PART II

5.0 Selected Remedial Actions

The Air Force and U.S. EPA evaluated and co-selected remedial actions for the 18 NEWIOU soil, sediment, and surface water sites. The State of California, through the Cal-EPA/DTSC and the San Francisco Bay RWQCB, concurs with the selected soil, sediment, and surface water remedies. Each of the selected remedies will be protective of human health and the environment and will comply with ARARs. The remedies are effective at reducing contaminant exposure, are implementable and cost-effective, and are acceptable to the public. The Air Force based the selection of these remedial actions on environmental and land use considerations and the nature and extent of contamination found at each site. U.S. EPA guidance and criteria evaluations and available technology were additional factors used in the selection process.

The Air Force is responsible for implementing, maintaining, and monitoring the remedial actions identified herein for the duration of the remedies selected in this ROD. It will exercise this responsibility in accordance with CERCLA and the NCP.

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

The following subsections present the selected remedial action at each site, the soil or sediment cleanup levels for the sites that require active remedial actions, and the rationale for the selection. Figures showing conceptual designs for the selected soil remedial actions are included following the rationale for the selected remedy.

5.1 Description of Selected Remedial Alternatives

The Air Force evaluated six potential remedial alternatives to address contaminated surface water in the NEWIOU and seven potential remedial alternatives to address contaminated soil and sediment in the NEWIOU. Table II-5-1 presents a description of the evaluated remedial alternatives.

Subsequent to the evaluation of alternatives, the Air Force selected remedial actions for the 18 NEWIOU sites addressed in this ROD. Alternatives 10, 16, 17, and 18 were selected remedial actions, as further described hereafter.

5.1.1 Alternative 10—No Action for Surface Water

Alternative 10 means no physical or administrative action is required for surface water at a site. The surface water at the site does not present an unacceptable risk to ecological or human receptors. While not a remedy implemented under this ROD, extraction and treatment of groundwater, implemented under the NEWIOU and WABOU Groundwater IRODs, addresses contaminated groundwater and prevents possible contamination movement to

Table II-5-1
Evaluated Remedial Alternatives
North/East/West Industrial Operable Unit Soil, Sediment, and Surface Water Record of Decision, Travis AFB, California

Cleanup Alternative[a]	Description
Surface Water Remedial Alternatives[a]	
10. No Action	Federal regulations require the use of this alternative as a starting point for comparing the other alternatives. Under this alternative, no surface water treatment takes place.
11. Institutional Actions	Surface water would be monitored to determine the levels of contamination over time. No active treatment of the water is involved. The Base General Plan will be updated after the ROD is signed to note that the surface water is being monitored and not for use.
12. Collection Sump, Ion Exchange, Activated Carbon, Discharge to Union Creek	Water is pumped into a collection sump, where it is held and treated. Two forms of treatment are used. First, ion exchange uses special resins to remove metals from the water. Second, the water, still contaminated with organic contaminants, is then passed through charcoal filters. The contaminants adsorb onto the charcoal, which can later be regenerated to remove the contaminants. Treated water is discharged (in accordance with effluent discharge limits) to Union Creek, which empties into the Suisun Marsh via the Hill Slough.
13. Collection Sump, Activated Carbon, Discharge to Union Creek	Same as Alternative 12, without ion exchange. This alternative would be used at sites without metal contamination.
14. Slip-Lining and Collaring Storm Sewer	During slip-lining, a plastic pipe is installed within an existing deteriorated storm sewer pipe, thereby limiting infiltration of contaminated groundwater into the storm sewer system. Collars are external barriers installed along the pipe to prevent contaminated water from moving through the gravel surrounding the pipe.
15. Source Control	Source control relies on treating contamination at the source, before it is discharged into a creek. Pump and treat interim actions to address contaminated groundwater will prevent possible contaminant movement to surface water. Periodic cleanout of storm sewers and sumps also will prevent contaminants from reaching the creek.
Soil and Sediment Remedial Alternatives[a]	
16. No Action	Federal regulations require the use of this alternative as a starting point for comparing the other alternatives. Under this alternative, no soil or sediment treatment takes place.
17. Land Use Controls	Future land use and soil and sediment disturbance activities are restricted. The Base General Plan will be updated after the ROD is signed to reflect any specific restrictions required at each site.
18. Excavation	Contaminated soils are excavated and removed to a designated CAMU at Travis AFB or to an off-base landfill.
19. Cap	The site is covered with a material such as asphalt, concrete, synthetic membrane, or soil and /or clay. For landfill areas, the area also is graded to control runoff, thereby minimizing the potential for rainwater to move through contaminated soil, to protect the groundwater below from contamination.
20. Excavation, Ex Situ High Temperature Thermal Treatment, Disposal at Landfill	Contaminated soil is excavated and treated at high temperatures (for example, in a rotary kiln incinerator). As a result, organic contaminants are destroyed through conversion to carbon dioxide, water, and hydrochloric acid. The acid is then removed. Treated soil is placed at the designated CAMU or at an off-base landfill.

Table II-5-1 (Cont'd)
Evaluated Remedial Alternatives
North/East/West Industrial Operable Unit Soil, Sediment, and Surface Water Record of Decision, Travis AFB, California

Cleanup Alternative[a]	Description
Soil and Sediment Remedial Alternatives[a] (cont'd)	
21. In Situ Soil Vapor Extraction (SVE), Off-Gas Treatment	Contaminated soil vapor is extracted from the ground to remove contaminants. The contaminated vapors are then treated by catalytic or thermal oxidation, which converts VOCs to carbon dioxide, water, and hydrochloric acid. The acid is then removed.
22. In Situ Bioventing	Air is injected below the ground surface to encourage the growth of microorganisms in the soil. Microorganisms can help break down certain VOCs.

[a] Surface water alternatives are numbered 10 through 15, and soil and sediment alternatives are numbered 16 through 22 to be consistent with the numbers used in the NEWIOU Feasibility Study (Radian Corporation, 1996a). Groundwater alternatives were numbered 1 through 9.

CAMU = Corrective Action Management Unit
NEWIOU = North/East/West Industrial Operable Unit
ROD = record of decision
VOC = volatile organic compound

surface water. The NEWIOU SSSW Proposed Plan proposed Alternative 15, "Source Control" (groundwater extraction and treatment) for surface water at SD001 and SD033, indicating Union Creek is not a source of contamination, but that the creek may be receiving TCE-contaminated water from groundwater through storm sewer infiltration. Subsequent to the NEWIOU SSSW Proposed Plan, extraction and treatment (pump and treat) of contaminated groundwater was implemented as part of the WABOU and NEWIOU Groundwater IRODs. GSAP sampling has shown that extraction of groundwater has reduced the levels of TCE in the creek to levels that do not pose a risk to human health or the environment. As "Source Control" has already been implemented under these groundwater IRODs, "No Action" will be implemented under this ROD for surface water. As with all the remedies initiated under the groundwater IRODs, the source control remedy will be re-evaluated in the Travis AFB Basewide Groundwater ROD.

5.1.2 Alternative 16—No Action for Soil or Sediment

Alternative 16 means no further physical or administrative action is required for soil or sediment at a site. The soil and sediment do not present unacceptable risks to ecological or human receptors and are suitable for unrestricted residential or industrial activities.

