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MCAS EL TORO
SSIC # 5090.3

Health Assessment for

EL TORO MARINE CORPS AIR STATION

SANTA ANA, ORANGE COUNTY, CALIFORNIA

CERCLIS NO. CA6170023208

FEBRUARY 8, 1993

TITLE: HUMAN HEALTH RISK ASSESSMENT FOR MCAS EL TORO

AUTHOR: ASTDR

DATE: 02/08/93

CATEGORY: 8.1

MARCH 23, 1993

THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104 (i) (7) (A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risks assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, this Health Assessment has been conducted using available data. Additional Health Assessments may be conducted for this site as more information becomes available.

The conclusions and recommendations presented in this Health Assessment are the result of site specific analyses and are not to be cited or quoted for other evaluations or Health Assessments.

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

PUBLIC HEALTH ASSESSMENT

EL TORO MARINE CORPS AIR STATION

SANTA ANA, ORANGE COUNTY, CALIFORNIA

CERCLIS NO. CA6170023208

Defense Facilities Assessment Section
Federal Programs Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry
Atlanta, Georgia

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations 42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the Agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited timeframe. To the extent possible, it presents an assessment of the potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30 day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

Comments regarding this report are welcome. Please address to:

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SUMMARY

The El Toro Marine Corps Air Station public health assessment has been prepared for public comment. Each comment received during the public comment period will be included in the appendix of the final release of the public health assessment accompanied by a written response.

The Agency for Toxic Substances and Disease Registry (ATSDR) identifies actual or perceived site-related health effects, and the level of public health hazard posed by the site. ATSDR then makes recommendations to the installation, the Environmental Protection Agency (EPA), and state and local agencies on preventing or alleviating human exposures to site-related contaminants. When indicated, ATSDR identifies a need for any follow-up health activities such as epidemiologic studies, registries or community health education. Finally, ATSDR provides a mechanism to re-evaluate health issues as site conditions change (e.g., after site remediation or changes in land use) or when new data or information are available.

El Toro Marine Corps Air Station is in Orange County, California, near the city of Irvine. The Marine Corps established El Toro in 1943, and it currently serves as the center for marine aviation operations on the Pacific Coast. The facility occupies 4700 acres comprising hangars, flightline areas, maintenance areas, fueling facilities, a clinic, housing areas, and a golf course. Portions of land on El Toro Marine Corps Air Station are leased to private companies for nursery and agriculture use, e.g., growing oranges, strawberries, and asparagus.

El Toro Marine Corps Air Station was proposed for listing on EPA's National Priorities List (NPL) in 1989 because past operations and disposal practices contaminated local groundwater. In 1990, El Toro Marine Corps Air Station was listed on the NPL.

ATSDR has categorized the El Toro Marine Corps Air Station as an indeterminate public health hazard due to the limited data available from on-station media that would indicate whether or not humans are being exposed to levels of contaminants expected to cause adverse health effects.

Off-station groundwater data have been collected by the Orange County Water District since 1985 when routine monitoring detected trichloroethylene in irrigation wells less than one-half mile from the El Toro Marine Corps Air Station boundary.

Agricultural farm workers and well operators are exposed to contaminants in groundwater through unintentional ingestion of contaminated groundwater, dermal contact with contaminated groundwater, and inhalation of aerosolized groundwater

contaminants. Based on the evaluation of current groundwater data, contaminants detected in groundwater both on station and off station do not pose a health hazard to those workers.

Future exposure could occur through two potable water wells that are located 10 miles downgradient of the contaminant plume. At the current rate of contaminant migration, those wells will be affected in one and a half to five years. The Orange County Water District has developed plans for additional groundwater treatment to prevent additional wells from becoming contaminated.

The environmental data used in the public health assessment are provided by the Navy, EPA, state environmental agencies, state and local health agencies, and other groups. ATSDR does not routinely perform environmental sampling.

Based on records review and personnel interviews, El Toro Marine Corps Air Station has identified 22 on-station sites for further investigation, which will include the sampling of soil, soil gas, groundwater, surface water and sediment.

At this time, data from the three extraction wells and the soil gas and ambient air at the landfills are the only data available from on-station areas. However, comprehensive sampling is currently underway, by the Marine Corps.

A public health action plan (PHAP) is included in the public health assessment. It contains a description of actions ATSDR and other parties will take at and in the vicinity of the station. The purpose of the PHAP is to provide a plan of action for preventing or mitigating adverse human health effects resulting from exposure to hazardous substances in the environment. ATSDR annually monitors the implementation of the plan. Follow-up public health actions may include, but are not limited to, restricting site access, sampling, surveillance, registries, health studies, environmental health education, and applied substance-specific research.

As part of ATSDR's public health action plan, ATSDR will hold a public availability session to discuss the material presented in the public health assessment and to gather additional community concerns. Additionally, ATSDR will review information on changes in land use as they become available.

ATSDR's Health Activities Recommendation Panel (HARP) has determined that based on the evaluation of available data and on current site conditions at the El Toro Marine Corps Air Station, follow-up public health actions are not being considered at this time. As more data become available, ATSDR will evaluate the data to determine if follow-up public health actions are indicated for the community near the station.

BACKGROUND

A. Station Description and History

Station Description

El Toro Marine Corps Air Station (MCAS) is within an unincorporated area of Orange County, California, one-half mile east of the city of Irvine, eight miles southeast of the city of Santa Ana, and 12 miles northeast of the city of Laguna Beach on the Pacific Coast. The Department of the Navy's Marine Corps began construction of the air station on 2319 acres of land. An additional 2379 acres were acquired between 1944 and 1977 to bring MCAS to its present size of 4741 acres. Contained on MCAS are flight lines, hangars, maintenance shops, a hospital, a clinic, housing areas, schools, a golf course, and office buildings. MCAS leases portions of land to private companies for nursery and agriculture use, e.g., growing oranges, strawberries, and asparagus.

MCAS operates a jet air station and provides services and materiel to support aviation activities for the Marine Corps and Navy on the West Coast. Operations include equipment maintenance and testing requiring the use of fuels, oils, solvents, and other hazardous materials. Past storage, handling, use, and disposal practices have led to environmental contamination. The U.S. Environmental Protection Agency (EPA) placed MCAS on the National Priorities List (NPL) in 1990 because of the detection of trichloroethylene (TCE) in irrigation wells outside the station boundaries and in monitoring wells inside the station boundaries.

Based on information gathered from record reviews and from employee interviews, MCAS identified 22 areas for Remedial Investigation and Feasibility Study (RI/FS). The Marine Corps will perform the RI/FS which will characterize the extent of environmental contamination and evaluate various clean-up methods. These 22 areas are grouped into three operable units (OUs).

Operable Unit 1 (OU-1) also referred to as Site 18 - Regional Groundwater Volatile Organic Compound (VOC) Investigation is the overall contaminated groundwater investigation. This investigation includes a groundwater contamination plume at the western portion of MCAS, which extends off-station three miles to the northwest. Operable Unit 2 (OU-2) consists of four landfills and a petroleum disposal area which are the suspected sources of groundwater contamination (1). Operable Unit 3 (OU-3) is made up of the remaining sixteen sites which include PCB spill areas, Fire Training areas, Battery Disposal areas, and others.

An Operable Unit 4 (OU-4) has been designated to address the abandoned wastewater treatment plant receiving lines, plus additional sites identified during a RCRA (Resource Conservation and Recovery Act of 1978) Facility Assessment Confirmation Study for future inclusion into the RI/FS program. The Confirmation Study includes the investigation of on-station abandoned storage tanks and sites previously identified by the Regional Water Quality Control Board (2).

Because data collected from Operable Unit 1, Site 18 - Regional Groundwater VOC Investigation, are the only complete quantitative data available at this time for MCAS, this public health assessment will focus on that area. However, when further data become available on the 21 on-station sites, ATSDR will evaluate the data to identify any public health hazards.

For purposes of clarity in this public health assessment, the term "station" refers to the El Toro Marine Corps Air Station and the term "site" refers to the potentially contaminated source areas within the station.

Table 1 lists the 22 identified sites, operable units, and suspected contaminants at each site. Areas in OU 2-3 are further described in Appendix A.

Operable Unit - 1

Site 18 - Regional Groundwater Volatile Organic Chemical (VOC) Investigation (OU-1)

The groundwater contaminant plume is at the western section of MCAS and continues off station 3 miles in a northwesterly direction (see Figure 1, page 15). The plume has been identified in several permeable zones which occur between 200 to 450 feet below the ground surface. Contaminants detected include the VOCs: carbon tetrachloride, chloroform, tetrachloroethylene, TCE, and dichloroethylene. Nitrates-N, aluminum and manganese were also detected in the groundwater. Monitoring wells have been installed on-station by the Marine Corps and off-station by Orange County Water District to monitor the contaminant plume. The source(s) for the groundwater contamination are currently under investigation. Groundwater treatment is being conducted off-station by Orange County Water District and on-station by the Marine Corps to reduce the concentrations of VOCs.

