4.0 SUMMARY OF NEWIOU GROUNDWATER FEASIBILITY STUDY

The Air Force performed a Feasibility Study (FS) for the NEWIOU and the results are summarized in the FS Report dated September 1996. The FS consisted of the following activities:

- Develop Remedial Action Objectives;
- Combine cleanup technologies into remedial alternatives;
- Perform an Initial Screening of Alternatives;
- Evaluate each alternative against specific criteria;
- Perform a Detailed Analysis of Alternatives; and
- Rank each alternative for total score and cost/benefit.

This section describes each of the nine alternatives evaluated in the FS and how the Air Force combined Alternatives 3 through 9 into one alternative (Alternative 3) for this IROD. The Air Force and regulatory agencies developed Remedial Action Objectives (RAOs) in the FS to address contamination cleanup. As described in Section 3.3, the Air Force and regulatory agencies developed Interim Remediation Goals (IRGs) in the RI. The IRGs are risk based cleanup goals which are similar to cleanup levels but they are not enforceable. The Air Force used both IRGs and RAOs in the FS to evaluate the alternatives against specific criteria as described in Section 4.3.

4.1 Alternative Description

The Air Force and regulatory agencies first developed alternatives in the FS by performing an Initial Screening of Alternatives (ISA) process. This screening considered the environmental conditions at each site, the RAOs, and the IRGs to screen all potential remedial technologies for applicability for remediation of contaminated groundwater. The screening

process evaluated the effectiveness, implementability, and cost of each technology. The Air Force combined the technologies that passed the screening into a set of alternatives that could address each of the groundwater sites. The Air Force and regulatory agencies then subjected these alternatives to the second part of the FS process, the Detailed Analysis of Alternatives (DAA), which is summarized in Section 4.3.

The alternatives evaluated in the FS for groundwater were:

- Alternative #1: No Action
- Alternative #2: Institutional Actions: Access Restrictions, Monitoring, Natural Attenuation
- Alternative #3: Horizontal Well Extraction, Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #4: Horizontal Well Extraction, Air Stripper/Catalytic Oxidation, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #5: Horizontal Well Extraction, Ultraviolet Radiation and Oxidation (UV-OX), Ion Exchange, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #6: Horizontal Well Extraction, UV-OX, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #7: Horizontal Well Extraction, Ion Exchange, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #8: Horizontal Well Extraction, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #9: Vertical Well Extraction, Bioslurping, Recovered Product Recycling, Off Gas Catalytic Oxidation

These alternatives are summarized in the following sections. For the PP and IROD, the Air Force consolidated Alternatives #3 through #9 into a new Alternative 3, since the FS found that these active treatment alternatives had similar costs and effectiveness ratings.

4.1.1 No Action

This alternative (Alternative 1 in the FS) leaves the site as it is. No action is used as a baseline option for all sites. Under this alternative, the base would undertake no activity toward cleanup or risk mitigation. CERCLA guidance requires that the No Action alternative always be considered as a baseline alternative in an FS.

4.1.2 Natural Attenuation/Monitoring (Institutional Actions)

This alternative (Alternative 2 in the FS, where it was called “Institutional Actions”) uses institutional controls to restrict access to groundwater and allows contaminant concentrations to naturally attenuate. This option includes monitoring to evaluate the effect of natural attenuation on contaminants in groundwater. The Air Force would perform monitoring to confirm the stability of impacted groundwater and to provide an early warning if contaminants threatened receptors, such as agricultural wells or ecological receptors. Monitoring would also track the decline in concentrations resulting from natural attenuation processes.

4.1.3 Extraction, Treatment, and Discharge

Alternatives 3 through 9 in the FS all used extraction with different types of treatment; therefore, the Air Force subsequently consolidated them into Alternative 3 for the PP and the Groundwater IROD. Alternative 3 addresses contaminated plumes by extracting contaminated groundwater and then treating to comply with regulations for discharge of water.

The Air Force evaluated five groundwater treatment options in the FS. The five treatment options were: air stripping; catalytic oxidation (catox); UV-OX; ion exchange; and

activated carbon. The Air Force combined these five treatment options into 7 different treatment trains as described in the NEWIOU FS. Extraction, treatment, and discharge processes are summarized below. A more detailed description of these processes is provided in Section 5.2.2 of the Groundwater IROD.

4.1.3.1 Extraction

Extraction processes include both horizontal and vertical extraction wells. Bioslurping, two-phase, dual phase or soil vapor extraction systems to remove soil gas, floating petroleum product and/or groundwater are methods to enhance extraction and were also included.

4.1.3.2 Treatment

The five general or representative treatment processes covered in the NEWIOU FS are summarized below.

Air Stripping – Air stripping utilizes the volatility of many common organic contaminants to remove them from the contaminated water and transfer them to the gaseous phase. Contaminated water is introduced to the top of the tower while air is blown upwards through the tower. The agitation provided by the air and plates or synthetic media within the column break up the water into small droplets, providing a large water surface-to-air interface for organics to volatilize into the air phase. Treated water exits the bottom of the tower while air carrying the organic contaminants exits the top of the tower.

Catalytic Oxidation – Catalytic oxidation processes use a catalyst, which is a material that accelerates a chemical reaction but is not itself consumed in the reaction, to oxidize contaminants. This technology would be used to treat contaminants in process offgas streams, e.g., from air stripping processes.

Activated Carbon – Activated carbon can be used to treat groundwater for removal of VOCs; the carbon is replaced or regenerated once the adsorbent is saturated. Activated carbon can also be used to treat VOCs in the vapor phase effluent from a treatment process.

Ion Exchange – Ion exchange systems are used for metals removal. Ion exchange systems use polymeric resins (or inorganic media) to sorb specific suites of metals from the water. Metal hydroxide precipitation is used following a pH adjustment step.

Ultraviolet Radiation and Oxidation (UV-OX) – UV-OX is a liquid phase process and requires chemical reagents, such as hydrogen peroxide, promoted with UV light to destroy VOCs. This process option differs from an air stripper because there is no generation (and required subsequent treatment) of an offgas stream.

4.1.3.3 Discharge

The FS assumed treated groundwater would be discharged to Travis AFB's non-potable water irrigation system or directly discharged on-base to surface water meeting NPDES limits, such as Union Creek and the storm drain system. These options are performed for the ongoing groundwater removal actions.

4.2 Summary of Comparative Analysis of Alternatives

This section summarizes how the Air Force and regulatory agencies evaluated the three alternatives (Alternative 1 - No Action, Alternative 2 - Natural Attenuation/Monitoring, and Alternative 3 - Extraction, Treatment, and Discharge) against EPA’s nine criteria in the FS. The Air Force and regulatory agencies divided these criteria into three classes: threshold criteria, balancing criteria, and modifying criteria. The following sections discuss each of these types of criteria, and how the alternatives were compared. Figure 4-1 defines the evaluation criteria, while Table 4-1 compares the alternatives to the threshold and balancing criteria.

4.2.1 Threshold Criteria

4.2.1.1 Overall Protection of Human Health and the Environment

Alternative 3 (Extraction, Treatment, and Discharge) would provide the greatest protection of human health and the environment since the contaminants would be removed by extraction. Alternative 2 (Natural Attenuation/Monitoring) would be protective of human health and the environment if natural attenuation is taking place and there is no pathway to receptors such as using groundwater for drinking water. Alternative 1 (No Action) would not be protective because people and the environment could be exposed, or potentially exposed, to groundwater. Without monitoring, the Air Force and regulatory agencies could not assess natural attenuation of the groundwater and the subsequent rate of risk reduction.

4.2.1.2 Compliance with ARARs

The Air Force would achieve compliance with ARARs for Alternative 3. Although the Air Force and regulatory agencies have not established final cleanup levels for groundwater at Travis AFB, the interim actions using Alternative 3 will reduce contamination and potential risk. In addition, the Air Force and regulatory agencies will use the data obtained to allow for selection of final cleanup levels and technically and economically feasible long-term remedial actions.

