moved. The horses recovered and the area has not been used for grazing since.

The site is located within an actively used field that meets important worker safety training and construction needs on Travis AFB. The soil contaminants are attributed to the asphalt and other construction debris that is stockpiled onsite and do not impact the local groundwater.

COCs detected in surface soils include benzo(a)anthracene, benzo(a)pyrene, and dibenz(a,h)anthracene. These contaminants are also COECs together with to benzo(k)fluoranthene, fluoranthene, and pyrene.

COCs detected in subsurface soils include benzo(a)anthracene, benzo(a)pyrene, and dibenz(a,h)anthracene, benzo(k)fluoranthene. These contaminants are also subsurface COECs together with anthracene, acenaphthene, benzo(b)fluoranthene, benzo (g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, bis(2-ethlhexyl)phthalate, cadmium, lead, and silver. Sections 4.8.7 and 4.8.8 of the WABOU RI report present a detailed description of the HHRA and ERA for Landfill X, respectively.

3.3.7 Former Small Arms Range (SD045)

The Former Small Arms Range comprises 2.8 acres of flat, grassy terrain; no traces of previous firing range activities are visible. Periodically the site is disked. The location of the site was determined from historical photographs.

Lead is the COC and a COEC at this site, both in surface and subsurface soil. Other COECs in surface soil are antimony and copper. Sections 4.10.7 and 4.10.8 of the WABOU RI report present a detailed description of the HHRA and ERA for the Former Small Arms Range, respectively.

3.3.8 Railhead Munitions Staging Area (SS046)

The Railhead Munitions Staging Area site consists of a railroad track and concrete pad that formerly served as a railhead at the south terminus of a spur off the Northern Sacramento Railroad. This site served as a weapons-handling facility from 1953 to 1962.

COCs detected in surface soil include benzo(a)pyrene, benzo(b)fluoranthene, benzo(a)anthracene, and benzo(k)fluoranthene. COCs detected in subsurface soil include cadmium, lead, benzo(a)pyrene, benzo(k)fluoranthene, fluoranthene, phenanthrene, pyrene, and pentachlorophenol. All of the COCs were detected in the vicinity of the railroad tracks. Section 4.12.7 of the WABOU RI report presents a detailed description of the HHRA for the Railhead Munitions Staging Area.

COECs were detected in isolated areas surrounding the concrete pad. The COECs include benzo(a)pyrene, benzo(k)fluoranthene, fluoranthene, pentachlorophenol, phenanthrene, pyrene, cadmium, and lead. Section 4.12.8 of the WABOU RI report presents a detailed description of the ERA for this site.

3.3.9 Cypress Lakes Golf Course (Annex 10) (SS041)

Annex 10 is an active facility consisting of an 18-hole golf course with an associated maintenance yard, and the Travis AFB water supply wellfield. The maintenance yard was constructed in 1974 and includes several buildings, garages, and storage areas. It also has several concrete pads used for cleaning and servicing vehicles and mixing herbicides and pesticides.

COCs detected in surface soil samples include dieldrin and DDE. These contaminants are also considered COECs together with DDT, alpha-chlordane, gamma-chlordane, endosulfan, and endosulfan sulfate. Sections 4.18.7 and 4.18.8 of the WABOU RI report present a detailed description of the HHRA and ERA for the Cypress Lakes Golf Course, respectively. Section 2.2.3 (Removal Actions) describes the removal action that removed the above chemicals from the maintenance yard.

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

This site consists of a fenced backfilled trench, approximately 50 feet by 100 feet. This area was formerly used to bury low-level radioactive wastes generated during maintenance activities for nuclear weapons.

The COC for this site is enriched uranium (U-234 and U-235), detected in subsurface soil. No COECs were detected. Sections 4.21.7 and 4.21.8 of the WABOU RI report present a detailed description of the HHRA and ERA for the Radioactive Burial Site 2/Dry Waste Landfill, respectively.

