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COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

CLEAN II

FINAL FIELD SAMPLING PLAN PHASE II REMEDIAL INVESTIGATION/FEASIBILITY STUDY MARINE CORPS AIR STATION EL TORO, CALIFORNIA

CTO-0059

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SUMMARY

A Phase II Remedial Investigation and Feasibility Study (RI/FS) will be conducted at the Marine Corps Air Station El Toro located in Orange County, California. This Field Sampling Plan was prepared in response to a series of meetings held since June 1994 and regulatory agency comments on the draft Phase II RI/FS Sampling and Analysis Plan (Jacobs Engineering 1993a).

This Field Sampling Plan and the Quality Assurance Project Plan (BNI 1995a) comprise the Sampling and Analysis Plan as stipulated by the United States Environmental Protection Agency (U.S. EPA) guidelines (U.S. EPA 1988). The Field Sampling Plan was prepared in accordance with the U.S. EPA Region IX guidance for sampling plans (U.S. EPA 1992).

The Field Sampling Plan provides an overview of field sampling procedures and data-gathering methods that will be used during the Phase II RI/FS. Currently, there are 25 Installation Restoration Program sites at Marine Corps Air Station El Toro; however, this document specifically discusses the sampling plan for 23 of these sites. One of the 25 sites is being considered under a separate RI/FS (Site 18, Regional Groundwater Contamination). The other site (Site 23, Sewer Lines) was recommended for a No Further Action based on the results of a Resource Conservation and Recovery Act Facility Assessment (Jacobs Engineering 1993b). Though the sampling procedures presented in this document were developed for the remaining 23 sites, the procedures presented for sampling and analyses can be applied to any site that may be added to the Installation Restoration Program.

Specific objectives of the Phase II RI/FS at Marine Corps Air Station El Toro are:

- optimize data collection,
- minimize lengthy, expensive fixed-base laboratory methods,
- maximize field analytical methods,
- provide sufficient data to evaluate risks to human health and environment,
- characterize horizontal and vertical nature and extent of contaminants, and
- assess remedial alternatives, especially cost-effective removal actions, if needed.

The attachments to the Field Sampling Plan provide site-specific discussions about site contamination, previous investigations, factors relevant to sampling, and sampling plans. Maps illustrate site-specific information such as site boundaries, site units, topography, previous sampling locations, physical features of each site, and proposed sampling locations. Quality assurance for sampling and analytical methods are discussed in the Quality Assurance Project Plan (BNI 1995a).

The field methods to be followed during the Phase II RI/FS are based on project team experience, comments from regulatory agencies, available technologies, and Comprehensive Long-Term Environmental Action Navy (CLEAN) II Program Standard Operating Procedures. During procurement, mobilization, or implementation, these field methods may change to incorporate revisions, innovative technologies, or other supplemental information. The CLEAN II Standard Operating Procedures will be maintained on-site for reference. Additional information on verification and validation of analytical methods is in the Phase II RI/FS Quality

Assurance Project Plan (QAPP 1995a). Field activities will be conducted under the supervision of a Registered Geologist, Professional Engineer, or appropriate certified or registered professional, as needed.

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ACRONYMS/ABBREVIATIONS

Air SWAT	Air Quality Solid Waste Assessment Test
ASTM	American Society for Testing and Materials
BCT	BRAC Cleanup Team
BEIDMS	Bechtel Environmental Integrated Data Management System
bgs	below ground surface
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
°C	degrees Celsius
Cal/EPA	California Environmental Protection Agency
CARB	California Air Resources Board
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	U.S. EPA Contract Laboratory Program
CNDDB	California Natural Diversity Data Base
COPC	chemical of potential concern
CPT	cone penetrometer test
CTO	Contract Task Order
DC	direct current
DCE	dichloroethene
Desalter	Irvine Desalter Project
DoD	Department of Defense
DON	Department of the Navy
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
EC	electrical conductivity
EOD	explosive ordnance disposal
°F	degrees Fahrenheit
FFA	Federal Facilities Agreement
FID	flame ionization detector
FS	Feasibility Study
FSP	Field Sampling Plan
ft/day	feet per day

ACRONYMS/ABBREVIATIONS (continued)

GC	gas chromatograph
gpm	gallons per minute
GPR	ground-penetrating radar
IAFS	Interim-Action Feasibility Study
IAS	Initial Assessment Study
ID	inside diameter
IDWMP	Investigation-Derived Waste Management Plan
IRP	Installation Restoration Program
L/min	liters per minute
µmhos/cm	micromhos per centimeter
MCAS	Marine Corps Air Station
MeCl	methylene chloride
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
MSL	mean sea level
NACIP	Navy Assessment and Control of Installation Pollutants
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center (formerly NEESA)
NFRAP	No Further Response Action Planned
NPL	National Priorities List
NTU	nephelometric turbidity units
OCWD	Orange County Water District
OD	outside diameter
OU	operable unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
psi	per square inch
psig	per square inch gauge

ACRONYMS/ABBREVIATIONS (continued)

QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROICC	Resident Officer in Charge of Construction
RPD	relative percent difference
RWQCB	(California) Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SCAQMD	South Coast Air Quality Management District
SIPOA	Site Inspection Plan of Action
SOP	Standard Operating Procedure
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWDIV	Southwest Division Naval Facilities Engineering Command
SWMU/AOC	solid waste management unit/area of concern
TCA	trichloroethane
TCE	trichloroethylene
TDS	total dissolved solids
TIC	The Irvine Company
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
USCS	Unified Soils Classification System
U.S. EPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound
v/v	volume per volume
WSA	waste staging area

SECTION 1

INTRODUCTION

Section 1
INTRODUCTION

A Phase II Remedial Investigation (RI)/Feasibility Study (FS) will be conducted at the Marine Corps Air Station (MCAS) El Toro located in Orange County, California (Map 3-1). This draft of the Field Sampling Plan (FSP) for the Phase II RI/FS has been prepared by Bechtel National, Inc. (BNI), on behalf of the Southwest Division Facilities Engineering Command (SWDIV) in accordance with Contract Task Order (CTO)-0059, issued under the Comprehensive Long-Term Environmental Action Navy (CLEAN) II Program, contract No. N68711-92-D-4670. This draft FSP for Phase II RI/FS was prepared in response to a series of meetings held since June 1994 and regulatory agency comments on the draft Phase II RI/FS Sampling and Analysis Plan (SAP) (Jacobs Engineering 1993a).

This FSP and the Quality Assurance Project Plan (QAPP) (BNI 1995a) compose the SAP as stipulated by the United States Environmental Protection Agency (U.S. EPA) guidelines (U.S. EPA 1988). The FSP was prepared in accordance with the U.S. EPA Region IX guidance for sampling plans (U.S. EPA 1992).

1.1 PURPOSE

The purpose of the FSP is to provide an overview of field sampling procedures and data-gathering methods that will be used during the Phase II RI/FS. The FSP and its associated plans are a requirement of the Federal Facilities Agreement (FFA) between the U.S. Department of the Navy (DON), U.S. EPA, Region IX, California Department of Health Services (now referred to as the California Environmental Protection Agency [Cal/EPA]), and California Regional Water Quality Control Board (RWQCB), Santa Ana Region, dated October 1990 (FFA 1990). The FSP provides a mechanism for the Base Realignment and Closure (BRAC) Cleanup Team (BCT) to approve field sampling activities.

1.2 OBJECTIVES

The scope of Phase II RI/FS work is to collect sufficient information to support the required decision-making process to determine risks associated with Installation Restoration Program (IRP) sites and appropriate response actions when IRP sites pose unacceptable risks to human health and the environment. There are a total of 25 IRP sites that are assigned to three operable units (OUs) at MCAS El Toro. OU-1 encompasses Site 18 (Regional Groundwater). OU-2 is subdivided into OU-2A, OU-2B, and OU-2C. OU-2A encompasses Sites 24 and 25. OU-2B encompasses Sites 2 and 17. OU-2C encompasses Sites 3 and 5. Sites in OU-2B and 2C are generally referred to as the landfill sites. OU-3 encompasses Sites 1, 4, 6 through 16, and 19 through 23. This FSP presents the sampling procedure for collecting the necessary information at 23 of these IRP sites at MCAS El Toro. Two of the IRP sites (Site 18 – Regional Volatile Organic Compound [VOC] Groundwater Contamination and Site 23 – Sewer Lines) are not addressed in this FSP. Site 18 was evaluated in a separate RI/FS effort (Jacobs Engineering 1994a,b). Site 23 was recommended for no further action based on the results of a Resource Conservation and Recovery Act (RCRA) Facility Assessment

(RFA) (Jacobs Engineering 1993b). Table 1-1 presents a summary of the 23 sites, and Map 3-2 illustrates the locations of these sites on MCAS EL Toro.

The information from the proposed Phase II RI/FS at MCAS El Toro will support decisions for selecting the appropriate response action. Possible response actions include:

- Early Action,
- Long-Term Action, and
- No Further Response Action Planned (NFRAP).

Specific objectives of the Phase II RI/FS at MCAS El Toro are:

- optimize data collection;
- minimize lengthy, expensive, fixed-base laboratory methods;
- maximize field analytical methods;
- provide sufficient data to evaluate risks to human health and environment;
- characterize horizontal and vertical nature and extent of contaminants; and
- assess remedial alternatives, especially cost-effective removal actions, if needed.

1.3 FIELD SAMPLING PLAN CONTENTS

The contents of the FSP focus on the field sampling procedures and types of information to be collected during the field effort at MCAS El Toro IRP sites. The FSP consists of the following sections:

- Section 1 – Introduction to the FSP,
- Section 2 – A summarized version of the background and setting of MCAS El Toro,
- Section 3 – Maps illustrating proposed field sampling locations and types of samples,
- Section 4 – A summarized version of the rationale for the Phase II RI/FS field sampling efforts,
- Section 5 – A summary of the field screening, mobile laboratory, and fixed-base laboratory samples and analyses,
- Section 6 – A discussion of field methods and procedures,
- Section 7 – A compilation of program field documents,
- Section 8 – References, and
- Attachments – Site-specific FSPs that focus on unique sampling programs developed for each IR site.

Table 1-1
Installation Restoration Program Sites

Site No.	Site Name	Site Description
1	Explosive Ordnance Disposal Range	This site is normally used for the disposal of small munitions (i.e., flares and small ordnance). Whether undetonated explosives or drums are still present is unknown. Drums containing approximately 2,000 gallons of sulfur trioxide chlorosulfonic acid were disposed in trenches and ruptured with small explosive charges. It is estimated that approximately 75 percent of the compound may have remained after the explosions.
2	Magazine Road Landfill	This site was used as a landfill from 1959 until 1991. Reports estimate that approximately 800,000 to 1,000,000 cubic yards of wastes were disposed in the landfill. Wastes consisted of construction debris, municipal waste, batteries, waste oils, hydraulic fluids, paint residues, transformers, and solvents. Methane has been detected within the landfill at levels as high as 45-percent volume according to landfill gas samples.
3	Original Landfill	The Original Landfill was used from 1943 to approximately 1965. Estimates of waste burned and buried in the landfill range from 163,500 to 243,000 cubic yards of metals, incinerator ash, solvents, paint residues, hydraulic fluids, engine coolants, construction debris, oily wastes, municipal solid wastes, and various inert solid waste. Chloroform, TCE, and PCE were detected in landfill gas samples.
4	Ferrocene Spill Area	Approximately 5 gallons of ferrocene and a hydrocarbon carrier solution were spilled in this area.
5	Perimeter Road Landfill	The landfill was in use from 1955 to the late 1960s. Approximately 50,000 to 60,000 cubic yards of wastes were disposed in the landfill, including burnable trash, municipal solid waste, unspecified fuels, oils, solvents, cleaning fluids, scrap metal, paint residues, and other waste materials.
6	Drop Tank Drainage Area No. 1	From 1969 to 1983, aircraft drop tanks were transported to this area, drained of jet fuel, and washed out on the concrete pad. The jet fuel and wash/rinse water drained off the concrete pad onto adjacent area. It is estimated that 1,400 gallons of jet fuel have drained onto the vegetated area.
7	Drop Tank Drainage Area No. 2	Aircraft drop tanks were drained of jet fuel and washed out on the concrete pad from 1969 to 1983. The jet fuel and wash/rinse water drained off the concrete pad onto the adjacent area. Waste lubrication oil from nearby maintenance buildings was also disposed in this area. In addition, portions of this area served as an unpaved parking area. Lubrication oils were applied for dust control. In 1982, 2,000 gallons of jet fuel were accidentally spilled in this area. The fuel and wash water flowed onto soil around the concrete pad.

(table continues)

Table 1-1 (continued)

Site No.	Site Name	Site Description
8	DRMO Storage Area	This area has been used since the mid-1970s. The yard is used to store various scrap and salvage materials (i.e., mechanical and electrical components) and containerized liquids of unknown composition. In 1984, PCBs were spilled on soils in the immediate area. Soils were excavated up to one foot below grade.
9	Crash Crew Pit No. 1	This area was used from 1965 to 1971. Materials used and ignited during training included jet fuel, aviation gasoline, and other liquid waste. Approximately 123,700 gallons of liquid waste were estimated to have been used during training.
10	Petroleum Disposal Area	Approximately 52,000 gallons of waste crankcase oil, antifreeze, hydraulic and transmission fluids, motor oils, and solvents were applied to the ground for dust control.
11	Transformer Storage Area	Fifty to 75 electrical transformers were stored in this area from 1965 to 1983. Five transformers leaked, and one spilled an estimated 60 gallons of PCB transformer oil onto the concrete pad. The PCB oil probably ran off the concrete pad into the adjacent ditch and surrounding soils.
12	Sludge Drying Beds	From 1943 to 1972, MCAS El Toro operated a secondary wastewater treatment plant. The sludge generated from the wastewater treatment plant was dewatered in this area and subsequently was abandoned in the drying beds and plowed under. Chemicals of potential concern include silver, arsenic, cadmium, copper, mercury, nickel, lead, selenium, and zinc.
13	Oil Change Area	It is estimated that about 7,000 gallons of waste crankcase oil were drained directly onto the ground at this site during vehicle maintenance.
14	Battery Acid Disposal Area	From 1977 to 1983, an estimated 210 gallons of battery acid were drained onto the soil from vehicles.
15	Suspended Fuel Tanks	Between 1979 to 1984, an estimated 500 gallons of diesel fuel leaked from nozzles and hoses of two 500-gallon elevated diesel tanks.
16	Crash Crew Pit No. 2	This area was used from 1972 to 1985. Materials used and ignited during training included jet fuel, leaded aviation gasoline, hydraulic fluid and crankcase oil. Approximately 275,700 gallons of fluids were estimated to have been used during training. Of this amount, approximately 10 percent (24,700 gallons) may have infiltrated the soil. Small quantities of napalm, white phosphorus, and magnesium phosphate were also burned at the site.

(table continues)

Table 1-1 (continued)

Site No.	Site Name	Site Description
17	Communication Station Landfill	The landfill is reported to have been used from 1981 to 1983; however, there is some evidence that the area may have been used as a landfill as early as 1970 and as late as 1986. Wastes disposed in this landfill include domestic waste and rubble, cooking greases, oils and fuels from sumps, empty drums, and other unknown materials. As much as 36,000 gallons of liquid wastes may have been dumped at this site.
19	Aircraft Expeditionary Refueling Site	Six aboveground bladder tanks, each containing 20,000 gallons of jet fuel, were used from 1964 to 1987. In 1986, one tank ruptured, spilling 15,000 gallons of jet fuel. A 300- by 60-foot area was excavated to a depth of 2 feet; the soil is stockpiled at the site.
20	Hobby Shop	The area is used by military personnel to service privately owned vehicles. The ground surface around an underground waste oil tank is stained black from oil. A ditch is also stained black by wastewater from the 700-gallon oil/water separators. Until 1976, kerosene was routinely used to wash down the pavement in the area.
21	Materials Management Group	The area was used to store drums of contaminated materials. The hazard potential of these contaminated materials was not documented. In 1964, approximately 1,000 drums were stored in the area. By 1986, only 100 to 125 drums were stored in this area. No reported leakages or spills have occurred.
22	Tactical Air Fuel Dispensing System	This site has a history of undocumented spills and leakages of jet fuel and other fuels.
24	Potential Volatile Organic Compounds Source Area	This new site has been established for an expanded groundwater source investigation in the proximity of IR Sites 7, 8, 9, 10, and 22. Phase I RI indicated that one or more sources may exist for the VOCs in groundwater in the vicinity of these sites.
25	Major Drainages	Site 25 includes the soil, subsurface soil, and surface water in Agua Chinon Wash, Bee Canyon Wash, Borrego Canyon Wash, and Marshburn Channel. These media and washes were formerly part of Site 18 Regional Groundwater Investigation.

This plan is one of seven associated plans for the Phase II RI/FS. A brief description of each is provided below:

- Work Plan – summarizes general background and presents rationale for Phase II RI/FS efforts (BNI 1995b);
- Field Sampling Plan – summarizes field methods and analytical techniques to be applied for the Phase II RI/FS;
- Quality Assurance Project Plan – summarizes data measurement objectives, sample collection procedures, and data quality management procedures (BNI 1995a);
- Data Management Plan – summarizes the procedures for managing data collected during the Phase RI/FS efforts (BNI 1995c);
- Risk Assessment Work Plan – presents the procedures for assessing risks to human health and the environment (BNI 1995d);
- Investigation Derived Waste Management Plan – summarizes procedures for handling, storing, and disposing of waste materials generated during the Phase RI/FS (BNI 1995e); and
- Health and Safety Plan – summarizes measures to protect site workers health and safety (BNI 1995f).

SECTION 2

BACKGROUND AND SETTING

Section 2
BACKGROUND AND SETTING

This section provides a summary of the site background information relevant to the activities that resulted in contamination, and factors affecting the Phase II RI/FS sampling activities. The attachments to the FSP provide site-specific discussions about site contamination, previous investigations, and factors relevant to sampling. A more detailed discussion of MCAS El Toro history and setting is presented in the revised draft Work Plan for the Phase II RI/FS (BNI 1995b).

2.1 LOCATION

MCAS El Toro is situated in a semiurban agricultural area in southern California, approximately 8 miles southeast of Santa Ana and 12 miles northeast of Laguna Beach (Map 3-1). Land northwest of MCAS El Toro is used for agricultural purposes; the land to the south and northeast is used mainly for commercial, light industrial, and residential purposes. The closest residential areas are the cities of Lake Forest, Irvine, and Laguna Hills (MCAS El Toro 1991).

2.2 HISTORY

The following subsections provide a summary of the history, recent base operations, and previous investigations of MCAS El Toro. This history section was used to develop the scope of work for the Phase II RI/FS.

2.2.1 History of MCAS El Toro

In March 1943, MCAS El Toro was commissioned as a Marine Corps pilot fleet operation training facility. In 1950, MCAS El Toro was selected for development as a master jet station and permanent center for Marine Corps aviation on the west coast to support the operations and combat readiness of Pacific Fleet Marine Forces. Since commissioning, MCAS El Toro has been utilized for aviation activities. Other activities that have been performed on the base include maintenance and refurbishing operations, metal plating, sewage treatment, and incineration of trash. These activities have generated waste oils, paint residues, hydraulic fluid, used batteries, and other wastes (MCAS El Toro 1991).

2.2.2 Recent Base Operations

MCAS El Toro has continued to provide materials and support for aviation activities of the U.S. Marine Corps. The base comprises runways, aircraft maintenance areas, training facilities, housing, shopping facilities, and other support facilities totaling 4,471 acres. The base also provides housing for 5,250 Marines and 2,000 dependents (as of 1991). Additional military personnel and civilians live off-base but work at MCAS El Toro. The base is currently undergoing BRAC closure. Some base operations have closed, and various parts of the base may no longer be in use. Squadrons have been transferred to other Marine Corps and Naval Air Stations.

Currently, hazardous materials wastes are managed under RCRA requirements. Hazardous wastes are stored in containers at generator accumulation areas and are held for less than 90 days. The on-base RCRA Interim-Status Storage Facility holds these wastes until they are released for disposal. MCAS El Toro contracts with waste transporters as well as treatment, storage, and disposal facilities to transport, recycle, treat, or dispose of hazardous wastes. The contracts are established through either the Defense Reutilization and Marketing Office (DRMO) (established in 1973) or through the Environmental Office at MCAS El Toro.

2.2.3 Previous Investigations

In 1985, the Navy began 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 (NACIP) Program, which was the Navy version of the Department of Defense (DoD) IRP at that time. The IAS report identified 17 sites as potential sources of contamination (Brown and Caldwell 1986).

In June 1985, while the IAS was underway, the Orange County Water District (OCWD) discovered trichloroethene (TCE) in an agricultural well belonging to The Irvine Company (TIC) approximately 3,000 feet west of MCAS El Toro. OCWD subsequently conducted an investigation to determine the source and extent of the TCE contamination in this well (TIC 45). After installing a network of monitoring wells and soil vapor probes and reviewing the results of independent investigations, OCWD concluded that MCAS El Toro was the source of the contamination. These OCWD investigations are ongoing (Herndon and Reilly 1989; Herndon 1990).

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 included a recommendation of 19 sites for study and amended the site sampling plans proposed in the IAS report. One site (Site 18) was intended to address the off-base contaminant plume of VOCs in groundwater.

In 1988, the Marine Corps conducted a Perimeter Study Investigation of VOC contamination along the southwestern boundary of the station (JMM 1989). As a consequence, an interim groundwater pump-and-treat system was installed near the station boundary. This system began operation in June 1989 and could pump approximately 30 gallons per minute (gpm) of groundwater from three extraction wells and treat the water at an on-site granular-activated carbon unit for treatment. The effluent was used to irrigate the Station golf course.

In May 1988, the Marine Corps submitted Air Quality Solid Waste Assessment Test (Air SWAT) proposals for the four station landfills to the South Coast Air Quality Management District (SCAQMD). These four landfills were listed as IRP sites in 1986. Following SCAQMD approval, the fieldwork was conducted, which consisted of meteorological and geophysical surveys, and sampling of landfill gas, ambient air, and surface gas (Strata 1991). The geophysical surveys using ground-penetrating radar

(GPR) were partially successful at defining the landfill perimeters. TCE, tetrachloroethene (PCE), chloroform, and benzene were detected in landfill gas samples in concentrations above the minimum detection limits determined by the California Air Resources Board (CARB). Methylene chloride (MeCl) was also detected in the landfill gases, but the presence of MeCl may have been due to inadequate decontamination procedures (Strata 1991, p. 3-9, 4-7, and 8-6). The ambient air samples collected at the station landfills contained concentrations of MeCl, trichloroethane (TCA), and PCE near the CARB detection limits. These concentrations, based on upwind and downwind measurements, were not necessarily attributable to emissions from the landfills.

In June 1988, the U.S. EPA recommended listing MCAS El Toro on the National Priorities List (NPL) of the Superfund Program because of the presence of VOC contamination at the base boundary and the detection of VOCs in the agricultural wells to the west. MCAS El Toro was listed on the NPL in February 1990. An FFA between the U.S. EPA, California RWQCB, Cal/EPA, and DON was signed in October 1990 (FFA 1990).

In December 1989, the Navy began preparing the Phase I RI Work Plan and associated documents for MCAS El Toro. The Navy concluded that 22 sites would be investigated (Jacobs Engineering 1993c). These sites were grouped into three OUs. OU-1 comprised the regional VOC groundwater investigation (Site 18), which was conducted both on- and off-Station. OU-2 included the sites considered potential source areas for the regional groundwater VOC contamination: the four landfill sites (Sites 2, 3, 5, and 17) and the Petroleum Disposal Area (Site 10). The remaining 16 sites were grouped together as OU-3. These sites were considered to be potential sources for a variety of contaminants.

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

In July 1993, a Draft Technical Memorandum was submitted that documented the results of the Phase I RI (Jacobs Engineering 1993c). The Phase I RI detected a variety of contaminants in the groundwater, soil, surface water, and sediment at MCAS El Toro. Contaminants in the soil and sediment consisted primarily of low concentrations of semivolatile organic compounds (SVOCs), petroleum hydrocarbons, pesticides, herbicides, and polychlorinated biphenyls (PCBs) (Jacobs Engineering 1993c). The document also concluded that the source of contamination for regional groundwater is in the southwest quadrant of the Station, but no specific sources were identified. The sampling events yielded sufficient information to conduct a preliminary risk assessment of contaminants at the sites for both groundwater and soil contamination. The results of the Phase I RI provided the primary data for the Phase II RI/FS.

Concurrent with the Phase I RI, the Navy conducted an RFA at MCAS El Toro. The final RFA report was submitted in July 1993 (Jacobs Engineering 1993b). The purpose of the RFA was to evaluate whether an additional 140 sites at MCAS El Toro would require further investigation under the Phase II RI/FS program. Several solid waste management units/areas of concern (SWMUs/AOCs) were located in or near IRP sites and were recommended for sampling under the IRP. In particular SWMU/AOC 194, the Former Incinerator Site, where PCE concentrations exceeded the U.S. EPA Region IX Preliminary Remediation Goals (PRGs) and SWMU/AOC 300, a spill area, were included in the Phase II RI/FS by expanding the boundaries at Site 3 (Original Landfill). SWMU/AOC 90 is the former sewage treatment plant at the Station. Although it was not recommended for further action in the RFA report, the Phase II RI/FS Program incorporates it into Site 12 (Sludge Drying Beds). Other SWMUs/AOCs are located within existing site boundaries and are to be sampled in the Phase II RI/FS.

Based on the Phase I RI, two sites were added to the IRP as part of OU-2 (Sites 24 and 25). A soil gas survey was performed at these sites in June 1994 during which soil gas samples were collected from depths between 5 and 30 feet (Jacobs Engineering 1994c). Fourteen of the 18 VOC soil gas plumes identified in this survey were recommended for further investigation as soil gas concentrations increased with depth. One main soil gas source area and 12 other possible shallow VOC source areas were identified.

In November 1993, a draft work plan for the Phase II RI/FS was issued (Jacobs Engineering 1993d). This draft work plan presented an approach to conduct the Phase II RI a 23 sites at MCAS El Toro. The basis for the plan was the results of the Phase I RI and development of data quality objectives (DQOs) with the BCT. The objectives of the draft Phase II plan were as follows: to present a statistically based sampling strategy to numerically establish confidence that references made from the data are correct; to establish background concentrations of metals in soils and groundwater concentrations of metals soils and groundwater; and ultimately, to collect sufficient information to support decisions on risk management. This revised draft work plan for the Phase II RF/FS incorporated into the DQOs several issues that evolved since the draft work plan was issued as well as comments from the BCT, including:

- formal recognition of the Superfund Accelerated Cleanup Model and Removal Actions;
- acceptance of judgmental samples rather than exclusively statistically collected samples;
- recognition of No Further Investigation designation for portions of the sites;
- use of the seven-step DQO process;
- use of pilot testing with air sparging, soil vapor extraction, and aquifer testing;
- use of soil gas to evaluate relation of near-surface soil gas hot spots and groundwater contamination;
- use of soil gas to evaluate alternatives at landfills;
- application of Department of Toxic Substances Control ecological risk assessment guidelines and, in particular, use of predictive modeling to assess ecological risks; and

- emphasis of field analytical methods, including immunoassays, mobile laboratories, and portable gas chromatographs, and a confirmation procedure of these field methods by fixed-base laboratories.