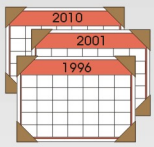
If natural attenuation is taking place and the plume is stable or decreasing in size at the sites where the Air Force implements this alternative, then Alternative 2 may meet ARARs.

THRESHOLD CRITERIA

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 or federal and state environmental statutes and/or provide grounds for invoking a waiver.

BALANCING CRITERIA



3 Long-Term Effectiveness
Refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.

4 Reduction of Toxicity, Mobility, or Volume Through Treatment
Refers to the anticipated ability of a remedy to reduce the toxicity, mobility, and volume of the hazardous components present at the site.

5 Short-Term Effectiveness
Addresses both the period of time needed to complete the remedy and any adverse impacts on human health and the environment that may result from construction and implementation of the remedy.

6 Implementability
Refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to construct and implement a particular remedy.

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

MODIFYING CRITERIA

8 State Acceptance
Indicates whether, based on its review of the information, the state concurs with, opposes, or has no comment on the preferred alternative. Evaluated in the IROD.

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, the U.S. EPA is compelled by law to balance community concerns with all the previously mentioned criteria. Evaluated in the IROD.

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Alternative 1: No Action
Alternative 2: Natural Attenuation and Monitoring
Alternative 3: Extraction, Treatment, and Disposal for Off-Base Remediation, Source Control, and Migration Control

Figure 4-2. The Nine CERCLA Criteria

Table 4-1

Comparison of Alternatives Versus the CERCLA Threshold and Balancing Evaluation Criteria

	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 6	Criterion 7
Alternative	**Overall Protection of Human Health and the Environment**	**Compliance with Laws and Regulations (ARARs)**	**Long-term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume through Treatment**	**Short-term Effectiveness**	**Implementability**
No Action (Alternative 1)	Does not protect human health or the environment	Does not comply with ARARs	No long-term effectiveness	No reduction from action	No short-term effectiveness	Easily implemented; no equipment needed
Natural Attenuation/ Monitoring (Alternative 2)	Provides some protection of human health and the environment	May meet ARARs in long term	Will have long-term effectiveness from natural attenuation	No reduction from active treatment	No short-term effectiveness	Is implementable; minor equipment needed
Extraction, Treatment, and Discharge (Alternative 3) (Treatment Alternatives 3-9 in the FS)	Protects human health and environment in the long term	Will meet ARARs in the long term (sooner than Alternative 2)	Most effective at removing contamination	Will reduce contaminant volume and mobility	Short-term effectiveness depends on removal rate	Technology is implementable but does require effort to maintain system and will have some effect on base operations

Note: Criterion 5 (costs) are shown in Table 4-2.

Alternative 1 (No Action) will not comply with ARARs for groundwater, and without monitoring there would be no way to determine when or if groundwater cleanup levels had been achieved. Affected groundwater would have the potential to discharge to Union Creek.

4.2.2 Primary Balancing Criteria

4.2.2.1 Long-Term Effectiveness and Permanence

Alternative 3 would be the most effective at removing contamination from the groundwater. Alternative 2 may be effective if natural attenuation is taking place at the selected sites. Alternative 1 would be the least effective in the long-term since no steps are taken to reduce risks, or monitor the reduction in risks.

4.2.2.2 Reduction of Toxicity, Mobility, and Volume through Treatment

Only Alternative 3 would incorporate active treatment, and therefore it would reduce the contaminant volume, and to some degree, contaminant mobility through hydraulic containment. Alternative 1 would not reduce contaminant toxicity, mobility, and volume since it does not include active treatment. Alternative 2 may reduce contaminant toxicity, mobility, and volume although at a slower rate than Alternative 3.

4.2.2.3 Short-Term Effectiveness

Alternative 3 would remove contaminated groundwater, control the further spread of groundwater contamination and would be the most effective alternative in the short-term.

Alternative 2 is not as effective in the short-term. This alternative is expected to take longer than Alternative 3 to reach cleanup levels since it does not actively extract or treat groundwater. Alternative 1 would be the least effective in the short-term since no steps are taken to reduce risks, or monitor the reduction in risks.

4.2.2.4 Implementability

Alternative 1 would be easily implemented since no actions would be involved. Alternative 2 would be implementable, and only minor additional equipment or monitoring wells would be required. Alternative 3 would use available technology such as treatment equipment and wells, but it would take time to design and install all of the required equipment. Because Travis AFB is an active military Air Force installation, the installation and operation of this equipment must be coordinated with base operations.

4.2.2.5 Cost

The Air Force estimated order-of-magnitude costs in the FS for each alternative applicable for each site. The Air Force considered both capital costs and operation and maintenance (O&M) costs. The Air Force estimated costs to be accurate to -30% to +50%, per U.S. EPA CERCLA Guidance. The Air Force assumed a 5% discount rate, including the effects of inflation, for present worth analysis, again based on the CERCLA Guidance. The Air Force estimated costs only for the purposes of comparing alternatives according to the CERCLA Guidance. Actual remediation costs could vary significantly from those in the FS and will be determined in the remedial design phase. The Air Force calculated capital costs for each alternative as separate components and then assembled as appropriate for each remedial alternative. Component construction costs were calculated using the RACER/ENVEST™ cost estimating model (version 3.1) (U.S. Air Force, 1993). The RACER/ENVEST™ model was developed by the U.S. Air Force specifically for estimating costs of remediation approaches for CERCLA documents, including FSs.

Table 4-2 shows the relative costs in thousands of dollars estimated in the FS of each alternative as applied to the 15 different IRP sites within the NEWIOU (costs were calculated separately for LF007B, LF007C, and LF007D). The treatment alternative with the lowest cost is presented in Table 4-2. The cost presented for all alternatives is the capital cost plus the first year

of operating and/or monitoring. The cost of the different treatment technology trains depends on the type, volume, and concentrations of the contaminated groundwater. The Air Force will determine the actual costs for the selected alternative(s) during the remedial design stage following signing of the IROD. Because all treatment processes are effective at removing contaminants, the initial treatment processes used will depend on costs, which will, in turn, depend on the volume and contaminant concentration of the extracted groundwater. The Air Force would select the treatment plant locations during the remedial design stage. As concentrations and volumes change with time, the Air Force could implement different treatment processes if they are more cost-effective.

Alternative 1 has no cost. Alternative 2 has a low cost since it relies on labor and analytical costs, and requires little additional equipment. The Air Force and regulatory agencies assumed natural attenuation and monitoring costs to be constant at each site: three new monitoring wells and analytical costs were assumed for four quarters. The Air Force will develop the number and layout of monitoring wells and associated monitoring costs as part of the site-specific RD. The costs shown for Alternative 3 are the lowest costs for the various treatment alternatives evaluated in the FS. Alternative 3 costs more than Alternative 2 due to the capital equipment required, and the comparatively high operation and maintenance costs.

4.2.3 Modifying Criteria

4.2.3.1 State Acceptance

State acceptance was not evaluated in the FS. Refer to Section 5.3.6 of the Groundwater IROD for state acceptance discussion.