5.1.3 Alternative 17—Land Use Controls

As discussed in more detail in Section 5.4, Land Use Controls, Alternative 17, restricts residential development (including day care centers, kindergarten through 12th grade (K-12) schools, play areas, and hospitals) and prevents unauthorized disturbance and relocation of the contaminated soil (such as use of excavated contaminated soil as fill) at areas where soil contamination is at levels that do not allow for unlimited use and unrestricted exposure. For the CAMU cover at LF007, Alternative 17 prohibits all activities on the cover other than CAMU operations and maintenance activities as described in the *LF007 Soil Remedial Action Design Report and Post-Closure Maintenance Plan* (CH2M HILL, 2002). Alternative 17 also prevents unauthorized disturbance and relocation of contaminated sediment.

5.1.4 Alternative 18—Excavation

Alternative 18 is described in the NEWIOU SSSW Proposed Plan as excavation of contaminated soil and removal to a designated CAMU at Travis AFB or to an off-base landfill. Travis AFB will comply with the off-site requirements of 40 CFR Section 300.440 for any soil removed to an off-base landfill. Since the Proposed Plan was issued, the Air Force has built a CAMU within the boundaries of LF007, a Base landfill that was closed and capped with native soil in 1974. The WABOU Soil ROD (Travis AFB, 2002a) provided the authority to build the CAMU. In 2003, excavated soil from three WABOU sites and the SS015 soil removal action were consolidated in the CAMU and capped with an ET cap.

The Air Force and regulatory agencies have established CAMU soil acceptance levels to determine the contaminant types and soil concentrations that can be placed in the CAMU. These requirements are presented in Table II-5-2. The following is the acceptance level sampling process that supports the placement of soil in the CAMU.

- If sample results for excavated contaminated soil are less than the "Soil Acceptance Level" for each COC or COEC at the site, the soil will go to the CAMU.

- If any results are greater than those levels, a DI WET leaching test will be performed for the COCs/COECs in question.

- If the DI WET results are less than the "Leachate Acceptance Level" for each COC or COEC in question, the soil will go to the CAMU.

- If the DI WET results are greater than the "Leachate Acceptance Level" for any COC or COEC in question, the soil will be segregated and evaluated for treatment or transported to an appropriate permitted off-base landfill for disposal.

Figure II-5-1 presents the acceptance level sampling process as a decision tree. The *Corrective Action Management Unit Soil Acceptance Criteria* Technical Memorandum (Radian, 2001) explains the development of CAMU acceptance levels.

Based on the most recent data, most, if not all, of the soil and sediment excavated from NEWIOU sites should meet CAMU soil acceptance levels and be suitable for placement in the CAMU. For these soils, the availability of the CAMU eliminates any need for thermal treatment of soil (Alternative 20) prior to disposal.

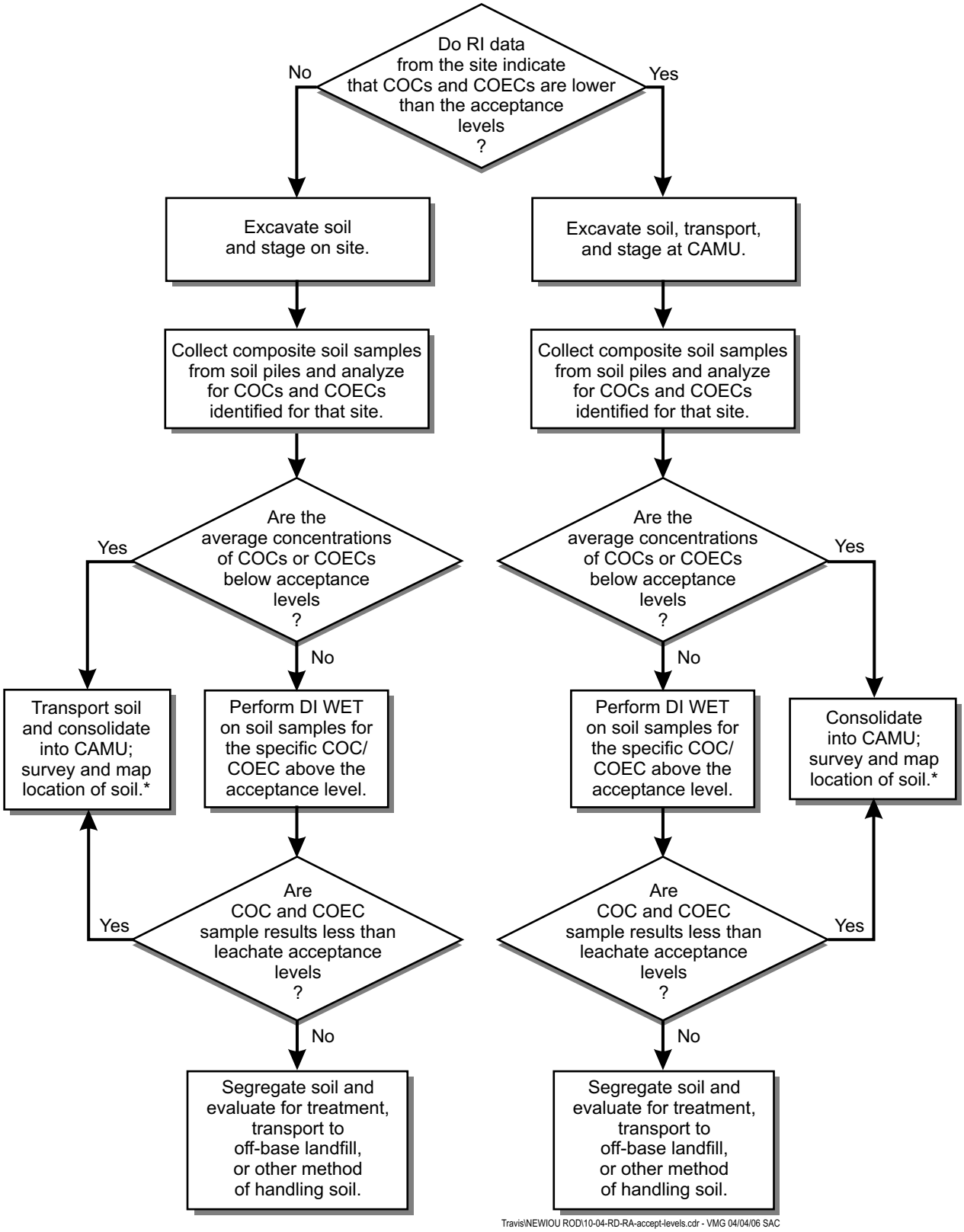
For additional information, The *LF007 Soil Remedial Action Design Report and Post-Closure Maintenance Plan* (CH2M HILL, 2002) addresses the CAMU design and maintenance. The *LF007 Soil Remedial Action Phase I Landfill Cap, CAMU Subgrade, Wetland Mitigation Report* (Shaw E&I, 2003) summarizes the construction of Phase 1 of the CAMU, including performing maintenance on the existing landfill cap, preparing the foundation for the CAMU, and constructing new wetlands to mitigate for wetlands filled in for cap maintenance. The *LF007 Phase 2 Soil Remedial Action Report* (Shaw E&I, 2004) summarizes the construction of Phase 2 of the CAMU, which involved consolidating and capping soil from four ERP sites. Additional phase(s) of CAMU construction will be used to add and cap excavated soil from NEWIOU sites, as specified in this ROD.