The Navy has conducted a RI and Interim-Action Feasibility Study (IAFS) for the regional groundwater contamination designated as OU-1 (Jacobs Engineering 1994a,b). This response action to the VOC contamination in the regional groundwater was addressed by the DON because of the planned development of the Irvine Desalter Project (Desalter) by the OCWD. Based on the detailed analysis presented in the IAFS, several alternatives were considered. The key criteria in alternative selection were:

- containing the higher-concentration VOCs on-Station;
- reducing VOC concentrations in the principal and shallow aquifers downgradient of the source areas;
- containing TCE at the downgradient edge of the existing plume; and
- safeguarding the Desalter water supply by providing on-Station pretreatment of groundwater to reduce VOCs prior to treatment at the Desalter treatment facility.

The interim-action alternative has not been selected as of August 1995.

2.3 SETTING

The following subsections describe the setting of MCAS El Toro in terms of:

- weather and climate,
- topography and geography,
- land use and demographics,
- biological setting,
- geology,
- hydrogeology, and
- hydrology.

2.3.1 Weather and Climate

MCAS El Toro has a Mediterranean climate, characterized by cool, moist winters and warm, dry summers. Early morning fogs are typical in late spring and early summer. Annual precipitation averages 12.2 inches with most of the rainfall occurring from November through April. Winter temperatures seldom drop below freezing. The mean low temperature is 37 degrees Fahrenheit (°F). Summer temperatures rarely exceed 100°F. Night temperatures are generally cool throughout the year. From March through October, the prevailing wind is from the west, and it averages 6 knots. From November through February, the prevailing wind is from the east, and it averages 4 knots. During the late fall and early winter, strong dry gusty offshore winds (known locally as "Santa Ana" winds) are common.

2.3.2 Topography and Geography

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 southeast end of the Los Angeles Basin, a large sedimentary basin in the Peninsular Ranges Geologic Province. At the west corner of the facility, the elevation is approximately 215 feet above mean sea level (MSL) and rises to approximately 800 feet above MSL at the east corner of the station, in the foothills of the Santa Ana Mountains.

2.3.3 Land Use and Demographics

MCAS El Toro encompasses 7.4 square miles (about 4,471 acres). Approximately 1,000 acres are designated for outleases because airfield safety clearances render them unsuitable for any other use. The outleased lands are at the corners of the Station and are used for agricultural purposes, including landscape nurseries, livestock grazing, and crop production. Crops grown on-base include strawberries, winter celery, tomatoes, and avocados (MCAS El Toro 1991).

Land use on MCAS El Toro consists of a few general types of land use and general Station land uses that are separated in the following four quadrants, as defined by the bisecting north-south and east-west runways:

- the northwest quadrant consists of administrative services (including the MCAS El Toro headquarters, family and bachelor housing, and community support services);
- the northeast quadrant consists of Marine Aircraft Group activities (including training, maintenance, supply and storage, and airfield operations), family housing, community services, and ordnance storage for areas isolated by topographic relief and distance from other developments (MCAS El Toro 1991);
- the southeast quadrant consists of administrative services, maintenance facilities, ordnance storage, and the golf course; and
- the southwest quadrant consists of maintenance facilities, supply and storage facilities, and limited administrative services.

The locations of structures, principal roads, and runways are shown on Map 3-2. A boundary fence surrounds MCAS El Toro, and access is limited to four gates. Only two of the gates are open 24 hours: the Main Gate (off Trabuco Road) and Gate No. 2 (off Irvine Boulevard).

2.3.4 Biological Setting

The IAS described the biological features and existing habitats of MCAS El Toro (Brown and Caldwell 1986). Ecological descriptions (based on reconnaissance surveys conducted in early May 1992 and September 1993, and a biological inventory conducted by the U.S. Fish and Wildlife Service [USFWS]) describe MCAS El Toro habitats (Jacobs Engineering 1993c). Ninety percent of the native habitats of MCAS El Toro have been cleared for agriculture, housing, and base operations. In the remaining 10 percent of the Station, three native habitats predominate: annual grassland (70 percent), coastal sage scrub, and riparian woodland (Brown and Caldwell 1986). Many wildlife species typically include multiple habitat types within their home range.

2.3.4.1 SENSITIVE HABITATS

The following sensitive natural communities were identified by the California Natural Diversity Data Base (CNDDB) as potentially occurring in the Orange County area, including MCAS El Toro (CNDDB 1993):

- southern coast live oak riparian forest,
- southern sycamore alder riparian woodland,
- southern cottonwood willow riparian forest,
- southern riparian scrub, and
- valley needlegrass grassland.

Wetlands are limited to sections of washes on MCAS El Toro, and washes and reservoirs in the surrounding areas. Identification of these sensitive habitats is currently being conducted in the eastern portion of the station (Wilson, pers. com. 1994). These habitats are usually associated with one or more special-status wildlife species.

2.3.4.2 SPECIAL-STATUS WILDLIFE

Special-status wildlife species include the following:

- animals listed or proposed for listing as threatened or endangered under the federal Endangered Species Act of 1973, as amended;
- animals that are Category 1 or 2 candidates for listing as threatened or endangered under the federal Endangered Species Act (Category 1 candidates are those for which the USFWS has sufficient information to support listing as threatened or endangered. Category 2 candidates are those for which further information is required to determine their appropriate status.);
- animals listed or proposed for listing under the California Endangered Species Act;
- animals fully protected in California by the California Fish and Game Code, which prohibits at any time the taking or possession of protected animals or parts thereof;
- animals that meet the definitions of rare or endangered species under the California Environmental Quality Act (CEQA);

- animal “Species of Special Concern” to the California Department of Fish and Game (CDFG); and
- birds protected by the 1972 Migratory Bird Treaty Act.

Table 2-1 contains a list of special-status species known to occur or expected to occur near MCAS El Toro and identifies the habitat utilization of species known to occur at MCAS El Toro.

2.3.5 Geology

This subsection provides a summary of background information on the geology of the MCAS El Toro vicinity and a discussion of the interpreted subsurface geology based on the data derived from the Phase I RI (Jacobs Engineering 1993c).

2.3.5.1 STRATIGRAPHY

MCAS El Toro is underlain chiefly by Tertiary sedimentary rocks, which are overlain by Holocene and Pleistocene surficial units (Fife 1974). The Holocene materials consist of isolated coarse-grained, stream-channel deposits contained within a matrix of fine-grained overbank deposits that range in thickness up to 300 feet (Herndon and Reilly 1989). The Holocene alluvial materials conformably overlie Pleistocene Age sediments predominantly composed of interlayered fine-grained lagoonal and near-shore marine deposits (Singer 1973). The deeper Quaternary sediments may be equivalent to the lower Pleistocene San Pedro Formation, which consists of semiconsolidated silts, clays, and sands with interbedded limestone. These lagoonal and shallow marine deposits are considered to be a major water-bearing unit in the region (Brown and Caldwell 1986).

The Pleistocene deposits unconformably overlie older semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene age; these units make up the Niguel, Fernando, and Capistrano Formations. These semiconsolidated sediments are considered bedrock near MCAS El Toro. The lower Pliocene Fernando Formation is the base of the water-bearing units at MCAS El Toro (Herndon and Reilly 1989). This formation probably interfingers with marine clayey and sandy siltstones of the Capistrano and Niguel Formations west of MCAS El Toro, and together they range up to 1,500 feet in thickness (JMM 1988).

2.3.5.2 STRUCTURAL GEOLOGY

In the study area, several faults and folds are found on the flanks of the Los Angeles Basin syncline (Table 2-2). Three northwest-trending faults (Shady Canyon, Pelican Hill, and Newport-Inglewood) are less than 10 miles southwest of MCAS El Toro. The Shady Canyon fault is a normal fault with the west side down.

Table 2-1
Wildlife Known to Occur at MCAS El Toro and Habitat Utilization

Common Name	Scientific Name	Special Status	Habitat Annual Grassland	Habitat Coastal Sage Scrub	Habitat Riparian
AMPHIBIANS					
Bullfrog	*Rana catesbeiana*			X	
Western toad	*Bufo boreas*		X	X	
REPTILES					
California whipsnake	*Masticophis lateralis*		X		
Coast horned lizard	*Phrynosoma coronatum*		X	X	
Common king snake	*Lampropeltis getulus*		X	X	
Gopher snake	*Pituophis melanoleucus*		X	X	
Orange-throated whiptail	*Cnemidophorus hyperrythus*	X		X	
Rosy boa	*Lichanura trivirgata*			X	
San Diego horned lizard	*Phrynosoma coronatum blainvillei*	X		X	
Side-blotched lizard	*Uta stransburiana*		X	X	
Western blind snake	*Leptotyphlops humilis*			X	
Western fence lizard	*Sceloporus occidentalis*		X	X	
Western rattlesnake	*Crotalus viridis*		X	X	
Western skink	*Eumeces skiltonianus*			X	
BIRDS					
Anna's hummingbird	*Calypte anna*			X	
Ash-throated flycatcher	*Myiarchus cinerascens*			X	
Bell's sage sparrow	*Amphispiza belli*	X		X	
Black phoebe	*Sayornis nigricans*				X
Black-chinned sparrow	*Spizella atrogularis*			X	
Black-headed grosbeak	*Pheucticus melanocephalus*			X	
Black-shouldered kite	*Elanus caeruleus*		X		
Bushtit	*Psaltriparus minimus*				X
California gnatcatcher	*Polioptila melanura*	X		X	
California horned lark	*Eremophila alpestris*	X	X		
California quail	*Callipepla californica*		X	X	X

(table continues)

Table 2-1 (continued)

Common Name	Scientific Name	Special Status	Annual Grassland	Habitat Coastal Sage Scrub	Riparian
BIRDS (continued)					
California towhee	*Pipilo fuscus*			X	
Common barn owl	*Tyto alba*		X	X	
Common raven	*Corvus corax*				X
Cooper's hawk	*Accipiter cooperii*	X	X	X	
Golden eagle	*Aquila chrysaetos*	X	X		
Grasshopper sparrow	*Ammooramus savannarum*		X		
Greater roadrunner	*Geococcyx californianus*		X	X	
Hermit thrush	*Catharus guttatus*			X	
Lark sparrow	*Chondestes grammacus*		X		
Lesser goldfinch	*Carduelis psaltria*				X
Loggerhead shrike	*Lanius ludovicianus*	X	X	X	
Mallard	*Anas platyrhynchos*			X	
Mourning dove	*Zenaida macroura*		X	X	
Northern harrier	*Circus cyaneus*	X	X		
Northern mockingbird	*Mimus polyglottos*		X	X	
Plain titmouse	*Parus inornatus*				X
Red-shouldered hawk	*Buteo lineatus*		X		
Red-tailed hawk	*Buteo jamaicensis*		X	X	X
Rufous-crowned sparrow	*Aimophila ruficeps*		X		
San Diego cactus wren	*Campylorhynchus brunnei capillus*	X		X	
Say's phoebe	*Sayornis saya*			X	
Turkey vulture	*Cathartes aura*		X		
Western meadowlark	*Sturnella neglecta*		X	X	
White-crowned sparrow	*Zonotrichia leucophrys*			X	
MAMMALS					
Brush rabbit	*Sylvilagus bachmani*			X	X
Cactus mouse	*Peromyscus eremicus*			X	
California ground squirrel	*Spermophilus beecheyi*		X		

(table continues)

Table 2-1 (continued)

Common Name	Scientific Name	Special Status	Annual Grassland	Habitat Coastal Sage Scrub	Riparian
MAMMALS (continued)					
California mouse	*Peromyscus californicus*			X	
California pocket mouse	*Chaetodipus californicus*		X	X	
California vole	*Microtus californicus*		X		
Coyote	*Canis latrans*		X	X	X
Deer mouse	*Peromyscus maniculatus*		X	X	
Desert cottontail	*Sylvilagus audubonii*			X	
Dusky-footed woodrat	*Neotoma fuscipes*		X		
Gray fox	*Urocyon cinereoargenteus*			X	
Little pocket mouse	*Perognathus longimembris*	X		X	
Pacific kangaroo rat	*Dipodomys agilis*			X	
Pallid bat	*Antrozous pallidus*	X		X	
Raccoon	*Procyon lotor*			X	
San Diego black-tailed hare	*Lepus californicus*	X	X	X	
San Diego pocket mouse	*Chaetodipus fallax*	X		X	
Southwestern pocket gopher	*Thomomys bottae*			X	X
Striped skunk	*Mephitis mephitis*			X	
Western harvest mouse	*Reithrodontomys megalotis*		X		

Source: Jacobs Engineering 1993c

Table 2-2
Faults in the Vicinity of MCAS El Toro

Fault	Location (from Station)	Orientation	Type	Movement Direction	Latest Reported Movement
Shady Canyon	4 miles SW	NW	Normal	SW down	Pre-Middle Miocene
Pelican Hill	7 miles SW	NW	Strike-Slip	Right-Lateral	Late Pliocene
Newport-Inglewood	10 miles SW	NW	Strike-Slip	Right-Lateral	Holocene
Christianitos	3 miles E	N	Normal	W down	Pliocene

Source: Jacobs Engineering 1993c

The Pelican Hill Fault, probably a branch of the Newport-Inglewood Fault, is a right-lateral strike-slip fault (Miller and Tan 1976). Of these faults, only the Newport-Inglewood Fault (also a right-lateral strike-slip fault) is considered active (Holocene movement). The Christianitos Fault, a north-trending high-angle normal fault, is 3 miles east of MCAS El Toro. This fault appears to converge with a system of northwest-trending frontal faults along the southwest side of the Santa Ana Mountains (Fife 1974).

2.3.6 Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Subbasin (Irvine Subbasin). The Irvine Subbasin and the main basin underlie the Tustin Plain and Downey Plain (DWR 1967), which are surficial physiographic features. The information on hydrogeology was developed from drilling, installing, and sampling monitoring wells for the IRP and information from regional water districts.

2.3.6.1 AQUIFER SYSTEMS

Aquifer zones in the Irvine Subbasin have been described as occasional discontinuous lenses of clayey and silty sands and gravels contained within an assemblage of sandy clays and sandy silts. The sandy lenticular nature of the silts and clays that separate the more permeable lenses probably allows groundwater to flow between the aquifer zones. Thus, rather than being separated into identifiable aquifers that may be correlated from place to place, the groundwater has been considered to flow in a single, large-scale heterogeneous system (Herndon and Reilly 1989). For the purposes of this plan, the uppermost sediments, comprising the main hydrogeological units beneath MCAS El Toro, are identified as the shallow zone, the deeper gravel intermediate sediments as the principal aquifer, and the fine-grained intermediate zone that appears to hydraulically separate the two as the horizon of fine-grained materials. Underlying the principal aquifer system are semiconsolidated materials, the contact of which is referred to as the base of the water-bearing zone.

2.3.6.2 HORIZONTAL FLOW

Information gathered during Phase I RI drilling shows that depth to groundwater has generally ranged from 80 to 120 feet below ground surface (bgs). Groundwater is shallowest in the foothills, where it is about 45 to 60 feet bgs. In the alluvial basin, groundwater is first encountered at a depth greater than 240 feet on the northeastern portion of MCAS El Toro along Irvine Boulevard (near Sites 3, 4, and 5) and decreases to a depth of 85 feet bgs along the southwestern boundary (Jacobs Engineering 1993c).

According to 1989 water levels, the direction of flow along the southwest boundary of MCAS El Toro was northwest at a gradient of 0.0066 (JMM 1989). Regional flow has been west and northwest since the 1940s and has been controlled locally by large pumping depressions. Phase I RI data indicate that regional groundwater flow is toward the northwest with an average groundwater gradient of about 0.008.

2.3.6.3 VERTICAL FLOW

Water level information for multiple-port monitoring wells and cluster wells throughout the Irvine Subbasin suggests hydraulic separation may exist between the shallower and deeper portions of the regional groundwater aquifer. In general, deep-screened zones in wells located near pumping centers in the main portion of the Irvine Subbasin appear to exhibit seasonal fluctuations in piezometric pressure more strongly than shallow-screened intervals in the same wells. A "step-change" in water levels is observed when comparing hydrographs for shallow-screened intervals and deep-screened intervals. The difference in seasonal behavior of water levels measured in the shallow versus deep zones suggests an intermediate zone of separation that hydraulically isolates shallow pressures, to a varying extent, from the stresses of pumping from deep-screened production wells.

2.3.6.4 AVERAGE LINEAR GROUNDWATER FLOW VELOCITIES

The average linear groundwater-flow velocities in the uppermost aquifer across MCAS El Toro are in the range of 0.02 to 1.9 feet per day (ft/day). Aquifer tests in monitoring wells installed on and near MCAS El Toro generated hydraulic conductivity estimates of 2.2 to 36 ft/day, with an average of 30 ft/day determined in a 72-hour aquifer test (JMM 1990). Pumping tests and slug tests performed during Phase I estimated hydraulic conductivity from 0.3 to 65 ft/day. These values are comparable to, but have a larger range than, the previous tests conducted (OCWD 1993; JMM 1990).

Three storage coefficients were estimated from the Phase I tests: 0.013 for shallow groundwater at Wells 5D and 5E; 0.00078 at Wells 5B and RW-2; and 0.00063 at Wells IDP and 103 for deeper groundwater.

Phase I RI test results also suggest that the fine-grained confining units are leaky. Vertical movement of water through units of lower permeability can be a major source of water to wells in aquifers consisting of alternating layers of coarse-grained and fine-grained sediments. A leakage factor of 0.1 was estimated for the only shallow-zone test (Wells 5D/5E), and leakage factors of 0.1 and 0.05 were found at the two tests of deeper zones (Wells 5B/RW-2 and Wells IDP1/103, respectively).

2.3.6.5 WATER QUALITY

In addition to the VOC contamination described earlier, other contaminants have been associated with the historical degradation of shallow groundwater quality in the Irvine area. Increases in the levels of total dissolved solids (TDS), selenium, and nitrates in the groundwater have been related to agricultural activities and incursions of lower-quality water from the margins of the basin under the influence of pumping wells. The largest area of groundwater not affected by this contamination lies in deeper zones in the central pressure area of the basin (Banks 1984). The Phase I RI Technical Memorandum presents the concentration contour maps for some important detected VOCs (Jacobs Engineering 1993c). The VOCs listed below are considered as COPCs for OU-1 (Site 18 – Regional Groundwater Contamination) and include TCE, PCE, 1,2-dichloroethene (DCE), 1,1-DCE, carbon tetrachloride, and benzene.

2.3.7 Surface Hydrology

Surface drainage near 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 MCAS El Toro and flow through or adjacent to the base en route to San Diego Creek. Off-base drainage from the hills and upgradient irrigated farmlands combines with base runoff at MCAS El Toro (generated from the extensive paved surfaces) and flows into four main drainage channels: Borrego Canyon, Agua Chinon, Bee Canyon, and Marshburn Channel (Map 3-2). The southernmost wash is Borrego Canyon Wash, which flows along the southeast boundary of MCAS El Toro. Both Agua Chinon and Bee Canyon Washes cross the central portion of MCAS El Toro and receive runoff mainly through storm sewers. These washes are contained in culverts through most of their pathways across the base. Both washes are unlined along several hundred feet at the southwest 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 MCAS El Toro.

SECTION 3

MAPS

Section 3
MAPS

The maps on the following pages present the locations of the 23 IRP sites to be sampled during the Phase II RI/FS at MCAS El Toro. These maps illustrate site boundaries, site units, topography, previous sampling locations, and physical features of each site. The site-specific attachments (Attachments A-X) include maps that illustrating proposed and sampling locations. These maps are referenced in other sections of this FSP.

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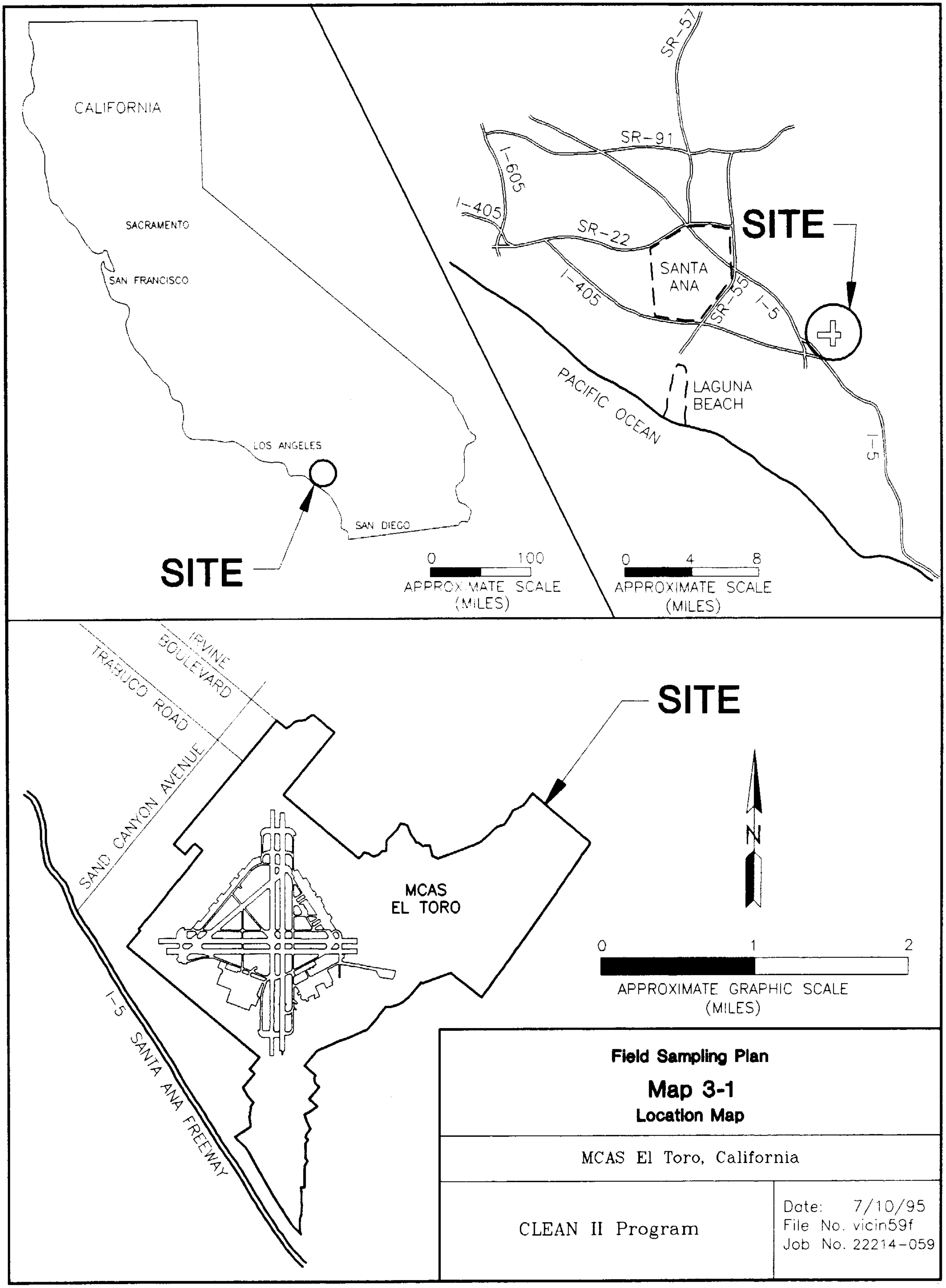

Field Sampling Plan

Map 3-1

Location Map

MCAS El Toro, California

CLEAN II Program

Date: 7/10/95
File No. vicin59f
Job No. 22214-059

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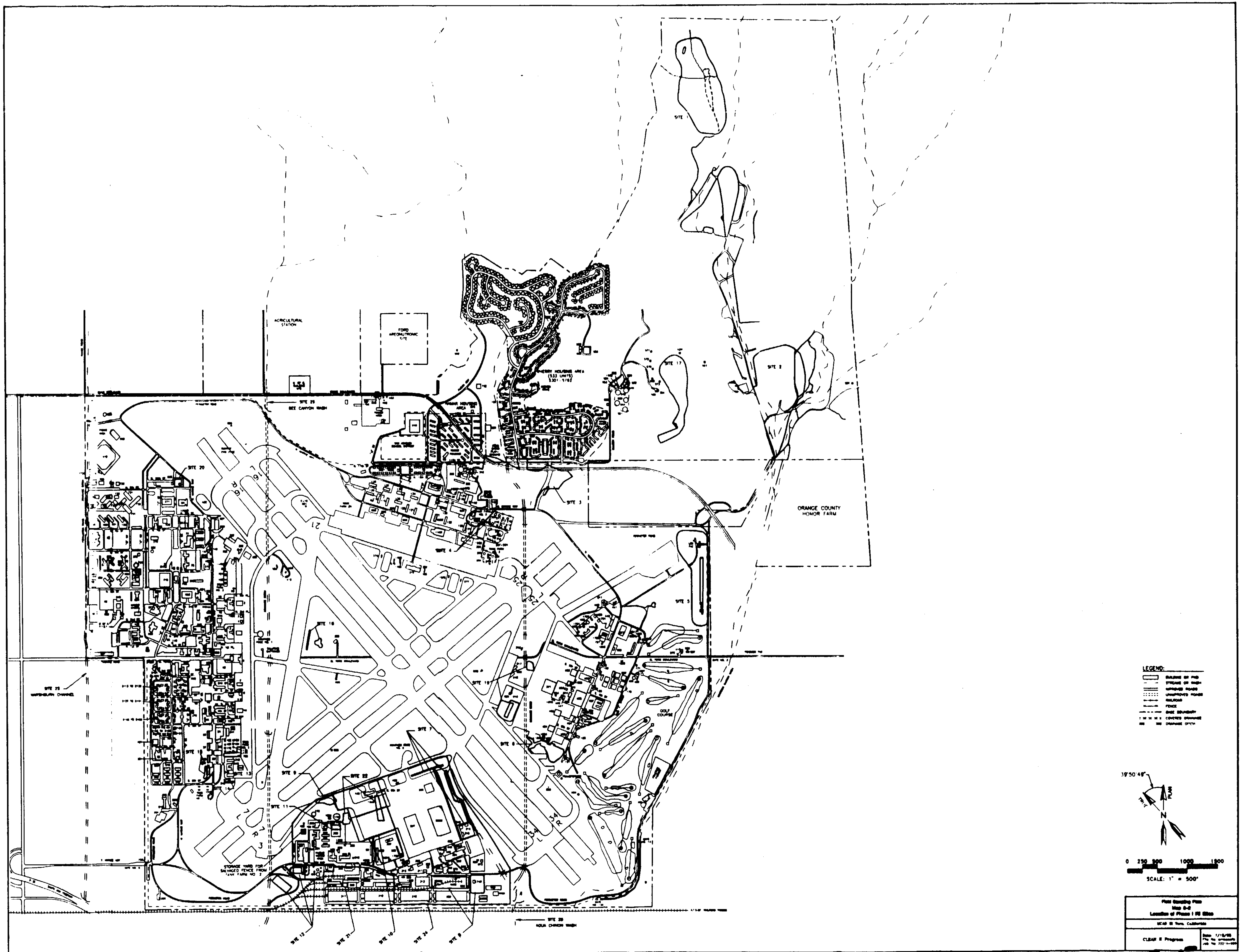
AGRICULTURAL STATION
FORD AERONUTRONIC SITE
ORANGE COUNTY HONOR FARM
SITE 2
SITE 3
SITE 4
SITE 5
SITE 7
SITE 8
SITE 9
SITE 11
SITE 17
SITE 22
SITE 25 BEE CANYON WASH
SITE 25 MARSHBURN CHANNEL
SITE 25 AGUA CHINON WASH
GOLF COURSE
STORAGE YARD FOR SALVAGED FENCE FROM TANK FARM NO 2
SITE 12
SITE 21
SITE 10
SITE 24
SITE 8
LEGEND:
COVERED DRAINAGE
39°50'49"
PLAN
N
0 250 500 1000 1500
SCALE: 1" = 500'
CLEAN II Program

