United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R09-91/067
August 1991

EPA

Superfund Record of Decision:

Castle Air Force Base, CA

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R09-91/067	2.	3. Recipient's Accession No.

4. Title and Subtitle
SUPERFUND RECORD OF DECISION
Castle Air Force Base, CA
First Remedial Action

5. Report Date
08/12/91

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Orgainization Name and Address

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered
800/000

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 2,777-acre Castle Air Force Base is a Strategic Air Command training base 6 miles northwest of the City of Merced in Merced County, California. Land use in the area is predominantly agricultural. Several irrigation canals and laterals are located within 1 mile of the base including Canal Creek, which borders the base on its southwest boundary and receives runoff from the base and irrigated land downstream. At least 20 agricultural wells are located within 3 to 4 miles of the site, and a number of residential and municipal wells are located within 2 miles of the site. Since 1941, the site has been used as a military air training base. Fire training activities, as well as aircraft and jet engine maintenance activities including metal plating and processing, have occurred onsite. Both processes involve the use of fuels, solvents, and chemicals and have generated municipal and chemical wastes. During routine well sampling, the State identified elevated TCE concentrations in ground water in the shallow aquifer beneath and south of the site. In 1984, the base was required not only to implement remedial measures to correct this identified contamination but also to prevent future ground water degradation from waste discharges. The site has been divided into operable units (OUs) for remediation.

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Castle Air Force Base, CA
First Remedial Action
Contaminated Medium: gw
Key Contaminants: VOCs (benzene, PCE, TCE)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report) None

20. Security Class (This Page) None

21. No. of Pages 54

22. Price

(See ANSI-Z39.18) *See Instructions on Reverse*

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

EPA/ROD/R09-91/067
Castle Air Force Base, CA
First Remedial Action

Abstract (Continued)

This Record of Decision (ROD) provides an interim remedy for the main TCE plume, as OU1. Future RODs will address remaining soil and ground water contamination. The primary contaminants of concern affecting the ground water are VOCs including benzene, PCE, and TCE.

The selected remedial action for this interim remedy includes onsite pumping and treatment of ground water using air stripping, followed by natural biological enhancement to accelerate the release and degradation of hazardous constituents in the saturated zone; reinjecting the treated ground water onsite to maintain hydraulic control and avoid depletion of the aquifer; treating emissions from the air stripping process using granular activated carbon; and treating the emissions abatement unit by onsite steam regeneration, and disposing of the liquid condensate offsite. The estimated present worth cost for this remedial action is $28,445,000, which includes an annual O&M cost of $2,744,000.

PERFORMANCE STANDARDS OR GOALS: Ground water clean-up goals based on MCLs and risk levels will be established in a subsequent ROD.

RECORD OF DECISION
INTERIM
OPERABLE UNIT No. 1
CASTLE AIR FORCE BASE
CALIFORNIA

August 7, 1991

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INTERIM OPERABLE UNIT NO. 1
CASTLE AIR FORCE BASE
CALIFORNIA

1.0 DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Castle Air Force Base

Merced County, California

STATEMENT OF BASIS AND PURPOSE

This decision document represents the selected interim remedial action for Operable Unit No. 1 at Castle Air Force Base, which was developed in full accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as well as the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

This decision is based upon the Preliminary Site Characterization Report (PSCR) (IT September 1990) and the Feasibility Study (FS) and the Proposed Plan (PP) for Interim Operable Unit No. 1 (IT, December 1990). All of these documents are available in the Administrative Record for Castle AFB.

The United States Environmental Protection Agency and the State of California agree on the selected remedy.

ASSESSMENT OF THE SITE

The Main Trichloroethylene (TCE) Plume, defined as TCE above the maximum contaminant level (MCL) of 5 ppb in the shallow aquifer beneath the Base, contains TCE which, if not addressed by implementing the selected interim remedy in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health and welfare. The terms "Main TCE Plume" and "MTP" are used throughout this document to designate a plume that contains a variety of contaminants. TCE has been the most prevalent and mobile of the contaminants and can thus be used to determine the extent of groundwater contamination.

DESCRIPTION OF THE REMEDY

The remedy described in Interim Operable Unit No. 1 represents an early effort to extract and treat the contaminated groundwater under the Base. This operable unit will be succeeded by subsequent operable units which will address groundwater contamination on and off Base and, ultimately, an overall Base ROD which will assure that all contamination, including any contaminated soils, is addressed.

The Main TCE Plume (MTP), is one of the sites currently being investigated at the Castle Air Force Base. Operable Unit No. 1 (OU-1) addresses the principal MTP groundwater threat posed by TCE concentrations in the shallow aquifer groundwater beneath the central portion of Base or Main Sector of the Base and the contiguous areas to the south and southwest of the Base (Figure 1-1). The shallow aquifer in which the plume occurs is also used as a drinking/or irrigation water source for some off-base residents.

The interim remedy addresses the remediation of groundwater contamination by eliminating or reducing the risks posed by the site, through treatment and engineering and institutional controls. The final remedy will be selected in a subsequent ROD.

The major components of the selected interim remedy are:

- Pumping groundwater from a series of shallow aquifer extraction wells to maintain hydraulic control of the plume and begin reducing residual TCE concentrations.
- Surface treating the extracted groundwater by air stripping to allow the return of water to beneficial use (resource recovery).
- Reinjecting the treated groundwater back to the shallow aquifer to assist in maintaining hydraulic control and to avoid depletion of the aquifer.
- Applying natural biological enhancement to accelerate the degradation of hazardous constituents in the saturated zone.
- Abating the air stripper emissions with granular activated carbon to avoid degrading ambient air quality. The abatement unit would be steam regenerated on site and the liquid condensate would be disposed off site at an EPA-RCRA approved recycling facility.

DECLARATION

This interim action is protective of human health and the environment, complies with Federal and State applicable or relevant and appropriate requirements for this limited-scope action and is cost effective. Although this interim action is not intended to address fully the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action does utilize treatment and thus is in furtherance of that statutory mandate. Because this action does not constitute the final remedy for the operable unit, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action. Subsequent actions are planned to address fully the threats posed by the conditions at this operable unit. Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within five years after commencement of the remedial action. Because this is an interim action ROD, review of this site and of this remedy will be ongoing as Castle AFB continues to develop final remedial alternatives for the Main TCE Plume operable unit and the overall Castle AFB site.

AUG 2 1 1991

Colonel Michael J. Kehoe
Chairman, Environmental Protection Committee
Castle Air Force Base

12 AUG 1991

Daniel W. McGovern for
Regional Administrator
United States Environmental Protection
Agency, Region IX

AUG 2 3 1991

Val Siebal
Regional Administrator
California Department of Health Services
Toxic Substance Control Program, Region I

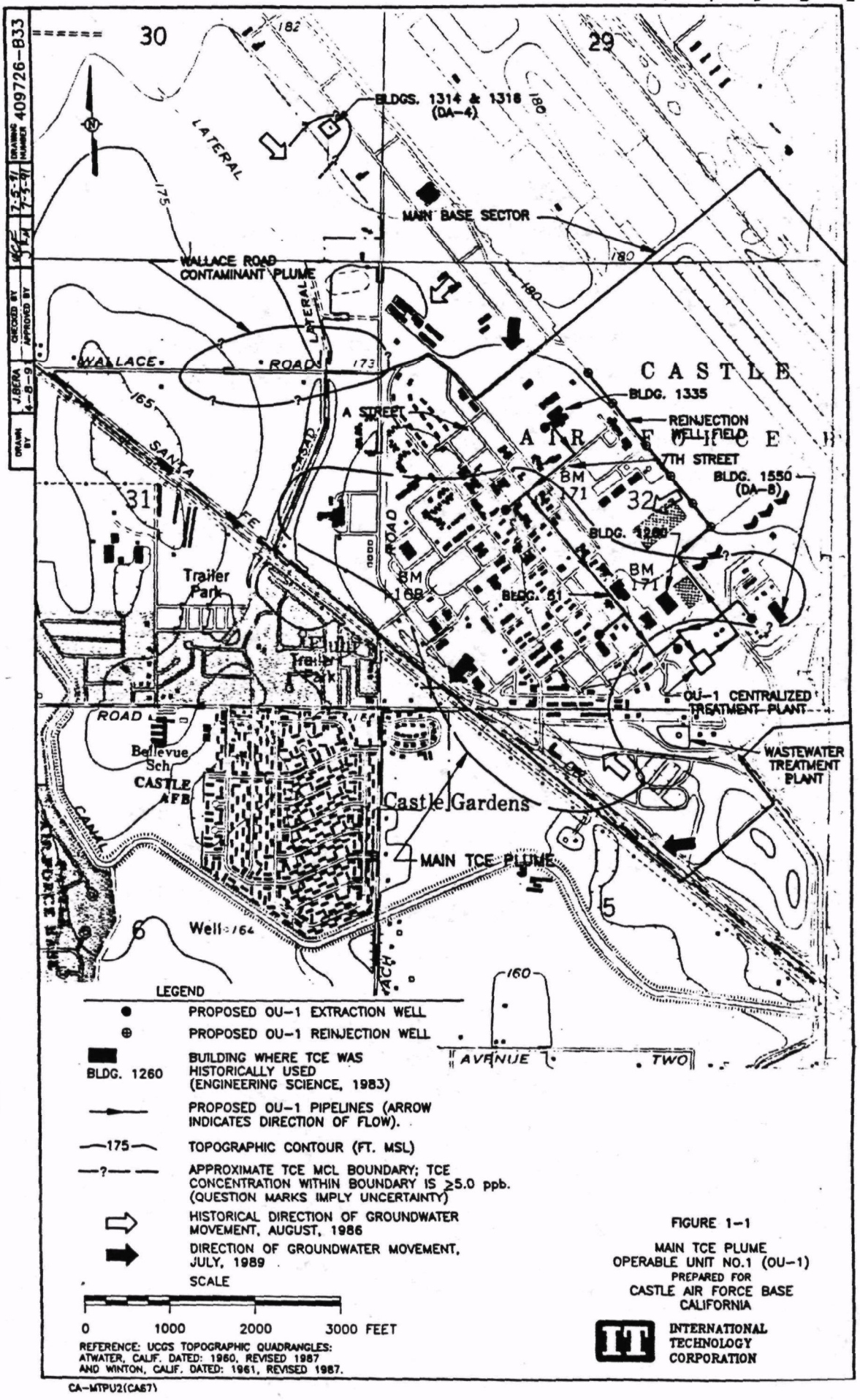

FIGURE 1-1

MAIN TCE PLUME
OPERABLE UNIT NO.1 (OU-1)
PREPARED FOR
CASTLE AIR FORCE BASE
CALIFORNIA

INTERNATIONAL TECHNOLOGY CORPORATION

2.0 SITE DESCRIPTION, SITE HISTORY, COMMUNITY RELATIONS

SITE NAME, LOCATION, AND DESCRIPTION

Castle AFB is a Strategic Air Command (SAC) Training Base located in Merced County, California approximately six miles northwest of the City of Merced in the State of California. Neighboring communities within six miles of the Base include Winton (Pop. 7,583), Atwater (Pop. 22,585), Livingston (Pop. 7,103), and Merced (Pop. 50,000) (Figure 2-1). The Base covers an area of 2,777 acres comprising runway and airfield operations, industrial areas, housing, recreational facilities, and several noncontiguous parcels. In addition, two residential off-Base housing annexes that total approximately 206 acres are located southwest of the Base for housing of military personnel and their families. The site, the Main TCE Plume (Operable Unit No. 1), consists of TCE concentrations above 5 ppb in the shallow aquifer groundwater located beneath the central portion or main sector of Castle AFB and the contiguous areas to the south and southwest of the Base (Figure 1-1).

