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GEORGE AFB
CALIFORNIA

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 719

719.1

File: 17A-43
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719

PRE-DRAFT
RECORD OF DECISION
OPERABLE UNIT NO. 2
GEORGE AIR FORCE BASE
CALIFORNIA

DRAFT

December 1992

PRE-DRAFT
RECORD OF DECISION
OPERABLE UNIT NO. 2
GEORGE AIR FORCE BASE
CALIFORNIA

IT Project No. 191012

Contract DACA05-91-D-0018

PREPARED FOR:

U.S. Army Corps of Engineers
U.S. Army Engineer District, Sacramento
Hazardous/Toxic Waste Section
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PREPARED BY:

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San Bernardino, California 92408

December 1992

MZ/12-17-92/EES/GEO/0046-COV.lpj

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1.0 Declaration for the Record of Decision

Site Name and Location

George Air Force Base
San Bernardino County, California

Statement of Basis and Purpose

This decision document presents the selected remedial action for Operable Unit No. 2 (OU#2) at George Air Force Base (GAFB), 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 GAFB OU#2 Remedial Investigation (RI) Report, Feasibility Study (FS), and Proposed Plan (PP). All of these documents are available in the Administrative Record for GAFB.

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

Assessment of the Site

A large volume of JP-4 jet fuel has leaked from underground piping in two source areas along the operational apron at the Base. The JP-4 has flowed downward through high permeability sands to the water table where a free product plume is present (Figure 1-1). A dissolve phase JP-4 plume has formed in the perched aquifer approximately 128 feet beneath the surface (Figure 1-2). This plume contains benzene, above the maximum contaminant level (MCL) of 1 ppb, and if not addressed by implementing the selected remedy in this Record of Decision (ROD) may present an imminent and substantial endangerment to public health and welfare.

Description of the Remedy

The OU#2 remedy removes the free product (JP-4) floating on the groundwater surface, the JP-4 in the capillary fringe zone of the soil which extends upward from the groundwater surface for a distance of 20 feet, and the JP-4 and its constituents in the groundwater in the perched aquifer.

OU#2 addresses the underground fuel (JP-4) contamination near the fuel pits and along the flight line (operational apron), including the liquid fuel distribution system, waste fuel storage facility 690, the storage tank farm and pump station 708. OU#2 is one of three operable units currently being investigated at GAFB (Figure 1-3).

The selected remedy addresses the remediation of the JP-4 groundwater contamination, the floating free product on the groundwater surface, and the JP-4 in the capillary fringe zone of the soil, thereby eliminating or reducing the risks posed by the site through engineering treatment and institutional controls.

The major components of the selected remedy are:

- Removal of the free product floating on the water table by skimming using existing extraction wells and installing additional wells to increase the recovery rate to 100 gallons per day. Additionally, a mobile bailing/skimmer system will be used to remove free product from any monitoring well having recoverable free product.
- Remediation of the JP-4 in the capillary fringe zone to 20 feet above the water table using soil vapor extraction and abating the soil vapor extraction system using either catalytic thermal oxidation or an internal combustion engine.
- Remediation of the groundwater hot spots using insitu-air sparging and abatement of the soil vapor (from sparging) using a soil vapor collection/extraction system equipped with a catalytic thermal oxidation system or internal combustion engine.
- Natural attenuation to degrade constituents after the free product source and capillary fringe hot spots have been mitigated. Modeling will continue to confirm natural degradation is proceeding as predicted at a reasonable rate.

Declaration

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate requirements (ARARs) for this remedial action, and is cost effective. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practical. Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years

after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

_____

(later)
George Air Force Base

_____

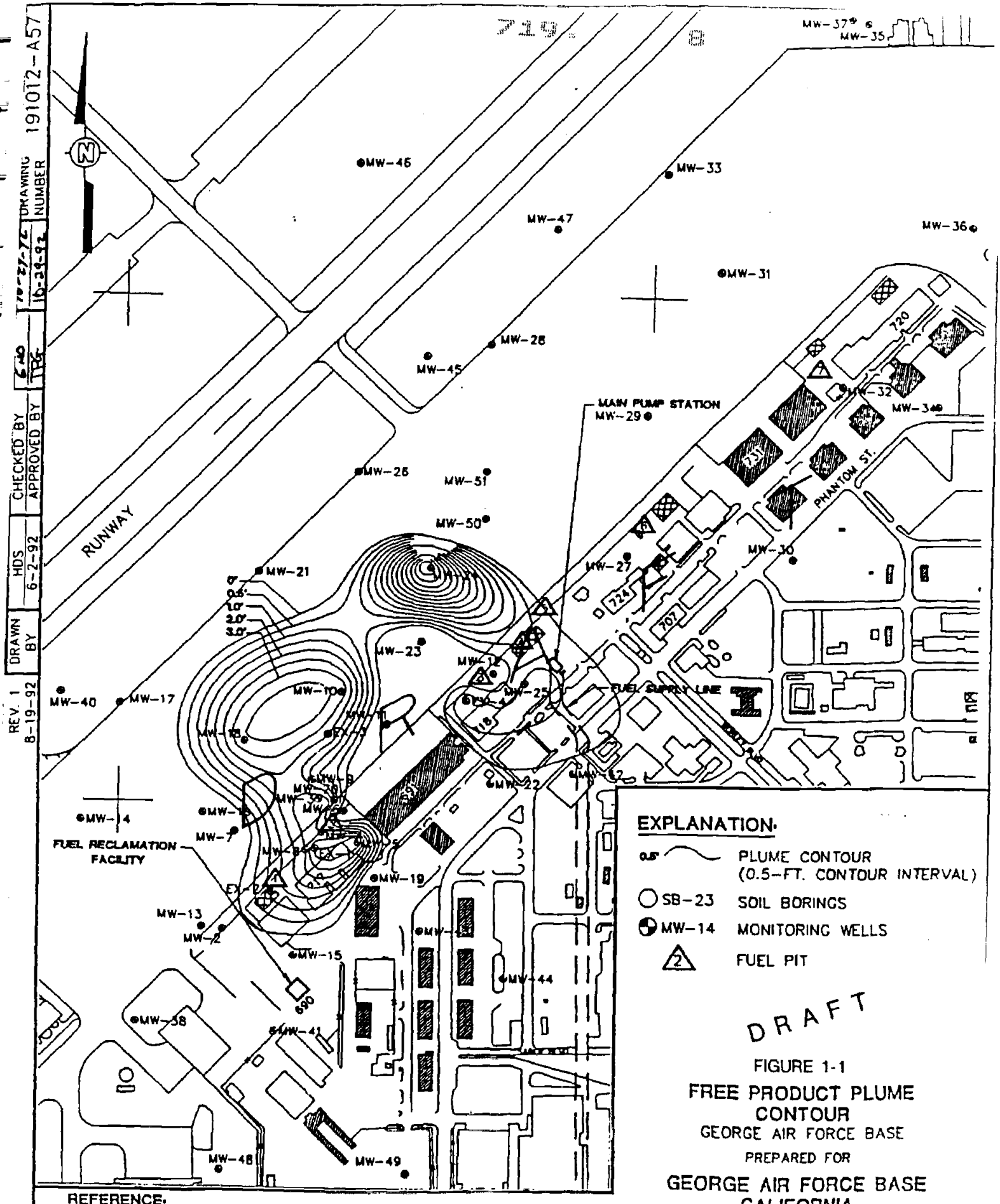
(later)
Regional Administrator
United States Environmental Protection
Agency, Region IX

_____

(later)
Regional Administrator
California EPA
Department of Toxic Substance Control, Region IV

_____

(later)
Regional Administrator
Lahontin Regional Water Quality Control Board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MW-46
MW-33
MW-47
MW-36
MW-31
MW-28
MW-45
MW-32
MW-34
MAIN PUMP STATION MW-29
RUNWAY
MW-26
MW-51
MW-50
PHANTOM ST.
MW-21
MW-27
MW-30
MW-23
MW-40
MW-17
MW-25
FUEL SUPPLY LINE
MW-4
FUEL RECLAMATION FACILITY
MW-7
MW-19
MW-13
MW-2
MW-15
MW-44
MW-38
MW-41
MW-48
MW-49
REFERENCE:
- MAP FROM HUNTER LAND SURVEYING, INC. DATED: 5-92; SCALE: 1"=400'
- CONTOURED BY GMP MODELING FROM 3\25\92 DATA (TABLE 4-2)
SCALE:
0 250 500 1000 FT.
EXPLANATION:
PLUME CONTOUR (0.5-FT. CONTOUR INTERVAL)
SB-23 SOIL BORINGS
MW-14 MONITORING WELLS
FUEL PIT
DRAFT
FIGURE 1-1
FREE PRODUCT PLUME CONTOUR
GEORGE AIR FORCE BASE
PREPARED FOR
GEORGE AIR FORCE BASE
CALIFORNIA
INTERNATIONAL TECHNOLOGY CORPORATION

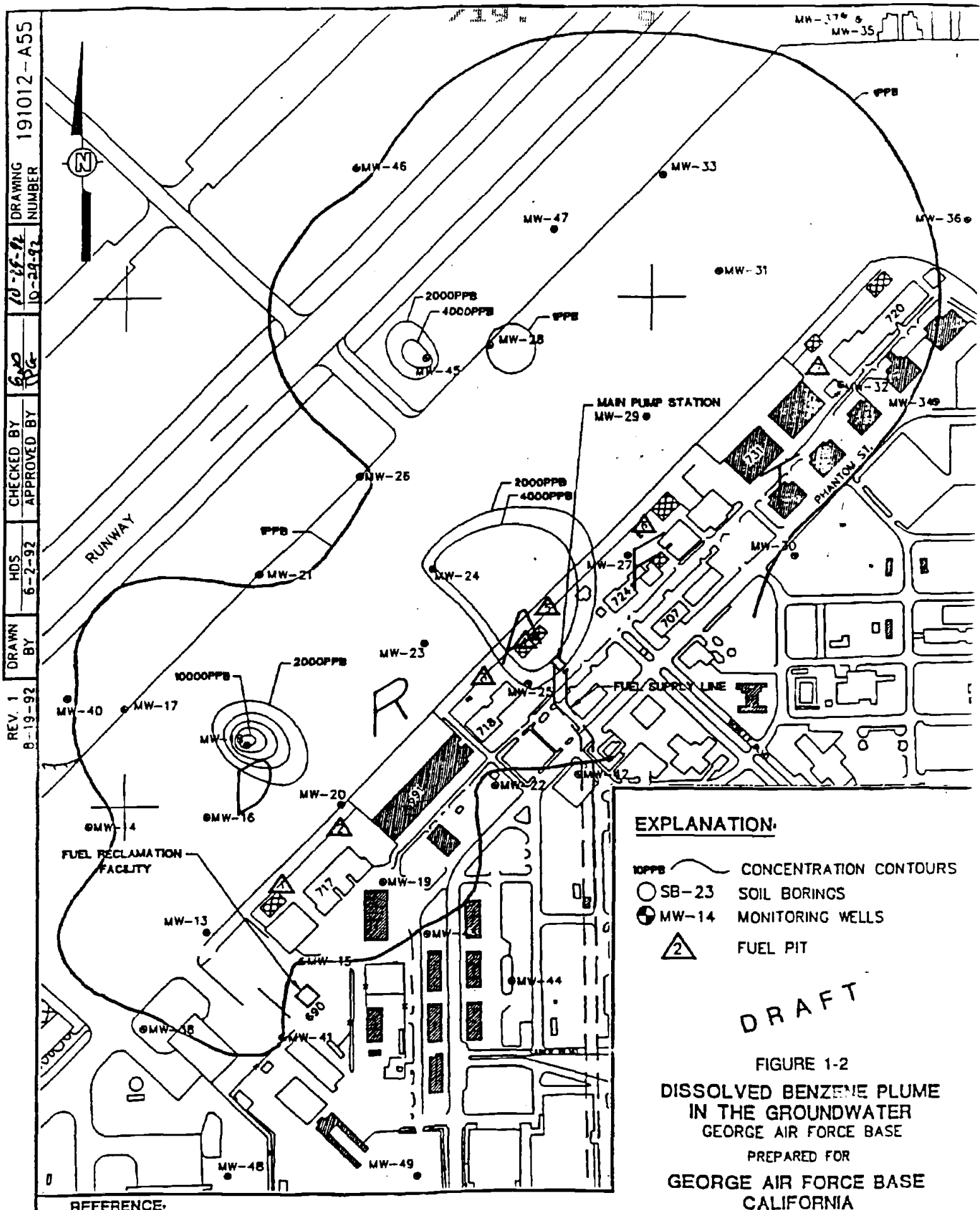

FIGURE 1-2

DISSOLVED BENZENE PLUME IN THE GROUNDWATER
GEORGE AIR FORCE BASE

PREPARED FOR

GEORGE AIR FORCE BASE
CALIFORNIA

INTERNATIONAL TECHNOLOGY CORPORATION

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BM 2593

VICTOR VALLEY WASTEWATER TREATMENT AGENCY

OU-1

BASE BOUNDARY

PERC. PONDS

OU-1

OU-2

MAIN FUEL LINES

TANK FARM BULK FUEL STORAGE

BASE SUPPLY FUEL LINE

MAIN GATE

G E O R G E A I R F O R C E B A S E

Adelanto

Freeman

Wash

LEVEE

HELENDALE

ROAD

MOJAVE

Res

Gravel Pit

Victor Valley Country

EXPLANATION:

- OU-1 — OPERABLE UNIT NO. 1
- OU-2 — OPERABLE UNIT NO. 2
- GROUNDWATER CONTAMINATION PLUME (10 PPB TOLUENE LIMIT)
- FREE PRODUCT PLUME FLOATING ON THE WATER TABLE
- DECONTAMINATION PAD
- ▲ PROBABLE POINT SOURCES OF FUEL LEAKS
- ○ DEEP MONITORING WELL INTO THE REGIONAL AQUIFER
- ● DEEP SOIL BORINGS INTO THE AQUITARD

REFERENCE:

U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, VICTORVILLE QUADRANGLE, DATED 1981, AND ADELANTO QUADRANGLE, DATED 1980.

SCALE

0 2000 4000 FEET

DRAFT

FIGURE 1-3

OU #2 STUDY AREA
GEORGE AIR FORCE BASE

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GEORGE AIR FORCE BASE

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2.0 Site Description, Site History, Community Relations

Site Name, Location, and Description

George Air Force Base (GAFB) is located in the Victor Valley in the western Mojave Desert region of south central California. The Base is approximately 20 miles northwest of the San Bernardino Mountains, 20 miles northeast of the San Gabriel Mountains, and 10 miles southwest of Quartzite Mountain (Figure 2-1). The Base is located between the cities of Victorville (1990 pop. 40,734) and Adelanto (1990 pop. 6,354) in San Bernardino County. The town of Adelanto borders the west side of the Base, while the city of Victorville is approximately six miles southeast of the Base. Other nearby communities within the Victor Valley include Oro Grande (1988 pop. 350), Apple Valley (1990 pop. 50,000), and Hesperia (1990 pop. 53,200). The Victor Valley area in which the Base is located is one of the fastest growing areas in San Bernardino County.

The major land uses in the area surrounding the Base include military and support facilities, residential development, government and commercial services, cement manufacturing, railroad and highway transportation, and localized agricultural activities along the Mojave River. The California Aqueduct carries water across the high desert about five miles south of the Base. A major fuel distribution pipeline parallels Air Base Road for half the length of the Base, and a high-voltage transmission utility corridor crosses the southeast corner of the Base. The Victor Valley Waste Water Treatment Agency treatment plant and property, and a cement quarry operation are also located northeast of the Base (Figure 1-3).

The total relief across the Base is approximately 100 feet, ranging from about 2,400 feet above mean sea level (MSL) at the southeastern corner to about 2,800 feet above MSL at the northwestern boundary corner. Relief within the Base boundaries has a gentle slope to the northwest.

The Mojave River, which has its origin in the San Bernardino Mountains and flows northwesterly along the northeast boundary of the Base, forms the major drainage in the vicinity of the Base and plays a major role in surface-water hydrogeology (Figure 2-2). Surface flows in the river are intermittent due to the arid climate and geomorphology of the basin, and are not considered to be a major water source for the region. During periods of high flow, the river becomes continuous throughout its length. Much of the flow of the river infiltrates and recharges individual groundwater basins within the entire drainage system. A perennial

stream occurs south of the Base due to granitic bedrock that forms a subsurface barrier and causes the underground river to flow to the surface.

The climate in the region is an arid desert climate with an annual precipitation averaging only 4.2 inches. Surface runoff at the OU#2 site is predominant to the north/northeast. Over 90 percent of the surface of the OU#2 site is covered by concrete pavement and asphalt. The industrial storm drain system collects surface water from the site and directs it to the north end of the operational apron (Figure 2-2). At this point, the drain system splits into two paths, a main easterly path to an oil/water separator from which water is pumped into the sanitary sewer system, and a secondary northerly system (high-flow bypass) that drains overflow directly to an earthen outfall ditch during high storm-water flows. This drainage channel directs surface flows off Base toward the Mojave River. Runoff from the southeast portion of the Base is directed to similar drainage channels on the eastern flanks of the Base. Several tributary gullies are formed in the southeast portion of the Base between the Base and the Mojave River. No permanent surface-water bodies exist on the Base.

The Base is located in a transition area between two plant communities, the Creosote Bush and the Joshua Tree Shrub. Two other vegetational areas have also been identified: 1) disturbed areas on the site, indicated by a predominance of tumbleweed (Salsola Kali); and 2) riparian, or shoreline areas, such as along the Mojave River. Riparian vegetation consists of cottonwoods (Populus fremontii) and willows (Salix exigua).

Animal life found in the Creosote Bush shrub areas includes scorpions and spiders, grasshoppers, desert tortoise, desert iguanas, rattlesnakes, quail, roadrunners, ravens, mourning doves, sparrows, and mockingbirds. Mammals are mostly small species, such as kangaroo rats, deer mice, ground squirrels, and desert cottontail and jack rabbit. Larger mammals throughout the Mojave Desert region include coyote, kit and gray foxes, badger, and bighorn sheep.

Seven rare, two endangered, and two threatened species have been recorded in the vicinity of the Base. The endangered species included the Western Yellow Billed Cuckoo and the Willow Fly Catcher, while the threatened species included the Desert Tortoise and the Mojave Ground Squirrel. Many of these species were sighted in the Mojave River corridor. However, only some, such as the Western Yellow-Billed Cuckoo, Yellow-Breasted Chat, Mojave Vole, and Summer Tanager, are dependent on a riparian (river-related) habitat.

Desert tortoises, which are known to occupy the Base, can be found in Creosote and Thorn Shrub areas, and also in washes and canyon bottoms. They feed on grasses and forms (non-grass herbaceous plants) and construct and inhabit shallow, horizontal burrows.

The subsurface geology at the Base was interpreted from drilling activities during the remedial investigation. The Base overlies a deep alluvium-filled graben called the George Subbasin. The subbasin extends from State Highway 18 to a few miles north of the Base and from the edge of the Base to a few miles west of the town of Adelanto (Figure 2-1). The alluvium filling the graben consists of three units. The lower unit is an alluvial fan deposit, consisting of generally unsorted granular material and has little bedding features. The middle unit is a clayey silt lake bed deposit about 40 feet thick and 200 feet deep. This lake bed deposit is continuous throughout the subbasin and acts as a barrier to downward movement of groundwater. The upper sedimentary unit of the George Subbasin contains deposits associated with an ancestral northwest trending Mojave River. These deposits are about 200 feet thick and consist of interbedded sands, silts, and gravels. The upper 45 feet consists predominantly of medium to coarse sand. From depths of about 45 to 130 feet interbedded sand, silt, clay, and clayey sands form complex cut-and-fill channel deposits.

The water table at OU#2 is approximately 119 to 133 feet below the surface and slopes to the north-northwest at a gradient of about 0.034. The aquifer is called the perched aquifer, and the aquiclude that causes the perched condition is the silt/clay lake bed deposit at about the 200-foot depth. Groundwater movement in the perched aquifer is strongly controlled by the northwest trending paleo channel deposits. Beneath the aquiclude is a thick vadose zone above a deep aquifer, which is not connected to the perched aquifer.

Site History and Enforcement Actions

George Air Force Base was initially activated in 1941 as Victorville Army Airfield. Following a period of inactivity after World War II, it was activated in 1950 as a jet fighter training base and renamed George AFB. In 1951 the Tactical Air Command took control of the Base to carry out jet fighter operations and to provide training for air crew and maintenance personnel.

During the mid-1950s, fuel pits (concrete vaults), that extend approximately eight feet below the surface, and associated fuel supply piping were constructed at the Base. The fuel supply lines were three- and six-inch diameter aluminum pipes. Following reported leaks and the

degradation of the fuel lines around Fuel Pits No. 1 and 2, the aluminum fuel lines were replaced in 1972 and in 1974 with six-inch diameter fiberglass supply lines.

In 1976, two thin-walled fiberglass lateral lines extending from Fuel Pit No. 1 leaked. In 1980, the fuel supply lines from Fuel Pits Nos. 1 and 2 were replaced by the present system of six- and eight-inch diameter Schedule 40 iron pipes. Both the fuel pits and associated piping have been used for JP-4 fuel exclusively. Since then, several fuel leaks have been reported in the current fuel supply system.

In December 1988, the Base was informed that it would be decommissioned as an Air Force Base in December 1992. In February 1990 the Base was to be placed on the National Priorities List (NPL).

Prior to the OU#2 RI, an active environmental cleanup program has been underway at GAFB since 1981. As part of the Air Force's Installation Restoration Program (IRP) studies at bases nationwide, the cleanup at GAFB is being conducted under the requirements of the CERCLA.

The IRP Phase I records search at GAFB was performed in 1982 by CH2M Hill. This search involved reviewing records to identify possible hazardous waste sites and potential problems that may result from contaminant migration. The Phase II, Stage 1 confirmation investigation and Stage 2 confirmation/quantification investigation were performed in 1985 by Science Applications International Corporation (SAIC). The latter investigation was the equivalent of the initial site characterization and field investigation portions of the RI/FS.

During the Phase II investigation, soil contamination was encountered beneath fuel pit 1 in two soil borings. In 1986, James M. Montgomery (JMM) was tasked to collect soil samples at locations adjacent to those sampled by SAIC. As part of this task, JMM drilled three borings along the east edge of the flight line apron, and one monitoring well. The first boring which was drilled to groundwater, showed evidence of soil contamination starting at a depth of about 20 feet. Floating product was observed on the groundwater at 130 feet. The second boring, drilled to the top of groundwater, first exhibited soil contamination at 110 feet. Analytical results for soil samples collected from the borehole indicated low levels of ethylbenzene (10 to 14 mg/kg), toluene (18 to 26 mg/kg), and o-xylenes (55 to 75 mg/kg) in a sample collected at a depth of 110 feet. These contaminants were also found in the

groundwater samples at the same location at the following concentrations: 8.4 mg/ℓ benzene, 1.2 mg/ℓ ethylbenzene, 8.6 mg/ℓ toluene, 6.4 mg/ℓ m, p-xylenes, and 1.7 mg/ℓ xylenes.