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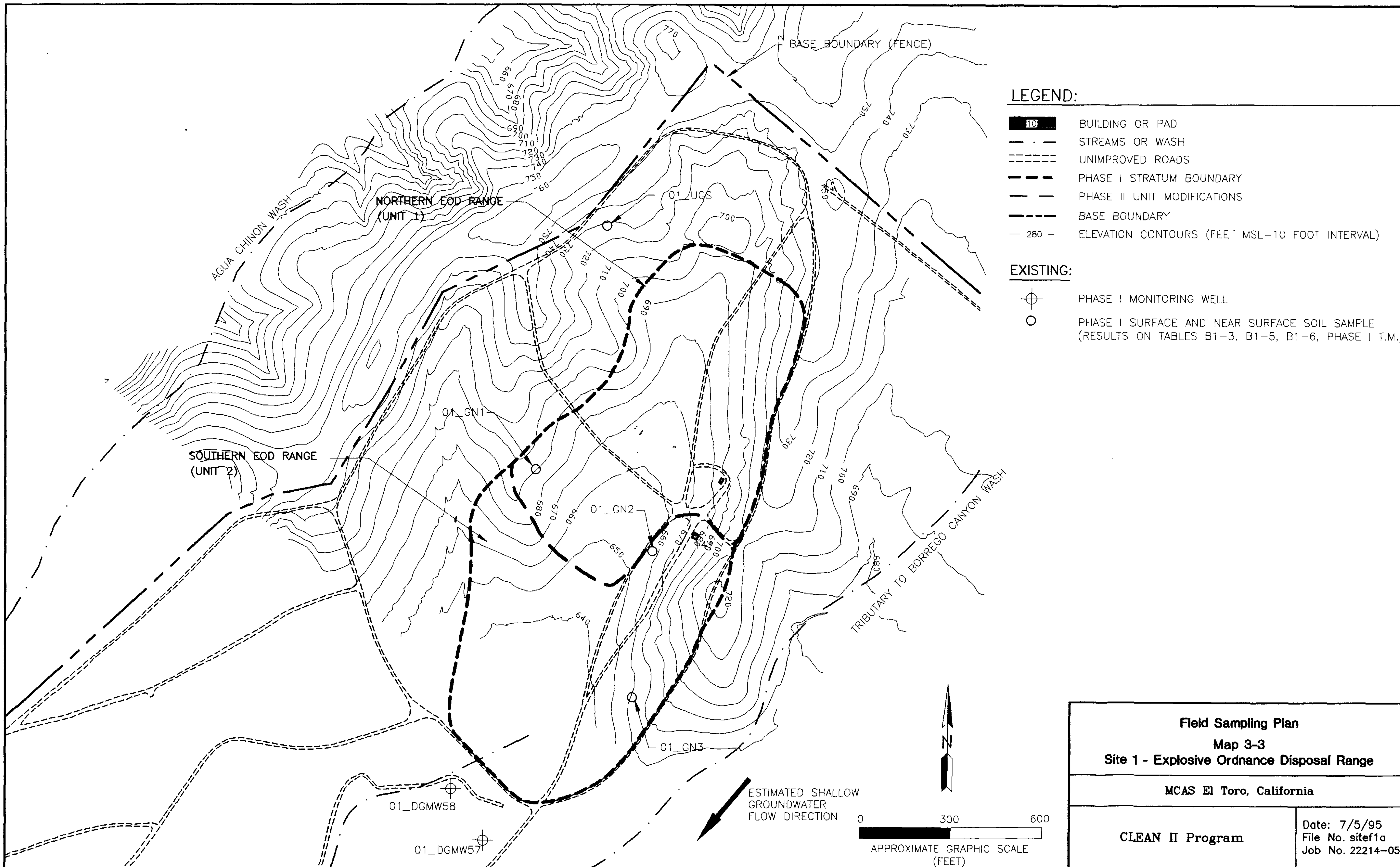
BASE BOUNDARY (FENCE)
AGUA CHINON WASH
NORTHERN EOD RANGE (UNIT 1)
SOUTHERN EOD RANGE (UNIT 2)
01_UGS
01_GN1
01_GN2
01_GN3
01_DGMW58
01_DGMW57
TRIBUTARY TO BORREGO CANYON WASH
ESTIMATED SHALLOW GROUNDWATER FLOW DIRECTION
0
300
600
APPROXIMATE GRAPHIC SCALE (FEET)
N
LEGEND:
10
BUILDING OR PAD
STREAMS OR WASH
UNIMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
BASE BOUNDARY
280
ELEVATION CONTOURS (FEET MSL-10 FOOT INTERVAL)
EXISTING:
PHASE I MONITORING WELL
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLES B1-3, B1-5, B1-6, PHASE I T.M.)
Field Sampling Plan
Map 3-3
Site 1 - Explosive Ordnance Disposal Range
MCAS El Toro, California
CLEAN II Program
Date: 7/5/95
File No. sitef1a
Job No. 22214-059

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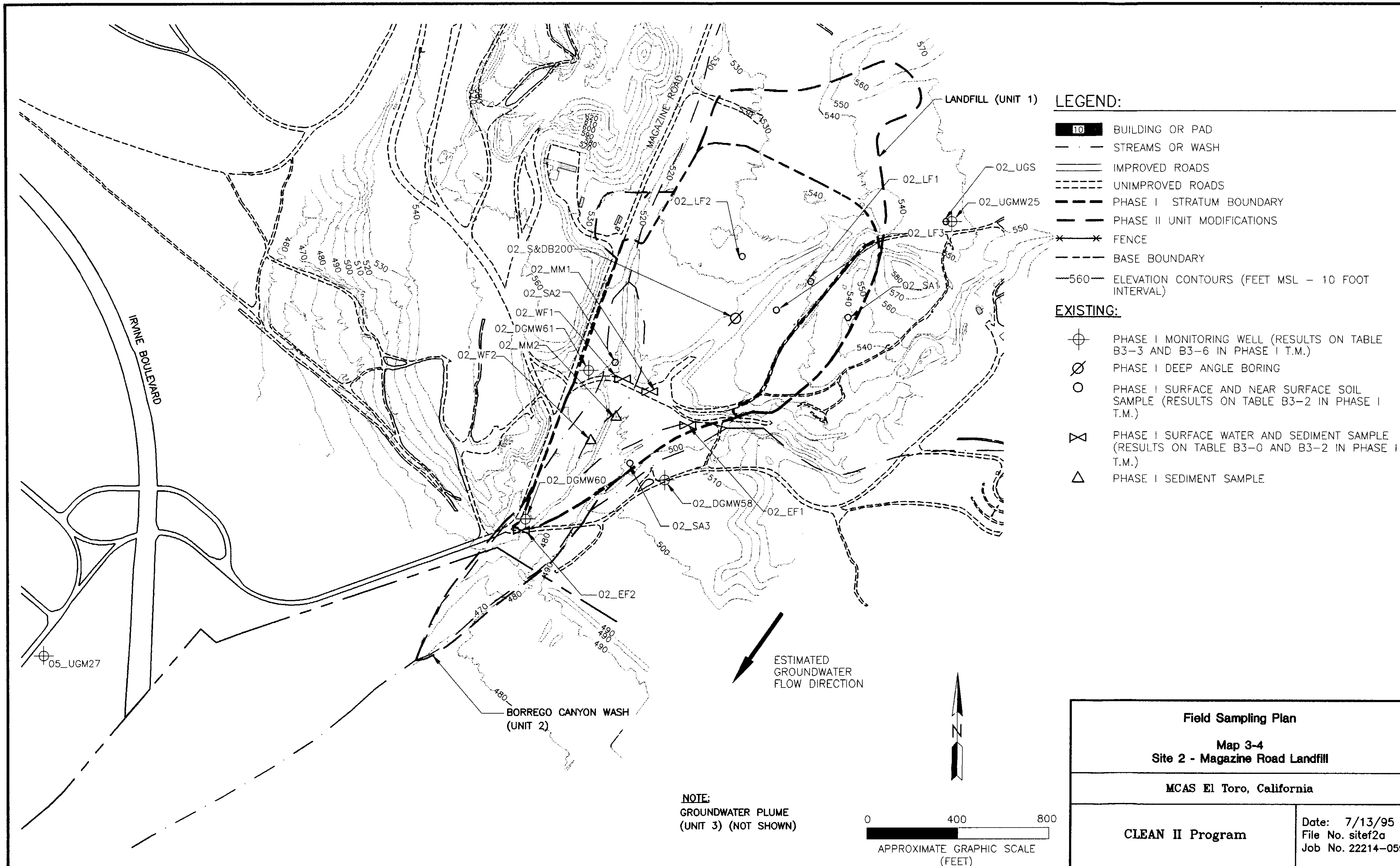
LANDFILL (UNIT 1)
MAGAZINE ROAD
IRVINE BOULEVARD
BORREGO CANYON WASH
(UNIT 2)
ESTIMATED
GROUNDWATER
FLOW DIRECTION
02_UGS
02_LF1
02_UGMW25
02_LF2
02_LF3
02_S&DB200
02_MM1
02_SA2
02_WF1
02_DGMW61
02_MM2
02_WF2
02_SA1
02_DGMW60
02_DGMW58
02_EF1
02_SA3
02_EF2
05_UGM27
N
LEGEND:
10 BUILDING OR PAD
STREAMS OR WASH
IMPROVED ROADS
UNIMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
FENCE
BASE BOUNDARY
560 ELEVATION CONTOURS (FEET MSL – 10 FOOT INTERVAL)
EXISTING:
PHASE I MONITORING WELL (RESULTS ON TABLE B3-3 AND B3-6 IN PHASE I T.M.)
PHASE I DEEP ANGLE BORING
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B3-2 IN PHASE I T.M.)
PHASE I SURFACE WATER AND SEDIMENT SAMPLE (RESULTS ON TABLE B3-0 AND B3-2 IN PHASE I T.M.)
PHASE I SEDIMENT SAMPLE
NOTE:
GROUNDWATER PLUME
(UNIT 3) (NOT SHOWN)
0
400
800
APPROXIMATE GRAPHIC SCALE
(FEET)
Field Sampling Plan
Map 3-4
Site 2 - Magazine Road Landfill
MCAS El Toro, California
CLEAN II Program
Date: 7/13/95
File No. sitef2a
Job No. 22214-059

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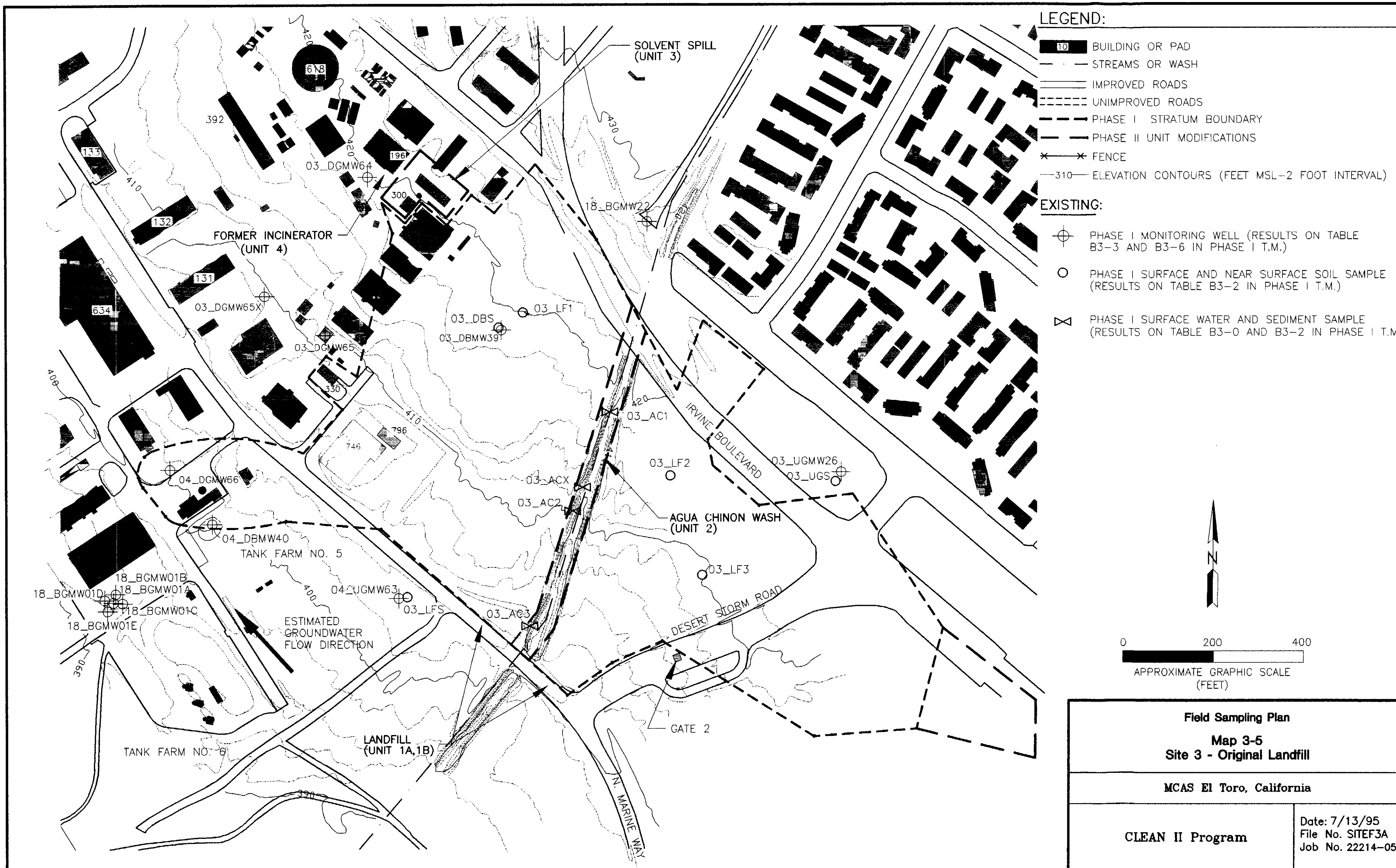
LEGEND:
BUILDING OR PAD
STREAMS OR WASH
IMPROVED ROADS
UNIMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
FENCE
ELEVATION CONTOURS (FEET MSL-2 FOOT INTERVAL)
EXISTING:
PHASE I MONITORING WELL (RESULTS ON TABLE B3-3 AND B3-6 IN PHASE I T.M.)
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B3-2 IN PHASE I T.M.)
PHASE I SURFACE WATER AND SEDIMENT SAMPLE (RESULTS ON TABLE B3-0 AND B3-2 IN PHASE I T.M.)
SOLVENT SPILL (UNIT 3)
FORMER INCINERATOR (UNIT 4)
AGUA CHINON WASH (UNIT 2)
LANDFILL (UNIT 1A,1B)
TANK FARM NO. 5
TANK FARM NO. 6
ESTIMATED GROUNDWATER FLOW DIRECTION
IRVINE BOULEVARD
DESERT STORM ROAD
N. MARINE WAY
GATE 2
03_DGMW64
03_DGMW65X
03_DGMW65
04_DGMW66
04_DBMW40
18_BGMW01B
18_BGMW01A
18_BGMW01C
18_BGMW01D
18_BGMW01E
04_UGMW63
03_LFS
03_AC3
03_AC2
03_ACX
03_AC1
03_DBS
03_DBMW39
03_LF1
03_LF2
03_LF3
18_BGMW22
03_UGMW26
03_UGS
0 200 400
APPROXIMATE GRAPHIC SCALE (FEET)
Field Sampling Plan
Map 3-5
Site 3 - Original Landfill
MCAS El Toro, California
CLEAN II Program
Date: 7/13/95
File No. SITEF3A
Job No. 22214-059

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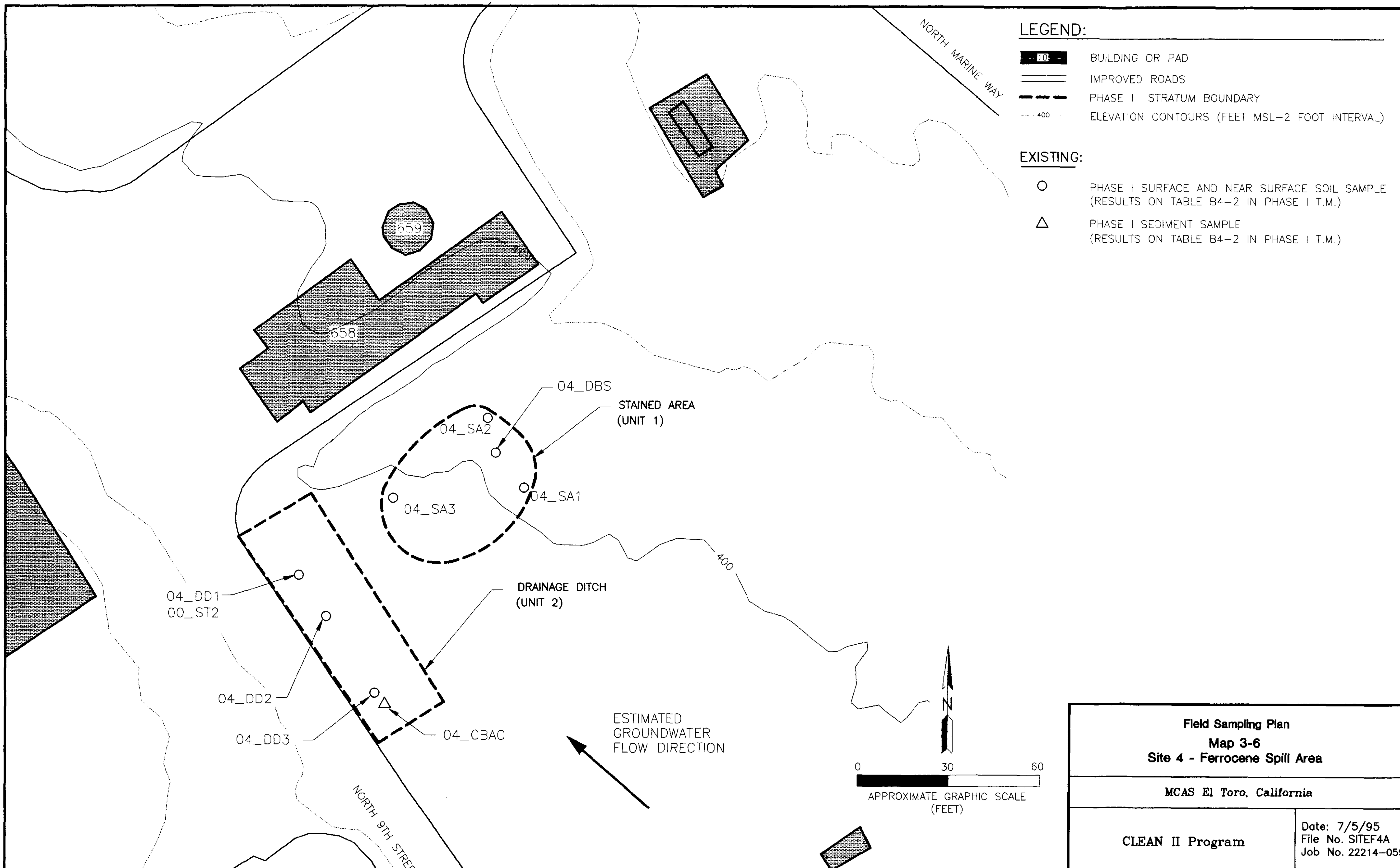

Field Sampling Plan
Map 3-6
Site 4 - Ferrocene Spill Area

MCAS El Toro, California

CLEAN II Program	Date: 7/5/95 File No. SITEF4A Job No. 22214-059

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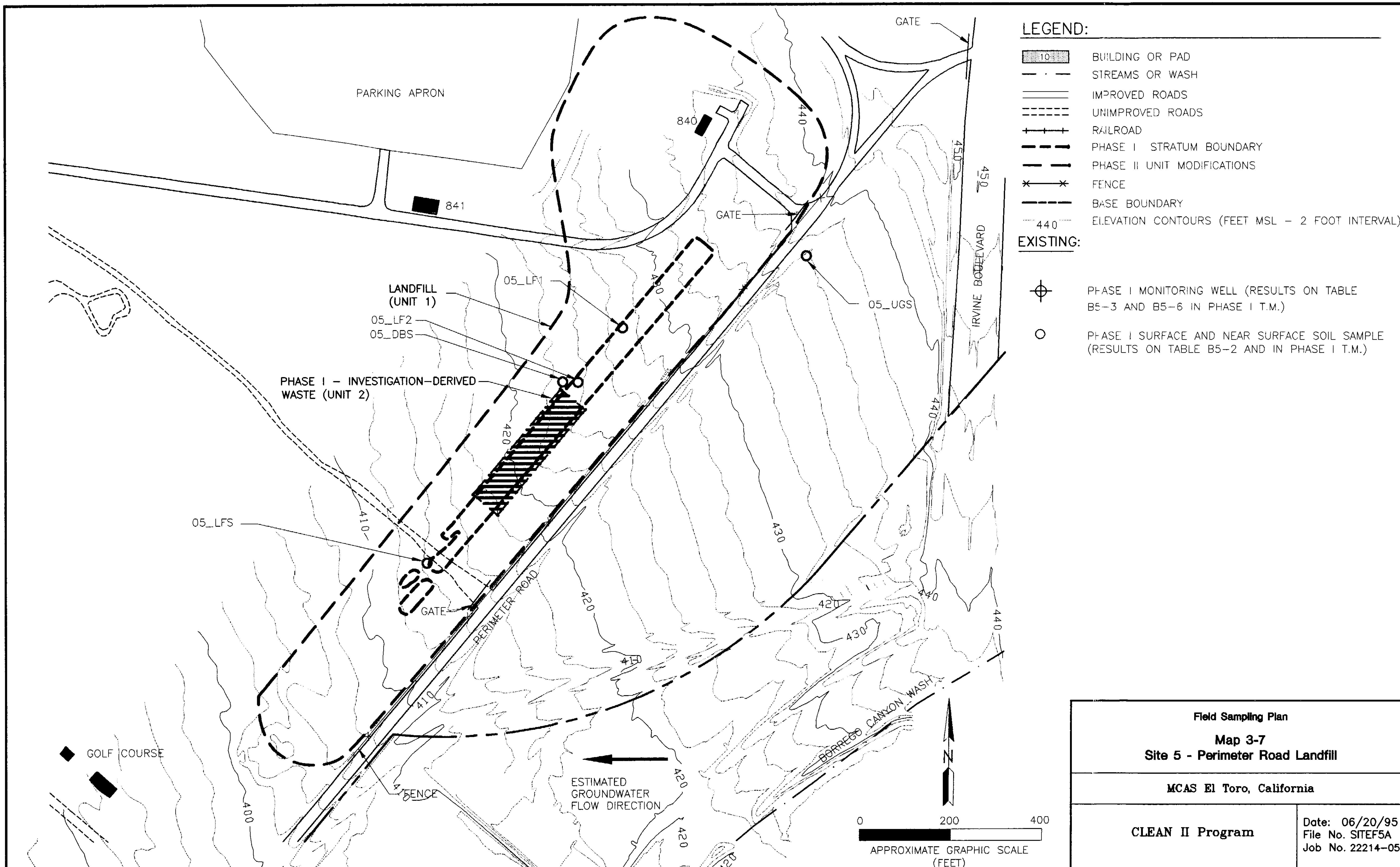

Field Sampling Plan

Map 3-7
Site 5 - Perimeter Road Landfill

MCAS El Toro, California

CLEAN II Program

Date: 06/20/95
File No. SITEF5A
Job No. 22214-059

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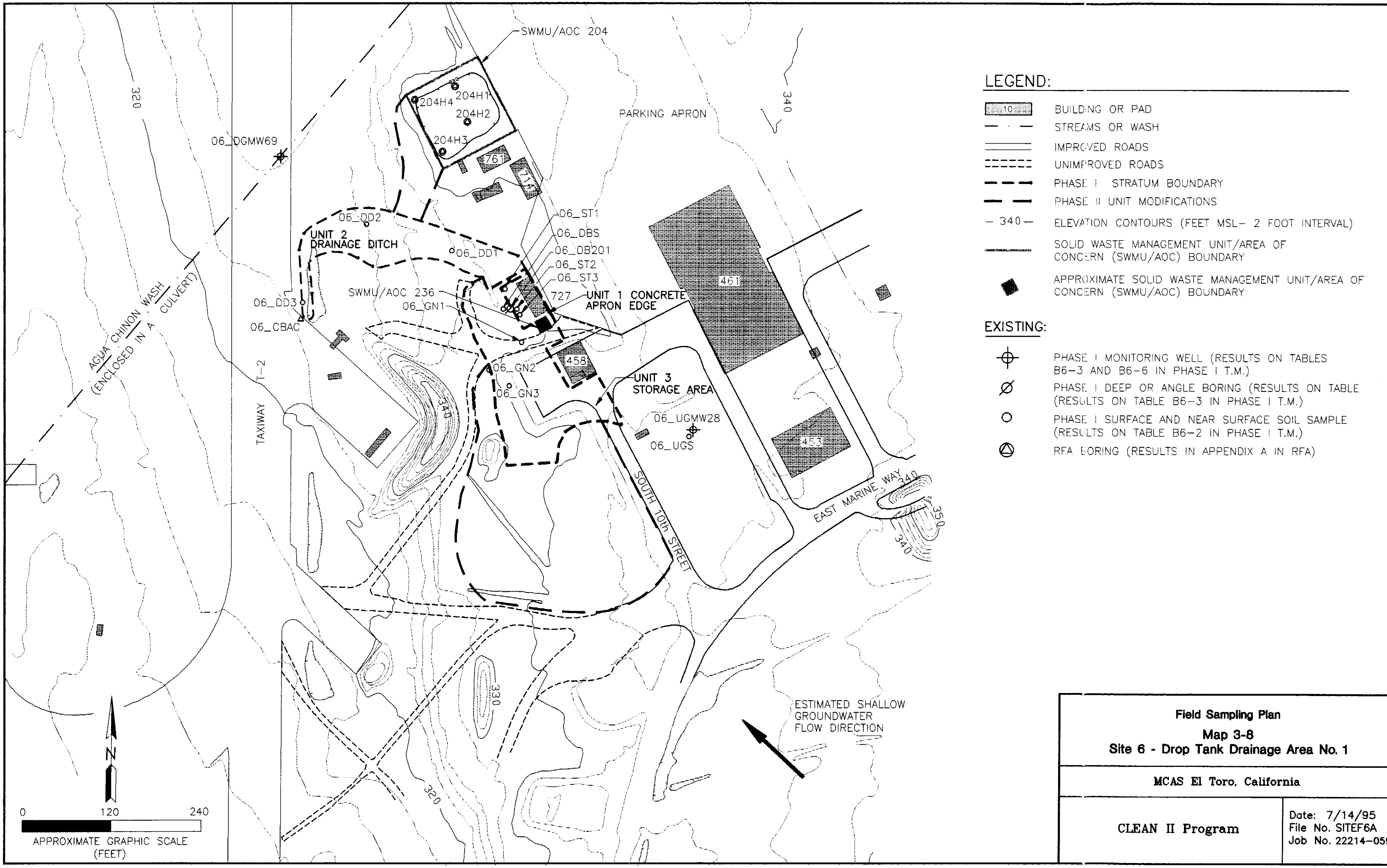