The total relief across the Base is approximately 35 feet, ranging from 200 feet above mean sea level (MSL) at the northwestern corner to 165 feet above MSL at the southern boundary corner. Relief within the Base boundaries is essentially flat.

Land use within a two-mile radius of the Base is primarily agricultural. Crops grown in the area consist primarily of almonds, peaches, and grapes. Several small dairies and a large chicken farm are located to the east. Open pasture lands are located to the north and east. Residential areas are located primarily west of the Base and include Base housing, trailer parks, recently constructed residential suburban housing and rural farm residences.

There are no major surface water bodies (lakes or rivers) within five miles of the Base. Domestic and agricultural water are supplied to the region by both groundwater wells and the canals of the California Central Valley irrigation projects. A number of irrigation canals and laterals (Black Rascal Creek) are located within one mile of the Base, the largest and most significant is Canal Creek, which is controlled by the Merced Irrigation District. Canal Creek borders the Base proper on the southwest boundary (Figure 2-2). In it's upper reaches upstream from the Base, Canal Creek's flow is diverted for irrigation use. Downstream from the Base, it receives runoff from the Base and irrigated land.

The Merced Irrigation District operates at least 20 agricultural wells within three to four miles of the Base. The City of Atwater, a number of private residences, and the Base operate domestic water wells within two miles of the Base proper. A number of these wells were abandoned due to TCE contamination. Under county code the residences were supplied with bottled water or connected to new wells installed in the deeper confined aquifers. Other residences whose wells were contaminated were furnished with granulated activated carbon (GAC) filtration systems. The Base currently monitors approximately 18 off-Base private residential wells on a regular basis.

Wildlife in the area consists almost exclusively of jack rabbits, rodents, and birds (including ducks and pheasants). The Base is located in the historical range of three endangered species. The Air Force will have a biologist determine the presence or absence of these species and also have a qualified agency determine the presence or absence of wetlands. Any surface area disturbance associated with the selected interim remedy is minimal and should not have a significant impact on endangered species' habitats or wetland areas, should they exist. There are no geologic faults identified below the Base. There are no historic places located within three miles of the Base; nor does the Base lie within a designated floodplain area. The average annual rainfall is approximately six inches.

The natural vegetation of the area consists primarily of salt-tolerant plants. Much of the soils in the area contain soluble salts and alkalis. The principal grass is salt grass (Distichlis spicata). Trees such as the white oak, Fremont cottonwood, Oregon ash, box elder, and willows are found along surface drainage areas.

The subsurface geology was interpreted from over 150 monitoring wells and borings installed during the remedial investigation and related to existing geologic literature. The following generalizations about the geology beneath the Base were developed by relating cross-sectional information and established stratigraphic units.

Sediments from about 0 to 95 feet below grade generally consist of complexly interbedded sequences of alluvial deposits consisting of silty sand, silts, sands, and gravels. These sediments are identified regionally as older alluvium. The gravels generally occur from about 70 to 95 feet below grade, and a high percentage of the gravels are concentrated in the Main

Base Sector. Hardpan, which is a thin layer of cemented soil, exists intermittently at depths generally up to 10 feet below grade.

The older alluvium unconformably overlies a section composed predominantly of clay. This section was identified as the upper Turlock Lake formation. The contact between the clay section and the overlying alluvial deposits appears to be erosional, and the thickest sequences of gravel in the older alluvium have accumulated in trough-like depressions into the clay sequence. The clay sequence itself contains lenses of gravels, sands, and clayey sands which are not correlatable throughout the Base.

The Turlock Lake formation is divided into an upper and lower unit. The upper unit contains mostly finer-grained materials as described above; the lower contains sands. The lower Turlock Lake formation is a fairly continuous unit occurring from about 260 to 320 feet below grade. These sands comprise the confined aquifer at the Base.

A deep regional aquifer occurs at about 650 feet below grade and is an important source of water in the Modesto-Merced Area. The deep water-bearing unit is located in the upper part of the Mehrten Formation. In the region of the Base, this formation consists of claystone, siltstone, sandstone, and conglomerate. The vertical extent of the deep aquifer is unknown. However, it would not be usable for beneficial purposes below the level where saline water occurs, which is at about 1,200 feet below the ground surface.

SITE HISTORY AND ENFORCEMENT ACTIONS

Castle AFB was first used as a military air base in December 1941. The primary mission of the Base through World War II was the training of Army air crews. The Strategic Air Command assumed responsibility of the Base in 1946 and has occupied the Base with the 93rd Bombardment Wing since 1947.

The construction of facilities at the Base has paralleled increases in the size of its mission and the number of organizations in residence. Originally, the major industrial activities related to aircraft maintenance centered in two hangers (Buildings 47 and 51) and the machine shop (Building 52, later demolished in 1977), located on the southwestern side of Apron Avenue (Figure 1-1). In 1955, an additional parking apron, hanger (Building 1550), and other

structures were added to support the newly arrived 456th Fighter Interceptor Squadron (Figure 1-1). Since 1955, Building 1550 has been used extensively for industrial activities. Buildings 1253 and 1260 were built in the late 1970s and assumed the majority of the industrial activities previously performed in Building 52. These activities included metal plating and processing, and jet engine maintenance.

Fuels (JP-4), solvents (TCE) and chemicals have been handled at the Base since the 1940s. Municipal and chemical wastes have also been generated as a result of maintenance operations, fuel management, fire training, and other Base activities. In the 1950s, expanded industrial activities related to the SAC mission resulted in increased waste generation rates.

Prior to the current remedial investigation, several previous studies and investigations have been performed to identify the historical use of chemicals, disposal, and/or leakage of these chemicals to the soil, and the extent and impact of these chemicals on groundwater resources in and around the Base.

During the routine sampling of several Base and private wells in 1980, trace levels of TCE were detected in the four Base water production wells. Seven test wells were then installed in the shallow aquifer by the Base as part of the investigation. The results of this sampling program prompted the Base to construct a new deep aquifer water supply well (PW-10) and provided the impetus for the start of the Air Force's Installation Restoration Program (IRP) at Castle AFB.

In 1981, Phase I of the IRP was conducted by Engineering Science. A total of 35 separate sites were identified and organized into 26 sites or groups of sites having the potential for environmental contamination. Recommendations for further investigative work called for 21 of the 26 sites to be evaluated. The 21 sites were grouped into 15 investigation sites located in the central part of the Base, the landfills, and the west and north flight line areas.

In March 1984, the California Regional Water Quality Control Board - Central Valley Region issued Cleanup and Abatement Order Number 84-027. This order required the Base to provide users of the Base water supply and impacted off-Base wells with potable water

supplies. Also, the Base was required to implement remedial measures to correct identified and future groundwater degradation from waste discharges.

In September 1984, the Phase II, Stage 1 field investigation was conducted by the Roy F. Weston Company. This investigation included the installation of 27 monitoring wells and 11 unsaturated zone lysimeters into the shallow aquifer to sample for groundwater contamination and to test for perched water zones. Two rounds of water quality sampling were conducted.

The Phase II, Stage 1 investigation determined that the soils and sediments at the Base had not been significantly impacted at the majority of the sites investigated, but that the groundwater needed further evaluation. This conclusion is considered preliminary and will be verified in the RI/FS for the overall Base. Significant TCE concentrations were detected in the central or Main Base Sector. The Weston Phase II, Stage 1 Final Report recommended additional investigations of the landfill, fire training areas, fuel spills, and disposal areas, and for further evaluation of the TCE plume in the Main Base Sector.

Results of the Phase II, Stage 1 investigation and the Base's groundwater sampling program indicated that TCE contamination may be present not only in the Main Base Sector, but also in the South Base Sector and Disposal Areas Nos. 2 and 4. As a result of these findings, Weston conducted a Phase II, Stage 2 investigation which included further evaluations of the landfills, fuel spills and leaks, and selected disposal areas. The field investigation included soil organic vapor (SOV) monitoring at 205 points, the drilling of 48 soil borings, the installation of 27 monitoring wells and 5 lysimeters or perched wells, and conducting two rounds of groundwater sampling. The Phase II, Stage 2 investigation was completed in April 1987, and the final report was issued in August 1988.

In 1986, the Air Force contracted Oak Ridge National Laboratory (ORNL), operated by Martin Marietta Energy System, Inc., and their subcontractor, IT Corporation (IT), to support the Phase IV-A IRP activities. These activities included conducting an SOV monitoring survey and additional record searches. Approximately 374 SOV points on a 300-foot spacing were sampled in the Main Base Sector to identify potential volatile organic contaminant source areas.

Castle fell under the provisions of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) when amended in 1986. Castle Air Force Base was then placed on the National Priorities List (NPL) in 1987.