TABLE 1: SUSPECTED CONTAMINANTS AT El Toro Marine Corps Air Station

Operable Unit	Site Number	Suspected Contaminants
OU-1	18	Heavy metals, red and white phosphorus, nitroamines, TCE, PCE, DCE, toluene, chlorobenzene, nitrate TDS, and selenium
OU-2	2	General categories of construction debris, municipal wastes, batteries, waste oils, hydraulic fluids, paint residues, transformers, and waste solvents
	3	Burnt waste, metals, incinerator ash, solvents, paint residues, hydraulic fluids, engine coolants, construction debris, oily wastes, municipal solid wastes, and various inert solid wastes
	5	Burnt waste, municipal solid waste, unspecified fuels, oils, solvents/cleaning fluids, scrap metals, and paint residues
	10	Waste oils, antifreeze, hydraulic/transmission fluids, and various solvents
	17	Domestic waste, cooking grease, oils and fuels from sumps, empty drums, and other unknown materials
OU-3	1	FS smoke (sulfur trioxide chlorosulfonic acid), low-level radioactive material, metals, nitrated toluene/sulfates, and waste from FS smoke disposal
	4	Ferrocene, hydrocarbon carrier solution and oily wastes
	6	JP-5 fuel and waste lubricant oils
	7	JP-5 fuel and waste oils
	8	Various scrap/salvage materials and PCBs
	9	JP-5 fuel, aviation gasoline, and other waste oils
	11	PCBs
	12	Sludge from secondary wastewater treatment, heavy metals (Silver, Arsenic, Cadmium, Copper, Mercury, Lead, Selenium, and Zinc), pesticides, and hydrocarbons
	13	Crankcase oils, metals, and PCBs
	14	Battery acid, paints, lead, and other priority metals, waste oils, methylene chloride, and phenols
	15	Diesel fuel
	16	JP-5 fuel, leaded aviation gasoline, hydraulic fluid, waste oils, napalm, white phosphorus, and magnesium phosphate
	19	JP-5 fuel
	20	Kerosene, waste oils, and heavy metals
	21	Drums containing chemicals
	22	Fuel

Source: Brown and Caldwell, 1986. Marine Corps Air Station, El Toro, Installation Restoration Program, Draft Final Remedial Investigation and Feasibility Study Work Plan, 28 April 1991.

History

Since 1980, the Marine Corps has been investigating and cleaning past hazardous waste disposal sites on Marine Corps installations through the Installation Restoration Program (IRP). The Naval Facilities Engineering Command manages the technical aspects of the IRP. The goals of the IRP include the identification and cleanup of areas contaminated by the release of hazardous substances into the environment. The IRP addresses cleanup of contamination resulting from past, not current disposal operations. The IRP's initial steps are to identify potentially contaminated sites, evaluate the extent of contamination, and determine the need for remedial actions (2). Waste generated from current operations is regulated by EPA's Resource Conservation and Recovery Act (RCRA) Program.

The first study identifying potential sources of contamination at MCAS was the Initial Assessment Study (IAS), begun in 1985 by Navy contractors, Brown and Caldwell Engineers. At the completion of the study, 17 potential source areas were identified. Although sampling was not conducted, recommendations for future sampling locations and analytical parameters were made (3).

Concurrent with the IAS, the Orange County Water District discovered TCE contamination in two off-station agricultural wells downgradient of MCAS boundary. That discovery launched a program of in-depth investigations to characterize the extent and source of the groundwater contamination (4).

In 1987, the Navy contracted James M. Montgomery Engineers, Inc., to review the previous work by Brown and Caldwell and to produce a Site Inspection Plan of Action. While that study was underway, the Marine Corps prepared a supplemental plan to address off-station TCE contamination. The Plan of Action, completed in August 1988, recommended 19 areas for further study including Site 18 - Regional Groundwater VOC Investigation which would address the off-station contaminant plume (3).

A Perimeter Study Investigation (PSI) was initiated in 1988 by the Navy contractor, James M. Montgomery Engineers, Inc., in 1988 in response to concerns expressed by the Regional Water Quality Control Board that MCAS was a possible source of a VOC groundwater contamination plume that extended three miles off station. The PSI results indicated that VOCs were present in the shallow groundwater along the southwestern boundary of the facility prompting the Marine Corps to install an interim pump and treatment system to treat approximately 10 gallons of groundwater per minute (gpm) from three extraction wells (3).

The RI/FS Work Plan and associated documents for MCAS were initiated in 1989. During the investigation conducted for the compilation of the RI/FS Work Plan, MCAS added three additional sites to the 19 previously identified sites bringing to 22 the total number of sites to be investigated.

In March 1990, the Marine Corps completed an off-station Remedial Investigation Work Plan. It included recommendations for monitoring well installation and it served as a starting point for the Regional Groundwater VOC Investigation currently being conducted under the RI/FS Program (3).

The Orange County Water District implemented a VOC groundwater treatment operation to reduce off-station groundwater contamination. It began operating in 1990 at a rate of 700 gpm with a maximum capacity of 1200 gpm (5).

B. Site Visit

ATSDR staff conducted a site visit on March 21-25, 1991. They were accompanied by representative of Southwestern Naval Facilities Engineering Command and MCAS. During the site visit, all of the sites (excluding Site 18 - Regional Groundwater VOC Investigation) were visited. ATSDR representatives observed the following from the tour of sites.

- The station is surrounded by a six-foot chain-link fence with guards at every gate. Only authorized personnel are permitted access to the station.
- Within the station, certain high security areas are patrolled, and entry is strictly regulated.
- Access to the sites was found to be restricted, usually by six-foot chain-link fence topped with barbed-wire, by patrol, or by both. However, Site 17 - Communication Station Landfill, which is located at the base of a steep incline, had no fence to restrict access.
- Site 17 may represent a physical hazard since many large household appliances (i.e., refrigerators, freezers, etc.) were seen exposed in the landfill area, providing a potential for children to get trapped and suffocate. Access to the site is not prohibited, but there was no evidence of activity in the landfill area. Children were seen walking down an adjacent hill.

- MCAS leases portions of land to private companies for nursery use, and agriculture use, e.g., growing oranges, strawberries, and asparagus. Past land leases included use for quarry mining.

ATSDR interviewed the Joint Public Affairs staff, the Station Industrial Hygienist, the Station Occupational Medicine physician, and the Community Planning and Liaison staff to identify any on-station or off-station community health concerns.

ATSDR personnel attended a Technical Review Committee Meeting and made contacts with representatives from Orange County Water District, Orange County Health Care Agency, CH2M Hill Contractors, California Department of Health Services, Orange County Environmental Management Agency, EPA, and The Irvine Company.

C. Demographics, Land Use and Natural Resources Use

On-Station Demographics

Bachelor housing is provided for 3250 marines in barracks on the main facility of El Toro Marine Corps Air Station. Family housing for 1256 marines and 4000 dependents is provided in housing facilities on the east side of Irvine Boulevard.

There are 2950 military personnel who work at the facility, but live off station. MCAS employs 1750 civilian personnel, with the majority of personnel living in the towns of Lake Forest (El Toro), Irvine, Santa Ana, and Anaheim, California, between one mile and ten miles from MCAS (6).

Off-Station Demographics

Previously known as the community of El Toro, the area now called the city of Lake Forest is less than one-half mile from the southeastern boundary of MCAS. Its estimated 1990 population was 62,685. The population break-down consists of 94.2 percent Caucasian, 7.0 percent Hispanic, 4.1 percent Asian/Pacific Islander, 1.1 percent African-American, and 0.6 percent American Indian. There are 16,508 persons less than 18 years old, and 46,177 persons 18 years and older. The median education is 13.9 years of school. The median household income is $40,411 compared to the median household income of all of Orange County of $40,248. Approximately 48 percent of the households earn more than $50,000 per year. An

estimated 71 percent of employed residents work in "white-collar" jobs, 18 percent in "blue-collar" jobs, 10 percent in services, and less than 1 percent in agriculture and fishing. The 1990 unemployment rate was 3.1 percent (2).

The city of Irvine, located in central Orange County, less than one mile west of MCAS, covers 43.6 square miles and has a total population of 102,418 with a median age of 29.8 years. There are 29,445 persons less than 18 years old, 65,129 persons between 18 and 60 years old, and 7844 persons over 60 years old. Approximately 74 percent of the city's population is Caucasian, 18 percent Asian/Pacific Islander, 6.3 percent Hispanic, 1.7 percent African-American, 0.19 percent American Indian, and 0.11 percent other (7). The median education is 14.4 years with 34.7 percent of all residents being college graduates. Over 19 percent of the population falls into the $75,000 and above annual income range. There was an estimated four percent unemployment rate in 1990.

Most of the farms near MCAS employ migrant workers who have moved to the U.S. from Mexico. Migrant farm workers are not enumerated separately in the 1990 Census, and no other estimates of the migrant population for MCAS area are currently available.

Land Use

MCAS is situated in a semi-urban, agricultural area of Southern California. The majority of the land immediately surrounding MCAS is used to raise oranges, strawberries, asparagus, and other agricultural crops. Portions of the station are leased for nursery use and agriculture use. The University of California, Irvine, has an agricultural field station directly north of MCAS. Located just northeast of the MCAS is a large nursery where fruit trees are grown. Until 10 years ago, the entire area surrounding MCAS was agricultural land; since then, urbanization has brought development closer to MCAS. New housing developments lie about one-half mile to the northeast of Site 1. About one-half mile northwest of the MCAS boundary are the main residential areas of the city of Irvine. The land farther north and northeast of MCAS in the Santa Ana Mountains and the San Joaquin Hills remains essentially undeveloped (2).

Another residential area is located less than one mile from the southeastern border of the station. The area directly southeast of the station boundary is a small, recently

developed industrial complex, containing offices and warehouses.

Within the Irvine Unified School District, there are 19 elementary schools, four middle schools and four high schools. One of the elementary schools is on MCAS less than one mile from Sites 3 and 4.

Natural Resources Use

Groundwater

Groundwater in the surrounding area of MCAS is primarily used for irrigation of agricultural and greenbelt areas (i.e., parkways and parks that encircle the local communities). Municipal wells are located west of Newport Boulevard, eight miles west of MCAS. Municipal wells are used as drinking water sources for 45,000 people (8).