In 1990, IT Corporation (IT) installed six monitoring wells (MW-1 through MW-6) and drilled five soil borings (SB-1 through SB-5) within OU#2 as part of the site characterization to assess the nature and extent of soil and groundwater contamination. Nine soil samples were collected from each boring and monitoring well and analyzed for JP-4, diesel No. 2, and "leaded" gasoline. Groundwater samples were also collected and analyzed for the same parameters as the soil samples, as well as Volatile Organic Compounds (VOCs). Free product thickness was also measured in both the monitoring wells and the temporary wells installed in the soil borings. Field observations and analytical data indicated that fuel-related contamination existed in the vadose zone and groundwater beneath OU#2, and that JP-4 was the major source of contamination. Six potential JP-4 sources were identified. Four of them involved JP-4 leaks from the laterals at fuel pits 1 and 2; while the other two were associated with the fuel supply lines leading from fuel pit 2. Contamination was also noted near fuel pit 3 but did not appear to be related to spills at fuel pits 1 and 2.

As a result of this investigation, the OU#2 site was expanded to include: the main pipeline from the Base boundary, the bulk fuel storage area, all piping to the flight line distribution system, the pump station, the seven fuel pits, the waste fuel reclamation area (Facility 690), and all lateral fuel lines under the flight ramp. The total study area encompasses approximately 0.4 square miles.

Results of the above field investigations and data collection activities were used to develop the current OU#2 RI/FS program. The RI field investigation was initiated by IT in February 1992. These activities included the drilling and sampling of 49 soil borings to define vadose contamination and provide geologic data; the installation and sampling of 49 monitoring wells to define the extent of the free product plume and groundwater contamination; drilling two deep-soil borings and one deep monitoring well to assess the continuity of the aquiclude, deep vadose zone, and deep groundwater table; geophysical logging of soil borings and monitoring wells; three-dimensional modeling of the analytical data and conductivity logs to simulate the lithology of the site; conducting a 511-point soil gas survey to explore for possible leaks along the main fuel supply lines; conducting a bioremediation assessment of the site to the groundwater table; and conducting two, short-term (five-hour) pump tests.

Four media were evaluated as part of OU#2 remedial investigation. They include the groundwater, (which contains the JP-4 plume), the capillary fringe zone, (which is defined as the soil between the free product in the groundwater up to about 20 feet), and the free product (which floats on the perched aquifer water table). Soil contamination at the site, which will require treatment, is restricted to the capillary fringe zone located directly above the free product plume. Soils within the vadose zone above the capillary fringe will require no further action due to the lack of completed pathways to potential receptors, and the insignificant potential for groundwater impacts due to vapor-phase diffusion of contaminants through the soil column.

In addition to OU#2, Operable Unit No. 1 will address the TCE contamination in the deep and perched aquifer groundwater beneath the northeast disposal area and north of the operational apron, while Operable Unit No. 3 will address potential soil and groundwater contamination at 58 other sites located throughout the Base (Figure 1-3).

Estimated dates for the completion of these activities are:

- Final ROD for Operable Unit No. 1 (Later)
- Final ROD for Operable Unit No. 2 (Later)
- Final ROD for Operable Unit No. 3 (Later)
- Installation-wide Remedial Investigation Report (Later)
- Installation-wide Feasibility Study (FS) (Later)
- Installation-wide Record of Decision (ROD) (Later)

Highlights of Community Participation

A Community Relations Plan for the Base was finalized in 1991. 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 OU#2 Feasibility Study was released for public comment in 1993.

A Proposed Plan announcement for OU#2 was mailed to interested parties and an announcement of the public comment period and community meeting was placed in local papers. The public comment period began on (Later), and a community meeting was held on (Later) in the City of Victorville, to discuss the proposed OU#2 cleanup alternatives. The public comment period ended on (Later). All comments were received during the public

comment period and a Responsiveness Summary was prepared by the Air Force addressing these comments (Section 10).

Additionally, the Air Force holds quarterly Technical Review Committee meetings with representatives of the Air Force, regulatory agencies, and the community and provides a forum for selected members of the community to be briefed on Base activities.

The Administrative Record for the Base is retained by the Air Force and is available for public inspection through the Base Public Affairs office, as is an index to the Administrative Record. Additionally documents issued for the public record such as the OU#2 Feasibility Study Report are placed in local county libraries, including the Victorville Branch and the Adelanto Branch, and in the GAFB Library.

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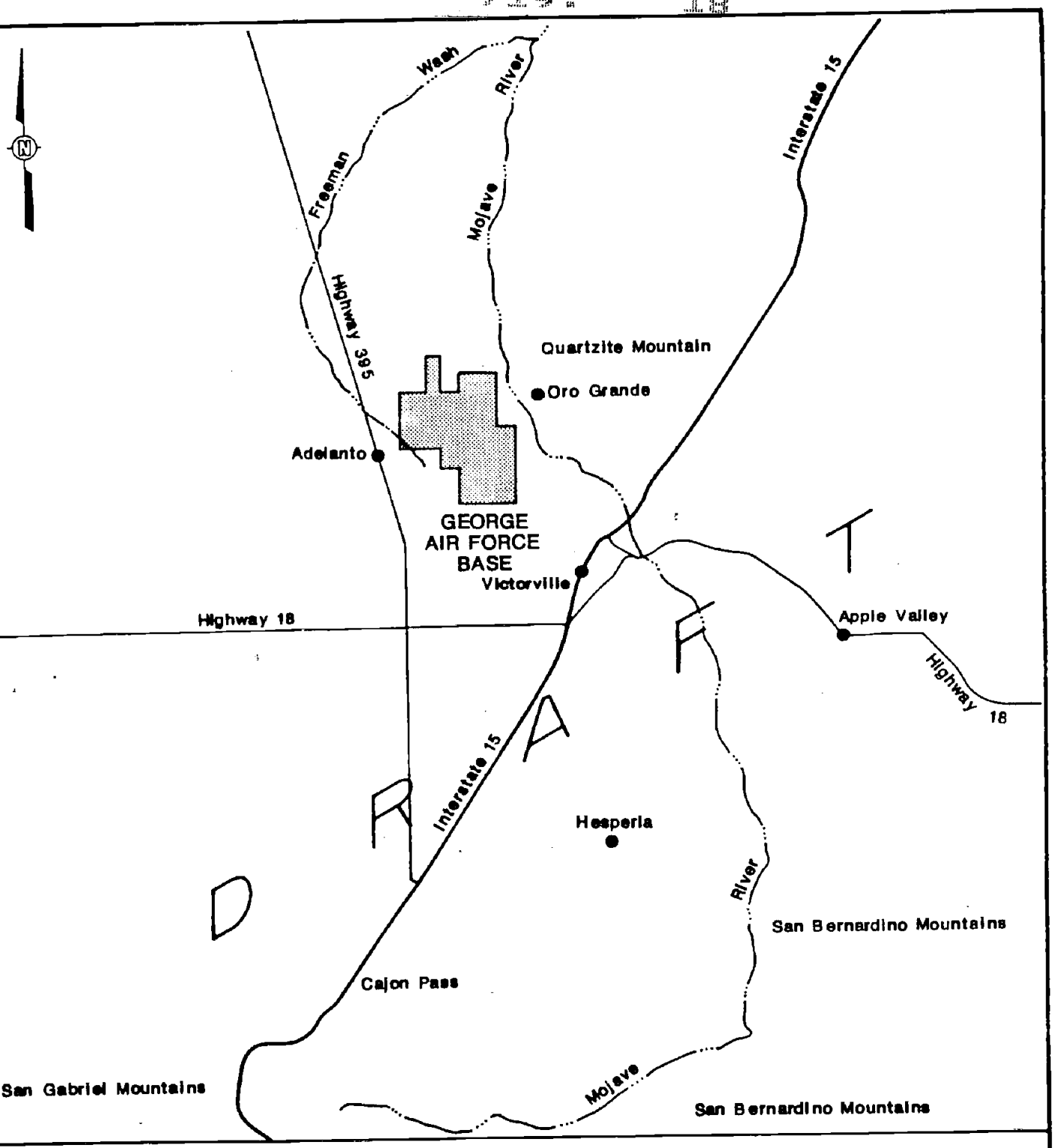

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FIGURE 2-1

SITE LOCATION MAP

GEORGE AIR FORCE BASE

PREPARED FOR

GEORGE AIR FORCE BASE

REFERENCE:

DIVISION OF MINES AND GEOLOGY, GEOLOGIC MAP OF THE SAN BERNARDINO QUADRANGLE, CALIFORNIA, SCALE 1:250,000, MAP NO. 3A, SHEET 1 OF 5, DATED 1986.

INTERNATIONAL TECHNOLOGY CORPORATION

Do Not Scale This Drawing

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APPROVED BY			
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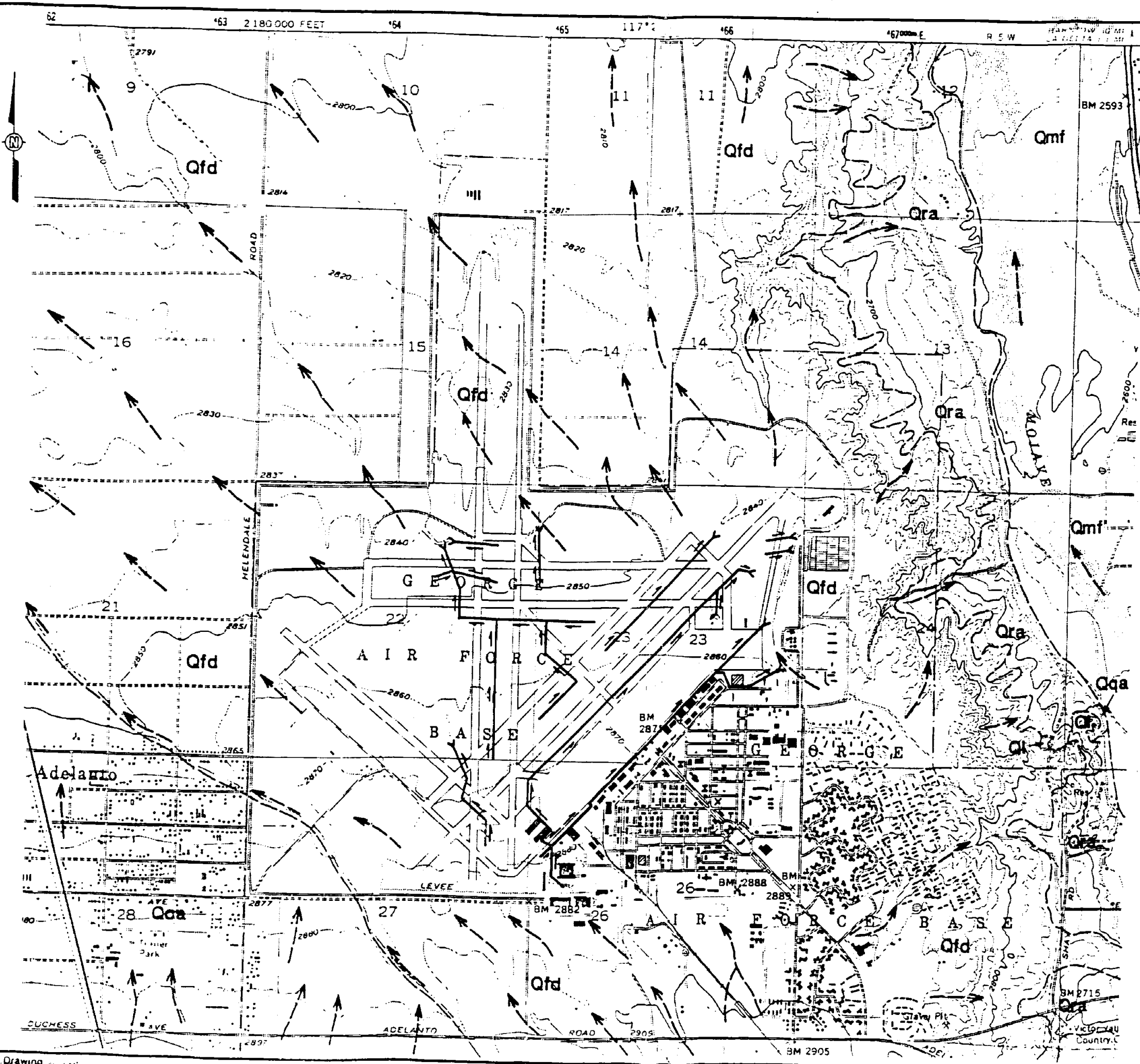

EXPLANATION:

GEOLOGIC UNITS

Qmf	MOJAVE RIVER FLOODPLAIN
Qra	RECENT ALLUVIAL DEPOSITS
Qfd	FLUVIAL DEPOSITS OF PALEO-MOJAVE RIVER AND PLEISTOCENE LAKE EVENTS
Qoa	OLD ALLUVIAL FAN DEPOSITS
Ql	LAKE CLAYEY SILT, AQUITARD
Qqa	QUARTZ MOUNTAIN ALLUVIAL FAN

SYMBOLS

- APPROXIMATE GEOLOGIC CONTACT
- FLOW DIRECTION OF SURFACE DRAINAGE
- APPROXIMATE LOCATION OF STORM DRAIN, SHOWING FLOW DIRECTION
- STORM DRAIN OUTLET

REFERENCES:

1. FIELD RECONNAISSANCE MAPPING AND AERIAL PHOTOS.
2. U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, VICTORVILLE QUADRANGLE, DATED 1981, AND ADELANTO QUADRANGLE, DATED 1980.
3. GEOLOGIC MAPPING BY I T CORP.