Results of all the above field investigations and data collection activities were used to develop the current Remedial Investigation/Feasibility Study (RI/FS) program. The first phase of RI field activities was initiated by IT Corporation in August 1988. These activities included the installation of 63 monitoring wells in the upper and lower zone of the shallow aquifer and 9 monitoring wells in the confined aquifer. In June 1989, the second phase of the RI was initiated and included conducting two rounds of quarterly groundwater sampling in 160 wells. These wells included previously installed Base and Phase II wells, new RI Base wells, and off-Base private wells. In addition, 77 soil borings were drilled and sampled to assist in the future characterization of various investigative sites. Two rounds of groundwater level measurements were made, and 15 short-term (4-hour) pump tests were also conducted. The second phase of the RI field activities was completed in February 1990. The results of the above field activities are described in the Preliminary Site Characterization Report, which is the basis for the Interim Operable Unit No. 1 Feasibility Study.

The third phase of RI field activities began in March 1990 and continued through May 1991. These activities included quarterly groundwater sampling rounds 3, 4, and 5, two 30-day aquifer pump tests, a preliminary site assessment of Castle Vista landfills, six water level snap shots and development of work plan No. 2. Ongoing and near-term future RI field activities include the installation of approximately 50 VOC probes, continued quarterly groundwater samplings, water level snap shots, and a sewer line TV camera survey.

In addition to Operable Unit No. 1 (OU-1), Operable Unit No. 2 (OU-2) will address remedial actions on groundwater contamination in the Wallace Road and DA-4 areas while Operable Unit No. 3 (OU-3) will address any remaining groundwater contamination not addressed by OU-1 and OU-2. Operable Unit No. 3 will be implemented following additional RI activities to determine the remaining extent of groundwater contamination. A contaminant source assessment task will be performed to identify and to characterize any remaining potential waste sites at Castle AFB. Following this task, an RI Work Plan for Existing Sites and

Contaminant Source Assessment Sites will be prepared and implemented to complete the RI. An installation wide RI/FS report and ROD will conclude the RI/FS process at the Base.

Estimated dates for the completion of these activities are:

• Draft Final ROD for Operable Unit No. 2 (See Section 3.0)	October 1992
• Draft Final ROD for Operable Unit No. 3 (See Section 3.0)	February 1994
• Work Plan for Existing Sites and Contaminant Source Assessment Sites	July 1992
• Implementation of the Work Plan for Existing Sites and Contaminant Source Assessment Sites	April 1993
• Installation-wide Remedial Investigation Report (RI)	January 1994
• Installation-wide Feasibility Study (FS)	June 1994
• Installation-wide Record of Decision (ROD)	April 1995

HIGHLIGHTS OF COMMUNITY PARTICIPATION

A Community Relations Plan for the Base was finalized in June 1990. This Plan lists contacts and interested parties throughout the Air Force, government, and local community. It also established communication pathways to ensure timely dissemination of pertinent information through mailings, public announcements in the local paper, and local information repositories. The Interim Operable Unit No. 1 Feasibility Study was released for public comment in December 1990.

A Proposed Plan announcement for Operable Unit No. 1 (OU-1) was mailed to interested parties and an announcement of the OU-1 public comment period and community meeting was placed in local papers. The public comment period began on December 20, 1990 and a community meeting was held on January 8, 1991 in the City of Atwater, to discuss the proposed TCE groundwater clean up alternatives. The public comment period was then extended to February 21, 1991, following a written request by a concerned member of the community. All comments were received during the public comment period and a Responsiveness Summary was prepared by the Air Force addressing these comments (Section 10).

3.0 SCOPE AND ROLE OF THE OPERABLE UNIT

Currently three operable units have been identified at the Base. They include: the Main TCE Plume (Operable Unit No. 1), the Wallace Road/DA-4 TCE plumes (Operable Unit No. 2) and the remaining groundwater cleanup on/and off-Base (Operable Unit No. 3). Current investigations suggest that the groundwater contamination in the Wallace Road/DA-4 TCE plumes stem from sources other than the Main TCE Plume. Operable Unit No. 3 will address groundwater remediation for the remaining portions of groundwater contamination on and off-Base not previously covered by Operable Units No. 1 and 2. Operable Unit No. 3 will proceed following the completion of site characterization activities and will complete the defintion of groundwater contamination at Castle AFB. The remaining contamination on Base will be addressed in the overall RI/FS and ROD for the entire Base.

The principal risk to public health posed by Operable Unit No. 1 is the TCE plume to the south and southwest of the Base which has the potential to impact off-Base residential water wells. Delays in remediating the Main TCE Plume (MTP) could potentially affect additional wells and a greater area, making remediation more difficult and costly.

The lateral area delineated by the MTP, defined as TCE at or above the drinking water MCL of 5 parts per billion (ppb), exceeds 212 acres (Figure 1-1). The full extent of the plume delineated at less than 5 ppb in all directions is not completely known at this time. Additional off site investigations are planned. The two other operable units will address the remaining problems of groundwater contamination both on and off the Base.

Since data has shown that Applicable or Relevant and Appropriate Requirements (ARARs) have been exceeded in the groundwater under Castle AFB, this interim operable unit is designed to initiate early action to mitigate potential threats to public health and the environment. Subsequent operable units and the overall Base ROD will define further actions to mitigate potential threats. The selected interim remedy in this action is expected to be consistent with subsequent remedies and planned future actions at the Base. Pursuant to regulatory guidance for interim remedial actions, the Interim Operable Unit No. 1 Feasibility Study does not contain a baseline risk assessment. Risks to public health and the environment will be assessed in a subsequent ROD.

4.0 SUMMARY OF SITE CHARACTERISTICS

In addition to the original investigative sites identified at the Base, the state has identified further areas of potential contamination. Investigation of these sites is under way. The sites include areas where disposal of wastes or known leaks or spills of significant amounts of fuels or chemicals have occurred on the Base. During the remedial investigations, soil sampling (of borings) and groundwater sampling were performed in order to characterize each site. Other geophysical and investigative techniques were also used to identify potential buried drums, unusual objects, levels of radioactivity, or high levels of significant volatile soil organic vapor.

The site investigation identified three groundwater plumes containing various chemicals but primarily TCE (Figure 1-1). The largest plume, the Main TCE Plume (MTP) (Operable Unit No. 1), consisted of a number of smaller plumes from different source areas which have merged to form one large plume beneath the central portion of the Base. The MTP occurs in the shallow aquifer which is used as a drinking/irrigation water source for some off-Base residents. The soils, investigated thus far, were found to contain trace levels of volatile organics (Figure 4-2). A number of sites were found to contain potentially significant levels of petroleum-type hydrocarbons as a result of former fuel leaks and spills. Remediation of soils will be determined in a later ROD.

A number of chemicals have been identified in the groundwater within the MTP (Tables 4-1, 4-2 and 4-3). Some of the chemicals have established Maximum Contaminant Levels (MCLs) under the Federal and State Safe Drinking Water Act (Tables 4-2, 4-3). The remedial action MTP chemicals of potential concern which exceed MCL's include:

- Trichloroethylene (TCE)
- Benzene
- Tetrachloroethylene (PCE)
- cis-1,2-Dichloroethylene (1,2-DCE)
- Chloroform
- 1,2-Dichloroethane (1,2-DCA)
- 1,1-Dichloroethylene
- Carbon Tetrachloride
- Chloromethane
- 1,1-Dichloroethane

Elevated levels of JP-4 (jet fuel) were also detected, but there are no regulatory cleanup standards set for JP-4 since it consists of a diverse mixture of petroleum hydrocarbons. However, there are MCLs established for individual components of JP-4 such as benzene, toluene, xylene, ethylbenzene, etc., which may pose a health risk (Tables 4-2 and 4-3). Only benzene has been detected above MCLs.

Figure 1-1 shows the delineation of the TCE plume at the 5 parts per billion (ppb) boundary. This level is the drinking water standard for TCE promulgated by the U.S. EPA under National Primary Drinking Water Standards. The plume also delineates the extent of contamination of the other constituents of concern described above. The selected interim remedy will remove and treat the constituents listed in Tables 4-2 and 4-3 within the delineated area. Potential groundwater users are the Air Force, nearby residents, and farmers.

The highest level of TCE detected during the four rounds of quarterly RI groundwater sampling within the MTP was 1,200 ppb (Table 4-1). A number of TCE hot spots were also identified which exceeded 100 ppb. The vast majority of groundwater within the MTP contains TCE at levels less than 50 ppb. Benzene was detected at a maximum concentration of 660 ppb in a monitoring well located in the immediate vicinity of the petroleum, oils and lubricants (POL) storage area (Table 4-2). The POL storage area is the primary area of the Base where fuels (which contain benzene) are handled.

The Main TCE Plume is in a relatively porous and transmissive formation. It is influenced by off-Base pumping of irrigation and municipal wells indicating these wells may be screened higher than well log reports indicate. It is expanding at a rate that is potentially significant to water sources.

TABLE 4-1

SUMMARY OF TCE DETECTED IN GROUNDWATER FOR THE MAIN TCE PLUME (ppb)

WELL NO.*	ROUND 1	ROUND 2	ROUND 3	ROUND 4
MW-115	20	22	46	Dry
MW-120	(Free product)	(Free product)	Dry	Dry
MW-125	0.8	0.8	1.4	1.2
MW-210	35	39	38	43
MW-220	16	25	25	49
MW-245	0.6	ND	ND	Dry
MW-290	ND	ND	ND	0.9
MW-300	8.7	6.4	6.2	0.8
MW-310	150	94	120	83
MW-509	0.9	0.8	2.2	2.2
MW-510	25	39	40	61
MW-511	2.6	ND	3	5.9
MW-512	16	25	32	35
MW-513	ND	0.8	0.8	0.3
MW-514	3.1	3.0	3.5	3.5
MW-515	2.3	4.8	0.7	ND
MW-516	49	76.0	71	59
MW-517	2.3	1.8	3.4	0.7
MW-518	4.9	ND	11	7.8
MW-519	530	730	920	1000
MW-520	2.6	1.3	1.9	1.4
MW-521	240	390	340	610
MW-522	55	310	160	330
MW-523	7.3	14	9.3	15
MW-524	38	45	70	48
MW-525	0.5	120	140	170
MW-527	7.1	8.4	12	10
MW-528	24	26	23	9.5
MW-529	1,000	1,144	1,200	1,100
MW-530	1.3	ND	2.1	1.4
MW-531	18	26	120	63
MW-532	0.4	0.4	ND	0.4
MW-534	ND	0.4	0.3	1