Drinking water is supplied to MCAS and the surrounding area from Irvine Water District and Orange County Water District. The water is blended with water obtained from the Colorado River.

As the demand for water has increased, the need for additional water sources has necessitated the evaluation of local groundwater as a potential drinking water source. Since June 1990, the Orange County Water District has operated a VOC groundwater treatment facility that treats 700 gallons of contaminated groundwater per minute. The treated water is discharged into the reclaimed water line where it is used for non-potable agricultural and greenbelt irrigation in areas in and around the city of Irvine. Future water development plans call for expanding the remediation/treatment system, and using the treated water for drinking (5).

Surface Water

Surface drainage in the vicinity of MCAS flows to the southwest, following the slope of the land perpendicular to the trend of the Santa Ana Mountains (4). Off-station drainage from the hills to the northeast and upgradient irrigated farmlands combine with on-station runoff generated from the extensive paved surfaces at the station, and flows into four main drainage channels: Marshburn Channel, Borrego Canyon Wash, Agua Chinon Wash, and Bee Canyon Wash (see Figure 1). Three of these drainage channels: Borrego Canyon Wash, Agua Chinon Wash, and Bee Canyon Wash have continuous flow, from natural washes that originate in the Santa Ana Mountains (4).

Marshburn Channel is a lined drainage channel that runs along the northwestern boundary of MCAS and receives runoff from the western part of the facility. The channel flows into San Diego Creek less than one mile northwest of Bee Canyon Wash.

Southernmost of these channels is the Borrego Canyon Wash, gravel lined channel that flows along the southeast boundary of MCAS. Borrego Canyon Wash crosses the southern corner of the station, and joins Agua Chinon Wash about one-quarter of a mile from the station boundary.

Agua Chinon Wash and Bee Canyon Wash descend from the Santa Ana Mountains through MCAS. They submerge into culverts as they approach the flightline area, then emerge just past the flightline area.

Agua Chinon Wash flows into San Diego Creek just east of the intersection of the San Diego and Laguna Freeways, approximately one mile downstream of its intersection with Borrego Canyon Wash. Bee Canyon Wash flows into San Diego Creek about 1500 feet north of Agua Chinon Wash.

San Diego Creek receives continuous flow from the run-off of the Borrego Canyon Wash, Agua Chinon Wash, Bee Canyon Wash, and the paved Marshburn Channel. Approximately 5 miles downstream from MCAS, the San Diego Creek runs through a recreational area consisting of hiking, biking, and equestrian trails as it makes its way to Newport Bay. Newport Bay is a major recreational area used for swimming and fishing.

D. Health Outcome Data

Health outcome data or health effects data are collected from cancer or tumor registry databases and birth defects data provided by the state and local health agencies, and any site-specific health studies that may have been performed.

ATSDR conducts a review of health outcome data if completed exposure pathways have been identified; if the toxicologic evaluation shows the likelihood of health outcomes; and if the community near the site has health concerns.

The State of California maintains a cancer registry from 1988. Orange County has maintained complete tumor registry data since 1984. Other health data bases maintained by California State include Birth Defects Registry, and an Alzheimer Disease Registry.

COMMUNITY HEALTH CONCERNS

Community health concerns are collected from logs kept by Navy Public Affairs Office, EPA's Community Relations representative, and state and local health and environmental agencies.

ATSDR representatives spoke with MCAS medical officers and with the Public Affairs Officer, state, city, and county health officers as well as a member of the El Toro Community Association in order to identify community health concerns. No community health concerns were identified from those discussions.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

Contaminants discussed in the subsequent sections of this public health assessment will be evaluated to determine whether exposure to them has public health significance. All the contaminants detected are not included in this document. Instead, ATSDR has selected certain contaminants that require further evaluation in this public health assessment.

ATSDR selects and discusses contaminants based on several factors: concentrations of environmental contaminants on and off the air station, field and laboratory data quality, sampling design, and comparison of chemical concentrations to public health assessment comparison values for carcinogenic and non-

carcinogenic health effects. Community health concerns are also considered when selecting the contaminants presented in this public health assessment.

Listing a chemical contaminant in the data tables that follow does not mean that it will cause adverse health effects. Instead, the list indicates which contaminants will be evaluated further in the public health assessment. The potential adverse health effects from those selected contaminants will be discussed in the Public Health Evaluation section of this document. When selected in one medium, a contaminant will be reported in all media in which it is found.

The comparison values for ATSDR public health assessments are developed by environmental and health agencies to provide an estimate of chemical concentrations present in each environmental medium (air, water, soil) that should be evaluated for possible health effects if exposure to the contaminants occurs. In many cases, the values have been derived from animal studies or occupational studies. Health effects are related to the exposure dose, the routes of entry into the body, and the amount of chemical absorbed by the body.

The data tables include the following abbreviations for these comparison values.

CREG — Cancer Risk Evaluation Guide. CREGs are public health assessment comparison values that correspond to one excess cancer in a million persons exposed over a lifetime. CREGs are calculated from standard cancer risk, adult body weight, adult ingestion rate, and EPA's cancer slope factor (toxicity values for carcinogenic effects).

EMEG — Environmental Media Evaluation Guide. EMEGs are media-specific values that correspond to ATSDR's Minimal Risk Level (MRL). They are calculated by using ATSDR's conservative exposure assumptions that would protect the most sensitive populations.

MCL — Maximum Contaminant Level. MCLs represent contaminant concentrations that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an ingestion rate of two liters of water per day. MCLs are enforceable regulatory standards.

Secondary MCL	Secondary Maximum Contaminant Level. Secondary MCLs are non-enforceable drinking water limits that may affect the aesthetic qualities (i.e. taste and color) and the public's acceptance of drinking water (9).
MCLG	Maximum Contaminant Level Goals. MCLGs are drinking water health goals. MCLGs are set at a level at which no known or anticipated adverse human health effects occur. MCLGs are not enforceable standards.
MRL	Minimal Risk Level. Developed by ATSDR, MRLs are estimates of daily exposure to a chemical that is not likely to cause adverse non-carcinogenic health effects. MRLs are based on the most current information available.
NOAEL	No Observed Adverse Effect Level. The NOAEL is a dose of chemical in a study or group of studies that clearly shows no adverse health effects.
RfD	Reference Dose. EPA's RfD is an estimate (with uncertainty spanning perhaps a factor of ten) of the daily exposure of a person to a contaminant that is unlikely to cause adverse health effects. The RfD is operationally derived from the NOAEL (from animal and human studies) by a consistent application of uncertainty factors that reflect various types of data used to estimate RfDs and an additional modifying factor, which is based on a professional judgement of the entire database on the chemical.

Additionally, individual chemicals may be grouped into general chemical classifications based on their similar physical properties. The following abbreviations are used in the sections of the public health assessment that follow.

Inorganic Chemicals	Organic chemicals contain carbon; inorganic chemicals do not contain carbon. VOCs, PCBs, and some pesticides are organic chemicals. Elemental metals such as lead, mercury, cadmium, silver, nickel, and others are inorganic chemicals. Other non-metal inorganic chemicals include boron, antimony, and magnesium.

Nitrates Nitrites	Nitrate (NO_3^-) and nitrite (NO_2^-) are naturally occurring inorganic ions, which are part of the nitrogen cycle. Natural animal wastes containing organic nitrogen decompose in soil and water by microbial bacteria to first form ammonia, which is then oxidized to nitrate. Nitrate is the predominate form of nitrogen found in groundwater and surface water. In agricultural areas, nitrogen-based fertilizers are the major source of contamination of groundwater and surface water. Nitrate-containing compounds in the soil are generally soluble and readily migrate in groundwater.
PCBs	Polychlorinated Biphenyls. These chemicals are very stable and persistent in the environment. They are used as heat transfer liquids in transformers, hydraulic fluids, lubricants, and in plasticizers, surface coatings, inks, and adhesives. They are also used as pesticide extenders and for microencapsulation of dyes for carbonless duplicating paper. There are 209 chemicals are classified as PCBs.
VOCs	Volatile organic compounds. The chemicals in this group readily evaporate or volatilize into gases when exposed to air. This chemical class includes carbon tetrachloride, chloroform, PCE, TCE, DCE, benzene, toluene, xylenes, etc.

A. On-station contamination

The information for this section was obtained from the Solid Waste Air Quality Assessment Test Report and MCAS El Toro Aquasorb Treatment System Monitoring Report (listed in the "References" section of this document). There is currently no quantitative data on the concentrations of suspected contaminants listed in Table 1 (i.e., waste oils, solvents, JP-5 fuel, etc). Consequently, discussion of on-station contamination sources and pathways for soil, air and surface water must necessarily wait until site-specific information is available.

Groundwater

In July 1989, MCAS began groundwater treatment. The groundwater treatment system consists of three wells (PS-1, PS-3, and PS-4) that extract groundwater from the western

perimeter of the air station at a rate of 5 - 10 gallons per minute. The groundwater pumped from each well merges into one line that enters two granular activated carbon (GAC) filters. The filtered water then enters a storage tank before it is used to irrigate the station's golf course. To monitor the effectiveness of the treatment system, sampling valves have been inserted at six locations: one valve at each well outlet, at the combined inlet where the three wells merge, in between the first and second carbon filter, and at the effluent stage as the treated water exits the system (10).

The extracted groundwater is analyzed for VOCs only. At the combined inlet prior to filtration, TCE has been detected at a maximum concentration of 160 ppb. Tetrachloroethylene (PCE) has been detected at a maximum concentration of 100 ppb. Since July 1989, TCE has been detected in all 38 samples prior to treatment. PCE has been detected in 34 of the samples prior to treatment. Other VOCs detected at levels below comparison values include 1,2 DCE, acetone, methylene chloride, chloroform, and 2-butanone.