0 2000 4000 FEET
SCALE

DRAFT

FIGURE 2-2

SURFACE GEOLOGY AND DRAINAGE PATTERN

PREPARED FOR

GEORGE AIR FORCE BASE

INTERNATIONAL TECHNOLOGY CORPORATION

137773

Do Not Scale This Drawing

3.0 Scope and Role of the Operable Unit

Currently, three operable units have been identified at the Base. They include: TCE groundwater contamination in the deep and perched aquifer groundwater beneath the northeast disposal area and north of the operational apron (OU#1), the JP-4 fuel spills along the operational apron (OU#2), and the remaining soil and groundwater cleanup at 58 sites (OU#3). OU#3 will proceed following the completion of site characterization activities at the other two operable units. Any remaining contamination at the Base will be addressed in the installation-wide RI/FS and ROD.

The principal risk to public health posed by contamination at OU#2 results from benzene, which has the potential to impact off-Base wells. The lateral area delineated by the benzene plume, at or above the drinking water MCL of 1 part per billion (ppb) is approximately 6.7 million square feet (Figure 1-2). Delays in remediating the source (free product) and the dissolved hot spots in the plume could potentially cause the plume to expand and affect a greater area, making remediation more difficult and costly.

Since data have shown that Applicable or Relevant and Appropriate Requirements (ARARs) have been exceeded in the groundwater beneath the Base, this operable unit is designed to initiate early action to mitigate potential threats to public health and the environment. The installation-wide ROD will define further actions to mitigate potential threats at other sites. The selected remedy in this action is expected to be consistent with subsequent remedies and planned future actions at the Base. Pursuant to regulatory guidance for remedial actions, the OU#2 RI contains a baseline risk assessment which addresses risks to public health and the environment.

4.0 Summary of Site Characteristics

The remedial investigation identified a JP-4 groundwater plume containing dissolved constituents of JP-4 free product floating on the surface of the perched aquifer, and JP-4 in the capillary fringe zone. There are no regulatory cleanup standards set for JP-4 since it consists of a diverse mixture of petroleum hydrocarbons including benzene, toluene, xylene, and ethylbenzene.

Four chemicals of concern have been identified for the groundwater within OU#2. These chemicals, which are JP-4 constituents, have established Maximum Contaminant Levels (MCLs) under the Federal and State Safe Drinking Water Act, and may pose a health risk (Table 4-1). The remedial investigation chemicals of potential concern are:

- Benzene
- Toluene
- Ethylbenzene
- Xylene

Several of these chemicals have been detected above MCLs in the groundwater (Table 4-1). Figure 1-2 shows the delineation of the dissolved benzene plume at the 1 part per billion (ppb) boundary. This level is the drinking water standard for benzene promulgated by the U.S. EPA under National Primary Drinking Water Standards. The plume also delineates the extent of contamination of two other chemicals, trichlorethylene (TCE) and Perchloroethylene-(PCE) at maximum observed concentrations of 32 and 5 ppb respectively. The TCE/PCE contamination has not been fully characterized and will be examined later as part of the OU#3 RI. The selected remedy will remove and treat the four chemicals of concern listed in Table 4-2 within the delineated area. Potential groundwater users are the government, nearby residents, and farmers.

The highest level of benzene detected during the RI groundwater sampling within the plume was 11,000 ppb (Table 4-2). A number of benzene hot spots were also identified which exceeded 1 ppb. The vast majority of groundwater within the plume contains these chemicals of concern at or below their detection limits.

TABLE 4-1
PRELIMINARY CHEMICAL SPECIFIC ACTION LEVELS FOR OPERABLE UNIT No. 2

CAS NO.	CONSTITUENT	MAXIMUM OBSERVED CONC (µg/l)	FEDERAL MCL (µg/l)	SAFE DRINKING WATER ACT MCLG (µg/l)	U.S. EPA RFI GUIDE HB PARAMETERS[1] (µg/l)	CALIFORNIA DEPARTMENT OF HEALTH SERVICES	
						MCL (µg/l)	DWAL (µg/l)
71-43-2	Benzene (A)[3]	11,000	5	-	-	1	-
1330-20-7	Xylenes	9,000	10,000[2]	10,000	-	1,750	-
100-41-4	Ethylbenzene	1,500	700[2]	700	-	680	-
108-88-3	Toluene	19,000	1,000[2]	1,000	-	-	1,000

[1] RFI (RCRA Facility Guidance) evaluates the constituents on the basis of Reference Doses (RFDs) and Risk Specific Doses (RSDs) for the systemic toxicants and carcinogenic chemicals on the list. The exposure scenario used to arrive at the water concentrations assumes that a 70-kg adult will drink 2 liters of water per day over a 70-year period. Values presented represent Corrective Measure Action Levels (CMALs) (40 CFR 264, 55 FR 30789, July 27, 1990).

[2] This federal MCL will be effective July 30, 1992.

[3] The EPA weight-of-evidence classification system for carcinogenicity describes Group "A" as human carcinogens and Group "B2" as probable human carcinogens. B-2 indicated sufficient evidence in animals and inadequate or no evidence in humans.

TABLE 4-2

SUMMARY OF GROUNDWATER ANALYTICAL DATA
OPERABLE UNIT #2, GAFB

	(ug/l)							(mg/l)
Well #	TPH as JP-4	Benzene	Xylene	Toluene	EthylBenz	TCE	PCE	TDS
MW-13	4820	160	260	320	48	nd	nd	321
MW-14	nd	nd	nd	1J	nd	nd	5J	333
MW-15	nd	1J	nd	nd	nd	nd	nd	380
MW-16	270	6J	13	2J	nd	nd	nd	nd
MW-17	nd	83	98	160	15	nd	nd	390
MW-18	2,520,000*	11000	9000	19000	1500	nd	nd	374
MW-19	2870*	520	650	250	130	nd	nd	424
MW-20	257,000	460	5200	3700	880	nd	nd	290
MW-21	nd	nd	nd	2J	nd	nd	nd	339
MW-22	nd	nd	nd	nd	nd	nd	nd	336
MW-23	nd	11	7J	15	3J	7J	nd	535
MW-24	2,540,000*	3700	4800	8800	780	nd	nd	541
MW-25	82,800	2600	5800	9300	1100	nd	nd	520
MW-26	nd	nd	nd	nd	nd	2J	nd	577
MW-27	1630*	560	290	110	41J	nd	nd	605
MW-28	640*	nd	nd	1J	4J	12	1J	439
MW-29	730*	730	120	nd	nd	nd	nd	735
MW-30	nd	nd	nd	nd	nd	10	nd	866
MW-31	nd	41	2J	2J	nd	2J	nd	707
MW-32	nd/nd	2J/10	nd/nd	1J/nd	nd/nd	1J/nd	nd/nd	882/850
MW-33	nd	5J	nd	nd	nd	2J	nd	750
MW-34	nd	nd	nd	nd	nd	nd	nd	785
MW-35	nd	nd	nd	2J	nd	nd	nd	694
MW-36	nd	nd	nd	3J	nd	5J	nd	684
MW-37B	nd	nd	nd	5J	nd	nd	nd	403
MW-38	nd	nd	nd	nd	nd	nd	nd	302
MW-39	nd	nd	nd	nd	nd	nd	1J	306
MW-40	nd	nd	nd	nd	nd	nd	2J	355
MW-41	nd	1J	nd	1J	nd	nd	nd	332
MW-42	nd	nd	nd	1J	nd	nd	nd	536
MW-43	nd	nd	nd	nd	nd	nd	nd	351
MW-44	nd	nd	nd	1J	nd	nd	nd	345
MW-45	15,500*	5500	2500	4400	490	nd	nd	676
MW-46	nd	nd	nd	nd	nd	9J	nd	384
MW-47	nd	260	nd	nd	nd	nd	nd	623
MW-48	nd	nd	nd	nd	nd	3J	nd	342
MW-49	nd	nd	1BJ	nd	nd	32	nd	390

J = Estimated.
nd = Nondetect.
B = Analyte also found in associated blank.
* = Identity uncertain, not equal to JP-4 standard. TPH chromatograph for MW-18, -24, -28 and -29 is similiar to diesel. TPH chromatograph for MW-19, -27 and -45 is similar to gasoline.

5.0 Summary of Site Risks

Site risks have been characterized, however, it is clear that MCLs have been exceeded for several contaminants in the groundwater, as discussed in Section 4.0. Therefore, it is appropriate to initiate early cleanup action via the selected remedy. Four organic chemicals of potential concern were previously identified for OU#2. The general goals of this 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 addressed by this remedy in that treatment actions will be expedited.

Site risks have been characterized in the OU#2 RI report. The potential risk to humans and ecological receptors resulting from contamination found at OU#2 were estimated in accordance with EPA *Risk Assessment Guidance for Superfund.* This section summarizes the results of these assessments and the uncertainties associated with the quantitative risk characterizations.

No chemicals occur in the surface soils at detectable concentrations, so there are no chemicals of potential concern (CPCs) for this medium. Surface water does not occur at the site, so no CPCs are identified for this medium. Benzene, ethylbenzene, toluene, and xylenes are the CPCs for subsurface soils and groundwater. For each constituent, the upper 95 percentile concentration on the arithmetic mean is used as the reasonable maximum exposure (RME) case concentration. Potential risks for humans are estimated using this concentration.

Industrial site workers and off-base residents are the existing potentially exposed human populations. Desert vegetation and animals, including rare, threatened, and endangered species, are the ecological receptors. Based on existing site conditions and environmental chemical constituents, there are no complete exposure pathways for any receptor group and, consequently, there are no existing health and ecological risks. This conclusion is based on the following exposure pathway analysis.

- The groundwater beneath the OU#2 is not used as drinking, industrial, or agricultural water. Water supply wells downgradient of OU#2 do not have detectable concentrations of CPCs, or other chemicals potentially associated with OU#2. Neither flow seeps nor other surface water releases of groundwater are known for

the vicinity of OU#2. Finally, because of the depth to groundwater, it is unlikely that the root systems of the plant species in the area extend to this resource.

- Since the soils that are contaminated are subsurface, there are no direct human exposures (i.e., incidental ingestion and dermal contact) to these soils. Indirect exposures for both humans and ecological receptors are expected to be insignificant since the paving over OU#2 acts as a cap to volatile and particulate emissions.

