FINAL RECORD OF DECISION
OPERABLE UNIT 1
SITE 18 – REGIONAL VOLATILE ORGANIC COMPOUND GROUNDWATER PLUME
OPERABLE UNIT 2A
SITE 24 – VOC SOURCE AREA
FORMER MARINE CORPS AIR STATION
EL TORO, CALIFORNIA

JUNE 2002

FINAL RECORD OF DECISION
OPERABLE UNIT 1
SITE 18 – REGIONAL VOLATILE ORGANIC COMPOUND GROUNDWATER PLUME
OPERABLE UNIT 2A
SITE 24 – VOC SOURCE AREA
FORMER MARINE CORPS AIR STATION
EL TORO, CALIFORNIA

JUNE 2002

BECHTEL NATIONAL, INC.

CLEAN II TRANSMITTAL/DELIVERABLE RECEIPT

Contract No. N-68711-92-D-4670 **Document Control No.:** CTO-0164/0296-3

File Code: 0214

TO: Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Ms. Karen Rooney, Code 02R1.KR
1220 Pacific Highway
San Diego, CA 92132-5190

DATE: July 30, 2002
CTO #: 0164
LOCATION: MCAS El Toro, CA

FROM: Jon M Gillus Hei
Thurman L. Heironimus, Project Manager

DESCRIPTION: **Errata Sheets** for Draft Final Record Of Decision For Groundwater At Sites 18 and 24 Dated July 2002

TYPE: ____ Contract Deliverable (Cost) X CTO Deliverable (Technical) ____ Other

VERSION: N/A REVISION #: 3 (Errata Sheets)

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IN REPLY REFERENCE: CTO-0164/0296-3

July 30, 2002

Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Ms. Karen Rooney, Code 02R1.KR
1220 Pacific Highway
San Diego, CA 92132-5190

Subject: Errata Sheets for Draft Final Record of Decision for Operable Unit 1 Site 18 – Regional Volatile Organic Compound Groundwater Plume – and Operable Unit 2A Site 24 – VOC Source Area – Former MCAS El Toro, CA – Dated July 2002

Dear Ms. Rooney:

It is our pleasure to submit the enclosed errata sheets (including an executed signature page), replacement spines and cover inserts to convert the Draft Final subject document to Final. U.S. EPA, DTSC, RWQCB, and the Administrative Record Coordinator have received the replacement spines and cover inserts previously and are only being sent one replacement page reflecting a minor correction made after the last transmittal.

Responses to agency comments on the Draft Final Record of Decision are being sent under separate cover.

We appreciate the opportunity to be of service to you on this project. If you have any questions or would like further information, please contact Jane Wilzbach at (619) 744-3029, or me at (619) 744-3004.

Sincerely,

Jan M Gillis for
Thurman L. Heironimus, R.G.
Project Manager

TLH/sp
Enclosure

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CLEAN II TRANSMITTAL/DELIVERABLE RECEIPT

Contract No. N-68711-92-D-4670 **Document Control No.:** CTO-0164/0296-2

File Code: 0214

TO: Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Mr. Richard Selby, Code 02R1
1220 Pacific Highway
San Diego, CA 92132-5190

DATE: June 20, 2002
CTO #: 0164
LOCATION: MCAS El Toro, CA

FROM: _____
Thurman L. Heironimus, Project Manager

DESCRIPTION: **Errata Sheets** for Draft Final Record Of Decision For Groundwater At Sites 18 and 24 Dated June 2002

TYPE: ____ Contract Deliverable (Cost) __X__ CTO Deliverable (Technical) ____ Other

VERSION: N/A REVISION #: 2 (Errata Sheets)

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Contract No. N-68711-92-D-4670 **Document Control No.:** CTO-0164/0296-1

File Code: 0214

TO: Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Mr. Richard Selby, Code 02R1
1220 Pacific Highway
San Diego, CA 92132-5190

DATE: June 17, 2002
CTO #: 0164
LOCATION: MCAS El Toro, CA

FROM: _____
Thurman L. Heironimus, Project Manager

DESCRIPTION: Attachment A – Administrative Record for Sites 18 and 24
Dated June 2002

TYPE: ____ Contract Deliverable (Cost) X CTO Deliverable (Technical) ____ Other

VERSION: Draft Final REVISION #: 1

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- R. Ress, Miramar (1C/1E)
- W. Lee, Miramar (1C/1E)
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Bechtel Job No. 22214
Contract No. N68711-92-D-4670
File Code: 0214

IN REPLY REFERENCE: CTO-0164/0296-1

June 17, 2002

Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Mr. Richard Selby, Code 02R1
1220 Pacific Highway
San Diego, CA 92132-5190

Subject: Attachment A – Administrative Record for Sites 18 and 24 – Former MCAS El Toro, CA Dated June 2002

Dear Mr. Selby:

It is our pleasure to submit this site-specific Administrative Record Index for Sites 18 and 24 – for the Former Marine Corps Air Station (MCAS) El Toro, California. This document was prepared under Contract Task Order (CTO) 0164 and Contract No. N68711-92-D-4670 and is a Federal Facility Agreement (FFA) deliverable. The index was intentionally left out of the Draft Final Record of Decision (ROD) that was transmitted to the BRAC Cleanup Team and other recipients on May 8, 2002 to allow additional documents to be added. The updated index should be added as Attachment A to the ROD.

The Navy is currently responding to comments on the draft final Record of Decision that were received from U.S. EPA, DTSC, and RWQCB. The responses to these comments, errata sheets, and new spine and cover are expected to be forwarded the week of June 17, 2002.

We appreciate the opportunity to be of service to you on this project. If you have any questions or would like further information, please contact Jane Wilzbach at (619) 744-3029, or me at (619) 744-3004.

Sincerely,

Thurman L. Heironimus, R.G.
Project Manager

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BECHTEL NATIONAL INC.

CLEAN II TRANSMITTAL/DELIVERABLE RECEIPT

Contract No. N-68711-92-D-4670 **Document Control No.:** CTO-0164/0296

File Code: 0214

TO: Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Mr. Richard Selby, Code 02R1
1220 Pacific Highway
San Diego, CA 92132-5190

DATE: May 8, 2002
CTO #: 0164
LOCATION: MCAS El Toro, CA

FROM: Thurman L. Heironimus, Project Manager

DESCRIPTION: Draft Final Record of Decision for Operable Unit 1 Site 18 – Regional Volatile Organic Compound Groundwater Plume Operable Unit 2A Site 24 – VOC Source Area Dated May 2002

TYPE: ____ Contract Deliverable (Cost) X CTO Deliverable (Technical) ____ Other

VERSION: Draft Final REVISION #: 0

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Bechtel Job No. 22214
Contract No. N68711-92-D-4670
File Code: 0214

IN REPLY REFERENCE: CTO-0164/0296

May 8, 2002

Contracting Officer
Naval Facilities Engineering Command
Southwest Division
Mr. Richard Selby, Code 02R1
1220 Pacific Highway
San Diego, CA 92132-5190

Subject: Draft Final Record of Decision for Operable Unit 1 Site 18 – Regional Volatile Organic Compound Groundwater Plume Operable Unit 2A Site 24 – VOC Source Area Former MCAS El Toro, CA - Dated May 2002

Dear Mr. Selby:

It is our pleasure to submit the Draft Final Record of Decision (ROD) for Operable Unit (OU) 1 Site 18 and OU-2A Site 24 – for the Former Marine Corps Air Station (MCAS) El Toro, California. This document was prepared under Contract Task Order (CTO) 0164 and Contract No. N68711-92-D-4670 and is a Federal Facility Agreement (FFA) deliverable. The draft final ROD addresses all comments received during the 60-day comment period for the draft ROD and includes revised institutional controls language submitted to and reviewed by the BCT during the comment incorporation period. Preliminary responses to comments on the draft ROD were provided to the BCT in April 2002. Final responses are included in this mailing.

In accordance with the terms of the FFA, unless additional comments are received within 30 days, this document will be considered final. Therefore, should you have any additional comments on this document, please submit them no later than 8 June 2002 to Mr. Dean Gould, BRAC Environmental Coordinator, gouldda@efdsw.navfac.navy.mil.

We appreciate the opportunity to be of service to you on this project. If you have any questions or would like further information, please contact Jane Wilzbach at (619) 744-3029, or me at (619) 744-3004.

Sincerely,

Thurman L. Heironimus, R.G.
Project Manager

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DECLARATION

DECLARATION

SITE NAME AND LOCATION

Site 18, Regional Volatile Organic Compound (VOC) Groundwater Plume – Operable Unit 1 (OU-1)

Site 24, VOC Source Area – Operable Unit 2A (OU-2A)

Former Marine Corps Air Station (MCAS) El Toro
Santa Ana, California 92709

National Superfund Database Identification Number: CA6170023208

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected remedial action for groundwater at Sites 18 and 24 at Former MCAS El Toro, located in Orange County, California.

This document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 *United States Code* Section 9602 et seq., and in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 *Code of Federal Regulations* Part 300, et seq. This decision is based on the administrative record files for these sites. A site-specific administrative record index is included as Attachment A.

The state of California (through the California Environmental Protection Agency [Cal/EPA] Department of Toxic Substances Control [DTSC] and the Regional Water Quality Control Board Santa Ana Region [RWQCB]) and the United States Environmental Protection Agency (U.S. EPA) concur on the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from groundwater at Sites 18 and 24, if not addressed by implementing the remedial action selected in this ROD, may present a current or potential threat to public health and welfare or to the environment.

DESCRIPTION OF THE REMEDY

Site 24, VOC Source Area, comprises two media: soil and groundwater. In the past, VOC contamination migrated from the soil at Site 24 to the shallow groundwater unit and from the shallow groundwater unit to the principal aquifer at Site 18. This ROD presents the final remedy for groundwater at Sites 18 and 24. Contaminated soil at Site 24 was addressed previously in an interim ROD that documented selection of soil vapor extraction as the remedy for removal of the VOC contamination. The Site 24 ROD was considered interim because it addressed soil but did not address contaminated groundwater at Site 24. The remedy for soil has been implemented, and a closure report has been submitted to the Base Realignment and Closure (BRAC) Cleanup Team (BCT). A separate ROD or ROD amendment addressing soil at Site 24 will be issued at a later date.

Site 18, Regional VOC Groundwater Plume, comprises only groundwater. The selected remedy for groundwater at Sites 18 and 24 is extraction and treatment and institutional controls. Groundwater will be extracted from wells installed in the areas of highest reported trichloroethene (TCE) concentrations at Site 24. At Site 18, groundwater will be extracted from areas of the groundwater plume where TCE concentrations are equal to or greater than 5 micrograms per liter. This extraction procedure will help prevent migration of VOCs from Site 24 to Site 18, contain VOC migration at Site 18, and reduce concentrations of VOCs in groundwater at both sites to federal or state drinking water standards.

Groundwater extracted at both sites will be treated at the Irvine Desalter Project (IDP) facility to remove VOCs using air stripping. VOC vapors will be treated with activated carbon filters before the air is discharged to the atmosphere. When the activated carbon filters become saturated with VOCs, the filters will be returned to the manufacturer where they will be regenerated and the VOCs destroyed.

The IDP is a proposed water supply development project initiated by the Orange County Water District and the Irvine Ranch Water District (OCWD/IRWD). The goal of this project is to develop a local water supply, drawing from the principal aquifer, by 1) intercepting, containing, and treating groundwater with high concentrations of total dissolved solids (TDS) and nitrates; and 2) accepting and treating for VOC removal the groundwater that the Marine Corps must remediate. The IDP as developed by OCWD/IRWD is composed of two separate components—a nonpotable system and a potable system—designed to treat groundwater from two areas in the principal aquifer and from the shallow groundwater unit at Site 24.

- Nonpotable System – groundwater from Site 24 and areas inside the principal aquifer VOC plume (which is contaminated above drinking water standards) would be extracted, treated, and conveyed for use as recycled water. Only the VOC-related portion of the IDP that treats water from Site 24 and other areas within the principal aquifer VOC plume would be considered part of the Department of the Navy's (DON's) CERCLA remedy.
- Potable System – VOCs have not been reported in the potable well locations. Groundwater from areas outside the principal aquifer VOC plume would be extracted and treated to remove TDS and nitrates. Treated water would then be supplied for domestic purposes. This is not part of the DON's CERCLA remedy.

The selected remedy for groundwater includes:

- construction, operation, and maintenance of a groundwater extraction system to remove VOCs from groundwater;
- performance monitoring throughout the remedial action;
- treatment of VOC-contaminated groundwater using air stripping and treatment of VOC vapors with activated carbon filters to meet air quality standards before discharge to the atmosphere;

- confirmatory groundwater sampling at the end of the remediation to confirm that VOC concentrations meet federal and state cleanup levels; and
- institutional controls to prevent use of contaminated groundwater, protect equipment, and allow access to the DON, OCWD/IRWD, and regulatory personnel.

Groundwater extraction addresses the risk posed by VOC contamination (which can be characterized as the primary threat at these sites) by removing and permanently destroying the contaminants, thereby significantly reducing the toxicity, mobility, and volume of hazardous substances in groundwater.

Institutional controls for the on-Station portion of the groundwater plume are necessary to protect the integrity of the groundwater extraction, injection, and monitoring wells and associated piping and equipment. Institutional controls are also necessary to prevent use of contaminated groundwater and to allow the DON, OCWD/IRWD, and regulatory personnel access to install, operate, and maintain equipment and to monitor the remedial action. For land containing the on-Station portion of the groundwater plume, institutional controls would be implemented through two separate legal instruments: 1) one or more Environmental Restriction Covenant and Agreements with DTSC addressing on-Station real property containing the Site 24 Shallow Groundwater Plume and associated buffer zone and 2) one or more quitclaim deeds/leases between transferee(s)/lessee(s) and the DON conveying/leasing on-Station real property containing the Site 24 Shallow Groundwater Plume and associated buffer zone. The Environmental Restriction Covenant and Agreement(s) will incorporate the land-use restrictions into restrictive covenants that run with the land and that are enforceable by DTSC against future transferees. The quitclaim deed(s) will include the identical land-use restrictions in environmental restrictive covenants that run with the land and that will be enforceable by the DON against future transferees. In essence, the DON and DTSC will each have the legal authority to enforce the land-use restrictions and will share responsibility for their enforcement.

Institutional controls for the off-Station portion of the groundwater plume are necessary to protect residents from using contaminated groundwater in the principal aquifer and shallow groundwater unit for domestic purposes until cleanup goals are reached. Off-Station institutional controls are administered by Orange County Health Care Agency (OCHCA) and IRWD through the well permitting process. The DON is continuing to work with OCHCA and IRWD to assure that any conditions that are necessary to assure adequate protection of public health (e.g., treatment to comply with federal and state drinking water standards) shall be included in any permits that they issue for construction of wells intended to be used for domestic drinking water supply. The DON will also assist OCHCA and IRWD in this process by providing them annually with updated copies of figures delineating the off-Station groundwater plume.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy uses permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfies the statutory preference for remedies employing treatment that reduces toxicity, mobility, or volume as a principal element.

The effectiveness of the remedial action selected in this ROD will be reviewed at a minimum at 5-year intervals to assure that the remedy continues to adequately protect human health and the environment and is achieving cleanup goals. Once cleanup goals have been achieved, the 5-year review will no longer apply to this action because hazardous substances will not remain above health-based levels.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary:

- chemicals of concern and their respective concentrations (Section 5)
- baseline risk represented by the chemicals of concern (Section 7)
- cleanup levels established for chemicals of concern and the basis for these levels (Section 8)
- how source materials constituting principal threats are addressed (Section 8)
- current and reasonably anticipated future land-use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Sections 6 and 7)
- potential land and groundwater use that will be available at the sites as a result of the selected remedy (Section 10)
- estimated capital, annual operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (Section 10)
- key factors that led to selecting the remedy (Sections 8, 9, and 10)

Additional information can be found in the administrative record file for these sites.

Date: 06/18/02

Declaration

Signature: _____ Date: 06/18/02

Mr. Dean Gould
Base Realignment and Closure Environmental Coordinator
Former Marine Corps Air Station El Toro

Signature: _____ Date: 6/20/02

Mr. John E. Scandura, Chief
Southern California Operations
Office of Military Facilities
Department of Toxic Substances Control

Signature: _____ FOR D. ARDAN Date: 6/25/02

Ms. Deborah Jordan, Chief
Federal Facilities Cleanup Branch
United States Environmental Protection Agency, Region 9

Signature: _____ Date: 6/24/02

for Mr. Gerard J. Thibeault
Executive Officer
Regional Water Quality Control Board Santa Ana Region

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Section

Page

ATTACHMENTS

Attachment

FIGURES

TABLES

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ACRONYMS/ABBREVIATIONS

AFB	Air Force Base
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
BACT	best available control technology
BCT	BRAC Cleanup Team
bgs	below ground surface
BHC	benzene hexachloride
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
Cal. Civ. Code	*California Civil Code*
Cal. Code Regs.	*California Code of Regulations*
Cal/EPA	California Environmental Protection Agency
Cal. Health & Safety Code	*California Health and Safety Code*
Cal. Water Code	*California Water Code*
CAO	Cleanup and Abatement Order
CDM	CDM Federal Programs Corporation
CDMG	California Division of Mines and Geology
CDWR	California Department of Water Resources
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
C.F.R.	*Code of Federal Regulations*
COC	chemical of concern
COPC	chemical of potential concern
DCA	dichloroethane
DCE	dichloroethene
DDT	dichlorodiphenyltrichloroethane
DHS	Department of Health Services
DNAPL	dense nonaqueous-phase liquid
DoD	Department of Defense
DOJ	Department of Justice
DON	Department of the Navy
DOT	Department of Transportation
DQO	data quality objective
DTSC	(Cal/EPA) Department of Toxic Substances Control
Exec. Order No.	Executive Order Number
Fed. Reg.	Federal Regulation
FFA	Federal Facilities Agreement
FOSET	finding of suitability for early transfer
FOST	finding of suitability to transfer

Freon 12	dichlorodifluoromethane
Freon 113	1,1,2-trichloro-1,2,2-trifluoroethane
FS	feasibility study
GAC	granular activated carbon
gpd	gallons per day
gpm	gallons per minute
HHRA	human-health risk assessment
HI	hazard index
HQ	hazard quotient
IAFS	interim-action feasibility study
IAS	initial assessment study
IDP	Irvine Desalter Project
IRP	Installation Restoration Program
IRWD	Irvine Ranch Water District
JEG	Jacobs Engineering Group Inc.
JMM	James M. Montgomery Engineers, Inc.
lb	pound
LLNL	Lawrence Livermore National Laboratory
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
mg/L	milligrams per liter
MICR	maximum individual cancer risk
MPE	multiphase extraction
MSL	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OCHCA	Orange County Health Care Agency
OCWD	Orange County Water District
OHM	OHM Remediation Services Corp.
O&M	operation and maintenance
OU	operable unit

PAL	(California) provisional action level
PCA	tetrachloroethane
PCB	polychlorinated biphenyl
PCE	tetrachloroethene (perchloroethene)
ppm	parts per million
PRG	preliminary remediation goal
PSI	perimeter study investigation
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RFA	RCRA facility assessment
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
RWQCB	(California) Regional Water Quality Control Board
§	section
SARA	Superfund Amendments and Reauthorization Act of 1986
SCAQMD	South Coast Air Quality Management District
SDWA	Safe Drinking Water Act
SGU	shallow groundwater unit
SIP	site inspection plan
SIPOA	site inspection plan of action
STLC	soluble threshold limit concentration
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWDIV	Southwest Division Naval Facilities Engineering Command
SWMU	solid waste management unit
SWRCB	(California) State Water Resources Control Board
T-BACT	best available control technology for toxics
TCA	trichloroethane
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
tit.	title
TPH	total petroleum hydrocarbons
TSD	treatment, storage, and disposal
TTLC	total threshold limit concentration
UCL	upper confidence limit
U.S.C.	*United States Code*
U.S. EPA	United States Environmental Protection Agency

VGAC	vapor-phase granular activated carbon
VOA	volatile organic analysis
VOC	volatile organic compound
WQCP	water quality control plan
WQO	water quality objective

DECISION SUMMARY

Section 1

SITE NAME, LOCATION, AND DESCRIPTION

This Record of Decision (ROD) presents the selected remedial action for groundwater at Installation Restoration Program (IRP) Sites 18 and 24 at Former Marine Corps Air Station (MCAS) El Toro in Orange County, California. The National Superfund Database Identification Number for this facility is CA6170023208.

The document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision for these sites is based on information contained in the administrative record. The site-specific administrative record index for Sites 18 and 24 is found in Attachment A.

1.1 SITE NAME

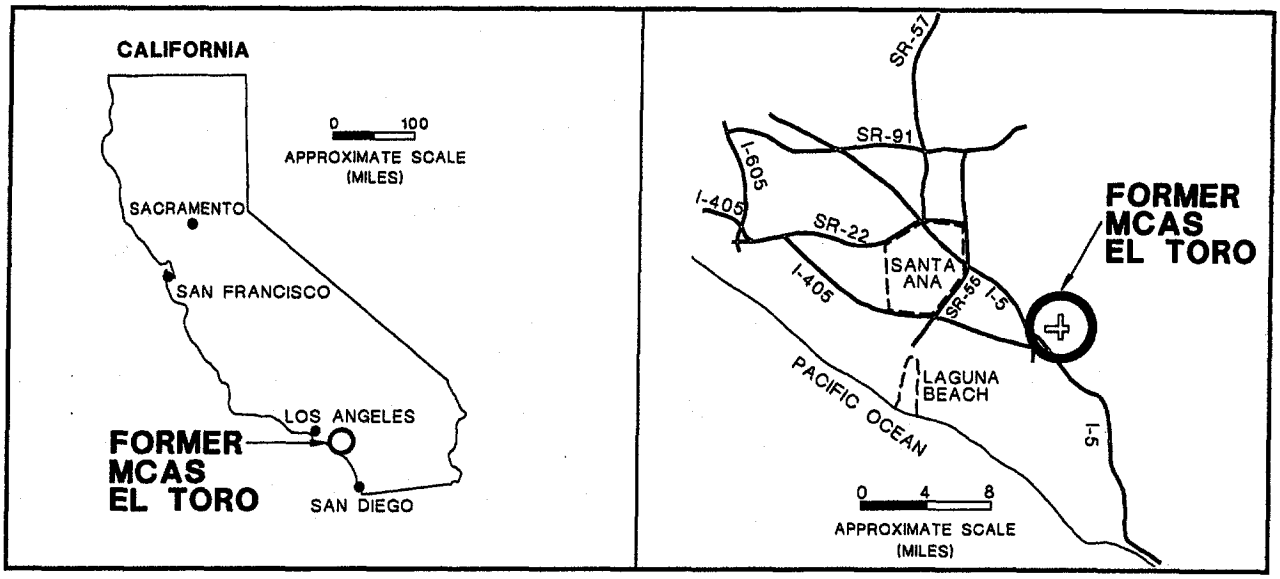
This decision document addresses groundwater at two related sites at Former MCAS El Toro: Operable Unit (OU)-1, IRP Site 18, Regional Volatile Organic Compound (VOC) Groundwater Plume; and OU-2A, IRP Site 24, VOC Source Area. Groundwater is the only medium affected at Site 18. Contaminated soil at Site 24 was addressed previously in an interim ROD (SWDIV 1997a). The final remedy for soil at Site 24 will be addressed in a separate ROD or ROD amendment.

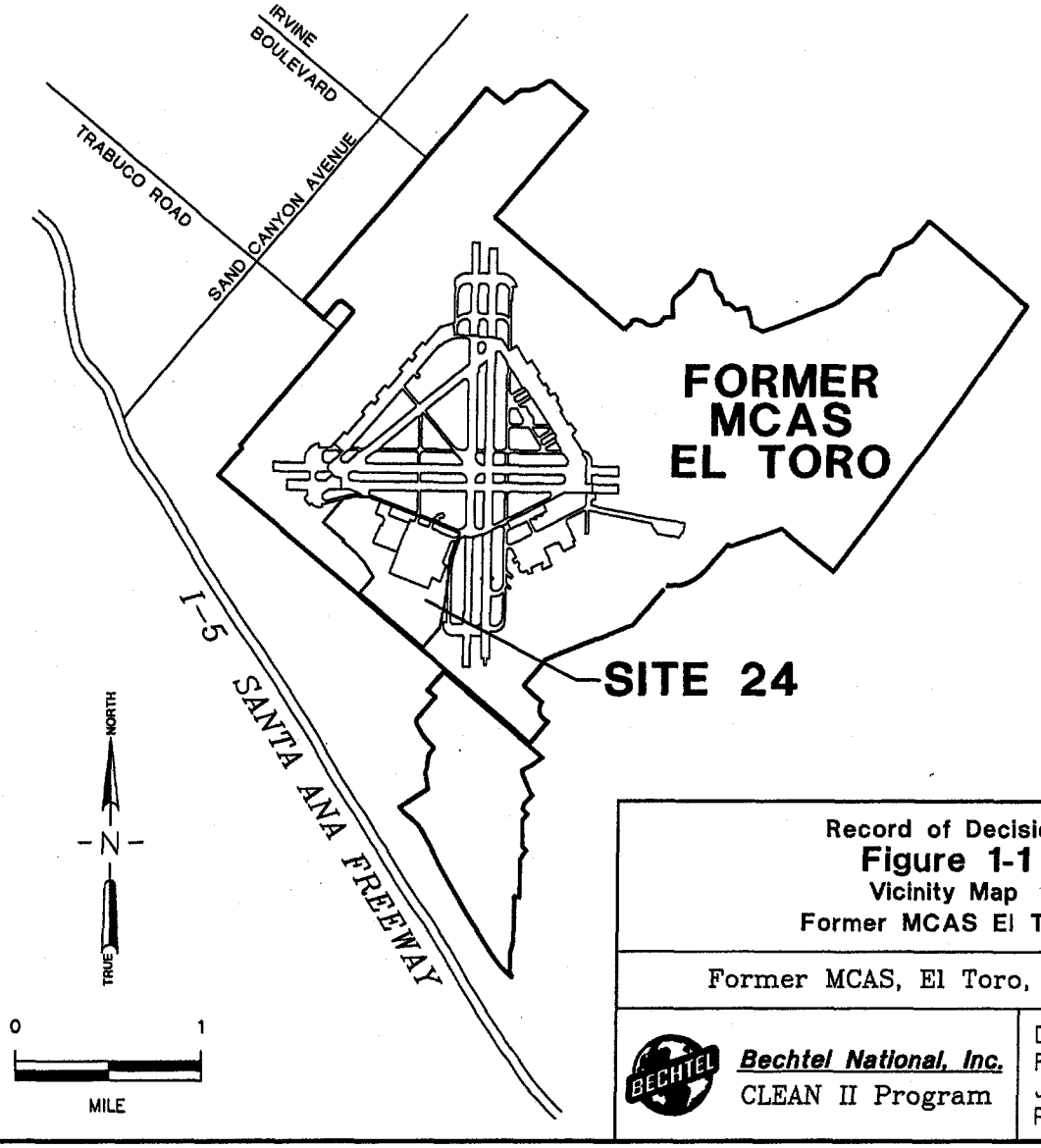
This ROD addresses groundwater at Sites 18 and 24 together because VOCs in the principal aquifer at Site 18 and in the shallow groundwater unit at Site 24 originated in the vadose zone at Site 24. Investigation results demonstrate that VOCs have migrated from their source at the Site 24 surface or subsurface to the shallow groundwater unit below. Downgradient of Site 24, the VOCs have migrated into the principal aquifer to form the regional groundwater plume of Site 18.

1.2 SITE LOCATION

Former MCAS El Toro lies in a semiurban agricultural area of southern California, approximately 8 miles southeast of Santa Ana and 12 miles northeast of the city of Laguna Beach (Figure 1-1). Land northwest of the Station is used for agriculture, whereas the land to the south and northeast is used mainly for commercial, light industrial, and residential purposes. Residential areas in the vicinity of Former MCAS El Toro include the cities of Lake Forest, Irvine, and Laguna Hills.

Site 24 is in the southwest quadrant of the Station (Figure 1-2). The shallow groundwater plume associated with Site 24 originates at this site and extends off-Station approximately to Sand Canyon Avenue (Figure 1-2). Site 18, the regional VOC groundwater plume in the principal aquifer, is located off-Station and extends off-Station from the westernmost boundary of Former MCAS El Toro approximately 3 miles to the west beneath the city of Irvine (Figure 1-2).