The source of groundwater contamination has not been determined. Groundwater treatment by MCAS at the current filtration rate is not sufficient to slow the rate of contamination migration to off-station areas.

Figure 1 illustrates the TCE plume, which appears to originate at MCAS, extends approximately three miles northwest of the station boundary, and covers a total area of 2900 acres (5).

Soil Gas and Air

Air and soil gas samples were taken between April and June 1990 at several locations within the boundaries of the four landfill sites: Site 2 - Magazine Road Landfill (OU-2), Site 3 - Original Landfill (OU-2), Site 5 - Perimeter Road Landfill (OU-2), and Site 17 - Communications Station Landfill (OU-2). Contractors for the Marine Corps sampled soil gas and ambient air (11).

Air samples were taken at two to three inches above ground surface. Soil gas samples were taken between seven and eight feet below ground surface. Air and soil gas samples were analyzed for VOCs, oxygen, and nitrogen content. VOCs detected include methane, vinyl chloride, benzene, ethylene dichloride, TCE, PCE, and chloroform. Concentrations of VOCs detected in air were below comparison values. Some soil gases were detected at levels above comparison values. However, at this time there is no human exposure to the subsurface soil gases due to its inaccessibility.

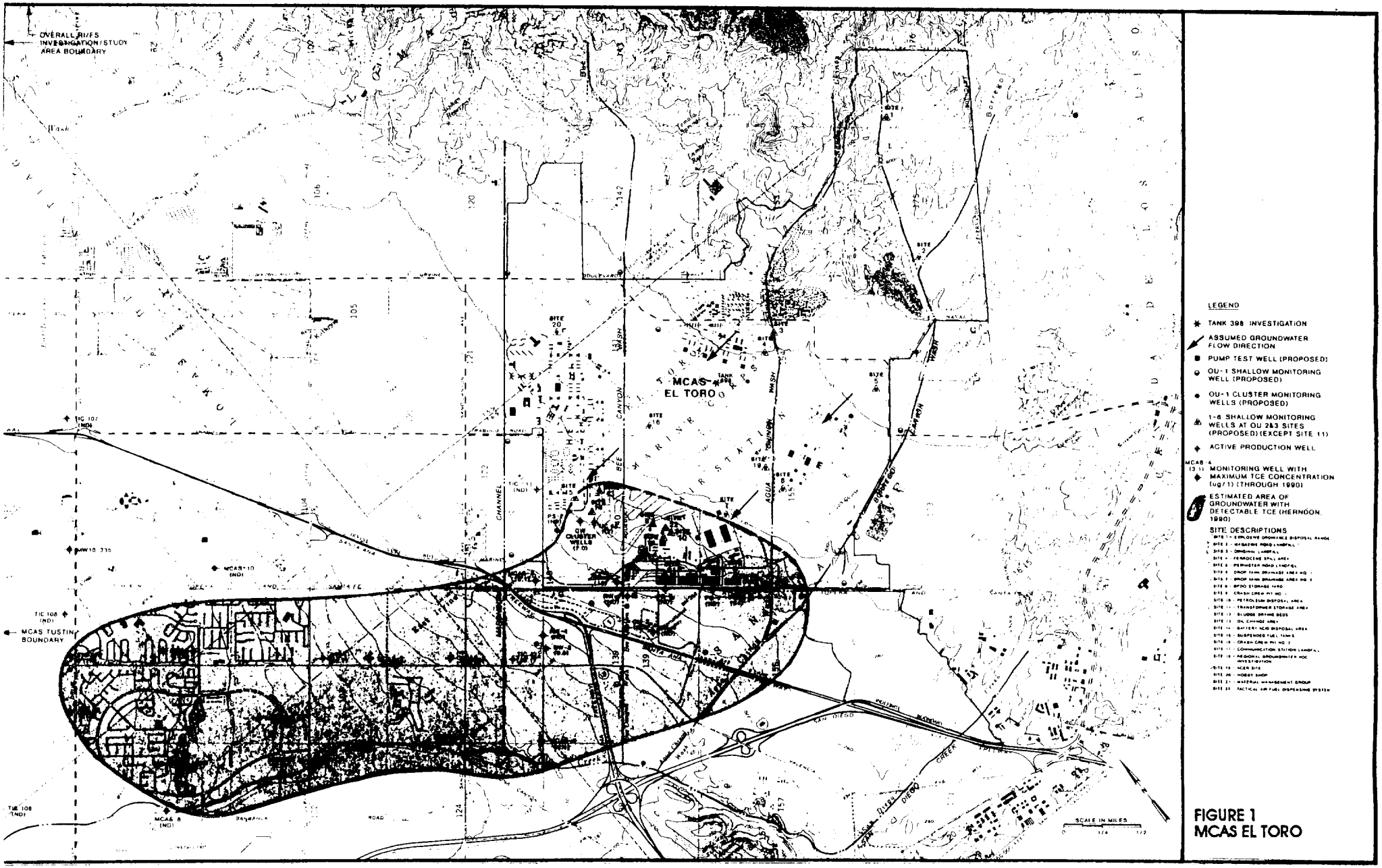

FIGURE 1
MCAS EL TORO

Potential Contamination

Past and present activities at MCAS present the potential for on-station contamination of air, water, and soil. Escaped organic vapor emissions from waste handling and processing, and wind-borne soil and dust are examples of potential air contamination. Soils may be contaminated from past storage practices, spills, leaks, or seepage. Contaminants may migrate through soils or surface water to the groundwater system. Portions of the station are leased for agricultural activities, and food crops may be grown in contaminated soil or irrigated with contaminated water.

The RI/FS Work Plan and the RCRA Facility Assessment, Preliminary Review at MCAS have separated environmental contamination into three operable units: OU-1, OU-2, and OU-3. OU-1 consists of an off-station plume of VOC-contaminated groundwater which will be discussed in the following section. OU-2 consists of five sites suspected of being the on-station sources of the VOC contamination, and OU-3 represents 16 sites identified as potential Solid Waste Management Units during the RCRA Preliminary Review.

Table 1 lists the contaminant sites according to applicable operational unit and potential waste type. Four of the OU-2 sites are landfills where VOCs and other materials were disposed. The five OU-2 sites, 16 OU-3 sites, and the respective contaminants of concern were identified from historical records and interviews with station personnel as sites where contaminants have been used or known releases have occurred.

B. Off-station contamination

Groundwater

The off-station groundwater contamination near MCAS has been documented in two reports by the Orange County Water District (4,5). Ten contaminants were detected in measurable quantities, with five of those at concentrations exceeding the comparison values (Table 2). Four of the five contaminants are VOCs that are used as organic solvents for cleaning and degreasing aircraft parts and military vehicles. TCE, PCE, chloroform, and carbon tetrachloride are highly mobile in soils, and have been observed to leach rapidly into groundwater (9). In surface waters, TCE has a volatilization half-life of hours to a few days, depending on water depth and turbulence (9).

The Orange County Water District (OCWD) evaluated the effectiveness of spray and drip irrigation as a remedial treatment of TCE contaminated groundwater, and they found volatilization rates of 97 percent and 42 percent, respectively (5).

The maximum concentration of TCE was measured at a well approximately 1 mile beyond the station boundary (ET-1, 89 μg/L). VOCs have been detected at depths between 165 and 450 feet, (below land surface) and have been moving northwest at a rate of 4-30 feet per day, which is considerably greater than the 1-4 feet/day regional flow rate (5). Toluene, ethylbenzene, and chlorobenzene were detected at concentrations below comparison values at depths greater than 500 feet and are believed by Orange County Water District personnel to be leaching from naturally occurring hydrocarbons which are common in this geographical area (5).

Table 2: CONTAMINANTS DETECTED IN OFF-STATION GROUNDWATER

CONTAMINANT	CONCENTRATION RANGE - (μg/L)	COMPARISON VALUE (μg/L)	REFERENCE
Carbon Tetrachloride	0.4 - 61	0.27	CREG
Chloroform	0.1 - 14	5.7	CREG
Nitrate-N	100 - 140,000	10,000	MCL
Tetrachloroethylene	trace - 81	0.7	CREG
Trichloroethylene	0.1 - 89	3.2	CREG

Adapted from Reference (5).

CREG = Cancer Risk Evaluation Guide
MCL = Maximum Contaminant Level

Nitrate-N was also detected in concentrations (up to 14 times the MCL) at depths less than 200 feet and greater than 500 feet, and are believed to be a result of agricultural activities (4). In a series of samples taken in 1988 and 1989, concentrations of iron and manganese greater than Secondary MCLs were detected in six of seven wells analyzed, but not at every depth within those wells. These inorganic metals were not analyzed at every site for every sampling

period; therefore, no discernible distribution pattern can be identified (4).

Secondary MCLs are non-enforceable drinking water limits that may affect the aesthetic qualities (i.e., taste and color) and the public's acceptance of drinking water (10). However, the large range of these values (sometimes four times higher) in samples over different depths and times indicates that the elevated concentrations are not natural background values. These metals are common components of the well and pump machinery, and high concentrations in the water may reflect those local sources. Alternatively, the elevated concentrations may represent leaching from upgradient sources such as landfills or disposal areas.