Field Sampling Plan

Map 3-8
Site 6 - Drop Tank Drainage Area No. 1

MCAS El Toro, California

CLEAN II Program

Date: 7/14/95
File No. SITEF6A
Job No. 22214-059

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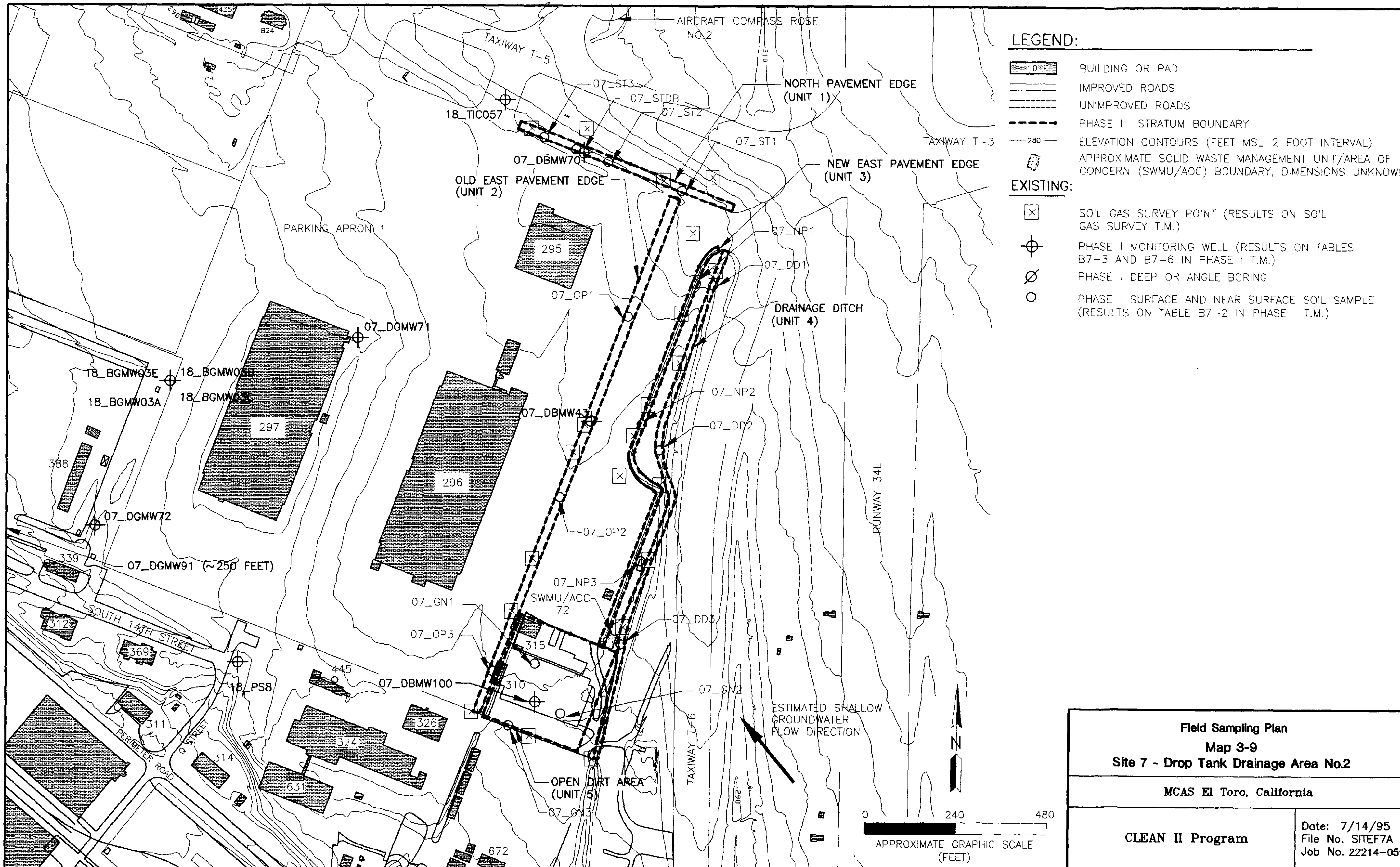
LEGEND:
BUILDING OR PAD
IMPROVED ROADS
UNIMPROVED ROADS
PHASE I STRATUM BOUNDARY
ELEVATION CONTOURS (FEET MSL-2 FOOT INTERVAL)
APPROXIMATE SOLID WASTE MANAGEMENT UNIT/AREA OF CONCERN (SWMU/AOC) BOUNDARY, DIMENSIONS UNKNOWN
EXISTING:
SOIL GAS SURVEY POINT (RESULTS ON SOIL GAS SURVEY T.M.)
PHASE I MONITORING WELL (RESULTS ON TABLES B7-3 AND B7-6 IN PHASE I T.M.)
PHASE I DEEP OR ANGLE BORING
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B7-2 IN PHASE I T.M.)
AIRCRAFT COMPASS ROSE NO.2
TAXIWAY T-5
NORTH PAVEMENT EDGE (UNIT 1)
07_ST3
07_STDB
07_ST2
07_ST1
18_TIC057
07_DBMW70
OLD EAST PAVEMENT EDGE (UNIT 2)
NEW EAST PAVEMENT EDGE (UNIT 3)
TAXIWAY T-3
PARKING APRON 1
295
07_NP1
07_DD1
07_OP1
DRAINAGE DITCH (UNIT 4)
07_DGMW71
18_BGMW03E
18_BGMW03B
18_BGMW03A
18_BGMW03C
297
296
07_DBMW43
07_NP2
07_DD2
388
RUNWAY 34L
07_DGMW72
07_OP2
339
07_DGMW91 (~250 FEET)
07_NP3
SWMU/AOC-72
07_GN1
07_DD3
312
SOUTH 14TH STREET
07_OP3
315
369
445
07_DBMW100
310
18_PS8
07_GN2
ESTIMATED SHALLOW GROUNDWATER FLOW DIRECTION
311
326
324
314
PERIMETER ROAD
Q STREET
631
OPEN DIRT AREA (UNIT 5)
07_GN3
TAXIWAY T-6
672
N
0
240
480
APPROXIMATE GRAPHIC SCALE (FEET)
Field Sampling Plan
Map 3-9
Site 7 - Drop Tank Drainage Area No.2
MCAS El Toro, California
CLEAN II Program
Date: 7/14/95
File No. SITEF7A
Job No. 22214-059

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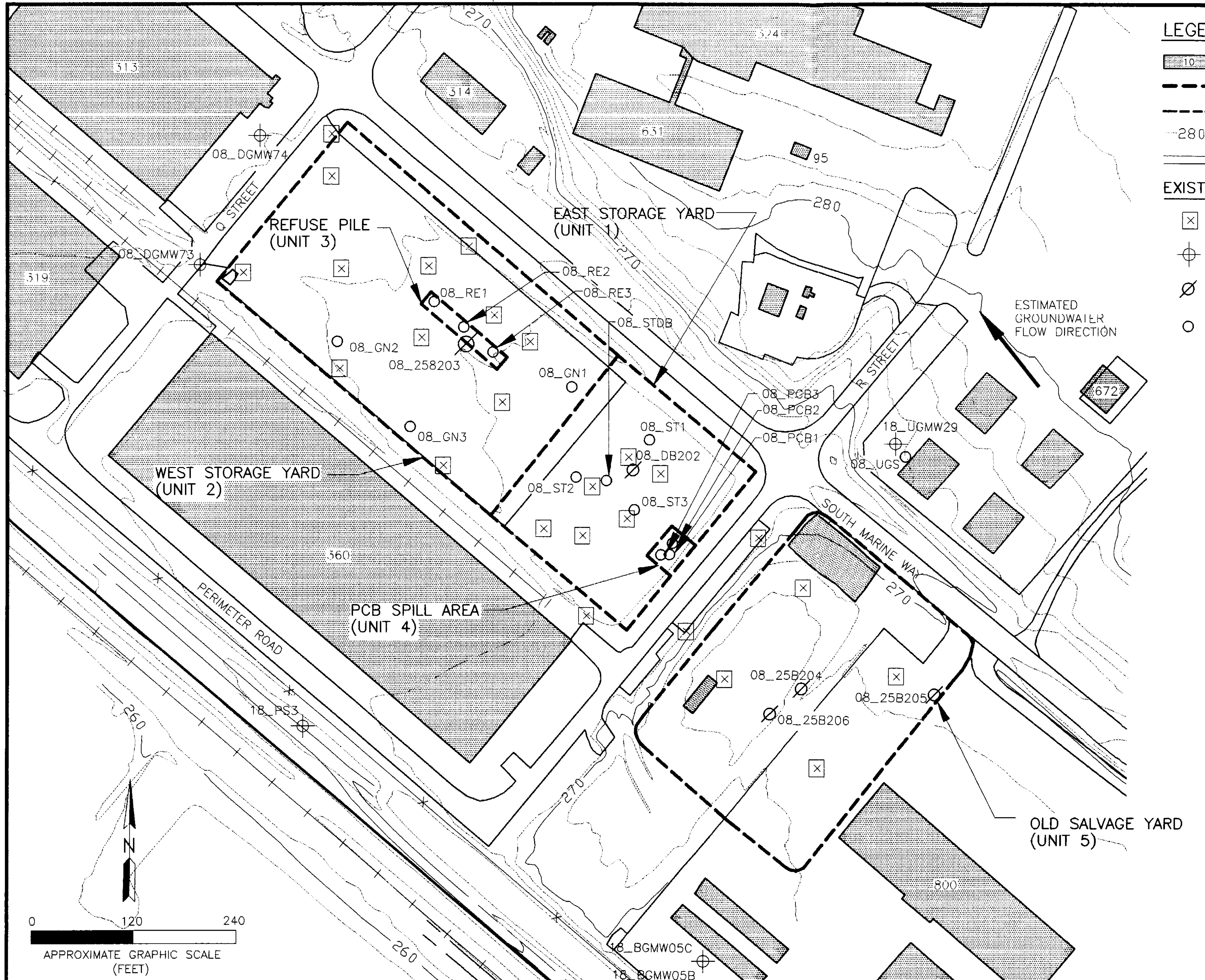

Field Sampling Plan
Map 3-10
Site 8 - DRMO Storage Yard

MCAS El Toro, California

CLEAN II Program

Date: 7/3/95
File No. SITEF8A
Job No. 22214-059

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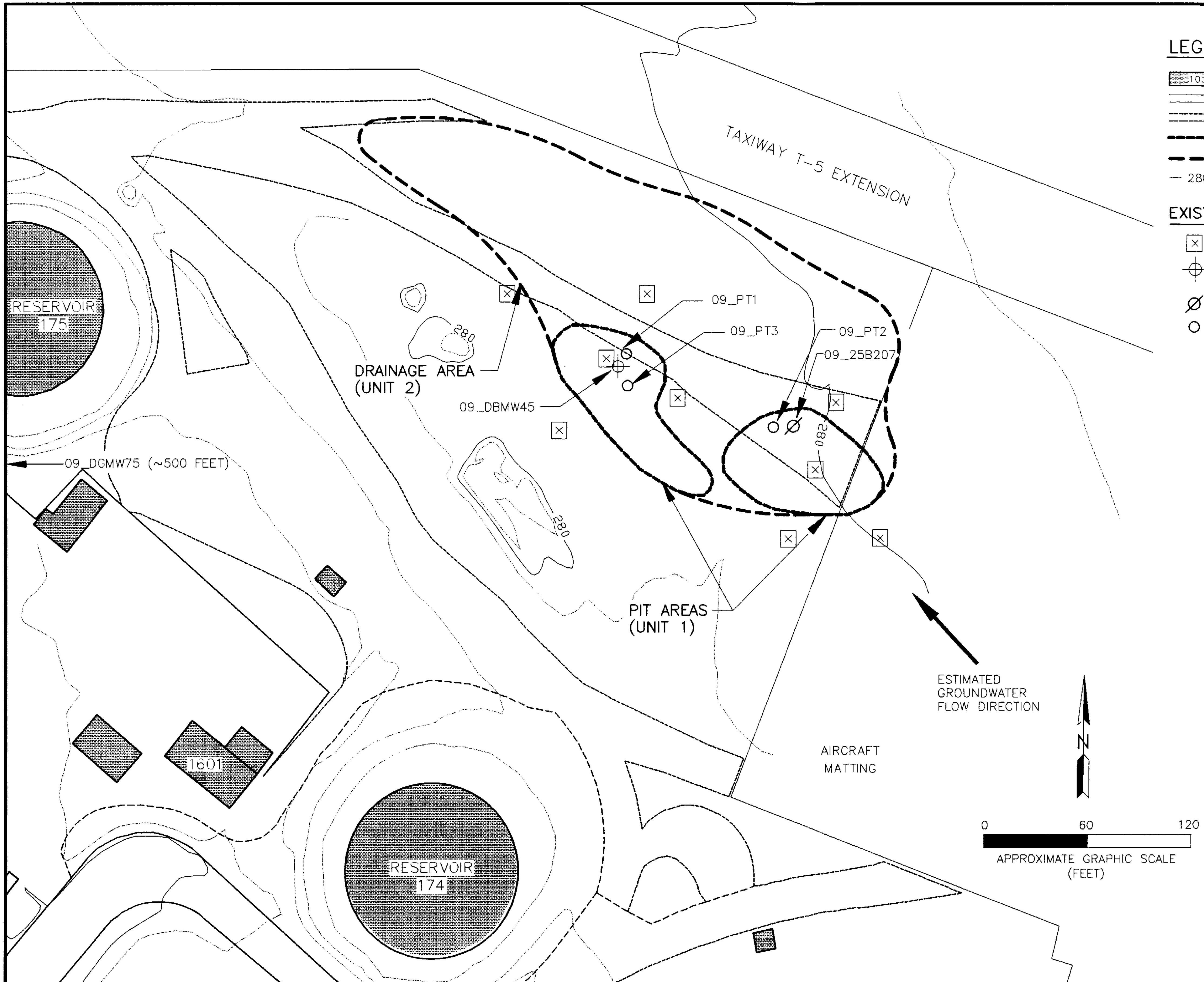

Field Sampling Plan **Map 3-11** **Site 9 - Crash Crew Pit No. 1**	
MCAS El Toro, California	
CLEAN II Program	Date: 7/3/95 File No. SITEF9A Job No. 22214-059

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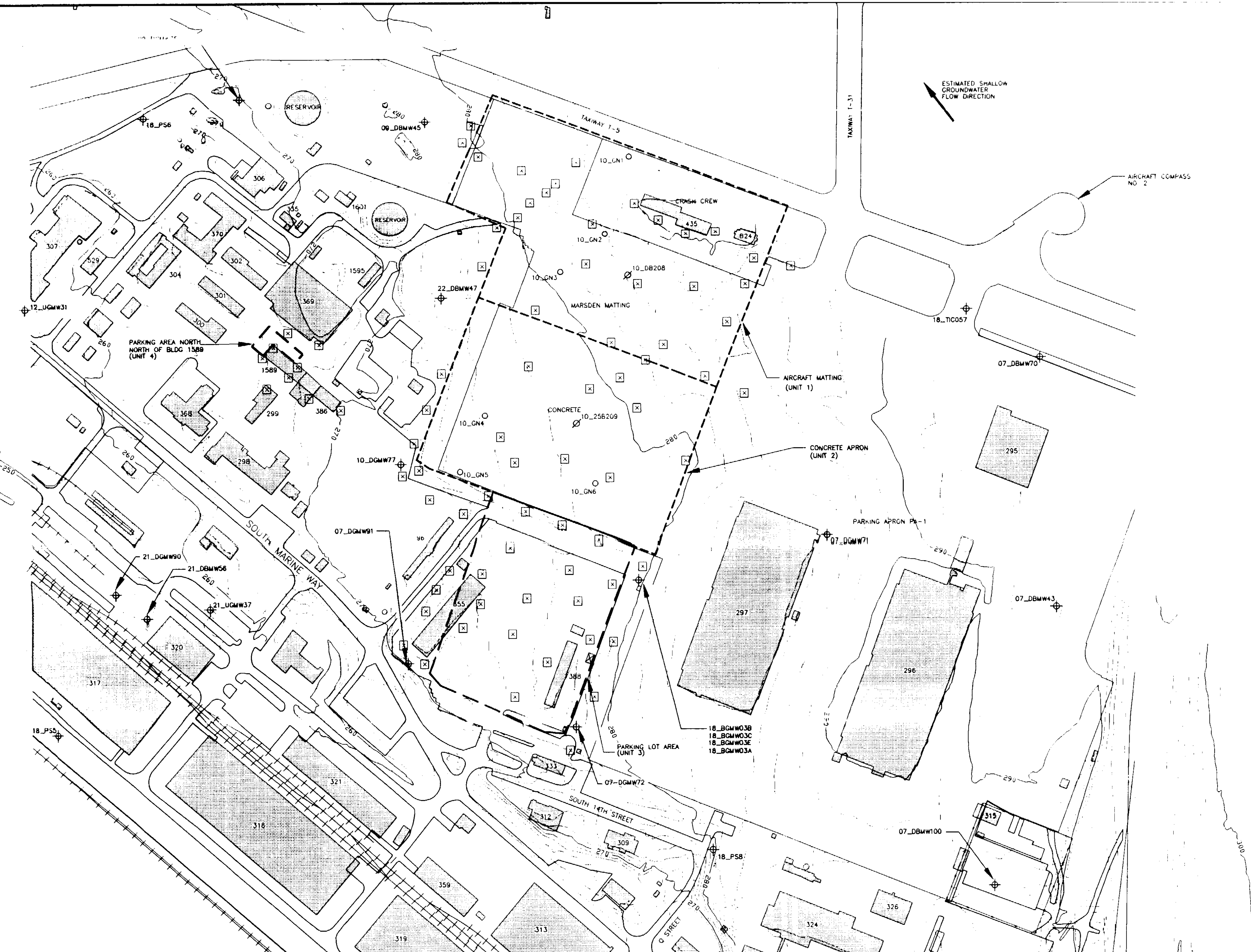

LEGEND:

- BUILDING OR PAD
- STREAMS OR WASH
- IMPROVED ROADS
- RAILROAD
- PHASE I STRATUM BOUNDARY
- PHASE II UNIT MODIFICATIONS
- BASE BOUNDARY
- 290 ELEVATION CONTOURS (FEET MSL-2 FOOT INTERVAL)

EXISTING:

- SOIL GAS SURVEY POINT
- PHASE I MONITORING WELL (RESULTS ON TABLES B6-3 AND B6-6 IN PHASE I T.M.)
- PHASE I DEEP ANGLE BORING
- PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B6-2 IN PHASE I T.M.)

N

0 150 300

APPROXIMATE GRAPHIC SCALE (FEET)

Field Sampling Plan

Map 3-12
Site 10 - Petroleum Disposal Area

MCAS El Toro, California

CLEAN II Program

Date: 7/5/95
File No. SITEF10A
Job No. 22214-059

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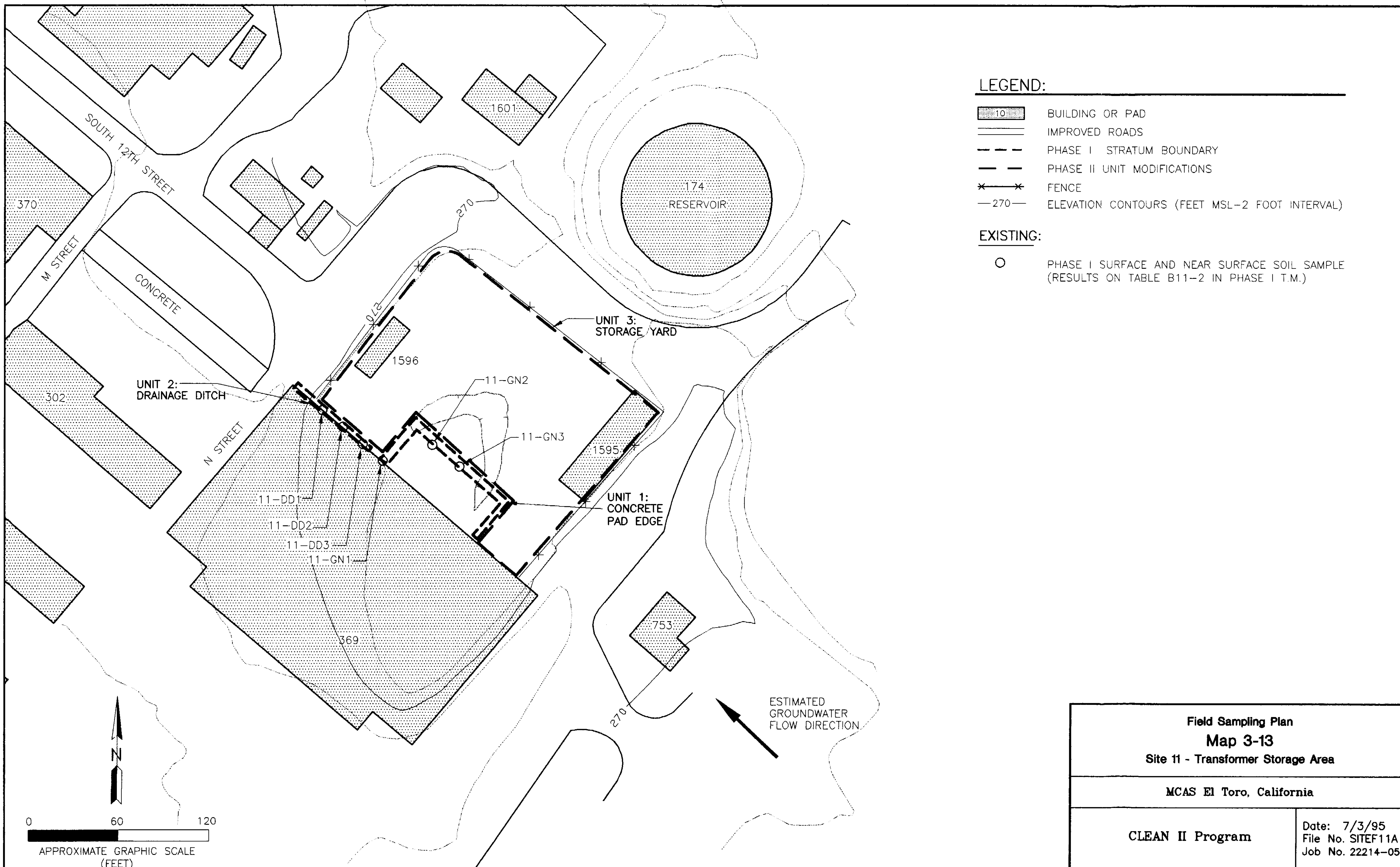

Field Sampling Plan

Map 3-13

Site 11 - Transformer Storage Area

MCAS El Toro, California

CLEAN II Program

Date: 7/3/95
File No. SITEF11A
Job No. 22214-059

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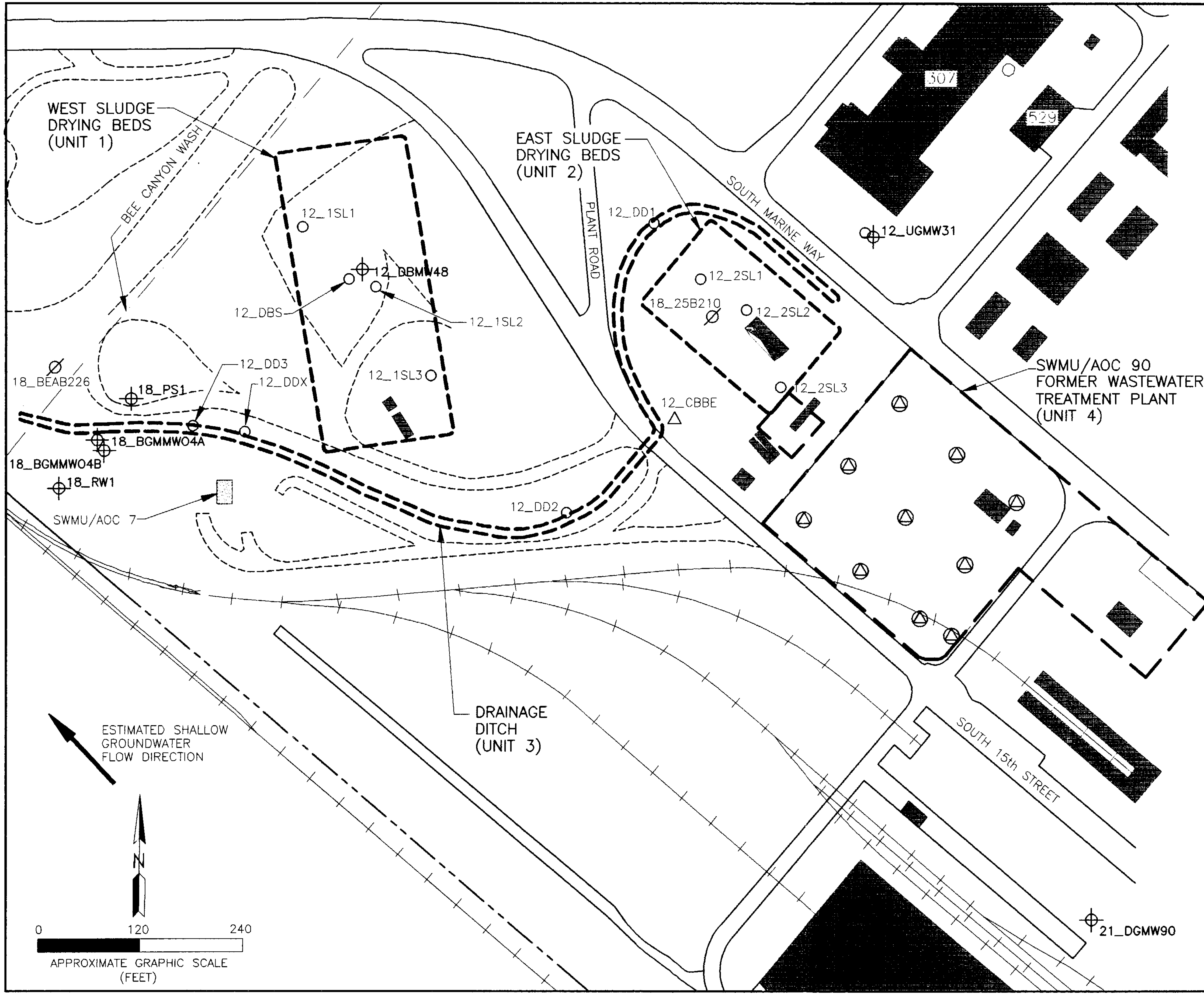