Table 4-2

Summary of Comparative Costs (thousands of dollars)

Site	Alternative 1 No Action	Alternative 2 Natural Attenuation/ Monitoring[1]	Alternative 3 Extraction, Treatment, and Discharge[2]		
			Capital Cost	First Year O&M	Total
FT004	0	90	915	280	1,200
FT005	0	90	1,800	260	2,100
LF006	0	90	640	61	700
LF007B	0	90	550	72	620
LF007C	0	90	450	58	510
LF007D	0	90	1,800	224	2,000
SS015	0	90	750	120	870
SS016	0	90	2,880[3]	274[3]	3,200[3]
SS029	0	90	1,600	170	1,800
SS030	0	90	490	78	570
SD031	0	90	620	128	750
ST032	0	90	2,000	280	2,300
SD033	0	90	2,300	140	2,400
SD034	0	90	380	79	460
SS035	0	90	190	100	290
SD036	0	90	795	110	910
SD037	0	90	2,600	210	2,800

[1] Natural attenuation/monitoring costs assumed to be the same for each site. The $90,000 estimates include $18,000 in capital costs to install monitoring wells and $72,000 in operational costs for the first year, mainly for sample analysis.

[2] Costs for the Extraction alternative include the capital cost to build the system and one year of operating the system. All costs in thousands of dollars. Costs were developed for NEWIOU FS and assume individual treatment plants for each site. The lowest cost estimate for all the treatment alternatives evaluated in the FS is shown.

[3] These costs are for Oil Spill Area portion of SS016, and do not include the "Remainder of Plume" costs which were calculated separately in the FS.

4.2.3.2 Community Acceptance

Community acceptance was not evaluated in the FS. Refer to Section 5.3.6 of the Groundwater IROD for community acceptance discussion.

4.2.4 Comparative Analysis

The FS presented quantitative, comparative analyses for the groundwater sites. The Air Force and regulatory agencies factored the results of a sensitivity analysis into these conclusions. The benefit/cost ratio and total effectiveness score were indicated for each representative alternative for each group of groundwater sites.

The Air Force and regulatory agencies used a relative numerical rating system to measure the degree to which an alternative fulfills each evaluation criterion. Subjective factors and numerical values in a rating system evaluate how completely an alternative meets the evaluation criteria (Table 4-3). The Air Force rated all criteria, with the exception of cost, with a three number system of 5, 3, or 0. The cost criterion includes a four number system including 5, 3, 1, and -1. The addition of a fourth score for the cost criterion is included to provide for a wider range of cost scores. These values are not absolute and served as a subjective ranking method for the purpose of performing the comparative analysis. This rating system assumed that each of the CERCLA criteria were equally important, since each are numerically weighted the same. This may not always be representative in that certain criteria can have more importance, depending on site-specific circumstances. For example, threshold factors must be achieved and therefore might be seen as more important than a balancing factor, such as implementability. Despite these factors, this unbiased scoring system was selected in the FS as the best method to consistently evaluate all alternatives.

Table 4-3

Remedial Alternative Evaluation Criteria Rating System

Evaluation Criterion	Condition	Value
Protective of human health and the environment	Is protective	5
	Potentially or contingent protection	3
	Is not protective	0
Compliance with appropriate ARARs	Complies with appropriate ARARs	5
	Complies with most appropriate ARARs or waivers needed	3
	Does not comply	0
Long-term effectiveness and permanence	Once cleanup is completed, there is no recurrence potential	5
	Contaminants transferred, future re-release possible	3
	Contaminants not removed or destroyed	0
Reduction in toxicity, mobility, and volume through treatment	Eliminates toxicity, mobility, and volume	5
	Reduces toxicity, mobility, and volume	3
	No reduction or no treatment	0
Short-term effectiveness	Short-term environmental improvement protects human health and the environment. No risks (or only insignificant risks) created by implementation	5
	Limited short-term improvement in environment. Minor risks created by implementation of alternative	3
	No short-term improvement in environment. Significant risks created by implementation	0
Implementability	Alternative proven, all materials and personnel available, permitting available or in place, little effect on operations	5
	Alternative requires significant space, raises some action-specific ARAR compliance issues, has some effect on operations	3
	Uncertain permitting, major impact on operations	0
Cost	<$1.5 million	5
	$1.5 to 5 million	3
	$5 to 10 million	1
	>$10 million	-1
State acceptance[a]	To be determined (in the IROD)	NA
Community acceptance[a]	To be determined (in the IROD)	NA

[a] These final two criteria are typically evaluated following comment on the RI/FS report and the Proposed Plan; and, therefore, were not scored in the FS.

ARARs = Applicable or Relevant and Appropriate Requirements
IROD = Interim Record of Decision
NA = Not Applicable

For the comparative analysis, two methods of quantitatively totaling the scores are presented. The “Total Score” sums the seven criterion scores (i.e., all criteria except for the two modifying considerations). A higher score indicates that more of the criteria were met. The “Benefit/Cost Ratio” sums the scores of the five effectiveness criteria and divides by the estimated cost, in millions of dollars. While the total score measures overall compliance with the CERCLA criteria, the benefit/cost ratio better quantifies the degree to which CERCLA criteria are satisfied per unit cost.

4.2.4.1 Total Score

The active treatment alternatives consistently had the highest total scores for all the groundwater sites, with the differences in total scores between the different technologies not being significant. The natural attenuation/monitoring alternative scored lower that the treatment alternatives, but greater than the no action alternative.

4.2.4.2 Benefit/Cost Ratio

The benefit/cost ratios were more variable among alternatives. The natural attenuation/monitoring alternative in some cases scored higher than the treatment alternatives, and lower in other cases. The benefit/cost ratios were more favorable for Alternative 2 than the treatment alternatives because the lower cost of natural attenuation/monitoring was a greater factor in computing the benefit/cost ratio than in computing total cost.

4.2.4.3 Conclusion

The FS concluded that the active treatment alternatives, Alternatives #3 through #9, have similar total scores and benefit/cost ratios, which is why these alternatives were later consolidated into Alternative 3 in the PP and IROD. The natural attenuation/monitoring alternative had lower total scores than the active treatment alternatives but often had higher

benefit/cost ratios because benefit is provided at a much lower cost. However, the benefit (i.e., remediation) is often slower than with extraction and treatment.

The FS did not recommend implementation of specific alternatives for each site. The FS provides information on the pros and cons of each alternative and site-specific factors to consider when selecting site alternatives. The FS evaluated and compared the complete implementation of each single alternative at each site, to provide maximum information to be later used in selecting alternatives, or combinations of alternatives, at each site. The PP/IROD process then performed a site-by-site analysis to develop selected alternatives.

FS Alternatives 3 through 9 were all found to be equally protective and effective for remediating contaminated groundwater depending on the type and concentration of contaminant (i.e., petroleum products, VOCs, metals). Therefore, the Air Force has decided to determine the most appropriate method of extraction treatment and discharge during the RD. This is discussed further in Section 5.0 (Alternative 3).

5.0 INTERIM REMEDIAL ACTIONS

Travis Air Force Base (AFB) has selected interim remedial actions for the North/East/West Industrial Operable Unit (NEWIOU) sites with groundwater contamination. Section 5.1 presents the selected interim remedial actions and the rationale for the actions; Section 5.2 describes the selected alternatives; and Section 5.3 presents the statutory determinations.

5.1 Selected Interim Remedial Actions

The Air Force has developed interim remedial objectives for this Interim Record of Decision (IROD) as shown on Table 5-1. A later, final ROD will include the final cleanup goals; therefore, the Air Force has developed interim remediation goals (IRGs) to evaluate the performance of implemented remedial alternatives during the five-year interim period. These IRGs are similar to final cleanup levels but are not enforceable goals. The IRGs are shown on Table 5-2.

Figure 5-1 shows the selected interim remedial actions for the NEWIOU groundwater IROD. Table 5-3 shows these same interim remedial actions in table format. Table 5-3 lists the 15 NEWIOU Installation Restoration Program (IRP) sites with groundwater contamination. The table includes site summary figure numbers and site names for reference. A checkmark indicates the selected interim action for each site. If Alternative 3 (Extraction, Treatment, and Discharge) is the selected interim action, the objective of the extraction is source control, migration control, off-base remediation, or a combination of these.

Each of the selected remedies will protect human health and the environment, and comply with ARARs. They will be effective at reducing contamination, and are implementable, cost-effective, and acceptable to the public and the State of California.