Record of Decision

Figure 1-1

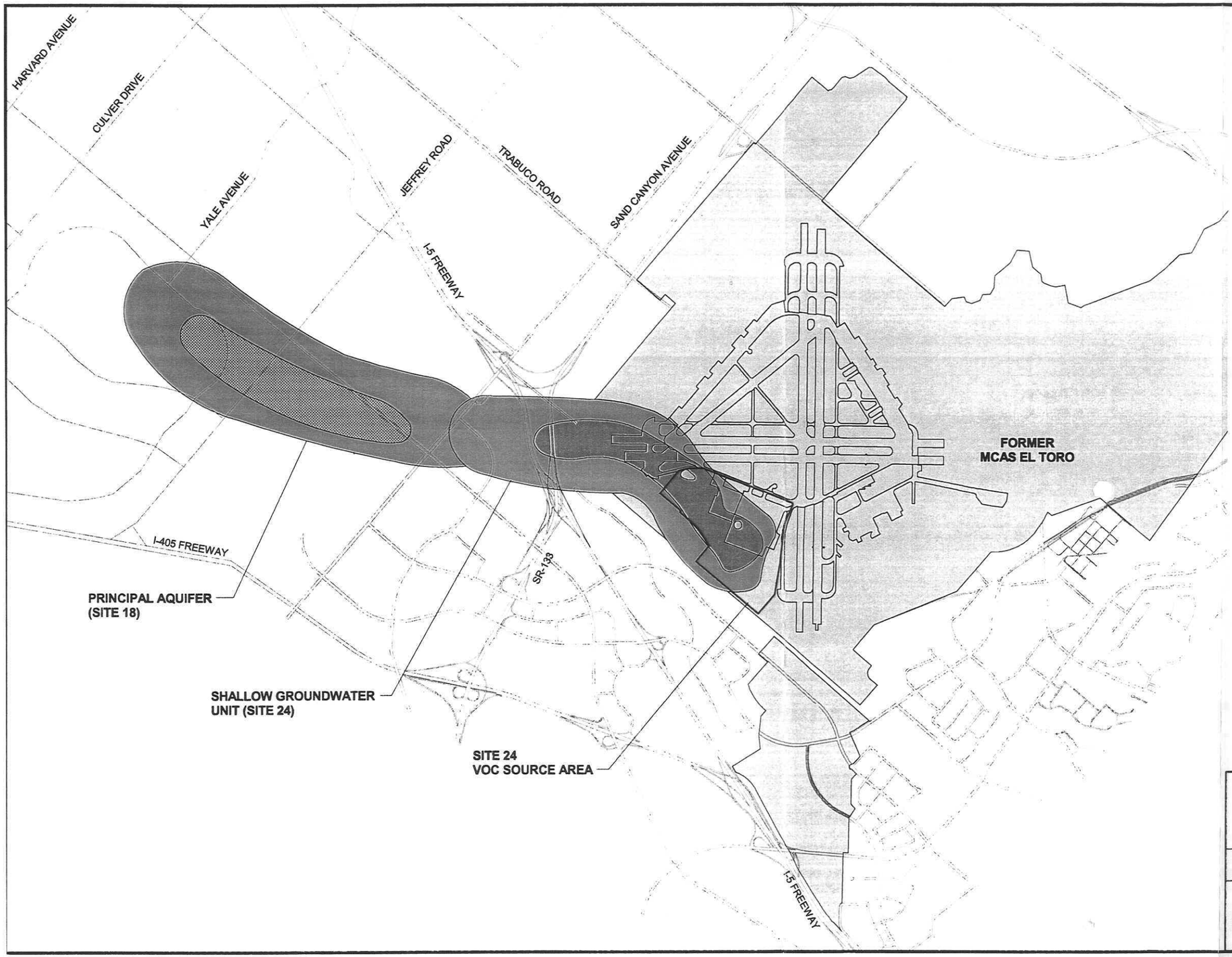
Vicinity Map

Former MCAS El Toro

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 4/17/02
File No: 164R7923
Job No: 22214-164
Rev No: B



LEGEND

- AIRFIELD
- ROADS
- SITE 24 BOUNDARY
- FORMER MCAS EL TORO BOUNDARY

TCE CONCENTRATIONS IN REGIONAL GROUNDWATER:

- 5 TO 50 MICROGRAMS PER LITER (ug/L) (SHALLOW GROUNDWATER UNIT) 5 TO 10 ug/L TCE (PRINCIPAL AQUIFER)
- GREATER THAN 10 ug/L TCE
- 50 TO 500 ug/L TCE
- GREATER THAN 500 ug/L

NOTE:

TRICHLOROETHENE CONCENTRATIONS ABOVE 5 ug/L EXCEED THE STATE AND FEDERAL WATER QUALITY STANDARD

REGIONAL GROUNDWATER INVESTIGATION AREAS INCLUDE ON-STATION PROPERTY AND OFF-STATION AREAS BOUND BY INTERSTATE 405, HARVARD AVENUE AND TRABUCO ROAD

SOURCE: PLUME DATA FROM "FINAL GROUNDWATER MONITORING REPORT SEPTEMBER 2001MONITORING ROUND 14" MARINE CORPS AIR STATION EL TORO, CALIFORNIA (CDM 2002)

N

3000 0 3000 Feet

Record of Decision

Figure 1-2

IRP Sites 18 and 24

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 5/1/02
File No.: 164R8707
Job No.: 22214-164
Rev No.: B

PAGE NO. 1-4

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1.3 LEAD AND SUPPORT AGENCIES

Former MCAS El Toro is a federal facility and is on the National Priorities List (NPL) of the Superfund Program. The lead agency for remedial investigation and remedial action at this facility is the Department of the Navy (DON). Regulatory agencies providing support and oversight include the United States Environmental Protection Agency (U.S. EPA), the California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC), and the Santa Ana Regional Water Quality Control Board (RWQCB). The DON, U.S. EPA, DTSC, and RWQCB entered into a federal facilities agreement (FFA) for Former MCAS El Toro in 1990.

1.4 SITE DESCRIPTION

Former MCAS El Toro was commissioned in 1943 as a Marine Corps pilot fleet operation training facility. In 1950, the Station was selected for development as a master jet station and permanent center for Marine Corps aviation on the west coast. The Station mission has involved the operation and maintenance of military aircraft and ground-support equipment. Historical activities on the Station included aircraft maintenance and repair. Much of the industrial activity supporting this mission took place in the southwest quadrant of the Station, where Site 24 is located.

To support the Station's mission, facility operations were expanded over the years to include runways, aircraft maintenance and training facilities, housing, shopping facilities, and other support facilities. Former MCAS El Toro occupies 4,738 acres of land, including 580 acres that are leased for commercial farming (DON 1999). The adjacent/surrounding land uses around Former MCAS El Toro include residential, commercial, industrial, and recreational.

Former MCAS El Toro ceased operations on 02 July 1999. The Marine Corps' mission at the Station was incorporated primarily into MCAS Miramar operations in San Diego, California.

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Section 2
SITE HISTORY AND ENFORCEMENT ACTIVITIES

Past operations and practices at Former MCAS El Toro have contributed to soil and groundwater VOC contamination. Industrial activities at Site 24, such as dust suppression with waste liquids, paint stripping, degreasing, vehicle and aircraft washing, and waste disposal practices, involved the use of solvents containing VOCs such as trichloroethene (TCE) and tetrachloroethene (PCE). Waste solvents may have reached the surface or subsurface through leakage, runoff, storm drains, or direct application to the soil and are believed to be the source of VOCs in the regional groundwater. The precise origin, nature, and use of TCE released at the site and the circumstances and quantities of individual releases are not documented. TCE usage at Former MCAS El Toro is believed to have been discontinued in the mid-1970s.

Environmental remediation activities at Former MCAS El Toro are performed under the IRP. The IRP was developed in 1980 by the Department of Defense (DoD) to comply with federal guidelines to manage and control contamination from past hazardous waste disposal actions (DON 1997).

2.1 INITIAL INVESTIGATIONS

The first indication of contamination at the Station occurred during routine water quality monitoring in 1985, when the Orange County Water District (OCWD) discovered TCE in groundwater at an irrigation well approximately 3,000 feet downgradient of Former MCAS El Toro. In 1985, the DON began to work on an initial assessment study (IAS) to locate potentially contaminated sites on the Station. This work was conducted for the Naval Facilities Engineering Command under the Navy Assessment and Control of Installation Pollutants Program, which was the DON version of the DoD IRP at that time. The IAS report identified 17 sites as potential sources of contamination (Brown and Caldwell 1986). The report also identified potentially contaminated sites based on the results of record searches and employee interviews and recommended sampling locations and analytical parameters to assess the suspected contamination.

In 1987, the Marine Corps contracted for a review of the IAS to produce a site inspection plan of action (SIPOA) (JMM 1988). The SIPOA, released in August 1988, recommended 19 sites for study and amended the site sampling plans proposed in the IAS report. This SIPOA report was the basis for a sampling and analysis plan for the remedial investigation (RI)/feasibility study (FS) sites.

In July 1987, while the SIPOA study was under way, RWQCB Santa Ana Region issued a Cleanup and Abatement Order (CAO) to the Marine Corps requiring the Station to initiate a perimeter groundwater VOC investigation and submit a draft report. Because the investigation revealed VOCs in the shallow groundwater unit near the Station boundary, an interim groundwater pump and treatment system was installed at this boundary. Between June 1989 and September 1993, the system pumped and treated groundwater from three extraction wells at approximately 30 gallons per minute (gpm). Over the life of the system, reported concentrations of TCE in the influent were about 10 to

160 micrograms per liter (µg/L) and reported concentrations of PCE were 25 to 100 µg/L. The extracted groundwater was treated with a granular activated carbon (GAC) treatment system and used to irrigate the Station golf course. On 13 April 1993, RWQCB rescinded the CAO, because the required actions were complete and because the DON had entered into an FFA to investigate and remediate environmental impacts associated with past and present activities at Former MCAS El Toro. In September 1993, the pump and treatment system was shut down (JEG 1996a).

2.2 PHASE I AND II REMEDIAL INVESTIGATIONS

In June 1988, U.S. EPA recommended adding Former MCAS El Toro to the NPL of the Superfund Program because of VOC contamination at the Station boundary and in the agricultural wells west of the Station. Former MCAS El Toro was added to the NPL on 15 February 1990. In October 1990, the Marine Corps/DON signed an FFA with U.S. EPA Region 9, California Department of Health Services (now referred to as the DTSC), and RWQCB Santa Ana Region (FFA 1990). The FFA is a cooperative agreement that:

- assures that environmental impacts are investigated and appropriate response actions are taken to protect human health and the environment;
- establishes a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions;
- facilitates cooperation, exchange of information, and participation of the parties; and
- assures adequate assessment, prompt notification, and coordination between federal and state agencies.

The Base Realignment and Closure (BRAC) Cleanup Team (BCT) is responsible for implementing the FFA. The BCT consists of representatives from the DON Southwest Division Naval Facilities Engineering Command (SWDIV), U.S. EPA, DTSC, and RWQCB Santa Ana Region. The team was established to manage and coordinate environmental restoration and compliance programs related to the closure and disposal of Former MCAS El Toro by July 1999.

The vision of the BCT is "to expedite restoration and reuse of Former MCAS El Toro." The BCT's mission is "fast-track remediation of Former MCAS El Toro, to promote reuse and protect human health and the environment, by working cooperatively with the BCT, the community, and the stakeholders."

In December 1989, the DON began preparing a Phase I RI work plan and associated documents for Former MCAS El Toro. The DON reviewed the available reports and other documents pertinent to past disposal practices and concluded that 22 sites would be investigated (JEG 1993a). These sites were grouped into three OUs. OU-1 consisted of the regional VOC groundwater plume investigation and included groundwater at Site 18 and throughout MCAS El Toro, including the area later defined as Site 24. OU-2

originally included four landfill sites (Sites 2, 3, 5, and 17) (OU-2A Site 24 was added later) and Site 10, the petroleum disposal area (this site was later moved to OU-3). The remaining 16 sites, grouped together as OU-3, were potential sources for a variety of contaminants. The principal objectives of the Phase I RI were to evaluate the source(s) of contamination in regional groundwater west of the Station and to determine whether contamination existed and, if so, whether contamination was affecting the environment at sites in OU-2 and OU-3.

The results of the Phase I RI were documented in a draft Technical Memorandum issued in 1993 (JEG 1993a), a draft RI report for OU-1 issued in July 1994 (JEG 1994a), a final technical memorandum on soil gas issued in October 1994 (JEG 1994b), and a draft final RI/FS report for OU-1 issued in August 1996 (JEG 1996a–h). A variety of contaminants in the groundwater, soil, surface water, and sediment at Former MCAS El Toro were identified during the Phase I RI. Contaminants in the soil and sediment consisted primarily of low concentrations of semivolatile organic compounds (SVOCs), petroleum hydrocarbons, pesticides, herbicides, and polychlorinated biphenyls (PCBs) (JEG 1993a). During the Phase I RI, the source of contamination for regional groundwater was found to be in the southwest quadrant of the Station, but no specific source was identified. (It was later determined during the Phase II RI that Site 24 is the source of the regional groundwater contamination.) The sampling events yielded sufficient information to warrant a preliminary risk assessment of both groundwater and soil contamination. The OU-1 risk assessment showed that the risk drivers in groundwater at OU-1 were VOCs and metals. However, further evaluation showed that metals concentrations were consistent with background. The results of the Phase I RI provided the primary data for the Phase II RI/FS and allowed further investigations of the VOC plume and source area to focus on VOCs, which were demonstrated to be the chemicals of concern at these areas.

In March 1993, Former MCAS El Toro was placed on the BRAC III list of military facilities considered for closure. Under the terms of the FFA, Station closure would not affect the DON's obligation to conduct the RI/FS and comply with other FFA requirements (FFA 1990, Section 37, Base Closure).

Concurrently with the Phase I RI, the DON conducted a Resource Conservation and Recovery Act (RCRA) facilities assessment (RFA) at Former MCAS El Toro to evaluate whether an additional 140 sites at the Station required further investigation under the Phase II RI/FS. The final RFA report was submitted in July 1993 (JEG 1993b). Based on analytical results, 25 solid waste management units/areas of concern (AOCs) were recommended for further action. Site 23 (Wastewater Treatment Plant Sewer Lines) was evaluated in the RFA and recommended for no further action.

Interviews with active and retired personnel from the Fuel Operations Division and Facility Management Department (later known as the Installations Department) were held in July 1994 at Former MCAS El Toro (JEG 1994c). The meeting was conducted to confirm and supplement information from past interviews and field investigations (to obtain a better understanding of current and historical operations at Former MCAS

El Toro) and to identify additional areas of potential environmental concern. Those interviewed had knowledge of operations and procedures for storage and disposal of hazardous materials and waste. The interview panel consisted of regulatory agency personnel, DON and Former MCAS El Toro personnel, and contractor personnel.

Issued in July 1995, the final Work Plan for the Phase II RI/FS presented an approach to conduct the Phase II RI at 24 sites, including the newly identified Site 24 (VOC Source Area) and Site 25 (Major Drainages) (BNI 1995). For Site 24, the Phase II Work Plan objectives were to determine whether VOC-contaminated soil at Site 24 was an active source of the regional VOC groundwater plume, assess potential risks to human health and the environment, and characterize the site to evaluate response actions. The Phase II RI, conducted in 1995 and 1996, demonstrated that soil at Site 24 was the source of the regional VOC contamination and that human-health risk from exposure to the groundwater exceeded U.S. EPA guidelines (BNI 1997a).

During this period, the DON evaluated background concentrations of metals in soils and reference levels for pesticides and herbicides in soils (BNI 1996a). This enabled site-specific analytical results of soil sampling to be compared with background and reference levels during the RI to identify potential releases.

2.3 FEASIBILITY STUDIES

Remedial action objectives for Sites 18 and 24 were developed during the RI. The FS for Site 18 (JEG 1996b) and FSs for soil and groundwater at Site 24 (BNI 1997b,c) identified and screened numerous technologies to develop remedial alternatives capable of achieving the remedial action objectives. Groundwater extraction and treatment was the technology selected for both sites to permanently remove VOCs from the aquifer. The groundwater alternatives differed in the well locations based on the treatment and discharge options. The Site 24 FS for soil presented soil vapor extraction (SVE) as an effective technology to remove VOCs from the soil, thus minimizing further groundwater contamination.

2.4 PILOT TESTING

Pilot-test data from small-scale groundwater extraction (BNI 1997b) and SVE tests (BNI 1997d) were used to support the FS evaluations. The pilot tests collected site-specific information to assess the effectiveness of the most promising remediation technologies. Data from the SVE pilot testing were subsequently used to support the SVE engineering design (BNI 1998a). Investigations performed during groundwater pilot testing helped demonstrate the migration pathway of VOCs from the shallow groundwater unit to the principal aquifer. The pilot-test data will also help support remedial design activities.

2.5 RECENT EVALUATIONS AND ASSESSMENTS

Subsequent to the Phase II RI, three groundwater evaluations were performed: an evaluation of metals (BNI 1999a), an evaluation of perchlorate (BNI 1999b,

Earth Tech 2001a), and an evaluation of radionuclides (Earth Tech 2000b). The purpose of these evaluations was to determine whether the reported concentrations of metals, perchlorate, and radionuclides in groundwater at Former MCAS El Toro reflect ambient conditions or are the result of historical Station activities.

The evaluation of metals showed that, even though the reported concentrations of some metals at various sites at Former MCAS El Toro exceed maximum contaminant levels (MCLs), such conditions reflect ambient basewide groundwater quality conditions and are not the result of site-related contamination (BNI 1999b). The evaluation of perchlorate showed that the reported concentrations of perchlorate exceeded the California provisional action level (PAL) of 18 µg/L at Sites 1, 18, and 19 and the federal PAL of 32 µg/L at Site 1. (The California PAL of 18 µg/L was established in 1997. As of January 2002, the California PAL for perchlorate is 4 µg/L.) Site 1 is a former explosive ordnance disposal range. A site-specific perchlorate investigation at this site showed that perchlorate was present above state and federal PALs at only one well, located in approximately the center of the site. Perchlorate was also present in 4 of 42 soil samples. However, none of the reported concentrations exceeded residential or industrial preliminary remediation goals (Earth Tech 2001a). The evaluation of radionuclides confirmed that the radionuclides in groundwater at Former MCAS El Toro are naturally occurring and are not due to historical activities conducted at the Station (Earth Tech 2001b).

From 1998 through 1999, the DON conducted a historical radiological assessment of Former MCAS El Toro as part of the base closure process (Roy F. Weston 2000). A historical radiological assessment report summarizing the results of the assessment was issued in May 2000. The report recommended that a radiological survey be conducted at selected sites and buildings at Former MCAS El Toro. The survey was completed in November 2001. Results were summarized in a draft Radiological Release Report (Roy F. Weston 2002) that is expected to be released in spring 2002 and finalized in fall 2002.

In September 2001, the DON conducted additional sampling for VOCs at Building 307, a former dry cleaning facility in the southwest portion of Site 24. Results of the sampling did not identify a significant release at this location (Earth Tech 2001c).

Table 2-1 summarizes the enforcement activities and environmental investigations at Former MCAS El Toro.

2.6 GROUNDWATER MONITORING

Delineation of the nature and extent of groundwater contamination at Former MCAS El Toro was originally based on two rounds (Round 1 and 2) of groundwater data collected as part of the Phase I RI (September 1992 to February 1993 and June 1993 to December 1993, respectively), as well as off-Station data collected by OCWD. These early groundwater samples were analyzed for a large list of analytes, including VOCs, SVOCs, pesticides/PCBs, herbicides, total fuel hydrocarbons, total recoverable petroleum hydrocarbons, metals, cyanide, general chemistry parameters, gross alpha/gross beta, and dioxins/furans (JEG 1995).

Table 2-1
Summary of Environmental Activities at Former MCAS El Toro

Date	Investigation/Activity	Objective	Summary of Findings
1985	IAS	Locate potentially contaminated sites at Former MCAS El Toro using record searches and employee interviews.	Identified 17 sites as potential sources of contamination. Recommended sampling locations and sample analytical parameters to confirm the suspected contamination at the 17 sites.
1986	OCWD groundwater investigation	Investigate source of TCE found in agricultural well west of Former MCAS El Toro.	After installing a series of monitoring wells and soil vapor probes and reviewing independent investigations, OCWD concluded that Former MCAS El Toro was the source of TCE contamination in groundwater downgradient of the Station.
1987	RWQCB issues CAO 87-97	Required Former MCAS El Toro to perform the following actions: submit a plan of action, submit progress reports, submit an interim report containing findings of field investigations, and submit a supplementary report on an off-site groundwater investigation.	In response to the CAO, Former MCAS El Toro performed the actions specified in the order. As a result of the investigations, on 16 February 1990 the U.S. EPA listed Former MCAS El Toro on the NPL. In October 1990, the DON signed an FFA committing to investigate and remediate environmental impacts associated with past and present activities. CAO 87-97 was rescinded by Order No. 93-36, Rescission of Cleanup and Abatement Order No. 87-97, in April 1993.
1988	Site inspection plan of action	Review IAS findings.	Recommended 19 sites for investigation and amended the site sampling plans proposed in the IAS report. This included one site (Site 18) intended to address the off-Station contaminant plume of VOCs.
1988	Perimeter study investigation	Address the RWQCB Santa Ana Region cleanup and abatement order requiring investigation of the source of regional VOC groundwater contamination.	Reported VOCs in shallow groundwater near the southwestern boundary of the Station.
1989–1993	Interim pump-and-treat system	Pump and treat VOC-contaminated groundwater from three extraction wells near the Station boundary.	Groundwater was extracted at a combined rate of 30 gpm from three wells and treated with granular activated carbon. Extracted groundwater had reported concentrations of TCE and PCE from 10 to 160 and 25 to 100 µg/L, respectively.

(table continues)

Table 2-1 (continued)

Date	Investigation/Activity	Objective	Summary of Findings
1989	Phase I RI planning	Formulate Work Plan, Field Sampling Plan, and associated documents to direct the Phase I fieldwork.	The DON concluded that 22 sites would be investigated and grouped into three OUs.
1990	Superfund NPL	Identify sites with imminent risks to the public.	Former MCAS El Toro was added to the NPL for the Superfund Program due to VOC contamination at the Station boundary and in agricultural wells to the west.
1993	Base Closure and Realignment Act	Identify sites for closure.	Former MCAS El Toro was placed on the BRAC III list. Under the terms of the FFA, Station closure would not affect the DON's obligation to conduct the RI/FS and comply with the other FFA requirements.
1993	Phase I RI	Make an initial determination of the existence and risks of contamination at sites in OU-1, OU-2, and OU-3.	The draft Technical Memorandum and draft OU-1 RI Reports document the results of the Phase I RI. Various contaminants in the groundwater, soil, surface water, and sediment were reported at Former MCAS El Toro. Soil and sediment contaminants were primarily SVOCs, petroleum hydrocarbons, pesticides, herbicides, and PCBs. The Phase I RI concluded that the source of regional groundwater contamination was the southwest quadrant of the Station, but it did not indicate specific sources. A preliminary risk assessment was conducted for contaminants in both groundwater and soil at the sites. Sites 24 and 25 were added during the Phase I RI.
1993	RCRA facility assessment	Evaluate whether an additional 140 sites at Former MCAS El Toro would require further investigation under the Phase II RI/FS program.	Based on the RCRA facility assessment results, 25 SWMUs/AOCs were recommended for further action. This action included additional subsurface investigation and other activities such as inspection of underground storage tanks, repair of cracks in concrete-paved areas, and excavation of contaminated soil. Two SWMUs/AOCs were recommended for further action under the Phase II RI/FS program. Site 23 was investigated and recommended for no further action.

(table continues)

Table 2-1 (continued)

Date	Investigation/Activity	Objective	Summary of Findings
1994	Phase I soil gas survey for Sites 24 and 25	Identify potential VOC sources at Sites 24 and 25.	The soil gas survey investigated soil conditions (generally 12 to 20 feet below ground surface). Elevated concentrations of VOCs were reported beneath the aircraft maintenance hangars (Buildings 296 and 297). TCE was the compound most frequently reported; others included PCE, 1,1-dichloroethene, Freon 113, carbon tetrachloride, and chloroform.
1994	Interviews with active and retired personnel	Supplement and confirm information from past investigations and interviews, better understand current and past operations, and identify further areas of potential environmental concern.	The interview panel provided information about types of operations that occurred on-Station and types of chemicals used in these operations.
1995	Development of final Work Plan for Phase II RI/FS and associated documents	Present an approach to conduct the Phase II RI at 24 sites at Former MCAS El Toro using the U.S. EPA DQO process. Identify background concentrations of metals in soils and establish a process to collect sufficient information to support risk management decisions.	Established DQO process for conducting RI/FS. Sites 24 and 25 were established for investigation in Phase II.
1996	Evaluation of background concentrations and reference levels in soil	Calculate background concentrations of metals in soil and reference levels of herbicides and pesticides in soil at Former MCAS El Toro.	Background concentrations of metals and reference levels of herbicides were developed for comparison with site-specific analytical results in the RI to identify potential releases.
1996	Interim-action RI/FS for groundwater contamination designated as OU-1	Document results of Phase I RI at OU-1 and evaluate potential actions to reduce the impact of the VOC-contaminated groundwater.	A range of alternatives for groundwater remediation was prepared and evaluated. The least costly alternatives used the IDP to treat extracted groundwater. These alternatives also removed the largest mass of TCE from groundwater. The preferred alternative is presented in this ROD.

(table continues)

Table 2-1 (*continued*)

Date	Investigation/Activity	Objective	Summary of Findings
1997	RI for Site 24 VOC contamination	Determine the nature and extent of contamination at Site 24 and evaluate the human-health risk from this contamination.	Soil and groundwater were investigated. The RI linked the groundwater hot spot identified during the Phase II RI with high concentrations of TCE in the vadose zone beneath Buildings 296 and 297.
1997	FS for vadose zone contamination at Site 24	Evaluate potential actions to remediate the VOC-contaminated soils at Site 24.	SVE is presented as the presumptive remedy most appropriate for remediation of contaminated soils.
1997	Interim ROD for vadose zone contamination at Site 24	Select interim remedial action for Site 24 vadose zone.	SVE was selected for remediation of contaminated soil at Site 24.
1997	FS for groundwater contamination at Site 24	Evaluate potential actions to remediate VOC-contaminated groundwater at Site 24.	Five alternatives for remediation of shallow groundwater at Site 24 were evaluated. The most effective alternatives used pump and treat from the groundwater hot spot and extraction and discharge to the IDP. Groundwater modeling included OU-1 and confirmed the effectiveness of natural attenuation in the principal aquifer.
1996–1998	SVE pilot testing	Evaluate effectiveness of SVE at Site 24.	SVE was shown to be effective at Site 24. Air flow rates were highly variable because of site stratigraphy. Over 800 pounds of TCE was removed.
1998	Groundwater remediation pilot test at Site 24	Collect additional data to assist in the design of a remedial alternative capable of minimizing VOC migration within the shallow groundwater unit and from the shallow groundwater unit to the principal aquifer.	The pilot test confirmed that the vertical interval of TCE-contaminated groundwater is limited to the top 50 to 60 feet of the shallow groundwater unit within the pilot test area. New data showed that the TCE hot spot (TCE concentrations greater than 500 µg/L) extends approximately 1,300 feet farther downgradient than was previously known and delineated the migration pathway from the shallow groundwater unit to the principal aquifer. Pilot test data also showed that vacuum-enhanced groundwater extraction increased the well yield, extraction well capture zone, and VOC mass removal in most wells.

(*table continues*)

Table 2-1 (continued)

Date	Investigation/Activity	Objective	Summary of Findings
1998	Evaluation of metals in groundwater at Former MCAS El Toro	Evaluate whether the reported concentrations of metals in groundwater at Former MCAS El Toro reflect ambient conditions or are the result of past Station operations.	Although the concentrations of some metals at various sites at Former MCAS El Toro exceed MCLs, such conditions are characteristic of basewide groundwater quality. Conditions are not indicative of site-related contamination.
1998–1999	Evaluation of perchlorate in groundwater	Evaluate whether the reported concentrations of perchlorate in groundwater at Former MCAS El Toro reflect ambient conditions or are the result of past station operations.	Concentrations of perchlorate exceeded both state or federal action levels at only one site, Site 1. Soil and groundwater at Site 1 were evaluated further. Perchlorate in groundwater exceeded federal action levels at one well located in the center of one site. Perchlorate in soil does not exceed residential or industrial PRGs.
1999	Evaluate effectiveness of final alternative for Site 18	Optimize conceptual design of Site 18 alternative.	IRWD held focus group meetings to evaluate public acceptance of treated groundwater. This led to development of Alternative 8A that uses separate treatment systems for groundwater extracted from areas inside and outside the TCE plume in the principal aquifer. Modeling showed that this alternative is effective in containing plume movement and permanently reducing VOCs.
1998–2000	Remediation of vadose zone contamination at Site 24	Operate SVE at Site 24 and monitor effectiveness.	Vapor concentrations in all SVE wells were below soil gas cleanup goals by the end of 1999. Rebound testing performed in September 2000 confirmed that soil gas cleanup goals have been achieved throughout the soil gas plume. A closure report documenting that soil gas cleanup goals have been attained was submitted to the BCT in June 2001. This report is expected to be finalized in spring 2002.
2000	Historical radiological assessment of Former MCAS El Toro	Evaluate historical use, storage, and disposal of radiological materials at Former MCAS El Toro and recommend follow-on investigations of potentially impacted areas.	The final Historical Radiological Assessment Report, dated May 2000, identified candidate sites for radiological surveys on the basis of historical information. Sites 18 and 24 do not require further radiological investigation.

(table continues)

Table 2-1 (continued)

Date	Investigation/Activity	Objective	Summary of Findings
2001	Radiological survey	Evaluate selected sites and buildings for radiological materials or contamination.	The radiological survey was conducted from June through November 2001. The final Radiological Release Report is scheduled to be issued in fall 2002.
2000–2001	Radionuclide investigation of groundwater	Evaluate whether reported levels of radioactivity in groundwater at Former MCAS El Toro reflect ambient conditions or are the result of past Station operations.	Precise laboratory analysis of radionuclide concentrations has shown that the reported levels of radionuclides present at Former MCAS El Toro are consistent with background. Therefore, radionuclides are not chemicals of concern in groundwater at Former MCAS El Toro.
2001	Preliminary assessment of VOCs at Building 307	Identify and characterize the possible presence of VOCs in soil gas, soil, and groundwater as a result of laundry and dry cleaning operations at Building 307.	The preliminary assessment confirmed that there has not been a significant release to either the environment at Building 307 or along the sewer line segment from Building 307 to the former sewage disposal plant due to past dry cleaning operations. These results did not change previous conclusions regarding VOC contamination at Site 24 nor change the remedy already in place at the site.

Acronyms/Abbreviations:
AOC – area of concern
BCT – BRAC Closure Team
BRAC – Base Realignment and Closure
CAO – Cleanup and Abatement Order
DON – Department of the Navy
DQO – data quality objective
FFA – Federal Facilities Agreement
Freon 113 – 1,1,2-trichloro-1,2,2-trifluoroethane
FS – feasibility study
gpm – gallons per minute
IAS – initial assessment study
IDP – Irvine Desalter Project
IRWD – Irvine Ranch Water District
µg/L – micrograms per liter
MCAS – Marine Corps Air Station
MCL – maximum contaminant level
NPL – National Priorities List
OCWD – Orange County Water District
OU – operable unit
PCB – polychlorinated biphenyl
PCE – tetrachloroethene
PRG – preliminary remediation goal
RCRA – Resource Conservation and Recovery Act
RI – remedial investigation
ROD – record of decision
RWQCB – (California) Regional Water Quality Control Board
SVE – soil vapor extraction
SVOC – semivolatile organic compound
SWMU – solid waste management unit
TCE – trichloroethene
U.S. EPA – United States Environmental Protection Agency
VOC – volatile organic compound

Routine on-Station groundwater monitoring was suspended during the Phase II RI and continued in 1996 and 1997 (Rounds 3 through 7) using an initial RI/FS Groundwater Monitoring Plan that was developed in 1995 (JEG 1995). The plan was modified as required to reflect additions of new wells, deletions of wells where contaminants had not been reported, and evaluation of the information gathered.