4.0 WABOU Feasibility Study Summary

Travis AFB conducted an FS in the WABOU to assist in selecting remedial actions for the contaminated WABOU soil sites. The primary objectives of this study were to:

1. Identify potential response actions, technologies, and process options to address the potential risks in the WABOU
2. Screen the technologies and process options
3. Assemble feasible and appropriate remedial alternatives
4. Provide detailed evaluations of the remedial alternatives
5. Perform a comparative analysis of the alternatives

The FS can be divided into three main phases:

1. The Initial Screening of Alternatives
2. The Detailed Analysis of Alternatives
3. The Comparative Analysis of Alternatives

4.1 Initial Screening of Alternatives

The purpose of the Initial Screening of Alternatives (ISA) is to develop an appropriate range of remedial alternatives that would protect human health and the environment at the nine soil sites identified in the WABOU RI.

This is necessary because of the large number of remedial technologies available to handle a wide variety of contaminants under various site conditions.

With all of the combinations of remedial options available, the evaluation process could easily become too complicated and cumbersome. To prevent this, the ISA screened out those technologies that were not appropriate for the contaminants and site conditions found in the WABOU. Then it used the remaining technologies to develop the most promising remedial alternatives.

The alternatives screening process consists of the following seven steps:

Step 1: Establish Remedial Action Objectives. Remedial Action Objectives (RAO) specify the extent of cleanup required to protect human health and the environment. The RAO for a site takes into account the contaminant that poses the potential risk, the exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route.

Step 2: Develop General Response Actions. General response actions describe the broad range of actions that will satisfy the RAOs.

Step 3: Identify Potential Remedial Technologies and Process Options. Many potentially applicable technology types are available to remediate all categories of contaminants under various site conditions. Some technologies have a proven record of performance; others are promising but have not been tested under all field conditions. General technology types that

can be used to implement a general response action are referred to as remedial technologies. Specific technology types within a remedial technology are called process options. An example of a remedial technology for an administrative action is access restrictions; an example of a process option within this remedial technology is fencing. Information on remedial technologies and process options is acquired through database searches and technical journal reviews. This review of all potentially applicable technologies ensures that the best technologies are not overlooked early in the FS process.

Step 4: Screen Process Options for Technical Implementability. In this step the list of technology and process options is reduced by evaluating the technical implementability of the options. Technical implementability refers to the ability of the remedial technology or process option to meet an RAO. The result of this step is a list of technologies and process options that are capable of addressing contaminant types found in the WABOU under existing site conditions.

Step 5: Technology Evaluation and Selection of Representative Process Options. The process options that survived the Step 4 screening are evaluated for administrative implementability, effectiveness, and cost. Examples of administrative implementability are the ability to obtain the necessary permits and the availability of necessary equipment and workers to implement the process option. This evaluation further reduces the list of process options to those that can be implemented, that are effective in treating the contaminants in the WABOU, and that are not cost-prohibitive.

Even after the above evaluations are completed, a number of process options could be implemented to meet the RAOs. From the list of remaining process options within each remedial technology, a representative process option is selected. The representative process option is used to develop the alternatives, but the other equally promising process options are retained.

Step 6: Assemble Remedial Alternatives. The representative process options are used to assemble remedial alternatives that represent a range of general response actions specifically for the WABOU sites.

Step 7: Screen Remedial Alternatives. In this final step of the ISA the remedial alternatives are again screened to ensure they meet three criteria: protectiveness of human health and the environment, implementability, and cost-effectiveness.

The WABOU ISA resulted in the development of seven potential soil remedial alternatives. Table II-4-1 provides a brief description of these potential soil remedial alternatives.

TABLE II-4-1
Potential Soil Remedial Alternatives
WABOU Soil ROD
Travis AFB, California

Cleanup Alternative	Description
S1 - No Action	Federal regulations require the use of this alternative as a starting point for comparing the other alternatives. No soil treatment takes place.
S2 – Land Use and Access Restrictions	Land use restrictions are used to prohibit the excavation or disturbance of contaminated soil and prevent residential use where residential cleanup levels are exceeded. Fences and signs are posted to prevent access.
S3 – Containment: Capping	A multilayer cap is placed over contaminated soil to prevent access to the soil. A cap is an impermeable covering that is made of layers of compacted clay and/or synthetic material. Land use and access restrictions are included to protect the cap.
S4 – Excavation/Treatment/ On-base Consolidation	Contaminated soil is excavated, treated using a chemical stabilization process, and placed in an on-base Corrective Action Management Unit (CAMU). The excavation is filled with uncontaminated soil or imported fill. Land use and access restrictions may be included, depending on the soil cleanup level that is attained.
S5 – Excavation/Off-base Disposal	Contaminated soil is excavated and transported by truck to an off-base landfill. The excavation is filled with uncontaminated soil or imported fill. Land use and access restrictions may be included, depending on the soil cleanup level that is attained.
S6 – Excavation/On-base Consolidation	Contaminated soil is excavated and placed in an on-base CAMU. The excavation is filled with uncontaminated soil or imported fill. Land use and access restrictions may be included, depending on the soil cleanup level that is attained.
S7 - In Situ Treatment/ Capping	Contaminated soil is treated using a chemical stabilization process. The resulting soil/slurry mix is covered with an asphalt cap, surrounded by a fence, and protected with land use restrictions.