In accordance with *Risk Assessment Guidance for Superfund, Part A*, human health risks associated with a future use of the site have been considered. As of 1992, there are no plans to redevelop the Base; however, for this assessment it was assumed that the OU#2 site would be re-used for residential housing. This scenario includes hypothesizing that the groundwater directly beneath OU#2 will be used to supply the domestic water to these homes. Because of the depth of the known contamination, direct and indirect exposure pathways associated with subsurface soils are incomplete: construction activities are unlikely to disturb these chemicals and bring them to the surface. The potentially complete exposure pathways associated with groundwater use are:

- ingestion of groundwater,
- dermal contact with groundwater during bathing, and
- inhalation of volatile chemicals during water use.

For each of these exposure pathways, RME-chronic daily intakes have been estimated. The RME estimates are based on the 95 percent upper confidence limit (UCL) concentrations and values for exposure factors (e.g., quantity of water that is ingested) that are plausible, but at the upper end of the statistical distributions of these values. For example, it is assumed that a receptor would spend 30 years at a single home; however, the median length of residence at a single location is 9 years. Further, it has been assumed that fate and transport processes (such as biodegradation and volatilization) do not affect the concentration of chemicals in the groundwater; that is, it has been assumed that the concentrations of CPCs remain constant for the entire exposure period.

Based on these exposure scenarios, the potential cumulative cancer risk to humans is 2×10^{-3}. The vast majority of this risk is a result of exposure to benzene, a known human carcinogen. This assessment also indicated that no individual chemical is likely to cause significant noncarcinogenic health effects; however, if the effects of ethylbenzene, toluene, and xylenes are considered additive, there is a potential for noncarcinogenic health effects to occur. These

are possible risks, not actual risks, associated with the chemicals in the soils and groundwater at OU#2. The uncertainty associated with this risk characterization is high because of the many assumptions and extrapolations that are involved, especially the assumption that the Base will be redeveloped for housing.

6.0 Description of Alternatives

As discussed in Section 5.0, the goals of the selected remedy are to prevent the spread of further contamination and to initiate removal of contamination from the aquifer. 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 remedial alternatives developed and screened for each affected media is provided below. For purposes of comparing the net present worth of each alternative, a discount rate of seven percent was assumed (Table 7-1). This rate was considered to be representative of the economic conditions at the time the OU#2 FS was prepared.

Alternatives F-2 is based on using the existing four permanent free product recovery systems. In addition, for new wells and permanent recovery systems will be installed in addition to the use of a mobile skimmer system to remove free product from affected wells. These measures are expected to yield a total recoverable amount of 100 gallons per day of free product.

Alternatives C-2 and C-3 are based on using 153 wells to either extract or flush contaminants from the capillary fringe zone. The appropriate number of wells was determined by using a mass transfer based model for movement in the unsaturated zone.

Alternatives G-3 and G-4 are based on pilot tests performed to demonstrate the feasibility of insitu-air sparging and modeling to estimate the natural attenuation rate of JP-4 constituents. The pilot test indicated the formation was amenable to sparging and a reasonable radius of influence from a vertical well was amenable to sparging and a reasonable radius of influence from vertical wells was achievable at this site. The number and placement of wells is based on the radius of influence as determined by the pilot test to be at least 90 feet. Modeling indicated that once source areas above 1,000 ppb benzene are removed, natural attenuation of remaining constituents will occur within a reasonable time frame. Assuming that sparging would require some type of emission control to minimize the potential impact on the vadoze zone and ambient air quality, a vadoze zone soil vapor collection system is included. The appropriate number of vadoze zone gas recovery wells was determined by using an appropriate soil vapor extraction/vadoze transport model.

Alternatives G-5, G-6, and G-7 are pump and treat alternatives which were developed using a groundwater transport modeling to determine the appropriate number of extraction/injection wells.

Alternative Descriptions

The remedial action alternatives developed in the FS are described in detail in this section. These alternatives were developed for each affected media then a preferred alternative was selected for each media and combined to develop the preferred remedy.

Free Product Alternatives

Alternative F-1 (No Action)

CERCLA requires evaluation of a no action alternative as a baseline to compare relative risks, cost and remedial duration. Under this alternative no institutional or remedial action will be undertaken. All routine monitoring will be discontinued and operation of the existing skimmer systems will be terminated.

Alternative F-2 (Free Product Skimming of Recovery Wells)

Under Alternative F-2, the existing, passive free product removal system installed earlier at OU#2 under an Engineering Evaluation/Cost Analysis (EE/CA) assessment, will be expanded to recover approximately 100 gallons of free product per day. This will include installing four additional product recovery wells and recovery pumps (four wells are assumed for estimating purposes). Additionally, a mobile bailing/skimmer system will be procured to remove free product from any monitoring wells having recoverable free product. Free product will be disposed off site using a licensed hazardous waste disposal/recycling contractor.

Capillary Fringe Alternatives

Alternative C-1 (No Action)

CERCLA requires evaluation of a no action alternative as a baseline to compare relative risks, cost and remedial duration. Under this alternative no institutional or remedial action will be under taken. All routine monitoring will be discontinued.

Alternative C-2 (Soil Vapor Extraction with Thermal Abatement)

Under Alternative C-2, soil gas extraction wells will be installed to effectively remediate the capillary fringe zone. The capillary fringe zone is considered to be the volume of soil delineated aerially from the surface of the free product plume up to 20 feet above the water table, and includes three small localized areas extending (80) feet above the water table. The optimum number of soil gas extraction wells will be determined after field pilot tests are conducted. For the purpose of costing this alternative, 153 wells are assumed. Vapor abatement from the soil gas extraction system will be accomplished using catalytic thermal oxidation or an internal combustion engine. The selection of the most appropriate abatement option will be made after soil gas pilot tests are conducted to determine volume, concentration, and pertinent design data.

Alternative C-3 (Soil Flushing)

Under Alternative C-3, soil flushing injection wells will be installed to effectively flush out the capillary fringe. The optimum number of soil flushing injection wells will be determined after field pilot tests are conducted. For the purpose of costing, 153 wells are assumed. Soil flushing will require hydraulic control and remediation of contaminants transferred to the groundwater. Options for groundwater treatment are addressed under alternatives for that media.

Groundwater Alternatives

Administrative Measures for Alternatives G-3 through G-7

During the short term, administrative measures will include regulatory enforcement prohibiting the domestic use of the water from the affected aquifer. Those alternatives requiring routine monitoring include quarterly monitoring of 15 wells to measure the progress of the remediation and, in some cases, modeling to predict or confirm the degree of natural attenuation. Some new monitoring wells may be needed, and some existing ones may be abandoned, at the discretion of the overseeing regulatory agencies. In the long term, water rights to the Base domestic supply wells will be turned over as an alternate water supply to the government or private agency responsible for developing the Base in the post military period. A legal prohibition for using the contaminated aquifer (restriction of water rights) will be entered on to the deed for the Base property upon transfer to the new administering agency. The deed restriction shall remain in effect until the remediation is complete.

The OU#2 site shall be considered clean after six months of consecutive monitoring indicating the detected levels of the chemicals of concern are less than the cleanup levels for these chemicals in all groundwater monitoring wells within the OU#2 plume. At that point, the Air Force has the option to terminate remedial activities and will enter a two-year interim monitoring period. Should the detectable levels of the chemicals of concern remain below the cleanup levels for the two-year interim monitoring period, OU#2 shall be considered clean and remediated, at which time permanent closure of the affected operable unit shall commence terminating all remedial activities.

Alternative G-1 (No Action)

CERCLA requires evaluation of the no action alternative as a baseline to compare relative risks, cost, and remedial duration. Under Alternative G-1 no institutional or remedial action will be under taken and the natural attenuation of groundwater contamination will be allowed to continue. All routine monitoring would be discontinued.

Alternative G-2 (Institutional Controls)

Under Alternative G-2 no active treatment or remediation will occur. However, institutional controls will be implemented restricting access to the contaminated aquifer. Over the short term, while military activity continues at the Base, administrative measures will include regulatory enforcement prohibiting the domestic use of water from the aquifer and abandonment of most monitoring wells. Approximately 15 wells will be retained for quarterly groundwater monitoring of the plume for a period of 30 years. Monitoring using the Bio-Plume II computer modeling software or equivalent will be performed on a biannual basis to confirm the progress of natural attenuation. Over the long term, water rights to the Base's domestic water supply wells will be turned over as an alternate water supply to the government or private agency responsible for administering or developing the Base during the post military period. A legal prohibition for using the contaminated aquifer (restriction of water rights) will be entered onto the deed for the Base property transfer to the new administering agency, which shall remain in effect until the remediation is complete.

Alternative G-3 (In Situ Air Sparging Throughout the 1 ppb Benzene Contour, SVE Recovery/Abatement In the Vadose Zone, Groundwater Monitoring)

Under Alternative G-3, a well field of approximately 318 sparge wells will be placed throughout the plume. Injection of air at each well will occur at a flow rate of 25 cfm into the bottom 10 feet of the perched aquifer. A total of 1,031 soil gas extraction wells will be used to capture Volatile Organic Compounds (VOCs) that have been transferred from the

liquid to vapor phase. Vapor abatement from the soil gas extraction system will be accomplished using catalytic thermal oxidation or an internal combustion engine. The selection of the most appropriate abatement option will be made after soil gas pilot tests are conducted to determine volume, concentration, and pertinent design data.

Alternative G-4 (In Situ Air Sparging Throughout the 1,000 ppb Benzene Contour Only, SVE Recovery/Abatement in the Vadose Zone, Groundwater Monitoring and Modeling of Natural Attenuation Outside the 1,000 ppb Contour

Under Alternative G-4, a well field of approximately 25 sparge wells will be placed in hot spot areas defined by the greater than 1,000 ppb benzene plume contours. Injection of air at each well will occur at a flow rate of 25 cubic feet per minute (cfm) into the bottom 10 feet of the perched aquifer. A total of 70 soil gas extraction wells will be used to capture VOC's that have been transferred from the liquid to vapor phase. Vapor abatement from the soil gas extraction system will be accomplished using catalytic thermal oxidation or an internal combustion engine. The selection of the most appropriate abatement option will be made after soil gas pilot tests are conducted to determine volume, concentration, and pertinent design data.

The remaining dissolved phase groundwater contamination will be relegated to natural attenuation, which will be monitored through the implementation of an annual groundwater monitoring program. Natural attenuation will be modeled annually utilizing Bio-Plume II.

Alternative G-5 (Groundwater Extraction, Surface Groundwater Treatment with Enhanced UV-Peroxide Oxidation, Followed by Reinjection of Treated Groundwater with In Situ Bio-Enhancement)

Under Alternative G-5, a well field of approximately 18 extraction wells will be placed throughout the plume. Each well will be pumped at an average rate of 25 gallons per minute (gpm), for a combined total of 450 gpm. The extracted water will be pumped to a central surface treatment plant using aqueous enhanced ultra violet (UV)-peroxide oxidation to remove contaminants from the groundwater. The treated groundwater will be reinjected through a series of 11 injection wells around the perimeter of the plume. Reinjection will return a combined flow rate of 275 gpm directly to the contaminated aquifer. Reinjected water will be enhanced with nutrients and hydrogen peroxide to stimulate naturally occurring aerobic bacteria to accelerate degradation of the JP-4 plume. Due to hydraulic limitations, a surface discharge of 175 gpm of treated water will be necessary. This discharge will meet the permit requirements under NPDES (for a storm water discharge) or a State Water Resources Board waste discharge permit (if the former on-Base percolation ponds are used).