TABLE 4-1

SUMMARY OF TCE DETECTED IN GROUNDWATER FOR THE MAIN TCE PLUME (ppb)

MW-536	0.3	0.3	ND	0.8
MW-543	46	73	130	130
MW-544	23	24	22	45
MW-551	16	31	13	46
MW-552	0.4	ND	ND	ND
MW-554	29	47	61	66
MW-556	30	36	150	100
MW-557	9.9	6.6	16	9.6
MW-602	ND	1.2	ND	ND
MW-603	ND	ND	30	51
MW-606	ND	10	15	5.6
MW-608	ND	0.8	0.5	ND
MW-711	ND	0.3	ND	ND
MW-712	0.3	1.6	4.8	2
MW-752	1.3	1.8	2.4	3
MW-TW-13	2.3	2.1	3.3	1.1
MW-TW-14	58	69	120	---
MW-TW-15	4.7	5.5	5.5	6.1
MW-TW-16	470	350	480	---
MW-TW-17	7.3	7.4	10	---
MW-TW-18	(Not functioning)	20	34	34
MW-PW-2	2.6	2.3	---	---
MW-PW-3	2.9	2.3	---	---
MW-PW-4	3.1	---	---	---
MW-PW-9	0.3	0.3	---	---
MW-PW-10	0.5	ND	---	---
MW-BOYLE2	ND	ND	0.3	ND
MW-BOYLE4	ND	0.7	1.2	1.5
MW-MID228	12	13	---	---
MW-4781	1.3	0.9	---	---
MW-2679	ND	0.3	---	---

* Well locations are shown on Figure 1-4 in the Interim Operable Unit No. 1 Feasibility Study for Castle AFB, December 1990

ND = None detected

TABLE 4-2
ORGANIC COMPOUNDS DETECTED IN MTP GROUNDWATER
SAMPLING ROUNDS 1, 2, 3, AND 4

COMPOUND	HIGHEST CONCENTRATION DETECTED WITHIN MAIN TCE PLUME (ppb)	MCL (ppb)	SAMPLE LOCATION
Trichloroethylene*	1,200	5	MW-529
Benzene*	660	1	MW-531
Tetrachloroethylene*	180	5	MW-521
Cis-1,2-Dichloroethylene*	140	6	MW-531
Methylene Chloride	44	--	MW-519
Xylenes	43	1750	MW-531
Ethylbenzene	38	680	MW-531
Acetone	26	--	MW-608
Toluene	17	--	MW-531
1,1-Dichloroethylene*	17	6	MW-529
1,2-Dichloroethane*	16	0.5	MW-531
Carbon Tetrachloride*	15	0.5	MW-525
Chloroform*	12	100	MW-523
Dichlorodifluoromethane	7.5	--	MW-Boyle-2
JP4	7.4	--	MW-609
1,1-Dichloroethane*	5.5	5	MW-533
Chloromethane*	5.0	--	MW-521
Trichlorofluoromethane	2.3	150	MW-352
Trans-1,2-Dichloroethylene	2	10	MW-522
1,2-Dichloropropane	1.2	5	MW-609
Chloroethane	1.1	--	MW-709
Chlorobenzene	0.4	30	MW-531/523/524/607
1,2-Dichlorobenzene	0.4	--	MW-608
Bromoform	0.4	--	MW-Boyle-4

* Contaminants of Concern

TABLE 4-3
METALS AND IONS DETECTED IN MTP GROUNDWATER
SAMPLING ROUNDS 1, 2, 3 AND 4

	HIGHEST CONCENTRATION DETECTED WITHIN MAIN TCE PLUME (ppm)	MCL (ppm)	SAMPLE LOCATION
Arsenic	ND	0.05	--
Barium	0.32	1	MW-536/TW-17
Bromide	1	--	MW-525
Cadmium	0.005	0.01	MW-533/557
Calcium	71	--	MW-TW-13
Chloride	59	--	MW-559
Chromium	0.01	0.05	MW-557
Copper	0.025	--	MW-557
Cyanide	0.02	--	MW-557
Fluoride	0.4	--	MW-608
Hardness	280	--	MW-531/532
Iron	0.9	--	MW-115
Lead	0.005	0.05	MW-125
Magnesium	29	--	MW-115
Manganese	2.4	--	MW-533
Nitrate	14	45	MW-TW-15
Phosphate	2.2	--	MW-513
Potassium	50	--	MW-605
Selenium	0.005	0.01	MW-557
Silver	0.01	0.05	MW-557
Sodium	68	--	MW-559
Specific Conductance	790 umhos/cm	--	MW-115
Sodium Sulfate	69	--	MW-245
Total Dissolved Solids	500	--	MW-536
Zinc	0.06	--	MW-525
pH (low)	6.3 std units	--	MW-Boyle-3
pH (high)	9.7 std units	--	MW-605/607/TW-16

MA:ENG:9327T4-3.BM

5.0 SUMMARY OF SITE RISKS

Site risks have not been fully characterized, however, it is clear that MCLs have been exceeded for several contaminants as discussed in Section 4 (Tables 4-2 and 4-3). Therefore, it is appropriate to initiate early cleanup action via an interim remedy. Ten organic chemicals of potential concern were previously identified for the MTP area. The general goals of this interim action are to prevent the further spread of contamination and initiate mass removal of contamination from the aquifer. This action is designed to stabilize the spread of contamination, prevent further degradation, and to achieve risk reduction quickly. Risks are partially addressed by this interim remedy in that treatment actions will be expedited. More specific findings on risk and ultimate target cleanup levels for the groundwater will be established in a subsequent final action ROD.

6.0 DESCRIPTION OF ALTERNATIVES

As discussed in Section 5.0, the goals of this interim action are to prevent the spread of further contamination and to initiate removal of contamination from the aquifer. The cleanup target for the aquifer will be established in a subsequent ROD. Any residual contaminants resulting from the cleanup alternatives will be treated or disposed of in accordance with the Resource Conservation and Recovery Act (RCRA). A description of the nine alternatives developed and screened is provided below. For purposes of comparing the net present worth of each alternative, a discount rate of seven percent and an annual inflation rate of six percent were assumed (Table 7-1). These rates were considered to be representative of the economic conditions at the time the Operable Unit No. 1 Feasibility Study was prepared. Alternatives B through I are based on pumping groundwater through extraction wells located in the Main Base Sector. The pumping rate and optimum configuration of the wells will be determined during the remedial design phase. Based on conceptual modeling, a total pumping rate of 1250 gallons per minute from five extraction wells was used for the preliminary design basis.

The air stripping towers, identified in Alternatives B, C, D, and I, were conceptually sized for estimating purposes at 84 inches diameter, 25 foot packing depth, and a required air flow rate of 3345 SCFM. The preliminary tower sizing is based on (worst case) high levels of detected organic compounds in the Base groundwater sampling data from rounds one, two, three, and found, and on achieving a removal concentration level to meet established MCLs for the chemicals of concern.

As noted in Section 5.0, this action does not set specific cleanup levels. All pump and treat Alternatives (B through I) would initiate the remediation of groundwater to meet the objectives of this action. As a part of this action, cleanup levels will be established for the treated effluent and any possible air emissions from the air stripper. The treated groundwater will be cleaned to the MCLs and/or ARAR listed on Tables 4-2 and 4-3.

ALTERNATIVE A

Alternative A is the no-action alternative. This alternative was evaluated for baseline comparison purposes. The alternative considers taking no active remedial measures such as

groundwater pumping or removal of contamination. There is no reduction of toxicity, mobility, and volume through treatment. A site monitoring period of 30 years is used as the basis for estimating a reasonable cost and present worth. A net present worth of $9,368,000 is estimated for this alternative resulting from an estimated annual operating cost of $360,000 over a 30-year period.

ALTERNATIVE B

Alternative B considers groundwater removal by pumping and surface treatment of the groundwater using air stripping. The emissions from the air stripper would be abated using a gas fired thermal combustor. Burning the emissions would destroy contaminants and eliminate the need to dispose of waste off-site. Treated groundwater would be reinjected into the same aquifer, increasing the flushing rate of contaminants and avoiding aquifer depletion caused by groundwater pumping.

This alternative is estimated to have a net present worth of $34,020,000, an initial capital cost of $2,277,000, and an annual operational cost of $1,438,000. A remedial duration of 25 years is estimated for this alternative.

ALTERNATIVE C

Alternative C considers groundwater removal by pumping and the same treatment and control measures as Alternative B. In addition, in situ biological enhancement is included which stimulates naturally occurring soil bacteria to accelerate the degradation of contaminants in the groundwater and those adsorbed onto soil particles. Upon completion of the remediation, the bacteria die off leaving no residuals. Treated groundwater would be reinjected, preventing regional aquifer depletion. In some applications, the process reduces the clean up time by as much as 90 percent.

This alternative is estimated to have a net present worth of $26,308,000, an initial capital cost of $2,437,000, and annual operational costs of $2,530,000. A remedial duration of 10 years is estimated for this alternative.

ALTERNATIVE D

Alternative D evaluates groundwater pumping and surface treatment using the same equipment configuration and emission controls as Alternative B. Treated groundwater is disposed through a surface outfall into an irrigation or drainage canal instead of reinjection back into the aquifer. In situ biological enhancement is not considered as part of this alternative. This alternative would be expected to deplete the aquifer at a rate of up to 10 feet per year if implemented.

This alternative is estimated to have a net present worth of $39,302,000, an initial capital cost of $2,027,000, and annual operational costs of $1,438,000. A remedial duration of 30 years is estimated for this alternative.

ALTERNATIVE E

Alternative E evaluates groundwater pumping and reinjection of treated groundwater. The surface treatment technology for the pumped groundwater is liquid phase granular activated carbon adsorption. The carbon would be regenerated on-site using medium pressure steam. The regeneration process generates a condensate from the units which contains contaminants removed from the groundwater. Regenerant condensate containing recovered contaminants would be collected and taken off-site to an approved recycling facility. Treated groundwater will be reinjected into the same aquifer. In situ biological enhancement is not considered as part of this alternative.

This alternative is estimated to have a net present worth of $39,330,000, an initial capital cost of $3,484,000, and annual operational costs of $1,623,000. A remedial duration of 25 years is estimated for this alternative.