4.2 Corrective Action Management Unit

The WABOU ISA describes the Corrective Action Management Unit (CAMU), an important strategy at Travis AFB for the on-base consolidation of contaminated soil. A CAMU is a designated area within a facility that is designed to carry out a corrective action, such as the management of contaminated soil. The state and federal CAMU regulations were written to give regulatory agencies greater flexibility in selection and implementing the most effective and appropriate waste management strategy for the cleanup of large complex facilities, such as Travis AFB.

The final CAMU rules were published in the Federal Register on February 16, 1993 (EPA, 1993 - Federal Register "40 Code of Federal Regulations [CFR] 260, et al., Corrective Action Management Units and Temporary Units; Corrective Action Provisions; Final Rule." Volume 58, No. 29. February 16, 1993) and are found in 40 CFR 264.552. These regulations have been adopted under the California RCRA program and are found in Title 22, California Code of Regulations (CCR), Section 66264.552. In addition, EPA has adopted a new CAMU regulation (67 Fed. Reg. 2961, Jan. 22, 2002) that allows a facility to use the previous CAMU regulation if a substantially complete CAMU proposal was submitted prior to November 20, 2000. The regulatory agencies have concurred that Travis AFB has met the substantive portion of this requirement prior to the deadline.

The CAMU allows for more flexibility when managing remediation wastes and leads to expeditious implementation of protective and cost-effective remedies at CERCLA sites. For instance, consolidation or placement of remediation wastes into the CAMU would not constitute creation of a waste management unit subject to minimum technology requirements (MTR). In addition, remediation wastes managed within the CAMU, which were generated as part of a corrective action at the facility, would not be subject to RCRA permitting requirements. The waste may be placed within the CAMU without pre-treatment to the technology-based levels established under the RCRA land disposal restrictions (LDR) programs. However, the CAMU must be protective of human health and the environment and will require monitoring in accordance with Title 27 CCR. The CAMU cover will also be designed to meet Title 27 CCR substantive cover requirements.

There are several advantages of the CAMU approach:

- The consolidation of contaminated soil would provide needed material for the construction of the LF007 cap. This would reduce the amount of clean soil that would need to be purchased.
- A large quantity of contaminated soil would never have to leave Travis AFB, avoiding the transport of this soil by truck on major roads and highways. This would reduce air emissions, noise, and the risk of vehicle accidents associated with the cleanup actions.
- The amount of soil that would have to go to commercial off-base landfills would be reduced. This would extend the functional life of these landfills.
- The amount of paperwork generated to track the contaminated soil would be significantly reduced, resulting in a project management cost reduction.
- The use of a CAMU would significantly reduce the cost of cleaning up the other IRP soil sites by reducing or eliminating off-base landfill disposal fees.

Landfill 2 (LF007) is a soil site in the NEWIOU that has been selected as a favorable location for the CAMU. This landfill was used from the 1950s through the 1970s as a Base municipal landfill. As part of the closure plan for the landfill, a large quantity of soil must be used to fill in depressions in the soil cover over the existing waste to provide a foundation for a cap. The CAMU design calls for a four-foot evapotranspiration cap that will prevent people, animals, and plants from coming in contact with the waste. The cap also limits infiltration of rainwater, thereby reducing leaching of contaminants and protecting groundwater. In order for Travis AFB to place contaminated soil within the CAMU as part of the foundation for the cap over part of LF007, the contaminated soil must meet acceptance criteria that are protective of groundwater beneficial use objectives. The consolidation requirements are used to ensure compatibility between contaminated soil from different sites as well as compatibility with existing landfill waste and cap materials.