In 1999, after a total of seven rounds of groundwater monitoring had been conducted, the DON prepared a comprehensive CERCLA Groundwater Monitoring Plan (BNI 1999). This plan summarized the results of sampling to date; analyzed the frequency of detection and distribution of VOCs, SVOCs, pesticides/PCBs, herbicides, radionuclides, and metals in groundwater; and made recommendations for which analytes and wells should be monitored in the future.

The evaluation summarized in the CERCLA Groundwater Monitoring Plan concluded that the only chemical category confirmed to have impacted groundwater at Sites 18 and 24 was VOCs. SVOCs, pesticides/PCBs, and herbicides were eliminated as chemicals of concern for the following reasons.

- SVOCs were not consistently reported for every sampling event for any single well. For this reason, the reported SVOC concentrations were interpreted to be isolated occurrences, most likely attributable to sampling and analysis errors.
- PCBs were never reported in any groundwater samples.
- All of the pesticides and herbicides were interpreted to be isolated occurrences because none of these compounds were consistently reported in every sampling event from a given well.

Radionuclides were recommended for further evaluation. The results of the evaluation of radionuclides and of metals are summarized in Section 2.5.

Since the CERCLA Groundwater Monitoring Plan was issued, seven additional groundwater monitoring rounds (Rounds 8 through 14) have been conducted at Former MCAS El Toro.

Section 3

HIGHLIGHTS OF COMMUNITY PARTICIPATION

A community relations plan (BNI 1996b) was developed to document concerns identified during community interviews and to provide a detailed description of community relations activities planned in response to information received from the community. Initially prepared in 1991, the plan was revised in 1993 and again in 1996 and will be updated in 2002 to incorporate the most recent assessment of community issues, concerns, and informational needs about the ongoing environmental investigation and remediation program at Former MCAS El Toro.

The community relations program includes specific activities for obtaining community input and keeping the community informed. These activities include conducting interviews, holding public meetings, issuing fact sheets to provide updates on remediation activities, maintaining an information repository where the public can access technical documents and program information, disseminating information to the local and regional media, and making presentations to local groups.

Community members and local government agencies have also participated in planning for the reuse of Former MCAS El Toro through development of the Community Reuse Plan.

3.1 RESTORATION ADVISORY BOARD

In 1994, establishment of the Restoration Advisory Board (RAB) gave individuals from local communities a channel for increasingly significant participation in the environmental restoration process. Original membership on the board, which was solicited by the Marine Corps and the DON through paid newspaper notices, exceeded 50 business and homeowners' representatives, locally elected officials and local regulatory agencies, and interested residents.

Currently, the RAB is composed of 28 registered members: 12 community members or private citizens and 16 representatives from various government agencies. RAB meetings are held every 2 months and are scheduled in the evenings after normal working hours (6:30 to 9:00 p.m.) at the city of Irvine City Hall, Conference and Training Center. The meetings are open to the public and include representatives from the Marine Corps and the DON, city and county offices, and regulatory agencies. By sharing information from the regular meetings with the groups they represent, RAB members help increase awareness of the IRP process; in addition, members of the public can contact RAB members to obtain information or express concerns to be discussed at subsequent meetings.

Copies of the RAB meeting minutes are available at the Former MCAS El Toro Information Repository, located at the Heritage Park Regional Library in Irvine, California. RAB meeting minutes are also located on the DON's SWDIV environmental web site: http://www.efdsw.navfac.navy.mil/environmental/envhome.htm.

VOC-contaminated groundwater at Sites 18 and 24 and soil at Site 24 have been key topics for presentations and discussions at over 30 RAB meetings. Early presentations focused on the remedial investigation and provided background and educational information to RAB members on the extent of groundwater contamination both off-Station and on-Station. The OU-1 interim action remedial investigation/feasibility

study was often the focus of the technical presentations, which also provided information on alternatives that would be implemented by the DON alone or as a joint project with local water districts (OCWD/Irvine Ranch Water District [IRWD]). Presentation handouts were provided to RAB members at all meetings.

Later meetings concentrated on the remedial investigation of on-Station soil and groundwater contamination. Draft final Feasibility Study Reports for OU-2A were prepared separately for soil and groundwater at Site 24. For soil, the focal point was on U.S. EPA's presumptive remedy, SVE. The draft final Feasibility Study Reports for both OU-1 and OU-2A presented information on the development of remedial alternatives and cost comparisons for groundwater remediation. Regulatory agency representatives discussed technical issues and commented on reports and other documents pertaining to VOC-contaminated soil and groundwater, groundwater monitoring, FFA schedules, and related issues. RAB subcommittee meetings focused on the specific aspects of the FS reports. Updates on the negotiations between the DON and the OCWD/IRWD regarding a joint project to remediate contaminated groundwater were also presented to the RAB. A public briefing at the January 1999 RAB meeting announced the Marine Corps' intention to proceed with SVE at the VOC Source Area, Site 24.

The most recent RAB meetings have focused on progress of and changes to the OCWD/IRWD joint project, especially the change to a dual-purpose project. Originally, all treated groundwater was to be used for drinking water purposes. OCWD/IRWD changed this conceptual design based on public response. In the new design, water from areas inside the VOC plume will be treated (CERCLA action) and used for reclaimed water purposes, such as landscape irrigation. Water from areas outside the plume, which currently meets drinking water standards except with regard to total dissolved solids (TDS) and nitrates, will be treated to remove TDS and nitrates and used for drinking purposes (non-CERCLA action).

3.2 PUBLIC MAILINGS

Public mailings, including information updates, fact sheets, and proposed plans, have been used to broaden the dissemination of information within the local community. The first information update announcing the IRP process at Former MCAS El Toro was delivered in November 1991 to area residents and mailed to city, state, and federal officials; agencies; local groups; and individuals identified in the Community Relations Plan. Subsequent fact sheets were mailed to the community as significant remediation milestones were reached (Table 3-1). These publications included information concerning the status of site investigations, the upcoming remedy selection process, the means of public participation in the investigation and remediation of Former MCAS El Toro, and the availability of the administrative record.

Proposed plans are summaries of remedial alternatives proposed for a site or group of sites. The plan describes each of the alternatives, evaluates each alternative against nine criteria, and identifies the preferred alternative. This document is issued to the public prior to the beginning of a public comment period to provide information and solicit

Table 3-1
Summary of Former MCAS El Toro Updates, Fact Sheets, and Proposed Plans

Fact Sheet Number	Date	Summary of Contents
–*	11/91	Information Update/IRP Process
–	12/92	Information Update
1	12/93	Phase II RI Results
2	12/93	RAB Formation
3	07/95	Information Update/Tank 398
4	10/95	Information Update, Engineering Evaluation/Cost Analysis
5	11/95	Former MCAS El Toro Building 673-T3 Certification for Closure
6	04/96	Looking Back-Moving Forward Update on IRP Progress
7	12/96	Groundwater Remediation OU-1 and OU-2A
–	04/97	Proposed Plan for Site 24 Vadose Zone
–	06/97	Proposed Plan for No Action Sites
–	05/98	Proposed Plan for Sites 2, 3, 5, and 17
8	02/99	SVE Design Completed, Proceed with Interim Action for Site 24 Vadose Zone
–	05/99	Proposed Plan for OU-3 Sites 8, 11, and 12
–	09/00	Proposed Plan for Sites 7 and 14
–	11/01	Proposed Plan for Groundwater at Sites 18 and 24

Note:
* dash indicates updates or proposed plans, which are not given fact sheet numbers

Acronyms/Abbreviations:
IRP – Installation Restoration Program
MCAS – Marine Corps Air Station
OU – operable unit
RAB – Restoration Advisory Board
RI – remedial investigation
SVE – soil vapor extraction

public input on the potential remedial options that underwent detailed evaluation. Once the public comment period closes, the comments are compiled, reviewed by the BCT, and used to refine the remedial action. The final decision and response to comments (known as a "Responsiveness Summary") are presented in this ROD.

To reach as many community members as possible, the updates, fact sheets, and proposed plans are mailed to approximately 600 households, businesses, public officials, and agencies. Copies are also made available at the information repository at Heritage Park Library and in the administrative record file at Former MCAS El Toro.

3.3 COMMUNITY PARTICIPATION FOR SITES 18 AND 24

The Interim-Action RI/FS Report for Site 18 was released to the public in August 1996. The RI Report for Site 24 was issued in March 1997. The FS reports for Site 24 vadose zone and groundwater were issued in March and December 1997, respectively. The Proposed Plan for the vadose zone at Site 24 was issued in April 1997 and the interim ROD for the Site 24 vadose zone was finalized in September 1997. This schedule enabled the remedial design and remedial actions for the vadose zone to be implemented before the remedial action for groundwater was finalized. In conjunction with the 27 January 1999 RAB meeting, a public briefing formally announced the Marine Corps' intent to proceed with the Interim Remedial Action for soil at Site 24 by the end of March 1999. A fact sheet was distributed to those in attendance at the briefing and mailed to those on the Former MCAS El Toro project mailing list. The SVE system that was used at Norton Air Force Base (AFB) was brought to Former MCAS El Toro to be used to remediate VOC-contaminated soil at Site 24. A tour of the SVE system at Site 24 was conducted for RAB members and other interested community members on 27 February 1999.

The Proposed Plan for groundwater at Sites 18 and Site 24 was mailed in November 2001 to recipients on the Former MCAS El Toro project mailing list. This plan described the DON's preferred alternative for groundwater remediation and documented the progress of soil remediation.

The Interim-Action RI/FS Report for Site 18, RI Report for Site 24, FS Reports for Site 24 vadose zone and groundwater, Proposed Plan for the Site 24 vadose zone, Interim ROD for the Site 24 vadose zone, and other key documents related to Sites 18 and 24 were made available to the public at the information repository at the Heritage Park Regional Library. The notices of availability of these documents were published in the *Orange County Register* and the *Los Angeles Times (Orange County Edition)* approximately 1 week before the start of the public comment period on the Proposed Plan. The notices also announced the availability of the complete administrative record file at the SWDIV BRAC office in San Diego and at Former MCAS El Toro. Because of space limitations at the library, only a partial administrative record file is available for review at the information repository, but the information repository contains a complete index of the administrative record file along with information on how to access the complete file at Former MCAS El Toro.

A public comment period for the Proposed Plan for Sites 18 and 24 groundwater was held from 07 November to 07 December 2001, and a public meeting was held on 13 November 2001. The public meeting was announced in the *Orange County Register* and the *Los Angeles Times (Orange County Edition)* on 06 November 2001 and in the Proposed Plan. At the public meeting, representatives from the DON, Former MCAS El Toro, and environmental regulatory agencies answered questions about site conditions and the remedial alternatives under consideration, and a court reporter recorded public comments. A transcript of the meeting is included as Attachment B. Comment forms were provided to encourage submittal of written comments during or after the meeting, and responses to the comments received during this period are included in the Responsiveness Summary, which is part of this ROD.

Section 4
SCOPE AND ROLE OF OPERABLE UNIT

Twenty-five IRP sites have been investigated at Former MCAS El Toro. Twenty-four of these sites are grouped into three OUs. Site 23 was evaluated in an RFA under the FFA and, as a result, was eliminated as an environmental concern. OU-1 encompasses Site 18 (Regional VOC Groundwater Plume). OU-2 is subdivided into OU-2A, OU-2B, and OU-2C. OU-3 is subdivided into OU-3A and OU-3B.

OU-1 Site 18 is included in this ROD.

OU-2A, which includes Site 24 (VOC Source Area) and Site 25 (Major Drainages), was defined to address the potential sources of regional groundwater contamination. Site 25 was included in OU-2A because it was not known whether the major drainages at Former MCAS El Toro were a source of the regional VOC groundwater contamination. After the Phase II RI showed that Site 25 was not a source of regional groundwater contamination, the site was recommended for no action and included with several OU-3 sites in a no action ROD that was signed in September 1997 (SWDIV 1997b).

As this OU-1/OU-2A ROD demonstrates, groundwater is a contaminated medium shared by Sites 18 and 24. Prior to remediation, Site 24 also included contaminated soil, which was the source of the regional groundwater contamination. Remediation of soil at Site 24 was addressed in an interim ROD that was signed in September 1997 (SWDIV 1997a). The interim ROD selected SVE as the remedy for removing the VOC-contaminated soil. The Site 24 ROD was interim because it did not address groundwater at Site 24 and because the DON agreed to reevaluate cleanup levels for soil in the final ROD, which will be issued later. This ROD documents the selected remedy for groundwater at Sites 18 and 24.

OU-2B encompasses Sites 2 and 17, and OU-2C encompasses Sites 3 and 5. Sites 2, 3, 5, and 17 are generally referred to as the landfill sites. Sites 2 and 17 were addressed in an interim ROD that was issued to the public in April 2000 and signed in July 2000 (SWDIV 2000). The ROD was interim because it presented the selected remedial action for only vadose zone soil at Site 2 and for vadose zone soil and groundwater at Site 17. Remediation of groundwater at Site 2 will be addressed in the final ROD. A radiological survey was conducted at Sites 2 and 17 in August through October 2001. The final ROD will also summarize the results of the survey and address radiological contamination, if any, at both Sites 2 and 17. Sites 3 and 5 will be addressed in an OU-2C ROD that is expected to be issued to the public in 2002.

OU-3 was defined to address the remaining IRP sites at Former MCAS El Toro. Of the 13 sites in OU-3A, Sites 4, 6, 9, 10, 13, 15, 19, 20, 21, and 22 were investigated, found to contain no unacceptable risks to human health or the environment, and recommended for no action. These sites were addressed along with Site 25 in the signed no action ROD (SWDIV 1997b). OU-3A Site 11 was addressed in an action ROD that was signed in September 1999 (SWDIV 1999). OU-3B Sites 7 and 14 were addressed in a no action ROD that was signed in June 2001 (SWDIV 2001). The remaining OU-3A sites (Sites 8 and 12) and OU-3B sites (Sites 1 and 16) are currently being evaluated.

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Section 5
SUMMARY OF SITE CHARACTERISTICS

This section describes the regional characteristics of Former MCAS El Toro, provides a brief history of the source of contamination at Sites 18 and 24, summarizes the sampling performed at these sites, and presents figures illustrating site-specific sampling results. This section also discusses current and potential future migration of chemicals of potential concern at the sites and concludes with an estimate of the mass of TCE present in groundwater. A complete discussion of sampling locations and methodologies, compounds reported at each site, and the nature and extent of contamination appears in the Phase I RI Technical Memorandum, Draft Final Operable Unit 1 Interim Action Remedial Investigation/Feasibility Study Report (JEG 1996a,c,d), and the Phase II RI Report for Site 24 (BNI 1997a).

The nature and extent of contamination at Sites 18 and 24 is based on the Phase I and II RI data presented in the above-referenced reports and on pilot tests, rebound tests, and routine groundwater monitoring performed subsequent to the RIs. The Phase I RI was conducted during 1992 and 1993 and included groundwater at sites throughout Former MCAS El Toro. The Phase II RI was conducted in 1996 and included Site 24. Data collected during the Site 24 RI include the results of shallow and deeper subsurface soils investigations, groundwater investigations, aerial photograph reviews, and interviews with Former MCAS El Toro personnel. An extensive soil gas survey was also conducted at Site 24. Data collected during the Site 18 RI include only results of groundwater investigations because contamination at this site is limited, by definition, to groundwater.

5.1 REGIONAL CHARACTERISTICS

Former MCAS El Toro is situated on the southeastern edge of the Tustin Plain, a gently sloping surface of alluvial fan deposits derived mainly from the Santa Ana Mountains. The Tustin Plain, bounded on the north and east by the Santa Ana Mountains and on the south by the San Joaquin Hills, is at the southeastern end of the Los Angeles Basin, a large sedimentary basin in the Peninsular Ranges Geologic Province. The elevation at Former MCAS El Toro ranges from 215 feet above mean sea level (MSL) in the western portion to approximately 800 feet above MSL in the eastern portion.

5.1.1 Geology and Hydrogeology

The Tustin Plain is a broad basin composed of Quaternary marine and alluvial sediments deposited on Tertiary marine sedimentary bedrock (Fife 1974). The Quaternary deposits are generally less consolidated and more permeable than the bedrock. The Tustin Plain is bounded by bedrock, exposed in the Santa Ana Mountains to the north and east and in the San Joaquin Hills to the south.

The Tertiary bedrock consists of semiconsolidated marine sandstones, siltstones, and conglomerates of the Sespe, Vaqueros, Topanga, Capistrano, Niguel, and Fernando Formations (CDMG 1981). The lower-Pliocene Fernando Formation forms the base of the water-bearing units at Former MCAS El Toro (Herndon and Reilly 1989). The

Fernando Formation is interbedded with marine clayey and sandy siltstones of the Capistrano and Niguel Formations west of Former MCAS El Toro (JMM 1988).

Pleistocene sediments predominantly composed of interlayered fine-grained lagoonal and nearshore marine deposits unconformably overlie the Tertiary sedimentary bedrock (Singer 1973). These deeper Quaternary sediments may be equivalent to the lower Pleistocene San Pedro Formation, which consists of semiconsolidated silts, clays, and sands with interbedded limestone.

Conformably overlying the Pleistocene sediments are Holocene materials consisting of isolated coarse-grained stream channel deposits within fine-grained overbank deposits. These Holocene sediments were deposited as alluvium and range in thickness up to 300 feet (Herndon and Reilly 1989).

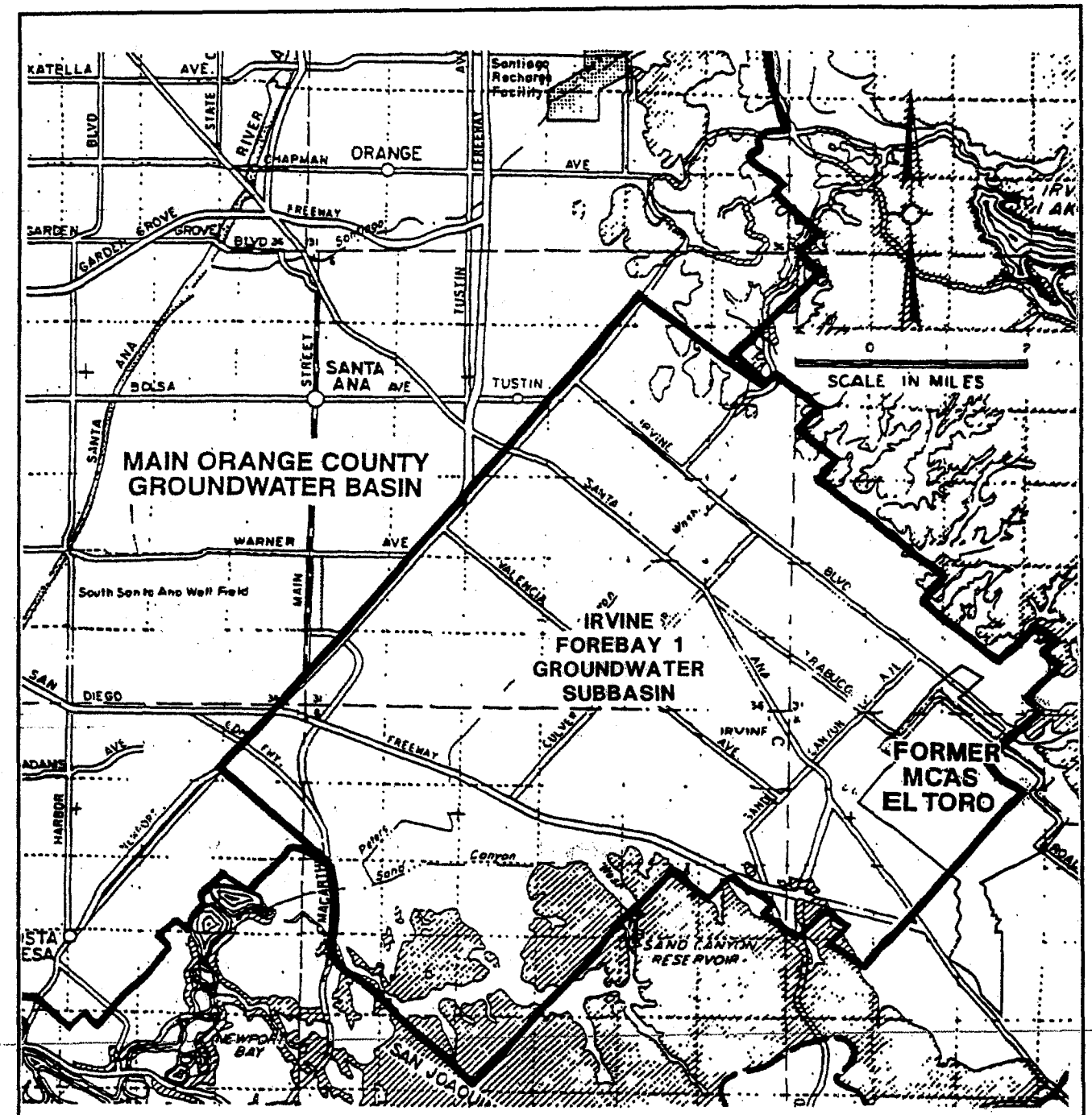
Former MCAS El Toro lies within the Irvine Forebay I Groundwater Subbasin, which is southeast of and adjacent to the main Orange County Groundwater Basin (Figure 5-1). The Irvine Subbasin has been designated by RWQCB Santa Ana Region as a public water supply source (RWQCB 1995). Regional aquifer systems in the Irvine Subbasin have been described as a series of discontinuous lenses of clayey sands and gravels contained within an assemblage of sandy clay and silt. These aquifer systems are within the less consolidated and more permeable Quaternary sedimentary deposits.

Four hydrostratigraphic units were defined at the Station from existing literature and from information gathered during the Phase I RI (JEG 1996b). From shallowest to deepest, these units are:

- Shallow Groundwater Unit (water-bearing),
- Intermediate Horizon (confining),
- Principal Aquifer (water-bearing), and
- Semiconsolidated Materials (sparsely water-bearing).

The water-bearing properties of these hydrostratigraphic units depend on the physical characteristics of their constituent geologic materials. The sediments encountered during drilling for the Phase I RI essentially consisted of unconsolidated clays and silts variously interbedded with sands and gravels. The variable, unconsolidated sediments are typical of alluvial, floodplain, and shallow marine deposits formed from the sedimentary formations that comprise the surrounding foothills. Silts and clays predominate in the central and northwestern portions of the Station whereas sands are more common near the foothills. Sands are predominantly well graded (poorly sorted), ranging from coarse- to fine-grained, and commonly contain clay streaks. Clays exhibit medium plasticity and contain sand.

Shallow Groundwater Unit. This is the uppermost unconsolidated sediment sequence beneath the Station and consists mostly of sands with interbedded fine-grained silts and clays. The water table occurs in the shallow groundwater unit. Typical of alluvial fan deposits, the water-bearing characteristics within this unit are highly variable. In general, this unit can yield moderate quantities of water while localized areas will yield lesser



LEGEND

BEDROCK

Source: OCWD/Banks, 1984, and California DWR, 1967

Record of Decision

Figure 5-1

Groundwater Basin Boundaries

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 1/3/02
File No: -
Job No: 22214-164
Rev No: B

amounts of water. The thickness of this unit generally ranges from 100 feet to 150 feet. Near the foothills, the thickness is about 40 feet.

The shallow groundwater unit overlies the relatively fine-grained intermediate horizon over most areas in and around the Station. However, the intermediate horizon pinches out toward the northeast area of the Station near the foothills and the coarse-grained materials of the shallow groundwater unit merge with the coarse-grained materials of the principal aquifer.

Intermediate Horizon. This unit hydraulically restricts groundwater flow between the overlying shallow groundwater unit and the underlying principal aquifer over most of the areas in and around the Station. This unit consists mostly of fine-grained silts and clays with interbedded sands and gravels. Typical of alluvial fan deposits, the water-bearing characteristics within this unit are highly variable. Because of this variable nature, in some locations the intermediate horizon is not identifiable from inspection of drill cuttings alone and may resemble both the shallow groundwater unit and the principal aquifer. The intermediate horizon is, however, interpreted to be present where finer-grained materials are not observed in drill cuttings because of the unique potentiometric groundwater elevations in the shallow groundwater unit and principal aquifer.

The estimated thickness of the intermediate horizon ranges from approximately 70 to 140 feet. As the horizon pinches out toward the northeast foothills, the coarse-grained materials become more abundant and fine-grained materials become less abundant. In addition, the potentiometric elevations in the shallow groundwater unit become indistinguishable from those of the principal aquifer in this area.

Although restricted, groundwater flow between the shallow groundwater unit and principal aquifer does occur. This is evidenced by the occurrence of chlorinated VOCs in the principal aquifer downgradient of the Station.

Principal Aquifer. This is the lowest unconsolidated sediment sequence at the Station and consists primarily of sands and gravels with interbedded fine-grained silts and clays. This is the main aquifer for irrigation groundwater supply to IRWD and the Irvine Company northwest of the Station. Although the water-bearing characteristics within this unit are highly variable, this unit can yield moderate to large quantities of water. The thickness of this unit ranges from less than 50 feet in the eastern portion of the Irvine Subbasin to about 1,200 feet in the western portion.

Semiconsolidated Materials. The deepest materials encountered during the Phase I RI consisted of the semiconsolidated materials underlying the unconsolidated materials of the principal aquifer. These materials consist of sandstones, siltstones, and conglomerates of late Miocene to late Pliocene age, and are considered to be the top of the bedrock in the Former MCAS El Toro area. Although they may yield some quantities of groundwater, these materials are not considered to be appreciably water bearing. The semiconsolidated materials effectively bound the bottom of the groundwater flow system of the Irvine Subbasin.

The depth to shallow groundwater beneath Former MCAS El Toro ranges from approximately 45 to 60 feet below ground surface (bgs) in the foothills to approximately

85 feet bgs along the southwestern boundary to greater than 240 feet bgs along Irvine Boulevard (JEG 1993a). Depth to the principal aquifer ranges from less than 200 feet bgs on-Station to 300 to 375 feet bgs at Site 18.

Groundwater in the shallow aquifer flows northwest at gradients ranging from 0.005 to 0.025 foot/foot (Figure 5-2). The hydraulic gradient has been influenced strongly by the pumping of irrigation wells west of Former MCAS El Toro. Average linear groundwater flow velocities are reported to range from 0.02 foot to 1.9 feet per day (JMM 1990).

Groundwater in the vicinity of Former MCAS El Toro contains elevated concentrations of inorganic compounds, including TDS, sulfate, nitrate, and chloride. These inorganic parameters exist in groundwater at concentrations that exceed drinking water standards and the applicable water quality objectives specified in the Water Quality Control Plan for the Santa Ana Basin (RWQCB 1995). The observed concentrations of inorganic parameters in groundwater, particularly TDS and nitrate, were evaluated in the OU-1 RI/FS and were determined to be the result of naturally occurring subsurface conditions and past and current land uses, in particular past agricultural practices (JEG 1996h).

Former MCAS El Toro occupies an area in which the historically predominant land uses have been agriculture and grazing. The widespread occurrence of elevated TDS concentrations in the vicinity of Former MCAS El Toro has been documented for more than 100 years. Elevated concentrations of nitrate have been documented for the past 25 years.

Former MCAS El Toro is not the source of the elevated TDS and nitrate concentrations. The principal sources of TDS appear to be marine sediments; fine-grained materials, specifically clays, in the sediments of the Irvine Subbasin; subsurface inflow of groundwater through marine sedimentary rocks of the Santa Ana Mountains and San Joaquin Hills; and accumulated salts in irrigation return flow. Nitrate contamination is attributed to historical agricultural use, farm animal waste, landscaping, domestic septic tank wastewater disposal, and industrial operation discharges (JEG 1996h).

5.1.2 Surface Hydrology

Surface drainage near Former MCAS El Toro generally flows southwest, following the slope of the land perpendicular to the trend of the Santa Ana Mountains. Several washes originate in the hills northeast of Former MCAS El Toro and flow through or adjacent to the Station en route to San Diego Creek. Off-Station drainage from the hills and upgradient irrigated farmland combines with Station runoff at Former MCAS El Toro (generated from the extensive paved surfaces) and flows into four main drainage channels. Three of these drainage channels (Borrego Canyon, Agua Chinon, and Bee Canyon) are contiguous with natural washes that originate in the Santa Ana Mountains. The fourth drainage is Marshburn Channel (Figure 5-3).

Borrego Canyon Wash flows along the southeastern boundary of Former MCAS El Toro. The wash is unlined in the Santa Ana Mountains and unlined downstream of Irvine

Boulevard. Borrego Canyon Wash crosses the southern corner of the Station and joins Agua Chinon Wash about 1/4 mile downstream of the Station boundary.

Both Agua Chinon and the Bee Canyon Washes cross the central portion of Former MCAS El Toro and receive on-Station runoff mainly through storm sewers. These washes are contained in culverts through most of their pathways across the Station. Both washes are unlined along several hundred feet at the southwestern edge of the Station and are lined again in a culvert beneath the Irvine Spectrum development adjacent to the southwestern boundary of the Station. Marshburn Channel is a lined drainage channel that runs along the northwestern boundary of Former MCAS El Toro. The channel receives runoff from the western part of the Station. All of the drainages ultimately discharge into San Diego Creek.

The MCAS El Toro Master Plan indicates that much of the Station lies within the 100-year floodplain. Existing drainage systems were developed for agricultural use, not for the increased flows generated by the urban development now surrounding the base. Approximately 15 acres of an agricultural lease was flooded and crops were destroyed during a storm on 29 November 1997. Figure 5-3 shows the area included in the 100-year floodplain.