ALTERNATIVE F

Alternative F considers the same removal, surface treatment, and groundwater disposal (reinjection) technologies as Alternative E. Similar to Alternative C, in situ biological enhancement is also included. The alternative is unique in that on-site treatment of the condensate generated from the granular activated carbon regeneration process is included. The technology evaluated for on-site treatment of the regenerant is ultra-violet (UV) photolysis which is considered an innovative technology.

This alternative is estimated to have a net present worth of $26,752,000, an initial capital cost of $4,010,000, and annual operational costs of $2,411,000. A remedial duration of 10 years is estimated for this alternative.

ALTERNATIVE G

Alternative G evaluates the potential advantages of smaller decentralized treatment units. This alternative considers the advantages of using individual granular activated carbon treatment units at each groundwater extraction well location. After treatment, groundwater would be reinjected. The carbon units would be regenerated using a mobile skid mounted boiler system. Regenerant condensate containing recovered contaminants would be collected and taken off-site to an approved recycling facility. The primary disadvantage of decentralized operation is the cost of system maintenance and monitoring.

This alternative is estimated to have a net present worth of $65,240,000, an initial capital cost of $4,333,000, and annual operational costs of $2,753,000. A remedial duration of 25 years is estimated for this alternative.

ALTERNATIVE H

Alternative H evaluates utilizing UV photolysis treatment for treating the entire groundwater volume. Groundwater would be pumped to the surface and the contaminants broken down by passing the groundwater past strong ultra-violet lights. In addition, hydrogen peroxide would be added to accelerate decomposition. The technology is innovative and avoids some of the problems associated with other alternatives such as waste generation and disposal. Following treatment, the groundwater would be reinjected, minimizing aquifer depletion. In situ biological enhancement is also included as a technology option with this alternative.

This alternative is estimated to have a net present worth of $44,013,000, an initial capital cost of $7,735,000, and annual operational costs of $3,836,000. A remedial duration of 10 years is estimated for this alternative.

ALTERNATIVE I

Alternative I is identical to Alternative C except that the thermal combustor used for air emission abatement under Alternative C is replaced with a vapor phase granular activated

carbon (GAC) abatement unit. Groundwater extraction, centralized air stripping treatment, treated groundwater reinjection and in situ biological enhancement are technology options included as part of Alternative I. The carbon would be regenerated on-site using medium pressure steam. The regeneration process generates a condensate from the units which contain contaminants removed from the groundwater. This condensate would be collected and taken off-site to an EPA-RCRA approved recycling facility.

This alternative is estimated to have a net present worth of $28,445,000, an initial capital cost of $2,541,000, and annual operational costs of $2,744,000. A remedial duration of 10 years is estimated for this alternative.

7.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The nine alternatives were evaluated according to the nine National Contingency Plan (NCP) evaluation criteria to determine the most appropriate or preferred alternative.

NCP EVALUATION CRITERIA

The nine-point evaluation criteria includes the following:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume
- Short-Term Effectiveness
- Implementability
- Cost
- State and/or Support Agency Acceptance
- Community Acceptance.

EPA policy states that in the case of interim remedial actions, ARARs for aquifer restoration do not apply. It is understood that the interim remedy will be followed up by a final remedy which will establish cleanup levels based on ARARs and a risk assessment.

A summary comparison of cleanup Alternatives A through I is shown on Table 7-1. A discussion of each of the evaluation criteria follows.

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative A is least protective of human health and the environment due to the long anticipated duration to achieve protective levels in the groundwater and the likelihood that more wells would become contaminated. Under Alternatives B, C, D, F, and H destruction will ideally reduce contaminants to simpler less toxic compounds. However, an assessment of thermal abatement equipment for Alternatives B, C, and D will be performed to insure

incomplete combustion by-products are not formed. Risk due to media transfer of chemicals to the air must be managed to insignificant levels under air stripper Alternatives B, C, D, and I. Monitoring of air emissions will be performed upon implementation of these alternatives in order to assure adequate human health protection is being achieved. Waste transferred off site to a state approved recycling facility under Alternatives E, G, and I (and to a lesser extent B, C, D, and F) have a residual risk associated with the proper control of the off site facility. In-situ biological enhanced recovery under Alternatives C, F, H, and I is expected to achieve better risk reduction and protection of human health and the environment than the remaining treatment alternatives since it is expected to result in earlier cleanup. Alternative G is the most responsive alternative for addressing new areas of contamination in a short period of time, simply by installing additional units to add treatment capacity. Under Alternative D, discharging to surface water contributes to aquifer depletion. Alternatives C, F, H, and I are the most effective alternatives in terms of overall protection of human health and the environment, with Alternative H being the most protective.

COMPLIANCE WITH ARARs/TO BE CONSIDERED (TBCS) MATERIALS

The Superfund Amendments and Reauthorization Act (SARA) requires that remedial actions meet legally applicable or relevant and appropriate requirements (ARARs) of other environmental laws. These laws may include: the Toxic Substances Control Act, the Safe Drinking Water Act, the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, and any state law which has stricter requirements than the corresponding federal law. A list of potential Federal and State ARARs for the MTP are shown on Tables 7-3 and 7-4, respectively.

A "legally applicable" requirement is one which would legally apply to the response action if that action were not taken pursuant to Sections 104, 106 or 122 or CERCLA. A "relevant and appropriate" requirement is one that, while not "applicable" is designed to apply to problems sufficiently similar that their application is appropriate.

Since this is an interim remedial action, it is not necessary to establish cleanup levels for the groundwater. MCLs are therefore not ARARs for the groundwater. Groundwater cleanup levels based on MCLs and risks will be established in a subsequent ROD. ARARs do apply for treated water prior to disposal or reinjection. All alternatives, with the exception of

Alternative A, will comply with ARARs specific to this action to cleanup the treated water to appropriate levels (as defined by discharge permit requirements) prior to reinjection and to properly address air emissions (as defined with emission permit requirements).

Air emission limitations (ARARs) will be established by the more stringent of either (1) the Merced County Air Pollution Control District permit to operate requirements (Rules 210.1 and/or 210.2) or (2) EPA's OSWER Directive 9355.O-28 (Guidance to Control Air Emissions From Air Strippers at Superfund Sites). Discharge/re-injection limitations (ARARs) will be established by the more stringent of either (1) the State's Porter-Cologne Water Quality Act (Water Code, Division 7, Section 13000 et seq., CCR Title 23) or (2) the State's RWQCB permit requirements. Additional ARARs may apply pending review of permit requirements, remedial design documents and the outcome of the wetlands and endangered species assessments.

Long-Term Effectiveness and Permanence

Alternative A, the no action alternative, has a high residual risk and poor control due to the fact that residuals are left in place and natural attenuation may not occur for a significant period of time. During this time the plume would be expected to continue expanding into unaffected areas. This alternative is not considered to be long-term effective and permanent. Alternatives C, F, H, and I are expected to have the least residual risk due to the flushing effect of reinjection combined with the enhanced desorption of chemicals from the vadose zone soils as a result of in-situ biological enhancements. Carbon adsorption Alternatives E, F, G, and I retain some risk due to possible mismanagement at an off-site location.

Alternatives C and H provide the most long-term effective and permanent solution due to the utilization of on site destruction of chemical contaminants removed from the aquifer. Alternatives with thermal abatement will destroy the contaminants on site, however extensive testing would be required to ensure that incomplete combustion is not creating more hazardous substances.

Reduction of Toxicity, Mobility and Volume by Treatment

Under the Alternative A (no action), mobility and expansion of the plume would occur resulting in an increase in the volume of affected groundwater. Under the active treatment Alternatives

B through G, treatment reduces the toxicity, mobility, and volume of chemicals in affected groundwater. Under Alternatives B, C, D, and H (and to a lesser extent F), the chemicals of concern are destroyed through thermal treatment, while Alternatives E, G, and I result in moving chemicals to an approved off site or recycling facility. Alternatives F and H destroy contaminants on site through photolytic oxidation. Table 7-2 lists quantities of hazardous wastes and emissions that would be generated by Alternatives A through I and assumes no products of incomplete combustion will occur. Toxicity and exposure will be managed through abatement and compliance with risk assessment-derived health protective limits on air emissions set by permit requirements.

Short-Term Effectiveness

Alternatives C, F, H, and I using in situ biological enhancement are expected to achieve protection in the shortest time period. Under Alternative G, the ability to move and deploy additional treatment systems rapidly upon discovering a new hot spot will be a short term advantage over other treatment alternatives. Alternative D is expected to take the longest period of time of all the active alternatives to achieve protection. Alternative A will not meet NCP criteria for short-term effectiveness. Alternative B which utilizes incineration, has the potential for incomplete combustion which may result in the production of highly toxic compounds which could pose a threat to public health and the environment.

Wells known to be contaminated were either previously removed from service or had filtration units placed on them to protect the community during remedial actions. Should additional wells become contaminated, the Base will take prompt action to properly remove these wells from service or install filtration units to provide a safe water supply. Any well taken out of service will be abandoned through proper procedures or converted to a monitoring well in order to monitor contamination levels.

Air exposure pathways generated from media transfer operations and a small level of incomplete abatement will occur under the air stripper Alternatives B, C, D, and I. Alternatives which use thermal abatement will take longer to implement due to the need to conduct extensive testing to assure there are no highly toxic substances being produced via incomplete combustion.

Compliance with standard operating procedures, the Occupational Safety and Health Administration (OSHA) requirements, and health and safety plans, if required, are expected to protect workers during remedial activities.

Under Alternative A, relying on natural attenuation/dilution could environmentally impact the deeper aquifers and contaminate larger volumes of water. Under Alternative D, the discharge of treated groundwater to surface waters will result in groundwater depletion, possible subsidence, wells drying out, and disturbance of an existing surface water regime could occur.

Implementability

All alternatives are constructable and implementable. The use of ultraviolet (UV) photolytic treatment under Alternatives F and H are innovative, however difficulties with technical implementation are not expected. Reliance on material attenuation only renders Alternative A technically ineffective. The decentralized GAC Alternative G is the most flexible alternative in terms of remediating new areas, but would also require the largest number of effluent discharge monitoring stations. As a result, labor and maintenance costs would be higher. Air emission monitoring will be required under Alternatives B, C, D, and I. Test burn and air dispersion modeling will be required for all alternatives that require thermal abatement. A contract with an off site facility and/or disposal facility will be required for alternatives utilizing GAC.