In evaluating whether the use of a CAMU for onsite consolidation of remediation wastes is a viable option, the following seven criteria must be considered and met:

1. The CAMU must facilitate the implementation of reliable, protective, and cost-effective corrective action measures.

2. Waste management activities associated with the CAMU shall not create unacceptable risks to humans or the environment.
3. The CAMU shall incorporate uncontaminated areas only if the inclusion of such areas allows better protection.
4. Areas within the CAMU, where wastes remain in place after closure of the CAMU, shall be managed and contained to minimize the potential for future releases.
5. The CAMU shall expedite the implementation of corrective measures.
6. The CAMU shall enable the use of treatment technologies to enhance long-term effectiveness of corrective actions by reducing the toxicity, mobility, or volume of wastes.
7. To the extent practicable, the CAMU shall minimize the land areas where wastes will remain in place after closure of the CAMU.

To demonstrate that the contaminated soil to be placed in the CAMU will not impact the underlying groundwater in excess of beneficial use objectives (MCLs), the Air Force conducted a leachability assessment using the California Waste Extraction Test modified to use deionized water as the extractant. A site-specific dissociation constant was calculated by dividing the leachate concentration by the total soil concentration. The CAMU acceptance levels were calculated using the product of the water quality objective, the dissociation constant, and a dilution/attenuation factor as modeled in consideration of the landfill cover and the CAMU cap design. The *Corrective Action Management Unit Soil Acceptance Criteria* (Radian, 2000) provides a more detailed description of the leachate assessment.

4.3 Detailed Analysis of Alternatives

The purpose of the Detailed Analysis of Alternatives is to analyze the alternatives identified in the ISA and present the relevant information needed to select the appropriate remedies. This is accomplished by evaluating each alternative against the nine criteria provided under CERCLA. Figure II-4-1 identifies and defines the nine evaluation criteria. The *Community Acceptance* and *State Acceptance* criteria are addressed in this WABOU Soil ROD on the basis of acceptance of the WABOU Soil Proposed Plan and the evaluation of comments received during the July 8, 1998 to August 8, 1998 public comment period.

4.4 Comparative Analysis of Alternatives

In the final phase of the FS, the soil remediation alternatives are evaluated in accordance with the requirements of each CERCLA criterion. This evaluation identifies the relative strengths and weaknesses of each alternative to determine the preferred alternatives at each site. The following subsections provide a ranking of how alternatives meet CERCLA criteria; discussions are organized with the most favorable alternatives first. Section 9.0 of the WABOU FS (CH2M HILL, 1998) presents the comparative analysis of soil alternatives in greater detail. Tables II-4-2 through II-4-7 provide summary qualitative evaluations of the performance of each soil alternative on a site-by-site basis, using five of the CERCLA criteria. A remedial alternative must meet the Overall Protection of Human Health and the

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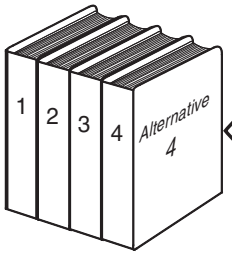
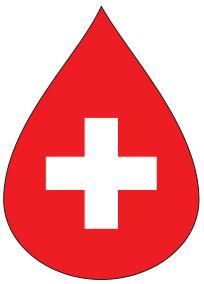
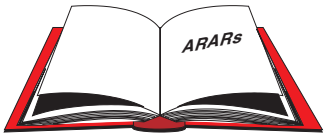
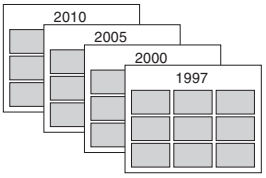




1. **Overall Protection of Human Health and the Environment**
Addresses whether a remedy provides adequate protection of human health and the environment and describes how risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.



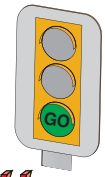
2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)**
Addresses whether a remedy will meet all ARARs [federal and state environmental statutes] and/or provide grounds for invoking a waiver.



3. **Long-term Effectiveness and Permanence**
Refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean up goals have been met.

4. **Reduction of Toxicity, Mobility, or Volume (TMV) Through Treatment**
Refers to the anticipated ability of a remedy to reduce the TMV of the hazardous components present at the site.

5. **Short-term Effectiveness**
Addresses the period of time needed to complete the remedy, and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until the clean up goals are achieved.