Table 5-1

Interim Remedial Action Objectives for NEWIOU Groundwater IROD

Interim Remedial Action Objectives
1. Utilize an IROD, as opposed to a final ROD, to begin to quickly remediate groundwater contamination to reduce contamination and risk, while collecting information necessary to allow for selection of final cleanup levels and technically and economically feasible long-term actions.
Comply with NEWIOU ARARs.
Coordinate remedial actions with ongoing interim removal actions, e.g., the Tower Area Removal Action (TARA) in SS016.
Consolidate sites whenever possible to cost-effectively treat groundwater, e.g., at FT005, SS029, and SS030.
Use treated groundwater on base whenever possible (i.e., for industrial or irrigation use) or discharge to the sanitary sewer, if feasible.
Ensure any discharge of treated water to Union Creek meets substantive National Pollutant Discharge Elimination System (NPDES) requirements.
Consider use of existing groundwater treatment plants, e.g., SS016, Outfall III treatment system.
Meet all Federal Facilities Agreement (FFA) dates.
Do not impact Travis AFB's mission.

Table 5-2

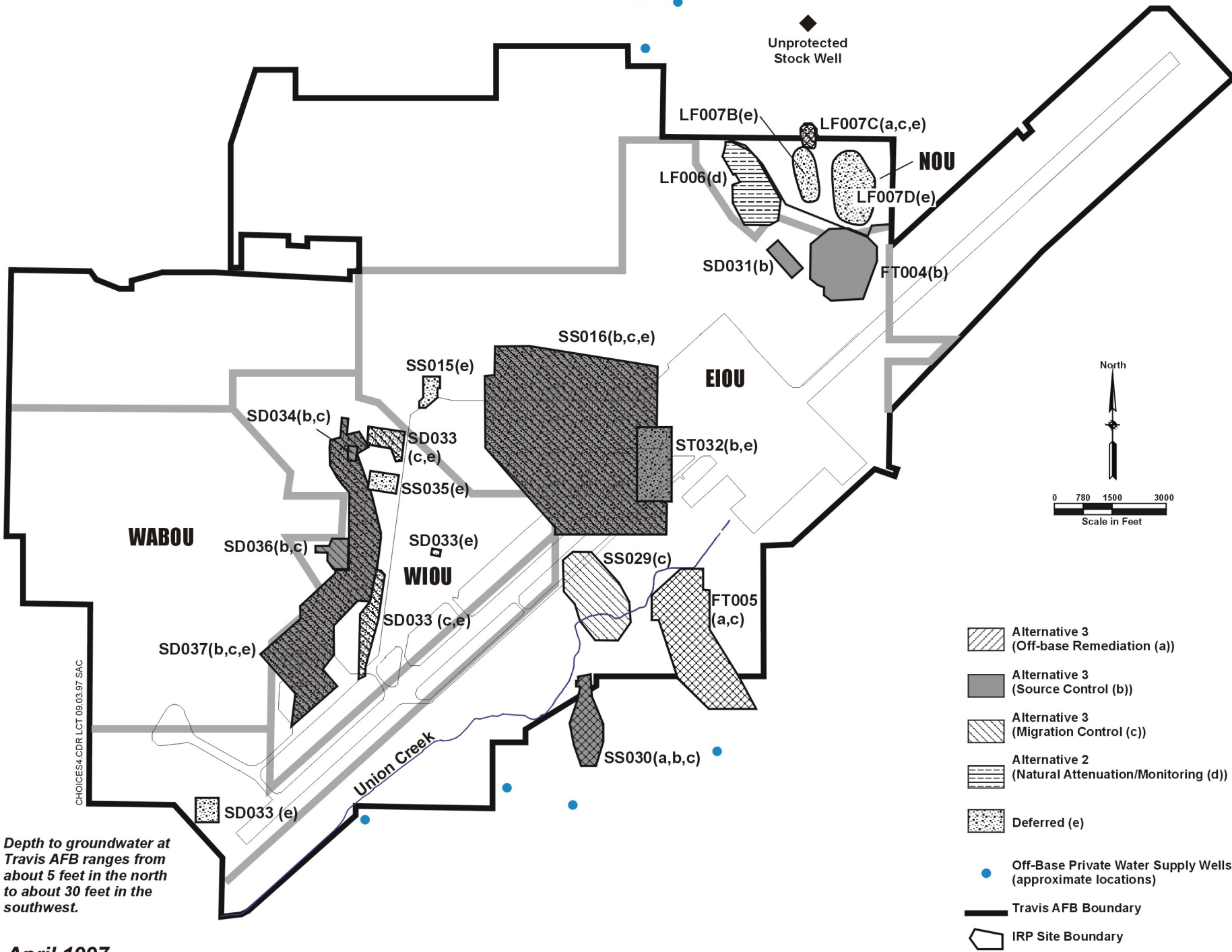
Interim Remediation Goals for NEWIOU Groundwater IROD

Chemical	IRG Concentration (mg/L)	Applicable Sites
Benzene	1.0×10^{-3} (1)	LF007, SS016, SS029, SD031, ST032*, SD034*, SD036, SD037
Bis(2-ethylhexyl)phthalate	4.0×10^{-3} (1)	FT004, FT005, LF007, SS015, SS016, ST032, SD034, SD037
Carbon Tetrachloride	5.0×10^{-4} (1)	SD031, SD037
Chlorobenzene	7.0×10^{-2} (1)	LF007
Chloroform	1.0×10^{-1} (1), (2)	FT004, FT005, SS016, SS029, SS030, SD031
Chloromethane	1.50×10^{-3} (5)	SD037
1,4-Dichlorobenzene	5.0×10^{-3} (1)	LF007, SS015, SS016
Dichlorobromomethane	1.0×10^{-1} (1), (2)	FT004, FT005, SS016, SS030, SD036, SD037
1,2-Dichloroethane	5.0×10^{-4} (1)	FT004, FT005, LF007, SS015, SS016, SS029, SS030, SD031, SD033, SD036, SD037
1,1-Dichloroethene	6.0×10^{-3} (1)	FT004, LF006, LF007, SS016, SS029, SD031, ST032, SD033, SD034, SD036, SD037
cis-1,2-Dichloroethene	6.0×10^{-3} (1)	FT004, FT005, SS015, SS016, SS029, SD031, SD033, SD034, SD036, SD037
1,2-Dichloropropane	5.0×10^{-3} (1), (2)	LF007
Napthalene	2.0×10^{-2} (4)	SD037
Nickel	1.0×10^{-1} (1)	FT004, FT005, SS015, SS016, SS030, SD031
PCBs	5.0×10^{-4} (1), (2)	LF007
2,3,7,8-Tetrachlorodibenzo-p-dioxin	3.0×10^{-8} (1), (2)	LF007
Tetrachloroethene	5.0×10^{-3} (1), (2)	SS015, SS016, SD034, SD036, SD037
TPH as Diesel	1.0×10^{-1} (3)	LF006, SD033, SD034*, SS035, SD036, SD037
TPH as Gasoline	5.0×10^{-3} (3)	SD033, SD034, SD036, SD037
Trichloroethene	5.0×10^{-3} (1), (2)	FT004, FT005, LF006, LF007, SS015, SS016, SS029, SS030, SD031, ST032, SD033, SD034, SS035, SD036, SD037
Vinyl Chloride	5.0×10^{-4} (1)	FT004, LF007, SS015, SS016, SS029, SD031, SD034, SD036, SD037
Xylenes	2.0×10^{-2} (3)	ST032

IRG = Interim Remediation Goal
mg/L = milligrams per liter
NE = Not Established
PCBs = Polychlorinated Biphenyls
TPH = total petroleum hydrocarbon

* Light Non-Aqueous Phase Liquid (LNAPL) or floating petroleum product has been detected at Sites ST032 and SD034.