5.1.3 Rainfall and Prevailing Wind Conditions

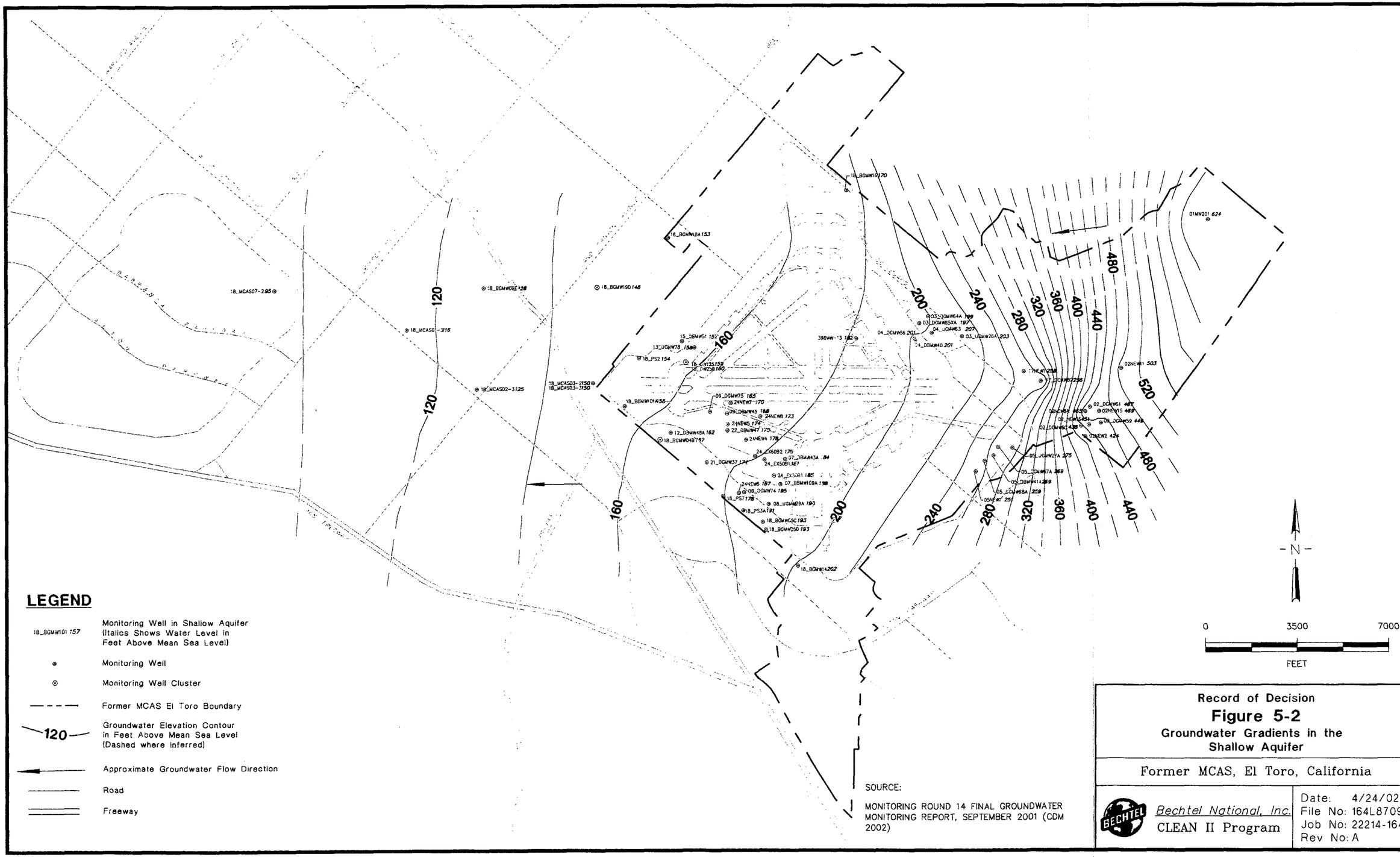
The mean average rainfall at Former MCAS El Toro is approximately 12.2 inches, most of which occurs from November through April (JEG 1993a). Because of the low average annual rainfall and high evapotranspiration rates, net infiltration from precipitation is low.

From March through October, the prevailing wind is from the west, averaging 6 knots. From November through February, the prevailing wind is from the east, averaging 4 knots. Dry, gusty, offshore winds (locally known as "Santa Ana winds") are common during late fall and winter. The typically dry conditions and persistent winds may result in light to moderate wind erosion.

5.2 SITE CHARACTERISTICS

This section discusses characteristics of Sites 18 and 24. The sites are addressed together because Site 24 has been identified as the source of VOCs in the shallow groundwater unit beneath Site 24 and downgradient of Site 24, where VOCs have migrated into the principal aquifer to form the regional groundwater plume of Site 18.

Site 18, Regional VOC Groundwater Plume, is defined as the area where TCE concentrations are greater than 5 µg/L in the principal aquifer. Site 18 is downgradient of Site 24 and is located entirely off-Station. The contaminated groundwater of Site 18 originates in the shallow aquifer at Site 24, migrates into the principal aquifer near the southwestern Station boundary, and extends into the principal aquifer off-Station approximately 3 miles to the west beneath the city of Irvine. The average width of the off-Station VOC plume is approximately 1/2 mile. VOC contamination reaches depths of 450 feet bgs in some areas.



LEGEND

18_BGMW101 157	Monitoring Well in Shallow Aquifer (Italics Shows Water Level in Feet Above Mean Sea Level)
⊙	Monitoring Well
⊙	Monitoring Well Cluster
— — —	Former MCAS El Toro Boundary
120	Groundwater Elevation Contour in Feet Above Mean Sea Level (Dashed where Inferred)
←	Approximate Groundwater Flow Direction
———	Road
═══	Freeway

SOURCE:

MONITORING ROUND 14 FINAL GROUNDWATER MONITORING REPORT, SEPTEMBER 2001 (CDM 2002)

Record of Decision

Figure 5-2

Groundwater Gradients in the Shallow Aquifer

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 4/24/02
File No: 164L8709
Job No: 22214-164
Rev No: A

PAGE NO. 5-8

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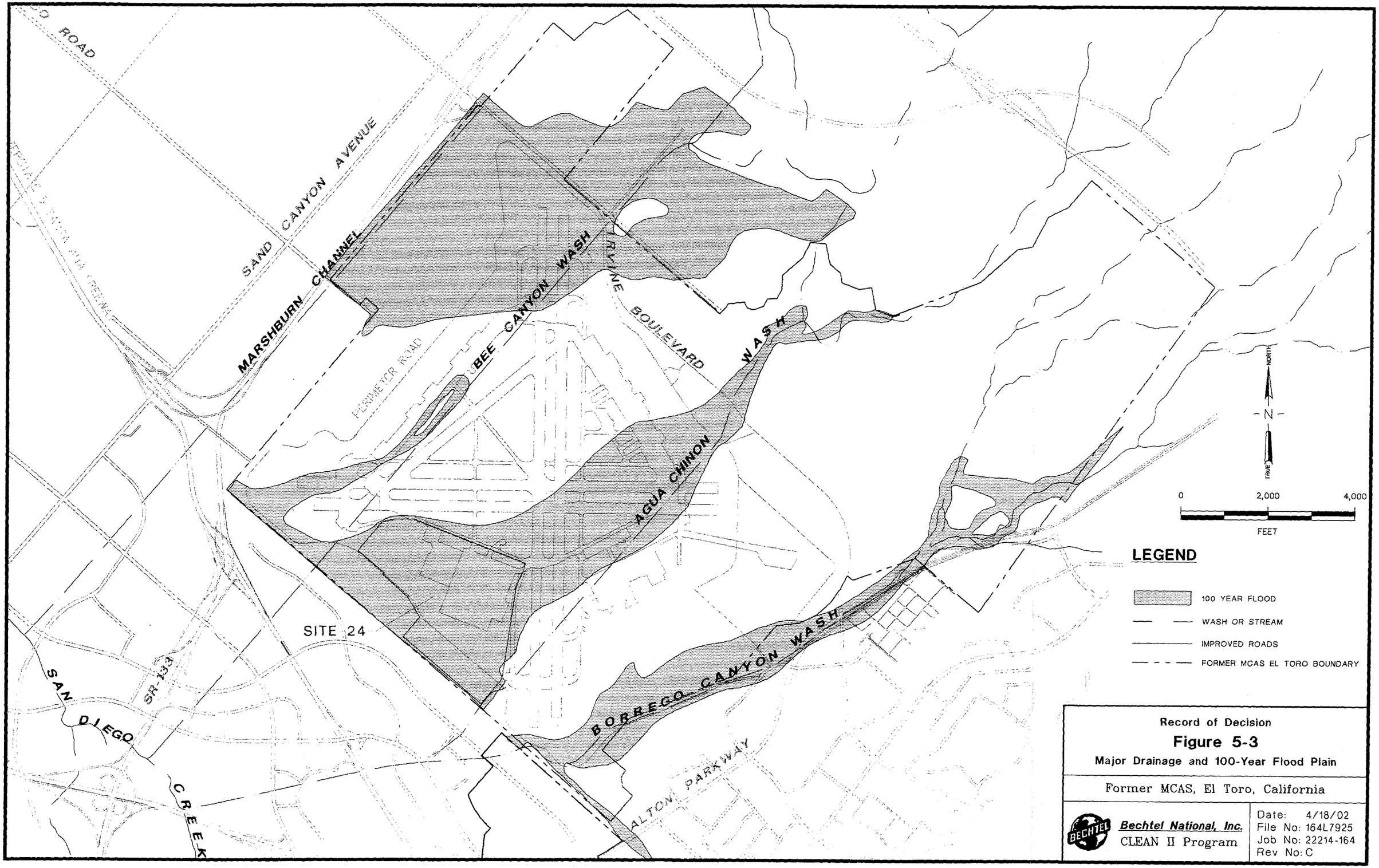

Record of Decision

Figure 5-3

Major Drainage and 100-Year Flood Plain

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 4/18/02
File No: 164L7925
Job No: 22214-164
Rev No: C

PAGE NO. 5-10

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Site 24, VOC source area, encompasses approximately 200 acres. The site slopes toward the west from about 320 feet above MSL at the intersection of the east-west and north-south runways to approximately 240 feet above MSL near the end of the east-west runway. The site is largely industrialized and contains two large aircraft hangars (Buildings 296 and 297) and several smaller buildings that were used for aircraft and vehicle maintenance and repair (Figure 5-4). Maintenance activities (e.g., aircraft washing, degreasing) conducted adjacent to and within these buildings are believed to be the source of the VOC contamination in site soil and groundwater.

The Site 24 surface cover consists of unpaved open ground, asphalt, and concrete. Most of the site (170 acres) is paved. Asphalt-covered areas were used primarily for access roads and parking lots for military and personal vehicles. Concrete covers the areas where most of the industrial activities at Site 24 have been conducted, including slabs for Buildings 296 and 297 (the two aircraft hangars), Building 295 (the helicopter hangar), and Building 324 (the former engine test facility).

A network of storm drains collects rainwater from the paved surfaces of Site 24. When industrial activities were conducted at Site 24, wastewater generated from the concrete-paved areas would also have been transported via this network. The network discharges to Agua Chinon Wash on the eastern portion of the site and Bee Canyon Wash on the western portion, near the Station boundaries in these locations.

Because Site 24 includes most of the southwest quadrant on the Station, it encompasses IRP Sites 7, 8, 9, 10, 11, 12, 22, and a portion of Site 25. These are soil sites and contamination present at the sites does not extend to groundwater.

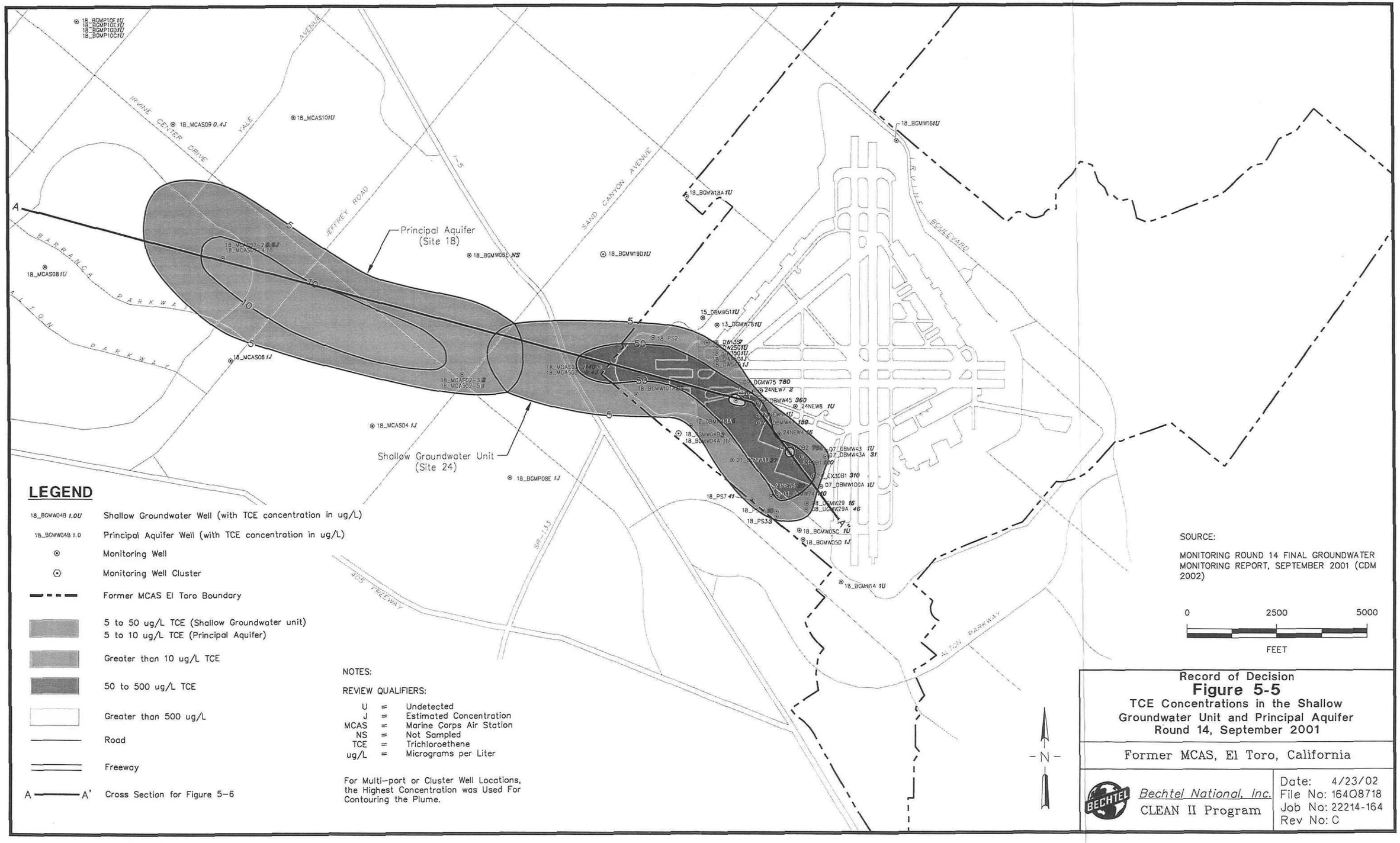
Site 7 and Sites 9, 10, 22, and 25 were investigated, found to require no action, and addressed in no action RODs that were finalized in June 2001 and September 1997, respectively. Sites 8, 11, and 12 contain low levels of soil contamination. Site 11 was addressed in a ROD that was finalized in September 1999. The ROD for Sites 8 and 12 is expected to be finalized in 2002.

Groundwater contamination, where present beneath Sites 7, 8, 9, 10, 11, 12, 22, and 25, has its origin at Site 24 and is addressed in this ROD. Figures 5-5 and 5-6 illustrate the relationship between Site 24 groundwater and Site 18 and the extent of the plume at Site 18.

5.2.1 Geology and Hydrogeology

The geology beneath Site 24 consists of sediments deposited in a basin as an alluvial fan. Lithologic data collected from Site 24 during the RI/FS were represented by two units of coarse-grained stream channel deposits (sands and gravels) interbedded with fine-grained overback deposits (silts and clays). These sediments were investigated to approximately 260 feet bgs. Beneath the main industrial areas of Site 24, Buildings 296 and 297, the coarse-grained and fine-grained units display a lenticular stratigraphy. Lenses of both units are laterally extensive on a large scale and show a high degree of heterogeneity on a small scale. Small-scale heterogeneities likely prevented low-permeability units from

Figure 5-4
Aerial Photograph of Site 24 Physical Features (1980)



LEGEND

18_BGMW04B 1.0U	Shallow Groundwater Well (with TCE concentration in ug/L)
18_BGMW04B 1.0	Principal Aquifer Well (with TCE concentration in ug/L)
⊙	Monitoring Well
⊙	Monitoring Well Cluster
— — —	Former MCAS El Toro Boundary
	5 to 50 ug/L TCE (Shallow Groundwater unit) 5 to 10 ug/L TCE (Principal Aquifer)
	Greater than 10 ug/L TCE
	50 to 500 ug/L TCE
	Greater than 500 ug/L
———	Road
═══	Freeway
A ——— A'	Cross Section for Figure 5-6

NOTES:

REVIEW QUALIFIERS:

U	=	Undetected
J	=	Estimated Concentration
MCAS	=	Marine Corps Air Station
NS	=	Not Sampled
TCE	=	Trichloroethene
ug/L	=	Micrograms per Liter

For Multi-port or Cluster Well Locations, the Highest Concentration was Used For Contouring the Plume.

SOURCE:

MONITORING ROUND 14 FINAL GROUNDWATER MONITORING REPORT, SEPTEMBER 2001 (CDM 2002)

0 2500 5000

FEET

Record of Decision

Figure 5-5

TCE Concentrations in the Shallow Groundwater Unit and Principal Aquifer Round 14, September 2001

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 4/23/02
File No: 164Q8718
Job No: 22214-164
Rev No: C

PAGE NO. 5-14

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A

NORTHWEST

IRWD-78 (Projected Well Location)

18_MCAS08 (Projected Well Location)

18_NLAKE (Projected Well Location)

18_MCAS07

18_MCAS02

ground surface

water table

SEA LEVEL

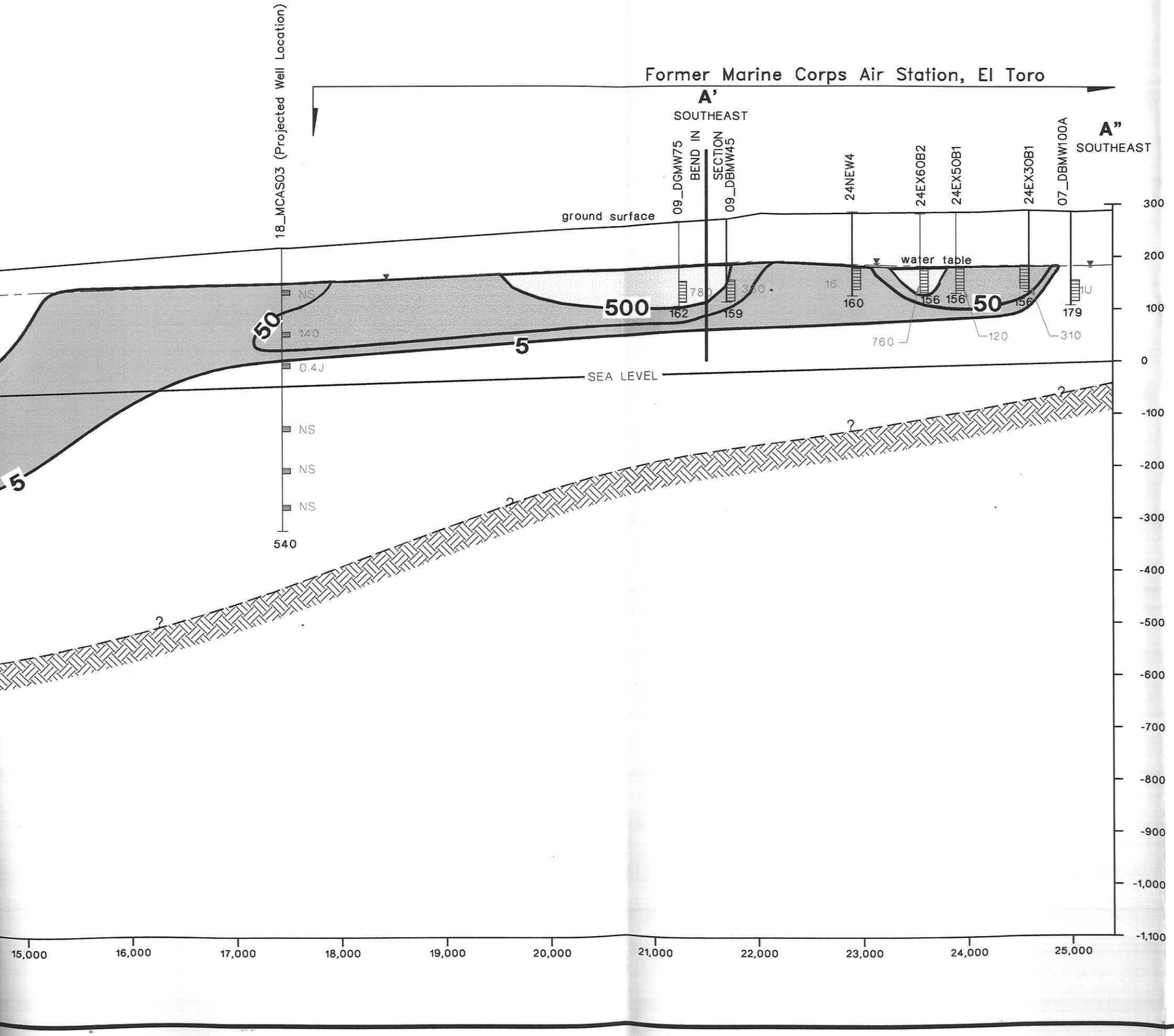
ELEVATION (Feet MSL)

300
200
100
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1,000
-1,100

NS
0.6J
NS
15
NS
NS
2
NS
9
NS
NS
NS
10U
435
690
890
1152
660
5
2

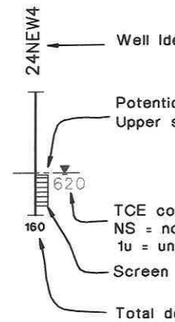
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
11,000
12,000
13,000
14,000

DISTANCE ALONG PROFILE (Feet)



LEGEND:

Location of A-A' shown on Figure 5-5



TCE CONCENTRATIONS IN GROUNDWATER

- 5.0 TO 50.0 ug/L TCE
- 50.0 TO 500.0 ug/L TCE
- GREATER THAN 500.0 ug/L TCE
- ILLUSTRATED TCE PLUME BELOW THE SHALLOW GROUNDWATER UNIT WAS TAKEN FROM September 2001 data.
- 5 — INFERRED TCE ISOCONCENTRATION CONTOUR (ug/L)
- Semiconsolidated low-permeability sediments
- (P) Production well

TCE = Trichloroethene
ug/L = Micrograms per liter
J = Estimated concentration

SOURCE:

MONITORING ROUND 14 FINAL GROUNDWATER MONITORING REPORT, SEPTEMBER 2001 (CDM 2002)

VERTICAL EXAGGERATION: 5x

0 1,000 2,000

HORIZONTAL SCALE IN FEET

Record of Decision

Figure 5-6

TCE Concentrations in Groundwater Cross Section A-A"

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 4/23/02
File No: 164X8711
Job No: 22214-164
Rev No: C

PAGE NO. 5-16

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completely stopping vertical fluid migration through the vadose zone. Under these conditions, fluid migration was primarily vertical through the vadose zone beneath Buildings 296 and 297 where solvents were used at Site 24 (BNI 1997a).

Groundwater is first encountered approximately 85 to 120 feet beneath Site 24 in the shallow groundwater unit. This unit consists of sands and minor gravel interbedded with silts and clays and is laterally continuous across the site. The thickness of the shallow groundwater unit ranges from 100 to 150 feet based on boring logs from Site 24. The upper 40 to 50 feet is relatively sandy with some fine-grained interbeds. The lower portion (the bottom 50 to 120 feet) of the unit, while still containing massive sandy units, becomes increasingly interbedded with finer-grained sediments.

Located approximately 100 feet below the first water encountered at Site 24 is an intermediate zone that also consists of interbedded sands, silts, and clays, but with a higher percentage of finer-grained sediments than the shallow groundwater unit. This intermediate zone, approximately 90 feet thick, appears to act as an aquitard in the area of Site 24 by restricting groundwater flow between the overlying shallow groundwater unit and the underlying principal aquifer (JEG 1996a).

The principal aquifer is encountered immediately below the intermediate zone approximately 290 feet bgs. The saturated thickness of the principal aquifer in the area is estimated to be over 200 feet. The deepest drilling during the RIs encountered the semiconsolidated, low-permeability sediments that underlie the principal aquifer and generally bound the bottom of the groundwater flow system of the Irvine Subbasin. This unit is not considered to be appreciably water bearing (BNI 1997a).

At Site 24, separation of the shallow groundwater unit from the principal aquifer is supported by lithologic, geochemical, and cone penetrometer test data. Geotechnical analytical results from the shallow groundwater unit, intermediate zone, and principal water-bearing zone indicate vertical hydraulic conductivities for the intermediate zone that are several orders of magnitude lower than the two water-bearing zones (BNI 1997a). Although small vertical gradients exist between shallow and deeper water-bearing intervals at Site 24, groundwater analytical data suggest that downward migration of VOCs from the shallow groundwater unit to the principal aquifer is minimal.

The potentiometric elevation data suggest that vertical groundwater flow throughout the basin occurs due to a slight downward gradient that becomes more pronounced when the principal aquifer agricultural wells are in operation (BNI 1999a). The off-Station TCE contamination in the principal aquifer is verification that some downward vertical migration has occurred. A groundwater pilot test performed in 1998, subsequent to completion of the RI, showed that vertical migration of VOCs from the shallow groundwater unit occurs downgradient of Site 24 (BNI 1998b).

The groundwater plume at Site 18 is limited to the principal aquifer which is first present approximately 300 to 375 bgs in this area. The saturated thickness of the aquifer ranges from less than 100 feet in the eastern portion of the site to about 700 feet in the western portion (Figure 5-6). During the RI, wells screened in the principal aquifer exhibited

transmissivity values ranging from 0.28 square foot per day to 5,680 square feet per day, hydraulic conductivity values of 0.01 foot per day to 56.8 feet per day, and storage coefficients of approximately 10^{-4} (JEG 1996e). Figure 5-7 illustrates the direction of groundwater flow.

Figure 5-8 presents a conceptual hydrogeologic model for Sites 18 and 24.

5.2.2 Site History

The Former MCAS El Toro mission has historically involved the operation and maintenance of military aircraft and ground-support equipment. The southwestern quadrant, which includes Site 24, was the center of industrial activity at the Station. Historical activities at Site 24 supporting the Station mission included aircraft maintenance and repair. These activities generated waste solvents that are believed to be the source of the VOC contamination at the site.

Active sources no longer exist at Site 24. Prior to Station closure, most of the potential sources, such as degreaser pits and solvent tanks, were either abandoned in place or completely removed, and former disposal practices, such as dust suppression with waste liquids, that may have led to the contamination were discontinued. Table 5-1 summarizes potential VOC sources at Site 24.

Land above the Site 18 groundwater plume has historically been used for agricultural activities. However, recently the land use has changed to mixed use with agricultural, commercial, and residential areas. The agricultural land use has likely contributed to the reportedly elevated concentrations of TDS and nitrate that are found throughout the basin, but it is not responsible for the extensive VOC contamination that originated at Site 24.

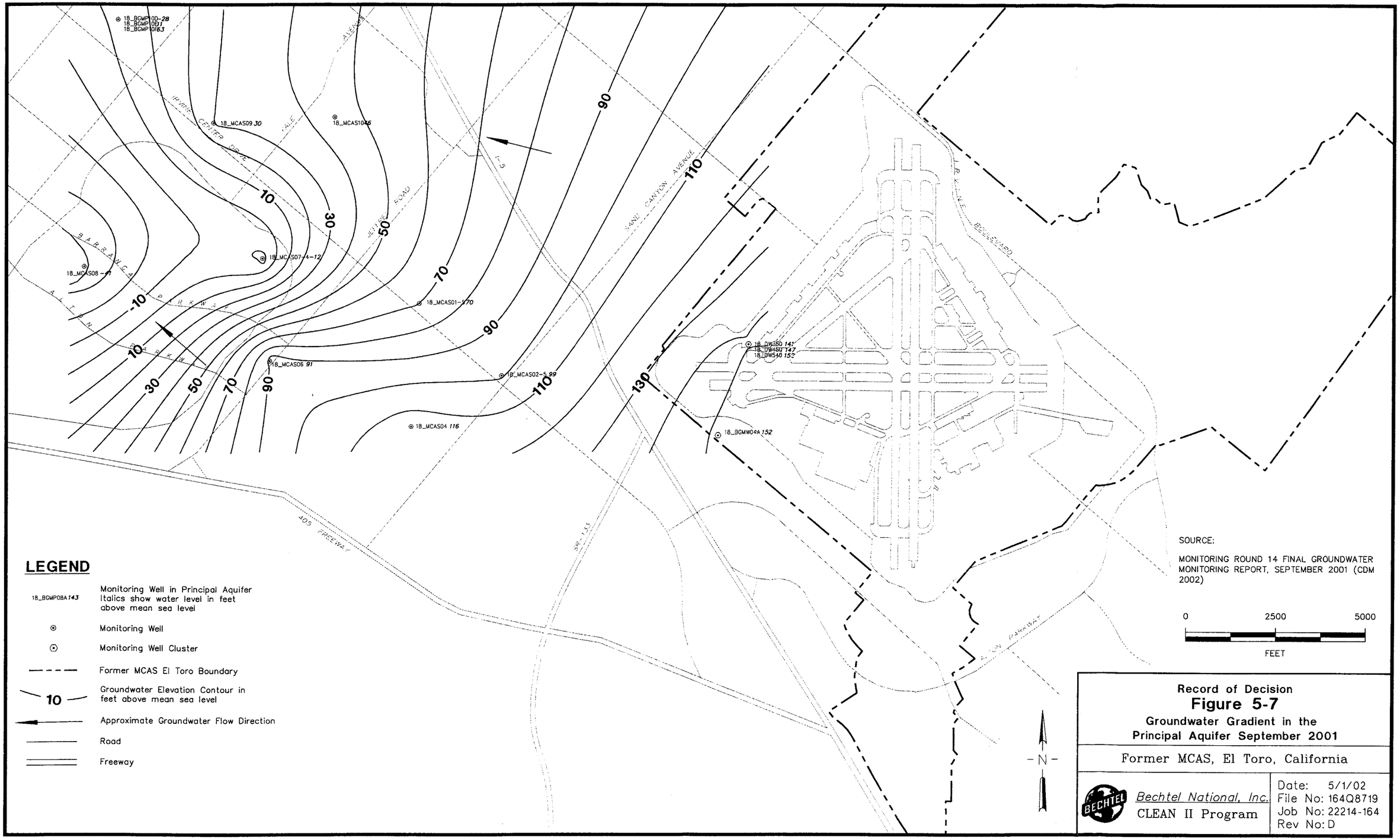
5.3 SITE INVESTIGATIONS

Investigations at Site 18 have consisted of a OCWD groundwater investigation (1985), a perimeter study investigation (1988), a Phase I RI (1991 through 1993), a perchlorate evaluation (1998 through 1999), and a radionuclide evaluation (2001). Because of the depth of the principal aquifer, HydroPunch® sampling at Site 18 is not possible; all sampling results come from monitoring or agricultural wells.