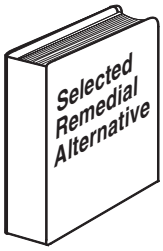


6. **Implementability**
Refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to carry out a particular option.

7. **Cost**
Evaluates the estimated capital and operation and maintenance costs of each alternative.

8. **State Acceptance**
Indicates whether, based on its review of the information, the state concurs with, is opposed to, or has no comment on the preferred alternative.

9. **Community Acceptance**
Indicates whether community concerns are addressed by the remedy and whether the community has a preference for a remedy. Although public comment is an important part of the final decision, EPA is compelled by law to balance community concerns with all of the previously mentioned criteria.



NOTE
The nine criteria are from the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988) and provide support for the selected Remedial Alternative.

FIGURE II-4-1
NINE EVALUATION CRITERIA
WEST/ANNEXES/BASEWIDE OPERABLE UNIT (WABOU)
SOIL ROD
TRAVIS AIR FORCE BASE, CALIFORNIA

E122001003RDD_902 (12/10/01)

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TABLE II-4-2
Summary of Comparative Analysis of Soil Alternatives — by Criterion
Long-term Effectiveness and Permanence
WABOU Soil ROD
Travis AFB, California

	Soil Alternative						
Site	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
B905	o	o	⊗	•	•	•	-
B916	o	-	-	•	•	•	⊗
B929/931 & 940	o	⊗	-	•	•	•	-
LF03	o	o	⊗	•	•	•	⊗
LF0X	o	⊗	⊗	•	•	•	⊗
SAR1	o	⊗	⊗	•	•	•	-
RMSA	o	⊗	-	•	•	•	-
AX10	o	⊗	⊗	•	•	•	-
RW13	o	⊗	-	-	•	-	⊗

Legend: Relative performance of the alternative at each site.

- • Better satisfies criterion
- ⊗ Moderately satisfies criterion
- o Poorly satisfies criterion
- - Alternative not applicable at this site

B905 = Building 905 (SS041)
B916 = Building 916 (SD043)
B929/931 & 940 = Buildings 929/931 and 940 (SD042)
LF03 = Landfill 3 (LF008)
LF0X = Landfill X (LF044)
SAR1 = Former Small Arms Range (SD045)
RMSA = Railhead Munitions Staging Area (SS046)
AX10 = Cypress Lakes Golf Course (Annex 10, SS041)
RW13 = Radioactive Burial Site 2/Dry Waste Landfill (RW013)

Alternative S1 — No-Action
Alternative S2 — Land Use and Access Restrictions
Alternative S3 — Containment: Capping
Alternative S4 — Excavation/Treatment/On-base Consolidation
Alternative S5 — Excavation/Off-base Disposal
Alternative S6 — Excavation/On-base Consolidation
Alternative S7 — In situ Treatment/Capping

TABLE II-4-3
Summary of Comparative Analysis of Soil Alternatives — by Criterion
Reduction of Toxicity, Mobility, or Volume through Treatment
WABOU Soil ROD
Travis AFB, California

	Soil Alternative						
Site	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
B905	o	o	⊗	•	•	•	-
B916	o	-	-	•	•	•	⊗
B929/931 & 940	o	o	-	•	•	•	-
LF03	o	o	⊗	•	•	•	⊗
LF0X	o	o	⊗	•	•	•	⊗
SAR1	o	o	⊗	•	•	•	-
RMSA	o	o	-	•	•	•	-
AX10	o	o	⊗	•	•	•	-
RW13	o	o	-	-	•	-	⊗

Legend: Relative performance of the alternative at each site.

• Better satisfies criterion

⊗ Moderately satisfies criterion

o Poorly satisfies criterion

- Alternative not applicable at this site

B905 = Building 905 (SS041)

B916 = Building 916 (SD043)

B929/931 & 940 = Buildings 929/931 and 940 (SD042)

LF03 = Landfill 3 (LF008)

LF0X = Landfill X (LF044)

SAR1 = Former Small Arms Range (SD045)

RMSA = Railhead Munitions Staging Area (SS046)

AX10 = Cypress Lakes Golf Course (Annex 10, SS041)

RW13 = Radioactive Burial Site 2/Dry Waste Landfill (RW013)