Alternative G-6 (Groundwater Extraction, Surface Groundwater Treatment with Thermally Abated Air Stripping, Followed by Reinjection of Treated Groundwater with In Situ Bio-Enhancement)

Under Alternative G-6, a well field of approximately 18 extraction wells will be placed throughout the plume. Each well will be pumped at an average rate of 25 gpm, for a combined total of 450 gpm. The extracted water will be pumped to a central surface treatment plant using an air stripper abated with a thermal fuel assisted combustor. The treated groundwater would be reinjected through a series of 11 injection wells located around the perimeter of the plume. Reinjection will return a combined flow rate of 275 gpm directly to the contaminated aquifer. Reinjected water will be enhanced with nutrients and hydrogen peroxide to stimulate naturally occurring aerobic bacteria to accelerate degradation of the JP-4 plume. Due to hydraulic limitations, a surface discharge of 175 gpm of treated water will be necessary. This discharge will meet the permit requirements under National Pollutant Discharge Elimination System (NPDES) (for a storm water discharge) or a State Water Resources Board waste discharge permit (if the former on-Base percolation ponds are used).

Alternative G-7 (Groundwater Extraction, Surface Groundwater Treatment with Steam Regenerated GAC, On-site UV-Peroxide Oxidation Treatment of Condensed Regenerant, Followed by Reinjection of Treated Groundwater with In Situ Bio-Enhancement)

Under Alternative G-7, a well field of approximately 18 extraction wells will be placed throughout the plume. Each well will be pumped at an average rate of 25 gpm, for a combined total of 450 gpm. The extracted water will be pumped to a central surface treatment plant using granular activated carbon (GAC) to remove contaminants to levels which will meet ARARs. The treated groundwater will be reinjected through a series of 11 injection wells located around the perimeter of the plume. Reinjection will return a combined flow rate of 275 gpm directly to the contaminated aquifer. Reinjected water will be enhanced with nutrients and hydrogen peroxide to stimulate naturally occurring aerobic bacteria to accelerate degradation of the JP-4 plume. Due to hydraulic limitations, a surface discharge of 175 gpm of treated water will be necessary. This discharge will meet the permit requirements under NPDES (for a storm water discharge) or a State Water Resources Board waste discharge permit (if the former on-Base percolation ponds are used). Spent carbon process waste would be steam regenerated on-site using medium pressure steam from a new electric or gas fired boiler. The condensed steam containing volatile organics desorbed from the carbon will be collected. Any free phase product will be decanted and recycled off site. The saturated condensate will be treated using UV-peroxide oxidation. After treatment, the clean condensate will be disposed through the GAC groundwater treatment system. Periodically

(approximately every 20 cycles) the carbon efficiency will decline and require replacement with kiln regenerated material. At that point, the spent carbon will be recycled off site at an approved facility.

7.0 Comparative Analysis of Alternatives

The two free product, three capillary fringe, and seven groundwater alternatives were evaluated according to the nine 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.

A summary comparison of the cleanup alternatives is shown on Table 7-1. A discussion of the evaluation criteria follows.

Overall Protection of Human Health

All the alternatives will be protective of human health except Alternatives F-1, C-1, G-1, and G-2. These alternatives are not protective because no remedial action is taken or treatment performed. Natural processes will not achieve protective levels within a reasonable period of time without removing or treating the source areas, thus placing the public at potential risk. The remaining alternatives will achieve protection of human health by remediation, removal, and/or treatment of the constituents of concern in a reasonable period of time.

Compliance with ARARs

All the alternatives will meet ARARs except Alternatives F-1, C-1, G-1, and G-2. These alternatives fail to meet ARARs because the constituents of concern are allowed to remain in the environment, relying only on natural processes to achieve contaminant specific limits in soil and groundwater. Eventually these limits could be reached by natural degradation and attenuation. However, the extremely long duration poses an unacceptable potential health risk and poses a significant potential to spread the contamination off-site through attenuation.

Without treatment and control, attenuation would impact an increasingly greater area and potentially impact a greater number of residents. These alternatives fail to meet the requirements of the NCP to mitigate or remediate releases of hazardous materials that are potentially threatening public health and the environment. The remaining alternatives will achieve ARARs in a reasonable period of time through remediation and treatment.

Long-Term Effectiveness and Permanence

All the alternatives provide an effective and permanent solution except Alternatives F-1, C-1, G-1, and G-2. Because these alternatives do not actively mitigate or remediate the constituents of concern, permanence is achieved only as a result of natural attenuation and degradation. A long term effective and permanent solution will not be achieved in a reasonable period of time. Contamination will continue to spread as a result of attenuation impacting an increasingly greater area and potentially impacting a greater number of residents. The remaining alternatives will achieve a long term effective and permanent solution through remediation, treatment, and permanent removal/destruction of the constituents of concern.

Reduction of Toxicity, Mobility, and Volume (Through Treatment)

All the alternatives provide a reduction in toxicity, mobility, and volume except Alternatives F-1, C-1, G-1, and G-2. Since these alternatives do not involve any active treatment or remediation, an increase in mobility and the volume of affected media will result. Although the toxicity will be gradually reduced through natural attenuation and degradation, dilution will play a major role in the reduction which is not acceptable or protective in the interim. The remaining alternatives rely on active remedial measures and treatment to remove/destroy contaminants, decreasing the toxicity, controlling the mobility, and reducing the volume of affected media in a reasonable time frame.

Short Term Effectiveness

All the alternatives provide short term effectiveness except Alternatives F-1, C-1, G-1, and G-2. These alternatives do not involve any active treatment or remediation. As such, these alternatives do not present a short term risk as a result of remediation or treatment. However, because the constituents of concern are not mitigated, a continuing threat to the public exists due to the failure to remove the sources and the continuing spread of contamination as a result of natural attenuation. The public is not protected in the short term during the period in which natural processes dilute or degrade the constituents of concern. Of the remaining

alternatives which involve treatment, the combination of Alternatives F-2, C-2, and G-3 to address each of the three affected media is the most short term effective having the shortest estimated remedial duration of years (combined).

Implementability

All the alternatives are implementable. The no action Alternatives F-1, C-1, and G-1, and Alternative G-2 (institutional controls), would be the easiest to implement. The remaining alternatives which involve remediation and/or treatment would be implementable. No technical limitations or material or equipment availability problems are anticipated with these treatment alternatives.

Cost

Based on net present worth, the no action Alternatives G-1, C-1, and F-1 would be the least costly to implement, followed by Alternative G-2 which involves institutional actions only, with no treatment or remediation. Based on having the shortest remedial duration, capillary fringe zone Alternative C-2 and free product zone Alternative F-2 have the lowest associated cost for remediation of their respective medias. Of the groundwater treatment alternatives, Alternative G-3 costs the most while Alternative G-4 costs the least. Alternatives G-6, G-8, and G-9 are relatively close in net present worth. The difference between the three alternatives is well within the accuracy of the cost estimate of +50 percent to -30 percent. There is some potential long-term liability which is not reflected in the costs for alternatives which rely on off-site disposal of materials (Alternative G-7).

State Acceptance

All the alternatives are acceptable to the State except Alternatives F-1, C-1, and G-1 (no action), and Alternative G-2 (institutional controls only). The remaining alternatives would be acceptable providing adequate engineering controls were also implemented to abate risks posed as a result of implementation of treatment or remediation. Alternatives with the shortest remedial durations and lower cost would be more preferable. Also, the State favors alternatives that use innovative technologies for treatment or remediation. Innovative technologies considered include UV-peroxide oxidation (Alternatives G-5, and G-7), soil gas extraction (Alternative C-2), soil flushing (Alternative C-3), and insitu sparging (Alternatives G-3 and G-4).

State and Community Acceptance

All the alternatives are acceptable to the community except Alternatives F-1, C-1, and G-1 (no action alternatives), and Alternative G-2 (institutional controls only). These are unacceptable because the potential risks posed by the constituents of concern are not mitigated and the duration until protection is achieved is extremely long. The remaining alternatives would all be acceptable providing adequate engineering controls were in place to protect the public and mitigate potential risks as a result of treatment, (which would also be a requirement of regulatory agencies). Alternatives with the shortest remedial duration would be preferable over alternatives with the longer remedial durations.

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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	NET PRESENT WORTH AT (DISCOUNT RATE 7%)	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
G-1 C-1 F-1	No Action	Not protective	Will not achieve ARAR's	Not a permanent solution	No reduction	Offers no short term protection Remedial duration: >100 years	Easiest to implement	$ 0	Not expected to approve	Not expected to approve
F-2	Free product skimmimg and bailing of recovery wells	Protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Remedial duration: 3 years	Implementable	$ 2,140,000	Expected to approve	Expected to approve
C-2	Soil vapor extraction with thermal abatement.	Protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Remedial duration: 5 years	Implementable	$ 17,940,995	Expected to apprave	Expected to approve
C-3	Soil flushing	Protective Potential to spread contamination	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Remedial duration: 16 years	Implementable	$ 28,024,000	Expected to approve May have concerns over potential to spread contamination	Expected to approve May have concerns over potential to spread contamination
G-2	Institutional control with Grounwater monitoring and modeling	Not protective	Will not achieve ARAR's	Not a permanent solution	No reduction	Offers no short term protection Remedial duration: >100 years	Implementable	$ 688,000	Not expected to approve	Not expected to apprave
G-3	In situ air sparging throughout the entire 1 ppb Benzene contour, SVE recovery/abatement in vadose zone, groundwater monitoring	Protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Remedial duration: 3 years	Implementable	$ 78,480,953	Expected to approve	Expected to approve
G-4	In situ air sparging through the 1,000 ppb Benzene contour only, SVE recovery/abatement in vadose zone, groundwater manitoring and modeling of natural attenuation outside the 1,000 ppb contour	Protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Remedial duration: 3 years	Implementable	$ 13,818,464	Expected ta approve	Expected to approve
G-5	Groundwater extraction, surface treatment with enhanced UV-peroxide oxidation, reinjection with in situ bio-enhancement	Protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Remedial duration: 14 years	Implementable	$ 28,000,000	Expected to approve	Expected to approve
G-6	Groundwater extraction, surface treatment with thermally abated air stripping, reinjection with in situ bio-enhancement	Protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Remedial duration: 14 years	Implementable	$ 20,100,000	Expected to approve	Expected to approve
G-7	Groundwater extraction, surface treatment with steam regenerated, GAC, on-site UV-peroxide oxidation of condensate regenerant, reinjection with in situ bio-enhance-ment.	Protective	Will meet ARAR's	Achieves a permanent and effective solution	Reduces toxicity, mobility and volume	Remedial duration: 14 years	Implementable	$ 22,100,000	Expected to approve	Expected to approve

TABLE 7-2

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

ALTERNATIVES	G-3	G-4	G-5	G-6	G-7	F-2	C-2	C-3
Hazardous Waste Solid								
Spent Carbon	None	None	None	None	59,100	None	None	None
Hazardous Waste,Liquid								
Free Product (as JP-4)	None	None	None	None	114,800	255,500	None	None
Spent Acid (from air stripper washing)	None	None	None	48,800	None	None	None	None
Priority Air Pollutants[2]								
Particulates	1,315	89.5	None	37.1	22.7	None	394	None
Sulfur Dioxide	157.8	10.7	None	8.88	2.73	None	47.3	None
Nitrogen Oxides	36,820	2506	None	2,074	638	None	11,040	None
Carbon Monoxide	9,205	627	None	519	159	None	2,760	None
Organics (as Hydrocarbons)	1,525	104	None	89	26.4	None	457	None
Organics (as chlorinated hydrocarbons)	None	None	None	Trace	Trace	None	Trace	None
Hydrochloric Acid (gas)	None	None	None	Trace	Trace	None	Trace	None