Under Alternatives B, C, D, and I the substantive requirements of any necessary air permits and air monitoring would have to be met by the Air Force upon implementation. Manifesting of off site waste shipments is required under Alternatives B, C, D, E, F, G, and I. The substantive requirements of the National Pollutant Discharge Elimination System (NPDES) permitting and monitoring will have to be met for treated groundwater for Alternative D.

COST

On a net present worth basis, Alternative A was the most economical alternative while Alternative G costs the most. A comparison of present worth cost for all nine alternatives is shown on Table 7-1.

STATE AND COMMUNITY ACCEPTANCE

U.S. Environmental Protection Agency (EPA) Region IX and the California Department of Health Services (DHS) and Regional Water Quality Control Board (RWQCB) have been involved in the technical review of the Interim Operable Unit No. 1 Feasibility Study (OUFS) and the development of the Proposed Plan and Record of Decision (ROD). The EPA and the State agree with the preferred alternative as presented in this Record of Decision.

Community acceptance of the interim remedial action has been positive. During the public comment period, only three written comments were received. The comments, along with questions raised during the public meeting, were intelligent and pertinent. The community seemed most concerned about; the depletion in the groundwater supply caused by remediation, the length of clean-up actions, and the possible production of additional hazardous wastes during the clean-up. The Responsiveness Summary (Section 10.0) provides a thorough review of the public comments received on the OUFS and Proposed Plan, and the Air Force's responses to the comments received.

TABLE 7-1
COMPARISON OF CLEANUP ALTERNATIVES

	ALTERNATIVE	OVERALL PROTECTION	COMPLIANCE WITH ARAR'S	LONG-TERM EFFECTIVENESS & PERMANENCE	REDUCES TOXICITY, MOBILITY, VOLUME, (TMV)	SHORT-TERM EFFECTIVENESS	IMPLEMENTABILITY	* COST (Present worth)	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
A	No Action	Not Protective	Will not achieve health protective MCL's	Not a permanent solution	No reduction	Offers no short term protection Remedial duration: >100 years	Easiest to implement	$ 9,368,000	Not expected to approve	Not expected to approve
B	Centralized thermally abated air stripper, GW reinjection	Less protective due to longer duration	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Potential air exposure pathway Remedial duration: 25 years	Implementable	$ 34,020,000	May have concern over thermal abatement	May have concern over thermal abatement
C	Centralized thermally abated air stripper, GW reinjection with in-situ biotreatment	Most protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Potential air exposure pathway Remedial duration: 10 years	Implementable	$ 26,308,000	May have concern over thermal abatement	May have concern over thermal abatement
D	Centralized thermally abated air stirpper surface water discharge	Less protective due to longer duration	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Potential air exposure pathway Remedial duration: 30 years	Implementable	$ 39,302,000	May have concern over aquifer depletion and thermal abatement	May have concern over aquifer depletion and thermal abatement
E	Centralized GAC, adsorption, steam regeneration, GW reinjection	Less protective due to longer duration	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Limited interim exposure Remedial duration: 25 years	Implementable	$ 39,330,000	Expected to approve	Expected to approve
F	Centralized GAC adsorption, steam regeneration, condensate photolysis and recycle, GW reinjection with in-situ biotreatment	Most protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Very limited interim exposure Remedial duration: 10 years	Implementable	$ 26,752,000	Expected to approve	Expected to approve
G	Decentralized GAC adsorption, steam regeneration, GW reinjection	Less protective due to longer duration	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Limited interim exposure Remedial duration: 25 years	Implementable	$ 65,240,000	Expected to approve	Expected to approve
H	Centralized UV photolysis treatment, GW reinjection with in situ biotreatment	Most protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Very limited interim exposure Remedial duration: 10 years	Implementable	$ 44,013,000	May have a concern over unwanted by-products	May have a concern over unwanted by-products
I	Centralized air stripper with GAC abatement, GW reinjection with in situ biotreatment	Most protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Potential air exposure pathway Remedial duration: 10 years	Implementable	$ 28,445,000	Expected to approve	Expected to approve

*ASSUMES A 6% INFLATION AND 7% DISCOUNT RATE.

TABLE 7-2

ESTIMATED MAXIMUM ANNUAL WASTE AND EMISSONS FOR REMEDIAL ALTERNATIVES
(Pounds)

ALTERNATIVES	A	B	C	D	E	F	G	H	I
Hazardous Waste Solid[1]									
Spent Carbon	None	None	None	None	32,200	32,200	32,200	None	32,200
Hazardous Waste,Liquid[1]									
Steam Regenerant w/organics	None	None	None	None	1,145,000	None	1,259,000	None	1,259,000
Chlorinated Organics (free liquid)	None	None	None	None	25,100	25,100	24,880	None	24,880
Spent Acid (from air stripper washing)	None	48,800	48,800	48,800	None	None	None	None	48,800
Priority Air Pollutants[2]									
*Particulates	None	99.3	99.3	99.3	3.5	3.5	3.9	None	3.9
*Sulfur Dioxide	None	23.8	23.8	23.8	0.84	0.84	0.93	None	0.93
*Nitrogen Oxides	None	5,560	5,560	5,560	198	198	217	None	217
*Carbon Monoxide	None	1,390	1,390	1,390	49	49	54	None	54
*Organics (as Hydrocarbons)	None	240	240	240	8.5	8.5	9.3	**Trace	274
*Organics (as chlorinated hydrocarbons)	None	82	82	82	***	***	***	**5.5	822
Hydrochloric Acid (gas)	None	17,100	17,100	17,100	Trace	Trace	Trace	**17,100	Trace

* A net reduction in overall base emissions would result since these emissions would be offset by a 110 percent equivalent reduction in emissions from existing sources as required for meeting regulations to permit new sources.

** Not emitted as air pollutants, returned dissolved in treated groundwater, emission offsets do not apply.

*** Storage tank breathing and working losses only.

[1] Residuals to be sent to EPA-RCRA Permitted Facility
[2] Air pollutants will meet established ARAR's

POTENTIAL FEDERAL APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

CHEMICAL SPECIFIC ARARS

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
I. Resource Conservation and Recovery Act (RCRA) as amended by Hazardous and Solid Waste Amendments (HSWA) (42 USCA 7401-7642) (40 CFR 260-280)	I. RCRA-related regulations are generally action specific. However, RCRA provides Maximum Concentration Limits (RCRA MCLs) as part of groundwater protection standards (40 CFR 264.94). (RELEVANT AND APPROPRIATE)
II. Safe Drinking Water Act (SDWA) [42 USCA 300(f)] (40 CFR Parts 141-149) (54FR22064, Federal Register, May 22, 1989)	II. Established MCLs which are enforceable standards for chemicals in public drinking water supplies. They not only consider health factors, but also economic and technical feasibility of removing a chemical from a water supply system. (RELEVANT AND APPROPRIATE)
III. Clean Water Act, amended (CWA) (33 USCA 1251-1376) (40 CFR 100-149)	III. Ambient Water Quality Criteria (AWQC); established under Section 304 of CWA (51 FR 43665), are based on effects on human health and aquatic life that do not reflect technological or economic considerations. CWA AWQC's would be applicable to water, to a sewer, or site runoff directed to a water body (including a storm drain or flood channel) with or without treatment. (MUST MEET RELEVANT AND APPROPRIATE DEFINITION)

POTENTIAL FEDERAL APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

IV. Clean Air Act (CAA) (42 USCA 7401-7642) (40 CFR 50-69)	IV. a. National Ambient Air Quality Standards (CAA Sec. 109) National primary and secondary ambient air quality standards (NAAQS) are required to be met under Section 109 of the CAA and are listed in 40 CFR 50. No air pollutants have been measured at Castle Air Force Base. (MAY BE RELEVANT AND APPROPRIATE-AMBIENT AIR) b. National Emission Standard for Hazardous Air Pollutants National Emission Standards for Hazardous Air Pollutants (NESHAPs) are process and industry specific and must be industry specific. They must be converted from point source standards to area source standards in order to be applied at CAFB. NESHAPs are currently limited to very few chemicals (40 CFR 61). (MAY BE RELEVANT AND APPROPRIATE-AMBIENT AIR)

LOCATION SPECIFIC ARARS - FEDERAL

There are no location-specific ARARs associated with CAFB. The Base is located in the historical range of three endangered species. The Air Force will have a biologist determine the presence or absence of these species. Any surface area disturbance associated with the selected interim remedy is minimal and should not have a significant impact on these species habitats, should they exist. The Air Force will also have a qualified agency assess the Base to determine the presence or absence of wetlands. Any surface area disturbance associated with the selected interim remedy will be minimal and should not significantly impact any wetlands should they exist. The Base is not in a floodplain, nor are there any known surface water bodies that are being affected. There are no geologic faults below or near the base. No historic places are located within 3 miles. Consequently, the following federal statutes are not "appropriate and relevant" to the Castle Air Force Base Operable Unit No. 1 (Main TCE Plume):

National Historic Preservation Act (NHPA) 16 CFR Part 470, et. seq. Endangered Species Act (ESA) 50 CFR Sections 402.01 and 402.04. Protection of Wetlands Executive Order 11990 (40 CFR 6.302 (a). Wild and Scenic Rivers Act (WSRA) 36 CFR Section 297.4 Coastal Zone Management Act (CZMA) 15 CFR Section 930.30 and 930.34. Wilderness Act (WA) 50 CFR Section 35.5.

POTENTIAL FEDERAL APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

TO BE CONSIDERED MATERIAL - FEDERAL

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
I. National Contingency Plan (NCP) (55 FR 8666, Federal Register, March 8, 1990) (40 CFR 300)	Baseline Risk Assessment will determine safe levels for those chemicals w/o MCLs, and will judge whether MCLs are sufficiently health-protective for the chemical mixture found in the plume.
II. Toxic Substances Control Act (TSCA) PCB Spill Cleanup Policy (52 FR 10688, April 2, 1987) (40 CFR Part 61, Suppart G)	While not potential ARARs, the requirements of the PCB spill cleanup policy may by "appropriate relevant" for CERCLA actions.
III. Groundwater Protection Strategy of U.S. EPA	While not potential ARARs, the groundwater classification guidelines are considered in the Baseline Risk Assessment and Feasibility Study.
IV. 40 CFR 264.94	Establishes three categories of groundwater protection standards: background, RCRA MCLs and Alternate Concentration Limits (ACLs). CERCLA Sec. 121(d)(2)(B)(ii) list three additional conditions limiting use of ACLs at Superfund sites.