Table II-5-2
CAMU Soil Acceptance Levels[a]
North/East/West Industrial Operable Unit Soil, Sediment, and Surface Water Record of Decision, Travis AFB, California

Contaminant	CAMU – Soil Acceptance Level (mg/kg)	CAMU – Leachable Acceptance Level (DI-WET Results µg/L)	Contaminant	CAMU – Soil Acceptance Level (mg/kg)	CAMU – Leachable Acceptance Level (DI-WET results µg/L)
Aluminum	35,500	100,000	Benzo(k)fluoranthene	184	92
Antimony	74	600	bis(2-Ethylhexyl) phthalate	1,893	400
Arsenic	1,000	5,000	Carbon Disulfide	0.52	1,000
Barium	1,096	100,000	Chrysene	542	920
Cadmium	7.50	500	4,4'-DDD	25	28
Chromium	840	5,000	4,4'-DDE	4	20
Copper	5,174	130,000	Dibenzo(a,h)anthracene	11	0.92
Lead	854	1,500	Dieldrin	0.030	0.420
Mercury	64	200	Di-n-butyl phthalate	87,700	370,000
Molybdenum	360	18,000	Dioxin as 2,3,7,8-TCDD(eq)	0.034	0.0030
Nickel	122	10,000	Endosulfan	0.31	220
Selenium	550	5,000	Endosulfan sulfate	NE	NE
Silver	24,360	10,000	Fluoranthene	43,785	150,000
Vanadium	26,000	26,000	Fluorene	1,272	24,000
Zinc	6,350	500,000	Gamma Chlordane	17.39	10
			Heptachlor	2.6	1.00
Acenaphthene	1,776	37,000	Heptachlor epoxide	0.052	1.00
Alpha Chlordane	38.6	10	Indeno(1,2,3-cd)pyrene	15	9.20
Anthracene	27,200	180,000	Methoxychlor	2,173	4,000
Aroclor-1254	184	50	Methoxone	NE	NE
Aroclor-1260	75	50	Phenanthrene	112	630
Benzo(a)anthracene	25	10	Pyrene	4,788	18,000
Benzo(a)pyrene	164	20	Toxaphene	3.17	300
Benzo(b)fluoranthene	65	9.2			

[a] Soil includes sediment.

CAMU = Corrective Action Management Unit
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethene
DI WET = deionized water waste extraction test
mg/kg = milligrams per kilogram
NE = Not established because there is not an established drinking water standard or adsorption coefficient for this compound.
NEWIOU = North/East/West Industrial Operable Unit
ROD = record of decision
TCDD(eq) = tetrachlorodibenzo-p-dioxin equivalent
µg/L = micrograms per liter



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

Figure II-5-1. Acceptance Level Sampling Process

5.2 Criteria Used to Determine Soil and Sediment Cleanup Levels

The selected soil and/or sediment cleanup levels for COCs and COECs at each site represent the residual site-specific contaminant concentrations that can remain after completion of a remedial action and are protective of human health, ecological receptors, and the environment. Since no chemical-specific ARARs that establish soil (including sediment) cleanup levels exist, the following subsections present the criteria that provide the basis for the cleanup levels for soil and sediment at the NEWIOU sites. Surface water cleanup levels were not developed because Alternative 10 (No Action) is the selected alternative for surface water under this ROD. GSAP sampling has shown that extraction of groundwater has reduced the levels of TCE in the creek to levels that do not pose a risk to human health or the environment.

5.2.1 Residential/Industrial Exposure Scenarios

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

The residential exposure scenario, the more conservative of the two, assumes that the site is available for any possible use. In this scenario, the risk assessor makes assumptions about the amount of potential chemical exposure that a resident may receive. Since the assumptions for this scenario represent the maximum potential exposure, the residential risk calculations usually result in high values. The residential exposure scenario is used to determine the need for land use controls.

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

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

> The preamble to the NCP states that U.S. EPA will consider future land use as residential in many cases. In general, residential areas should be assumed to remain residential; and undeveloped areas can be assumed to be residential in the future unless sites are in areas where residential land use is unreasonable. Often the exposure scenarios based on potential future residential land use provide the greatest risk estimates (e.g., reasonable maximum exposure scenario) and are important considerations in deciding whether to take action (55 Fed. Reg. at 8710).
>
> However, the NCP also states that "the assumption of future residential land use may not be justifiable if the probability that the site will support residential use

> in the future is small." Sites that are adjacent to operating industrial facilities can be assumed to remain as industrial areas unless there is an indication that this is not appropriate. Other land uses, such as recreational or agricultural, may be used, if appropriate. When exposures based on reasonable future land use are used to estimate risk, the NCP preamble states that the ROD "should include a qualitative assessment of the likelihood that the assumed future land use will occur" (55 Fed. Reg. at 8710).

Travis AFB is host to the largest airlift organization in the Air Force, with a versatile fleet of C-5 Galaxy cargo aircraft and KC-10 Extender refueling aircraft to support its strategic airlift mission. The Base is also the west coast terminus for aeromedical aircraft returning sick or incapacitated military personnel from the Pacific and is a west coast port of embarkation for military personnel. Travis AFB is undergoing an extensive construction program that is replacing aging inefficient buildings with new facilities and upgrading existing structures to better conform to their functions. There is a large geographical separation between the northern residential housing areas and the southern industrial areas on Travis AFB. All of the NEWIOU sites are located within or adjacent to industrial facilities. In summary, the number of personnel, units, and assigned mission responsibilities at Travis AFB have grown over the past few years. The present land use near all NEWIOU sites is industrial in nature, and there are no solid indications that this condition will change in the near future. Therefore, the use of industrial criteria in deriving cleanup levels is appropriate for the NEWIOU soil sites. Land use controls will be implemented, monitored, maintained, and enforced as described in Section 5.4 (Land Use Controls).

5.2.2 Risk Management

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

5.2.2.1 Risk Management Range

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

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

Consistent with this language, the Air Force will ensure that any residual soil contaminants after completion of a remedial action will fall within or below the 10^{-4} to 10^{-6} risk range. For each site, the specific cleanup level within that range must be determined based on site-specific factors. The NCP at 40 CFR 300.430(e)(2)(i)(A)(2) further states the following:

> The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not

sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.

Therefore, the 10^{-6} risk level and the industrial exposure scenario are the basis for cleanup concentrations at NEWIOU soil sites. These concentrations provide a margin of safety for workers, since Travis AFB is an industrial facility, as described in Section 5.2.1 (Residential/ Industrial Exposure Scenarios), and conservative exposure assumptions were used in the risk calculations. As explained in Section 5.2.3, for this NEWIOU SSSW ROD, PRGs are used to achieve this risk level.