Investigations conducted at Site 24 include a Phase I groundwater characterization and soil gas survey, a Phase II RI, perchlorate and radionuclide evaluations, and a preliminary assessment of Building 307, the location of a former dry cleaning facility, and the sewer line segment from Building 307 to the former industrial wastewater treatment plant. In addition, routine groundwater monitoring has taken place at Sites 18 and 24 since 1992.

5.3.1 OCWD Groundwater Investigation

In June 1985, OCWD discovered TCE in an agricultural well (TIC 47) approximately 3,000 feet west of the Station. OCWD subsequently launched its own off-Station investigation to determine the source and extent of the TCE contamination. After



LEGEND

- 18_BGMP08A 143 — Monitoring Well in Principal Aquifer italics show water level in feet above mean sea level
- Monitoring Well
- Monitoring Well Cluster
- Former MCAS El Toro Boundary
- 10 — Groundwater Elevation Contour in feet above mean sea level
- Approximate Groundwater Flow Direction
- Road
- Freeway

Record of Decision

Figure 5-7

Groundwater Gradient in the Principal Aquifer September 2001

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 5/1/02
File No: 164Q8719
Job No: 22214-164
Rev No: D

PAGE NO. 5-20

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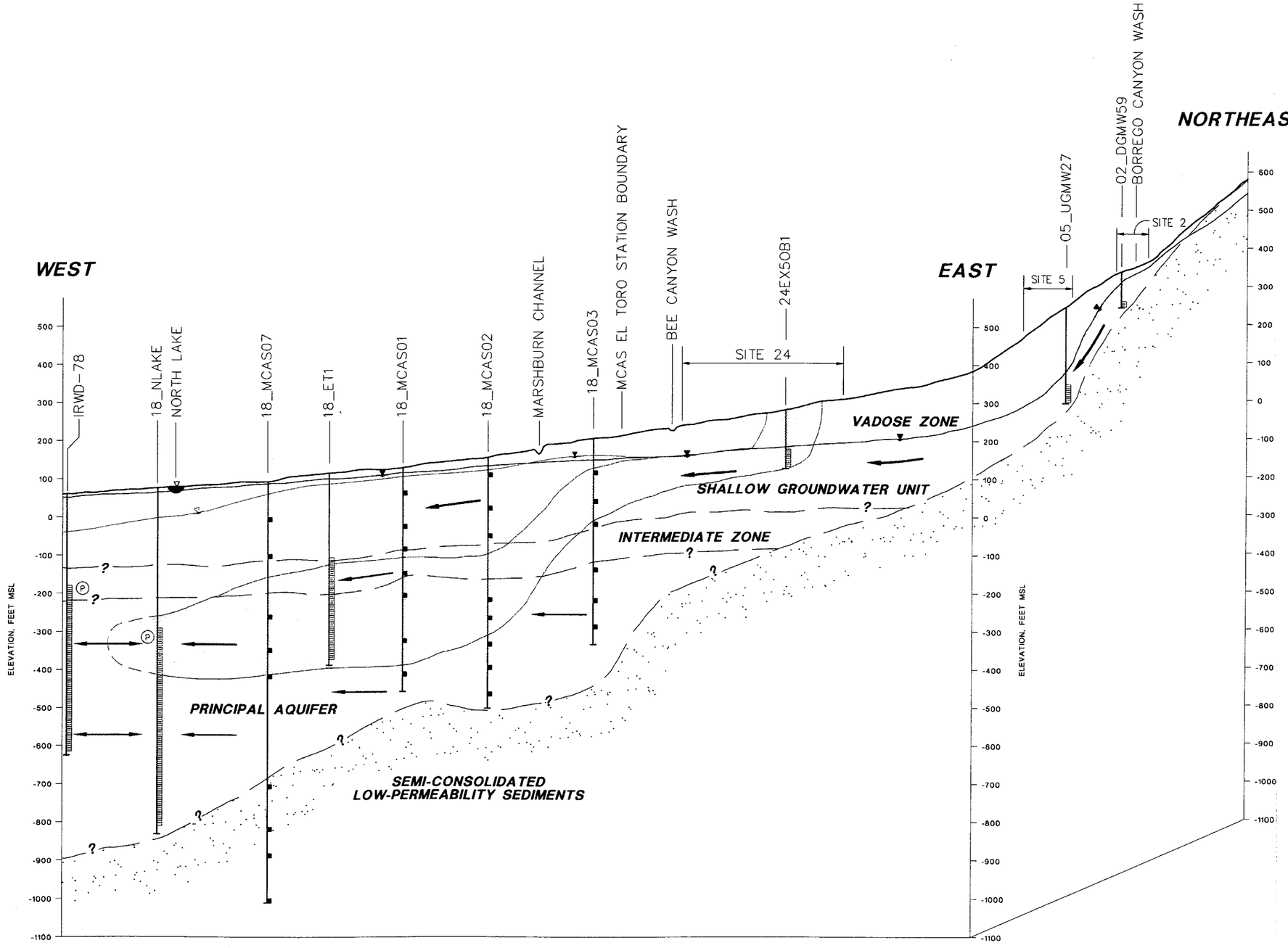

LEGEND

- BORING OR WELL LOCATION
- WESTBAY WELL PORTS
- SCREENED INTERVAL
- POTENTIOMETRIC ELEVATION OF THE SHALLOW GROUNDWATER UNIT
- POTENTIOMETRIC ELEVATION OF THE PRINCIPAL AQUIFER
- GEOLOGIC CONTACT
- LIMIT OF ZONE WHERE TCE EXCEEDS 5 UG/L CONCENTRATION IN GROUNDWATER
- DIRECTION OF GROUNDWATER FLOW IN THE SHALLOW GROUNDWATER UNIT
- DIRECTION OF GROUNDWATER FLOW IN THE PRINCIPAL AQUIFER
- (P) LOCATION OF PRODUCTION WELL PUMP INTAKE

SOURCE: DRAFT FINAL CERCLA GROUNDWATER MONITORING PLAN (BNI 1999a)

VERTICAL EXAGGERATION: 25:1

0 5,000 10,000

HORIZONTAL SCALE, FEET

Record of Decision

Figure 5-8

Former MCAS El Toro Conceptual Hydrogeologic Model

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Progr.

Date: 4/18/02
File No: 164X7926
Job No: 22214-164
Rev No: C

PAGE NO. 5-22

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Table 5-1
Potential Sources of VOC Contamination at Site 24

Location	Description
Subsurface	Former degreaser pits and solvent tanks Storm drains and industrial wastewater lines Vehicle wash racks with associated drains and sumps Underground storage tanks
Surface	Aircraft washing Waste-handling practices Hazardous waste storage areas Tarmac runoff

Acronym/Abbreviation:
VOC – volatile organic compound

installing a network of monitoring wells and soil vapor probes and reviewing the results of independent investigations by Cannon, Inc., and Wilma Pacific, Inc. (JEG 1993b), OCWD concluded that the Station was the source of the TCE contamination.

5.3.2 Perimeter Study Investigation

In 1988, James M. Montgomery Engineers, Inc., was contracted by the Marine Corps to conduct a perimeter study investigation (PSI) to study VOC contamination along the southwestern boundary of the Station. The PSI results indicated that VOCs are present in the shallow groundwater near the Station boundary.

5.3.3 Phase I Remedial Investigation

From 1992 through 1993, the DON conducted a Phase I RI for the regional groundwater contamination area designated as OU-1. The OU-1 study area included groundwater beneath the entire Station as well as the regional groundwater plume and groundwater beneath all areas at Former MCAS El Toro was known as Site 18 (Site 24 had not been designated yet). The RI identified groundwater contamination at several areas throughout Former MCAS El Toro, including Magazine Road Landfill, Site 2, and Crash Crew Pit, Site 16. Contaminated groundwater at Sites 2 and 16 is being addressed in conjunction with soil contamination at these sites in separate RODs. OU-1 is now considered to include only Site 18.

The Phase I RI groundwater characterization identified a plume of TCE in groundwater originating beneath the area now designated as Site 24. The plume extended approximately 3 miles off-site and downgradient of Former MCAS El Toro. The Phase I soil gas survey identified potential VOC sources by collecting soil gas samples from the upper 30 feet of soil at Site 24. TCE in soil gas was reported throughout a large area beneath Buildings 296 and 297, but the area of highest TCE concentrations in groundwater was separated from this apparent vadose zone source by approximately

1,500 feet (JEG 1994b). The area of highest reported TCE concentrations in groundwater was approximately 1,500 feet northwest of Building 297 at Site 24. The highest concentration of TCE reported in groundwater during the Phase I RI was 2,000 µg/L (JEG 1993a).

Chemicals reported in groundwater during the Phase I RI included VOCs, SVOCs, pesticides, herbicides, and metals. The primary contaminants found in groundwater at Sites 18 and 24 were VOCs (Table 5-2), especially TCE. TCE has been reported beyond the Station as far west as Culver Drive in Irvine. TCE was also the compound reported most often and at the highest concentrations in groundwater at Sites 18 and 24, followed by PCE and carbon tetrachloride.

An evaluation of metals in groundwater was performed during the Phase I RI and subsequent to the Phase II RI (JEG 1996a, BNI 1999a). These evaluations supported the conclusion that elevated concentrations of metals in groundwater at Former MCAS El Toro are the result of ambient conditions and are not the result of activities that took place at the Station. For this reason, metals are not included as chemicals of concern (COCs) at Sites 18 or 24.

SVOCs were reported during the OU-1 RI. With few exceptions, the only SVOCs observed in groundwater were phthalates. Phthalates are man-made compounds typically associated with plastics manufacturing and are commonly found in the environment at low concentrations; they are also common laboratory contaminants. The available groundwater data do not suggest the presence of a distinct source of SVOC contamination and, therefore, SVOCs were not included as COCs at Site 18 and 24.

Seven pesticides and nine herbicides were also reported in groundwater at OU-1. All but one of the pesticides and one of the herbicides were reported in the first of two rounds of sampling. The OU-1 RI concluded that the presence of these organic compounds may be due to past and current agricultural activities. The RI also noted that the presence of these organic compounds may be due to the potable water drawn from fire hydrants used as source water for drilling since low levels of pesticides were reported in the hydrants' water. Based on the OU-1 evaluation, pesticides and herbicides were not considered COCs at Sites 18 and 24.

TDS and nitrate concentrations were also evaluated during the Phase I RI. Both parameters were reported at elevated concentrations throughout the shallow groundwater unit and principal aquifer (Figures 5-9 and 5-10). The concentrations varied with depth.

The highest TDS concentrations were in the shallowest (surface to 200 feet bgs: mean of 1,326 milligrams per liter [mg/L]) and deepest (greater than 650 feet: mean of 1,273 mg/L) portions of the aquifer system. The middle two depth intervals (200 to 650 feet bgs) had lower average TDS concentrations (853 to 932 mg/L).

Nitrate concentrations decreased with sampling depth. Nitrate concentrations above an upper screen depth of about 200 feet were about twice concentrations at the 200- to 400-foot depth interval (mean concentrations of 18.9 mg/L versus 8.21 mg/L). Nitrate concentrations below 650 feet were below the detection limit.

Table 5-2
Groups of VOCs Reported in Groundwater at Sites 18 and 24

Chemical Group	Site 18	Site 24
PCE/TCE		
1,1-DCA	x	
1,2-DCA	x	x
1,1-DCE	x	x
1,2-DCE	x	x
1,1,2,2-PCA	x	
PCE	x	x
1,1,1-TCA	x	x
1,1,2-TCA	x	x
1,2-TCA	x	
TCE	x	x
Vinyl chloride	x	
Carbon Tetrachloride		
Carbon tetrachloride	x	x
Chloroform	x	x
Chloromethane (methyl chloride)	x	x
Methylene chloride (dichloromethane)	x	x
Benzene		
Benzene	x	x
Ethylbenzene	x	x
Styrene		x
Toluene	x	x
Xylenes	x	x
Other		
Acetone	x	x
2-Butanone		x
Carbon disulfide		x
Chlorobenzene	x	
1,2-Dichloropropane	x	
4-Methyl-2-pentanone		x
Trichlorofluoromethane (Freon 11)	x	

Acronyms/Abbreviations:
DCA – dichloroethane
DCE – dichloroethene
PCA – tetrachloroethane
PCE – tetrachloroethene
TCA – trichloroethane
TCE – trichloroethene
VOC – volatile organic compound

5.3.4 Phase II Remedial Investigation

The Phase II RI of Site 24 was designed to characterize the nature and extent of VOCs in soil and groundwater, collect data to be used for a baseline human-health risk assessment, and determine why the area of highest TCE concentrations in groundwater appeared to be separated from the vadose zone source.

Vadose Zone Investigation

The horizontal and vertical extent of VOCs in the vadose zone was characterized using Phase I and Phase II soil and soil gas analytical results. The results confirmed that, at the time of the RI, a primary TCE source area was present beneath Buildings 296 and 297. This source area extended vertically to groundwater directly beneath those buildings, with the highest concentrations near the water table. The trend of increasing concentration with depth suggested a depleting source at the surface, which is consistent with the end of TCE usage in approximately 1975.

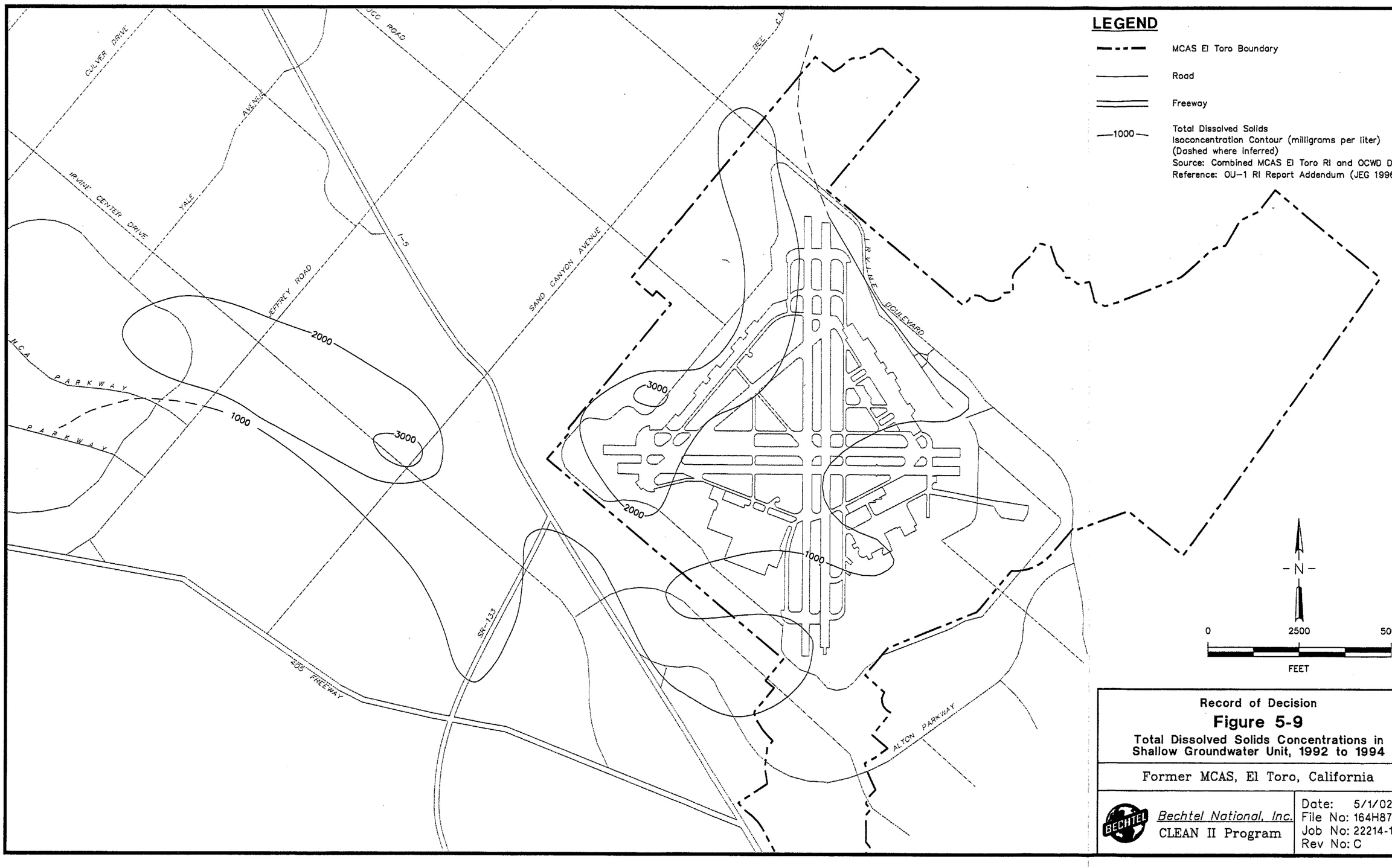
The maximum concentration of TCE reported in soil during the Phase II RI was 190 micrograms per kilogram (µg/kg), compared with a concentration of 400 µg/kg during the Phase I investigation. TCE in soil gas was reported at concentrations up to 6,120 µg/L. This exceeds the concentration in equilibrium with TCE-contaminated groundwater and indicates that an active mechanism existed to transfer TCE in the vadose zone to groundwater.

In addition to TCE, other chlorinated VOCs, such as PCE, carbon tetrachloride, and related organic chemicals, were also reported in soil at Site 24, but with less frequency and at much lower concentrations. 1,1,2-Trichloro-1,2,2-trifluoroenthane (Freon 113) had a soil gas volume nearly as large as that of TCE, but was not considered a threat to groundwater due to relatively low concentrations and toxicity.

Groundwater Investigation

Beneath Site 24, the VOC groundwater contamination was found to be limited to approximately the top 100 feet of the shallow groundwater unit. Most of the contamination is present in a VOC plume that extends from beneath Buildings 296 and 297 south to the Station boundary and northwest off-Station to approximately 3 miles from the Station boundary. Since strong vertical hydraulic gradients are absent, vertical migration of VOC is effectively impeded by the low permeability of the silt and clay layers that are present. As a result, VOC migration in the area of Site 24 is generally horizontal in a northwest direction along the more permeable sand beds (BNI 1997b).

The maximum areal extent of the VOC groundwater plume that requires remedial action is defined by any VOC reported above its federal or state MCL (i.e., 5 µg/L in the case of TCE and PCE). Within the boundaries of Site 24, the VOC-contaminated groundwater appears to be confined to the shallow groundwater unit. As the groundwater contamination moves away from Site 24 and off-Station, it turns more westward and migrates to a greater depth in response to hydraulic gradients created by the pumping of



LEGEND

- MCAS El Toro Boundary
- Road
- Freeway
- —1000— Total Dissolved Solids Isoconcentration Contour (milligrams per liter) (Dashed where inferred)

Source: Combined MCAS El Toro RI and OCWD Data
Reference: OU-1 RI Report Addendum (JEG 1996h)

N

0 2500 5000

FEET

Record of Decision

Figure 5-9

Total Dissolved Solids Concentrations in Shallow Groundwater Unit, 1992 to 1994

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 5/1/02
File No: 164H8720
Job No: 22214-164
Rev No: C

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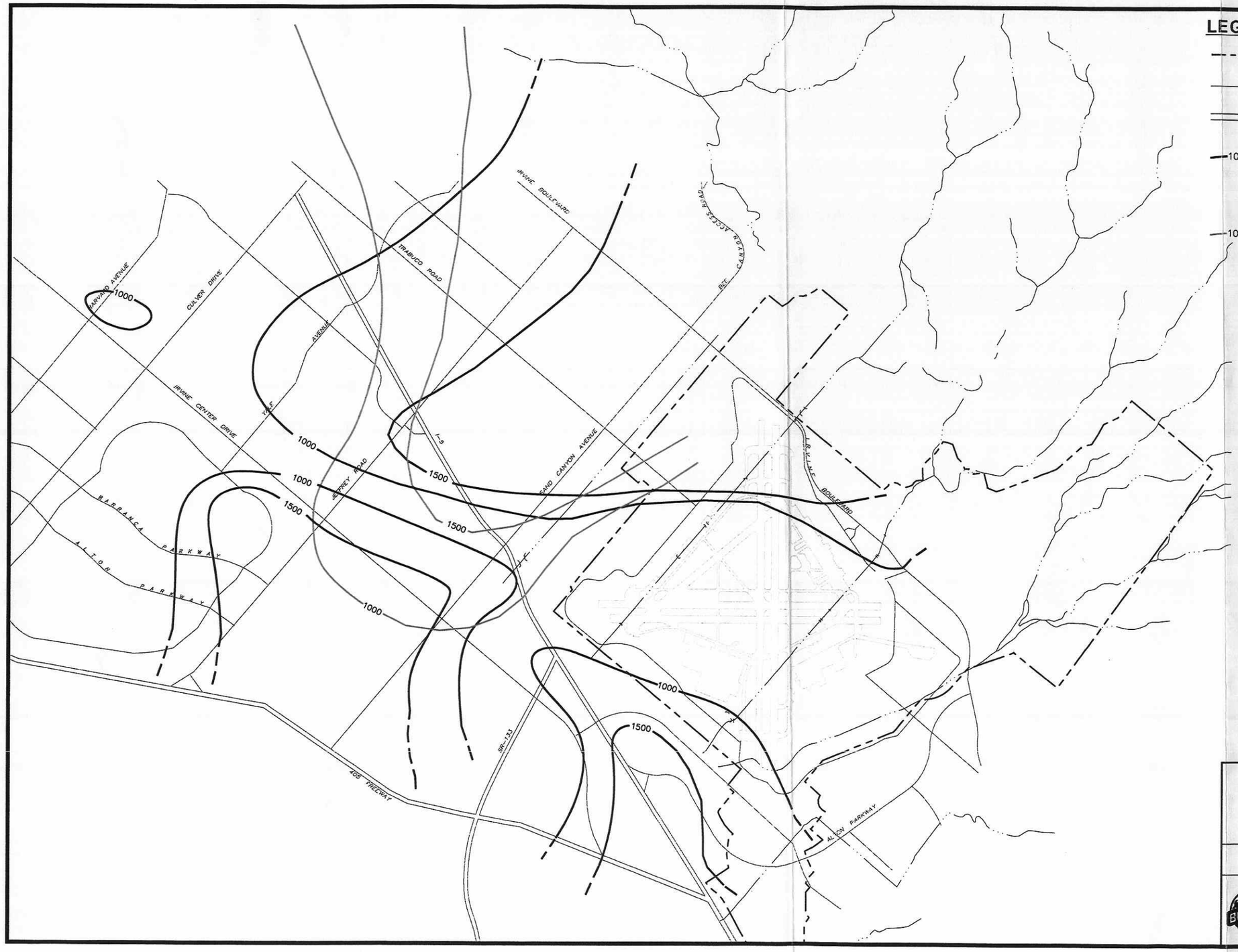

LEGEND

- MCAS EL TORO BOUNDARY
- ROAD
- FREEWAY
- 1000 — TOTAL DISSOLVED SOLIDS ISOCONCENTRATION CONTOUR (MILLIGRAMS PER LITER) (DASHED WHERE INFERRED) SOURCE: COMBINED MCAS EL TORO RI AND OCWD DATA REFERENCE: OU-1 RI REPORT ADDENDUM (JEG 1996h)
- 1000 — TOTAL DISSOLVED SOLIDS ISOCONCENTRATION CONTOUR (MILLIGRAMS PER LITER) SOURCE: OCWD (1995) REFERENCE: OU-1 RI REPORT ADDENDUM (JEG 1996h)

N

0 3500 7000

FEET

Record of Decision

Figure 5-10

Total Dissolved Solids Concentrations in Principal Aquifer, 1992 to 1994

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 6/18/02
File No: 164H8721
Job No: 22214-164
Rev No: E

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principal aquifer agricultural wells. Figure 5-11 shows the maximum areal extent of the VOC plume in the shallow groundwater unit. Figure 5-6 shows the vertical extent of VOC contamination in the shallow groundwater unit.

Most VOCs reported at Sites 18 and 24 during the Phase I and II RIs belong to one of the following three groups: a PCE/TCE group, a carbon tetrachloride group, or a benzene group (Table 5-2).

- Compounds in the PCE/TCE group are common constituents in industrial solvents. Breakdown products of the PCE/TCE group are formed by dechlorination of the parent compounds.
- Carbon tetrachloride is also a common industrial solvent. Dechlorination of carbon tetrachloride yields chloroform, dichloromethane, and chloromethane.
- Compounds in the benzene group are common fuel constituents. Although remedial action of fuel releases is being addressed under the California Leaking Underground Fuel Tank program, compounds in the benzene group are sporadically present within the regional VOC plume at very low concentrations.

Other VOCs were not grouped, either because there were no obvious relationships or because their detection frequencies were low. The following subsections summarize the results of groundwater sampling conducted during the Site 24 Phase II RI and during groundwater remediation pilot testing conducted at Site 24 between July 1997 and July 1998 (BNI 1998b).

PCE/TCE Group. During the Site 24 Phase II RI, TCE was reported in 38 of 62 groundwater samples collected. Of those samples with reportable concentrations, 35 exceeded the MCL of 5 µg/L. During the Site 24 groundwater remediation pilot testing, which was generally conducted within the TCE hot spot (defined as the plume area with TCE concentration greater than 500 µg/L), 119 HydroPunch groundwater samples were collected. Of those samples, 115 had reportable concentrations of TCE and 101 exceeded the MCL. The maximum reported concentration of TCE was 4,850 µg/L near Building 296.

PCE was reported in 10 of 62 groundwater samples analyzed during the Phase II RI. Of those samples, three exceeded the MCL of 5 µg/L. During pilot testing, PCE was reported in 53 of 119 HydroPunch samples of which 11 exceeded the MCL. The maximum reported concentration was 46.5 µg/L near the west side of Building 297.

Other related VOCs were also reported, generally in samples with much higher TCE concentrations.

Carbon Tetrachloride Group. Carbon tetrachloride was reported in 11 of 62 groundwater samples analyzed during the Phase II RI. Of those samples, all but one exceeded the MCL of 0.5 µg/L. During pilot testing, 37 of 119 samples had reportable concentrations and 27 exceeded the MCL of 0.5 µg/L. Chloroform, chloromethane, and methylene chloride were also reported in groundwater samples, but concentrations did not exceed MCLs.

Benzene Group. None of the compounds in the benzene group exceeded their respective MCLs.

5.3.5 Potential for DNAPL

Because solvents were formerly used at the Station in nonaqueous liquid phase as cleaning and degreasing agents, the potential for the existence of dense nonaqueous-phase liquid (DNAPL) at the site was investigated during the Phase I and Phase II RIs. Conclusions reached by both investigative teams were consistent: there is little evidence of DNAPL at Site 24. The VOC concentrations reported in soil, soil gas, and groundwater were well below levels expected if an active DNAPL source were present at the site (U.S. EPA 1991a).

5.3.6 Vadose Zone Remediation

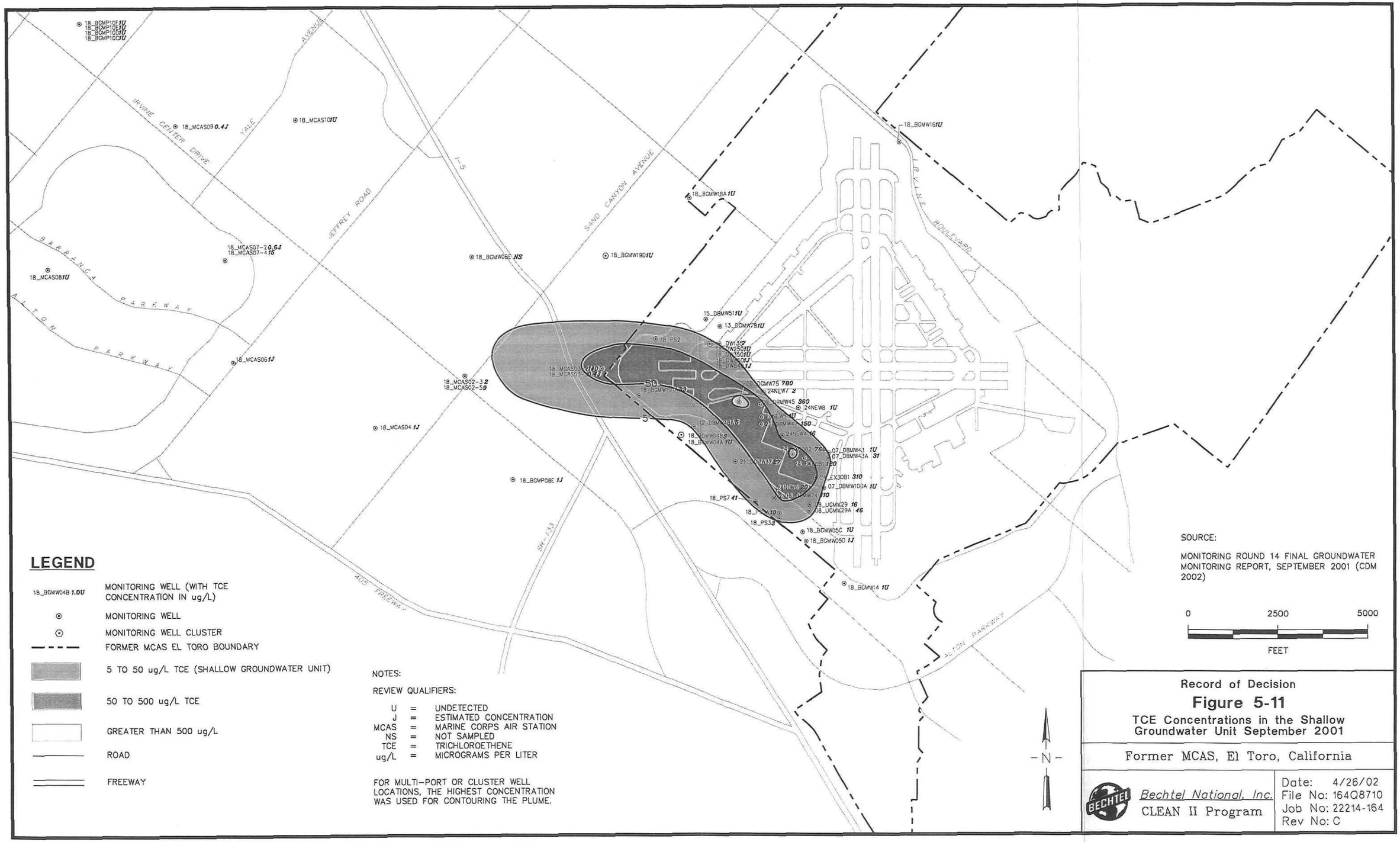
Calculations performed during the Phase II RI showed that the concentrations of VOCs present in deeper subsurface soil at Site 24 were high enough to contaminate groundwater to levels above drinking water standards. For this reason, the following remedial action objectives were developed for the vadose zone:

- Reduce concentrations of VOCs in the VOC source areas to prevent or minimize further degradation of the shallow groundwater unit above the MCLs for drinking water.
- Continue vadose zone remediation until VOC soil gas concentrations are below the established threshold concentrations (concentrations capable of contaminating the shallow groundwater unit above the MCLs).