Alternative S1 — No-Action
Alternative S2 — Land Use and Access Restrictions
Alternative S3 — Containment: Capping
Alternative S4 — Excavation/Treatment/On-base Consolidation
Alternative S5 — Excavation/Off-base Disposal
Alternative S6 — Excavation/On-base Consolidation
Alternative S7 — In situ Treatment/Capping

TABLE II-4-4
Summary of Comparative Analysis of Soil Alternatives — by Criterion
Short-term Effectiveness
WABOU Soil ROD
Travis AFB, California

	Soil Alternative						
Site	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
B905	o	•	•	⊗	⊗	⊗	-
B916	o	-	-	⊗	⊗	⊗	•
B929/931 & 940	o	•	-	⊗	⊗	⊗	-
LF03	o	•	•	⊗	⊗	⊗	•
LF0X	o	•	⊗	⊗	⊗	⊗	⊗
SAR1	o	•	•	⊗	⊗	⊗	-
RMSA	o	•	-	⊗	⊗	⊗	-
AX10	o	•	•	⊗	⊗	⊗	-
RW13	o	•	-	-	⊗	-	•

Legend: Relative performance of the alternative at each site.

• Better satisfies criterion

⊗ Moderately satisfies criterion

o Poorly satisfies criterion

- Alternative not applicable at this site

B905 = Building 905 (SS041)

B916 = Building 916 (SD043)

B929/931 & 940 = Buildings 929/931 and 940 (SD042)

LF03 = Landfill 3 (LF008)

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AX10 = Cypress Lakes Golf Course (Annex 10, SS041)

RW13 = Radioactive Burial Site 2/Dry Waste Landfill (RW013)

Alternative S1 — No-Action
Alternative S2 — Land Use and Access Restrictions
Alternative S3 — Containment: Capping
Alternative S4 — Excavation/Treatment/On-base Consolidation
Alternative S5 — Excavation/Off-base Disposal
Alternative S6 — Excavation/On-base Consolidation
Alternative S7 — In situ Treatment/Capping

TABLE II-4-5
Summary of Comparative Analysis of Soil Alternatives — by Criterion
Implementability
WABOU Soil ROD
Travis AFB, California

	Soil Alternative						
Site	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
B905	o	⊗	⊗	⊗	•	⊗	-
B916	o	-	-	⊗	•	⊗	⊗
B929/931 & 940	o	⊗	-	⊗	•	⊗	-
LF03	o	⊗	⊗	⊗	•	⊗	⊗
LF0X	o	o	o	⊗	•	⊗	o
SAR1	o	⊗	⊗	⊗	•	⊗	-
RMSA	o	⊗	-	⊗	•	⊗	-
AX10	o	o	⊗	⊗	•	⊗	-
RW13	o	⊗	-	-	•	-	⊗

Legend: Relative performance of the alternative at each site.

- • Better satisfies criterion
- ⊗ Moderately satisfies criterion
- o Poorly satisfies criterion
- - Alternative not applicable at this site

B905 = Building 905 (SS041)
B916 = Building 916 (SD043)
B929/931 & 940 = Buildings 929/931 and 940 (SD042)
LF03 = Landfill 3 (LF008)
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RMSA = Railhead Munitions Staging Area (SS046)
AX10 = Cypress Lakes Golf Course (Annex 10, SS041)
RW13 = Radioactive Burial Site 2/Dry Waste Landfill (RW013)

Alternative S1 — No-Action
Alternative S2 — Land Use and Access Restrictions
Alternative S3 — Containment: Capping
Alternative S4 — Excavation/Treatment/On-base Consolidation
Alternative S5 — Excavation/Off-base Disposal
Alternative S6 — Excavation/On-base Consolidation
Alternative S7 — In situ Treatment/Capping

TABLE II-4-6
Summary of Comparative Analysis of Soil Alternatives
Relative Performance of Soil Alternatives - by Cost
WABOU Soil ROD
Travis AFB, California

	Total Present Worth ($ x 1,000)						
Site	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
B905	-	-	65.8	90.6	56.7	31.8	-
B916	-	-	-	77.0	43.0	31.7	436.2
B929/931 & 940	-	63.1	-	197.6	175.7	86.0	-
LF03	-	-	451.0	1,641.0	4,162.0	336.0	3,045.0
LF0X	-	139.3	3,414.0	4,025.0	13,620.0	844.0	10,540.0
SAR1	-	48.3	1,639.0	833.0	2,255.0	186.3	-
RMSA	-	17.3	-	177.0	126.0	51.2	-
AX10	-	17.8	154.0	155.6	130.0	47.7	-
RW13	-	-	-	-	131.6	-	496.1

Legend: Relative performance of the alternative at each site.