5.2.2.2 Point of Departure

As a military facility, Travis AFB uses several self-imposed land use controls to maintain security and ensure safety for site workers. These restrictions also serve as potential mitigating factors to depart from the 10^{-6} risk level at sites within certain portions of the Base. After a review of these factors and their locations in relation to the NEWIOU soil, sediment, and surface water sites, no sites were found to warrant a departure from the 10^{-6} risk level. However, various factors, such as restricted areas, security areas, proximity to the runway, and bird/air strike hazard (BASH) areas, were considered at some sites in the risk-management decision-making process. Section 5.3 (Site-Specific Remedial Actions) discusses in more detail the use of these factors in the selection of remedial actions.

5.2.2.3 Consideration of Site Conditions

The Air Force used an initial screening approach that involved only numerical risk values to determine whether a soil site required a cleanup action. However, in working with the regulatory agencies to resolve legal and technical issues, the Air Force elected to apply a risk management strategy described in OSWER Directive 9355.0-30, the *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (U.S. EPA, 1991), to the 18 NEWIOU soil, sediment, and surface water sites. This resulted in an approach wherein the Air Force first determines whether the soil contamination levels exceed industrial use levels. If industrial use levels are exceeded, removal of those soils to the CAMU or an off-site disposal site is the remedial action. If contamination levels do not exceed industrial levels but do exceed residential levels, then Alternative 17 (Land Use Controls) is selected to provide an adequate measure of protection for site workers at these sites.

5.2.3 Human Health Exposure for Carcinogens and Non-Carcinogens

The NOU, EIOU, and WIOU HHRAs evaluated potential threats to human health from chemicals found at soil, sediment, and surface water sites in the absence of any remedial action. This information was used to determine which sites needed further evaluation and possible remedial action. Section 3.2.1 (Human Health Risk Assessment) presents a brief summary of the NOU, EIOU, and WIOU HHRAs.

Following lengthy negotiations with the regulatory agencies encompassing both the previously executed WABOU Soil ROD and this NEWIOU SSSW ROD, the Air Force accepted the U.S. EPA's recommendation to use the current PRGs (Smucker, 2004) as a basis for soil cleanup levels for carcinogenic chemicals that equate to a fixed level of risk (1 x 10-6) and for non-carcinogenic chemicals that equate to a fixed level of risk (HI = 1). PRGs are "TBCs," not federal

and state ARARs. TBCs include nonpromulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments. By definition, ARARs are promulgated, or legally enforceable, federal and state requirements. TBCs are not ARARs because of they are not promulgated requirements. The Air Force accepted human health cleanup levels based on PRGs for NEWIOU soil and sediment sites because most sites have multiple contaminants and a cumulative risk that needs to be addressed. While using these PRGs potentially results in cleanup levels more conservative than required, Travis AFB determined that its site-specific situations with multiple contaminants justified accepting the PRG-based cleanup levels. Travis AFB estimated the expense of justifying less conservative cleanup levels to the regulators in terms of time and money and ultimately determined that accepting the PRG-based cleanup levels will result in minimal incremental cleanup costs. This approach has already worked well under the WABOU Soil ROD. Cleanup levels based on PRGs will be used unless there are site-specific considerations that justify a less stringent cleanup level. In this ROD, there are no sites where a less stringent cleanup level was used. Surface water cleanup levels were not developed because Alternative 10 (No Action) is the selected alternative for surface water sites. Extraction and treatment of groundwater has been implemented as part of the WABOU and NEWIOU Groundwater IRODs to control possible migration of TCE-contaminated groundwater to Union Creek. No action will be implemented under this ROD for surface water.

The *Summary of Remedial Investigation Data and Risk Management Decisions for Human Health at NEWIOU Soil Sites, Travis Air Force Base, California* Technical Memorandum (URS, 2004a), referred to as the Human Health Tech Memo, presents a table of PRGs and a summary of contamination data (including site maps), site characteristics, and selected alternatives and rationale for the risk management decision at each site. The Human Health Tech Memo is the basis for the protection of human health conclusions presented in Section 5.3 of this ROD. After the final Human Health Tech Memo was completed and distributed to the appropriate regulatory agencies, the U.S. EPA Region 9 published an updated list of PRGs in October 2004. The rationale and conclusions presented in Section 5.3 of this ROD were updated based on the October 2004 PRG list.

The October 2004 U.S. EPA Region 9 PRG table contains concentrations for both residential and industrial use. Since Travis AFB is an industrial facility, as described in Section 5.2.1 (Residential/Industrial Exposure Scenarios), the soil cleanup levels for each site are based on the industrial PRGs. The tables summarizing soil cleanup levels for each site requiring active remedial action (Tables II-5-3, -5, -7, -9, -11, and -13), included in Section 5.3, contain two columns for the current residential PRGs (for carcinogens and non-carcinogens) and two columns for the current industrial PRGs (for carcinogens and non-carcinogens) that equate to a potential 10^{-6} cancer risk and potential HI of 1.

5.2.4 Ecological Exposure

ERAs were completed as part of the RIs for each of the three OUs. These ERAs evaluated the potential for risk from chemicals found at NEWIOU soil, sediment, and surface water sites in the absence of any remedial action. This information was used to determine which sites needed further evaluation and possible remedial action. Section 3.2.2 (Ecological Risk Assessment) briefly summarizes of the NOU, EIOU, and WIOU ERAs. The ERAs performed in the RIs consisted of pathway completeness determinations (scoping assessments) and conservative quantitative analyses (Tier 1 screening evaluations). No site-specific or Tier 2-level evaluations were performed, with the exception of tissue collection for purposes of calculating bioaccumu-

lation factors, and no risk-based recommendations were developed in these ERAs. Therefore, chemicals and receptors for which unacceptable risks were identified through the Tier 1 screening for each site were carried to a more refined Tier 2 evaluation. This tiered, risk-based ecological evaluation is documented in the *Ecological Technical Memorandum for the NEWIOU at Travis Air Force Base, California* (URS, 2005), referred to as the Eco Tech Memo. The evaluation in the Eco Tech Memo builds upon the findings and conclusions of the previous ERAs in the RIs and the basewide ERA that provided a comprehensive evaluation of Union Creek. In addition, a few new ecological receptors were added to some sites to ensure that all appropriate feeding guilds and trophic levels were represented in the ERA.

In the Eco Tech Memo, Tier 1 and Tier 2 critical toxicity values (CTVs) were estimated for each chemical and receptor and were compared to chemical concentrations detected in the relevant environmental media at each site. The CTVs represent ecologically protective concentrations in soil, sediment, or surface water that correspond to a toxicity quotient (TQ) of 1.0 for a given ecological receptor. Through this approach, the potential for adverse effects to ecological receptors was determined at each site. Chemicals found to be present at concentrations below which effects are unlikely to occur were recommended for no action. Those associated with an unacceptable level of risk were recommended for risk management or remediation.

The Eco Tech Memo presents an updated and extensive ERA and selected alternatives and rationale for the risk management decision at each site. The Eco Tech Memo is the basis for the protection of ecological receptors conclusions presented in Section 5.3 of this ROD.