IRGs are derived from the following:
(1) Drinking Water Standards - Maximum Contaminant Levels (MCL), California Department of Health Services, Primary MCL.
(2) Drinking Water Standards - MCLs, U.S. Environmental Protection Agency (U.S. EPA), Primary MCL.
(3) Other Taste and Odor Thresholds.
(4) Health Advisories or Suggested No-Adverse-Response Levels for toxicity other than cancer risk, U.S. EPA.
(5) Preliminary Remedial Goals, U.S. EPA.



Depth to groundwater at Travis AFB ranges from about 5 feet in the north to about 30 feet in the southwest.

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Figure 5-1. Selected Alternatives for NEWIOU IRP Sites with Groundwater Contamination

Table 5-3

Selected Interim Remedial Actions for NEWIOU IRP Sites with Groundwater Contamination

Associated Figure	IRP Site	Site Name	Selected Interim Actions			
			Alternative 2 Natural Attenuation/ Monitoring	Alternative 3 Extraction, Treatment, and Discharge		
				Source Control	Migration Control	Off-base Remediation
North Operable Unit						
Figure A-3	LF006	Landfill 1	X			
Figure A-4	LF007B†	Landfill 2, Area B	*			
Figure A-5	LF007C†	Landfill 2, Area C	* (on-base portion of plume)		X (at base boundary)	X (off-base portion of plume)
Figure A-6	LF007D†	Landfill 2, Area D	*			
East Industrial Operable Unit						
Figure A-1	FT004	Fire Training Area 3		X		
Figure A-2	FT005	Fire Training Area 4			X	X
Figure A-7	SS015	Solvent Spill Area and Facilities 550 and 552	*			
Figure A-8	SS016	Oil Spill Area (OSA) and Facilities 11, 13/14, 18, 20, 42/1941, 139/144, and selected sections of storm sewer right of way	*	X (OSA Area)	X (southern plume)	
Figure A-9	SS029	Monitoring Well 329 Area			X	
Figure A-10	SS030	Monitoring Well 269 Area		X	X	X
Figure A-11	SD031	Facility 1205		X		
Figure A-12	ST032	Monitoring Wells 107 and 246 Areas	* (Plume A)	X (bioslurp/free product removal for Plume B)		
West Industrial Operable Unit						

† As part of the RI and subsequently the FS, risks and remediation costs associated with contaminated groundwater were calculated for three areas in LF007; LF007B, LF007C, and LF007D.

* Selection of alternative for all or part of site is deferred until completion of the basewide natural attenuation assessment plan. Selected alternative will be documented in the basewide groundwater ROD.

Table 5-3

(Continued)

Associated Figure	IRP Site	Site Name	Selected Interim Actions			
			Alternative 2 Natural Attenuation/ Monitoring	Alternative 3 Extraction, Treatment, and Discharge		
				Source Control	Migration Control	Off-base Remediation
Figure A-13	SD033	Storm Sewer II, Facilities 810 and 1917, South Gate Area, and West Branch of Union Creek	* (South Gate Area, Facility 1917, and Facility 810 plumes)		X (Storm Sewer)	
Figure A-14	SD034	Facility 811		X (bioslurp/free product removal)	X (coordinated with SD037)	
Figure A-15	SS035	Facility 818/819	*			
Figure A-16	SD036	Facility 872/873/876	(complete AFCEE Natural Attenuation Study)	X (depending on results of AFCEE Natural Attenuation Study)	X (depending on results of AFCEE Natural Attenuation Study)	
Figure A-17	SD037	Sanitary Sewer System, Facilities 837, 838, 919, 977, 981, Area G Ramp, and Ragsdale/V Area	* (portions of plume near Facilities 919, 977, 981, and Area G Ramp)	X (portions of plume near Facilities 837, 838, and Ragsdale/V Area)	X (remainder of plume)	

* Selection of alternative for all or part of site is deferred until completion of the basewide natural attenuation assessment plan. Selected alternative will be documented in the basewide groundwater ROD.

5.1.1 Justification for Selected Interim Remedial Actions

The Air Force based the selection of interim remedial actions on the results of the RI/FS process, as well as on previous removal actions, treatability studies, and pilot studies conducted at Travis AFB. As discussed in Section 4.3.4.3, the FS provides the information to select an alternative for each site but does not specify each selected alternative. The PP/IROD process used the FS evaluation of each alternative at each site to select the interim remedial action, or combination of actions, appropriate to each site. This selection process also considered the interim nature of remedial actions under an IROD, as opposed to final actions under a ROD. Appendix A presents additional detail on the rationale for selection of remedial actions at each site. The Air Force eliminated the no action alternative because it does not adequately meet the nine CERCLA criteria.

Alternative 3, Extraction, Treatment, and Discharge, will be used at specified sites to reduce concentrations of groundwater contaminants and to remove floating petroleum product. The goal is to attempt to achieve IRGs, but the Air Force will, at a minimum, continue the action as necessary to prevent migration of the plume and will evaluate the level of cleanup that is economically and technically achievable using Alternative 3. Alternative 3, is the selected interim remedial action for sites where at least one of the following cases exists:

1. **Off-base Remediation** – Where dissolved VOC contamination extends off-base.

2. **Source Control** – Where floating petroleum product or secondary sources of VOC contamination (dense nonaqueous phase liquids [DNAPLs]) exist.

3. **Migration Control** – Where migration of contaminated groundwater is confirmed.

For sites where none of the above criteria apply, the Air Force considered **Alternative 2**, Natural Attenuation/Monitoring, as a possible interim action. Some portions of

groundwater plumes have low concentrations of contaminants; therefore, the contaminant plume may be stable due to natural processes, but additional characterization is needed to make a determination. In addition, some plumes have mixtures of VOCs and petroleum contamination, which can facilitate the natural degradation of chlorinated solvents. Also, some plumes contain breakdown products of TCE which may indicate that biodegradation is occurring. Although conditions at the sites indicate the potential for natural attenuation, confirmation that the process is taking place requires additional data and evaluation. Therefore, the interim remedial decision for these sites is:

1. Select **Alternative 2**, Natural Attenuation, as the interim remedial alternative for one representative site (LF006) to initiate a site-specific natural attenuation evaluation because of evidence indicating that natural attenuation is occurring.

2. Defer the selection of an alternative for the remaining sites, or portions of sites, until the Air Force obtains and evaluates additional data.

3. Initiate a basewide natural attenuation assessment plan to obtain the data for a natural attenuation evaluation for the remaining sites, or portions of sites. The evaluation at LF006 will develop Travis AFB's approach for this basewide assessment plan.

The Remedial Action/Remedial Design (RD/RA) Work Plan for LF006 will address placement of monitoring wells, protocols for monitoring, and evaluation procedures for determining if the contaminated plume is stable (no significant migration above water quality objectives). If natural attenuation is found to be inadequate to stabilize the plume, the Air Force will implement a contingency action such as Alternative 3. The work plan will indicate a "trigger point" based on methods such as modeling and statistical analysis that will indicate the need for contingency action. The agencies will review and approve the work plan. If a contingency action is necessary, the Air Force will not wait until the end of the five-year interim period. The Air Force will request funding and implement the contingency action as soon as funding becomes available.

Information obtained during the five-year interim period will be used to determine whether natural attenuation and/or containment is the most technologically and economically feasible final remedy. The Air Force will not allow horizontal or vertical migration of

contaminants along preferential pathways or within the aquifer at the natural attenuation sites during the five-year period.

Travis AFB will proceed with interim remedial actions to begin quickly to remediate groundwater contamination to reduce contamination and risk, while collecting information necessary to allow for the selection of final cleanup levels and technically and economically feasible long-term remedial actions in the final ROD.