In order to identify facilities that could contribute to the contamination near MCAS, ATSDR searched the Environmental Protection Agency's 1987, 1988, and 1989 Toxic Chemical Release Inventory (TRI). The TRI is an annual compilation of chemical manufacturers' self-reported quantity of toxic chemicals released into each environmental medium (e.g., air, soil, in surface water); the manufacturing facilities that report to the TRI must employ more than 10 people and must fall into certain industrial classification codes. Because MCAS is not a manufacturing facility, they are not required to report releases in the TRI. However, MCAS must comply with other state and federal reporting requirements regarding hazardous chemical releases.

In the database, several companies reported releases of TCE, carbon tetrachloride, chloroform, and PCE into air, and releases into wastewater discharges.

C. Quality Assurance and Quality Control

Although Quality Assurance and Quality Control information was not provided, the off-station data from the Orange County Water District were analyzed using EPA-approved methods in which Quality Control and Assurance procedures were used. The consistent reproducibility of the data indicates that the sampling and analysis is representative and verifiable. Therefore, the data used in this public health assessment are assumed to be accurate.

D. Physical and Other Hazards

Physical Hazards

Site 1 may contain unexploded ordnance that poses a physical explosive hazard for remedial workers or any persons who disturb buried material (see Appendix A for further site descriptions).

During the site tour, it was noted that Site 17 may represent a physical hazard since many household appliances were seen exposed in the landfill area and access to the site is not restricted. Children playing with the large exposed appliances may become trapped and suffocate. Children were noted walking down an adjacent hill, but there was no evidence of activity in the immediate landfill area.

Additionally, methane gas and other soil gases if present could potentially build up in confined areas of building located near landfills creating a potential physical explosive hazard. Methane is a naturally occurring gas produced during the decay of organic materials commonly found in landfills.

Other Hazards

Materials containing low level radiation have reportedly been buried at Site 1 - Explosive Ordnance Disposal Range (1). Anyone disturbing radioactive buried material may be exposed to low level radiation.

PATHWAYS ANALYSES

To determine whether humans are exposed to contaminants migrating from a site, ATSDR evaluates the environmental and human components that lead to human exposure. This evaluation or pathways analysis consists of five elements: source of contamination, environmental medium in which contaminants may be present or may migrate, points of human exposure such as a private water well, a route of human exposure such as ingestion, inhalation or dermal contact, and people who are exposed or potentially exposed.

ATSDR identifies exposure pathways as completed, potential, or eliminated. For a completed pathway to exist, all of the five elements must be present to provide evidence that exposure to a contaminant has occurred in the past, is occurring or will occur in the future. A potential pathway indicates that at least one of the five elements is missing, but could exist. Potential pathways indicate that exposure to a contaminant could have occurred, could be occurring or could occur in the future. Pathways are eliminated when at least one of the five elements is missing and will never be present.

Past, present, and future exposure pathways that may present a public health hazard are discussed in this section.

A. Completed Exposure Pathways

Groundwater Pathway

MCAS is located at the foot of the Santa Ana Mountains in a zone of groundwater recharge (4). The sediments underlying the station are relatively coarse resulting in migration of certain contaminants in the sediments to move rapidly downward and then westward into the regional groundwater. Leaching or seepage of contaminants into groundwater has occurred.

Based on available information, the most likely contaminant source for groundwater contamination at MCAS is the historical disposal practices of VOCs at MCAS. VOCs have migrated northwest from on-station disposal areas, with the highest concentrations within permeable zones between the depths of 200-450 feet below ground surface. TCE, carbon tetrachloride, chloroform, and PCE are the VOCs detected in groundwater at concentrations above comparison values (Table 2).

A secondary source of groundwater contamination in the area may be from the off-station application and subsequent

subsurface migration of agricultural fertilizers. Nitrate-N contaminated groundwater from off-station agricultural sources generally occurs at depths less than 200 feet. Intermittent monitoring of groundwater containing aluminum, iron, and manganese indicates high concentrations of those metals in groundwater, but a discrete source has not been defined.

Although groundwater contamination may be caused by different sources, human contact with contaminated groundwater represents a past, current, and future completed exposure pathway through the routes of ingestion and dermal absorption of groundwater, and inhalation of aerosolized groundwater contaminants. No drinking water wells currently exist within the area of the contaminant plume. Contaminated groundwater is used for irrigation of agricultural areas, and is extracted for VOC decontamination both on and off station. Farm workers who contact contaminated groundwater used for irrigation would be chronically exposed to contaminants (longer than one year). Well operators, and maintenance personnel may contact contaminated groundwater extracted for treatment; however, these exposures are unlikely to occur on a long-term (chronic) basis, but would be relatively infrequent and of short duration.

Table 3: Completed Exposure Pathways

SOURCE	ENVIRONMENTAL MEDIUM	CONTAMINANT	MAXIMUM CONCENTRATION (μg/L)	EXPOSURE POINTS	EXPOSURE ROUTES	EXPOSED POPULATION	EXPOSURE TIME
MCAS Storage, handling, use, and disposal of hazardous chemicals	Groundwater	Carbon Tetrachloride	61	Irrigation Wells	Unintentional ingestion, dermal absorption, and inhalation of volatilized chemicals	Farm Workers	Past Present Future
		Chloroform	14				
		Tetrachloroethylene	81	Extraction and Treatment Wells		Well Operators and Maintenance Personnel	
		Trichloroethylene	90				
Agricultural Activities on station and off-station	Groundwater	Nitrate-N	140,000	Irrigation Wells	Unintentional ingestion, dermal absorption, and inhalation of volatilized chemicals	Farm Workers	Past Present Future
		Aluminum	2400				
		Manganese	1600	Extraction and Treatment Wells		Well Operators and Maintenance Personnel	
		Iron	4000				

B. Potential Exposure Pathways

Groundwater Pathway

No drinking water wells currently exist within the area of the contaminant plume. However, farm workers' may drink contaminated water from irrigation hoses while in the field.

At the maximum rate of contaminant migration and in the absence of current remedial action, two down gradient potable wells could be affected in one and a half to five years (5). The Orange County Water District is currently evaluating the feasibility of installing additional wells within the TCE plume and using the treated water as a public drinking water supply.

The potential for human exposure to the contaminated groundwater exits at drinking water wells approximately 2 - 3 miles downgradient of the TCE contaminant plume. As assessed by the Orange County Water District, groundwater, at the maximum flow velocity of 30 ft/day, could be contaminated in approximately 500 days, although ongoing remediation by the Orange County Water District will slow the rate of contaminant migration (5).

Other Potential Exposure Pathways

Although only limited environmental data are available for on-station air and soil gas, and no environmental data are available for surface water, soil, or sediment, other potentially completed exposure pathways exist for humans to contact on-station contaminated media through inhalation, dermal contact with, and ingestion of contaminated soil, sediment, and surface water.

Additionally, the streams draining MCAS act as recharge sources for underlying groundwater (4). If surface water contaminants are present, they will be an additional contaminant source for groundwater, but provide little potential for direct human exposure.

C. Eliminated Exposure Pathways

Edible Food Pathway

Oranges, strawberries, and asparagus are grown on and off station, and are irrigated with contaminated groundwater. Contaminant concentrations in these foodstuffs are not available. The levels of contaminants that would be present

from groundwater irrigation systems would be so low as to be considered negligible due to the nature of VOCs to rapidly evaporate. Additionally, bioaccumulation of VOCs in edible fruits and vegetables is not of concern because plants do not readily absorb these chemicals (12). Therefore, the consumption of these foods has been eliminated as an exposure pathway.

PUBLIC HEALTH IMPLICATIONS

Chemicals released into the environment do not always result in human exposure. Human exposure to a chemical contaminant can only occur if people come in contact with the contaminant either by ingestion (eating or drinking a substance containing the chemical), inhalation (breathing air containing the chemical), or by dermal absorption (skin contact of a substance containing the chemical).

To understand the type and severity of health effects that may be caused from exposure to a specific chemical contaminant, several factors related to the interaction of the chemical with the individual must be considered. Such factors include the amount or chemical dose to which a person is exposed, the frequency and duration of exposure, the route the chemical enters the body (ingestion, inhalation or dermal absorption), and the multiplicity (combination of chemicals) of exposure. Estimated exposure doses take into consideration a persons body weight, the concentration of chemical present, the duration and frequency of exposure, and if known, the amount of chemical likely to be absorbed by the body.

Health effects are also related to such characteristics as age, sex, nutritional and health status, life style, and family traits, all of which may influence how a specific chemical is absorbed (taken up by the body); metabolized (broken down by the body); and excreted (eliminated from the body).

To determine the possible health effects produced by specific chemicals, ATSDR considers physical and biological factors as well as a variety of information, such as scientific literature, research reports, and reports from other federal, state, and local health and environmental agencies.

A. Toxicologic Evaluation

The following sections evaluate the potential health effects from identified contaminant exposure at and near MCAS. The

toxicological evaluation of each contaminant assesses probable health effects from exposure to the contaminant. Health effects are related to contaminant concentration, exposure route, exposure frequency, and the potentially exposed population. Populations known or suspected of being sensitive to the contaminant are included. Information will be presented in relation to those pathways identified as completed exposure pathways.

At this time, the only known completed exposure pathways exist for farm workers and well operators through accidental ingestion, dermal absorption, and inhalation of volatilized contaminants from groundwater. Past and current exposures to untreated groundwater and current exposures to treated groundwater do not present a health concern because of the low levels of contaminants detected in the groundwater and the tendency for exposure to be brief, and to involve exposure in open air settings. On the basis of existing information, ATSDR has concluded that carbon tetrachloride, chloroform, nitrate-N, PCE, and TCE at the concentrations present in groundwater are not of public health concern for farm workers and well operators.