TABLE 7-3

POTENTIAL FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2

CHEMICAL-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
I.	Resource Conservation and Recovery Act (RCRA) as amended by Hazardous and Solid Waste Amendments (HSWA) (40 USCA 7401-7462) (40 CFR 260-280)	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). Table 2-3 lists RCRA MCLs for constituents of concern. RCRA establishes three categories of groundwater protection standards: background, RCRA MCLs, and Alternate Concentration Limits (ACLs). CERCLA Sec. 121(d)(2)(B)(ii) lists three additional conditions limiting use of ACLs at Superfund sites. Hazardous constituents entering groundwater must not exceed concentration limits in the aquifer underlying the waste management unit. (RELEVANT AND APPROPRIATE)
II.	Safe Drinking Water Act (SDWA) [40 CFR 300(f)] (40 CFR Part 141) (54 Federal Register 22064, May 22, 1989)	Establishes MCLs which are enforceable standards for chemicals in public drinking water supplies. They not only consider health factors, but also the economic and technical feasibility of removing a chemical from a public water supply system. Table 2-3 lists MCLs for constituents of concern. (RELEVANT AND APPROPRIATE)
III.	Clean Water Act, amended (CWA) (40 CFR 100-140)	Ambient Water Quality Criteria (AWQC); established under Section 304 of CWA (51 FR 43665) are based on effects on human health and aquatic life and do not reflect technological or economic considerations. CWA AWQCs would be applicable to water discharged to a sewer or to site runoff directed to a water body discharged (including a storm drain or flood channel) with or without treatment. Effluent limitations are required to achieve all appropriate state water quality standards. Under Alternatives G-5, G-6, and G-7, reinjection of treated groundwater by release into an arroyo, a dry stream bed, has been considered. The arroyo is neither used to provide drinking water nor creates a permanent aquatic habitat, but releases through the arroyo could influence other surface waters or groundwaters which do provide these beneficial uses. (RELEVANT AND APPROPRIATE)

POTENTIAL FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2

CHEMICAL-SPECIFIC ARARs
(CONTINUED)

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
IV.	Clean Air Act (CAA) (40 CFR 50-69) CFR Part 60 Standards of Performance for New Stationary Sources	National Emission Standard for Hazardous Air Pollutants (NESHAPs) are process- and industry-specific requirements. Under the Clean Air Act, EPA establishes emission standards and testing methods for specific industrial processes. Treatment systems, such as those being considered for GAFB are not covered by a specific standard; so these regulations are not applicable. Subpart K, which regulated storage vessels which have a capacity greater than 40,000 gallons that are used for petroleum liquids, is considered potentially relevant and appropriate for Alternatives F-2, G-5, G-6, and G-7 that involve one or more small tanks (e.g., 300-gallon volumes) to hold recovered floating product or as surge tanks. This regulation requires covers and a vapor recovery systems on the tanks. (RELEVANT AND APPROPRIATE)

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F
R
D

POTENTIAL FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2

LOCATION-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
I.	Endangered Species Act of 1973 (50 CFR 200, 402) Fish and Wildlife Coordination Act (33 CFR 320-330)	Requires action to avoid jeopardizing the continued existence of listed endangered or threatened species or modification of their habitat. There are no especially sensitive ecosystems or endangered species at Operable Unit No. 2. The desert tortoise, a threatened species, has been observed on and near GAFB but not at OU#2. Several other threatened or endangered species have been observed in the nearby Mojave corridor but not at OU#2. NOT AN ARAR
II.	National Historic Preservation Act [36 CFR S.106 and S.110 (f)]	CERCLA remedial actions are required to take into account the effects of remedial activities on any historical properties included on or eligible for inclusion on the National Register of Historic Places. There are no known historic places located within three miles of GAFB. NOT AN ARAR
III.	Resource Conservation and Recovery Act 40 CFR 264.18 (Location Standards for New Treatment, Storage, Disposal Facility).	New treatment, storage, and disposal facilities should not be located within 200 feet of an Holocene earthquake fault, nor within a 100-year flood plain unless it can be demonstrated that flood waters will not be contaminated. OU#2 is not within a flood plain nor is there a known fault in this area. RELEVANT AND APPROPRIATE

POTENTIAL FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2

ACTION-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
1.	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 GAFB and RCRA-regulated practices makes it reasonable to judge RCRA requirements relevant and appropriate. Part 262 - Generator Requirements: This section establishes requirements for hazardous waste labeling and marking, storage requirements for tanks and drums (e.g., double containment need in storage areas), and safety and spill-response measurements. RELEVANT AND APPROPRIATE for Alternatives F-2, G-5, G-6 and G-7 that may involve the temporary storage of recovered free product. Parts 264 and 265 - Treatment, Storage, and Disposal Facilities (TSDFs). This section established steps for achieving closure of a land-disposal facility. They also establish standards for storage in containers (Part 264, Subpart I) and tanks (Part 264, Subpart J). Relevant and Appropriate: Inadvertent releases to soil are similar to uncontrolled releases from TSDFs. Subpart X - Miscellaneous Units - This section applies to air strippers. Its substantive requirements include design, construction, operation maintenance and closure of the unit that will ensure protection of human health and the environment. These actions would include general inspections for safety and operation efficiency, testing and maintenance of the equipment (including testing of warning systems). (RELEVANT AND APPROPRIATE) Part 268 - Land-Disposal Restrictions: This section established standards for the treatment of all hazardous wastes prior to land disposal. APPLICABLE. Any alternative considered for GAFB that involved off-site disposal would need to meet LDR treatment standards. Since none of the proposed alternatives involve direct redisposal of wastes at a disposal facility, this provision is not directly involved at GAFB. However, the ultimate disposal of the compounds concentrated on GAC (in Alternative G-7) will need to be treated to comply with LDRs (e.g., incineration of residuals may be required).

POTENTIAL FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2

ACTION-SPECIFIC ARARs (CONTINUED)

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
II.	Safe Drinking Water Act (40 USC 300f et seq.) (i) Underground Injection Control Regulations (40 CFR Parts 144 through 147)	Potentially applicable for alternatives utilizing a groundwater injection option to aquifers that are or may reasonably be expected to be a source of drinking water. Wells used to inject treated contaminated groundwater into the same formation from which it is allowed under RCRA 3020(b) not withstanding the SDWA prohibition. The substantive provisions include construction and operating requirements. Alternatives G-5, G-6 and G-7 involve reinjection of treated water. (APPLICABLE)
III.	Occupational Safety and Health Act (29 CFR 1910, 1926)	OSHA requirements under 19 CFR 1910.120 are applicable to worker exposures during response actions at CERCLA sites, except in states that enforce equivalent or more stringent requirements. Section 1910.120 established training, medical surveillance, communication, and personal protective equipment standards for hazardous waste operations workers. Section 1926 establishes Safety and Health regulations for construction, including general industry provisions for first-aid and medical attention (1926.23), fire prevention (1926.24) and sanitation (1926.27). Other parts establish safety requirements for construction operations such as hand and power tool (Subpart I), welding and cutting (Subpart J), and electrical work (Subpart K). These operations and others could be part of the installation and operation of a remediation system under all of the alternatives. (APPLICABLE)

POTENTIAL FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2

ACTION-SPECIFIC ARARs (CONTINUED)

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
IV.	National Ambient Air Quality Standards	San Bernardino is a nonattainment area for ozone and particulates. Any remedial conducted at GAFB must be in compliance with emission standards for these pollutants and pollutant precursors. (RELEVANT AND APPROPRIATE)
V.	National Emission Standard for Hazardous Air Pollutants (40 CFR 61)	National Emission Standards for Hazardous Air Pollutants (NESHAPs) are process and industry specific. They must be converted from point source standards to area source standards in order to be applied at GAFB. NESHAPs are currently limited to very few chemicals.

ACTION SPECIFIC TO-BE-CONSIDERED REQUIREMENTS

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
I.	Ground Water Protection Strategy of U.S. EPA	While not potential ARARs, the groundwater classification guidelines are considered in the Baseline Risk Assessment and Feasibility Study. They are used in determining potential beneficial uses, and, consequently, potential exposure pathways.
II.	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.	1) Requires FS to evaluate the impact of VOC emissions in attainment and non-attainment areas for ozone. 2) Requires consideration in the FS of health risks from the execution of the remedy as well as from 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. (TO BE CONSIDERED)

TABLE 7-4
POTENTIAL STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2

CHEMICAL-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
I.	Safe Drinking Water Act (SDWA) Health and Safety Code, Division 7, Part 1, 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. Where state MCLs are more stringent than federal, the state limits are ARAR. (RELEVANT AND APPROPRIATE)
II.	Mulford-Carrell Air Resources Act (Health and Safety Code Sections 39000-44563) as implemented by the Air Resources Board and enforced by local Air Quality Management Districts under CCR, Title 17, Part III.	Ambient Air Quality Standards are listed under Section 70200/70200.5 of CCR Title 17 (see Table 2-3). Benzene is identified as a toxic air contaminant. However, no threshold value has been determined. (RELEVANT AND APPROPRIATE)
III.	Hazardous Waste Control Act (HWCA) (Health and Safety Code Section 25100-25395) as administered by the Department of Toxic Substances Control, under the California Code of Regulations. Title 22 Chapter 11, Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes.	HWCA is 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 CCR, Title 22, Division 4.5, Chapter 11, Section 66300 provide no RCRA type exemption for CERCLA sites. Therefore, most regulations will be directly applicable to GAFB alternatives. (APPLICABLE)
IV.	Title 23, California Code of Regulations, Division 3, Chapter 15, Article 5.	Contains monitoring requirements for waste management units and establishes water quality protection standards for corrective action. Section 2550.4 provides criteria in establishing concentration limits (cleanup levels) greater than background conditions. (APPLICABLE)

TABLE 7-4
POTENTIAL STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2
(CONTINUED)

ACTION-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
V.	Criteria for identifying Hazardous Wastes (Title 22, 66261.1 through 66261.126) Disposal of Residuals from groundwater treatment.	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 of 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. Persistent and Biocumulative Toxic Substances (Title 22, 66699) Disposal of Residuals from groundwater treatment.
	Persistent and Biocumulative Toxic Substances (Title 22, 66699) Disposal of Residuals from groundwater treatment.	Total Threshold Limit Concentrations (TTLCs) and Soluble Threshold Limit Concentrations (STLCs) have been established for selected toxics. (APPLICABLE)

TABLE 7-4
POTENTIAL STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2 (CONTINUED)

ACTION-SPECIFIC ARARs

LOCATION-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
I.	South Coast Air Quality Management District (SCAQMD), Regulation IV, Rule 429 (Start-up and shut-down exemption provisions for oxides of nitrogen) and Regulation XI, Rule 1110.2 (Emissions from gaseous and liquid fueled IC engines).	These rules establish emission limits for nitrogen oxides (NO_x), CO, and reactive organic gases from stationary internal combustion engines based on operational stage, length of operation, and burn-conditions. Alternatives G-3, G-4, and G-6, may involve an internal combustion engine for thermal treatment of VOC gases. (APPLICABLE)
II.	SCAQMD Regulation IV, Rule 463 (Storage of Organic Liquids) and Regulation IX, Rule 1149 (Storage Tank Degassing).	These rules establish storage conditions, especially related to fixed and floating covers, on tanks or other containers used to store organic liquids. These rules provide specific requirements associated with the tanks and Reid vapor pressures of organic liquids. Alternatives F-2, G-5, G-6 and G-7 may involve a tank for the storage of recovered free product. Physical dimensions of tank(s) are smaller than those identified in this rule. Further, the physical properties of the recovered product are not known, so applicability of these rules is uncertain. (RELEVANT AND APPROPRIATE)

TABLE 7-4
POTENTIAL STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2
(CONTINUED)