5.2.5 Groundwater Protection

The Air Force evaluated the relationship between groundwater and residual soil contamination in the vadose zone at each of the 18 NEWIOU sites to determine whether remedial actions were necessary to protect the underlying groundwater. The evaluation found 10 sites where subsurface soil COCs were not found in associated groundwater and 8 sites where subsurface soil and groundwater contained one or more of the same COCs. The risk to groundwater was evaluated at each site based on surface soil, subsurface soil, and groundwater concentrations. Also considered was the depth to groundwater, environmental screening levels, inorganic reference concentrations, natural attenuation, and potential and current groundwater actions at the site. This evaluation is documented in the *Groundwater Protection at NEWIOU Soil Sites Technical Memorandum, Travis Air Force Base, California* (URS, 2004b), referred to as the Groundwater Protection Tech Memo. The conclusion of the evaluation is that no action (such as excavation or SVE) is necessary to protect groundwater from soil contamination at the NEWIOU sites.

5.2.6 NEWIOU Reference Concentrations

The NOU, EIOU, and WIOU RIs evaluated the inorganic chemicals found at soil, sediment, and surface water sites to determine whether inorganic constituents detected in samples are naturally occurring or are the result of contamination from past activities. Section 7.0 (Inorganic Constituent Evaluation) of the WIOU RI (Radian, 1996b) provides the Travis AFB reference inorganic concentrations and a more detailed discussion of the inorganic constituent evaluation used at all NEWIOU sites.

5.2.7 Vapor Intrusion

Vapor intrusion is the migration of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in buried wastes and/or contaminated groundwater can emit vapors that may migrate through subsurface solids and into air spaces of overlying buildings. In extreme cases, the vapors may accumulate in dwellings or occupied buildings to levels that may pose near-term safety hazards, acute health effects, or aesthetic problems. In most cases, however, the chemical concentrations in the subsurface are low; depending on site-specific conditions, vapors may not be present at detectable concentrations.

Sampling results in the RIs conducted in 1995 indicate low levels of VOC contamination in the soil and soil gas at NEWIOU sites, while the groundwater has significantly higher levels of contamination. No sources of VOC soil contamination were found during the RI sampling, and the low levels detected are not expected to adversely impact the groundwater, which ranges in depth from about 5 to 50 feet bgs. RI concentrations of VOCs in soil and soil gas are consistent with models of diffusion and adsorption from associated groundwater plumes, indicating that the VOC contamination in the soil is coming from the underlying contaminated groundwater plume.

In the Human Health Tech Memo, the maximum detection for each VOC found in soil gas and groundwater during the RI at each of the 18 sites in the NEWIOU SSSW ROD was compared to vapor-intrusion screening levels. The results of the vapor intrusion screening indicate a potential human health risk from vapor intrusion at all NEWIOU sites with contaminated groundwater. Off-gassing of groundwater contamination is the likely source of vapor contamination at each site, and vapor intrusion is being addressed by interim groundwater remedial actions rather than soil remedial actions. The regulatory agencies have agreed with the Air Force's request to address the indoor air/vapor intrusion pathway in the forthcoming Travis AFB Basewide Groundwater ROD. The Basewide Groundwater ROD will determine cleanup levels for groundwater that will address the vapor intrusion pathway and protection of occupants of buildings above contaminated plumes at groundwater sites.

Until the Basewide Groundwater ROD is completed, Travis will continue to operate the pump and treat systems implemented by the NEWIOU Groundwater IROD, which will reduce contamination in the groundwater. Also, until groundwater plumes are remediated, Travis AFB has administrative controls in place, such as excavation requests and the Environmental Impact Analysis Process (EIAP), to ensure that actions such as excavation and the selection of building sites prevent exposure of humans to contamination. In addition, engineered controls are used to mitigate human health risks. For example, for buildings above groundwater plumes, Travis AFB has designed and implemented passive vent systems, which are built into building foundations. The Base will continue to evaluate and mitigate risk from indoor air.

5.2.8 Total Petroleum Hydrocarbons (TPH)

During the RIs (in 1995 and 1996), many of the NEWIOU sites had residual amounts of TPH in the soil from leaks or spills associated with jet fuel, gasoline, diesel, motor oil, etc. Given the age of the contamination, the volatile constituents, such as benzene, toluene, ethylbenzene, and xylenes (BTEX), which have an established toxicological value, have volatilized or have migrated down to the groundwater. The remaining TPH does not have an established toxicological value; therefore, 100 parts per million (ppm) was used in the RIs as a screening level for

possible remedial action for TPH, based on the California State Water Resources Control Board *Leaking Underground Fuel Tank (LUFT) Field Manual* (California State Water Resources Control Board, 1989), a TBC.

In 2003, in preparation for this ROD, the Groundwater Protection Tech Memo and Human Health Tech Memo performed thorough reviews of site- specific conditions (area of contamination, percentage of samples above screening levels, current land use, likelihood of natural attenuation, etc.) and concluded that an action (excavation) was not warranted for the TPH-contaminated soil. Any subsequent determination of the need for LUCs at these sites is based on controlling any future soil excavations at sites that would present an unacceptable direct exposure risk in a residential scenario. Again, there are no established toxicological values for residual TPH. There are now, however, preliminary values that have been put forth by the Massachusetts Department of Environmental Protection (MADEP) and the TPH working group. The San Francisco Bay RWQCB has issued direct-exposure environmental screening levels (ESLs) based on these MADEP preliminary values (*Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater* (San Francisco Bay RWQCB, 2004). These ESLs are TBCs, not ARARS. This ROD uses the San Francisco Bay RWQCB direct-exposure ESL for a residential scenario of 2,300 ppm as a screening level for LUCs for TPH. Evaluation of site conditions against the 2,300 ppm screening level is the basis for the specification of LUCs for TPH in Section 5.3. The LUCs will remain in place unless, at some future time, it can be shown that the levels in the soil have attenuated so that they no longer pose an unacceptable direct-exposure risk in a residential scenario.

5.3 Site-Specific Remedial Actions

The following subsections present a brief description of the 18 soil, sediment, and surface water sites in the NEWIOU; the selected remedial alternative(s) for each site; and descriptions of the protectiveness of the remedial actions to human health, ecological receptors, and groundwater beneficial use objectives. The Air Force and U.S. EPA evaluated and co-selected these remedies as the most appropriate strategies for addressing contaminated soil, sediment, and surface water in the NEWIOU. These remedies address the potential human health and environmental risks that could result from the exposure of human and ecological receptors or the migration of contaminants to groundwater. A summary of selected actions is provided in Table II-5-15, Selected Remedial Alternatives, on page II-5-64.

Tables II-5-3, II-5-5, II-5-7, II-5-9, II-5-11, and II-5-13 present the soil and/or sediment cleanup levels for the sites that require active remedial action in accordance with the NCP. The shaded cells in the risk columns of these tables indicate the concentration (cancer, non-cancer, ecological, or groundwater protection) that led to the cleanup level. Where there are multiple risk drivers for the same contaminant, the lower (or more protective) cleanup level was selected (as indicated by shading in the table).