Carbon tetrachloride

Carbon tetrachloride is widely used as a degreasing agent and as a household spot remover. It is also used to make refrigerator fluid and propellants used in aerosol cans. Carbon tetrachloride binds readily to organic soil components. It is persistent in the environment and is broken down by chemical reactions in air at a half life rate of 30 to 100 years (13).

EPA has categorized carbon tetrachloride as a probable human carcinogen because evidence shows that it causes liver cancer in animals. It has been detected in wells not used for drinking water purposes at a maximum concentration of 61 μg/L. Farm workers would be chronically exposed (greater than one year) to groundwater contaminants by inhaling aerosolized contaminants from groundwater, by accidental ingestion of contaminated groundwater, and by dermal contact with contaminated groundwater. Workers who operate the groundwater treatment systems would be intermittently exposed (less than one year) to groundwater contaminants by inhaling aerosolized contaminants from groundwater, by accidental ingestion of contaminated groundwater, and by dermal contact with contaminated groundwater.

Short term exposure to carbon tetrachloride at levels 2 - 163 times higher (100 - 10,000 μg/L) than levels detected in groundwater can cause skin irritation, nausea, vomiting, and headache. Long term exposure to levels 20,000 - 200,000 μg/L can cause nephritis (kidney effects) and cirrhosis of the liver, jaundice, and elevated concentrations of liver enzymes in serum (13). When the maximum level of carbon tetrachloride detected is converted to an estimated dose of contaminant ingested per day, (0.00048 mg/kg/day), that dose is 1.5 times lower than EPA's oral reference dose (RfD) of 0.0007 mg/kg/day. The RfD is an estimate of daily exposure of people that is likely to be without an appreciable risk of causing non-cancerous, long-term adverse health effects. When compared to the cancer risk comparison values, exposure to the highest concentration of carbon tetrachloride detected in groundwater would not be expected to cause any increased cases of cancer. Therefore, based on the available information, exposure to carbon tetrachloride from irrigation wells does not present a health concern.

Chloroform

Chloroform is used in the pesticide, paper, and pharmaceutical industries. It is commonly released from automobile exhaust, chlorinated drinking water, and chlorinated swimming pool water. Many foods including seafood, diary products, meats, vegetables, breads, and beverages may contain small but measurable amounts of chloroform (14). EPA has categorized chloroform as a probable human carcinogen based on evidence that it causes liver cancer in animals. It has been detected in monitoring wells at a maximum concentration of 14 μg/L.

Farm workers would be chronically exposed (greater than one year) to groundwater contaminants by inhaling aerosolized contaminants from groundwater, by accidental ingestion of contaminated groundwater, and by dermal contact with contaminated groundwater. Workers who operate the groundwater treatment systems would be intermittently exposed (less than one year) to groundwater contaminants by inhaling aerosolized contaminants from groundwater, by accidental ingestion of contaminated groundwater, and by dermal contact with contaminated groundwater.

Occupational exposures to levels 5.5 times greater (77 μg/L) than maximum levels detected in groundwater have caused tiredness and depression. Chronic occupational exposures (1-4 years) to 400 μg/L have caused hepatitis and liver enlargement (14). When the maximum level of chloroform detected is converted to an estimated dose of contaminant ingested per

day, (0.0061 mg/kg/day), that dose is 81 times lower than both the Minimal Risk Level (MRL) of 0.01 mg/kg/day and the Reference Dose, of 0.01 mg/kg/day. MRLs are ATSDR's estimate of daily human exposure to a chemical that is not likely to cause adverse (non-cancerous) health effects. When compared to the cancer risk comparison values, ingestion of groundwater containing the highest concentration of chloroform detected in groundwater, would not be expected to cause an increase in cancer cases. Therefore, chloroform at the levels detected in groundwater does not pose a health concern.

Tetrachloroethylene (PCE)

Tetrachloroethylene (also called perchloroethylene or PCE) is used in dry cleaning, and as a metal parts degreaser. It is a common component of household spot removers, cleansers, and water repellants. Because experiments have shown that PCE causes liver cancer in mice, EPA has categorized it as a probable human carcinogen (15). It has been detected in wells not used for drinking water at a maximum concentration of 100 μg/L.

Farm workers would be chronically exposed (greater than one year) to groundwater contaminants by inhaling aerosolized contaminants from groundwater, by accidental ingestion of contaminated groundwater, and by dermal contact with contaminated groundwater. Workers who operate the groundwater treatment systems would be intermittently exposed (less than one year) to groundwater contaminants by inhaling aerosolized contaminants from groundwater, by accidental ingestion of contaminated groundwater, and by dermal contact with contaminated groundwater.

Acute exposure to PCE at levels 1200 times higher (101,000 μg/L) than levels detected in groundwater can cause dizziness, sleepiness, headache, and elevated levels of liver enzymes. At concentrations of 9000 μg/L, PCE can cause eye and upper respiratory tract irritation. Chronic exposure to 200,000 μg/L can cause cirrhosis of the liver, and toxic hepatitis (13). When the maximum level of PCE detected is converted to an estimated dose of contaminant ingested per day, (0.000648 mg/kg/day), that dose is 15 times lower than the RfD of 0.01 mg/kg/day. When compared to the cancer risk comparison values, the highest concentration of PCE detected in groundwater would not be expected to cause an increase in cancer cases. Based on this information, PCE at the levels seen in groundwater does not pose a health concern.

Trichloroethylene (TCE)

Trichloroethylene is mainly used as a metal part degreaser. However, it is also found in typewriter correction fluid, paint removers, and adhesive glues. TCE is categorized as a probable human carcinogen based on evidence that shows it causes liver cancer in animals (12). It has been detected in wells not used for drinking water at a maximum concentration of 160 μg/L.

Farm workers would be chronically exposed (greater than one year) to groundwater contaminants by inhaling aerosolized contaminants from groundwater, by accidental ingestion of contaminated groundwater, and by dermal contact with contaminated groundwater. Workers who operate the groundwater treatment systems would be intermittently exposed (less than one year) to groundwater contaminants by inhaling aerosolized contaminants from groundwater, by accidental ingestion of contaminated groundwater, and by dermal contact with contaminated groundwater.

Short term exposure to TCE at levels 300 to 1666 times higher (27,000 - 150,000 μg/L) than levels detected in groundwater may cause irritation of eyes/throat, nausea, drowsiness, and liver and kidney effects. Long term exposure to TCE at levels of 85,000 μg/L may cause vertigo, short-term memory loss, and adverse liver and kidney effects (12). When compared to health related comparison values, the highest concentrations of TCE detected in groundwater, would not be expected to cause an increase in cancer cases. Exposure through accidental ingestion, acute ingestion, inhalation, and dermal contact to the maximum level of TCE detected is not considered to be a public health hazard.

Nitrate-N

Nitrate-N, possibly introduced from the use of fertilizers, has been detected in off-station groundwater at levels of 140,000 μg/L. Ingestion of nitrates from drinking water sources containing such high levels have been associated with methemoglobinemia in infants, a condition involving the oxidation of hemoglobin resulting in oxygen depleted blood (17). However, because groundwater is not used as a drinking water source, the only completed exposure pathway to contaminants would be to farm workers and workers who operate the groundwater treatment systems. Exposures to groundwater contaminants would occur by accidentally ingesting contaminated groundwater and by contacting contaminated groundwater on the skin. People are not being exposed to

levels of nitrates that would be expected to cause adverse health effects.

Table 4: HEALTH RELATED COMPARISON VALUES FOR EXPOSURE TO CONTAMINANTS DETECTED IN OFF-STATION GROUNDWATER

CONTAMINANT	ESTIMATED EXPOSURE DOSE mg/kg/day	HEALTH GUIDELINES		
		VALUE mg/kg/day	SOURCE	EXCEEDED BY ESTIMATED EXPOSURE DOSE
Carbon Tetrachloride	0.000488	0.0007	RfD	No
Chloroform	0.000122	0.01	RfD/MRL	No
Nitrate-N	1.12	1.6	RfD	No
Tetrachloroethylene	0.000648	0.01	RfD	No
Trichloroethylene	0.00072	3.0	MRL	No

Comparison Values from IRIS database and ATSDR

NA = Data Not Available
RfD = Reference Dose
MRL = Minimal Risk Level (ingestion)

B. Health Outcome Data Evaluation

Due to the low levels of contaminants detected, and the limited exposure to these contaminants through unintentional contact, adverse health effects are not likely to occur. Based on this information and the absence of community health concerns, an analysis of Health Outcome Data has not been conducted at this time. However, if at some time either of those two conditions change, the pertinent health data base(s) will be reviewed.

C. Community Health Concerns Evaluation

As previously indicated, a member of the local community group did not express any community health concerns, and no concerns were reported to station personnel, county health officials, or state health officials.

CONCLUSIONS

1. El Toro Marine Corps Air Station represents an indeterminate public health hazard because of the limited amount of on-station data available on environmental contamination and human exposures. At this time, exposure to carbon tetrachloride, chloroform, TCE, PCE, and nitrates-N detected in regional groundwater through incidental ingestion, dermal absorption, and/or inhalation of volatilized contaminants at current levels detected does not represent a public health hazard.

2. ATSDR has reviewed the RI/FS Work Plan at MCAS. Data from on-station surface soil, sediments, and surface water have not been collected yet; however, comprehensive sampling of the relevant media at each site is currently underway.

3. Groundwater treatment is currently being performed on station by MCAS. Orange County Water District is conducting off-station groundwater treatment to slow the rate of contaminant migration and to reduce the potential for adverse health effects in those people who come in contact with local groundwater.

4. Sampling data from existing groundwater monitoring wells and irrigation wells both on station and off station are not adequate to fully characterize the existing or potential future groundwater contamination.