ACTION-SPECIFIC ARARS-FEDERAL

A. GROUNDWATER PUMP AND TREAT REMEDIATION ALTERNATIVE:

1. TREATMENT OF GROUNDWATER (DISCHARGES TO GROUNDWATER & DISPOSAL OF RESIDUALS):

REQUIREMENTS	APPLICATION TO THE MAIN TCE PLUME
I. Resource Conservation and Recovery Act (RCRA) as amended by Hazardous and Solid Waste Amendments (HSWA) (40 USCA 7401-7462) (40 CFR 264-265)	Although RCRA was not in effect during active waste disposal and is not strictly applicable, the similarity between the historical disposal at CAFB and RCRA regulated practices makes it reasonable to judge RCRA requirements generally relevant and appropriate. SARA relieves the requirement of obtaining a permit, but all RCRA requirements must be met.

POTENTIAL FEDERAL APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

II. Resource Conservation and Recovery Act (RCRA) as amended by Hazardous and Solid Waste Amendments (HSWA) (40 CFR 264.90) (40 CFR 264.94) Monitoring	Hazardous constituents entering groundwater must not exceed concentration limits in the aquifer underlying the waste management unit (WMU). The groundwater monitoring program must provide a reliable indication of groundwater quality below the WMU.
III. Underground Injection Control Regulations (40 CFR Parts 144 through 147)	Potentially applicable for alternatives utilizing a groundwater injection option.
IV. Clean Water Act (CWA) 33 USCA 1251-1376 40 CFR 100-149	The Clean Water Act requires permitting if effluent discharges under the NPDES permit program and seeks to protect the existing and attainable uses of waters of the U.S. Permit may not be required, but all requirements must be met.
(1). National Pollutant Discharge Elimination System (NPDES) 40 CFR 122-125	NPDES permits contain applicable standards, monitoring requirements, and standard and special conditions for water discharges. Both on-site and off-site discharges from CERCLA sites to surface waters are required to meet the substantive CWA requirements, and best management practices. Only off-site CERCLA discharges must be permitted. The base wastewater treatment facility has a NPDES discharge permit.
(2). Water Quality Standards CWA 402 (a)(1)	Effluent limitations are required to achieve all appropriate State water quality standards. EPA Policy for the Development of Water Quality Based Permit Limitations for Toxic Pollutants. (49 FR 9016, March 9, 1984) states that toxic pollutants contained in direct discharges will be controlled beyond Best Control Technology/Best Available Technology (BCT/BAT) equivalents in order to meet applicable state water quality standards.

2. TREATMENT OF GROUNDWATER (DISCHARGE TO POTW)

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
(1). Discharge to Publicly Owned Treatment Works (POTWs) (CWA 307)	Pretreatment regulations (40 CFR 403) control the introduction of pollutants to POTWs.

POTENTIAL FEDERAL APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

3. TREATMENT OF GROUNDWATER (DISCHARGE TO AMBIENT AIR):

REQUIREMENTS	APPLICATION TO THE MAIN TCE PLUME
(1). National Ambient Air Quality Standards (CAA Sec. 109)	No air pollutants have been measured at Castle Air Force Base. (MAY BE RELEVANT AND APPROPRIATE-AMBIENT AIR
(2). National Emission Standard for Hazardous Air Pollutants	National Emission Standards for Hazardous Air Pollutants (NESHAPs) are process and industry specific and must be industry specific. They must be converted from point source standards to area source standards in order to be applied at CAFB. NESHAPs are currently limited to very few chemicals (40 CFR 61).
(3). EPA - OSWER Directive 9355.0-28, "Guidance on the Control of Air Emissions from Air Strippers at Superfund Sites." Guidance seeks to incorporate air quality concerns into the Superfund remedy selection. Policy may set target levels (TBCs) where ARARs do not exist. The directive applies to future remedial decisions at Superfund sites located in ozone non-attainment areas. Such sites are required by the directive to control total volatile organic compound emissions from air stippers and soil vapor extraction operators to fifteen pounds per day.	1) Requires FS to evaluate the impact of VOC emissions in attainment and nonattainment areas for ozone. 2) Requires consideration in the FS of health risks from the execution of the remedy as well as form the uncontrolled site. 3) Requires alternatives and their costs in FS evaluation of control measures. 4) Requires FS to evaluate compliance with Air ARARs with implementation of alternative. 5) Requires a determination in the FS of estimated cumulative uncontrolled air emission rate from all air strippers at the site.

POTENTIAL STATE APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

CHEMICAL SPECIFIC ARARS - STATE

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
I. State Drinking Water Act (SDWA) Health and Safety Code, Division 7, Part I, Chapter 7, Section 4010 et seq.	SDWA establishes drinking water standards for sources of public drinking water. Federal MCLs are incorporated into State regulations, and in some cases the State may promulgate more stringent State MCLs. The DHS has set MCLs for 10 of the constituents found in the TCE plume at CAFB. Several of the MCLs are at the same levels or more stringent levels than PDWS-MCLs. (RELEVANT AND APPROPRIATE)
II. Mulford-Carrell Air Resources Act (Health and Safety Code Sections 39000-44563) as regulated by the Air Resources Board and enforced by local Air Quality Management Districts under CAC, Title 17, Part III.	Ambient Air Quality Standards are listed under Section 70200/70200.5 of CAC Title 17. Benzene is identified as a toxic air contaminant. However, no threshold value has been determined. (MAY BE RELEVANT & APPROPRIATE-AMBIENT AIR)
LOCATION SPECIFIC ARARS -STATE	
There are no location-specific ARARs associated with CAFB. The Base is located in the historical range of three endangered species. The Air Force will have a biologist determine the presence or absence of these species. Any surface area disturbance associated with the selected interim remedy is minimal and should not have a significant impact on these species habitats, should they exist. The Air Force will also have a qualified agency assess the Base to determine the presence or absence of wetlands. Any surface area disturbance associated with the selected interim remedy will be minimal and should not significantly impact any wetlands should they exist. The Base is not in a floodplain, nor are there any known surface water bodies that are being affected. There are no geologic faults below or near the base. No historic places are located within 3 miles. Consequently, the following state statutes are not "appropriate and relevant" to the Castle Air Force Base Operable Unit No. 1 (Main TCE Plume):	

NOTE: California DHS will provide a list of pertinent statutes for location-specific ARARs.

POTENTIAL STATE APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

TO BE CONSIDERED MATERIAL - STATE

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
1. DHS Applied Action Levels (AALs)	Applied action levels are exposure limits that are pollutant-and receptor-specific and are used as a point of departure for establishing cleanup levels. They are similar to the levels established by the Baseline Risk Assessment to assure that MCLs are adequately health-protective. (MUST BE APPROPRIATE AND RELEVANT)
2. Central Valley RWQCB. A compilation of Water Quality Goals. (10/88)	This guidance document contains a compilation of Water Quality Goals developed by CVWQCB for various beneficial uses of groundwater.
3. Safe Drinking Water & Toxics Enforcement Act (Proposition 65)	Reporting of hazardous materials (developmental toxicants) releases will be required if listed substances are being discharged to the environment at significant risk levels given in the statute. (MUST BE APPROPRIATE AND RELEVANT)

POTENTIAL STATE APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

ACTION-SPECIFIC ARARS - STATE

A. GROUNDWATER PUMP AND TREAT REMEDIATION ALTERNATIVE:

1. TREATMENT OF GROUND WATER (DISCHARGES TO GROUND WATER & DISPOSAL OF RESIDUALS):

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
1. Hazardous Waste Control Act (Health & Safety Code Section 25100-25395) as administered by the Department of Health Services (DHS) under the California Administrative Code Title 22, Chapter 30; Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes.	1. HWCA has many elements that are intended to control hazardous wastes from their point of generation through accumulation, transportation, treatment, storage, and ultimate disposal. It is implemented largely through regulations under the CAC, Title 22, Division 4, Chapter 30. Section 66300 of Chapter 30 provides no RCRA-type exemption for CERCLA sites; therefore most regulations will be directly applicable to CAFB alternatives.
(1) Criteria for identifying Hazardous Wastes (Title 22, 66693-66746) Disposal of Residuals from groundwater treatment.	(1) Tests for identifying hazardous characteristics are described in Title 22, Article 11, Sections 66693-66746. If a chemical is either listed or tested and found hazardous, it must comply with the hazardous waste requirements under Title 22. While these standards are not treatment or disposal limits, the resulting classification as hazardous waste results in efforts to meet the standard, thereby making hazardous designation methods a form of treatment standard.
(2) Persistent and Biocumulative Toxic Substances (66699) Disposal of Residuals from groundwater treatment.	(1) Total Threshold Limit Concentrations (TTLCs) and Soluble Threshold Limit Concentrations (STLCs) have been established for selected toxics.

POTENTIAL STATE APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
(3) Porter-Cologne Water Quality Act Water Code, Division 7, Section 13000 et seq., CCR Title 23, Chapter 3, Subchapter 9 and Subchapter 15, 1050-2836	Similar to the Federal CWA, the Act and its associated regulations apply to protection of waters of the state. An NPDES permit is required for off-site discharges, whereas, only substantive requirements are required for on-site discharges. Porter-Cologne delegates standard

2. TREATMENT OF GROUNDWATER (DISCHARGE TO POTW)

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
(1) Discharge to Publicly Owned Treatment Works (POTWs) County Sanitation District of Merced County	Pretreatment regulations (40 CFR 403) control the introduction of pollutants to POTWs

3. TREATMENT OF GROUNDWATER (DISCHARGES TO AMBIENT AIR)

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
(4) Mulford-Carrell Air Resources Act, Health and Safety Code, Division 26, Section 39000 et seq. 17 CAS Part III, Chapter 1, Section 60000 et seq.	The State counterpart of the Federal CAA, Mulford-Carrell, establishes the California Air Resources Board (CARB) and the local Air Quality Management Districts (AQMDs). Permitting authority is delegated in this act. While the treatment unit may not need a federal permit, it is not relieved from the requirements of this act. Allocation of allowable air emissions are on an air basin specific basis.
(5) Merced County Air Pollution Control District Rule 210.1 Standards for Authority to Construct and Rule 210.2 Standards for Permits to Operate.	There may be specific sections of the local Air Pollution Control Board regulations that must be met by the design and operation of an air stripping unit. These may include: Nuisances (including odors).