Tables II-5-4, II-5-6, II-5-8, II-5-10, II-5-12, and II-5-14 present the estimated cost of remedial alternatives evaluated for the sites that require active remedial action in accordance with the NCP. The shaded row indicates the primary remedial alternative selected. Note that the costs for Alternative 17 (Land Use Controls) are from the NEWIOU FS and NEWIOU SSSW Proposed Plan and include the cost of developing LUCs at Travis AFB. The actual costs would be less because the WABOU soil actions occurred first and initiated LUCs for the ERP.

The following subsections also provide the rationale for the selection of cleanup levels for each site. These soil and sediment cleanup levels take into account the site-specific conditions, comply with CERCLA, and are protective of human health, ecological receptors, and the environment. For sites where excavation is the selected remedy, figures showing the concentrations of COCs/COECs that exceed the cleanup level, comparison of each concentration to the cleanup level, and the proposed excavation areas are presented. The excavation areas are conservative estimates and will be refined in the site-specific remedial designs.

For clarification purposes, the NOU, EIOU, and WIOU RIs used HI to refer to a measure of non-carcinogenic risk to humans, and the NEWIOU Eco Tech Memo used the term "toxicity quotient" (TQ) to refer to a measure of ecological risk.

5.3.1 Storm Sewer Systems A and C, Union Creek (SD001)

Site Description—SD001 consists of Storm Sewer Systems (SSS) A and C and Union Creek. (System B drains areas in the WIOU and is designated as part of SD033.) All storm sewers discharge into Union Creek at Outfalls II, III, and IV. Union Creek exits Travis AFB at the southwestern tip and flows south to Hill Slough, which discharges into Suisun Marsh and ultimately to Suisun Bay. This summary presents information on contaminants in soil, sediment and surface water at SD001. Subsurface soil and groundwater contamination below the SSRW are discussed with the site summary presented for SS016.

Selected Remedial Alternative(s)— Alternative 18 (Excavation) is the selected remedial action for sediment in Union Creek in the area of sample location 0014 (shown on Figures II-5-2 and II-5-3) with concentrations of PAHs that pose a potential ecological risk. Alternative 17 (Land Use Controls) is the selected contingency remedial action if concentrations of PAHs remaining in sediment after excavation exceed levels that allow for unlimited use and unrestricted exposure. Alternative 16 (No Action) is the selected alternative for soil, and Alternative 10 (No Action) is the selected alternative for surface water. Groundwater extraction and treatment has been implemented as part of the WABOU and NEWIOU Groundwater IRODs to control the possible migration of TCE-contaminated groundwater to Union Creek. No action is necessary, nor will any be implemented under this ROD for surface water. Evaluations performed in the Human Health Tech Memo determined that soil, sediment, and surface water at the site do not pose a potential risk to current industrial workers or future residents. Evaluations performed in the Eco Tech Memo determined PAHs in sediment pose a potential risk to ecological receptors. The EIOU RI determined no soil, sediment, or surface water remedial action is necessary to protect groundwater. Based on RI data, all excavated sediment should meet CAMU acceptance criteria and, if so, will be placed in the CAMU. Any of the excavated sediment that does not meet the CAMU acceptance criteria will be sent to an appropriate off-base landfill.

Table II-5-3 presents the sediment cleanup levels for the COCs and COECs at the site.

The Air Force will excavate the PAH-contaminated sediment in Union Creek in the area of sample location 0014 based on sediment cleanup levels in Table II-5-3. Confirmation samples will be collected from the excavation to determine what contaminants, if any remain. The Air Force will review the results with the regulatory agencies to determine whether the cleanup levels have been achieved or additional excavation is required. Once cleanup levels have been achieved, the procedure described in Section 5.4.2 will be used to determine whether the remedial action is complete for ecological receptors. However, land use controls will be

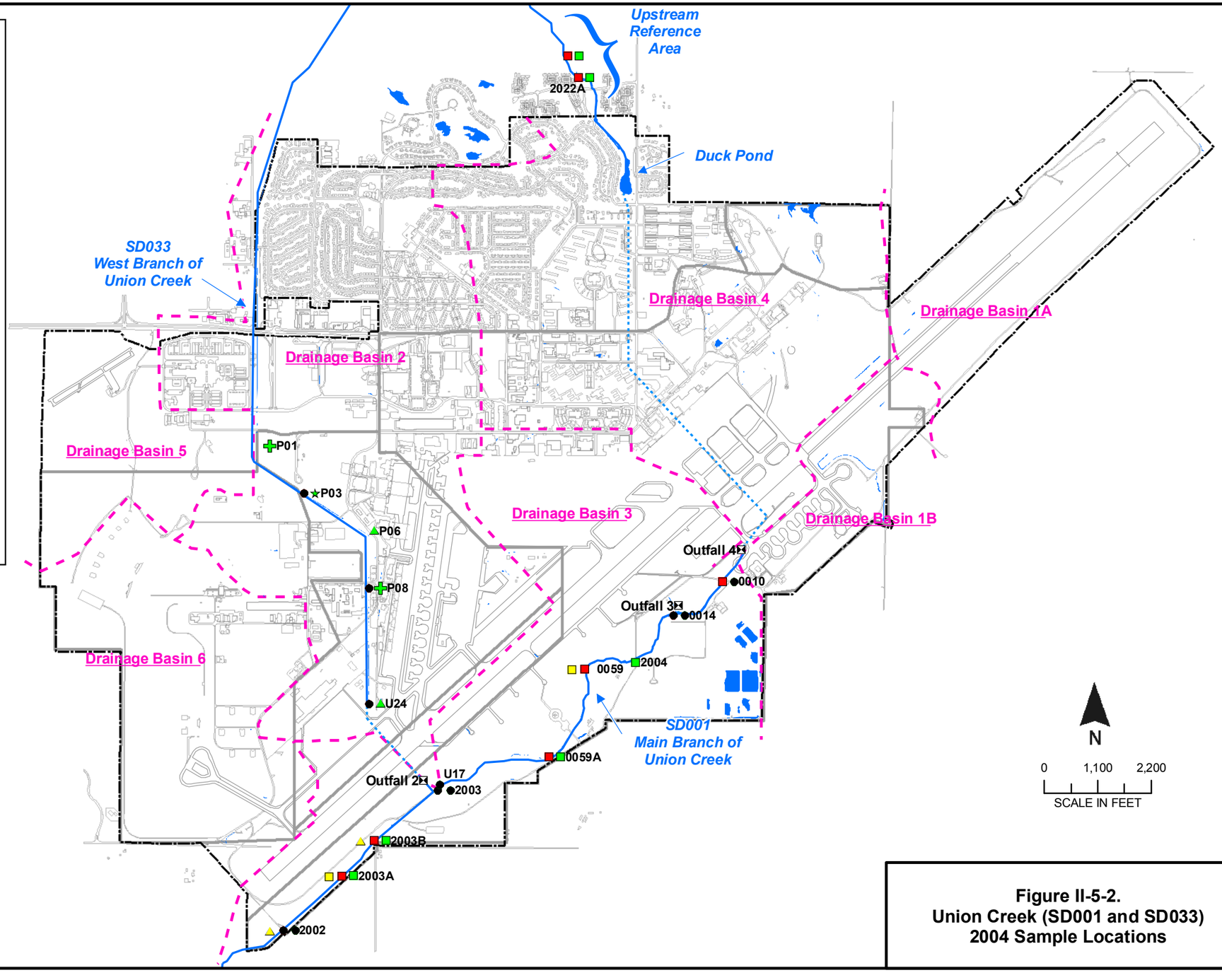
Legend

Crayfish Tissue Sampling
- Metals, Pesticides, PAHs
- Metals, Pesticides, PAHs, PCBs
- Sample collected and stored; not analyzed