ACTION-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
III.	SCAQMD Regulation IX, Rule 1166 (Volatile Organic Chemical Emissions from Decontamination of Soil).	This rule limits the emissions from soil contaminated with VOCs as a result of leakage from storage or transfer facilities, from accidental spillage, or other deposition. It specifies that Best Available Control Technology (BACT) should be used during treatment of soils using an underground VOC collection and disposal system. Alternatives C-2, G-3, and G-4 involve either soil vapor extraction (SVE) or in-situ air sparging with SVE recovery. Treatment systems for recovered gases should meet BACT. (APPLICABLE)
IV.	SCAQMD, Rule IX, Rule 1176 (Sump and Waste Water Separator).	This rule limits VOCs emissions from sumps, waste water separators, drains, boxes, and sewers at industrial facilities handling petroleum liquids. It requires that the separators be in covered tanks or be provided with a fixed or floating cover. Further, testing of the control equipment is required to verify its abatement efficiency. The remediation operations at George AFB may be similar to an industrial facility and the oil-water separator used as part of Alternatives G-5, G-6, and G-7 are comparable to the pumps being regulated by this rule. (RELEVANT AND APPROPRIATE)
V.	SCAQMD, Regulation XIV, Rule 1401 (New Source Review of Carcinogenic Air Contaminants).	This rule specifies that sources of carcinogenic air contaminants can not emit a concentrations of a chemical that would cause a risk greater than 1×10^{-6} without adding best available control technology for toxics (T-BACT) or a concentration resulting in a risk greater than 1×10^{-5} if T-BACT is applied. Benzene is a listed carcinogen under this rule and may be emitted at George AFB. Alternatives C-2, G-3, G-4, G-5, G-6, and G-7 may cause benzene emissions. (APPLICABLE)

TABLE 7-4
POTENTIAL STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT NO. 2
(CONTINUED)

ACTION-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
VI.	Above Ground Petroleum Storage Act, California Health and Safety Code, Division 20, Chapter 6.67, 25270 et seq.	Regulates use and discharges from above ground petroleum tanks. Includes testing, spill prevention, and corrective action requirements. It would apply to aboveground storage tanks at George AFB greater than 600 gallons. Storage tanks in Alternatives F-2, G-5, G-6, and G-7 are likely to be 300-gallon or smaller. (RELEVANT AND APPROPRIATE)
VII.	Water Well Standards, DWR Bulletin 74-90, 74-81, Water Code 13801.	Establishes minimum statewide requirements for construction, alteration, maintenance, and abandonment of water wells, monitoring wells, and cathodic protection wells. San Bernardino County has more stringent requirements that apply to monitoring wells, extraction wells, and soil borings drilled at George AFB. (APPLICABLE)
VIII.	Hazardous Waste Control Act (HWCA) (Health and Safety Code Section 25100-25395) as administered by the Department of Toxic Substances Control under the California Code of Regulations Title 22, Chapter 30. Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes. Hazardous materials release response plans and inventory Health and Safety Code (Division 20, Chapter 6.95).	HWCA is 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 CCR, Title 22, Division 4.5, Chapter 11. Section 66300 of Chapter 30 provides no RCRA-type exemption for CERCLA sites; therefore, most regulations will be directly applicable to GAFB alternatives. Prohibits the injection of hazardous wastes into or above drinking water. Requires injection of hazardous wastes below drinking water to be permitted and monitored to prevent hazardous wastes from migrating to drinking water. (APPLICABLE)
IX.	Toxic Injection Well Control Act of 1985 (Health and Safety Code Sections 25159.10-25159.25)	Prohibits the injection of hazardous wastes into or above drinking water. Requires injection of hazardous wastes below drinking water to be permitted and monitored to prevent hazardous wastes from migrating to drinking water. (APPLICABLE)

TABLE 7-4
POTENTIAL STATE APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS
FOR OPERABLE UNIT No. 2
(CONTINUED)

ACTION-SPECIFIC ARARs

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
X	The 8 CCR Chapter 4, Subchapter 7, General Industry Safety Orders and Chapter 4, Subchapter 5 Construction Safety Orders.	Cal OSHA establsihes safety and health requirements that are very similar to the U.S. OSHA standards. These standards establish monitoring, medical surveillance, and safe work practice requirements. Because GAFB is a federal installation, the Cal OSHA standards are not applicable, but because they cover issues that are similar to those that would arise during construction and operation phases of all the alternatives they are relevant and appropriate. (RELEVANT AND APPROPRIATE)
XI.	Porter-Cologne Water Quality Act Water Code, Division 7, Section 13000 et seq., CCR Title 23, Chapter 9 and Chapter 15, 1050-2836 Water Quality and Basin Plans, South Lahontan Basin	Similar to the federal CWA, the Act and its associated regulations apply to protection of waters of the state. Permit or waste discharge requirements may be required for off-site discharges, whereas only substantive requirements for on-site discharges. Each RWQCB prepares and implements a Water Quality Control Plan for its basin. The water quality objectives are promulgated criteria setting chemical-specific concentration levels for a variety of uses for specific bodies of water. The plan is based on the beneficial uses or the specific water bodies. Federal water quality criteria are used to set these state standards. There are no known surface water bodies that are affected. (RELEVANT AND APPROPRIATE)

TABLE 7-4
POTENTIAL STATE APPLICABLE, OR RELEVANT AND APPROPRIATE REQUIREMENTS
FOR OPERABLE UNIT No. 2
(CONTINUED)

TO-BE-CONSIDERED MATERIAL

	REQUIREMENT	APPLICATION TO OPERABLE UNIT NO. 2
I.	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.
II.	Designated Level Methodology for Waste Classification and Cleanup Level Determination, Central Valley	Could be used in combination with risk assessment to determine cleanup levels and resulting remedial actions. Has not been formally adopted by the Lahontan Regional Board. Offers guidance on how to classify wastes, select an appropriate disposal method, and determine the degree to which a contaminated site should be cleaned.
III.	Leaking Underground Fuel Tank (LUFT) Field Manual	The LUFT manual is a systematic means to determine if an unauthorized release has occurred, has contaminated soil so as to pose a threat to groundwater, or has directly affected groundwater. May be used to establish soil cleanup levels for petroleum products. Does not take into account vapor phase transport.

8.0 The Selected Remedy

The selected remedy for this ROD consists of:

- Removal of the free product floating on the water table by skimming existing extraction wells and installing additional wells to increase the recovery rate to 100 gallons per day. Additionally, a mobile bailing/skimmer system will be used to remove free product from any monitoring well having recoverable free product.

- Remediation of JP-4 in the capillary fringe zone to 20 feet above the water table using soil vapor extraction and abating the soil vapor extraction system using either catalytic thermal oxidation or an internal combustion engine.

- Remediation of the groundwater hot spots using insitu-air sparging and abatement of the soil vapor (from sparging) using a soil vapor collection/extraction system equipped with a catalytic thermal oxidation system or internal combustion engine.

- Natural attenuation to degrade constituents after the free product source and capillary fringe hot spots have been mitigated. Modeling will continue to confirm natural degradation is proceeding as predicted at a reasonable rate.

Conceptual Design of the Selected Remedy

The selected remedy will consist of a selected preferred alternative to address each of the affected media; the free product zone, capillary fringe zone, and the groundwater.

The free product zone will be remediated by skimming free phase product using the four existing permanent recovery systems. Additionally four more systems will be installed and a mobile skimming unit procured to remove free product from affected monitoring wells. This action is expected to require 3 years from the approval of the ROD and completion of remedial design to complete free product removal.

The capillary fringe will be remediated by installing 153 soil vapor extraction wells, throughout the area delineated by the free product plume. The wells will be connected to a soil vapor extraction system which will be abated by a catalytic thermal oxidizer or internal combustion engine. The anticipated duration of this action is five years, and it will occur concurrently with the removal of free product.

The groundwater will be remediated by installing 25 air sparging wells within the zone delineated by the 1,000 ppb benzene plume. VOCs removed as a result of the sparging will be collected insitu by 70 soil gas extraction wells. The soil gas collection system will be abated on the surface using a catalytic thermal oxidation system or an internal combustion engine. The air sparging phase of the groundwater remediation is expected to require approximately 3 years to complete.

After sparging is completed in the groundwater and the source areas are removed, natural attenuation will be allowed to degrade the remaining constituents outside the area delineated by the 1,000 ppb plume. Modeling has indicated it will require approximately 30 years for constituents to degrade to levels below the drinking water standard. During that period, the plume will not migrate beyond the current Base boundaries and will not impact any existing domestic water sources.

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 gpm 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 remedy will be finalized during the remedial design phase.

Summary of Preliminary Cost Estimates

The selected remedy provides overall effectiveness proportionate to its costs, such that it represents a reasonable value. Final cost estimates may vary from the estimates presented due to changes that may occur as a result of 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 total estimated cost for the preferred remedy as required by CERCLA guidance is based on a +50 percent to -30 percent engineering study grade estimate. A limited amount of preliminary design was performed to refine certain costs for some alternatives to an accuracy greater than was required. However, the limits of error in estimating the majority of costs are within that required by CERCLA.

The estimated capital cost for the preferred remedy in 1992 dollars is $14.6 million. The annual operating and maintenance costs are estimated at $3.7 million for the first three years, $3.1 million for the next two years, $1.9 million for the following three years, and $87,000 per year for the duration of the project. The preferred remedy has an estimated net present worth of $30.6 million (using a seven percent discount rate).

9.0 Statutory Determinations

Under CERCLA, Federal Facilities are responsible for undertaking remedial actions. The 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 are established for the four chemicals of concern (Section 4.0) for the groundwater and any potential air emissions. Potential ARARs have been identified by the EPA; the California EPA, California Water Resources Control Board, and the local Air Resources Control Board; the San Bernardino County Health Department; or any other agency with an applicable enforceable standard.

The selected remedy has been determined to 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 remedy meets these requirements is discussed below.

The selected remedy represents the best balance of trade-offs among alternatives with respect to pertinent criteria, given the limited scope of this action.

Protection of Human Health and the Environment

The selected remedy protects human health and the environment through removal of the JP-4 free product and remediation of the hot spot source areas using skimming, soil vapor extraction, and insitu sparging. Air sparging and natural attenuation of the groundwater will eventually eliminate the threat of exposure to the contaminants from direct contact, from inhalation, and from ingestion. There are no significant short-term threats associated with the selected remedy. JP-4 free product will be removed from the groundwater surface through expanded skimming operations and disposed offsite. The JP-4 in the capillary fringe zone will removed by soil vapor extraction. Abatement of the soil vapor extraction system by catalytic thermal oxidation or an internal combustion engine will eliminate the threat of exposure to the contaminants from direct contact, from inhalation, and from ingestion. Sparging abated by soil vapor extraction, will eliminate the JP-4 in the groundwater hot spot

areas, allowing natural attenuation to complete the degradation of contaminants long before there is any impacts on any domestic water supplies.

Attainment of ARARs

The selected remedy will achieve the ARARs for this operable unit as listed in Tables 7-3 and 7-4.

Cost Effectiveness

The combination of alternatives which address each individual affected media and are developed into the selected remedy were evaluated on the basis of cost effectiveness relative to the alternatives for each specific media. The selected remedy combines those alternatives which involve treatment and were determined to be the least costly for remediating each media on a net present worth basis. Although the selected alternative for each media was the least costly, cost was not the only or primary factor considered in the evaluation. Cost was considered in the context of cost and benefit relative to the NCP nine point criteria in order to select and assemble the selected remedy.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Possible

The selected remedy is not designed to be an overall remedy for the clean up at the Base. It is designed to be an overall remedy for OU#2 which is the liquid fuels distribution system at the Base and the resulting contamination of soil and groundwater from integrity failures of that system. The selected remedy represents the best balance among the alternatives developed for each media with respect to the nine point evaluation criteria, especially considering the criteria of implementability, short-term effectiveness, and cost. The selected remedy for OU#2 will be considered as part of an overall remedy for the Base, when the Base wide feasibility study is developed and a Base wide record of decision is issued. These later documents will assure all environmental issues are addressed before final closure of the Base. Resources will be conserved to the maximum extent possible.

Preference for Treatment as a Principal Element

The requirement that treatment be a principle element of the remedy will be satisfied in the final decision document for the site. The selected remedy for OU#2 includes treatment technologies for all affected media in consideration of selecting remedies that involve treatment. This operable unit action is consistent with planned future actions, to the maximum extent possible.

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10.0 Responsiveness Summary

(To be completed following the public comment period.)

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ADMINISTRATIVE RECORD

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