5.1.2 Institutional Actions

The Air Force will use institutional actions for groundwater together with Alternatives 2 and 3 at all groundwater sites within the NEWIOU. The Air Force will place administrative controls on the use of on-base groundwater from contaminated areas. Groundwater is not currently used for drinking water at Travis AFB. The Air Force will place administrative controls also on areas with groundwater contamination, restricting excavation and subsurface work where the excavation worker will encounter groundwater or vapors emitted from the groundwater. Excavation and work will only commence after the Air Force implements environmental and worker safety control measures. Travis AFB already has a program to restrict contractors and base personnel from digging in contaminated areas. This program requires that a digging permit be obtained prior to any excavation activities. The Base Master Plan will cover any land use restrictions, after the IROD proceeds to a final ROD.

The Air Force will implement alternative water supplies if monitoring identifies a threat to off-base water supply wells. A contingency plan for alternative water supplies will be incorporated into the RD/RA for sites with off-base plumes as a separate document.
Groundwater

from beneath Travis AFB is not used for on-base water supply; therefore, the Air Force needs no contingency plan for on-base water supply.

5.1.3 Groundwater Monitoring

Groundwater monitoring of all NEWIOU groundwater sites will continue during all interim remedial actions to document the effect of the interim actions. Data will be evaluated on a regular basis, with agency review, to determine the effectiveness of extraction remedies and to evaluate natural attenuation. At all groundwater sites, if data indicates the plume is not stable, the Air Force will initiate actions such as Alternative 3 to stabilize the plume. Appendix B contains recommendations to the Travis AFB groundwater monitoring program for developing data for all NEWIOU groundwater sites. The Air Force will consider these recommendations during the interim remedial design task, and will revise the existing groundwater monitoring plan accordingly. The GSAP annual report will be a primary document in accordance with the FFA. The RD/RA work plan for each site will include details for monitoring and evaluation based on site-specific conditions. Each work plan will address placement of monitoring wells, protocols and frequency for monitoring, and evaluation procedures to determine if significant migration is occurring. The agencies will review each of the site-specific RD/RA work plans, which are primary documents in accordance with the FFA.

5.2 Alternative Description

This subsection summarizes the selected interim remedial actions. Site-specific information on each alternative is provided in Appendix A.

5.2.1 Alternative 2 – Natural Attenuation/Monitoring

The Air Force has selected Alternative 2 (natural attenuation) for one site (LF006) because the results from the RI/FS indicate a high probability that natural attenuation is an

appropriate remedial alternative at this site. Additional characterization and field data will be collected to confirm that plume migration is stable and that natural attenuation is effective at LF006. The Air Force will implement Alternative 3 as a contingency action if natural attenuation is not effective and the plume is not stable at LF006. The Natural Attenuation Assessment Plan (NAAP) and the RD/RA Work Plan for LF006 will describe the specific details for implementation of Alternative 2 and LF006. As described in Section 5.1, the Air Force has deferred selection of the remedial alternative at other sites for entire plumes or portions of plumes.

The Air Force will develop a NAAP Work Plan which is a primary document in accordance with the FFA and will be submitted for approval to the regulatory agencies and will include a separate schedule for implementation. Appendix B further discusses Alternative 2 and elements of the NAAP.

The NAAP will be based on the AFCEE document "Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater" (Wiedemeier, et al, 1996). The NAAP will describe the Air Force's approach for assessing natural attenuation at LF006, the deferred sites, deferred portions of plumes, and will incorporate information from the AFCEE pilot Study at SD036. The NAAP will describe how the Air Force will collect additional information during the five-year interim period to evaluate the potential for selecting Alternative 2 (natural attenuation) at the deferred sites and/or deferred portions of plumes.

The NAAP will include a schedule and a decision matrix that outlines the method to determine which sites and/or portions of plumes are appropriate for remediation by Alternative 2 (natural attenuation). In reference to the sites where a portion of the plume is Alternative 3 and a portion has the alternative selection deferred, the NAAP will clearly explain the methodology to determine where the Air Force will apply Alternative 2 and Alternative 3.

The Air Force will modify the existing Basewide Groundwater Monitoring Plan as soon as possible to include additional parameters, which will be useful in assessing the effectiveness of natural attenuation.

The NAAP will provide a method to determine the migration rates for groundwater contaminants at each site. The NAAP will establish a method to determine points of compliance, locations for compliance wells, and a "trigger action" that initiates implementation of an appropriate contingency action if natural attenuation is not effective at a site.

5.2.1.1 Definition of Natural Attenuation

"Natural Attenuation" refers to naturally-occurring processes in groundwater that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in those media. These in-situ processes include biodegradation, adsorption, volatilization, and chemical or biological stabilization or destruction of contaminants. This option includes monitoring to evaluate the affect of natural attenuation on contaminants in groundwater, and to evaluate changes or migration of contaminated groundwater.

Monitored natural attenuation can be a viable method of remediation at some sites for soil and groundwater. However, the Air Force will select natural attenuation only where it meets all relevant remedy selection criteria, where it fully protects human health and the environment, and where it meets remedial action objectives within a feasible time frame.

Monitored natural attenuation is not a "no action" or "walk away" option because the Air Force must conduct adequate site characterization, monitoring and analysis to determine its viability as a remedy. Once in place, the Air Force will perform continued monitoring to verify that contaminant levels are decreasing as anticipated, and the remedy is protecting human health and the environment.

Monitored natural attenuation does not have to be the only remedy component at a site and it is typically combined with other types of remedies (such as source control or soil vapor extraction), or used to complete remediation after other remedy components have cleaned up most of the contamination and are no longer efficiently reducing contaminant levels. At Travis

AFB, the Air Force will assess each site to determine which plumes, or portions of plumes, the Air Force can address by natural attenuation.

Travis AFB will perform a site-specific natural attenuation evaluation at the selected natural attenuation site (LF006). The Air Force deferred the selected interim remedial alternative of remaining "non-Alternative-3" sites, because the Air Force needs additional data to make a proper selection of a remedial action. Therefore, Travis AFB will then perform a natural attenuation evaluation at each of these sites similar to the evaluation at LF006. The goals and contingencies of these evaluations will be the same as for the Alternative 2 (LF006) evaluation, and will apply the results of the LF006 evaluation.

Travis AFB is considering the purchase of off-base land adjacent to Site LF007C. Should the Air Force complete this purchase, then the selected interim remedial action for the off-base portion of the plume will change from Alternative 3 to deferred (and will be included in the basewide NAAP).

The Air Force will provide the monitoring data from all sites to the regulatory agencies and the Restoration Advisory Board (RAB) for their review and comment. At sites where the Air Force has assessed natural attenuation, the Air Force will also provide each site's data summary and assessment report for review and approval. A formal review at the end of the five-year interim period will address the acceptability of natural attenuation as a final cleanup action. After this five-year review, a Basewide Groundwater Proposed Plan will present the preferred final cleanup action (natural attenuation, pump and treat, or other) for each site. This Proposed Plan will have a minimum 30-day public comment period. Following the Proposed Plan, a Basewide Groundwater Record of Decision (ROD) will finalize the cleanup decision. The Air Force will

submit the Draft Basewide Groundwater ROD to the agencies and the RAB for review and comment. The regulatory agencies will review and approve the Draft Final Basewide Groundwater ROD.

5.2.2 Alternative 3 – Extraction, Treatment, and Discharge

This alternative (also referred to as "pump and treat") cleans or controls the contaminated plume by extracting contaminated groundwater. The Air Force will treat extracted groundwater to comply with discharge standards shown on Tables 6-7 and 6-8. The final ROD will include final cleanup goals in the final ROD; therefore, the Air Force has developed IRGs to evaluate the performance of implemented remedial alternatives during the five-year interim period. IRGs are shown in Table 5-2.

As part of Alternative 3, the Air Force will treat and discharge extracted groundwater. Extraction, treatment, and discharge processes that will be used for the interim remedial actions are described in the following sections.