Sediment Sampling
- Metals, Pesticides, PAHs
- Metals, Pesticides, PAHs, PCBs
- PAHs
- VOCs
- VOCs, Pesticides

Surface Water Sampling
- Metals
- Metals, Pesticides

Union Creek
- Above ground
- Underground
- Outfall Locations
- Drainage Basin Boundary
- OU Boundary
- Base Boundary
- Road
- Runway



K:\GIS\Projects\Travis\ArcMaps\Union-Creek.mxd VRL 4/13/06 SAC

Figure II-5-2.
Union Creek (SD001 and SD033)
2004 Sample Locations

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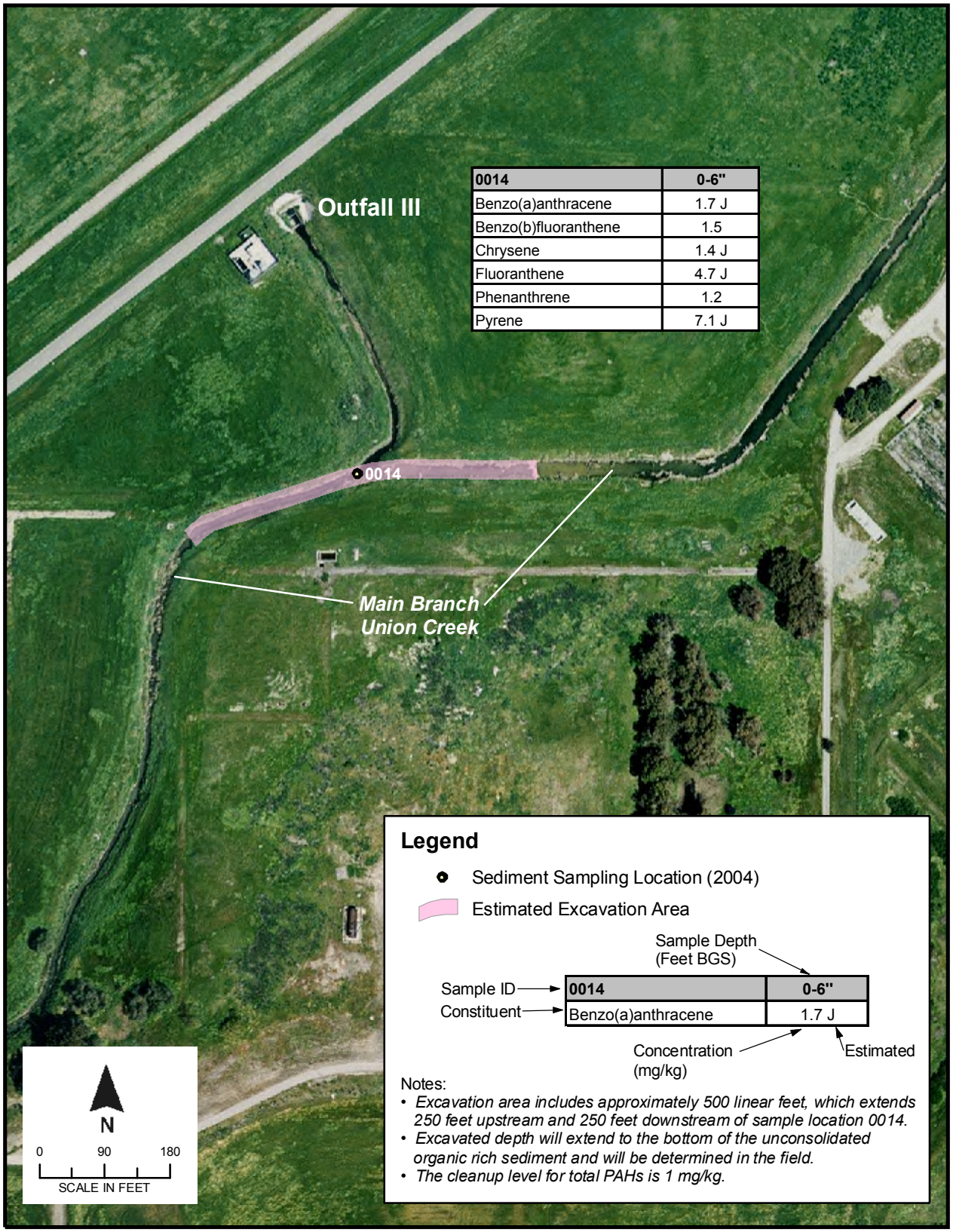

Figure II-5-3.
SD001 (Main Branch of Union Creek)
Estimated Excavation Area

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Table II-5-3
Cleanup Levels for Sediment COCs and COECs at SD001 (Main Branch of Union Creek)
North/East/West Industrial Operable Unit Soil, Sediment, and Surface Water Record of Decision, Travis AFB, California

Contaminant of Concern/ Contaminant of Ecological Concern	Sediment Cleanup Level (mg/kg)	Residential (mg/kg)		Industrial (mg/kg)		TQ=1 (mg/kg)	Potential for Groundwater Impact?
		10^{-6} Cancer Risk[a]	Chronic HI=1	10^{-6} Cancer Risk[a]	Chronic HI=1		
Benzo(a)anthracene	Total	0.62	NE	2.1	NE	Total	No
Benzo(b)fluoranthene	PAHs=1	0.62	NE	2.1	NE	PAHs	No
Chrysene		62	NE	210	NE	=1[b]	No
Fluoranthene		NE	2,300	NE	22,000		No
Phenanthrene		NE	NE	NE	NE		No
Pyrene		NE	2,300	NE	29,000		No

[a] 10^{-6} equals 1/1,000,000. For example, 0.62 times 10^{-6} equals 0.00000062 and 2.1 times 10^{-6} equals 0.0000021
[b] A level of 1 mg/kg was agreed to be proactive of demersal fish, based on the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (NOAA SQT) (Buchman, 1999).

COC = contaminant of concern
COEC = contaminant of ecological concern
HI = hazard index
mg/kg = milligrams per kilogram
NA = not applicable
NE = a value has not been established
NEWIOU = North/East/West Industrial Operable Unit
PAH = polycyclic aromatic hydrocarbons
ROD = record of decision
TQ = toxicity quotient

implemented to address human health issues if concentrations of PAHs remaining in sediment after excavation exceed levels that allow for unlimited use and unrestricted exposure. The estimated excavation area for SD001 is shown on Figure II-5-3. The excavation will extend approximately 500 linear feet (from 250 feet upstream to 250 feet downstream of sample location 0014). The estimated volume of soil to be excavated is approximately 850 cubic yards. As agreed with the regulatory agencies, the excavation will not be backfilled (with gravel or soil). Habitat will be allowed to restore naturally, to provide suitable conditions for a variety of benthic and aquatic species. The estimated costs for the alternatives evaluated for SD001 are summarized in Table II-5-4.