5. Past on-station sampling of air and soil gas is not adequate to fully characterize the extent of contamination and to determine possible sources of continuing groundwater contamination.

6. Site 17 - Communication Station Landfill is within one-half mile of a family housing complex. Access to the landfill is not restricted. Children who play in the area may become trapped in exposed large appliances and suffocate.

7. Site 1 - Explosive Ordnance Disposal Range may contain unexploded ordnance that present a hazard for remedial workers or any persons who disturb buried explosive material.

8. Because identified exposures do not indicate that adverse health effects are probable and because of the lack of community health concerns, an evaluation of Health Outcome Data bases has not been performed at this time.

9. ATSDR will continue to evaluate sampling data and community concerns as they become available.

RECOMMENDATIONS

1. Perform comprehensive on-station sampling in order to characterize the extent of contamination and the potential for human exposure to contaminants in groundwater, surface water, soil, and sediment as stated in the RI/FS Work Plan. Additionally, sampling should include the following.

   - Perform radiological surveys at Site 1 - Explosive Ordnance Disposal Range and on all landfill sites.

   - Evaluate Site 1 - Explosive Ordnance Disposal Range for unexploded ordnance to prevent hazards to remedial workers or any persons who disturb buried material. Samples should also be analyzed for elemental phosphorus.

   - Include methane gas in the soil gas analysis at Site 3 - Original Landfill. Sample ambient air conditions within confined areas of adjacent buildings and areas frequently occupied by people for methane gas.

2. Identify farm workers' sources of drinking water in the fields to determine if workers are drinking water from the irrigation wells. Inform workers and label irrigation well spigots (in Spanish and in English) that the water is not suitable for drinking.

3. Continue on-station and off-station monitoring of groundwater, and tracking of the groundwater contamination plume to determine changes in the VOC contaminated groundwater.

4. Because of past disposal practices, environmental media should be analyzed for the chemicals listed in EPA's Target Compound List and Target Analyte List.

5. Continue groundwater treatment techniques to retard the flow of contaminants toward the drinking water wells 8 miles northwest of the El Toro Marine Corps Air Station. Evaluate the efficiency of on-station groundwater treatment operations to ensure safety of the regional water supply so that downgradient residents are not exposed to contaminated groundwater.

6. Restrict access to Site 17 - Communications Landfill, to prohibit children from the neighboring family housing complex from using the area as a playground.

7. ATSDR's Health Activities Recommendation Panel (HARP) has determined that based on the evaluation of available data and on current site conditions at the El Toro Marine Corps Air

Station, follow-up public health actions are not being considered at this time. As more data become available, ATSDR will evaluate the data to determine if public health actions are indicated for the community near the site.

PUBLIC HEALTH ACTION PLAN

The public health action plan (PHAP) for El Toro Marine Corps Air Station contains a description of actions to be taken by ATSDR and other parties at and in the vicinity of the station. The purpose of the PHAP is to provide a plan of action for preventing or mitigating adverse human health effects resulting from exposure to hazardous substances in the environment.

A. Actions Planned

1. ATSDR will hold a public availability session to discuss the material presented in the public health assessment. Additional community concerns will be gathered as part of the public comment period. Each comment received during the public comment period will be included in the appendix of the final release of the public health assessment accompanied by a written response.

2. ATSDR will review plans and information on contaminated sites as they pertain to changes in future land use on MCAS.

3. ATSDR will provide an annual follow up to this PHAP, outlining the actions completed and those in progress. That report will be placed in repositories that contain copies of this public health assessment and will be provided to persons who request it.

4. ATSDR will reevaluate and expand this PHAP when needed. New environmental, toxicological, or health outcome data, or the results of implementing the above proposed actions may determine the need for additional actions at MCAS.

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Appendix A - On-Station Description of Sites

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The information presented in this Appendix was collected from Marine Corps Air Station, El Toro, Installation Restoration Program, Draft Final Remedial Investigation and Feasibility Study Work Plan, 28 April 1991.

Operable Unit - 2

Site 2 - Magazine Road Landfill (OU-2)

Site 2 is located between the Borrego Canyon Wash, one of its tributaries, and a man-made unlined drainage channel. The site occupies an estimated 22 acres. The site was used as a landfill from the late 1960s to 1980, accepting all waste generated at that time from the air station including waste oils, hydraulic fluids, paint residues, transformers, solvents, construction debris, batteries and municipal waste.

Originally, the landfill was a gravel borrow pit. Material was placed in the borrow pit and backfilled. The landfill is completely filled with dirt and the surface supports the growth of grass. At the time of the site visit a corner of the area was covered with sand and used as a volleyball court.

Air and soil gas samples were taken between April and June 1990 at several locations on Site 2 by Strata Technologies, Inc., contractors for the Marine Corps (3).

Access to Site 2 is restricted by fence. Only authorized personnel are permitted to access the site.

Site 3 - Original Landfill (OU-2)

Site 3 is located between Perimeter Road and North Marine Way, and comprises six trenches covering over a total of 20 acres. The landfill was used from 1943 to 1955 as a cut-and-fill facility in conjunction with frequent burning to reduce the waste volume. Any wastes that were generated on the facility during that time would have been disposed in the Original Landfill. Wastes that could potentially be found in this landfill include metals, incinerator ash, solvents, paint residues, hydraulic fluids, engine coolants, construction debris, oily wastes, municipal solid wastes, and various inert solid wastes. Buried wastes probably consist of ash and other

combustion wastes since standard practice was to burn the waste prior to burial to reduce volume (1). Reports indicate that in the past, black stains were visible in the sediments of Agua Chinon Wash that runs along the landfill area (1). That was not observed on the ATSDR site visit. The landfill is currently not in use; however, two of the trenches (one acre each) were uncovered during excavation for Building 746 and a parking area north of Building 380. Those buildings do not have basements. The parking lot and several buildings are adjacent to the landfill. Site access is not restricted other than those restrictions to gain admittance to the air station.
Air and soil gas samples were taken between April and June 1990 at several locations on Site 3 by Strata Technologies, Inc., contractors for the Marine Corps (3).

Site 5 - Perimeter Road Landfill (OU-2)

Site 5 is next to the golf course along the MCAS boundary. The landfill consists of a buried trench 1200 feet long, 60 feet wide, and 20 feet deep. The landfill operated from 1955 until late 1960s receiving all types of waste generated at the station including burnable trash, municipal solid waste, unspecified fuels, oils, and solvents, cleaning fluids, scrap metals, paint residues, and other materials. Burning was performed to reduce waste volume (1). Approximately 500 feet away, outside the station boundary fence, the Borrego Canyon Wash crosses outside the station perimeter next to fields of strawberries where an estimated 60 farm workers were seen by ATSDR personnel. Currently, the landfill is covered with dirt. The flat ground surface supports the growth of grass and serves as an outer boundary for the golf course. Site access is not restricted other than those restrictions to gain admittance to the station.

Air and soil gas samples were taken between April and June 1990 at several locations on Site 5 by Strata Technologies, Inc., contractors for the Marine Corps (3).

Site 10 - Petroleum Disposal Area (OU-2)

Site 10 is located between Buildings 435 and 369, and is approximately 1200 feet long and 800 feet wide. Activities between 1952 and mid-1960s included the application of waste oils directly to the ground for dust control (1). An estimated 52,000 gallons of waste crankcase oil, antifreeze, hydraulic and transmission fluids, motor oils, and solvents were used for this practice (1). The area has been excavated and currently is covered by aircraft matting and a concrete apron. Site access is controlled by a guarded gate and fence. Only authorized personnel are permitted to access the site.

Site 17 - Communications Station Landfill (OU-2)

Site 17 covers 26 acres and is in a small canyon in the foothills of the Santa Ana Mountains. The landfill operated from 1981 through 1983 and received all station-wide waste. Couches, washing machines, refrigerators, sinks, and old tires were seen during the site visit. Reported waste include cooking grease, oils, fuels from sumps, and drums (1). It is estimated that the landfill received 36,000 gallons of liquid waste during its operation (1). Currently the site is not in use. Access to the site is not restricted. Children were seen on-station walking down a hill less than one-half mile away.

Air and soil gas samples are taken between April and June 1990 at several locations on Site 17 by Strata Technologies, Inc., contractors for the Marine Corps (3).

Operable Unit - 3

Site 1 - Explosive Ordnance Disposal Range - (EOD) (OU-3)

The EOD Range is at an elevation of 700 feet above mean sea level at the foothills of the Santa Ana Mountains. The range is next to a tributary of the Borrego Canyon Wash in the extreme northeastern section of MCAS. The site is used for the detonation and disposal of small munitions. However, it is not known if some material remains undetonated. Explosives are ignited in a 10 foot pit then covered with dirt. It is not known how long this site has been used for explosive ordnance disposal operations (1). In 1982, approximately 2000 gallons of sulfur trioxide chlorosulfonic acid (FS smoke) were disposed in trenches at the northern part of the site. Drums containing the chemicals were partially buried, then rupture with small explosive charges. FS smoke is a water-reactive compound that degrades to an acidic compound upon contact with water. Unsubstantiated reports indicate that a portion of the site was used to dispose of low-level radioactive material (1).

The potential contaminants from munitions disposal operations would be metals and nitrated toluenes from explosive ordnance disposal, sulfates and acidic wastes from the FS smoke disposal operations, and radioactive isotopes from the reported low-level radioactive materials disposal (1). Site access is controlled by a series of guarded gates and fences. This area represents a physical hazard due to the possible unexploded ordnance.