Table 5-3 presents the threshold concentrations (cleanup goals) for the predominant VOCs present in soil at Site 24.

Alternatives for remediation of the vadose zone were presented in the Phase II FS Report (BNI 1997c). The preferred alternative used a central SVE treatment system that had been successfully used to remediate VOCs at Norton AFB. SVE pilot tests were successfully performed in 1996, and SVE was selected for vadose zone remediation in an interim ROD that was finalized in September 1997 (SWDIV 1997a). Transfer and installation of the SVE system used at Norton AFB was completed in 1998. In January 1999, the remedial design for the SVE system was completed and operational testing of the central treatment system remediation equipment began. Actual remedial action started in March 1999 with the use of portable SVE systems to extract VOCs from existing SVE wells. The central treatment system operation and installation of the initial phase of additional SVE wells and the associated vapor conveyance piping began in May 1999.

By the end of 1999, significant progress had been made in remediating the vadose zone, and vapor concentrations in all the SVE wells were below the soil gas cleanup (threshold) levels. Rebound testing of existing SVE wells and installation of supplemental SVE wells (to confirm that soil gas cleanup goals had been achieved throughout the soil gas plume) were completed in April 2000. Table 5-4 summarizes the total mass of



LEGEND

18_BGMW04B 1.0U	MONITORING WELL (WITH TCE CONCENTRATION IN ug/L)
⊙	MONITORING WELL
⊙	MONITORING WELL CLUSTER
— — —	FORMER MCAS EL TORO BOUNDARY
	5 TO 50 ug/L TCE (SHALLOW GROUNDWATER UNIT)
	50 TO 500 ug/L TCE
	GREATER THAN 500 ug/L
———	ROAD
═══	FREEWAY

NOTES:

REVIEW QUALIFIERS:

U	=	UNDETECTED
J	=	ESTIMATED CONCENTRATION
MCAS	=	MARINE CORPS AIR STATION
NS	=	NOT SAMPLED
TCE	=	TRICHLOROETHENE
ug/L	=	MICROGRAMS PER LITER

FOR MULTI-PORT OR CLUSTER WELL LOCATIONS, THE HIGHEST CONCENTRATION WAS USED FOR CONTOURING THE PLUME.

SOURCE:

MONITORING ROUND 14 FINAL GROUNDWATER MONITORING REPORT, SEPTEMBER 2001 (CDM 2002)

0 2500 5000

FEET

Record of Decision

Figure 5-11

TCE Concentrations in the Shallow Groundwater Unit September 2001

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 4/26/02
File No: 164Q8710
Job No: 22214-164
Rev No: C

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Table 5-3
Vadose Zone Cleanup Goals
(in micrograms per liter)

VOC	U.S. EPA MCL	Cleanup Goal (Soil Gas)	Highest Soil Gas Concentration Reported
Trichloroethene	5	27	6,120
Tetrachloroethene	5	69	192
Carbon tetrachloride	0.5*	61	31
1,1-Dichloroethene	6	563	447
Freon 113	1,200*	234,000	2,520

Note:
* California MCL

Acronyms/Abbreviations:
Freon 113 – 1,1,2-trichloro-1,2,2-trifluoroethane
MCL – maximum contaminant level
U.S. EPA – United States Environmental Protection Agency
VOC – volatile organic compound

Table 5-4
Mass of VOCs Removed During Vadose Zone Remediation at Site 24

Remediation Phase	Dates	Mass (lbs)*	Remarks
Mass of VOCs removed during pilot scale testing	4/95–5/98	1,439	Mass estimates are based on amounts stated in the draft final Engineering Design Report (BNI 1998a).
Mass of VOCs removed by portable SVE units	6/98–12/98	74	Mass estimates are based on data provided by OHM.
Mass of VOCs removed by central treatment system	5/99–9/00	283	Mass estimates are based on treatment system inlet concentrations.
Mass of VOCs removed by portable SVE units	1/99–9/00	193	Mass estimates are based on treatment system inlet concentrations.
Total		1,989	

Note:
* total mass of VOCs extracted is assumed to equal the total mass of primary contaminants (TCE, Freon, 1,1-DCE, and PCE) extracted

Acronyms/Abbreviations:
BNI – Bechtel National, Inc.
DCE – dichloroethene
lb – pound
OHM – OHM Remediation Services Corp.
PCE – tetrachloroethene
SVE – soil vapor extraction
TCE – trichloroethene
VOC – volatile organic carbon

VOCs extracted. In June 2001, a draft closure report for soil at Site 24 was issued (Earth Tech 2001d). This report is expected to be finalized in spring 2002. Remediation of soil at Site 24 will be discussed further in the final ROD for the Site 24 vadose zone.

5.3.7 Preliminary Assessment of Building 307

Building 307 is located in the southwest portion of Site 24 and is reported to have been a former dry cleaning plant.

In September 2001, the DON conducted a preliminary assessment at Building 307 to identify and characterize the possible presence of VOCs in soil gas, soil, and groundwater as a result of historical dry cleaning operations (Earth Tech 2001c). The purpose of the preliminary assessment was to determine whether releases had occurred at the building or along the sewer segment from Building 307 to the former industrial wastewater treatment plant. The primary constituents of concern were PCE, TCE, dichloroethene (DCE), and carbon tetrachloride.

The following samples were analyzed for VOCs: 84 shallow soil gas samples collected (between 5 and 15 feet bgs) in and around Building 307 and along the adjacent sewer line; 14 deep soil gas samples collected (between 15 and 90 feet bgs) at Building 307 and along the adjacent sewer line; 6 soil samples collected (between 15 and 25 feet bgs) in and around Building 307 and along the sewer line segment running from Building 307 to the former industrial wastewater treatment plant; and 3 HydroPunch groundwater samples collected (at approximately 100 feet bgs) upgradient, next to, and downgradient of Building 307.

VOCs in excess of the 1 µg/L detection limit were reported in 4 of the 76 shallow soil gas samples submitted to the on-site mobile laboratory. At these locations, Freon 113 was reported at 1.4 µg/L (10 feet bgs) and 4.6 µg/L (15 feet bgs), total xylenes at 1.9 µg/L (5 feet bgs), toluene at 1 µg/L (5 feet bgs), and dichlorodifluoromethane (Freon 12) at 130 µg/L (15 feet bgs). In addition, analyses of eight shallow soil gas duplicate samples conducted at a fixed-base laboratory reported concentrations less than 1 µg/L. These compounds, in addition to having relatively low reported concentrations, were not the primary constituents of concern for this investigation.

VOCs in excess of the 1 µg/L detection limit were reported in 5 of the 12 deep soil gas samples submitted to the on-site mobile laboratory. At these locations, 1,1-DCE was reported at 4.6 µg/L (60 feet bgs); and TCE at 5.0 µg/L (56.6 feet bgs), 2.6 µg/L (42 feet bgs), 7.8 µg/L (66 feet bgs), and 5.9 µg/L (90 feet bgs). However, analyses of two deep soil gas duplicate samples conducted at a fixed-base laboratory reported concentrations of TCE at 10.0 µg/L and Freon 113 at 14.0 µg/L in one of the duplicates at 66 feet bgs.

None of the soil samples collected had concentrations of VOCs above the reporting limit.

TCE was also reported in all three of the HydroPunch samples at concentrations ranging from 4.1 µg/L (100 feet bgs) to 8.4 µg/L (105 feet bgs). These concentrations are of the

same order of magnitude as concentrations reported in the basewide plume that also extends beneath the building.

The preliminary assessment of Building 307 confirmed the Site 24 RI conclusions that there has not been a significant release to the environment at Building 307 or along the sewer line segment between the building and the former industrial wastewater treatment plant due to past dry cleaning operations.

5.3.8 Aquifer Testing and Air-Sparging Pilot Tests

Aquifer and air-sparging pilot tests were performed as part of the Phase II groundwater FS. The aquifer tests were performed to evaluate the hydraulic characteristics of the shallow groundwater unit, including radius of influence and sustainable extraction and injection rates (BNI 1996c). Groundwater extraction and injection tests were also conducted to help evaluate remedial technologies described in the OU-1 Interim-Action Feasibility Study (IAFS) Report (JEG 1996b) and the OU-2A FS Report (BNI 1997b). The OU-1 IAFS assumed that extraction and injection wells screened across the shallow groundwater unit would be able to sustain 40 gpm. Aquifer testing was designed, in part, to test this assumption.

Aquifer pumping, recovery, and injection tests indicated hydraulic conductivity values ranging from 4.3 to 10.1 feet per day at Site 24 and between 11.1 and 15.3 feet per day at two locations near the southwestern corner of the Station. Radius-of-influence estimates ranged from 80 to 215 feet. Extraction and injection rates were in the range of 15 gpm, although step tests indicated that an injection rate of 25 gpm might be possible.

The air-sparging pilot test was conducted to determine whether air sparging would be effective in transferring VOCs in groundwater from a liquid to a vapor form, in which they could be captured in the vadose zone using SVE. The pilot test showed that VOC concentrations in groundwater did decline but that the air-sparging radius of influence was limited, suggesting a short circuit for airflow in the aquifer. Because airflow could not be effectively controlled in the subsurface, the pilot-test report concluded that sitewide implementation of air sparging would be problematic because of the heterogeneities in the aquifer. The results of the pilot test allowed the DON to eliminate air-sparging as a potential remedial technology for groundwater at Site 24.

5.3.9 Groundwater Remediation Pilot Testing

Groundwater remediation pilot testing at Site 24 was performed between June 1997 and July 1998. The pilot test collected additional data to assist in the design of a remedial alternative capable of minimizing VOC migration within the shallow groundwater unit and also from the shallow groundwater unit to the principal aquifer. The pilot tests evaluated standard and vacuum-enhanced groundwater extraction and groundwater injection based on their effectiveness to remediate or contain VOCs in groundwater.

Five extraction wells and two injection wells were tested. Extracted groundwater was treated with activated carbon to remove VOCs before being injected back into the aquifer.

The sustained well yields of the extraction and injection wells were estimated using step-drawdown or step-building testing before beginning the pilot testing. Extraction wells were pumped for 1 to 2 weeks using standard pumping and from 1 to 3 weeks with vacuum-enhanced pumping. An extended test at one extraction well was conducted for approximately 5 months. Approximately 6.4 million gallons of groundwater was extracted from the wells, which removed about 28 pounds of TCE from groundwater. Approximately 63 pounds of TCE was removed as vapor during the vacuum-enhanced portion of the test.

5.3.10 Perchlorate Evaluation

In December 1997, perchlorate was identified at low concentrations (< 8 µg/L) in groundwater downgradient from Former MCAS El Toro during sampling conducted by OCWD (Earth Tech 2001a). The reported concentrations were below the California PAL of 18 µg/L and the U.S. EPA action level of 32 µg/L. (The California PAL of 18 µg/L was established in 1997. As of January 2002, the California PAL for perchlorate is 4 µg/L.) HydroPunch samples were collected between 26 January and 09 March 1998 to further evaluate the presence of perchlorate at Former MCAS El Toro. Although perchorate was reported at concentrations from 4 to 23 µg/L, the concentrations of all but one sample were 12 µg/L or less.

In October 1998, January–February 1999, and July–August 1999, Stationwide perchlorate sampling was performed concurrently with groundwater monitoring to assess the presence and concentration of perchlorate in groundwater throughout Former MCAS El Toro. The results of sampling conducted at the Sites 18 and 24 wells are summarized in Table 5-5. The table shows that perchlorate was detected sporatically and at generally low concentrations (≤ 12 µg/L) at the site. For this reason, perchlorate is not considered a COC at Site 18.

5.3.11 Groundwater Monitoring

Routine groundwater monitoring has been conducted at Former MCAS El Toro since 1992. The latest published monitoring reports are those from Round 14 conducted in September 2001 (CDM 2002). Round 14 included VOC analysis for all groundwater samples collected from Sites 18 and 24. During Round 14, two groundwater samples from Site 24 were also submitted for analysis of general chemistry parameters. The results are summarized below. Figure 5-5 illustrates the estimated vertical extent of the plume. Figure 5-6 shows the estimated horizontal extent of the plume (CDM 2002).

Site 18

Sixteen of the monitoring wells/ports in the principal aquifer unit at Site 18 were monitored during Round 14. VOCs identified in Site 18 samples included TCE, PCE, 1,2-DCE, carbon disulfide, chloroform, styrene, vinyl chloride, and dichlorodifluoromethane. In general, the concentrations and distribution of VOCs

Table 5-5
Perchlorate Sampling Results for Wells at Sites 18 and 24
(in micrograms per liter)

Well	October 1998 Result	April–May 1999 Result	July–August 1999 Result
07_DBMW100	6	6	5
09_DBMW45	<4	NA	NA
09_DBMW75	<4	10	9
18_BGMP06D	4	4	7
18_BGMP06E	<4	NA	NA
18_BGMP08D	<4	NA	NA
18_BGMP10F	<4	NA	NA
18_BGMW05D	<4	NA	NA
18_BGMW101	7	5	6
18_BGMW16	<4	NA	NA
18_BGMW17	<4	NA	NA
18_BGMW18	<4	NA	NA
18_BGMW19D	<4	NA	NA
18_BGMW24	<4	NA	NA
18_DW135	13	11	12
18_MCAS01-1	<4	NA	NA
18_MCAS01-3	<4	NA	NA
18_MCAS01-5	<4	4	<4
18_MCAS01-6	<4	NA	NA
18_MCAS02-1	<4	NA	NA
18_MCAS02-3	<4	NA	NA
18_MCAS02-4	<4	2	3.3
18_MCAS03-1	<4	NA	NA
18_MCAS03-2	10	NA	7.7
18_MCAS03-3	<4	NA	NA
18_MCAS03-4	<4	NA	NA
18_MCAS07-2	<4	NA	NA
18_MCAS07-3	<4	NA	NA
18_MCAS07-4	<4	NA	NA
18_MCAS10	<4	NA	NA
19_DGMW86	13	NA	NA
21_DGMW90	6	5	6
24NEW4	<4	7	5
24NEW8	<4	NA	NA

Source:
Final Technical Memorandum Verification of Perchlorate at IRP Site 1, Explosive Ordnance Disposal Range (Earth Tech 2001a)

Acronym/Abbreviation:
NA – not applicable

identified in the principal groundwater aquifer were similar to those levels of VOCs measured during previous rounds (CDM 2002).

TCE continued to be the analyte most frequently reported above the detection limit in 7 of the 16 Site 18 wells. Reported concentrations were from 1 µg/L to 15 µg/L, with two samples reporting TCE concentrations (15 µg/L in 18_MCAS07-4 and 9 µg/L in 18_MCAS02-5) above the MCL (5 µg/L). All other VOC concentrations were reported below their MCLs (CDM 2002).

Site 24

Forty-six of the monitoring wells/ports in the shallow groundwater unit at Site 24 were monitored during Round 14. VOCs identified in Site 24 samples included TCE, PCE, 1,1-DCE, 1,2-DCE (total), carbon disulfide, carbon tetrachloride, chloroform, 1,2-dichloropropane, 1,1,2- trichloroethane (TCA), styrene, and Freon 113. In general, the concentrations and distribution of VOCs identified in the shallow groundwater unit were similar to the concentrations of VOCs reported during the previous round. With the exception of TCE, PCE, 1,2-DCE (total), carbon tetrachloride, and 1,1-DCE, the reported concentrations were below their respective MCLs (CDM 2002).

TCE continues to be the most frequently reported analyte in samples collected from the Site 24 wells. Two samples collected from Site 24 were reported to have TCE concentrations that exceeded 500 µg/L: 780 µg/L in a sample from well 09_DGMW75 and 760 µg/L in a sample from well 24_EX6OB2. These concentrations are similar to those previously reported in the same wells. The concentration of TCE at well 09_DGMW45, located near the source area, decreased from the previous round (from 580 µg/L to 360 µg/L). The decrease in TCE concentration near the source area may be due to the effectiveness of the SVE system installed and operated between May 1999 and January 2000 at Site 24 and an elevated level of precipitation during the few months prior to sampling.

PCE was reported in samples collected from 16 Site 24 monitoring wells during Round 14. Five of these wells had concentrations of PCE at or above the MCL of 5 µg/L, with a maximum concentration of 30 µg/L reported from well 12_DBMW48A.

1,2-DCE was reported in samples from eight wells at Site 24. Concentrations of cis-1,2-DCE have remained stable over time. Only the sample from well 18_MCAS03-2 had a concentration of cis-1,2-DCE (9 µg/L) above the MCL (6 µg/L).

Carbon tetrachloride was identified in samples from ten monitoring wells at or above the MCL of 0.5 µg/L. The maximum concentration of 28 µg/L was reported at well 18_DW135.

1,1-DCE was reported in samples from eight monitoring wells during Round 14. Two of wells had concentrations of 1,1-DCE above the MCL of 6 µg/L, with a maximum concentration of 14 µg/L (estimated) reported at well 09_DBMW45.

During Round 14, two groundwater samples from Site 24 were also submitted for analysis of general chemistry parameters. The general chemistry analyses included major anions (chloride, sulfate, nitrate/nitrite-N, carbonate, bicarbonate, and alkalinity) and TDS. Elevated chloride, nitrate/nitrite-H, sulfate, and TDS (above the primary MCL [nitrate/nitrite-N] and secondary MCLs [chloride, sulfate, and TDS]) were reported in both groundwater samples. General chemistry parameter results were consistent with previous results.

5.3.12 Radionuclide Evaluation

In 2001, a radionuclide evaluation was performed for groundwater throughout the Station (Earth Tech 2001b). The evaluation was designed to use analytical methods sensitive enough to determine conclusively whether the radionuclides present in groundwater at from Former MCAS El Toro are naturally occurring. Key factors in the evaluation were determining if the ratio of uranium^{238} to uranium^{235} is within naturally occurring limits and assessing whether isotopic strontium^{90} (a man-made isotope) is present in groundwater. The evaluation was conducted in concert with OCWD; field activities were conducted by DON contractors and observed by OCWD representatives. Groundwater samples were collected from 23 monitoring wells, including 9 wells associated with Sites 18 and 24, and analyzed for the following constituents:

- tritium and stable isotopes
- uranium isotopes
- radionuclides
- general chemistry parameters

Samples collected for analysis of the uranium^{238} to uranium^{235} ratio and hydrogen, oxygen, and tritium isotopes were submitted to GeoChron Laboratories in Cambridge, Massachusetts. Samples collected for analysis of gross alpha, gross beta, radium^{226}, radium^{228}, strontium^{90}, americum^{241}, and general chemistry parameters were submitted to Paragon Analytical Laboratories in Fort Collins, Colorado. Split samples were also collected from each well on behalf of the OCWD for analysis of uranium^{235}, uranium^{236}, and uranium^{238} at Lawrence Livermore National Laboratory (LLNL) in Livermore, California, using different analytical methods.

Laboratory analyses performed by GeoChron Laboratories and LLNL showed that the ratio of uranium^{238} to uranium^{235} in groundwater at Former MCAS El Toro is consistent within naturally occurring concentrations of these isotopes. Strontium^{90} was not reported above detection limits. Both of these results confirmed that there is no evidence of anthropogenic radionuclides in the groundwater at Former MCAS El Toro. On the basis of these results, the DON concluded that radionuclides are not COCs at Former MCAS El Toro and that no further evaluation of the origin of the radionuclides in groundwater is warranted. The BCT concurred with these conclusions.

5.4 ROUTES OF EXPOSURE

Figure 5-12 illustrates the routes of exposure for VOC contamination at Site 24. Due to the depth of the shallow groundwater unit at Site 24 and the principal aquifer in the area of Site 18, exposure to VOC-contaminated groundwater is expected to occur only if the groundwater is brought to the surface for potable or nonpotable uses.

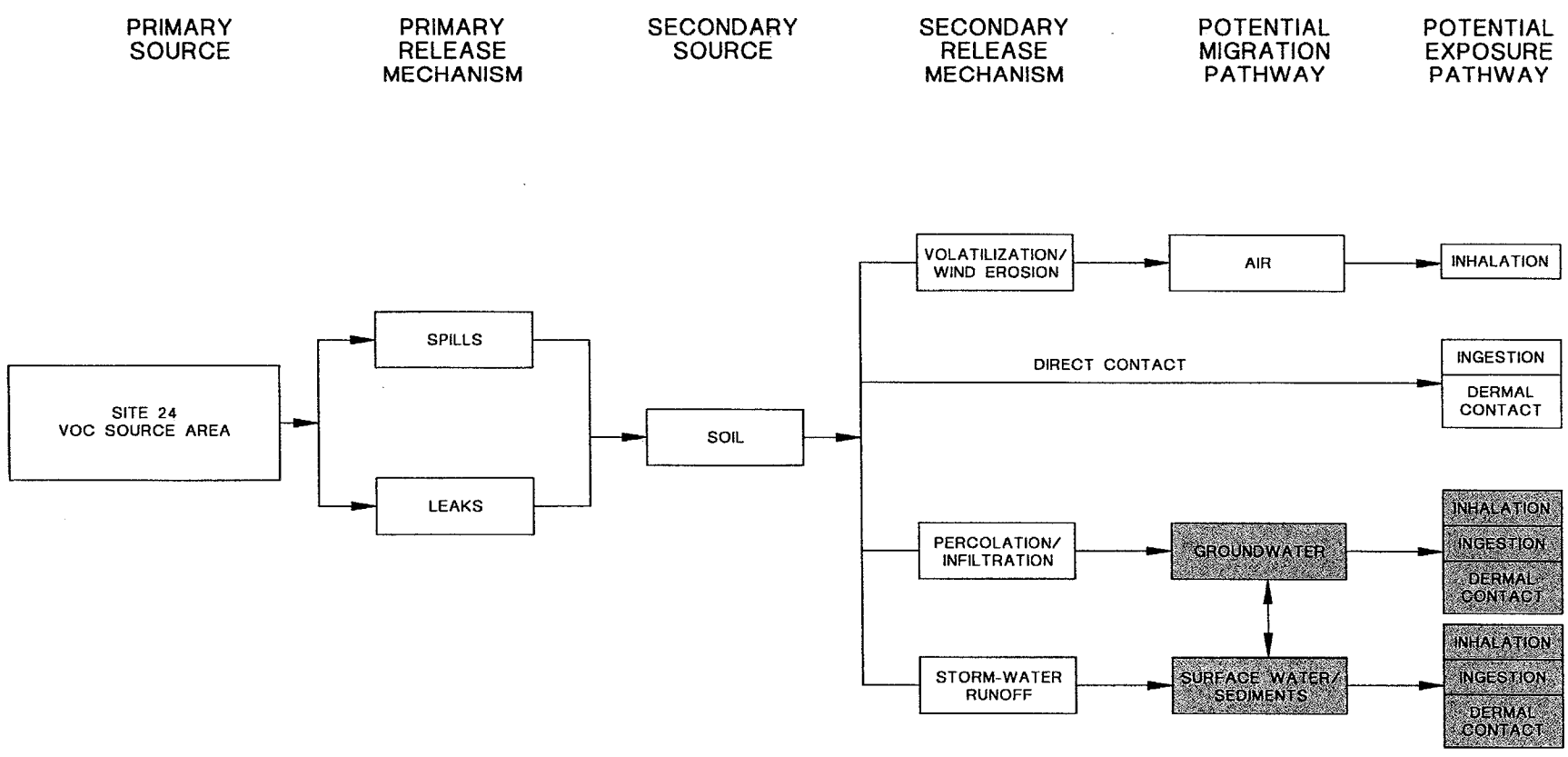
Currently, groundwater in the region of Former MCAS El Toro is not used for drinking water purposes. The nearest drinking-water well (Tustin Walnut Well) is 2.5 miles away from the leading edge of the TCE plume (this well is not located downgradient of the existing TCE plume). The nearest downgradient drinking-water well (Dyer Road Well #3) is 3.2 miles away from the leading edge of the plume. One on-Station well and eight off-Station active agricultural wells are found in the vicinity of Former MCAS El Toro. The agricultural wells are screened in the principal aquifer. The on-Station well does not extract VOC-contaminated groundwater because VOC contamination is not present in the principal aquifer on-Station. Current and future off-Station agricultural workers could be exposed to COCs in groundwater through dermal absorption and inhalation of VOCs. It is not considered plausible that on-Station agricultural workers could be exposed to VOCs in groundwater because agricultural wells are not screened in the shallow groundwater unit, where VOC contamination is present on-Station. It is also not likely that agricultural wells would be screened in the shallow groundwater unit in the future because of the lower yield and higher TDS and nitrate concentrations present in the shallow groundwater unit.

Groundwater in the OU-1 area is also used to supply North Lake, which is located in the Irvine community of Woodbridge. The lake is used for recreation, including boating, sailing, fishing, and wading. Groundwater samples collected from supply well 18_NLAKE have contained TCE and cis-1,2-DCE at low concentrations that do not present a risk to people using the lake (see Section 7.1.5.4). The highest concentration of TCE reported was 9 µg/L, which exceeds the MCL (5 µg/L). The highest concentration of cis-1,2-DCE was 1.6 µg/L, which is less than the MCL.

Currently, there are no complete exposure pathways to receptors from groundwater at Site 24 because groundwater beneath this site is not being used for potable purposes or for irrigation.

5.5 MASS OF TCE

The mass of TCE in groundwater was estimated during the Phase I RI to be approximately 3,630 pounds in the principal aquifer at Site 18 and 4,950 pounds in the shallow groundwater unit at Site 24 (JEG 1996f). The mass of TCE in the shallow groundwater unit was refined during the Phase II RI to be 2,080 pounds (BNI 1997c).



SHADED AREA DENOTES EXPOSURE PATHWAYS AT SITE 18

SOURCE: OU-3A REMEDIAL INVESTIGATION REPORT

Record of Decision

Figure 5-12

Potential Routes of Exposure
Sites 18 and 24

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 4/23/02
File No: 164C8200
Job No: 22214-164
Rev No: B

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Section 6

CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section summarizes the current and potential future land and resource uses at Sites 18 and 24.

6.1 CURRENT LAND USE

Former MCAS El Toro is bordered on the south and west by the city of Irvine and on the north and east by unincorporated lands. The local jurisdictions do not have authority over federal lands. Former MCAS El Toro encompasses about 4,738 acres of which approximately 1,000 acres are designated as outleased lands that are not available for development because of airfield safety clearances. The outleased lands are along the perimeter of the Station and are used for agricultural purposes, including landscape nurseries, livestock grazing, and crop production.

Former MCAS El Toro provided materials and support for aviation activities of the Marine Corps until it was closed in July 1999. Environmental compliance and restoration activities have continued since Station closure, and a caretaker staff will remain at the Station until property transfer is complete.

During operations, land use on Former MCAS El Toro consisted of a few general types. General Station land uses are described below for the following four quadrants, as defined by the bisecting north-south and east-west runways.

- The northwestern quadrant consisted of the Former MCAS El Toro headquarters, administrative services, family and bachelor housing, and community support services.
- The northeastern quadrant consisted of Marine Aircraft Group activities (e.g., training, maintenance, supply and storage, and airfield operations), family housing, community support services, and ordnance storage in areas isolated by topographic relief and distance from other developments.
- The southeastern quadrant consisted of administrative services, maintenance facilities, ordnance storage, and the golf course.
- The southwestern quadrant consisted of aircraft maintenance facilities, supply and storage facilities, and limited administrative services.

Site 24 is located in the southwestern quadrant of Former MCAS El Toro. The site is highly industrialized and contains two large aircraft hangars (Buildings 296 and 297) and several smaller buildings that were used for aircraft and vehicle maintenance and repair.

Historically, land use around Former MCAS El Toro has been largely agricultural. However, land to the south, southeast, and southwest has been developed over the past 10 to 15 years for commercial, light-industrial, and residential uses. Currently, expanding commercial areas adjoin the Station and additional residential areas are located to the northwest and west. Adjacent land to the northeast and northwest is used for agriculture.

Site 18 extends from the boundary of Site 24 approximately 3 miles to the west beneath the city of Irvine. Land above the Site 18 groundwater plume is generally used for agricultural, residential, and commercial purposes.