Field Sampling Plan

Map 3-14
Site 12 - Sludge Drying Beds

MCAS El Toro, California

CLEAN II Program

Date: 7/17/95
File No. SITEF12A
Job No. 22214-059

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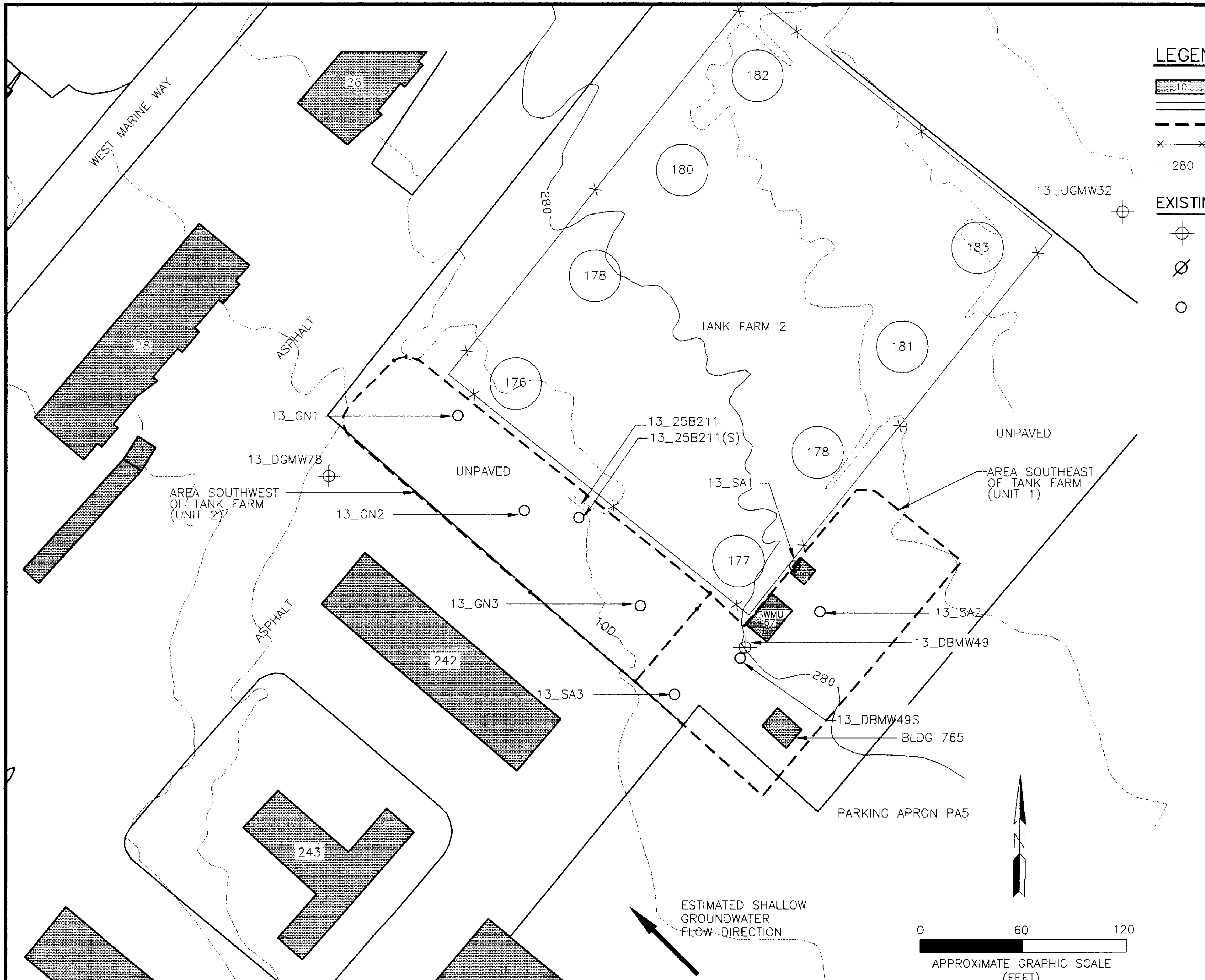

Field Sampling Plan

Map 3-15
Site 13 - Oil Change Area

MCAS El Toro, California

CLEAN II Program

Date: 7/3/95
File No. SITEF13A
Job No. 22214-059

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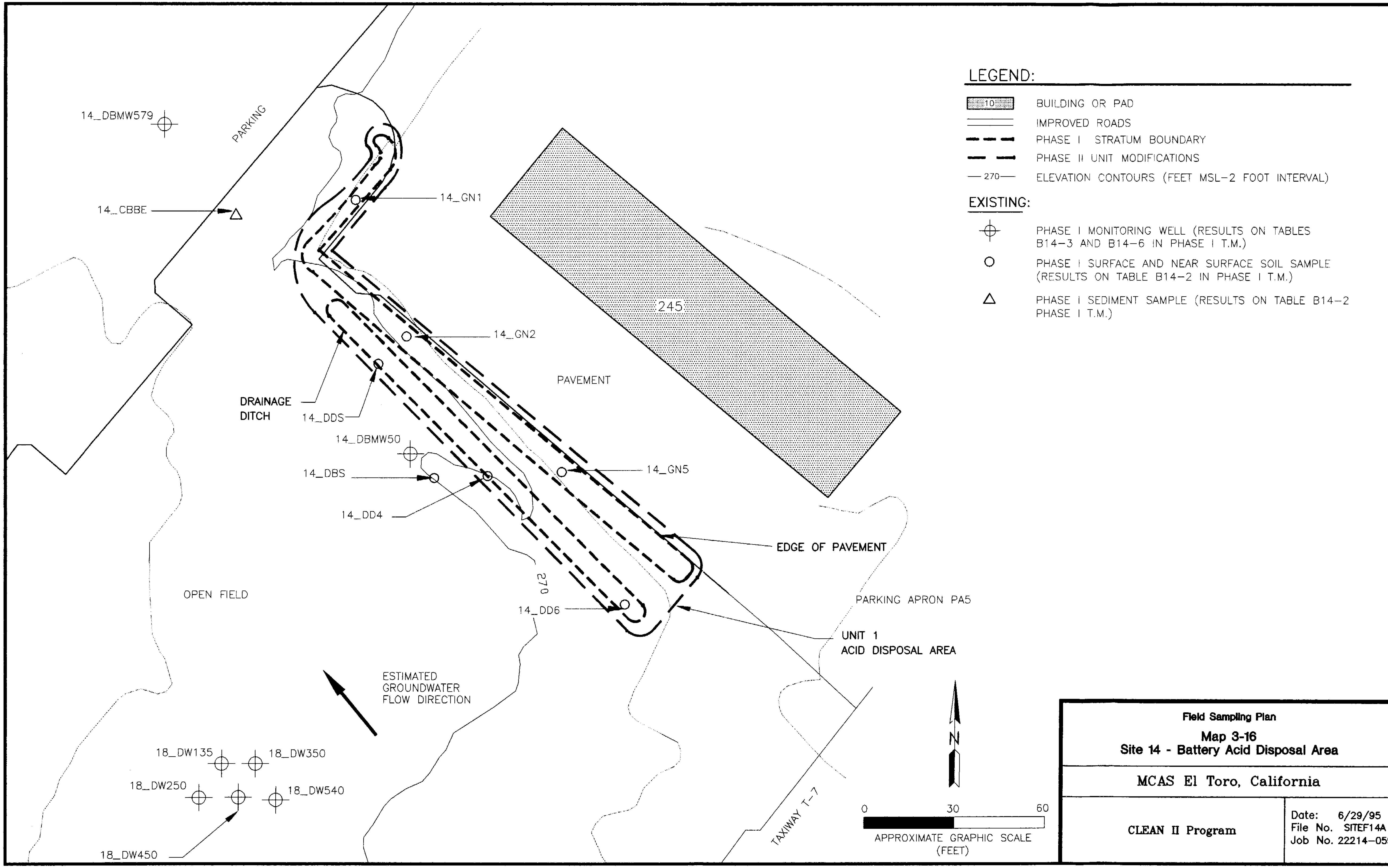
LEGEND:
10 BUILDING OR PAD
IMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
270 ELEVATION CONTOURS (FEET MSL-2 FOOT INTERVAL)
EXISTING:
PHASE I MONITORING WELL (RESULTS ON TABLES B14-3 AND B14-6 IN PHASE I T.M.)
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B14-2 IN PHASE I T.M.)
PHASE I SEDIMENT SAMPLE (RESULTS ON TABLE B14-2 PHASE I T.M.)
14_DBMW579
PARKING
14_CBBE
14_GN1
245
14_GN2
PAVEMENT
DRAINAGE DITCH
14_DDS
14_DBMW50
14_DBS
14_GN5
14_DD4
EDGE OF PAVEMENT
270
OPEN FIELD
14_DD6
PARKING APRON PA5
UNIT 1
ACID DISPOSAL AREA
ESTIMATED GROUNDWATER FLOW DIRECTION
18_DW135
18_DW350
18_DW250
18_DW540
18_DW450
TAXIWAY T-7
N
0
30
60
APPROXIMATE GRAPHIC SCALE (FEET)
Field Sampling Plan
Map 3-16
Site 14 - Battery Acid Disposal Area
MCAS El Toro, California
CLEAN II Program
Date: 6/29/95
File No. SITEF14A
Job No. 22214-059

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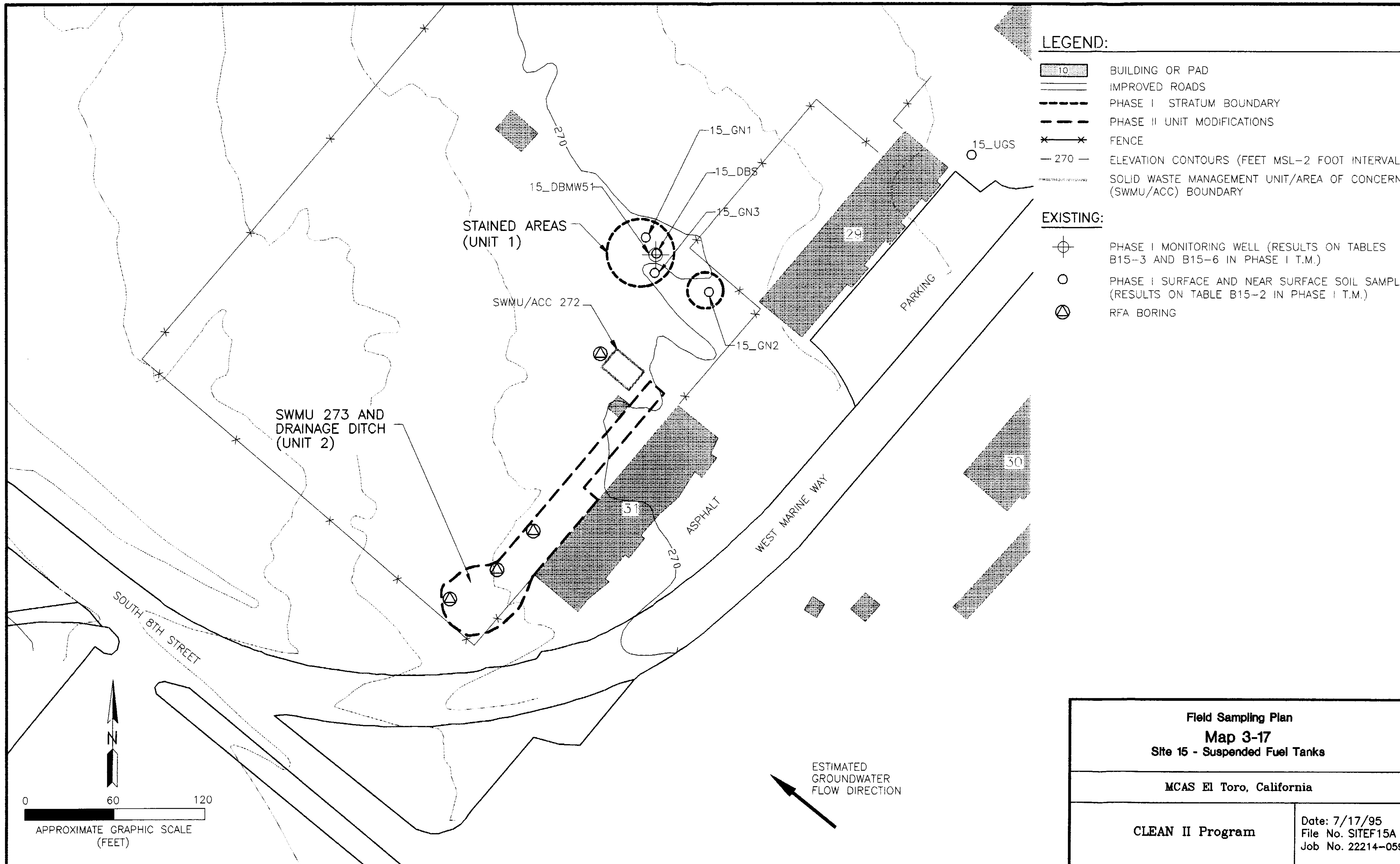

Field Sampling Plan
Map 3-17
Site 15 - Suspended Fuel Tanks

MCAS El Toro, California

CLEAN II Program

Date: 7/17/95
File No. SITEF15A
Job No. 22214-059

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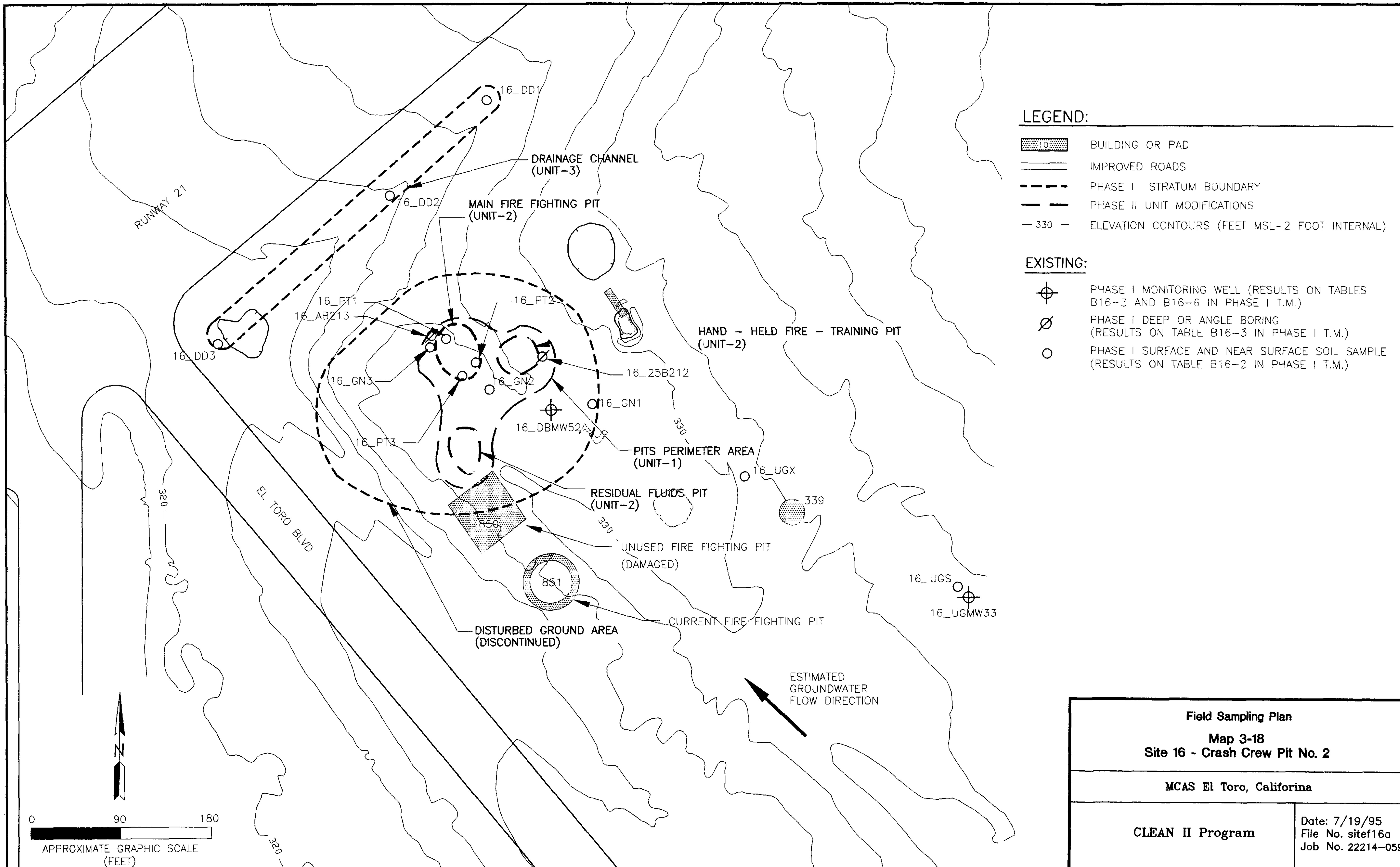

Field Sampling Plan Map 3-18 Site 16 - Crash Crew Pit No. 2	
MCAS El Toro, Califorina	
CLEAN II Program	Date: 7/19/95 File No. sitef16a Job No. 22214-059

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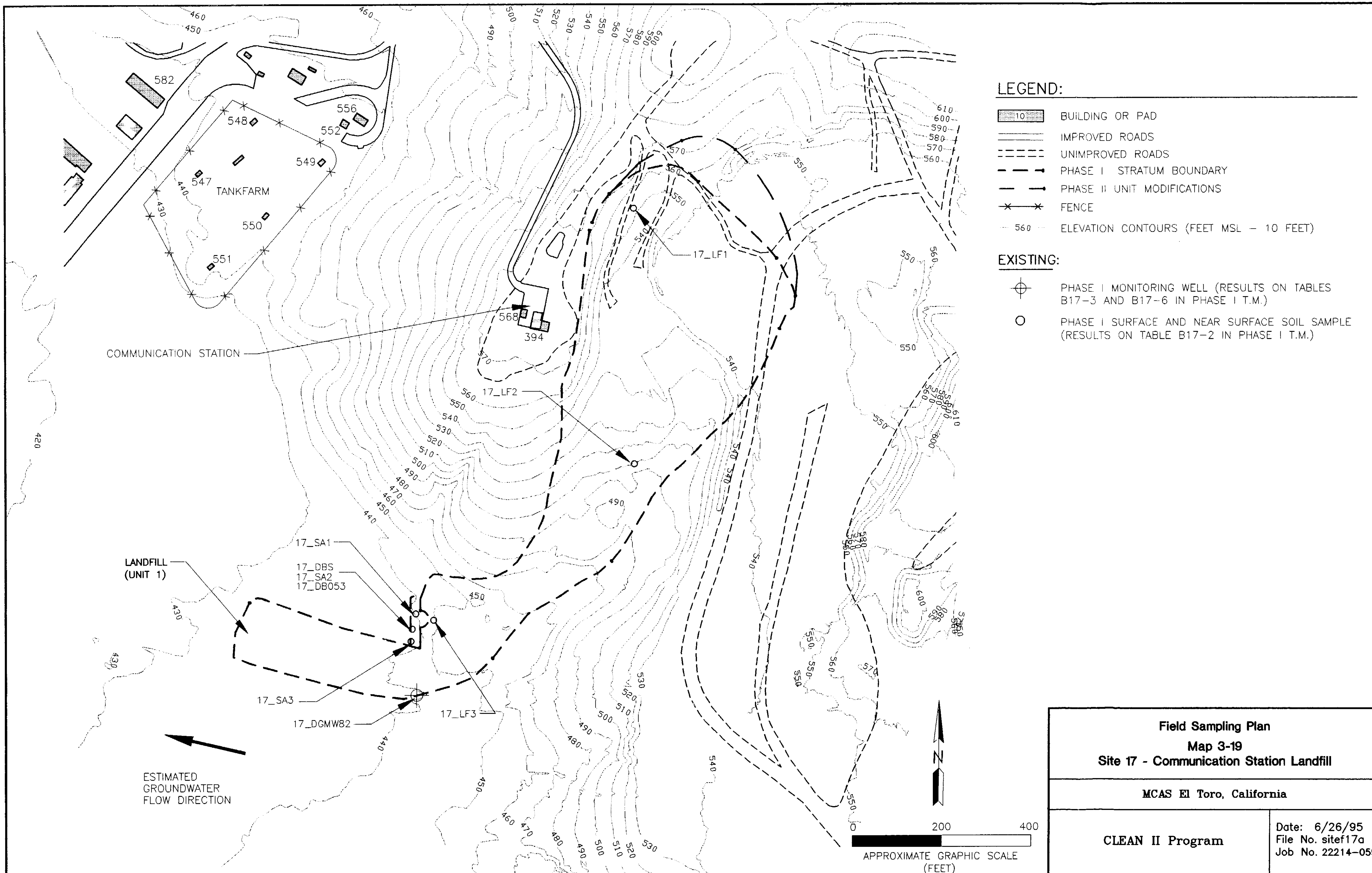
LEGEND:
BUILDING OR PAD
IMPROVED ROADS
UNIMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
FENCE
560 ELEVATION CONTOURS (FEET MSL – 10 FEET)
EXISTING:
PHASE I MONITORING WELL (RESULTS ON TABLES B17-3 AND B17-6 IN PHASE I T.M.)
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B17-2 IN PHASE I T.M.)
TANKFARM
COMMUNICATION STATION
17_LF1
17_LF2
17_LF3
17_SA1
17_DBS
17_SA2
17_DB053
17_SA3
17_DGMW82
LANDFILL (UNIT 1)
ESTIMATED GROUNDWATER FLOW DIRECTION
0 200 400
APPROXIMATE GRAPHIC SCALE (FEET)
Field Sampling Plan
Map 3-19
Site 17 - Communication Station Landfill
MCAS El Toro, California
CLEAN II Program
Date: 6/26/95
File No. sitef17a
Job No. 22214-059

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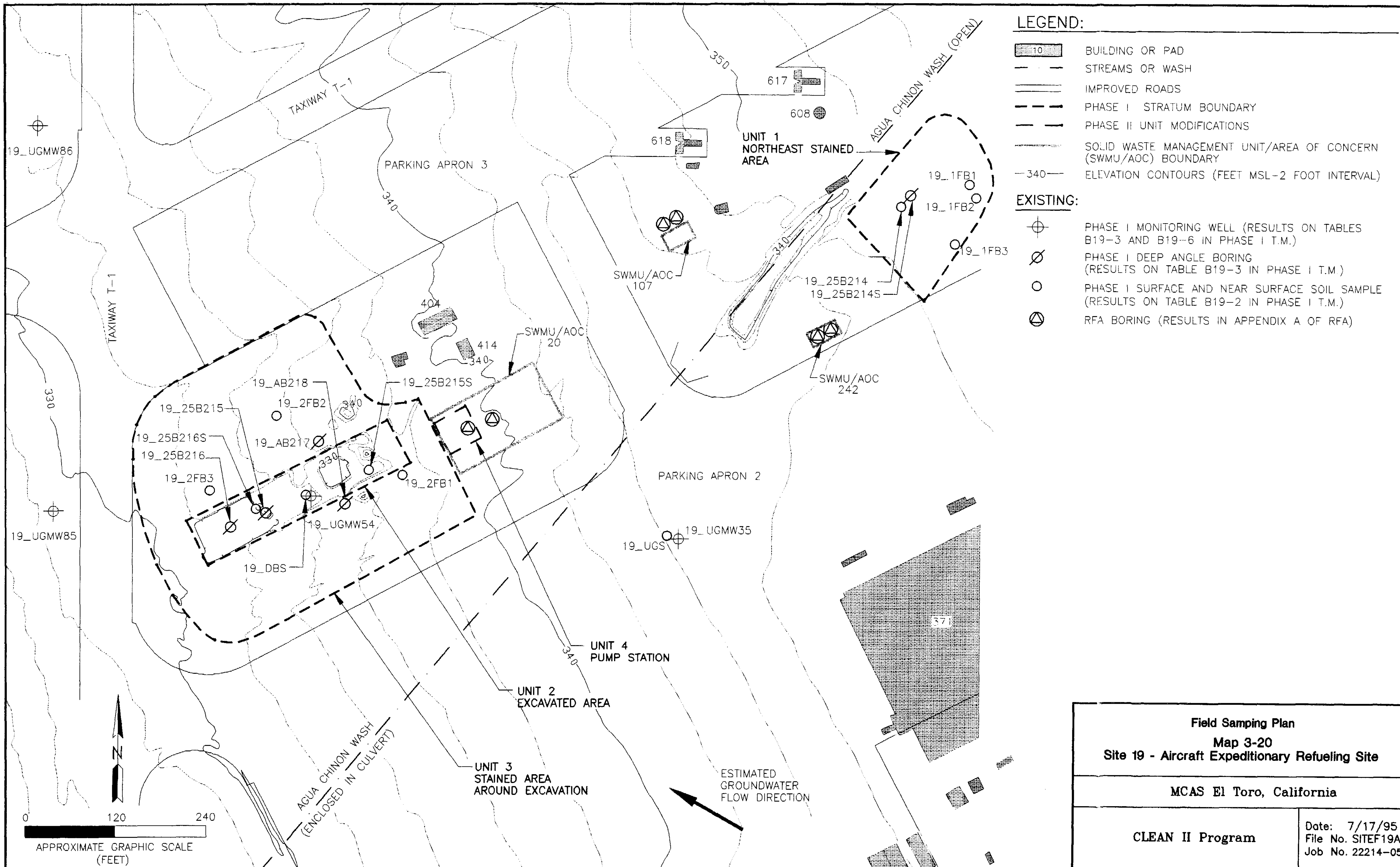

Field Samping Plan

Map 3-20

Site 19 - Aircraft Expeditionary Refueling Site

MCAS El Toro, California

CLEAN II Program

Date: 7/17/95
File No. SITEF19A
Job No. 22214-059

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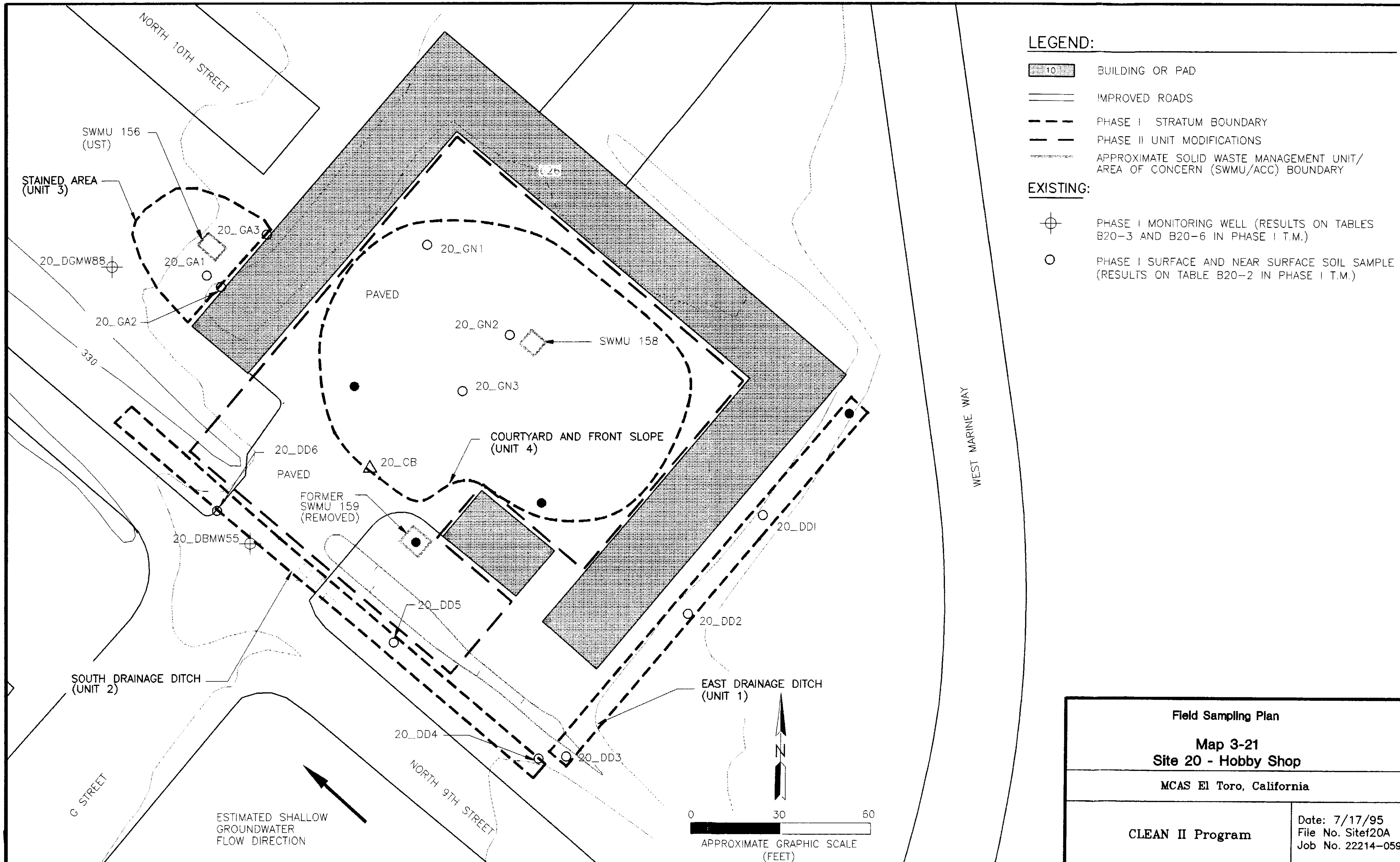