Table II-5-4
Estimated Cost of Remedial Alternatives Evaluated for SD001 (Main Branch of Union Creek)
North/East/West Industrial Operable Unit Soil, Sediment, and Surface Water Record of Decision, Travis AFB, California

Alternative	Estimated Cost ($)
17 (Land Use Controls)	100,183 (from the Feasibility Study and Proposed Plan)
18 (Excavation)	127,500[a]
19 (Capping)	Not Evaluated[b]
20 (Excavation /Thermal Treatment)	510,000[c]

[a] Cost estimated based on the excavation of 850 cubic yards of soil at $150/cubic yard, with all soils meeting CAMU acceptance criteria. The volume of soil to be excavated is estimated based on the following assumptions regarding excavation dimensions: 500-linear-foot length, 30-foot width, and 1.5-foot depth.
[b] Capping or paving the creek bed was not considered appropriate, and therefore was not evaluated.
[c] Thermal treatment cost estimated based on treating 850 cubic yards of soil at $600/cubic yard. This includes the cost of soil excavation.

CAMU = Corrective Action Management Unit
NEWIOU = North/East/West Industrial Operable Unit
ROD = record of decision

Alternative 18 (Excavation) is the most cost-effective remedy that meets the RAO of protecting ecological receptors. The following paragraphs provide additional details supporting the decisions for soil, sediment, and surface water at SD001.

Protection of Human Health—The following findings and conclusions with respect to soil and sediment contamination and the potential risks to human health were reached in the EIOU RI (Weston, 1995a) and in Appendix A of the Human Health Tech Memo.

The EIOU RI addressed the risk to a recreational user for surface water and sediment in Section 6.2.5.7 and concluded that the risks were less than 10^{-6} using the 1995 RI data. Union Creek sediment and surface water were sampled in 2004 to provide current data for an ERA. The results are included in the Eco Tech Memo and show that concentrations have substantially reduced since the RI. This change in concentrations probably results from a combination of improved pollution prevention practices at the Base, periodic dredging of the creek, groundwater source control (discussed below), and natural forces that affect sediment contamination and location. Based on this information, no action is necessary for Union Creek surface water for human health risk. Although the sediment is not a risk to recreational users, the contamination remaining after excavation may present a potential risk in a residential scenario. Therefore, land use controls will be implemented to address human health issues if concentrations of PAHs remaining in sediment after excavation exceed levels that allow for unlimited use and unrestricted exposure.

Source control (groundwater pump and treat) has been implemented under the WABOU and NEWIOU Groundwater IRODs to address migration of groundwater contaminated with VOCs (primarily TCE) to Union Creek. The groundwater extraction systems reduce the levels of contamination in the groundwater and, by lowering the water table, control the flow of groundwater into Union Creek and associated storm sewer systems. The levels of contamination in groundwater and surface water are monitored by the Base GSAP.

Protection of Ecological Receptors—The potential for risk to ecological receptors that may reside at SD001 was assessed in the Eco Tech Memo. Ecological receptor groups quantitatively evaluated include aquatic plants, fish, benthic and aquatic invertebrates, birds, and mammals. The findings of the ERA, which are discussed in detail in Section 7.9 of the Eco Tech Memo, demonstrate that potential exposure to PAHs that may be present in sediment at sample location 0014 (shown on Figures II-5-2 and II-5-3) poses an unacceptable level of risk to juvenile fish. Excavation of sediment in this area of the creek is selected to address potential ecological issues at the site.

Protection of Groundwater—The following conclusions with respect to groundwater protection were reached in Section 2.0 of the Groundwater Protection Tech Memo.

The EIOU RI concluded that soil, sediment, or surface water contaminants do not contaminate groundwater at SD001; therefore, no soil, sediment, or surface water action is necessary for the protection of groundwater.

5.3.2 Fire Training Area 1 (FT002)

Site Description—Site FT002 consists of former Fire Training Area 1 (FTA-1) located in the northwestern portion of the EIOU at Travis AFB. This site was used for fire training exercises

from 1943 to 1950. Fuels used for the exercises consisted of waste fuels, oils, solvents, and other combustible wastes. Most contamination is attributed to runoff from the parking lots (leaded fuels and motor oils). Dormitories and parking lots that were present at the site during the RI in 1995 have since been removed. FT002 is currently an open grassy field. This summary presents information on contaminants in the soil at FT002.

Selected Remedial Alternative(s)—Alternative 16 (No Action) is the selected remedial action for this site. Evaluations performed in the Human Health Tech Memo determined that soil contamination at the site does not pose a significant potential risk to current industrial workers or future residents based on industrial PRGs, residential PRGs, and the San Francisco Bay RWQCB ESLs. The Eco Tech Memo determined that no COPECs at FT002 were found to pose an unacceptable risk to ecological receptors. The Groundwater Protection Tech Memo determined that FT002 is not a source of contamination to the groundwater, and no soil remedial action is necessary to protect groundwater.

The following paragraphs provide additional details supporting the no action decision for soil at FT002.

Protection of Human Health—The following findings and conclusions with respect to soil contamination and the potential risks to human health were reached in the EIOU RI (Weston, 1995a) and in Appendix B of the Human Health Tech Memo.

Methylene chloride, lead, and TPH were the COCs identified at FT002. However, no action is selected for all COCs at FT002 because soil contamination at the site does not pose a significant risk to future residents. Methylene chloride concentrations exceed the residential PRG of 9.1 mg/kg in only one of 45 samples collected, and that concentration probably is related to laboratory contamination (Weston, 1995a). Lead concentrations in only 2 of 55 samples exceed the residential cleanup value of 146 mg/kg, which is the *DTSC Lead Risk Assessment Spreadsheet, Version 7* (Cal-EPA/DTSC, 1999) cutoff, where 99% of the child population studied remained below the blood-lead level of 10 milligrams per deciliter (mg/dL). In addition, only one of 55 samples exceeds the industrial cleanup level (800 mg/kg), and the maximum detected concentration (853 mg/kg) exceeds the industrial cleanup level by only approximately 6%. The maximum reported concentration of TPH extractable factor (TPH-E) (290 mg/kg) does not exceed the San Francisco Bay RWQCB ESL (2,300 mg/kg) (RWQCB, San Francisco Bay Region, 2004).

Protection of Ecological Receptors—The potential for risk to ecological receptors that may reside at the site was assessed in the Eco Tech Memo. Ecological receptor groups quantitatively evaluated include terrestrial plants, soil invertebrates, birds, and mammals. The findings of the ERA, which are discussed in detail in Section 7.2 of the Eco Tech Memo, demonstrate that potential exposure to COPECs does not pose an unacceptable level of risk to ecological receptors that may be present. No action is necessary to address ecological issues at the site.

Protection of Groundwater—The following conclusions with respect to groundwater protection were reached in Section 3.0 of the Groundwater Protection Tech Memo.

The RI concluded that metals contamination in soil at FT002 is unlikely to cause groundwater contamination. Metals are not very mobile and have not migrated to groundwater. The COPEC di-n-butyl phthalate is confined to the surface; it has not leached to the subsurface and migrated