- Alternative not applicable at this site

B905 = Building 905 (SS041)

B916 = Building 916 (SD043)

B929/931 & 940 = Buildings 929/931 and 940 (SD042)

LF03 = Landfill 3 (LF008)

LF0X = Landfill X (LF044)

SAR1 = Former Small Arms Range (SD045)

RMSA = Railhead Munitions Staging Area (SS046)

AX10 = Cypress Lakes Golf Course (Annex 10, SS041)

RW13 = Radioactive Burial Site 2/Dry Waste Landfill (RW013)

Alternative S1 — No-Action
Alternative S2 — Land Use and Access Restrictions
Alternative S3 — Containment: Capping
Alternative S4 — Excavation/Treatment/On-base Consolidation
Alternative S5 — Excavation/Off-base Disposal
Alternative S6 — Excavation/On-base Consolidation
Alternative S7 — In situ Treatment/Capping

Note: Present worth values are cost estimates that take into account the direct (i.e., construction and O&M) and indirect (i.e., project management and overhead) costs as well as the inflation rate.

TABLE II-4-7
Summary of Comparative Analysis of Soil Alternatives
Relative Performance of Soil Alternatives
WABOU Soil ROD
Travis AFB, California

	Overall Performance of Soil Alternative						
Site	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
B905	o	⊗	⊗	⊗	⊗	•	-
B916	o	-	-	⊗	⊗	•	⊗
B929/931 & 940	o	o	-	⊗	⊗	•	-
LF03	o	o	⊗	⊗	⊗	•	⊗
LF0X	o	o	⊗	⊗	⊗	•	⊗
SAR1	o	o	⊗	⊗	⊗	•	-
RMSA	o	o	-	⊗	⊗	•	-
AX10	o	o	⊗	⊗	⊗	•	-
RW13	o	⊗	-	-	•	-	⊗

Legend: Relative performance of the alternative at each site.

- • Better satisfies criterion
- ⊗ Moderately satisfies criterion
- o Poorly satisfies criterion
- \- Alternative not applicable at this site

B905 = Building 905 (SS041)
B916 = Building 916 (SD043)
B929/931 & 940 = Buildings 929/931 and 940 (SD042)
LF03 = Landfill 3 (LF008)
LF0X = Landfill X (LF044)
SAR1 = Former Small Arms Range (SD045)
RMSA = Railhead Munitions Staging Area (SS046)
AX10 = Cypress Lakes Golf Course (Annex 10, SS041)
RW13 = Radioactive Burial Site 2/Dry Waste Landfill (RW013)

Alternative S1 — No-Action
Alternative S2 — Land Use and Access Restrictions
Alternative S3 — Containment: Capping
Alternative S4 — Excavation/Treatment/On-base Consolidation
Alternative S5 — Excavation/Off-base Disposal
Alternative S6 — Excavation/On-base Consolidation
Alternative S7 — In situ Treatment/Capping

Environment as well as the Compliance with ARARs criteria to be selected as a remedy. Section 5.5.5 (State and Community Acceptance) addresses the way that the remedies in this soil ROD meet the State Acceptance and Community Acceptance criteria.

4.4.1 Overall Protection of Human Health and the Environment

The *Overall Protection of Human Health and the Environment* criterion serves as a threshold determination that must be met by any alternative for it to be selected as a remedy. Each of the soil alternatives, except for Alternative S1 (No Action), are protective of human health and the environment.

4.4.2 Compliance with ARARs

The *Compliance with ARARs* criterion also serves as a threshold determination that must be met by any alternative for it to be selected as a remedy. Each of the soil alternatives, except for Alternative S1 (No Action), will comply with ARARs.

4.4.3 Long-Term Effectiveness and Permanence

The *Long-term Effectiveness and Permanence* criterion is a measure of two principal factors: (1) the magnitude of residual risk; and (2) the adequacy and reliability of controls used to manage treatment residuals. Each of the soil alternatives, except for Alternative S1 (No Action), achieves some measure of long-term effectiveness and permanence. Table II-4-2 provides a summary qualitative evaluation of the performance of each of the soil alternatives against this criterion on a site-by-site basis.