LEGEND:
BUILDING OR PAD
IMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
APPROXIMATE SOLID WASTE MANAGEMENT UNIT/ AREA OF CONCERN (SWMU/ACC) BOUNDARY
EXISTING:
PHASE I MONITORING WELL (RESULTS ON TABLES B20-3 AND B20-6 IN PHASE I T.M.)
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B20-2 IN PHASE I T.M.)
NORTH 10TH STREET
SWMU 156 (UST)
STAINED AREA (UNIT 3)
20_GA3
20_GA1
20_GA2
20_DGMW88
330
20_GN1
PAVED
20_GN2
SWMU 158
20_GN3
COURTYARD AND FRONT SLOPE (UNIT 4)
20_CB
20_DD6
PAVED
FORMER SWMU 159 (REMOVED)
20_DBMW55
20_DD5
20_DDI
20_DD2
WEST MARINE WAY
SOUTH DRAINAGE DITCH (UNIT 2)
EAST DRAINAGE DITCH (UNIT 1)
20_DD4
20_DD3
G STREET
NORTH 9TH STREET
ESTIMATED SHALLOW GROUNDWATER FLOW DIRECTION
N
0 30 60
APPROXIMATE GRAPHIC SCALE (FEET)
Field Sampling Plan
Map 3-21
Site 20 - Hobby Shop
MCAS El Toro, California
CLEAN II Program
Date: 7/17/95
File No. Sitef20A
Job No. 22214-059

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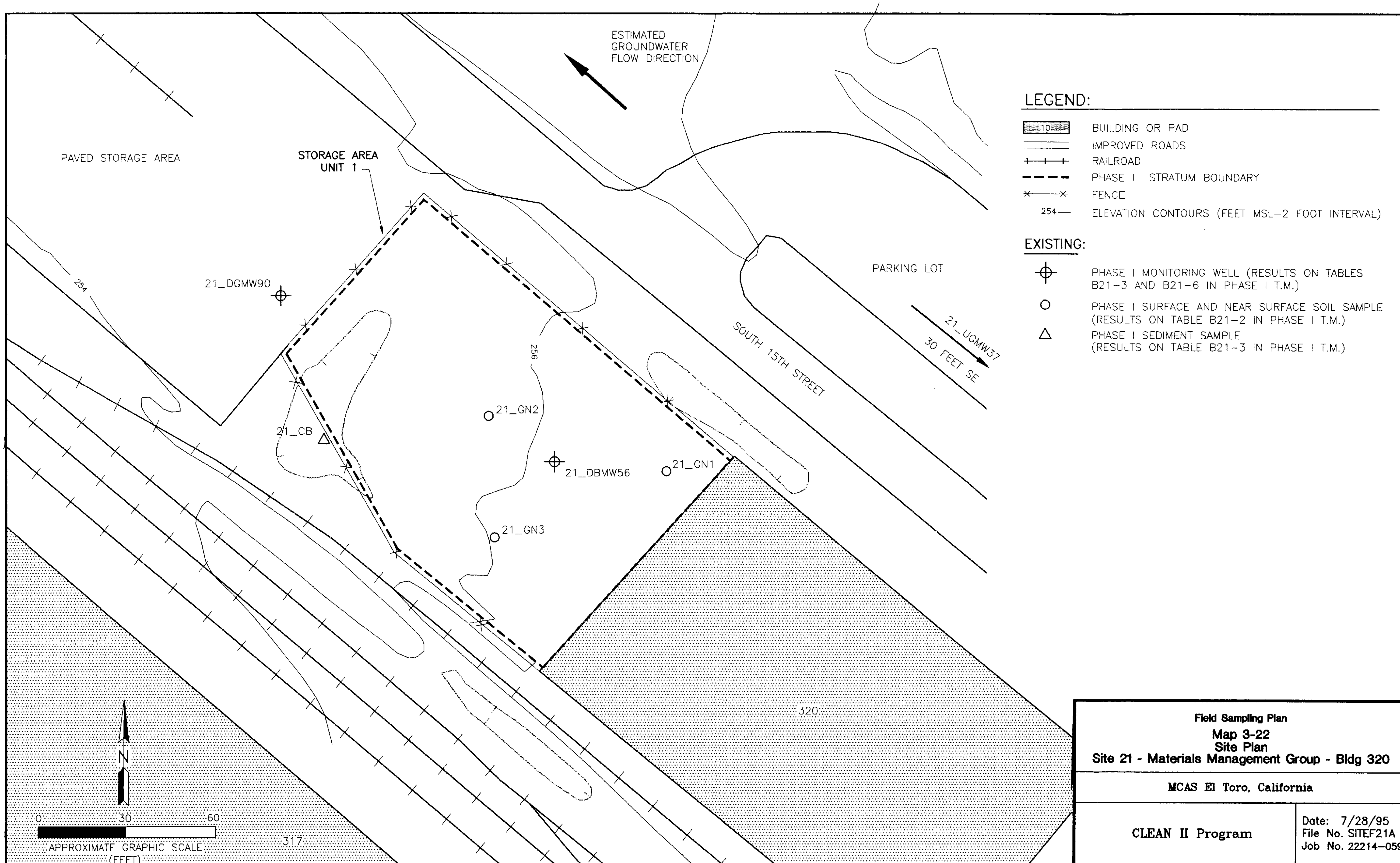

Field Sampling Plan

Map 3-22
Site Plan
Site 21 - Materials Management Group - Bldg 320

MCAS El Toro, California

CLEAN II Program

Date: 7/28/95
File No. SITEF21A
Job No. 22214-059

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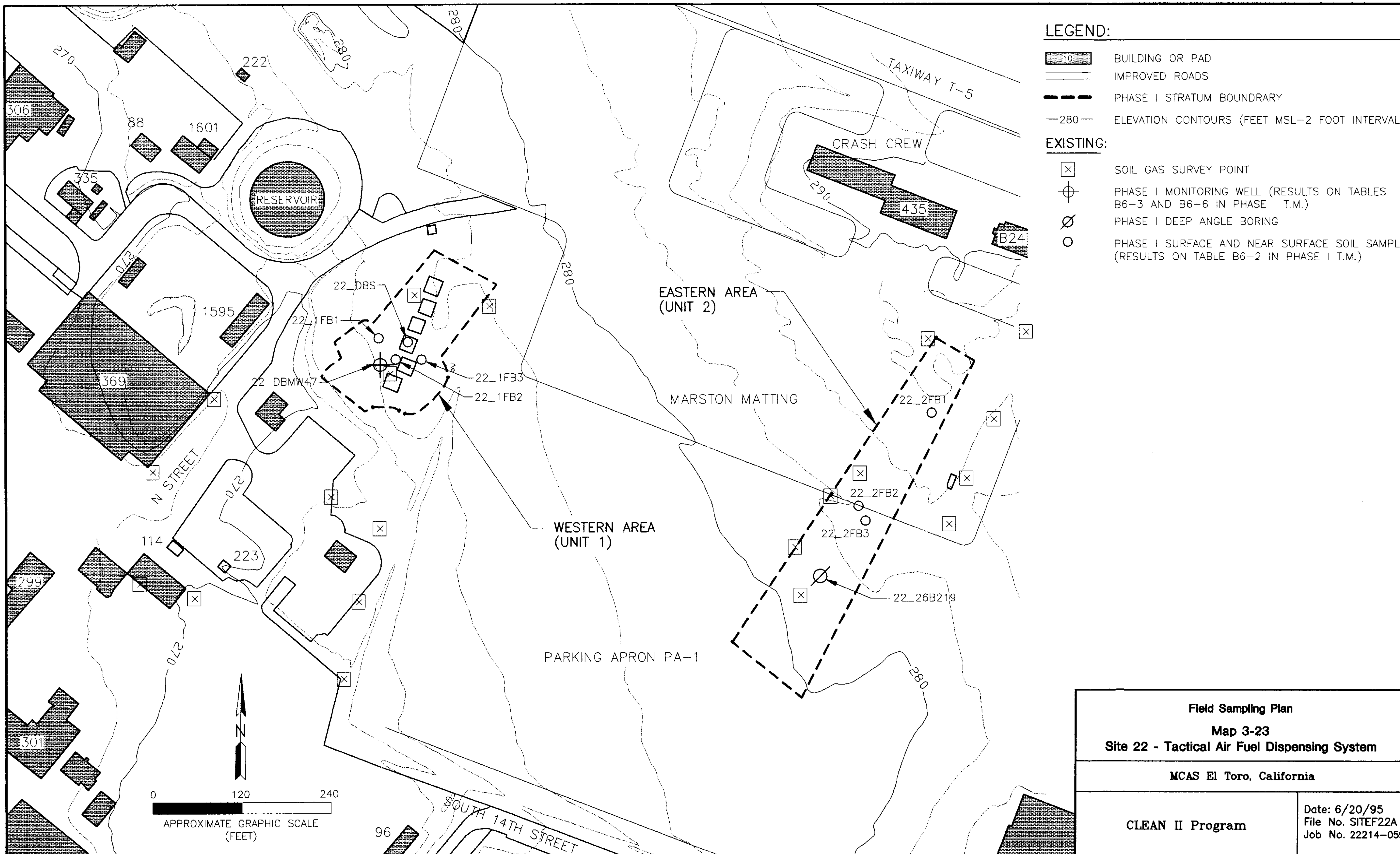

Field Sampling Plan

Map 3-23
Site 22 - Tactical Air Fuel Dispensing System

MCAS El Toro, California

CLEAN II Program

Date: 6/20/95
File No. SITEF22A
Job No. 22214-059

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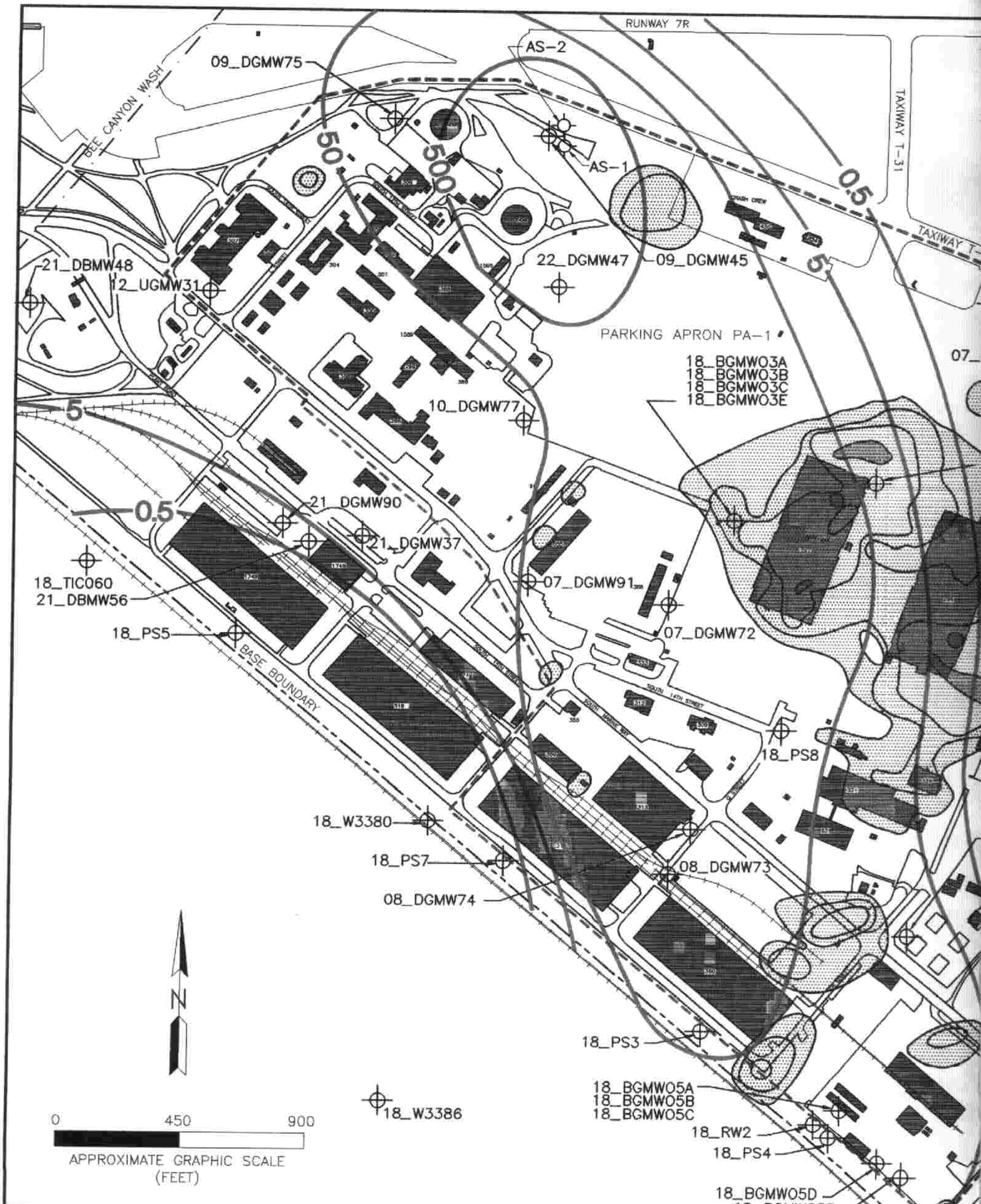
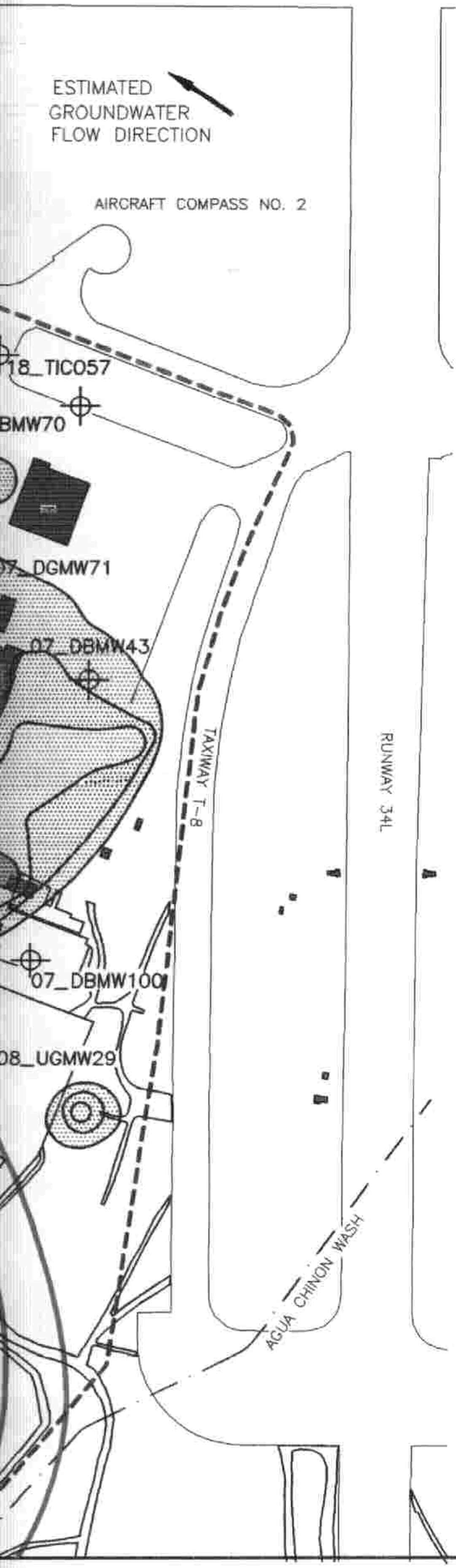


RUNWAY 7R
AS-2
AS-1
TAXIWAY T-31
TAXIWAY T
BEE CANYON WASH
09_DGMW75
09_DGMW45
22_DGMW47
21_DBMW48
12_UGMW31
PARKING APRON PA-1
18_BGMW03A
18_BGMW03B
18_BGMW03C
18_BGMW03E
10_DGMW77
21_DGMW90
21_DGMW37
18_TIC060
21_DBMW56
07_DGMW91
07_DGMW72
18_PS5
BASE BOUNDARY
18_PS8
18_W3380
18_PS7
08_DGMW73
08_DGMW74
18_PS3
18_BGMW05A
18_BGMW05B
18_BGMW05C
18_RW2
18_PS4
18_BGMW05D
18_BGMW05E
18_W3386
500
50
5
0.5
5
0.5
5
N
0
450
900
APPROXIMATE GRAPHIC SCALE
(FEET)



LEGEND:

- BUILDING OR PAD
- STREAMS OR WASH
- IMPROVED ROADS
- UNIMPROVED ROADS
- RAILROAD
- PHASE II UNIT BOUNDARY
- FENCE
- BASE BOUNDARY
- 500 — CONCENTRATION OF TCE IN GROUNDWATER (μg/L) (FROM SAMPLES COLLECTED JULY 1992 TO JANUARY 1993 RESULTS IN TABLE C-1 PHASE I T.M.)

SOIL GAS CONCENTRATIONS:

(RESULTS IN DRAFT SOIL GAS SURVEY T.M , TABLE C-1)

- 1.0 TO 5.0 ug/L TCE
- 5.0 TO 50.0 ug/L TCE
- 50.0 TO 500.0 ug/L TCE
- GREATER THAN 500.0 ug/L TCE

EXISTING:

- PHASE I MONITORING WELL (RESULTS ON TABLES B6-3 AND B6-6 IN PHASE I T.M.)

Field Sampling Plan

Map 3-24

Site 24 - VOC Source Area

MCAS El Toro, California

CLEAN II Program	Date: 7/25/95 File No. SITEF24G Job No. 22214-059

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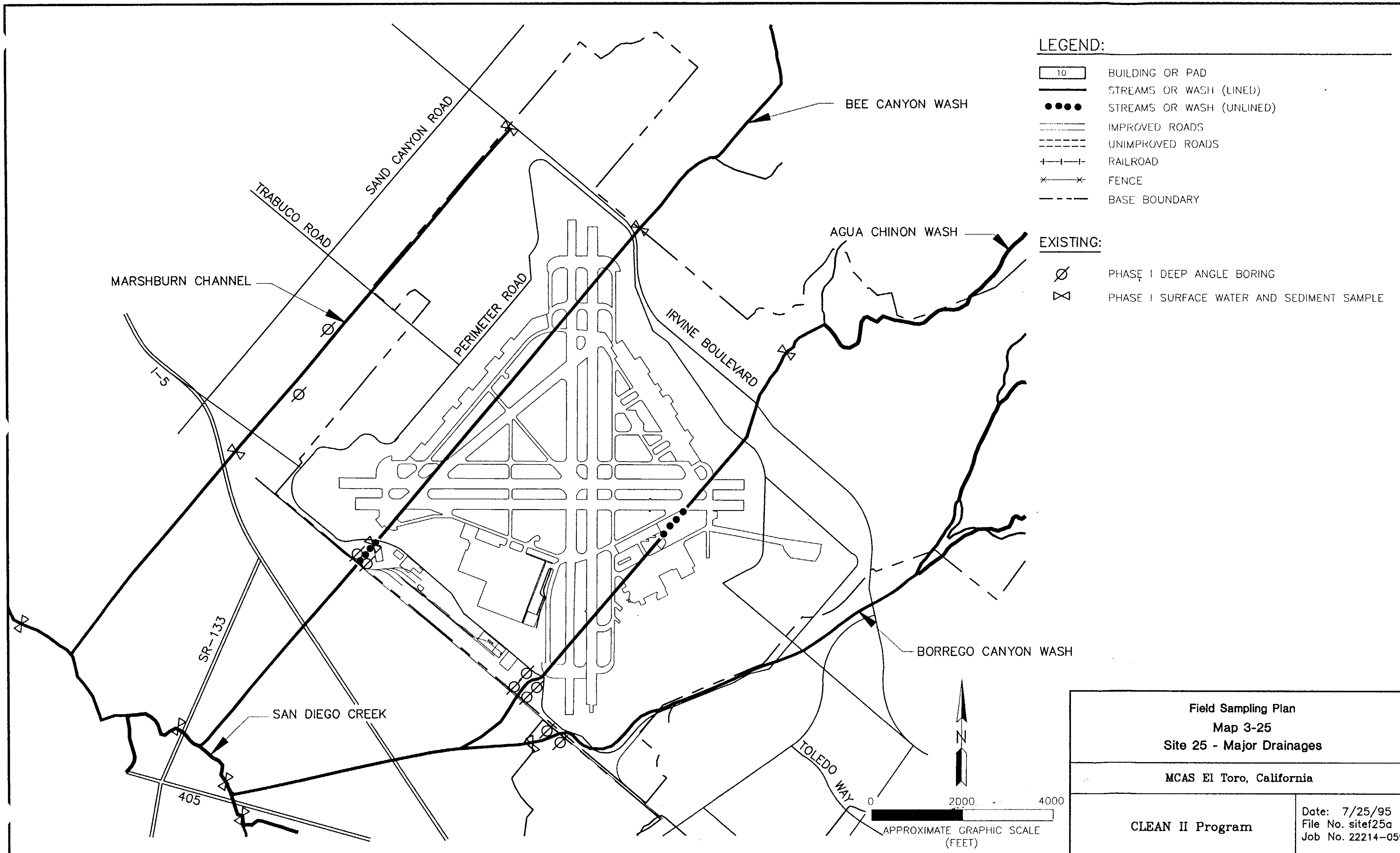
LEGEND:
BUILDING OR PAD
10
STREAMS OR WASH (LINED)
STREAMS OR WASH (UNLINED)
IMPROVED ROADS
UNIMPROVED ROADS
RAILROAD
FENCE
BASE BOUNDARY
EXISTING:
PHASE I DEEP ANGLE BORING
PHASE I SURFACE WATER AND SEDIMENT SAMPLE
BEE CANYON WASH
AGUA CHINON WASH
SAND CANYON ROAD
TRABUCO ROAD
MARSHBURN CHANNEL
PERIMETER ROAD
IRVINE BOULEVARD
I-5
SR-133
SAN DIEGO CREEK
405
TOLEDO WAY
BORREGO CANYON WASH
N
0
2000
4000
APPROXIMATE GRAPHIC SCALE
(FEET)
Field Sampling Plan
Map 3-25
Site 25 - Major Drainages
MCAS El Toro, California
CLEAN II Program
Date: 7/25/95
File No. sitef25a
Job No. 22214-059

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SECTION 4

RATIONALE FOR SAMPLING LOCATIONS

Section 4
RATIONALE FOR SAMPLING LOCATIONS

The Phase II RI/FS sampling locations have been chosen to collect sufficient information to complete a baseline risk assessment for human health and the environment and to characterize the nature and extent of the contamination at sites on MCAS El Toro. The sampling locations, field investigations, and analytical methods are site-specific and are based on the history of each site. Chemicals of potential concern (COPCs) for each site are presented in Table 4-1. Types of media (or substances) to be sampled for each site are presented in Table 4-2. A level of flexibility exists within the Phase II RI/FS to allow for real-time observations to affect strategic planning and to assure the best remedy for each site. Quality assurance for sampling and analytical methods are discussed in the QAPP (BNI 1995a).

4.1 RATIONALE FOR SAMPLING TYPES AND LOCATIONS

During the field investigation, a series of soil gas, soil, leachate, groundwater, surface water, animal and plant samples will be collected for analyses of COPCs (Tables 4-1 and 4-2). Selected soil samples will also be submitted for geotechnical analyses. Soil samples will be collected for:

- examination and description of physical characteristics,
- laboratory analyses to determine selected physical characteristics, and,
- laboratory analyses to determine the presence and concentrations of COPCs.

The sample locations at each site will evaluate the extent and concentration of COPCs in the media sampled. The number of sampling locations may be revised or rearranged based on interpretation of the field and analytical data acquired during Phase II activities. Site-specific rationale for sample types and locations are presented in the FSP Attachments.

4.1.1 Plant and Animal Samples

Plant and animal samples will be taken to assess the ecological risks (Table 4-2). Collection of soil invertebrates or small mammals may be performed. A representative number of earthworms may be initially collected for standard analytical testing at Sites 2 and 17 to assess potential ecological mitigation at these sites.

4.1.2 Leachate Samples

Leachate samples will be collected from the vadose zone beneath the landfill by lysimeters to assess potential leakage from the landfill (Table 4-2). Analyte concentrations in the leachate samples will be compared to analytical results from background lysimeter.