6.2 FUTURE LAND USE

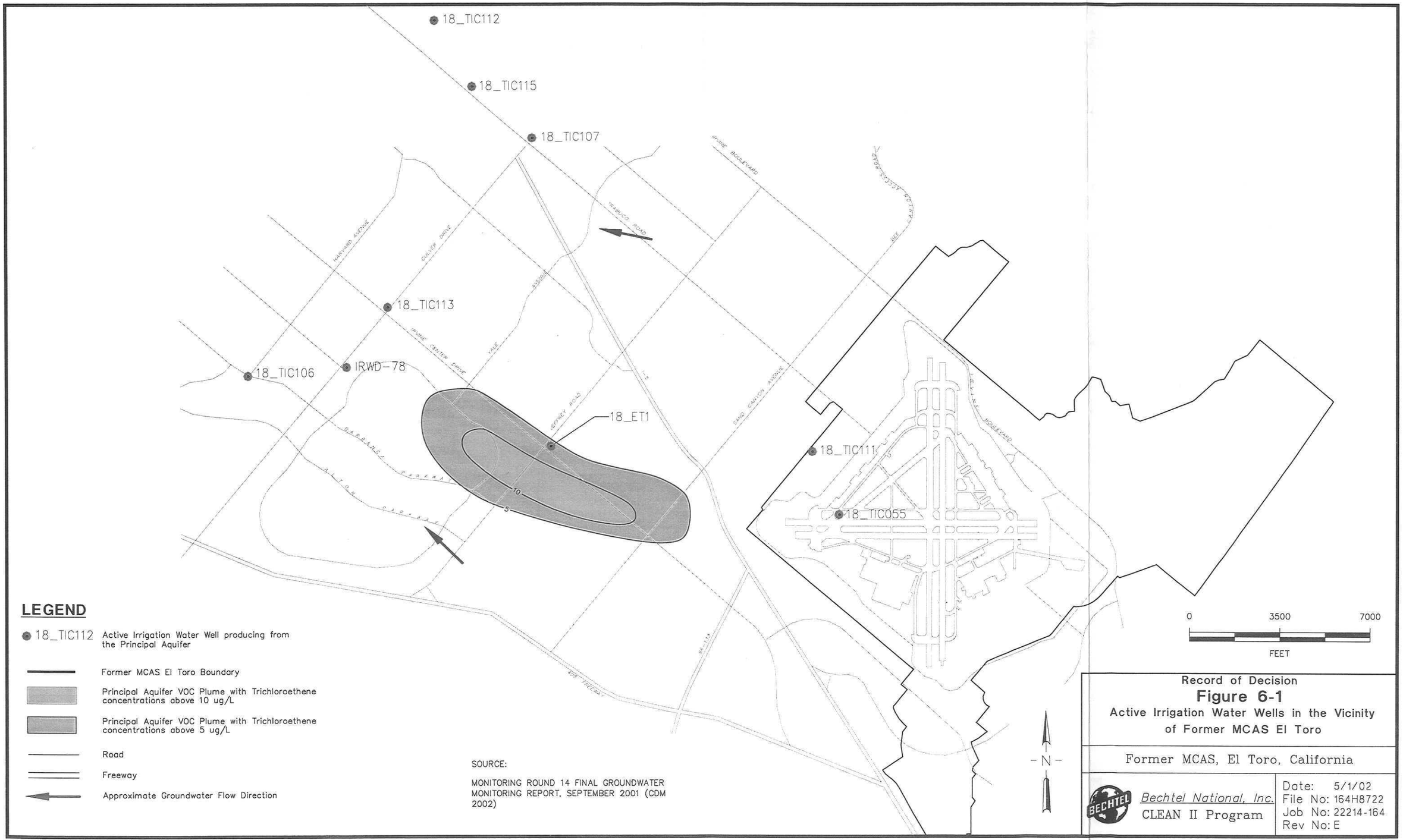
Former MCAS El Toro was closed on 02 July 1999. A community reuse plan was prepared and submitted to the DON in 1996 (P&D Consultants Team 1996). The reuse plan proposed to use Former MCAS El Toro for a commercial airport as well as for other public uses including schools, parks, wildlife refuges, golf courses, homeless services, and commercial/light-industrial uses. The 1996 plan was refined by the 1999 Airport System Master Plan, which incorporated airport planning activities that resulted in some land use areas being redefined. The DON and the Federal Aviation Administration are evaluating this proposed reuse of Former MCAS El Toro and other alternatives in their joint environmental impact statement (DON 2000). The proposed reuse for Site 24 is industrial (cargo).

6.3 GROUNDWATER USES

Former MCAS El Toro lies within the Irvine Forebay I Groundwater Subbasin (Irvine Subbasin) (Figure 5-1), which has been designated by RWQCB Santa Ana Region as a public water supply source (RWQCB 1995). The regional aquifer at Sites 18 and 24 is not currently a source of municipal drinking water because of widespread elevated concentrations of TDS and nitrates that exceed water quality standards; however, groundwater near the Station is used for agriculture. On-Station irrigation well 18_TIC055, at the western end of the east-west runway, is connected to the regional irrigation distribution system. Eight other irrigation wells are located in the vicinity of the Station (Figure 6-1). Well 18_TIC055 is screened in the principal aquifer upgradient of the principal aquifer VOC plume and, because of its upgradient location, does not extract groundwater from the principal aquifer VOC plume. Well 18_ET1 extracts water from an area within the TCE plume. Although a risk assessment performed by OCWD in 1986 showed that the water from this well does not represent an unacceptable human-health risk, the extracted groundwater is treated using air stripping to remove VOCs before it is discharged for irrigation (JEG 1996c).

The nearest drinking-water well (Tustin Walnut Well) is located at the intersection of Redhill and Walnut, approximately 2.5 miles from the leading edge of the TCE plume; however, the well is not hydraulically downgradient of the plume. The nearest downgradient drinking-water well (Dyer Road Well #3) is 3.2 miles from the leading edge of the plume (JEG 1996a). In addition, the IRWD plans to acquire well 18_TIC106, located approximately 1 mile from the leading edge of the plume, as a drinking-water well. Figure 6-1 shows the groundwater flow direction as well as the locations of these wells.

The selected remedy discussed in this ROD will treat contaminated groundwater at Sites 18 and 24 to remove VOCs and then use the treated groundwater for reclaimed water purposes (e.g., irrigation, industrial water). Groundwater will be treated at the



LEGEND

- 18_TIC112 — Active Irrigation Water Well producing from the Principal Aquifer
- Former MCAS El Toro Boundary
- Principal Aquifer VOC Plume with Trichloroethene concentrations above 10 ug/L
- Principal Aquifer VOC Plume with Trichloroethene concentrations above 5 ug/L
- Road
- Freeway
- Approximate Groundwater Flow Direction

SOURCE:

MONITORING ROUND 14 FINAL GROUNDWATER MONITORING REPORT, SEPTEMBER 2001 (CDM 2002)

Record of Decision

Figure 6-1

Active Irrigation Water Wells in the Vicinity of Former MCAS El Toro

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 5/1/02
File No: 164H8722
Job No: 22214-164
Rev No: E

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Irvine Desalter Project (IDP) central treatment facility. The IDP is a water supply development project initiated by the OCWD in conjunction with the IRWD. The priorities of the IDP are to:

- extract and treat groundwater to develop a drinking-water supply from the principal aquifer outside the VOC plume at the following well locations (IRWD 110 [formerly 18_T110], 75, 76, and 77); intercept, contain, and treat groundwater with high concentrations of TDS and nitrates; and
- accept and treat for VOC removal the groundwater that the Marine Corps/DON must remediate and use in IRWD's nonpotable water system.

The IDP is a local project prompted by a 1984 regional groundwater study that showed inorganic constituents, mainly TDS and nitrates, were migrating from the Irvine area toward the main portion of the Orange County groundwater basin (Banks 1984). The Irvine area's relatively poor quality of groundwater is mostly attributable to local geology and agricultural practices. After later studies identified VOCs, primarily TCE, in area groundwater, the IDP was modified to address VOCs in addition to TDS and nitrates.

The IDP is being designed to meet all federal and state drinking-water standards. The OCWD and IRWD have entered into an agreement that covers design, construction, operation, and funding of the project. The OCWD is responsible for the planning, right-of-way acquisition, design, and construction of project facilities, with full participation by IRWD. IRWD will operate the project facilities.

In June 2001, the DON and the Department of Justice (DOJ), on behalf of the Marine Corps, OCWD, and IRWD reached an agreement on how the IDP could fulfill the DON's obligation to remediate VOCs while achieving the OCWD and IRWD objectives of treating groundwater containing high concentrations of TDS and nitrates to provide a drinking- and reclaimed-water supply from the principal aquifer. A settlement agreement apportioning costs for the IDP components was signed by the OCWD on 13 June 2001, by IRWD on 19 June 2001, by the DON on 18 July 2001, and by DOJ on 07 September 2001. This settlement agreement is contingent upon regulatory agency concurrence with the DON's selected remedy described in this ROD. As discussed in Section 9, the DON's selected remedy uses the IDP as the key component of the groundwater treatment system for VOC removal at Sites 18 and 24.

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Section 7
SUMMARY OF BASELINE RISKS

Baseline risk assessments provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action. They provide the basis for determining whether remedial action is necessary and the justification for performing remedial actions (U.S. EPA 1988, 1991b). Baseline human-health risk assessments (HHRAs) were conducted for Site 18 using data collected during the Phase I RI and for Site 24 with data from the Phase I and II RIs. The HHRA methodology for Site 18 is described in Volume III of the draft final OU-1 Interim Action RI/FS Report (JEG 1996c). The methodology used at Site 24 is described in Section 6 and Appendix P of the draft final OU-2A RI Report (BNI 1997a). The HHRA results presented in this section support the need for remedial action at Sites 18 and 24.

Ecological risk assessments were not performed for these sites. The only complete pathway at Site 18 would be North Lake or South Lake. These recreational lakes are located in an urban environment and is not expected to provide suitable habitat for endangered or threatened species. Likewise, Site 24 is highly industrialized and does not provide a suitable habitat for any endangered or threatened species of wildlife.

7.1 SITE 18 RISK ASSESSMENT

The HHRA for Site 18 addressed all constituents in groundwater within the OU-1 investigation area (i.e., groundwater at Site 18 and throughout the entire station including the area later defined as Site 24). This evaluation assessed potential human-health risks from exposure to groundwater if no actions are taken to reduce the risk. The following assumptions were made.

- No remedial actions are undertaken.
- Untreated groundwater is used for drinking water.
- Chemical concentrations remain constant over the assumed exposure period.

At Site 18, potential human-health risks from exposure to groundwater contamination were characterized by estimating risks specific to each well.

7.1.1 Chemicals of Potential Concern

Table 7-1 lists the chemicals of potential concern (COPCs) used in the Phase I HHRA for Site 18. A total of 86 chemicals were reported in groundwater samples throughout the OU-1 study area. These chemicals included 56 organic chemicals and 30 inorganic chemicals. Essential nutrients (calcium, iron, magnesium, potassium, and sodium) and major cations/anions (chloride and sulfate) were eliminated from the assessment, leaving 79 chemicals as COPCs. Gross alpha and beta particle activities were also evaluated.

Table 7-1
Chemicals of Potential Concern in Groundwater
MCAS El Toro OU-1

VOCs	SVOCs	Pesticides	Herbicides	Metals	General Chemistry	Radionuclides
1,1,1-Trichloroethane	4-Methylphenol	4,4′ DDT	2-(2,4,5-Trichlorophenoxy)propionic acid	Aluminum	Ammonia	Gross-alpha
1,1,2-Trichloro-1,2,2-trifluoroethane	Benzyl butyl phthalate	Aldrin	2,4,5-Trichlorophenoxy acetic acid	Antimony	Cyanide	Gross-beta
1,1,2-Trichloroethane	bis(2-ethylhexyl)phthalate	gamma-BHC (lindane)	2,4-Dichlorophenoxy acetic acid	Arsenic	Nitrate/nitrite	
1,1-Dichloroethane	Bromoform	Dieldrin	2-(2-Methyl-4-chlorophenoxy) propionic acid	Barium	Phosphorus	
1,1-Dichloroethene	Chlorodibromomethane	Endosulfan sulfate	2-Methyl-4-chlorophenoxyacetic acid	Beryllium		
1,2-Dichloroethane	di-n-butyl phthalate	Heptachlor	4-(2,4-Dichlorophenoxy)butyric acid	Boron		
cis-1,2-dichloroethene	di-n-octyl phthalate	Methoxychlor	Dalapon	Cadmium		
1,2-Dichloroethene (total)	Diethyl phthalate		Dicamba	Chromium		
1,2-Dichloropropane	Dimethyl phthalate		Dichloroprop	Cobalt		
2-Butanone	n-Nitrosodiphenylamine		Dinoseb	Copper		
2-Hexanone	Phenol			Lead		
4-Methyl-2-pentanone				Manganese		
Acetone				Mercury		
Benzene				Nickel		
Bromodichloromethane				Selenium		
Carbon disulfide				Silver		
Carbon tetrachloride				Thallium		
Chlorobenzene				Vanadium		
Chloroform				Zinc		
Chloromethane						
Dichlorodifluoromethane						
Ethylbenzene						
Methylene chloride						
Styrene						
Tetrachloroethylene						
Toluene						
Trichloroethylene						
Xylenes (total)						

Source: OU-1 Human Health Risk Assessment Report (JEG 1996c)

Acronyms/Abbreviations:

BHC – benzene hexachloride
DDT – dichlorodiphenyltrichloroethane
MCAS – Marine Corps Air Station
OU – operable unit
SVOC – semivolatile organic compound
VOC – volatile organic compound

7.1.2 Exposure Assessment

Currently, groundwater near Former MCAS El Toro is not used for domestic purposes. The nearest drinking water well is 2.5 miles from the leading edge of the TCE plume, and the nearest downgradient well is 3.2 miles from the plume edge. However, to evaluate risk that could occur in the future if no remedial action is taken, the HHRA assumes that individuals in the future will use untreated groundwater for domestic purposes and be exposed to COPCs through ingestion of water, dermal contact with water, and inhalation of VOCs (e.g., while showering).

Groundwater in the area surrounding the Station is used for agricultural and recreational purposes. Current and future on-Station and off-Station agricultural workers could be exposed to COPCs in groundwater through dermal absorption of chemicals and inhalation of VOCs. Because the groundwater also supplies North Lake, individuals using the lake for recreation could be exposed to low concentrations of VOCs through inhalation of volatilized chemicals, ingestion of contaminated fish (JEG 1996c), or wading. Risks associated with these exposure scenarios are discussed in Sections 7.1.5.3 and 7.1.5.4.

Potential exposure routes evaluated in the Site 18 HHRA are summarized in Table 7-2. Human-health risks were evaluated assuming both the reasonable maximum exposure (RME) and the average exposure. The risk calculations assumed exposure to the same well for a duration of 9 years for the average residential scenario and 30 years for the RME.

U.S. EPA guidance states that potential remedial actions at Superfund sites should be based on an estimate of the RME expected to occur under both current and future land-use conditions. The RME is defined as the "highest exposure that is reasonably expected to occur at a site" (U.S. EPA 1989). The intent of the RME is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possibilities. Presentation of both the average and RME portions of the risk distribution allows risk management decisions to incorporate the relative uncertainty in the risk estimates. The average case exposure assumptions largely represent the 50th percentile values within the population.

Exposure-point concentrations were estimated using groundwater data collected during the Phase I RI/FS investigations and data obtained from OCWD/IRWD. It was assumed that the groundwater concentrations remain constant for the duration of the exposure period.

7.1.3 Toxicity Assessment

The toxicity assessment categorized the 79 COPCs by their carcinogenic and noncarcinogenic effects. Twenty-four COPCs were classified as known, probable, or possible human carcinogens. The potential for carcinogenic effects was evaluated by estimating excess lifetime cancer risk. Noncarcinogenic risk was assessed by comparing

Table 7-2
Potential Exposure Routes and Pathways at Site 18

Receptor	Route	Is Pathway Feasible?	Is Pathway Addressed in HHRA?	Rationale
Current on-Station commercial/military workers, resident	Inhalation (VOCs), dermal contact, ingestion	No	No	On-Station groundwater not currently used as a drinking water source.
Future on-Station commercial/military worker, resident	Inhalation (VOCs), dermal contact, ingestion	Yes	Yes	On-Station groundwater could be used as a future drinking water source.
Current off-Station commercial worker, resident	Inhalation (VOCs), dermal contact, ingestion	No	No	There are no active domestic wells in the OU-1 study area.
Future off-Station commercial worker, resident	Inhalation (VOCs), dermal contact, ingestion	Yes	Yes	Off-Station groundwater in the OU-1 study area could be used as a future drinking water source.
Current/future on-Station agricultural worker	Inhalation (VOCs), dermal contact	Yes	Yes	One on-Station production well is currently being used for agricultural purposes.
Current/future off-Station agricultural worker	Inhalation (VOCs), dermal contact	Yes	Yes	Eleven off-Station production wells in the study area are currently being used for agricultural purposes.
Current/future recreational users at North Lake	Inhalation (VOCs), ingestion of fish	Yes	Yes	Well 18_NLAKE is used to fill North Lake.

Acronyms/Abbreviations:
HHRA – human-health risk assessment
OU – operable unit
VOC – volatile organic compound

the estimated daily intake of a chemical to the estimated safe level of daily exposure (reference dose). Estimated excess lifetime cancer risks were developed using cancer potency factors developed by both U.S. EPA and Cal/EPA.

7.1.4 Risk Characterization

Noncarcinogenic health risks were analyzed quantitatively by comparing the daily chemical intake to the reference dose; the ratio of these is the hazard quotient (HQ). The chemical-specific HQs were added together to generate a total hazard index (HI) for each well from which groundwater data were collected. According to U.S. EPA, an HI of less than 1 is generally protective of human health and the environment. If the HI is greater than 1, the chemicals are assessed further to determine whether the HI represents an unacceptable health risk. This assessment considers the types of chemicals, historical activities at one site, background concentrations, and organs that are targeted by the chemicals (e.g., an HI greater than 1 is a concern only if the risk drivers target the same organ).

Potential carcinogenic health risks were analyzed by estimating the excess lifetime cancer risk. Excess lifetime cancer risk is the incremental increase in the probability of developing cancer during one's lifetime over the background probability of developing cancer if no exposure occurs. For example, an excess lifetime cancer risk of 2×10^{-6} means that for every 1 million people exposed to the carcinogen throughout their lifetimes, the average incidence of cancer may be increased by two additional cases of cancer.

To manage carcinogenic risk and protect human health, U.S. EPA has established the following protective risk ranges: the probability of greater than one additional cancer case in a population of 10,000 (10^{-4}) or less is unacceptable; the range of probability from one additional cancer case in a population of 10^{-4} to 1,000,000 (10^{-6}) is generally allowable; and less than one cancer case in a population of greater than 10^{-6} is allowable (U.S. EPA 1991b). Excess cancer risks are only a prediction of a potential increase in cancer incidence and do not represent exact numbers. Because of the health protection methods followed in estimating cancer potency factors, the excess lifetime cancer risks estimated in the HHRA should be regarded as upper bounds on the potential cancer risks.

7.1.5 Results

The following paragraphs summarize hypothetical risks from residential, agricultural, and recreational use of untreated groundwater at Site 18.

7.1.5.1 NONCARCINOGENIC RISKS – RESIDENTIAL EXPOSURE

The estimated HI for a hypothetical future residential exposure to untreated groundwater at Site 18 was calculated for both the average exposure and RME. Of the 92 wells at Site 18, an HI greater than 1 was calculated in 56 wells under average exposure conditions and in 71 wells under RME conditions. The major chemical group contributing to an estimated HI of greater than 1 for the RME was inorganic compounds. As discussed in Section 5.3.3, an evaluation of inorganic chemicals in groundwater indicated that the concentrations present at Site 18 are within background levels. Therefore, risks from exposure to inorganic

chemicals are not attributable to site-specific activities. For this reason, metals are not included as COCs at Site 18. The HI associated with VOCs exceeded 1 only at well 18_BGMW03E, where the primary risk drivers were nitrate/nitrite, antimony, and TCE.

7.1.5.2 CARCINOGENIC RISKS – RESIDENTIAL EXPOSURE

For the average hypothetical future residential exposure to untreated groundwater, the total estimated excess lifetime cancer risk was calculated using both U.S. EPA and Cal/EPA toxicity factors. For the 92 wells at Site 18, the primary chemical group contributing to an estimated excess lifetime cancer risk greater than 10^{-6} was inorganic chemicals. However, as discussed in Section 7.1.5.1, risks from exposure to inorganic chemicals are not attributable to site-specific activities, and inorganic chemicals are not Site 18 COCs. The estimated excess cancer risk associated with VOCs exceeded 10^{-6} in 29 wells. The primary VOCs responsible for these exceedances (i.e., the risk drivers) were the following:

- 1,1,2-TCA
- 1,1-DCE
- 1,2-DCA
- 1,2-dichloropropane
- benzene
- bromodichloromethane
- carbon tetrachloride
- chloroform
- chloromethane
- PCE
- TCE

7.1.5.3 AGRICULTURAL EXPOSURE SCENARIO

Four of the 12 active agricultural wells at Former MCAS El Toro have HIs greater than 1 for the residential RME. The major chemical contributors to these HIs are nitrate/nitrite and other inorganic chemicals. As noted previously, these chemicals are thought to represent regional background concentrations.

Two of the active agricultural wells (18-ETI and 18-TIC113) have an estimated excess lifetime cancer risk for a resident (residential RME) of greater than 10^{-6} for exposure to untreated groundwater. In well 18_ET1, the major chemical contributor is TCE, with an estimated excess lifetime cancer risk to a resident of 3×10^{-6}. Although this residential risk is within the range considered generally allowable by U.S. EPA and the risk to the agricultural worker (who is exposed for a shorter period of time and would not ingest the water) would be much lower, groundwater from 18_ET1 is currently being treated before distribution. The major chemical contributors in well 18_TIC113 are arsenic (8×10^{-5})

and beryllium (2×10^{-5}), inorganic chemicals believed to be present at regional background concentrations.

Subsequent to issuance of the Draft Final ROD and pursuant to comments from DTSC, the DON performed a risk assessment (BNI 2002a) to evaluate the non-cancer and cancer risks to an agricultural worker from exposure to VOCs in groundwater in the off-Station portion of the shallow groundwater unit. This portion of the plume contains TCE at a concentration (140 µg/L) over two times greater than the maximum concentration reported in the principal aquifer (61 µg/L) and, therefore, provides an upper-bound estimate of the risk to an off-Station agricultural worker.

The risk assessment was based on the following assumptions:

- the agricultural worker is exposed to VOCs in groundwater 8 hours a day, 250 days a year, for 25 years;
- the only complete pathway for exposure is inhalation;
- the worker is exposed to groundwater from a well (18_MCAS03) located in the area with the highest concentration of VOCs in the off-Station portion of the shallow groundwater plume; and
- each VOC was evaluated at the highest reported concentration.

The maximum resulting non-cancer risk to the agricultural worker was 0.0012. The maximum excess cancer risk was 5.2×10^{-8}. Both risks are within the range considered allowable by U.S. EPA and Cal/EPA.

7.1.5.4 RECREATIONAL EXPOSURE SCENARIO

Groundwater from well 18_NLAKE is used to supply four surface water bodies: two artificial lakes (North Lake and South Lake) and a children's pool associated with each lake. The estimated HI for this well calculated during the Phase I RI was 1, and the estimated excess lifetime cancer risk was 1×10^{-6}. The major chemical contributor to the HI was manganese, which is thought to be at background concentration. The major chemical contributors to the estimated excess lifetime cancer risk were 1,2-DCA (6×10^{-7}) and TCE (6×10^{-7}). The primary removal mechanism for these chemicals was volatilization to the atmosphere; neither chemical is expected to bioaccumulate in aquatic organisms (JEG 1996c).

The risk from exposure to VOCs at North Lake and the associated children's pool was reevaluated following the Phase II RI using sampling data collected by OCWD from 1995 to August 2001 (BNI 2002b). All organic chemicals reported above the laboratory detection limits were identified as COPCs. This included only two organic chemicals: cis-1,2-dichloroethene and trichloroethene. The risk assessment considered the following three exposure scenarios.

- Recreational use of the children's pool by a child. The pool is frequented by children who are assumed to live nearby and use the pool throughout the year.

The children were assumed to be exposed to COPCs in the surface water through inhalation, incidental ingestion of water, and dermal contact with water.

- Recreational use of North Lake by a swimmer. Exposure was assumed to take place over 30 years and occur through inhalation of vapors, incidental ingestion of surface water, and dermal contact with surface water.
- Recreational use of North Lake by an adult sportfisher who eats the fish that are caught. The sportfisher is assumed to fish throughout the year and be exposed to COPCs through inhalation of vapors and ingestion of fish.

The estimated cancer risk for a child exposed to surface water at the pool (assuming surface water concentrations are equal to groundwater concentrations in the well) for 350 days a year over a period of 7 years is 1.5×10^{-7}. The hazard index is estimated at 0.025. Both risks are within the range considered allowable by U.S. EPA and Cal/EPA.

The estimated cancer risk for a hypothetical adult swimmer who uses the lake 350 days a year over a period of 30 years is 2.9×10^{-7}. The hazard index is 0.011. Both risks are within the range considered allowable by U.S. EPA and Cal/EPA.

The estimated cancer risk for a hypothetical adult sportfisher exposed to chemicals in the lake through inhalation of vapors and consumption of fish over the course of 30 years is 2.3×10^{-7}. The hazard index is 0.0087. Both risks are within the range considered allowable by U.S. EPA and Cal/EPA.

7.1.6 Summary of Site 18 Risks

The HHRA showed that the primary risk drivers for groundwater at Site 18 are inorganics. However, as discussed in Section 5.3.3, an evaluation of metals in groundwater indicated that the concentrations of metals at Sites 18 and 24 are within the range of ambient conditions. Therefore, risks from exposure to inorganic chemicals are not attributable to activities that occurred at these sites.

As a result of the HHRA, the following VOCs were identified as COCs for Site 18:

- 1,1,2-TCA
- 1,1-DCE
- 1,2-DCA
- 1,2-dichloropropane
- benzene
- bromodichloromethane
- carbon tetrachloride
- chloroform
- chloromethane

- PCE
- TCE

7.2 SITE 24 RISK ASSESSMENT

An HHRA was conducted for Site 24 using data collected during the Phase I and Phase II RIs and following the methodology discussed in Section 6 and Appendix P of the draft final Phase II RI report (BNI 1997a). No ecological risk assessment was performed for this site because it is highly industrialized and does not provide a suitable habitat for any endangered or threatened species of wildlife. An additional assessment was conducted following issuance of the Draft Final ROD to evaluate the risk to an agricultural worker from groundwater in the off-station portion of the shallow groundwater unit. The results are discussed in Section 7.1.5.3.

7.2.1 Chemicals of Potential Concern

The procedures that were used to identify the COPCs in the Site 24 risk assessment are consistent with U.S. EPA Risk Assessment Guidance for Superfund (U.S. EPA 1989) and Guidance for Data Usability in Risk Assessment (U.S. EPA 1992). Only VOCs were evaluated, including those identified as COPCs during the Phase I RI and additional VOCs reported during the Phase II RI. This included 14 VOCs identified in the upper 10 feet of soil and 23 VOCs present in groundwater. COPCs for soil and groundwater are shown in Table 7-3.

7.2.2 Exposure Assessment

Located in a highly industrialized portion of Former MCAS El Toro, Site 24 contains buildings supporting aircraft activities and concrete parking areas for vehicles and aircraft. Off-Station land near Site 24 is zoned for commercial, industrial, and agricultural use. Former MCAS El Toro was closed in July 1999, and the proposed reuse plan

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Table 7-3
Chemicals of Potential Concern in Soil and Groundwater at Site 24

In Soil (0 to 2 feet bgs)	In Soil (0 to 10 feet bgs)	In Groundwater
Acetone	Acetone	Acetone
Benzene	Benzene	Benzene
2-Butanone	2-Butanone	Bromodichloromethane
Carbon disulfide	Carbon disulfide	Bromoform
Carbon tetrachloride	Carbon tetrachloride	2-Butanone
1,2-Dichloroethene (mixture)	1,2-Dichloroethene (mixture)	Carbon disulfide
Ethylbenzene	Ethylbenzene	Carbon tetrachloride
2-Hexanone	2-Hexanone	Chloroform
Methylene chloride	Methylene chloride	Chloromethane
Tetrachloroethene	Tetrachloroethene	Dibromochloromethane
Toluene	Toluene	1,2-Dichloroethane
1,1,1-Trichloroethane	1,1,1-Trichloroethane	1,1-Dichloroethene
Trichloroethene	Trichloroethene	1,2-Dichloroethene (mixture)
Xylenes	Xylenes	Ethylbenzene
		4-Methyl-2-pentanone
		Methylene chloride
		Styrene
		Tetrachloroethene
		Toluene
		1,1,1-Trichloroethane
		1,1,2-Trichloroethane
		Trichloroethene
		Xylenes

Source:
Draft Final Remedial Investigation Report Operable Unit 2A – Site 24 (BNI 1997a)

Acronym/Abbreviation:
bgs – below ground surface

specifies the primary reuse of Site 24 as industrial (cargo). However, since site-specific reuse plans had not been developed when the risk assessment was performed, a variety of scenarios, including residential, industrial, recreational, and excavation, were considered.

7.2.2.1 RESIDENTIAL SCENARIO

Under the residential scenario, the resident is assumed to be a person living in a house on-site from birth to age 30. Thirty years is the 90th percentile of time that people in the United States live at one address (U.S. EPA 1989). Soil excavation to about 10 feet may occur during the construction of basements and swimming pools, and some of the soil from the subsurface may be left on the surface. Therefore, COPCs in soil to 10 feet bgs or samples obtained closest to 10 feet bgs are treated as representative of soil conditions to which a resident could be exposed. Water used in the home is assumed to come from a private well drawing from the shallow aquifer beneath the site. The exposure routes used in the risk assessment for the resident included ingestion, dermal contact, and inhalation of soil VOCs, and ingestion, dermal contact, and inhalation of groundwater VOCs. Although it is unlikely that anyone would install a private well to obtain water for home use (because of the availability of a municipal water supply), the potential risk from the COPCs was conservatively estimated using exposure conditions associated with residential use of the groundwater as tap water.

7.2.2.2 INDUSTRIAL SCENARIO

If the site were redeveloped for commercial business, the individuals most likely to be exposed would be owners and employees of the businesses. An office worker representing these individuals is a person who works 8 hours a day in a commercial building on-site for a period of 25 years, the exposure duration recommended by U.S. EPA (U.S. EPA 1989) for workers. Only COPCs in the upper 2 feet of soil are considered to be available to the office worker. Because it is assumed that the workplace water supply is provided by the local water utility, exposure of the office worker to COPCs in the groundwater at the workplace is not considered viable. Exposure routes for soil include ingestion, dermal contact, and inhalation of VOCs.

7.2.2.3 RECREATIONAL SCENARIO

If the site were redeveloped into a park, the most highly exposed individuals would be grounds maintenance personnel or park users, depending on the frequency and amount of time spent at the park. A park user was chosen for the risk assessment because the risk to the park user approximates the risk to the grounds maintenance worker if the latter spends 1 or 2 days a week performing maintenance work. The park user is assumed to be an older child from age 9 to 16 years who plays unsupervised in the park daily 2 hours a day for 7 years. This exposure regimen was chosen after evaluation for its reasonableness. As with the office worker, only COPCs in the upper 2 feet of soil are considered to be available to the park user. Exposure routes for soil include ingestion, dermal contact, and inhalation of VOCs. COPCs in groundwater are assumed to be unavailable to the park user while at the park.

7.2.2.4 EXCAVATION WORKER SCENARIO

The excavation worker is a person who works installing underground utility lines, basements, and swimming pools. This worker is assumed to work for 8 hours a day for 1 year (250 workdays). The excavation worker is assumed to be exposed to soil to a depth of 10 feet bgs. Exposure routes for soil include ingestion, dermal contact, and inhalation of VOCs.