4.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Each of the soil treatment alternatives, including Alternative S1 (No Action), will achieve varying degrees of *Reduction in Contaminant Toxicity, Mobility, or Volume*. However, Alternative S1 will not achieve reduction through treatment. Table II-4-3 provides a summary qualitative evaluation of the performance of each of the soil alternatives against this criterion on a site-by-site basis.

4.4.5 Short-Term Effectiveness

The *Short-term Effectiveness* criterion is a measure of the protection afforded by each alternative during the construction and implementation process. As such, the time until the remedial action objectives are achieved is an important component of the criterion. Each of the soil alternatives, except for Alternative S1 (No Action), is effective in the short term to some degree. Table II-4-4 provides a summary qualitative evaluation of the soil alternatives against this criterion on a site-by-site basis.

4.4.6 Implementability

The *Implementability* criterion evaluates the technical and administrative difficulties associated with implementing each alternative. An important component of technical implementability is consideration of the reliability of the technology. Each of the soil alternatives is technically implementable. For Alternative S6, the most important issue related to administrative implementability is when Travis AFB will obtain a CAMU

designation. Table II-4-5 provides a summary qualitative evaluation of the soil alternatives against this criterion on a site-by-site basis.

4.4.7 Cost

Table II-4-6 presents the total project cost estimates for each soil alternative at each site. These *Cost* criterion estimates are a total of the site-specific capital and annual Operations and Maintenance (O&M) cost estimates for implementing the alternative.

Detailed cost summary tables are provided in Appendix A of the WABOU FS (CH2M HILL, 1998). These summary tables were developed using the Remedial Action Cost Engineering and Requirements System (RACER Version 3.2). RACER is a PC-based environmental cost estimating system developed by the U.S. Air Force. Section A.4 of the WABOU FS presents the assumptions on which the cost estimates are based.

4.4.8 Conclusions

The Comparative Analysis did not recommend the implementation of a specific alternative for each WABOU site. It described the overall performance and cost of each soil alternative at each site. The paragraphs below summarize the findings of this analysis. The relative performance of each soil alternative at each applicable WABOU site is summarized in Table II-4-7.

Alternative S6 – Excavation/On-base Consolidation has the highest degree of overall performance among the soil alternatives for 9 of the 10 WABOU soil sites. This alternative provides a high degree of protection to human health and the environment. Additionally, except for Alternative S2 – Land Use and Access Restrictions, it is the least costly of the soil alternatives. However, Alternative S6 requires the designation of a CAMU at Travis AFB. Without this designation, the alternative cannot be implemented. Travis AFB is actively pursuing a CAMU designation for Landfill 2 (LF007) in the NEWIOU. If successful, this CAMU designation will be promulgated in the NEWIOU Soil, Sediment, and Surface Water Record of Decision.

Alternative S5 – Excavation/Off-base Disposal and **Alternative S4 –** Excavation/ Treatment/On-base Consolidation have similar levels of overall performance at applicable WABOU soil sites. Alternative S5 has a slightly higher degree of overall performance, because it is not subject to potential implementation problems associated with obtaining a CAMU designation. However, these two alternatives have relatively high costs compared to Alternative S6. Offsite landfill disposal costs are high under Alternative S5, and soil treatment costs are high under Alternative S4.

Alternative S3 – Containment: Capping and **Alternative S7 –** In situ Treatment/Capping have similar levels of overall performance. Both alternatives provide adequate protection of human health and the environment. However, both alternatives are less implementable than Alternatives S4, S5, or S6 because of future land use considerations. At several WABOU soil sites these alternatives may be incompatible with future land use at Travis AFB. Also, these alternatives do not provide final solutions, because contaminated soil is left in place. Both capping and in situ treatment would likely require long-term monitoring to ensure continued protectiveness.

Alternative S2 – Land Use and Access Restrictions provides a low level of overall performance compared to the alternatives mentioned above. This alternative allows contaminated soil to remain in place. Land use and access restrictions reduce exposures to humans but provide relatively little protection of ecological receptors. The cost of implementing Alternative S2 is lower than the alternatives mentioned above.

By definition, **Alternative S1 –** No Action provides the lowest level of overall performance of any of the alternatives. There is no cost to implement this alternative.