POTENTIAL STATE APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE MAIN TCE PLUME (OPERABLE UNIT NO. 1)

REQUIREMENT	APPLICATION TO THE MAIN TCE PLUME
(6) Rule 1167-Air Stripping Operations (Reg. XI-Source Specific Stds)	This rule is designed to reduce volatile organic compound (VOC) emissions from new and existing air stripping equipment used in the treatment of affected groundwater.

8.0 THE SELECTED REMEDY

The selected interim remedy for this ROD is Alternative I, which consists of:

- Pumping groundwater from a series of shallow aquifer extraction wells to maintain hydraulic control of the TCE plume and begin removing residual TCE concentrations.
- Surface treating the extracted groundwater by air stripping to allow the return of water to beneficial use (resource recovery).
- Reinjecting the treated groundwater back to the shallow aquifer to assist in maintaining hydraulic control and avoid depletion of the aquifer.
- Applying natural biological enhancement to accelerate the release/ degradation of hazardous constituents in the saturated zone.
- Abating the air stripper emissions with granular activated carbon (GAC) to avoid degrading ambient air quality. The abatement unit would be steam regenerated on site and the liquid condensate would be disposed off site at a permitted recycling facility.

CONCEPTUAL DESIGN OF SELECTED REMEDY

The selected interim remedy under Alternative I will conceptually consist of groundwater extraction from an intercepting well field consisting of five wells, one well located at or near each of the TCE hot spots or identified source locations within the Main TCE Plume. The wells will tentatively be pumped at a rate of approximately 250 gallons per minute each. Pumping tests, scheduled to be performed later in the RI field program, will provide design data on the number of extraction wells required, their location, and discharge rates.

The surface treatment facility will conceptually consist of a new centralized treatment plant in an undeveloped area northeast of the POL/storage tank farm (Figure 1-1). The remedial treatment technology option will conceptually consist of twin air stripping towers operating in series, equipped with three double bed vapor phase GAC abatement units with the double beds operating in series flow. Two of the double bed units will be on-line continuously (one pair for each of the two strippers), while the third pair of beds remain on standby. An on-site oil or gas fired boiler will provide steam for the regeneration cycle. Regenerant steam will be condensed using a Hastelloy alloy heat exchanger and collected in a holding tank pending off-site disposal to an approved EPA-RCRA recycling facility. The third GAC unit is necessary for

continuous operation of the stripper, since the regeneration cycle will require approximately eight hours. Each adsorber vessel will be sized to contain 6,000 pounds of GAC. A life of 20 regeneration cycles for the GAC is assumed for estimating purposes. The steam requirement is estimated at 10,350 pounds for each single carbon bed.

The air stripping towers were conceptually sized for estimating purposes at 84 inches diameter, 25 foot packing depth, and a required air flow rate of 3345 SCFM. The preliminary tower sizing was based on (worst case) high levels of detected organic compounds in Base groundwater sampling data from rounds one, two, three, and four, and on achieving a removal concentration level to meet re-injection ARARs pursuant to the discharge permit.

The treated groundwater effluent will be piped to a reinjection well field upgradient from the extraction well field, with the exact locations to be specified after pumping tests are conducted. Reinjection wells will be spaced to maximize plume capture and to minimize time of cleanup.

In addition, nutrients and hydrogen peroxide will be reinjected with treated groundwater to increase available oxygen in the contaminated aquifer. This action serves to stimulate growth of natural indigenous bacteria, increase the release rate of contaminants from soil particles, and degrade some of the contaminants in-situ. A partial stream of 250 gallons per minute of the treated groundwater will be used as the carrier for the nutrients and returned to the aquifer by a combination of reinjection wells and separate biotreatment injection wells.

Details of the selected interim remedy will be finalized during the remedial design phase.

SUMMARY OF PRELIMINARY COST ESTIMATES

The selected interim remedy provides overall effectiveness proportionate to its costs, such that it represents a reasonable value. Tables 8-1 and 8-2 show the preliminary estimates of capital costs, operation and maintenance costs, and total net present value of the selected remedy (Alternative I). Final cost estimates may vary from the estimates presented due to changes that may occur as a result of hydraulic modeling, and difference in environmental setting at the time of remedial design and construction. Such changes, in general, will reflect modifications resulting from the engineering design process. The hydraulic gradient control

system and system performance evaluation and schedule will be developed during the remedial action design process.

TABLE 8-1

ALTERNATIVE I - PRESENT WORTH ANALYSIS

	$ COST*
Installed cost of 5 extraction well-pumps	96,000
Installed cost of 5 hotspot extraction wells	110,000
Installed cost of double contained groundwater transfer piping	214,000
Installed cost of air stripper treatment system with GAC emission abatement system	1,548,000
Annual operating cost of air stripper treatment plant	1,567,000
Installed cost of treated water reinjection transfer piping	149,000
Installed cost of 8 reinjection wells	176,000
Installed cost of biotreatment nutrient feed system	100,000
Installed cost of biotreatment injection wells	60,000
Annual operating cost of biotreatment nutrient feed system (assumes 250 GPM of 1250 GPM total groundwater extracted treated for bio-reinjection)	1,092,000
Cost to abandon MID No. 228	88,000
Replacement cost of 8 reinjection wells (assume 5 year well lifetime for present worth analysis)	176,000
**Annual maintenance cost	50,000
Total estimated capital expenditure (1990 basis)	2,541,000
Total estimated annual operating and maintenance cost (1990 basis)	2,744,200

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* Costs shown on 1990 dollar value basis

** Includes disposal costs for periodic stripper cleaning

TABLE 8-2

ALTERNATIVE I - PRESENT WORTH VALUES N 1990 DOLLARS*

ANNUAL INFLATION RATE

DISCOUNT RATE	4%	6%	8%	10%	12%
5%	28,420	31,263	34,478	38,065	42,085
7%	25,939	28,445	31,247	34,382	37,898
9%	23,795	26,004	28,469	32,220	34,292
11%	21,934	23,890	26,067	28,492	31,194
13%	20,310	22,049	23,981	26,128	28,515

*Values in thousands of dollars.

9.0 STATUTORY DETERMINATIONS

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as amended has designated Federal Facilities as responsible for undertaking remedial actions. EPA has the responsibility to ensure that the selected response actions protect human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedy for the site must comply with local, state and federal ARARs unless a waiver is justifiable (Tables 7-3 and 7-4). ARARs will have to be established for ten contaminants of potential concern (Section 4.0) for both the treated groundwater and any potential air emissions. ARARs apply whether the groundwater is to be disposed of via re-injection or by another means. Similarly, ARARs apply whether the air emissions from the air stripper are controlled or not controlled. Potential ARARs may be identified by EPA, the California DHS, Water Board, Air Board or by Merced County Health Department or any other agency with an applicable enforceable standard.

The selected remedy also must be cost effective and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. Remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as a major part of the remedy are preferable. How the selected interim remedy meets these requirements is discussed below.

The selected interim remedy represents the best balance of trade-offs among alternatives with respect to pertinent criteria, given the limited scope of this action. An in-situ biotreatment treatability study will be performed prior to the final design. This study will not cause a delay to the implementation of the remedy. Re-injection may begin without bio-enhancement should the treatability study results not be available. Further, bio-enhancement can begin when all parameters controlling bio-enhancement are determined.

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health and the environment through extraction of TCE contaminated groundwater and removal/treatment of volatile organic contaminants by air stripping. The volatile contaminants will be transferred to the gas phase, removed by granular

activated carbon (GAC) adsorption, then recovered by steam regeneration. The condensed steam containing contaminants adsorbed on the carbon will be collected for treatment or disposal at an approved facility, as would any spent carbon generated by the treatment process.

Extraction of the groundwater will eventually eliminate the threat of exposure to the contaminants from direct contact, from inhalation, and from ingestion. Once pumping begins and hydraulic control is achieved, there are no short term threats associated with the selected remedy. Wells (exposure routes) known to have been contaminated will have previously been removed from service or had filtration units placed on them prior to the start of remediation. Any new wells which become contaminated will also be taken out of service (Section 7.0).

No adverse affects as a result of cross media transfer are expected. Control of emissions using GAC will adequately control any potential exposure risk.

ATTAINMENT OF ARARs

The selected interim remedy will achieve ARARs (Tables 7-3 and 7-4) for the treated groundwater and any potential air emissions (including TBCs such as EPA's OSWER Directive 9355.0-28 regarding the control of emissions from air strippers). ARARs for the groundwater will be documented in a subsequent ROD.

ARARs for the treated groundwater will be determined by the California Regional Water Quality Control Board in the permit requirements for the discharge water. ARARs for the air emissions will be set by the Merced County Air Pollution Control District in the permit requirement for the air emissions.

COST EFFECTIVENESS

The selected remedy (Alternative I) was evaluated for cost effectiveness against the other eight alternatives (A-H). The selected remedy was one of the least costly alternatives and provides the same benefits and level of protection in the shortest period of time compared to the other alternatives (Table 7-1). The interim remedy will provide effectiveness proportional to the cost of the remedy given the operation and maintenance and present worth cost for the protection of human health and the environment.

UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT POSSIBLE

The selected interim remedy is not designed nor expected to be final but it represents the best tradeoffs among alternatives with respect to the pertinent criteria, especially the balancing criteria of implementability, short-term effectiveness and cost. The permanent solution will be established in a subsequent ROD. Contaminants will be permanently removed and eliminated by groundwater extraction and surface treatment. Contaminants will be reclaimed in the steam condensate and disposed off-site at an EPA-RCRA state approved recycling facility.

Resources will be conserved to the maximum extent possible using the selected remedy. Treated water will be reinjected back into the shallow aquifer. The life of the carbon used for abatement will be maximized by on site steam regeneration. Contaminant recovery will be implemented to the maximum extent possible without losing the removal efficiency of the abatement unit.

PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The requirement that treatment be a principal element of the remedy will be satisfied in the final decision document for the site or final operable unit. This operable unit action is consistent with planned future actions, to the extent possible.