7.2.2.5 EXPOSURE ASSUMPTIONS

Exposure conditions used in the estimation of risk were chosen to represent the RME. These exposure conditions are selected to deliberately overestimate risk, providing risk managers a margin of error for making remediation decisions. The combination of the intake variables, expressing the exposure conditions for each receptor, results in a chronic daily dose. The dose is an estimate of exposure for each pathway.

7.2.2.6 CALCULATION OF EXPOSURE-POINT CONCENTRATION

An exposure-point concentration is the concentration of a chemical in soil, water, or air at the point of contact with a receptor. To be consistent with the RME, the 95 percent upper confidence limit (UCL) of the arithmetic mean of the measured concentrations of each COPC was used as the exposure-point concentration except when the number of measurements was less than four or when the 95 percent UCL exceeded the highest measured concentration. In those cases, the highest measured concentration was used as the exposure-point concentration. The measured concentrations were assumed to have a lognormal distribution, so the 95 percent UCL for a lognormal distribution was calculated in accordance with procedures recommended by U.S. EPA (1992).

7.2.3 Toxicity Assessment

The toxicity assessment classified the 24 COPCs in Table 7-3 by their carcinogenic and noncarcinogenic effects. Fourteen COPCs were identified as known, probable, or possible human carcinogens. The potential for carcinogenic effects was evaluated by estimating excess lifetime cancer risk. Noncarcinogenic risk was assessed by comparing the estimated daily intake of a chemical to the estimated safe level of daily exposure (reference dose). Estimated excess lifetime cancer risks were developed using cancer potency factors developed by both U.S. EPA and Cal/EPA.

7.2.4 Risk Characterization

The results of the risk assessment for Site 24 are summarized in Table 7-4, which identifies the total cancer and/or noncancer risk for each receptor. This table also identifies the chemicals contributing most of the cancer risk and HI (risk drivers), the media associated with the risk drivers, and the exposure routes by which the risk drivers exert their effects. Cancer risks and risk drivers shown in Table 7-4 are based on a combination of U.S. EPA and Cal/EPA cancer slope factors.

Table 7-4
Summary of Risk Assessment Results at Site 24

Characteristic	Resident Adult	Resident Child	Recreational Child	Office Worker	Excavation Worker
Total cancer risk[a]					
COPCs in soil	2.2E-08	9.4E-09	2.4E-09	5.4E-09	5.1E-10
COPCs in groundwater	2.0E-03	7.4E-04	NA	NA	NA
Total	2.0E-03	7.4E-04	2.4E-09	5.4E-09	5.1E-10
Hazard index					
COPCs in soil	9.4E-04	2.5E-03	4.7E-04	2.9E-04	7.8E-04
COPCs in groundwater	8.6E+01	2.0E+02	NA	NA	NA
Total	8.6E+01	2.0E+02	4.7E-04	2.9E-04	7.8E-04
Risk drivers (carcinogenic effects and associated risk)[b]	Benzene (1.3E-06) Bromodichloromethane (5.2E-06) Carbon tetrachloride (1.1E-05) Chloroform (1.1E-05) Chloromethane (1.1E-06) Dibromochloromethane (1.1E-06) 1,2-Dichloroethane (4.6E-06) 1,1-Dichloroethene (5.0E-05) Tetrachloroethene (4.7E-06)[c] 1,1,2-Trichloroethane (4.2E-06) Trichloroethene (1.9E-03)	Bromodichloromethane (1.9E-06) Carbon tetrachloride (4.2E-06) Chloroform (4.2E-06) 1,2-Dichloroethane (1.7E-06) 1,1-Dichloroethene (1.8E-05) Tetrachloroethene (1.7E-06) 1,1,2-Trichloroethane (1.6E-06) Trichloroethene (7.1E-04)	None	None	None
Risk drivers (noncancer effects) and associated hazard index	Trichloroethene (8.5E+01)	Carbon tetrachloride (1.3E+00) Trichloroethene (2.0E+02)	None	None	None
Medium of concern[c]	Groundwater	Groundwater	NA	NA	NA
Exposure route of concern[d]	Ingestion, inhalation, dermal contact	Ingestion, inhalation, dermal contact	NA	NA	NA

Notes:
[a] based on United States Environmental Protection Agency and California Environmental Protection Agency cancer slope factors
[b] risk driver – COPC that poses a minimum multimedia cancer risk of 1.0E-06 or minimum hazard index of 1.0
[c] medium of concern – medium (e.g., soil) with COPCs that pose minimum multimedia cancer risk of 1.0E-06 or minimum hazard index of 1.0
[d] exposure route of concern – intake route through which COPCs pose a minimum multimedia cancer risk of 1.0E-06 or minimum hazard index of 1.0

Acronyms/Abbreviations:
COPC – chemical of potential concern
NA – not applicable

The HHRA results for potential exposure to soil showed that the lifetime excess upper-bound cancer risk presented by COPCs in the soil would be no more than about five chances in one billion (5×10^{-9}) for the exposure scenarios described in subsections 7.2.2.1 through 7.2.2.4. The results also indicate that the concentrations of the COPCs in the soil are not high enough to cause systemic noncarcinogenic effects to the same people.

The HHRA results indicate that if no remediation occurred and homes were built on-site, the lifetime excess upper-bound cancer risk presented by COPCs in the groundwater to adult occupants of the homes would be about 2 chances in 1,000 (risk estimate of 2×10^{-3}). The risk is primarily associated with 11 of the 23 COPCs in the groundwater, with TCE accounting for over 95 percent of the risk (BNI 1997a). Risk to children living in the homes from exposure to groundwater COPCs would be less than 7×10^{-4}. The results also showed that the concentrations of TCE and carbon tetrachloride in groundwater from on-site wells are high enough to potentially cause systemic effects in residents because the HIs for both of the compounds exceeded 1.0.

7.2.5 Summary of Site Risks

Risks posed by VOCs in groundwater are within the range that requires some type of remedial action (U.S. EPA 1991b). Accordingly, alternatives for groundwater remediation are presented and evaluated in Sections 8 through 10. Risks posed by VOCs in soil are within the allowable range and do not, by themselves, indicate that remedial action is necessary for soil. However, modeling performed during the Site 24 RI showed that VOCs present in deeper soil had the potential to contaminate groundwater above MCLs. Subsequent to the RI, an interim ROD (SWDIV 1997a) was produced to address this vadose zone contamination. The ROD established cleanup goals for soil and selected SVE as the remedial alternative. As discussed in Section 5, remediation of soil has been completed, and a closure report for soil at Site 24 is currently in review. Soil at Site 24 will be addressed in a final ROD or ROD amendment, expected to be issued in 2002.

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Section 8
DESCRIPTION OF ALTERNATIVES

This section describes the remedial alternatives selected for detailed analysis in the FSs for Sites 18 and 24. The section also describes one additional alternative that was developed by OCWD/IRWD after the FS reports were published. It was evaluated by the DON with respect to nine CERCLA evaluation criteria. All alternatives are based on the Phase I and Phase II RIs, the baseline HHRAs, and a review of applicable or relevant and appropriate requirements (ARARs). The following remedial action objectives were established for Sites 18 and 24.

- Site 18 groundwater
  - Reduce concentrations of VOCs in the AOC in the shallow groundwater unit and in the principal aquifer downgradient of the source areas to federal or state cleanup levels.
  - Contain migration of VOCs above cleanup levels in the principal aquifer.
  - Prevent domestic use of groundwater containing VOCs at concentrations above cleanup levels.
- Site 24 groundwater
  - Reduce concentrations of VOCs in the Site 24 shallow groundwater unit to federal or state cleanup levels.
  - Prevent use of groundwater containing VOCs at concentrations above cleanup levels.
  - Prevent VOCs at concentrations above cleanup levels from migrating beyond the shallow groundwater unit.
- Site 24 soil
  - Reduce concentrations of VOCs in the source areas to prevent or minimize further degradation of the shallow groundwater unit above the MCL for drinking water.
  - Continue vadose zone remediation until the average VOC soil gas concentrations are below threshold concentrations (concentrations capable of contaminating groundwater above the MCLs).

The remedial action objectives for Sites 18 and 24 are intended primarily to assure the continued beneficial use of groundwater from the principal aquifer. Groundwater from this aquifer (Irvine Forebay I) is currently used for agriculture but is also designated by RWQCB as a potential source of drinking water.

Table 8-1 presents numerical cleanup standards for groundwater. These cleanup standards are based on U.S. EPA and Cal/EPA MCLs or were developed using risk-based criteria. (Cleanup standards for soil are addressed in Section 5.3.6.)

Table 8-1
Cleanup Standards for Chemicals of Concern in Groundwater
(reported in micrograms per liter)

	CONCENTRATION				
Volatile Organic Compound	Federal Maximum Contaminant Level[a]	California Maximum Contaminant Level[b]	Controlling ARAR or Risk-Based Concentration	Maximum Concentration Reported During RI[c]	Maximum Concentration Reported During September 2001 Monitoring Round[d]
Benzene	5	1	1	730	ND
Bromodichloromethane	100[e]	100	100	11	ND
Carbon tetrachloride	5	0.5	0.5	61	28
Chloroform	100[e]	100	100	14	4
Chloromethane	—[f]	—	1.5[g]	1	ND
Dibromochloromethane	100[e]	100	100	2.6	ND
1,2-Dichloroethane	5	0.5	0.5	2.6	ND
1,1-Dichloroethene	7	6	6	36	14
1,2-Dichloropropane	5	5	5	4	6
Tetrachloroethene	5	5	5	81	30
1,1,2-Trichloroethane	5	5	5	3	2
Trichloroethylene	5	5	5	3,100	780

Notes:
[a] source: U.S. EPA Safe Drinking Water Act, 40 C.F.R. § 141, 01 July 1992
[b] source: Cal. Code Regs. tit. 22, § 64439, Requirements, and § 64444, Maximum Contaminant Levels
[c] maximum concentrations of contaminants of concern in groundwater are from the draft final OU-1 RI Report (JEG 1996a) and the draft final Phase II RI Report for Site 24 (BNI 1997a)
[d] source: Groundwater Monitoring Report, September 2001 Monitoring Round 14 (CDM 2002)
[e] MCL for total trihalomethanes includes chloroform, bromodichloromethane, dibromochloromethane, and bromoform
[f] dash indicates that MCL has not been established for this chemical
[g] risk-based concentration for chloromethane is the U.S. EPA 2000 preliminary remediation goal for this chemical

Acronyms/Abbreviations:
ARAR – applicable or relevant and appropriate requirement
Cal. Code Regs. – *California Code of Regulations*
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
C.F.R. – *Code of Federal Regulations*
MCL – maximum contaminant level
ND – not detected
OU – operable unit
RI – remedial investigation
§ – section
tit. – title
U.S. EPA – United States Environmental Protection Agency

Remedial alternatives were developed to meet the remedial action objectives in accordance with CERCLA, as amended by SARA, 42 *United States Code* (U.S.C.) § 9602 et seq., and the NCP. The development of remedial alternatives was also guided by prior U.S. EPA experience at VOC-contaminated sites. Documents considered in the development of remedial alternatives for soil and groundwater include the following.

- Presumptive Remedies: Policies and Procedures (U.S. EPA 1993a). This document describes certain preferred technologies or presumptive remedies for VOC-contaminated soil and groundwater.
- Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites With Volatile Organic Compounds in Soils (U.S. EPA 1993b).
- Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites (U.S. EPA 1996).
- Presumptive Remedy: Supplemental Bulletin Multi-Phase Extraction (MPE) Technology for VOCs in Soil and Groundwater (U.S. EPA 1997).

Presumptive remedies are preferred technologies for common categories of sites. These technologies are accepted by U.S. EPA based on historical patterns of remedial action selection and on evaluation of performance data on technology implementation; use of these technologies expedites site investigation and selection of remediation alternatives. The presumptive remedy approach allowed the FSs for Sites 18 and 24 to focus on technologies that have proved to be most effective at sites with similar VOC contamination.

The presumptive remedies selected for detailed evaluation were extraction and treatment of groundwater (Sites 18 and 24) and SVE in the vadose zone source area (Site 24). The remedial alternatives developed for groundwater differ in the configuration of the groundwater well fields (e.g., number of wells, location, screened intervals, pumping rates) and in whether the treated groundwater is injected into the aquifer. In addition, several alternatives developed for Sites 18 and 24 rely on natural attenuation, rather than extraction and treatment, to remediate the low concentrations of VOCs in the principal aquifer. Remedial action for VOCs in soil has been implemented and a closure report for this medium has been submitted to the BCT.

The sections that follow provide general descriptions of the groundwater remedial alternatives, including number of wells and well locations. These details were developed for modeling the progress of remediation using computer simulation to compare the remedial alternatives (JEG 1996e). The actual well field design of the selected alternative will be finalized during the engineering design phase. In addition, remedy refinements (e.g., adjustments to the number of extraction wells, modifications to flow rates, changes in well locations) will be made as necessary during the life of the remedy.

8.1 SITE 18 ALTERNATIVES

Twelve remedial action alternatives were developed in the IAFS for Site 18. These were grouped as follows.

- **No Action:** A no action alternative (Alternative 1) was developed as required by U.S. EPA as a baseline for comparing the performance of all other alternatives.
- **Former MCAS El Toro Project:** Four alternatives (2A, 2B, 2C, and 2D) were developed that rely on new wells placed to optimize VOC remediation. Treated water is injected back into the aquifer.
- **Irvine Desalter Project:** As discussed in Section 6.3, OCWD/IRWD is planning a project to extract groundwater, treat the extracted groundwater to reduce elevated TDS and nitrate concentrations, and distribute the treated groundwater for potable-water purposes. Alternative 3 uses the same extraction well configuration as originally planned for the IDP (before the presence of VOCs was discovered), but modifies the treatment process to treat VOC-contaminated groundwater.
- **Former MCAS El Toro Project and IDP:** Six alternatives (4A, 4B, 5A, 5B, 6A, and 6B) were evaluated that combine wells placed specifically for VOC remediation and wells previously planned for the IDP. Groundwater is treated at the IDP and distributed for potable water purposes.

Alternatives 2C, 3, 4A, 4B, 5A, and 5B were eliminated based on preliminary screening in the IAFS. Alternatives 2B, 2D, and 6B were eliminated through more-detailed screening using NCP criteria, leaving only Alternatives 1, 2A, and 6A. However, review comments on the draft OU-1 IAFS Report from U.S. EPA, DTSC, and RWQCB expressed concern over the high cost of groundwater extraction and treatment to reduce low concentrations of TCE in the principal aquifer. These agencies suggested that the DON evaluate lower-cost alternatives and a natural attenuation approach for the principal aquifer. To respond to these comments, the DON developed three additional alternatives (7A, 7B, and 8) that provide the same shallow, on-Station extraction and principal-aquifer background pumping as most of the previous alternatives but also include natural attenuation of TCE in the principal aquifer. These alternatives were added to the draft final IAFS Report in an addendum where they were compared with Alternatives 2A and 6A.

In spring of 1999, IRWD held focus group meetings to evaluate public acceptance of using treated groundwater for domestic purposes. As a result of these meetings, OCWD/IRWD developed a new alternative, Alternative 8A, that uses separate extraction and treatment systems for groundwater inside and outside the VOC plume. Alternative 8A uses the IDP to treat VOC-contaminated groundwater from within the TCE plume but distributes the groundwater for recycled, rather than potable, use. This alternative was evaluated using the same model as that used to evaluate the original OU-1 alternatives. The alternative was also evaluated with respect to NCP criteria and compared to the original OU-1 alternatives with respect to these same criteria. A final technical memorandum summarizing the results of this evaluation was presented to the BCT in October 2001 (BNI 2001).

To simplify the discussion in this ROD, only the alternatives that passed the screening in the IAFS Report and the Addendum (i.e., Alternatives 1, 2A, 6A, 7A, 7B, and 8) and

Alternative 8A are addressed. For a complete discussion of all Site 18 alternatives, see the draft final OU-1 Interim Action FS Report (JEG 1996b,g).

8.1.1 Alternative 1: No Action

Alternative 1 is required by CERCLA to provide a basis for developing and evaluating the other remedial alternatives. Under Alternative 1, no remedial measures or access or land-use controls would be initiated at Site 18. Existing production wells that were active at the time of the RI were assumed to continue to pump groundwater (Table 8-2), but the DON would conduct no groundwater extraction and the IDP would not be built. As VOCs spread from the source area at Site 24, off-Station contamination would increase. Eventually, the VOC concentration would decrease to the groundwater cleanup goals because of background production well pumping and natural attenuation in the aquifer. However, without any remedial action, the time required to meet these goals is expected to be greater than 100 years.

8.1.2 Alternative 2A: MCAS El Toro Project Without Well 18_ET1

Alternative 2A is a Former MCAS El Toro Project alternative that would use separate groundwater extraction, VOC treatment, and groundwater injection facilities for the shallow groundwater unit and principal aquifer. Institutional controls would be used to protect the remedy and prevent inadvertent use of contaminated groundwater. Groundwater monitoring would be performed using a network of 44 existing and 14 new wells. It is assumed the IDP would not be constructed.

8.1.2.1 SHALLOW GROUNDWATER REMEDIATION

Shallow groundwater would be extracted through a network of 31 new wells, treated, and injected into the shallow groundwater unit using 31 new injection wells (Figure 8-1). Twenty extraction wells would be located along the downgradient edge of the TCE area at Site 24, 5 wells would be installed at the downgradient edge of the TCE area near the southwestern corner of the Station, and 2 wells would be located near the western boundary of the Station. The 27 wells are intended to contain VOC contamination from the source area and avoid its further migration into the principal aquifer. The four remaining extraction wells are placed at the downgradient edge of a benzene plume at Fuel Farm 2.

Groundwater from the shallow groundwater unit would be treated on-Station using an air stripper and two parallel trains of two 20,000-pound carbon vessels in series that would apply liquid-phase LGAC adsorption. Activated carbon is the most common of the adsorbent materials used for treating water contaminated with VOCs and has been identified by U.S. EPA as one of the two best available control technologies (BACTs) for the removal of VOCs from drinking-water supplies (*Federal Register*, 08 July 1987). Vapor-phase GAC (VGAC) is used to treat off-gas from the air stripper to concentrations below regulatory standards for air emissions prior to its release.

Table 8-2
Background Irrigation Well Pumping
(in gallons per minute)

	PUMPING RATE	
Production Well	**Summer**	**Winter**
18_NLAKE	300	300
18_TIC047	335	—*
18_TIC055	535	—
18_TIC072	800	—
18_IRWD78	2,000	—
18_TIC0106	64	—
18_TIC107	1,100	—
18_TIC109	1,594	—
18_TIC111	602	—
18_TIC112	2,197	—
18_TIC113	1,988	—
18_TIC114	275	—
Total	**11,790**	**300**

Note:
* dash indicates that well is not being pumped during winter

The Alternative 2A treatment system would be designed to treat 1,260 gpm and to remove VOCs, total petroleum hydrocarbons–volatile organic analysis (TPH-VOA), and TPH as diesel to nondetectable levels (0.5 µg/L for TCE and 1 µg/L for other VOCs).

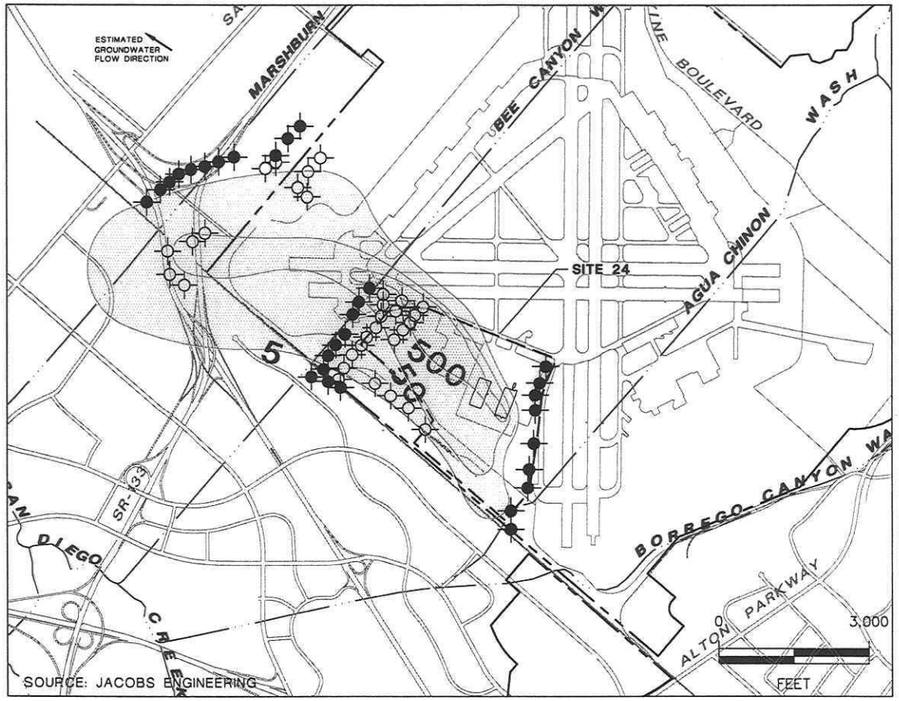
Treated groundwater would be injected back into the shallow groundwater unit through 31 injection wells. Ten wells would inject groundwater upgradient of the Site 24 area, 10 wells would inject groundwater near Bee Canyon Wash, and the remaining 11 wells would inject downgradient groundwater near Marshburn Channel. Well locations, shown in Figure 8-1, would be selected so that TDS concentrations of the treated groundwater would not exceed background levels in the area of injection.

8.1.2.2 PRINCIPAL AQUIFER REMEDIATION

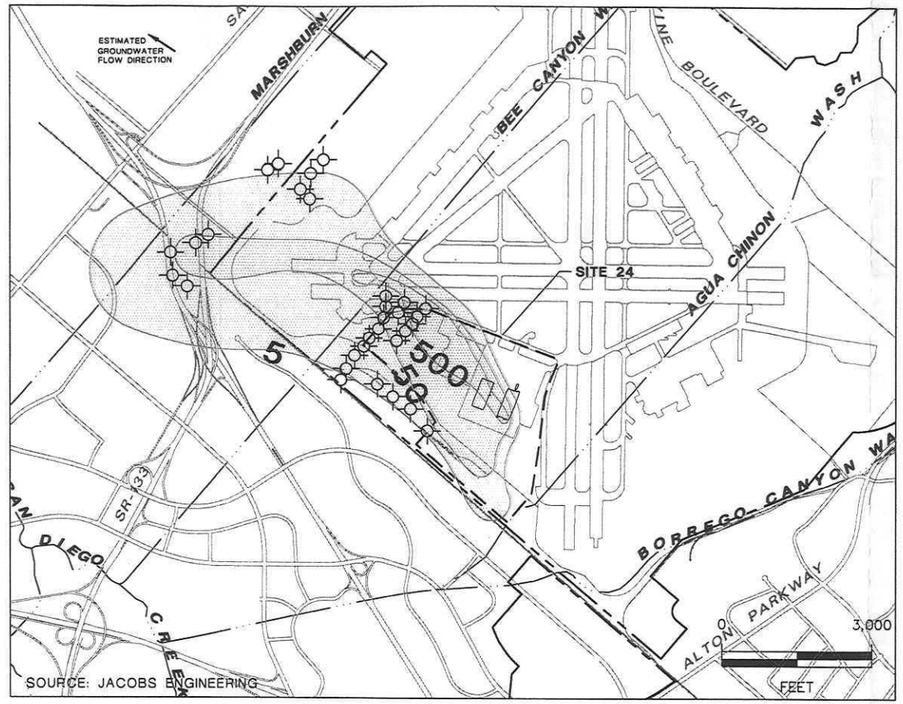
Two principal aquifer extraction wells (Figure 8-2) would confine the TCE contamination above the MCL to its present downgradient extent and remove VOC mass. The wells would be located at the downgradient edge of the 5-µg/L concentration of the TCE plume. Each extraction well would be pumped at an annual rate of 1,000 gpm.

The off-Station groundwater treatment system for the principal aquifer would use an air stripper with VGAC off-gas control. The system would be designed to remove VOCs

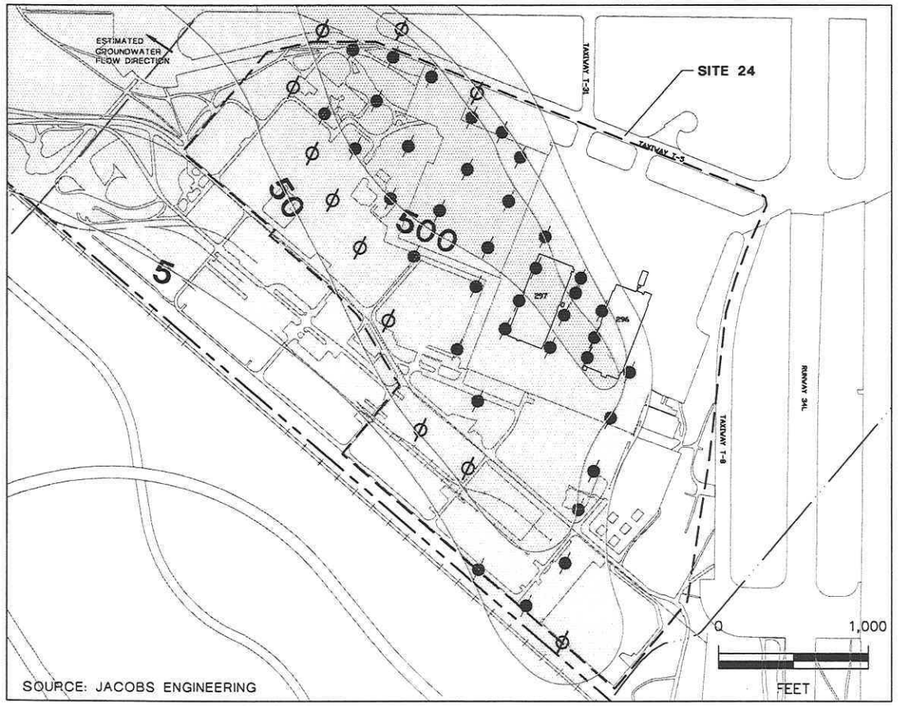
Continue



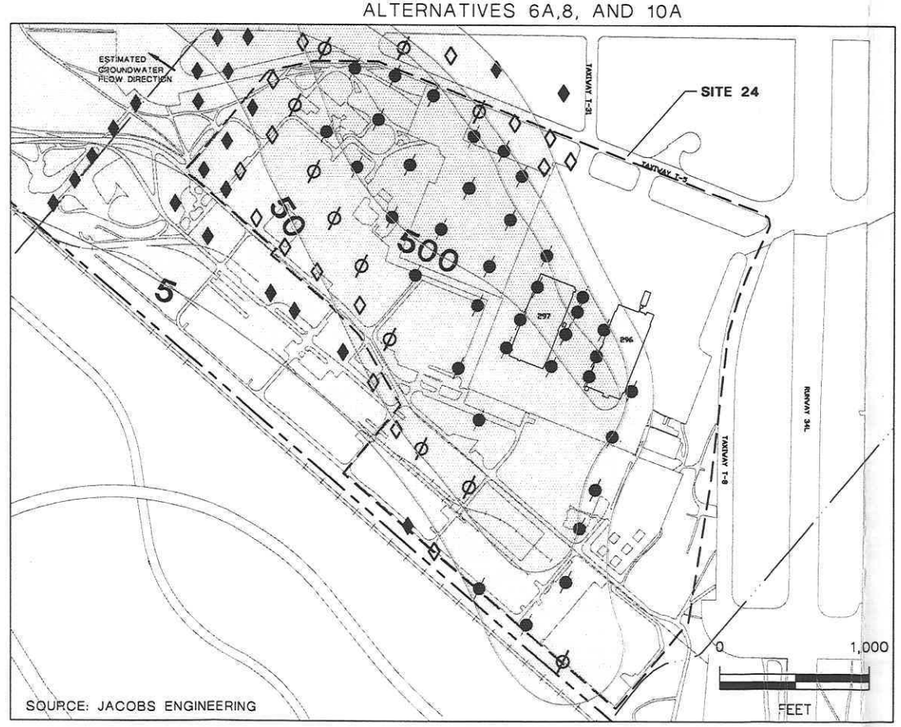
ALTERNATIVES 2A,7A,7B,8, AND 9



ALTERNATIVES 6A,8, AND 10A



ALTERNATIVE10B



ALTERNATIVE 11

LEGEND

NORTH
N
TRUE

- ROAD
- FREEWAY
- FORMER MCAS EL TORO BOUNDARY
- SITE 24 BOUNDARY
- STREAM OR WASH

PROPOSED

- CORE EXTRACTION WELL SCREENED IN UPPER 50 FEET OF SHALLOW GROUNDWATER UNIT
- PERIMETER EXTRACTION WELLS SCREENED IN UPPER 50 FEET OF SHALLOW GROUNDWATER UNIT
- SHORT-SCREEN INJECTION WELLS SCREENED IN UPPER 50 FEET OF SHALLOW GROUNDWATER UNIT
- FULL-SCREEN INJECTION WELLS SCREENED IN UPPER 100 FEET OF SHALLOW GROUNDWATER UNIT
- FORMER MCAS EL TORO INJECTION WELL
- FORMER MCAS EL TORO EXTRACTION WELL

TCE CONCENTRATIONS IN GROUNDWATER

- 5.0 TO 50.0 MICROGRAMS PER LITER (ug/L) TRICHLOROETHENE (TCE)
- 5.0 TO 500.0 ug/L TCE
- GREATER THAN 500.0 ug/L TCE
- 5 — INFERRED ISOCONCENTRATION CONTOUR (ug/L)

NOTES:

WELL PLACEMENT BASED ON GROUNDWATER MODELLING CONDUCTED IN 1996 (JACOBS 1996e) AND BECHTEL NATIONAL INC. (BNI 1997b) AND GROUNDWATER SAMPLING DATA COLLECTED IN MARCH 1997.

50 AND 500 ug/L CONCENTRATION CONTOURS REVISED TO REFLECT HYDROPUNCH SAMPLES COLLECTED BETWEEN JANUARY AND APRIL 1998.

FOR MULTI-PORT OR CLUSTER WELL LOCATIONS THE HIGHEST CONCENTRATION WAS USED FOR CONTOURING THE PLUME.

Record of Decision

Figure 8-1

Shallow Groundwater Unit Extraction / Injection Wells

Former MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 5/1/02
File No: 164H7928
Job No: 22214-164
Rev No: C