Table 4-1
Chemicals of Potential Concern for the MCAS El Toro Phase II Remedial Investigation/Feasibility Study

Chemicals of Potential Concern	IR PROGRAM SITES																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	24	25
Total Petroleum Hydrocarbons	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Total Recoverable Petroleum Hydrocarbons	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
BTEX																							
Benzene		X		X	X		X						X		X	X						X	
Toluene	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Ethylbenzene		X						X					X			X		X				X	
Xylene(s)		X	X	X		X	X	X		X		X	X		X	X		X	X			X	
HALOGENATED VOLATILE ORGANIC COMPOUNDS																							
Bromodichloromethane																	X						
Carbon tetrachloride		X				X	X		X	X		X	X	X		X			X		X	X	X
Chloroform		X	X				X		X	X		X		X		X	X			X	X	X	
Chloromethane	X		X		X	X	X		X	X			X		X				X	X		X	X
Dibromochloromethane			X														X						
1,1-Dichloroethane									X													X	
1,2-Dichloroethane									X													X	
1,1-Dichloroethene							X		X	X												X	
1,2-Dichloroethene (total)		X								X												X	
Methylene Chloride		X	X	X		X	X	X		X		X			X	X	X	X	X	X	X	X	X
Tetrachloroethene		X			X		X	X	X	X		X						X		X	X	X	
1,1,1-Trichloroethane						X	X		X				X									X	

(table continues)

Table 4-1 (continued)

Chemicals of Potential Concern	IR PROGRAM SITES																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	24	25
HALOGENATED VOLATILE ORGANIC COMPOUNDS (continued)																							
1,1,2-Trichloroethane		X																				X	
Trichloroethylene		X			X		X		X	X		X		X		X		X	X	X	X	X	
VOLATILE ORGANIC COMPOUNDS																							
Acetone		X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		
2-Butanone (Methyl ethyl ketone)	X	X	X				X	X	X			X	X		X	X	X	X	X		X	X	X
Carbon disulfide								X							X				X				
2-Hexanone		X	X	X		X		X								X			X		X	X	
4-Methyl-2-pentanone		X																X					
Vinyl Chloride																						X	
POLYNUCLEAR AROMATIC HYDROCARBONS																							
Acenaphthene																		X		X			
Acenaphthylene																		X		X			
Anthracene														X				X		X			
Benzo(a)anthracene							X			X		X		X			X	X		X	X		
Benzo(a)pyrene				X			X	X		X		X	X	X			X	X	X	X	X		
Benzo(b)fluoranthene				X			X			X		X	X	X				X		X	X		
Benzo(g,h,i)perylene							X	X		X		X	X	X			X	X	X	X	X		
Benzo(k)fluoranthene				X			X			X		X	X	X				X		X			
Chrysene				X			X	X		X		X	X	X	X		X	X		X	X		
Dibenzo(a,h)anthracene							X					X		X				X		X			

(table continues)

Table 4-1 (continued)

Chemicals of Potential Concern	IR PROGRAM SITES																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	24	25
POLYNUCLEAR AROMATIC HYDROCARBONS (continued)																							
Fluoranthene				X		X	X	X		X		X	X	X		X	X	X		X	X		
Fluorene																X		X		X			
Indeno(1,2,3-cd)pyrene							X	X		X		X	X	X			X	X		X	X		
Naphthalene				X												X		X			X		X
Phenanthrene							X			X		X	X	X	X	X		X		X	X		X
Pyrene				X		X	X	X		X		X	X	X		X	X	X	X	X	X		
SEMIVOLATILE ORGANIC COMPOUNDS																							
Benzyl butyl phthalate		X		X		X		X	X	X		X	X	X	X					X			X
Bis(2-ethylhexyl) phthalate	X	X	X	X	X			X	X	X			X	X	X	X		X	X	X			X
Carbazole							X							X				X		X			
2-Chlorophenol																		X					
4-Chloro-3-methylphenol																		X					
Dibenzofuran	X															X		X		X			X
1,4-Dichlorobenzene																		X					
Diethyl phthalate							X			X								X					
Dimethyl phthalate								X	X														
2,4-Dimethylphenol																	X						
Di-*n*-butyl phthalate								X															
Di-*n*-octyl phthalate																		X					
Hexachloroethane								X															

(table continues)

Table 4-1 (continued)

Chemicals of Potential Concern	IR PROGRAM SITES																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	24	25
SEMIVOLATILE ORGANIC COMPOUNDS (continued)																							
Isophorone																					X		
2-Methyl naphthalene				X												X		X	X	X	X		X
4-Methyl phenol																	X						
4-Nitrophenol																		X					
n-Nitrosodipropylamine																		X					
Pentachlorophenol																		X					
Phenol				X		X									X			X					
1,2,4-Trichlorobenzene																		X					
PESTICIDES/POLYCHLORINATED BIPHENYLS																							
Alpha chlordane		X		X				X				X					X			X			X
Alpha BHC																			X				
4,4'-DDD		X	X	X			X					X	X				X		X	X	X		X
4,4'-DDE		X	X	X			X	X				X					X		X	X	X		X
4,4'-DDT		X	X	X	X		X					X	X				X		X	X	X		X
Delta BHC				X				X					X				X		X				X
Dieldrin			X	X			X	X				X					X		X	X			
Endosulfan I				X															X				
Endosulfan II				X							X									X			
Endosulfan sulfate				X			X	X				X	X				X		X	X			X
Endrin				X			X				X								X	X			X

(table continues)

Table 4-1 (continued)

Chemicals of Potential Concern	IR PROGRAM SITES																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	24	25
PESTICIDES/POLYCHLORINATED BIPHENYLS (continued)																							
Endrin aldehyde				X							X	X											
Endrin ketone				X			X					X	X				X		X	X			X
Gamma chlordane		X	X	X								X					X		X				X
Heptachlor			X																				
Heptachlor epoxide																	X						
Lindane (gamma BHC)			X	X																X			
Methoxychlor						X						X					X			X			
PCB 1248								X			X												
PCB 1254								X			X	X											
PCB 1260								X			X	X											X
HERBICIDES																							
2,4-D												X											
2,4-DB		X										X					X			X			X
Dalapon		X	X									X					X						X
Dichloroprop		X										X					X						X
Dinoseb																	X						
MCPA		X															X						
MCPP		X	X		X							X					X						
2,4,5-trichlorophenoxy acetic acid			X	X																X			
2,4,5-trichlorophenoxy propionic acid (Silvex)			X		X							X											X

(table continues)

Table 4-1 (continued)

Chemicals of Potential Concern	IR PROGRAM SITES																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	24	25
DIOXIN/DIBENZOFURANS																							
Octachlorodibenzo-p-dioxins	X																						
RADIONUCLIDES																							
Gross alpha	X	X	X		X			X															
Gross beta	X	X	X		X			X															
EXPLOSIVES																							
HMX	X																						
RDX	X																						
2,4,6-Trinitrotoluene	X																						
INORGANICS																							
Total Cyanide/metallo			X																				
Nitrate-Nitrite	X		X	X																			
Phosphorus	X																						
TARGET ANALYTE LIST METALS																							
Aluminum	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Antimony		X		X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Arsenic	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Barium	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Beryllium		X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Cadmium	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Calcium		X			X																		
Chromium, hexavalent																							

(table continues)

Table 4-1 (continued)

Chemicals of Potential Concern	IR PROGRAM SITES																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	24	25
TARGET ANALYTE LIST METALS (continued)																							
Chromium		X	X	X	X			X				X	X	X	X		X		X	X			X
Cobalt	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Copper	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Lead	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Manganese	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Mercury	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		
Nickel	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Selenium	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Silver	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Sulfate	X	X	X														X						X
Thallium		X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Vanadium	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X
Zinc	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X

Table 4-2
Types of Sampling Media for the MCAS El Toro Phase II Remedial Investigation/Feasibility Study

	IR PROGRAM SITE																						
Type of Sampling Media	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**24**	**25**
Plant and animal samples	X	X	X		X												X							
Leachate samples		X	X		X												X							
Surface soil samples	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Subsurface soil samples	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Soil gas samples		X	X		X												X						X	
Sediment samples		X	X														X							X
Surface water samples		X	X																					X
Groundwater samples	X	X	X		X												X						X	
Wastewater samples	X	X	X		X												X						X	
Air samples		X	X		X												X							
Wipe samples											X													

4.1.3 Surface Soil Samples

Surface soil samples (0 to 1 feet bgs) will be collected to support the baseline risk assessment for human health and the environment, and to characterize the nature and extent of surface soil contamination, if necessary (Table 4-2). Surface soil sampling may be conducted using a tiered approach. The initial screening process uses less expensive sampling methods and utilizes field screening analyses to assess surface conditions. If initial sampling identifies site subareas containing concentrations of COPCs that exceed acceptable risk criteria, additional sampling may be conducted. The objective of additional sampling is to define the nature and extent of COPCs that exceed risk criteria, provided additional sampling costs are not more than a potential response action. Surface soil samples will be submitted for fixed-base laboratory analyses to verify field screening results.

4.1.4 Subsurface Soil Samples

Subsurface samples have been subdivided into two categories for purposes of the Phase II RI/FS. Shallow subsurface soils represent those present between ground surface and a depth of 10 feet bgs. Samples taken to 10 feet bgs may be used to support the baseline risk assessment for human health and the environment. Deeper subsurface soils are those present between 10 feet bgs and the water table. Subsurface soil sampling will also be conducted using the tiered approach. Subsurface soil samples will be collected during the additional effort to define the vertical and lateral extent of COPCs identified during initial sampling.

4.1.5 Soil Gas Samples

Soil gas samples will be collected from landfill sites (Sites 2, 3, 4, and 17) and the VOC Source Area (Site 24) to delineate extent of volatile organic vapors in the subsurface. Two primary sampling devices will be used: a soil gas probe driven to 15 feet bgs and a push-in soil gas sampler from drilling conducted with a hollow-stem auger drill rig. These samples will be analyzed for volatile organic vapor in an analytical laboratory and for landfill gases at the landfills.

4.1.6 Sediment Samples

Sediment soil samples will be collected from points of deposition within the water course (Table 4-2). Sediment samples will be collected and analyzed for geotechnical parameters and chemical analyses to aid in remedial alternative selection.

4.1.7 Surface Water Samples

Surface water samples will be collected at designated points in certain sites (e.g., upgradient and downgradient of the site) (Table 4-2). These samples will be collected and analyzed for geotechnical parameters and chemical analyses to aid in remedial alternative selection.

4.1.8 Groundwater Samples

Groundwater samples will be collected from new monitoring wells and air sparging wells installed during the field activities for Phase II RI (Table 4-2). In addition, selected existing wells that define upgradient and downgradient groundwater quality conditions will be sampled. Abandoned water supply wells will be sampled if they can be located and the casings are open. The data acquired will be used to determine whether differences in groundwater quality can be identified across a site. These samples would be collected following development of any new wells and would represent a one-time sampling event. It is assumed that subsequent sample collection activities would be conducted under a separate groundwater monitoring CTO to implement the groundwater monitoring plan at MCAS El Toro.

4.1.9 Wastewater Samples

Wastewater generated during aquifer testing and development of newly constructed monitoring wells and wastewater generated during purging of wells prior to sampling will be transported to the waste staging area. The wastewater will be treated using the on-site treatment system installed during the Phase I RI/FS at Site 13. Wastewater samples will be collected from the influent and effluent ends of the existing water treatment system. The treated water will ultimately be used for irrigation of the golf course.

4.1.10 Air Samples

Air samples will be collected from each of the landfill sites to measure ambient air quality upgradient and downgradient of the landfill. At a minimum, the ambient monitoring will include the 10 compounds outlined in the SCAQMD Rule 1150.2 (SCAQMD 1989). Additional compounds to be monitored may be selected based on the results of the soil and soil gas investigations. Also, the depth of the contamination and the volatility of the substances (or their potential to become airborne) will be considered. Meteorological data will also be collected during the monitoring program for each of the landfill sites. It is assumed that the samples will be collected for three 24-hour periods at each of the monitoring stations.

4.1.11 Wipe Samples

A wipe sample will be collected from an underground storage tank (UST) which will be analyzed for PCBs at Site 11. The wipe sample will be taken from the inside surface and will be used to evaluate disposition of the UST.

4.2 RATIONALE FOR FIXED-BASE LABORATORY ANALYSES

Various fixed-base laboratory analyses chosen are based on the COPCs, types of affected media, and objectives of the Phase II RI/FS (Tables 4-1 and 4-2). During the Phase II RI/FS, the Naval Facilities Engineering Service Center (NFESC, formerly known as Naval Energy and Environmental Support Activity [NEESA]) Level D guidelines for fixed-base laboratories must be followed. The analyses will be performed by a state- and NFESC-certified laboratory for CLEAN II. Data validation will be done following NFESC Level D guidelines on both U.S. EPA Contract Laboratory Program (CLP) and non-CLP methods. The specific analytical methods have been determined based on regulatory limits, health/risk calculation needs and U.S. EPA CLP analytical method limitations. Geotechnical analysis will be conducted using standard methods such as those stipulated by the American Society for Testing and Materials (ASTM).

4.3 RATIONALE FOR FIELD SCREENING

Field-screening methods are cost-effective, rapid procedures used to provide useful information during field investigations and remediation planning at contaminated sites. The data collected from the field-screening methods can minimize the number of nondetect samples submitted to a fixed-base laboratory and can also effectively assess the nature and extent of contamination, especially when confirmed by more defensible analytical methods. Site-specific field-screening analyses are based on COPCs, types of media, and objectives of the Phase II RI/FS.

SECTION 5

REQUEST FOR ANALYSES

Section 5
REQUEST FOR ANALYSES

The request for analyses is dependent upon the waste history of each site, the detection limits required, and the COPCs. Tables 5-1 and 5-2 summarize, respectively, the types of fixed-base laboratory and field-screening methods to be used at each site. Tables 5-3 through 5-8 summarize the number of samples to be collected from each site on a media-specific basis and list of analyses for those samples. Tables 5-9 and 5-10 summarize CLP methodology and field screening program. The primary objective when requesting an analytical method is to assure the analytical data are precise, accurate, representative, complete, and comparable. The analytical data must meet the DQOs discussed in detail in the QAPP and must follow all the guidelines established by the NFESC.

5.1 CONTRACT LABORATORY/NFESC PROCEDURES AND ANALYSES

The purpose of the NFESC requirements for field investigations and analyses of samples is to control activities performed in the field and laboratories. Each laboratory performing analyses must be approved and must comply with U.S. EPA CLP QC requirements. NFESC has adopted three of the five analytical levels identified in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as quality control (QC) requirements. They are Levels C, D, and E, which correlate with Levels 3, 4, and 5 described in the *Data Quality Objectives for Remedial and Response Activities Development Process* (U.S. EPA 1987). Work at MCAS El Toro requires Level D because the area is listed on the NPL and is located in a primarily residential area. Level D QC requires review and approval of the laboratory quality assurance (QA) plan, the site work plan and the field work plan. As a Level D site, U.S. EPA CLP methods must be followed and must generate CLP deliverables whenever possible, in addition to Level D data validation for both CLP and non-CLP methods. QA/QC requirements for field sampling and analytical methods are outlined in the NFESC requirements (NEESA 1988). Where U.S. EPA methods are not available for biota, methods from other agencies and published methods that have undergone method validation by the laboratory requesting approval must be used. Tables 5-1 and 5-3 through 5-8 summarize the number and types of CLP analyses. Table 5-9 summarizes the detection limits by U.S. EPA Method for COPCs and their respective PRGs.

5.2 FIELD SCREENING

Several field-screening devices, qualitative and quantitative, will be used during the geological and hydrogeological investigations and may include a handheld photoionization detector (PID) and/or flame ionization detector (FID), portable gas chromatography (GC) using the headspace method (U.S. EPA Method 3810), ion-selective electrodes, and portable scintillation counter for qualitative field screening. Group- and/or compound-specific immunoassay test kits and mobile laboratories will be used for quantitative field-screening purposes. A detailed discussion of these

Table 5-1
Contract Laboratory Program Analytical Methods for the MCAS El Toro Phase II Remedial Investigation/Feasibility Study

Analytical Methods	INSTALLATION RESTORATION PROGRAM SITE																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	23	24	25
U.S. EPA[a] 8020	X	X	X		X								X			X	X						X	X
U.S. EPA 8010		X	X		X	X	X	X	X							X	X		X	X			X	X
U.S. EPA 8015M (av. gas/JPS)	X			X		X	X	X	X	X		X	X	X	X	X		X	X	X	X			
LUFT[b] TPH[c]	X	X	X	X	X			X	X	X		X	X	X	X	X	X		X	X				X
LUFT TRPH[d]										X														
U.S. EPA 8080/PCBs[e]		X	X	X	X		X	X			X	X	X		X		X		X	X				X
U.S. EPA 8150		X	X		X							X					X			X				X
U.S. EPA 8240		X	X														X						X	X
U.S. EPA 8270	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X
U.S. EPA 8280	X								X							X								X
U.S. EPA 8310	X			X		X	X	X	X	X		X	X	X	X	X		X	X	X	X			
U.S. EPA 8330	X																							
U.S. EPA 200 Series	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X				X	X
U.S. EPA 703	X	X	X		X																			
U.S. EPA 365.1	X								X							X								
U.S. EPA 353.2	X				X												X							X
U.S. EPA 375.4		X	X		X									X			X							X
U.S. EPA 335.2		X	X									X					X							X
U.S. EPA 160.1	X													X										X

Notes:
- [a] U.S. EPA – United States Environmental Protection Agency
- [b] LUFT – California Leaking Underground Fuel Tank Field Manual
- [c] TPH – total petroleum hydrocarbons
- [d] TRPH – total recoverable petroleum hydrocarbons
- [e] PCB – polychlorinated biphenyl

Table 5-2
Field Screening Analytical Methods for the MCAS El Toro Phase II Remedial Investigation/Feasibility Study

Field Screening Methods	INSTALLATION RESTORATION PROGRAM SITE																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	23	24	25
Immunoassay - PAHs[a] (U.S. EPA[b] Method 4035)	X			X		X	X	X	X	X		X	X	X	X	X		X	X	X	X			
Ion-Selective Electrodes	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X				X	X
PID[d]/FID[e]/Portable GC[f]	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X
Scintillometer	X	X	X		X			X																
pH meter	X													X										
Mobile Labs:																								
U.S. EPA 8015M	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X			
U.S. EPA 8010		X	X		X	X	X	X	X							X	X		X	X			X	X
U.S. EPA 8020	X	X	X		X								X			X	X						X	X
U.S. EPA 8240		X	X														X						X	X
U.S. EPA 8270	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X
U.S. EPA 200 Series	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X				X	X

Notes:
- [a] PAH – polynuclear aromatic hydrocarbons
- [b] U.S. EPA – United States Environmental Protection Agency
- [c] PCB – polychlorinated biphenyl
- [d] PID – photoionization detector
- [e] FID – flame ionization detector
- [f] GC – gas chromatograph

Table 5-3
Summary for Phase II Remedial Investigation/Feasibility Study Samples

	GROUNDWATER SAMPLES			SHALLOW SOIL SAMPLES		SUBSURFACE SOIL SAMPLES		SEDIMENT AND SURFACE WATER SAMPLES		
Site No.	Proposed Monitoring Wells[a]	Existing Groundwater Wells[b]	Total	Soil Field Screening	Laboratory Analysis	Soil Field Screening[a]	Laboratory Analysis	Number of Sediment Samples	Number of Surface Water Samples	Air/Soil Gas Samples[a]
1	3	2	5	72	72	18	18	—	—	—
2	9	4	13	27	3	18	2	—	4	208
3	0	4	4	15	2	2	1	3	3	81
5	1	4	5	3	1	4	1	—	—	38
6	0	0[c]	0	24	24[d]	0	0	—	—	—
7	0	0[c]	0	15	9	0	0	—	—	—
8	0	0[c]	0	54	16	0	0	—	—	—
9	0	0[c]	0	33	12	0	0	—	—	—
10	0	0[c]	0	96	21[d]	0	0	—	—	—
11	0	0	0	24	24	0	0	—	—	—
12	0	0[c]	0	56	9	0	0	—	—	—
15	0	0[c]	0	18	4[d]	0	0	—	—	—
16	0	0[c]	0	34	12[d]	15	9	—	—	—
17	2	1	3	0	0	165	33	—	—	31
19	0	0[c]	0	21	8[d]	0	0	—	—	—
20	0	0	0	14	0[d]	0	0	—	—	—

(table continues)

Table 5-3 (continued)

Site No.	GROUNDWATER SAMPLES: Proposed Monitoring Wells[a]	Existing Groundwater Wells[b]	Total	SHALLOW SOIL SAMPLES: Soil Field Screening	Laboratory Analysis	SUBSURFACE SOIL SAMPLES: Soil Field Screening[a]	Laboratory Analysis	SEDIMENT AND SURFACE WATER SAMPLES: Number of Sediment Samples	Number of Surface Water Samples	Air/Soil Gas Samples[a]
21	0	0	0	6	3	0	0	—	—	—
22	0	0[c]	0	9	6	0	0	—	—	—
24	24[e]	6	30	16	3	182	17	0	0	200
25	0	0	0	6	2	22	4	2	12	—

Notes:
[a] Number may change depending on the results of initial Phase II RI/FS sampling.
[b] Groundwater monitoring wells were installed at most of the sites during the Phase I RI; however, most of these wells are only scheduled to be sampled as part of the basewide groundwater monitoring program.
[c] Not scheduled for sampling unless impacted media has potential to impact groundwater as indicated by Phase II RI/FS sampling or modeling.
[d] In addition to this number, for QA/QC support and verification, a minimum of 1 percent of the total number of positive, and a minimum of 5 percent of the total number of negative, field screening results will be analyzed by a fixed-base laboratory.
[e] Includes two air sparging wells.

Table 5-4
Summary for Phase II Remedial Investigation – Shallow Soil Samples and Analysis

Site Number	Unit	NUMBER OF SAMPLES: Field Screening	NUMBER OF SAMPLES: Laboratory CLP[a]	ANALYSES: VOC[b]	SVOC[c]	Pesticides/ PCBs[d]	Herbicides	TPH[e]-Gasoline	TPH-Diesel	Metals	Treatability Parameters	Other
1	1	36	36		X			X	X	X	X	X
	2	36	36		X			X	X	X	X	X
2	1					X						
	2											
	3	27[f]	3[g]	X	X	X	X	X	X	X		
3	1	63	13[g]									
	2											
	3	6	3	X	X	X	X	X	X	X		
	4	9	3	X	X	X	X	X	X	X		
5	1	12	3	X	X	X	X	X	X	X		
	2											
6	1	6	6	X	X			X	X	X		
	2	9	6	X	X			X	X	X		
	3	9	3	X	X			X	X	X	X	
7	2	NFI[h]										
	4	9	6	X	X			X	X	X		
	5	6	3	X	X	X		X	X	X	X	
8	2	20	6	X	X	X	X	X	X	X	X	X
	3	16	4		X	X		X	X	X		
8	5	18	6	X	X	X		X	X	X		
9	1	15	3	X	X			X	X	X		X
	2	18	9	X	X			X	X	X		X
10	1	24	5		X			X	X		X	
	2	30	6		X			X	X			
	3	36	9		X			X	X		X	
	4	6	6		X					X		
11	3	24	24			X						

(table continues)

Table 5-4 (continued)

		NUMBER OF SAMPLES		ANALYSES								
Site Number	Unit	Field Screening	Laboratory CLP[a]	VOC[b]	SVOC[c]	Pesticides/ PCBs[d]	Herbicides	TPH[e]-Gasoline	TPH-Diesel	Metals	Treatability Parameters	Other
12	1	8	3		X	X	X			X	X	X
	2	16	3		X	X	X			X	X	X
	4	32	3		X	X				X	X	X
15	2	18	4		X	X		X	X	X		
16	1	9	3	X	X			X	X	X		X
	2	16	3	X	X			X	X	X	X	X
	3	9	6		X			X	X	X		
17	1	6[e]	3	X	X	X	X	X	X	X		
19	3	18	5		X			X	X			
	4	3	3		X			X	X			
20	1	2	2		X				X	X		
	4	12	3	X	X			X	X	X		
21	1	6	3	X	X			X	X			
22	1	6	3		X			X	X		X	
	2	3	3		X			X	X		X	
24	NA[i]	16	3	X				X				
25	Agua Chinon	3	1		X			X	X			X
	Bee Canyon	3	1		X			X	X			X
	San Diego Creek	0	0									

Notes:

[a] CLP – U.S. EPA Contract Laboratory Program
[b] VOC – volatile organic compound
[c] SVOC – semivolatile organic compound
[d] PCB – polychlorinated biphenyl
[e] TPH – total petroleum hydrocarbons
[f] shallow soil samples will be collected in the groundwater monitoring well locations drilled off-site
[g] In addition to this number, for QA/QC support and verification, a minimum of 20 percent of the total number of field screened samples (2/3 are positive and 1/3 are nondetect).
[h] NFI – No Further Investigation
[i] NA – not applicable

Table 5-5
Summary for Phase II Remedial Investigation – Subsurface Soil Samples and Analysis

Site Number	Location	NUMBER OF SAMPLES[a] Field Screening	Laboratory CLP[b]	ANALYSES VOCs[c]	SVOCs[d]	Pesticides/ PCBs[e]	Herbicides	TPH[f]- Gasoline	TPH- Diesel	Metals	General Chemistry	Other
1	1	TBD[g]	TBD	X	X			X	X	X		X
	2	TBD	TBD	X	X			X	X	X		X
2	3	18	2	X	X	X	X	X	X	X		X
3	1	2	1	X	X	X	X	X	X	X		X
5	1	4	1	X	X	X	X	X	X	X		
16	2	15	9	X	X			X	X	X		X
17	1	6	1	X	X	X	X	X	X	X		X
19	2	10	6		X			X	X			
22	1	TBD	TBD		X			X	X			
24		182	27	X								
25	Agua Chinon	TBD	2		X			X	X			
25	Bee Canyon	TBD	1		X			X	X			

Notes:
- [a] number may change depending on the results of initial Phase II RI/FS sampling
- [b] CLP – U.S. EPA Contract Laboratory Program
- [c] VOC – volatile organic compound
- [d] SVOC – semivolatile organic compound
- [e] PCB – polychlorinated biphenyl
- [f] TPH – total petroleum hydrocarbons
- [g] TBD – to be determined

Table 5-6
Summary for Phase II Remedial Investigation-Groundwater Samples and Analysis

		WELL STATUS			ANALYSES									
Site Number	Number of Wells	Existing	Proposed	Number of Samples	VOCs[a]	SVOCs[b]	Pesticides/ PCBs[c]	Herbicides	TPH[d]- Gasoline	TPH- Diesel	Metals	General Chemistry	Treatability Parameters	Other
1	5	2	3	5	X	X			X	X	X	X		X
2	13	4	9	19[e]	X	X	X	X	X	X	X	X		X
3	4	4	TBD[f]	4	X	X	X	X	X	X	X	X		X
5	5	4	1	1	X	X	X	X	X	X	X	X		X
17	3	1	2	2	X	X	X	X	X	X	X	X		X
24	12	1	11	16	X	X	X				X	X		
25	NA[g]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
- [a] VOC – volatile organic compound
- [b] SVOC – semivolatile organic compound
- [c] PCB – polychlorinated biphenyl
- [d] TPH – total petroleum hydrocarbons
- [e] includes CPT groundwater samples
- [f] TBD – to be determined
- [g] NA – not applicable

Table 5-7
Summary for Phase II Remedial Investigation – Soil Gas Samples and Analyses

Site Number	Unit	NUMBER OF SAMPLES Laboratory	Field Screening	ANALYSES VOCs[a]	TPH[b]-Gasoline	Other
2	1	21	208			X[c]
3	1	4	41			X[c]
	2	1	4			X[c]
	3	3	30			X[c]
	4	1	6			X[c]
5	1	5	38			—
17	1	4	31			X[c]
24	1	200	NA[d]	X	X	X[c]

Notes:
[a] VOC – volatile organic compound
[b] TPH – total petroleum hydrocarbons
[c] Method TO-14 (modified to include methane)
[d] NA – not applicable

Table 5-8
Proposed Analyses for Phase II Remedial Investigation – Sediment and Surface Water Runoff Samples

Site Number	No. of Locations	No. of Samples	ANALYSES VOCs[a]	SVOCs[b]	Pesticides/ PCBs[c]	Herbicides	TPH[d]- Gasoline	TPH- Diesel	Metals	General Chemistry
2 (Surface Water)	4	4	X	X	X	X	X	X	X	X
3 (Surface Water)	3	3	X	X	X	X	X	X	X	X
3 (Sediment)	3	3	X	X	X	X	X	X	X	
25 (Sediment)	2	2			X				X	
25 (Surface Water)	12	12	X	X	X	X	X	X	X	X

Notes:
[a] VOC – volatile organic compound
[b] SVOC – semivolatile organic compound
[c] PCB – polychlorinated biphenyl
[d] TPH – total petroleum hydrocarbons

Table 5-9
Chemicals of Potential Concern, Method Detection Limits, and Preliminary Remediation Goals[a]

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS: Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m3[e])	Tap Water (µg/L)
TPH[f]	**DHS[g]-TPH (CA LUFT[h])**	**8015M-A**	10,000	500				
Methane	**TPH**	**8015**	NL[i]	NL	NL	NL	NL	NL
TRPH[j]	**IR[k]**	**418.1**	10,000	500				
BTEX[l]	**GC[m]**	**8020A**	**MDLs[n]**					
Benzene			50	0.5	1.4	3.2	0.23	0.39
Toluene			50	0.5	1,900	2,700	400	720
Ethylbenzene			50	0.5	2,900	3,100	1,100	1,300
Xylene			50	0.5	980	980	730	1,400
HVOCs[o]	**GC**	**8010B**	**CLP[p] EQLs[q]**					
Benzyl chloride			0.1	0.1	1.4	3.9	0.04	0.066
Bromodichloromethane			0.2	0.2	1.4	3.4	0.11	0.18
Bromoform			2.0	2.0	56	240	1.7	8.5
Bromomethane			3.0	3.0	15	57	52	87
Carbon tetrachloride			0.1	0.1	0.47	1.1	0.13	0.17
Chlorobenzene			0.1	0.1	160	570	21	39
Chloroethane			1.0	1.0	1,100	220	10,000	710
2-Chloroethyl vinyl ether			1.3	1.3	NL	NL	NL	NL