Site 4 - Ferrocene Spill Area (OU-3)

Site 4 is in the northeastern portion of the main station next to Site 3, at the southeastern side of Building 658 (engine testing facility). A dirt-lined drainage ditch along the spill site empties into the Agua Chinon Wash. In 1983, five gallons of ferrocene, a fuel additive, and hydrocarbon carrier solution were spilled on the ground. Reports indicate that the solution drained into the nearby drainage ditch leading to a catch basin for the Agua Chinon Wash (1). Site access is not restricted other than those restrictions to gain admittance to the station.

Site 6 - Drop Tank Drainage Area No. 1 (OU-3)

Site 6 is in a grass-covered area near Building 727, in the southern end of the hangar buildings. Nearby runoff empties into a dirt-lined ditch that flows along a catch basin eventually entering the Agua Chinon Wash. Past area use included draining JP-5 fuel from aircraft drop tanks and rinsing those tanks on the adjacent concrete apron that drains into the grassy area. It was estimated that 50 gallons per month were spilled on this area from 1969 to 1983 (1). Site access is controlled by fence and a guarded gate.

Site 7 - Drop Tank Drainage Area No.2 (OU-3)

Site 7 is between the runway and the concrete apron in an unpaved area covered with aircraft matting. A catch basin that discharges into the Agua Chinon and San Diego Creek is next to the spill area. From 1969 to 1983 this area was used to drain and wash aircraft drop tanks. Waste lubrication oils from nearby maintenance buildings were also disposed in this area (1). Reports indicate that many oil and fuel spills occurred over the years (1). Site access is restricted to authorized personnel.

Site 8 - Defense Reutilization and Marketing Office (DRMO) Storage Yard (OU-3)

Site 8 is approximately 1000 feet from the MCAS boundary in the southeastern portion of the station, at the intersection of Marine Way and R Street. In 1984, a polychlorinated biphenyl (PCB) spill from a leaking electrical console contaminated the soil. Much of the soil has been excavated to one foot below grade and transported by contractors to an off-site hazardous

waste facility. Currently, the area is used as a storage yard for scrap and salvage materials, electrical components and drums of unknown liquids (2). The unpaved area is surrounded by a six-foot, barbed-wire topped fence.

Site 9 - Crash Crew Pit (OU-3)

The Crash Crew Pit is located in the western quadrant of the facility, just west of Building 435. However, the exact location of Site 9 is unknown (1). Historical records, aerial photos, and geophysical techniques will be used to determine the crash crew pit's location. From 1965 through 1971, the unlined crash crew pit was used as a fire training pit that was filled with water then layered with hundreds of gallons of oil-contaminated JP-5 fuel, gasoline, and other waste flammable liquids, then ignited. Fire fighting trainees then practiced quenching the fires. It has been estimated that 500 gallons of flammable waste liquids were used in each fire-training session with four practice sessions taking place per week during four months of the year (1). Of that amount, approximately 12,000 gallons may have percolated into the ground (1). The area is currently buried underneath a grassy area next to aviation matting (steel mesh).

Site 11 - Transformer Storage Area (OU-3)

This area is a 30-foot square concrete pad located next to Building 369. A catch basin and an asphalt-lined ditch catches the runoff from the concrete pad and areas near Building 369. A dirt area extends the entire width of the concrete pad. It is estimated that 50 to 75 transformers containing PCBs were stored there from 1968 to 1983. Reports stated that there have been leaks from five transformers and one transformer spill of PCB oil (1). Approximately 60 gallons of PCB oil drained from the concrete pads into the drainage ditch and surrounding soils (1). In 1983, the transformers were removed and transported off station. Current use includes temporary storage and holding of drums and transformers. The entire area is surrounded by a six-foot chain-link fence topped with three strands of barbed wire.

Site 12 - Sludge Drying Beds (OU-3)

Site 12 is in the southwestern corner of the Marine Corps Air Station approximately 300 feet from the station boundary. The sludge drying beds were used to remove water from municipal sludge and industrial sludge created from the on-station secondary wastewater treatment plant that operated from 1943 to 1972. Common contaminants from these type of sludges include

heavy metals, pesticides, and hydrocarbons. The total area of approximately 880 cubic yards was plowed under when the wastewater treatment facility was closed. Approximately 150 feet away is a grass covered picnic area with several picnic tables. Next to the site is Building 307, a trailer used as an office. Bee Canyon Wash is approximately 250 feet from Site 12. Site access is not restricted other than those restrictions to gain admittance to the station.

Site 13 - Oil Change Area (OU-3)

Site 13 is in a grass-covered area next to Building 242 at the southwest corner of the facility. Past investigations indicated that from 1977 through 1983, 7000 gallons of crank case oils were drained from heavy equipment directly onto the ground at this site (1). Currently, the area is not in use and is surrounded by a six-foot chain-link fence with three strands of barbed wire on top.

Site 14 - Battery Acid Disposal Area (OU-3)

The battery acid disposal area is a grass-covered L-shaped strip of land approximately 75 feet long on one leg by 50 feet long on the other leg, and 3 feet wide approximately 50 feet from the former heavy equipment maintenance shop. A catch basin west of this patch of land receives drainage water from Site 14. The drainage then discharges into Bee Canyon Wash. Past disposal activities from 1977 through 1983 included the drainage of batteries directly onto the soil. The site is currently not in use. Site access is not restricted other than those restrictions to gain admittance to the station. During the site visit, ATSDR personnel noted a yellow patch of grass about 5 feet square within the lush green grass area of the site possibly indicating signs of stress.

Site 15 - Suspended Fuel Tanks (OU-3)

Site 15 is in a grass-covered area between Buildings 29 and 31, and consists of two investigation areas beneath elevated fuel tanks where stained soils were reported (1). From 1979 through 1984, two 500-gallon elevated diesel tanks were located there. Operations ceased in 1984 and the tanks were removed from the site. Reports state that two diesel tanks constantly leaked fuel from hoses and nozzles onto the soil beneath them (1). The heavy staining covered 750 square-feet. Currently, the area is not in use. Site access is restricted to authorized personnel by a six-foot chain-link fence.

Site 16 - Crash Crew Pit No. 2 (OU-3)

Site 16 is in the central runway area along El Toro Boulevard. The crash crew pit is a dirt area where fire training exercises were held. From 1972 to 1985 this area consisted of three pits. The largest pit, 50 feet in diameter and three feet deep was connected to a secondary pit 40 feet away by a drain pipe. The secondary pit was 12 feet by 35 feet wide and four feet deep. The third pit, ten feet long by three feet wide was used for practice with hand-held fire extinguishers. Parts of aircraft, jeeps, or machinery were placed in the pits, covered with waste fuels or oils, and then ignited. Trainees practiced putting out the fires. Reports state that small quantities of napalm, white phosphorus, and magnesium phosphate were also burned at this site (1). Today, the area is not in use. An old, charred helicopter still sits in the large pit. The secondary pit, at the time of the site visit, contained standing water from the recent rain. The Fire Training Area that is currently used is 200 feet away. It consists of two concrete pits: one circular pit and one Z-shaped pit each with built-in drainage channels. The entire Fire Training Area sits on a concrete pad surrounded by a 6-inch high concrete curb. Access to the site is prohibited due to its location within the flightline area.

Site 19 - ACER Site - (OU-3)

Site 19 is in a grass-covered area in the central flightline. The ACER site contained six 20,000-gallon bladder tanks for storage of JP-5 fuel. A 1600 square foot area with 4-foot high berm enclosed the tanks. From 1964 to 1987, leaks from fuel transfers, hoses, and couplings, in addition to a major spill in 1986 by a ruptured bladder tank, caused the contamination of soil. A 42-inch diameter subsurface storm channel runs to the east of Site 19 and drains to the Agua Chinon Wash. The tanks were removed and the soil was excavated to a depth of 15 feet. The soil was disposed of into a permitted hazardous chemical landfill. During the site visit, ATSDR personnel noted a 10-foot deep area containing standing water and several piles of "clean dirt". Access to the site is prohibited due to its location within the flightline area.

Site 20 - Hobby Shop (OU-3)

Site 20 is in Building 626 in the northwestern section of the facility. Since 1967, military personnel have used the hobby shop to service their privately-owned vehicles. A 600-gallon waste oil tank, located 10 feet underground, is routinely emptied by a private contractor. The soil area around the tank

is stained black from oil. Additionally, three 700-gallon oil-water separators are around the shop area. Oil from those separators is emptied periodically by contractors. Water drains from the separators into a black soil-lined ditch that runs along the front gate. There are also three 50-gallon solvent tanks at the Hobby Shop. Sludge from those tanks is disposed of in the separators, while waste solvents is disposed of in drums. Prior to 1976, kerosene was used to wash down the asphalt at the site. Since 1976, biodegradable soap has been used for washing the pavement. The liquid wash then drain into the separators. Site access is restricted to military personnel.

Site 21 - Material Management Group (OU-3)

Site 21 is in an asphalt-covered area outside Building 320, surrounded by a six-foot chain-link fence with three strands of barbed wire at the top. The area has been included in the RI/FS by recommendation from EPA due to the large numbers of stored drums that may have leaked. In 1964, approximately 1000 drums were stored there; by 1986 only 100-125 drums were stored at the site. However, no leaks or spills have been reported. Site access is restricted to authorized personnel.

Site 22 - Tactical Air Fuel Dispensing System (OU-3)

Site 22 is between Buildings 435 and 369 directly next to Site 10. The site has a history of petroleum-based fuel spills and leaks (1). Clean-up activities have occurred although the quantity of the spills was unspecified, as was the exact remedial activity that took place. Site access is restricted to authorized military personnel by a guarded gate/fence.