5.2.2.1 Extraction Strategy and Technology

Extraction processes could include both horizontal and vertical extraction wells; Travis AFB presently uses both types of wells at the base. Vertical wells with skimmer pumps could also be used for floating product recovery. Bioslurping, two-phase, dual phase or soil vapor extraction systems to remove soil gas, free product and/or groundwater may also be used. The Air Force will assess specific site conditions, such as land use, plume size and concentration, hydrogeology, soil permeability, and distribution of the contamination to determine the most appropriate extraction technique. For example, most of Travis AFB has low permeability soils, which result in limited production rates for vertical wells. Past experience at Travis AFB has shown that high vacuum enhanced extraction can increase the production rate of such wells. For higher permeability soils, experience at Travis AFB has shown that horizontal wells can effectively remove groundwater from a large area. The Air Force will select the method of extraction during the RD process.

5.2.2.2 Treatment Strategy and Technologies

One or more of the following treatment technologies will be implemented for treatment:

Air Stripping – Air stripping utilizes the volatility of many common organic contaminants to remove them from the contaminated water and transfer them to the gaseous phase. Air strippers may consist of towers with heights up to fifty feet, and with diameters from several inches to several feet. Contaminated water enters the top of the tower while air blows upwards through the tower. The agitation provided by the air and plates or synthetic media within the column break up the water into small droplets, providing a large water surface-to-air interface for organics to volatilize into the air phase. Treated water exits the bottom of the tower while air carrying the organic contaminants exits the top of the tower. Depending on concentration and local requirements, the contaminants in the air will usually require subsequent treatment, consisting of thermal or catalytic destruction or adsorption onto activated carbon, before discharge to the atmosphere.

Thermal and Catalytic Oxidation – Thermal and catalytic oxidation are two similar processes that are used to destroy contaminants in process offgas streams, such as the air stream from an air stripping tower or the effluent from a soil gas extraction blower. In a thermal oxidation process, the contaminant gas is heated in the presence of air to a high temperature sufficient to completely burn the contaminants and produce the combustion products of carbon dioxide, water, and hydrochloric acid. Hydrochloric acid is formed only if chlorine is present in the original contaminant. If a significant amount of hydrochloric acid is formed in this process, a scrubbing unit is added. Thermal oxidation systems are economically favored if the contaminated gas to be burned has a high fuel value, and the heat associated with burning the fuel can be recovered.

Catalytic oxidation processes occur at lower temperatures than thermal oxidation processes and can be economically favored if the gas to be treated has a low fuel value. A catalyst is a material that accelerates a chemical reaction but is not itself consumed in the

reaction. A specially formulated catalyst may be required to operate in the presence of hydrochloric acid, which would form from the oxidation of compounds such as TCE.

The target contaminant groups for catalytic oxidation are volatile and semivolatile organic compounds (VOCs and SVOCs, respectively). For groundwater treatment, catalytic oxidation would be the secondary technology in the treatment train. A primary treatment technology (e.g., air stripping) would be required to transfer contaminants from the liquid phase to the vapor phase prior to secondary treatment.

Activated Carbon – Activated carbon can be used to treat contaminated groundwater for VOCs; the carbon is replaced or regenerated once the adsorbent is saturated. Activated carbon is currently in use at Travis AFB and is effective in meeting discharge requirements for streams with initial moderate VOC concentration (1,000 ppb). The target contaminant groups for liquid-phase carbon adsorption are halogenated and non-halogenated semivolatile organic compounds. The technology can be used, but may be less effective, in treating halogenated VOCs, fuel hydrocarbons, pesticides, and inorganics.

The following factors may limit the applicability and effectiveness of liquid-phase carbon adsorption:

- The solubility and concentration of the contaminants can impact process performance;
- Metals can foul the system;

- Costs are high if used as the primary treatment on waste streams with high contaminant concentration levels; and

- Type and pore size of the carbon, as well as the operating temperature, will impact the process performance.

Vapor phase carbon could also be used to adsorb VOCs from the air stream, and the carbon filter would eventually need replacement or regeneration. The adsorptive capacity of activated carbon significantly increases when it is used with vapor phase rather than with aqueous phase contaminants. Vapor phase carbon has been used to remove VOCs from soil vapor extraction (SVE) system effluent at Travis AFB.

Ion Exchange – The Air Force will use ion exchange systems or comparable technology for metals removal if warranted. Ion exchange systems would be installed upstream of the activated carbon and downstream of the air stripper. Specific polymeric resins (or inorganic media) can be used to sorb specific suites of metals. In addition, ion exchange affords some operating flexibility because regeneration of the resin can occur either on- or off-site.

Ultraviolet Radiation and Oxidation – Ultraviolet Radiation and Oxidation (UV-OX) is a liquid phase process and requires chemical reagents, such as hydrogen peroxide, promoted with UV light, to destroy VOCs. Relative to an integrated system with an air stripper and catalytic oxidizer, this method is equally effective and implementable, and the estimated costs are comparable. However, this process option differs from an air stripper because there is no generation (and required subsequent treatment) of an offgas stream. As with the air stripper/catalytic oxidation system, an ion exchange unit followed by activated carbon will be placed downstream of the UV-OX to provide for metals removal and final VOC treatment, respectively. The target contaminant groups for UV oxidation are halogenated VOCs and SVOCs, and pesticides. The technology can also be used, but may be less effective, in treating

non-halogenated VOCs and fuels. The following factors may limit the applicability and effectiveness of UV oxidation:

- The technology cannot be applied on all contaminants; and
- The presence of inorganics and naturally occurring soil organics (e.g., humic substances) can adversely affect system performance.

Treatment Technology Selection

The above treatment processes present a "toolbox" of treatment options to use at sites where the Air Force implements Alternative 3. The FS concluded that the treatment technologies were all effective for treating contaminated groundwater. Therefore, the Air Force will select the most appropriate method of extraction and/or treatment for each site selected during the RD.

The Groundwater NEWIOU RD/RA Work Plan will provide a description of the overall rationale for treatment of contaminated groundwater. The Groundwater NEWIOU RD/RA Work Plan will incorporate experience from ongoing removal actions and will include a decision matrix that describes the procedure and rationale for selecting the appropriate technologies at each site. There will be an opportunity for further public participation during the Remedial Design phase.

5.2.2.3 Discharge

All treated groundwater discharges will comply with the discharge requirements of this IROD as described in Section 6.0 and Tables 6-6, 6-7, and 6-8. Additional NPDES substantive requirements will be established for each new discharge based on information provided during the development of site-specific RD/RA work plans. This information will include, but is not limited to, descriptions of treatment units with schematic drawings and design criteria, operation and maintenance procedures, results of chemical analyses of untreated groundwater (influent) at each site, projected maximum concentrations, projected flow rates, and topographic maps showing exact locations of proposed discharges. Based on a review of this information, NPDES

substantive requirements for sampling, monitoring, and reporting will be established and specified in the final site-specific RD/RA work plan which is a primary document in accordance with the FFA.

The Groundwater NEWIOU RD/RA Work Plan will use the Treated Groundwater Use Plan to estimate irrigation needs. The Groundwater NEWIOU RD/RA Work Plan will include a decision matrix that outlines the rationale and method for treated groundwater discharge at Travis AFB.

The RD/RA process, which includes agency review, will evaluate the volumes of treated groundwater discharged to Union Creek to ensure there are no adverse effects on the creek. For treated groundwater that is beneficially used on-base, the Air Force will meet the effluent treatment limits of Table 6-8. Since discharge of treated groundwater to Union Creek will always be a contingency to irrigation discharge, treatment methods will always be available to ensure that treated groundwater from all sites can meet the discharge standards in Tables 6-7 and 6-8.

The additional treated groundwater that is produced after 1997 may be used for both landscape irrigation and for industrial uses (aircraft wash water and car wash water). As interim remedial actions are designed and implemented, the Air Force will use the Treated Groundwater Use Plan to plan for the specific use of the additional treated groundwater.

Groundwater extraction and treatment will take place in phases, which will gradually increase the amount of treated water available for use. By 1999, the Air Force may extract and treat approximately 413 gpm (0.59 mgd) from contaminated groundwater sites. (The Treated Groundwater Use Plan presents the assumptions used to derive this rate.)

The Air Force will treat the extracted groundwater until contaminants have been reduced to the discharge standards, as found in Tables 6-6, 6-7, and 6-8. Travis AFB may use the treated groundwater for three possible general use options:

- Landscape irrigation at Travis AFB;
- Industrial uses such as car or aircraft washing; and
- Dust control during construction activities.

Travis AFB will discharge treated groundwater it cannot use in these options to the sanitary sewer operated by the Fairfield-Suisun Sewer District, if feasible, or to surface water (Union Creek). The figures in Appendix A indicate potential locations of discharge of treated groundwater to Union Creek.

The options for using treated groundwater on base include irrigating the following locations: Squadron operations; KC-10 maintenance facility; Grass areas, greenbelts, and ballfields; and 200 Building Area. Potential industrial uses of the treated groundwater include aircraft wash racks, car wash, motor pool, and above ground equipment.

Travis AFB will use most of the reused treated groundwater for irrigating landscape. During the wet season, varying amounts of treated groundwater will be needed for irrigation, depending on the rainfall and on when the wet season begins and ends. Consequently, Travis AFB will discharge treated groundwater to the sanitary sewer, if feasible, or to Union Creek during months of heavy precipitation.

5.3 Statutory Determinations

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

- Protectiveness;
- Applicable or Relevant and Appropriate Requirements;
- Cost Effectiveness;
- Use of Permanent Solutions, Alternative Treatment, or Resource Recovery Technologies;
- Preference for Treatment as a Principle Element;
- State and Community Acceptance.

5.3.1 Protectiveness

These selected remedies are protective of human health and the environment in the short term, and the actions are intended to increase protection until the final Groundwater ROD is signed. Protection is achieved by:

- Remediating all off-site dissolved phase contamination to below the IRGs through groundwater extraction, treatment, and discharge;
- Removing areas of contamination with floating petroleum products or VOC concentrations greater than 3,000 µg/L using groundwater extraction, treatment, and discharge;
- Preventing migration of contaminated groundwater using groundwater extraction, treatment, and discharge; and
- Monitoring by the Air Force to confirm the stability of the plumes due to the beneficial effects of natural attenuation.

5.3.2 Applicable or Relevant and Appropriate Requirements

The selected remedies comply with state and federal ARARs for this interim action. Specific ARARs are included in Section 6.0.

5.3.3 Cost Effectiveness

The technologies selected in implementing Alternative 3 for extraction, treatment, and discharge of contaminated groundwater will be the most cost-effective technologies from the "toolbox" that can meet the RAOs and IRGs. The Air Force will determine these technologies during the RD process.

The lower cost Alternative 2, Natural Attenuation/Monitoring, will be the most cost-effective remedy at sites not requiring Alternative 3, if effective at stabilizing and/or reducing the contaminated groundwater.

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

The selected remedies utilize permanent solutions to the potential threats posed by groundwater contamination at each of the sites to the maximum extent practicable. Use of groundwater extraction, treatment, and discharge will control and remove contamination from the subsurface permanently. Source control will remove and control contamination from the highest concentration areas, while remediation of the dissolved off-base contamination will remove contamination from areas outside the long-term control of the base. Natural attenuation of dissolved chlorinated solvents is an innovative and alternative treatment technique that may help remediate contaminated groundwater at the lower risk sites, while allowing the Air Force to focus resources to achieve the maximum benefit at the lowest cost.

5.3.5 Preference for Treatment as a Principle Element

All of these remedies will effectively use passive or active treatment to address the principal potential threats posed by contaminated groundwater. The Air Force will utilize the

operation of the groundwater extraction, treatment, and discharge options to maximize removal of contamination from the groundwater to the extent practicable.

5.3.6 State and Community Acceptance

State Acceptance

The State of California (DTSC and SFBRWQCB) concurs with the Air Force and the U.S. EPA in the selection of Alternatives 2 and 3 as the interim actions for the IRP groundwater sites within the NEWIOU.

Community Acceptance

Based on the comments received during the public comment period, the public has no preference of alternatives. The public comments received and the Air Force response is provided in Part III (Responsiveness Summary).

5.4 RD/RA Implementation and Schedule

The Air Force will implement the RD/RA in accordance with this IROD. In accordance with the Travis AFB FFA, within twenty-one days of signing the IROD, the Air Force shall propose deadlines for completing the site-specific RD/RA work plans and RDs.

The RD/RA schedule will be included in the Groundwater NEWIOU RD/RA Work Plan and is based on the Travis AFB IRP Priority Model. This model is a planning tool used by Travis AFB to prioritize and schedule funding for IRP sites. Factors considered in this model include human health risk, off-base migration, ecological risk, public interest, natural attenuation, mass of contaminants, groundwater concentration, capital cost, project execution, and projected funding levels.

The Groundwater NEWIOU RD/RA Work Plan will address the following elements:

- RD/RA initiation and purpose;
- Travis AFB site prioritization and annual site work schedule;
- An extracted groundwater treatment technology decision matrix;
- A groundwater treatment and discharge decision matrix; and
- Five-year review to evaluate the effectiveness of the remedy (five-year review will be the basis for establishment of final cleanup levels, final ROD issuance, and eventual completion of site cleanup).

Travis AFB will also develop a NAAP as described in Section 5.2.1 to assess the effectiveness of natural attenuation and revise the groundwater monitoring plan to include additional parameters needed to assess the effectiveness of natural attenuation. The NAAP will establish long term groundwater monitoring requirements to assess the effectiveness of Alternative 2. The existing Basewide Groundwater Monitoring Plan will be modified as soon as possible to include additional parameters which will be useful in assessing the effectiveness of natural attenuation.

Sites where the Air Force has selected Alternative 3 for using off-base dissolved plume remediation will be given first priority, and design and installation of the groundwater extraction, treatment, and discharge facilities will commence as soon as funding allows.

There is potential for contaminated groundwater to migrate along storm sewer lines and other preferential pathways. The Air Force will implement Alternative 3 at some sites to control migration of contaminated groundwater along preferential pathways. At other sites where the Air Force has deferred the remedy selection until the final ROD, the Air Force will employ monitoring and a contingency plan to ensure that preferential migration does not occur. At all

sites with known or potential interface between the storm sewer and contaminated groundwater, the Air Force will investigate the interface during the RD. At locations where the Air Force has found the contaminated groundwater to be migrating to the storm sewer or creek, the Air Force will use an interim remedial action such as pump and treat to control migration. Where pump and treat is used, the Air Force will monitor the effectiveness of this action; if the Air force finds that the pump and treat action is not adequately controlling the migration, the Air Force will initiate a contingency action such as repair or lining of the storm sewer.

As allocated funds become available, the Air Force will incorporate into the NEWIOU groundwater remediation action the remaining sites where Alternative 3 has been selected for migration control and source control. At SD036 AFCEE is currently conducting a natural attenuation study. This study will evaluate the site using the AFCEE document "Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater" (Wiedemeier, et. al., 1996). The Air Force will defer migration and source control interim actions selected for this site until results of the study are reviewed, estimated to be late 1998. Based on the results, the Air Force will implement or reevaluate the migration control and source control interim actions.

5.5 Documentation of Significant Changes

There have not been any significant changes to the selected remedies since the Air Force submitted the Proposed Plan for public comment on 25 September 1996.