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m[3e])	Tap Water (µg/L)
HVOCs[o] (continued)	**GC**	**8010B**	**CLP[p] EQLs[q]**					
Chloroform			0.2	0.2	0.53	1.1	0.084	0.16
Chloromethane			0.3	0.3	2.0	4.3	1.1	1.5
Dibromochloromethane			0.3	0.3	5.3	23	0.08	1.0
Dibromomethane			22	22	650	6,800	37	370
Dichlorodifluoromethane (Freon 12)			0.5	0.5	110	350	210	390
1,1-Dichloroethane			0.7	0.7	840	3,900	520	810
1,2-Dichloroethane			0.3	0.3	0.44	0.98	0.074	0.12
1,1-Dichloroethene			0.7	0.7	.038	0.082	0.038	0.046
cis-1,2-Dichloroethene			0.1	0.1	59	200	37	61
trans-1,2-Dichloroethene			1.0	1.0	170	600	730	120
1,2-Dichloropropane			0.4	0.4	0.68	1.5	0.099	0.16
trans-1,3-Dichloropropene			3.4	3.4	0.51	1.2	0.052	0.081
Methylene chloride			0.2	0.2	11	25	4.1	4.3
1,1,1,2-Tetrachloroethane			0.05	0.05	4.8	12	0.26	0.43
1,1,2,2-Tetrachloroethane			0.1	0.1	0.90	2.4	0.033	0.055
Tetrachloroethene			0.3	0.3	7.0	25	3.3	1.1
1,1,1-Trichloroethane			0.3	0.3	3,200	3,000	1,000	1,300
1,1,2-Trichloroethane			0.2	0.2	1.4	3.3	0.12	0.20

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	Proposed Detection Limit water (µg/L[c])	PRELIMINARY REMEDIATION GOALS: Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m[3e])	Tap Water (µg/L)
HVOCs[o] (continued)	**GC**	**8010B**	**CLP[o] EQLs[p]**					
Trichloroethene			0.2	0.2	7.1	17	1.1	1.6
Trichlorofluoromethane (Freon 11)			0.3	0.3	710	2,400	730	1,300
Trichlorotrifluoromethane (Freon 113)			50[r]	0.5[r]	3,600	3,600	31,000	59,000
Vinyl chloride			0.2	0.2	0.0052	0.011	0.022	0.02
VOCs[s]	**GC/MS[t]**	**8240B**	**CLP EQLs**					
Acetone			100	100	2,000	8,400	370	610
Acetonitrile			100	100	390	4,100	52	220
Acrolein (Propanol)			NL	NL	1,300	12,000	0.021	730
Acrylonitrile			NL	NL	0.13	0.30	0.028	3.7
Allyl alcohol			NL	NL	330	3,400	18	180
Allyl chloride			5	5	3,300	34,000	1.0	1,800
Benzyl chloride			100	100	1.45	3.9	0.04	0.066
Bromoacetone			NL	NL	NL	NL	NL	NL
Bromoform			5	5	56	240	1.7	8.5
Bromomethane			10	10	15	57	52	87
2-Butanone (Methyl ethyl ketone)			100	100	8,700	34,000	1,000	1,900
Carbon disulfide			100	100	16	52	10	21
Chlorobenzene			5	5	160	570	21	39

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
VOCs[s] (continued)	**GC/MS[t]**	**8240B**	**CLP EQLs**					
Chloroethane			10	10	1,100	2,200	10,000	710
2-Chloroethyl vinyl ether			10	10	NL	NL	NL	NL
Chloromethane			10	10	2.0	4.3	1.1	1.5
Chloroprene			5	5	6.3	21	7.3	14
1,2-Dibromo-3-chloropropane			100	100	0.06[u]	1.4	0.00096[u]	0.0048[u]
Dibromomethane			5	5	650	6,800	37	370
1,2-Dibromoethane			5	5	0.0051	0.021	0.0087	0.00076
1,4-Dichloro-2-butene			5	5	0.0076	0.018	0.00072	0.0012
Dichlorodifluoromethane			5	5	110	350	210	390
1,1-Dichloroethane			5	5	840	3,900	520	810
cis-1,2-Dichloroethene			5	5	59	200	37	61
trans-1,2-Dichloroethene			5	5	170	600	73	120
1,3-Dichloropropene			5	5	0.51	1.2	.052	0.081
1,4-Dioxane			NL	NL	14	37	0.61	1.0
Epichlorohydrin			NL	NL	8.6	30	1.0	2.0
Ethylbenzene			5	5	2,900	3,100	1,100	1,300
Ethylene oxide			NL	NL	0.12	0.30	0.19	0.024
Ethyl methacrylate			5	5	340	340	330	550

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
VOCs[s]	**GC/MS[t]**	**8240B**	**CLP EQLs**					
2-Hexanone			50	50	5,200	55,000	83	2,900
2-Hydroxypropionitrile			NL	NL	20,000	100,000	1,100	11,000
Malononitrile			NL	NL	1.3	14	0.073	0.73
Methacrylonitrile			100	100	1.3	5.1	0.73	1.0
Methylene chloride			5	5	11	25	4.1	43
Methyl methacrylate			5	50	520	55,000	290	2,900
4-Methyl-2-pentanone			50	50	5,200	55,000	8.3	2,900
Propargyl alcohol			NL	NL	130	1,400	7.3	73
Propionitrile			100	100	NL	NL	NL	NL
Pyridine			NL	NL	65	680	3.7	37
Styrene			5	5	2,200	2,200	1,100	1,600
Toluene			5	5	1,900	2,700	400	720
1,1,1-Trichloroethane			5	5	3,200	3,000	1,000	1,300
Trichlorofluoromethane (Freon 11)			10[r]	10[r]	710	2,400	730	1,300
Trichlorotrifluoromethane (Freon 113)			10[r]	10[r]	3,600	3,600	31,000	59,000
1,2,3-Trichloropropane			5	5	0.0066	0.015	0.00096	31
Vinyl chloride			50	50	0.0052	0.011	0.022	0.02
Xylene(s)			5	5	980	980	730	1,400

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m[3e])	Tap Water (µg/L)
Pesticides/PCBs[v,w]	**GC**	**8080A**	**PQLs[x]**					
Aldrin			2.68	0.04	0.026	0.11	0.00039	0.0040
Alpha BHC			2.01	0.03	NL	NL	NL	NL
Chlordane			40[r]	1[r]	0.34	1.5	0.0052	0.052
4',4'-DDD			7.37	0.11	1.9	7.9	0.028	0.28
4',4'-DDE			2.68	0.04	1.3	5.6	0.020	0.20
4',4'-DDT			8.04	0.12	1.3	5.6	0.020	0.20
Delta BHC			6.03	0.09	NL	NL	NL	NL
Dieldrin			1.34	0.02	0.028	0.12	0.00042	0.042
Endosulfan			9.38	0.14	3.3	34	0.18	1.8
Endosulfan sulfate			44.2	0.66	NL	NL	NL	NL
Endrin			4.02	0.06	20	200	1.1	11
Endrin aldehyde			15.4	0.23	NL	NL	NL	NL
Endrin ketone			3.3[r]	0.1[r]	NL	NL	NL	NL
Heptachlor			2.01	0.03	0.099	0.42	0.0015	0.015
Heptachlor epoxide			55.6	0.83	0.049	0.21	0.00074	0.0074
Lindane (gamma BHC)			2.68	0.04	NL	NL	NL	NL
Methoxychlor			117.9	1.76	330	3400	18	180
PCB 1016			13[r]	1[r]	4.9	65	0.26	2.6

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m[3e])	Tap Water (µg/L)
Pesticides/PCBs[v,w] (continued)	**GC**	**8080A**	**PQLs[x]**					
PCB 1221			13[r]	2[r]	0.066	0.34	0.00087	0.0087
PCB 1232			13[r]	1[r]	0.066	0.34	0.00087	0.0087
PCB 1242			43.6	0.65	0.066	0.34	0.00087	0.0087
PCB 1248			13[r]	1[r]	0.066	0.34	0.00087	0.0087
PCB 1254			13[r]	1[r]	1.4	19	0.073	0.73
PCB 1260			13[r]	1[r]	0.066	0.34	0.00087	0.0087
Polyaromatic Hydrocarbons	**HPLC[y]**	**8310**	**PQLs**					
Acenaphthene			1,206	18	360	360	220	370
Acenaphthylene			1,540	23	NL	NL	NL	NL
Anthracene			140	2.1	19	19	1,100	1,800
Benzo(a)anthracene			10	0.15	0.61	2.6	0.0092	0.092
Benzo(a)pyrene			15	0.23	0.061	0.26	0.00092	0.0015[u]
Benzo(b)fluoranthene			12	0.18	0.61	2.6	0.0092	0.092
Benzo(g,h,i)perylene			50	0.76	NL	NL	NL	NL
Benzo(k)fluoranthene			11	0.17	0.61[u]	26	0.092	0.92
Chrysene			100	1.5	6.1[u]	24	0.92	9.2
Dibenzo(a,h)anthracene			20	0.30	0.061	0.26	0.00092	0.0092
Fluoranthene			140	2.1	2,600	27,000	150	1,500

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m3[e])	Tap Water (µg/L)
Polyaromatic Hydrocarbons (continued)	**HPLC**	**8310**	**PQLs**					
Fluorene			140	2.1	30	300	150	240
Indeno(1,2,3-cd)pyrene			29	0.43	0.61	2.6	0.0092	0.092
Naphthalene			1,206	18	800	800	150	240
Phenanthrene			429	6.4	NL	NL	NL	NL
Pyrene			180	2.7	2,000	20,000	110	1,100
SVOCs[z]	**GC/MS**	**8270B**	**CLP EQLs**					
Benzyl butyl phthalate			660	10	13,000	100,000	730	7,300
Bis(2-ethylhexyl) phthalate			660	10	32	140	0.48	4.8
Carbazole			NL	NL	22	95	0.34	3.4
2-Chlorophenol			660	10	330	3,400	18	180
4-Chloro-3-methyl phenol			1,300	20	NL	NL	NL	NL
Dibenzofuran			660	10	260	2,700	15	150
Diethyl phthalate			660	10	52,000	100,000	2,900	29,000
Dimethyl phthalate			660	10	100,000	100,000	37,000	370,000
Di-*n*-butyl phthalate			NL	10	6,500	68,000	370	3,700
Di-*n*-octyl phthalate			660	10	1,300	14,000	73	730
Hexachloroethane			660	10	32	140	0.48	4.8

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (µg/m^3[e])	Tap Water (µg/L)
SVOCs[z] (continued)	**GC/MS**	**8270B**	**CLP EQLs**					
Isophorone			660	10	470	2,000	7.1	71
2-Methyl naphthalene			660	10	NL	NL	NL	NL
4-Methyl phenol			660	10	330	3,400	18	180
2-nitrophenol			660	10	NL	NL	NL	NL
4-nitrophenol			3,300	50	NL	NL	NL	NL
n-Nitrosodipropylamine			660	10	630	0.27	0.00096	0.0096
Pentachlorophenol			3,300	50	2.5	7.9	0.056	0.56
Phenol			660	10	39,000	100,000	2,200	22,000
Herbicides[w]	**GC**	**8150B**	**CLP EQLs**					
2,4-D			240	12	650	6,800	37	370
2,4-DB			182	9.1	520	5,500	29	2,990
Dalapon			1,160	58	2,000	20,000	110	1,100
Dicamba			54	2.7	2,000	20,000	110	1,100
Dichloroprop			130	6.5	NL	NL	NL	NL
Dinoseb			14	0.7	65	680	3.7	37
MCPA			49,800	200[f]	33	340	1.8	18
MCPP			38,400	200[f]	65	680	3.7	37

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air ($\mu g/m^3$[e])	Tap Water (µg/L)
Herbicides[w] (continued)	**GC**	**8150B**	**CLP EQLs**					
2,4,5-trichlorophenoxy acetic acid			40	2.0	650	6,800	37	370
2,4,5-trichlorophenoxy propionic acid (Silvex)			34	1.7	520	5,500	29	290
Dioxin	**GC/MS**	**8280**	**CLP EQLs (soil)**					
Octochlorodibenzo-p-dioxins			0.002[r]		0.00072	0.00031	0.0000015	0.000011
Radionuclides	**Scintillation counter**	**703**						
Gross alpha			NL		NL	NL	NL	NL
Gross beta			NL		NL	NL	NL	NL
Explosives	**HPLC (GC/MS)**	**8330A**	**CLP EQLs (soil)**					
HMX			2,200		3,300	34,000	180	1,800
RDX			1,000		4.0	17	0.061	0.61
1,3,5-TNB			250		3.3	34	0.18	1.8
1,3-DNB			250		6.5	68	0.37	3.7
Tertyl			650		650	6,800	37	370
Nitrobenzene			260		33	340	2.1	18
2,4,6-Trinitrotoluene			250		48	64	0.22	2.2
4-Amino-4,6-dinitrotoluene			NL		NL	NL	NL	NL
2-Amino-4,6-dinitrotoluene			NL		NL	NL	NL	NL

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (μg/kg[b])	water (μg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air (μg/m[3e])	Tap Water (μg/L)
Explosives (continued)	**HPLC (GC/MS)**	**8330A**	**CLP EQLs (soil)**					
2,4-Dinitrotoluene			260		130	1,400	7.3	73
2,6-Dinitrotoluene			250		65	680	3.7	37
2-Nitrotoluene			250		NL	NL	NL	NL
3-Nitrotoluene			250		650	6,800	37	370
4-Nitrotoluene			250		650	6,800	37	370
INORGANICS			**CLP CRDLs[aa]/EDLs[bb]**					
Total Cyanide/metallo	Colorimetric	9010/335	NL	10	1,300	14,000	NL	730
Nitrate-Nitrite	Colorimetric	353.2	NL	10	100,000/6,500	100,000	NL	58,000/3,700
Phosphorus	Colorimetric	365.2	51	10	NL	NL	0.073	NL
Sulfate	Colorimetric	375.4	5	5	NL	NL	NL	NL
General Chemistry								
TKN	Segmented flow analyzer	351.2	NL	10.0[r]				
TDS	Balance	160.1	NL	5,000[r]				
TOC	—	415.1	0.5%[r]	500[r]				
BOD	—	405.1	NL	4,000[r]				
COD	Filtration	410.4	NL	5,000[r]				
Total phenolics	Segmented flow analyzer	420.1	500[r]	10[r]				

(table continues)

Table 5-9 (continued)

Chemicals of Potential Concern	Method	Method Number	Proposed Detection Limit soil (µg/kg[b])	water (µg/L[c])	PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d])	Industrial Soil (mg/kg)	Ambient Air ($\mu g/m^3$[e])	Tap Water (µg/L)
TAL[cc] Metals[w]								
Aluminum	ICP[dd]	200.7	45	45	77,000	100,000	NL	37,000
Antimony	ICP-MS[ee]	200.8	32	0.02[r]	31	680	NL	15
Arsenic	ICP-MS	200.8	53	0.1[r]	0.32	2.0	0.00045	0.038
Barium	ICP	200.7	2	2	5,300	100,000	0.52	2,600
Beryllium	ICP-MS	200.8	0.3	0.02[r]	0.14	1.1	0.00080	0.016
Cadmium	ICP	200.7	4	4	9.0[u]	850	0.0011	18
Chromium, Hexavalent	GFAA[ff]	7196	200	20	0.20[u]	230	0.000023	0.16[u]
Chromium	ICP	200.7	7	7	210	1,600	0.00016	NL
Cobalt	ICP	200.7	7	7	NL	NL	1.0	NL
Copper	ICP	200.7	6	6	2,800	63,000	NL	1,400
Organic lead	GFAA	DHS method	50	50	NL	NL	NL	NL
Lead	GFAA	200.9	42	3	130[u]	1,000	NL	4.0
Manganese	ICP	200.7	2	2	380	8,300	0.051	180
Mercury	CVAA[gg]	200 Series	0.2	0.2	23	510	0.31	11
Nickel	ICP	200.7	15	40	150[u]	34,000	NL	730
Selenium	HAA[hh]	6010/200 Series	75	5	380	8,500	NL	180
Silver	ICP	200.7	7	7	380	8,500	NL	180
Thallium	ICP-MS	200.8	40	0.03[r]	6.1	140	NL	2.9
Vanadium	ICP	200.7	8	8	540	12,000	NL	260
Zinc	ICP	200.7	2	2	23,000	100,000	NL	11,000

(table continues)

Table 5-9 (continued)

Notes:

[a] the compound list provided under each method does not reflect the complete method compound list, only the compounds of potential concern at MCAS El Toro
[b] µg/kg – micrograms per kilogram
[c] µg/L – micrograms per liter
[d] mg/kg – milligrams per kilogram
[e] µg/m^3 – micrograms per cubic meter
[f] TPH – total petroleum hydrocarbons
[g] DHS – Department of Health Services - U.S. Environmental Protection Agency (U.S. EPA) SW-846 Test Methods for Evaluating Solid Waste
[h] LUFT – California Leaking Underground Fuel Tank Field Manual, November 1989
[i] NL – not listed
[j] TRPH – total recoverable petroleum hydrocarbons
[k] IR – infrared spectroscopy
[l] BTEX – benzene, toluene, ethylbenzene, and xylenes
[m] GC – gas chromatography
[n] MDLs – method detection limits using purge and trap method (U.S. EPA Method 5030)
[o] HVOCs – halogenated volatile organic compounds
[p] CLP – U.S. EPA Contract Laboratory Procedure
[q] EQLs – estimated quantitation limits
[r] CLEAN II contract laboratory QA Manual method reporting limits
[s] VOCs – volatile organic compounds
[t] GC/MS – gas chromatography/mass spectroscopy
[u] California-modified Preliminary Remediation Goal (PEA 1994)
[v] PCBs – polychorinated biphenyls
[w] Background detection limits proposed are based on risk-based concentrations and background concentration
[x] PQLs – practical quantitation limits
[y] HPLC – high-performance liquid chromatography
[z] SVOCs – semivolatile organic compounds
[aa] CRDLs – contract-required detection limits
[bb] EDLs – estimated detection limits
[cc] TAL – target analyte list
[dd] ICP – inductively coupled plasma spectroscopy
[ee] ICP-MS – inductively coupled plasma spectroscopy-mass spectrometry
[ff] GFAA – graphite furnace atomic absorption
[gg] CVAA – cold vapor atomic absorption spectroscopy
[hh] HAA – hydride atomic absorption spectroscopy

Table 5-10
Field Screening Instruments and Sensitivity Levels

Instrument	Parameters	Applicable U.S. EPA[a] Method	Sensitivity Levels
	Qualitative Field Screening		
Handheld PID[b]	VOCs[c]	NA[d]	0.1 - 2,000 mg/kg[e] vapor
FID[f]	VOCs, TPH[g] (including methane)	NA	0 - 10,000 mg/kg vapor
Portable GC[h]			
PID	VOCs	U.S. EPA 3810	< 1.0 - 100 μg/L[i] vapor
ECD[j]	Chlorinated VOCs	NA	
FID	VOCs, TPH	NA	
Portable Scintillation Counter	Gross alpha/beta	NA	
	Quantitative Field Screening		
Immunoassay Kits	PAHs[k] - soil		10 - 500 μg/kg[l]
Mobile Laboratory			
GC-PID	aromatic VOCs	U.S. EPA 8020	0.5 - 50 μg/kg
GC-FID	TPH, VOCs	U.S. EPA 8015	10 mg/kg - 10,000 mg/kg
GC-ELCD[m]	chlorinated VOCs	U.S. EPA 8010	0.1 - 50 μg/kg
GC/MS[n]	VOCs	U.S. EPA 8240	5 - 100 μg/kg
	SVOCs	U.S. EPA 8270	5 - 1,000 μg/kg
ICP[o]	metals	U.S. EPA 200 series	0.02 - 100 μg/kg
IR[p]	TRPH[q]	U.S. EPA 418.1	10 - 10,000 mg/kg

Notes:
[a] U.S. EPA – United States Environmental Protection Agency
[b] PID – photoionization detector
[c] VOCs – volatile organic compounds
[d] NA – not applicable
[e] mg/kg – milligrams per kilogram
[f] FID – flame ionization detector
[g] TPH – total petroleum hydrocarbons
[h] GC – gas chromatograph
[i] μg/L – micrograms per liter
[j] ECD – electron capture detector
[k] PAHs – polynuclear aromatic hydrocarbons
[l] μg/kg – micrograms per kilogram
[m] ELCD – electrolytic conductivity detector
[n] MS – mass spectrometer
[o] ICP – inductively coupled argon plasma
[p] IR – infrared
[q] TRPH – total recoverable petroleum hydrocarbons

field-screening methods can be found in Section 3 of the QAPP (BNI 1995a). Tables 5-2 and 5-3 present a summary of field-screening analyses. Table 5-10 describes the various types of field screening instruments, their applications, and their sensitivity levels. The field screening and fixed-base laboratory scheme to be performed during the Phase II RI/FS is detailed in the QAPP (BNI 1995a).

5.3 QUALITY CONTROL

The field and laboratory quality control procedures will be implemented to evaluate the performance of the field and analytical procedures. Field QA/QC audits will monitor sample handling, packaging and transport of samples to the approved laboratory in the form of trip blanks, rinseate blanks, field blanks, source water blanks, probe blanks, and duplicate samples. Mobile and fixed-base laboratory QA/QC audits will be performed to assure the analytical procedures are accurate and precise. The audits will evaluate method blanks, surrogate/matrix spikes (MS), and matrix spike duplicates (MSD). A further discussion of QA/QC procedures can be found in the QAPP (BNI 1995a).

QC samples are used to:

- assess data quality in terms of precision and accuracy; and
- verify that sampling procedures (e.g., chain-of-custody, decontamination, packaging, and shipping) are not introducing variables into the sampling chain that could render the validity of samples questionable.

Such QC samples are regularly prepared in the field and laboratory so that all phases of the sampling process are monitored. The types of QC samples to be collected during the Phase II RI/FS are discussed below.

5.3.1 Field Duplicate Samples

Duplicate samples will be collected by the sampling team and will be used to determine the representativeness of the sample and measure the precision of the sample collection process. Duplicates will be prepared following standard sampling and preparation techniques. These samples are matrix-specific. Duplicate aqueous samples will be collected in a frequency of one per ten samples collected. For soils, one duplicate will be collected per site. Duplicate samples will be analyzed by the same analysis as the samples.

Duplicates will be submitted to the laboratory "blind" (with no indication of the contents or associate sample) to independently assess the precision of the laboratory. The procedure for assessing precision is to calculate the relative percent difference (RPD), and the standard deviation. The RPDs are then plotted on QC charts.

5.3.2 Rinseates and Equipment Blanks

Blanks will be used to assess whether contaminants are being introduced into the sample at any given point. Equipment rinseate blanks are prepared by collecting samples of rinseate to evaluate decontamination procedures. All preservatives used in the field will be included in the equipment rinseate blanks. Equipment rinseate blanks will be prepared by the sample team by collecting samples of decontaminated sampling equipment and apparatus to evaluate equipment decontamination. These blanks will be collected by passing organic-free water through or over decontaminated sampling equipment and filling the rinseate sample bottles. One set of equipment rinseate blanks will be prepared per day from one piece of decontaminated equipment per site, per sample matrix. Initially, equipment rinseate blank sets from every other day should be analyzed. If analytes pertinent to the project are found in the rinseate, the remaining samples will be analyzed.

Source water blanks will consist of the collection of the source water used for the final rinse in the decontamination process. Soil gas blanks will consist of probe/equipment blanks taken prior to soil gas sampling to assure that equipment is free of contamination. Additional blanks will be analyzed, when necessary, to assure that cross-contamination does not occur from previously "hot" samples. The sampling procedure for soil gas equipment blanks will follow the guidelines set up by California RWQCB protocol for soil gas investigation (Appendix C in the QAPP [BNI 1995a]).

5.3.3 Trip Blanks

The purpose of trip blanks is to detect sample corruption caused by sample handling and/or shipment. Trip blanks are prepared by the laboratory for VOC sampling using laboratory-grade organic-free deionized water. The trip blanks are included in the sample supply shipment from the laboratory to the sampling team. Trip blanks are not opened in the field, but are kept each sample cooler and shipped back to the laboratory with the collected samples.

5.3.4 Laboratory Quality Control Checks

Laboratory method blanks and calibration standards will be used by the mobile and fixed-base laboratories during analyses as required by the CLP Statement of Work (U.S. EPA 1991a,b) and the methods being conducted. Laboratory checks will include the following procedures.

- Instruments will be calibrated according to the manufacturer's instructions and as required by the U.S. EPA CLP analytical method used. Where there are no specifications for each parameter, a three-point calibration curve will be implemented.
- Continuing calibration standards will be analyzed for each analytical method performed at the beginning and end of each laboratory shift and will be recorded and maintained daily in a logbook.
- Calibration and working standards should be traceable to a certified reference standard (e.g., National Bureau of Standards, National Institute of Standards and Technology, U.S. EPA). Alternatively, the highest-quality standard available

should be used. Calibration and working standards should be recorded in a logbook to document their traceability.

- An analysis of laboratory method blanks by each analytical method will be made as necessary for the laboratory internal CLP or NFESC QA compliance program.
- An analysis of one matrix spike sample will be made for every 20 samples and will be fortified with representative compounds for each analytical method performed.
- An analysis of one matrix duplicate sample will be made for every 20 samples analyzed, or one per batch, whichever is greater.

The term "matrix" refers to the use of the actual media collected in the field. Laboratory QC samples are an aliquot (subset) of the field samples. A routinely collected soil sample contains sufficient volume for routine sample analysis and additional laboratory QC analysis, including MS and MSD analysis. However, for water samples, triple volumes of samples are supplied to the laboratory for their use. The laboratory is alerted to the presence of this triple volume for MS and MSD analysis by its notation on the corresponding chain-of-custody document.

SECTION 6

FIELD METHODS AND PROCEDURES

Section 6
FIELD METHODS AND PROCEDURES

This section describes field methods to be followed during the Phase II RI/FS field investigation at MCAS El Toro. These methods are based on project team experience, comments from regulatory agencies, available technologies, and CLEAN II Program Standard Operating Procedures (SOPs). During procurement, mobilization, or implementation, these field methods may change to incorporate revisions, innovative technologies, or other supplemental information. Therefore, the most current version of the plan should always be consulted.

The most recent versions of the CLEAN II Program SOPs will be maintained on-site for reference. Additional information on verification and validation of these methods is in the Phase II RI/FS QAPP (BNI 1995a). Field activities will be conducted under the supervision of a Registered Geologist, Professional Engineer, or appropriate certified or registered professional, as needed.

6.1 SITE PROTOCOL AND GENERAL RECORD KEEPING

Site protocol and general record-keeping procedures include requirements for field office administration, field logbooks, photographs, access to sensitive military areas, and radio protocol. These protocols and procedures are necessary for clean and consistent documents for field activities.

6.1.1 Field Office Administration Records

Forms and field logs for specific procedures on the MCAS El Toro Phase II RI/FS are discussed below. Forms and records relating to health and safety are in the Site-Specific Health and Safety Plan (BNI 1995f); these records will be maintained on-site by the site health and safety manager. All forms and field logs will provide input to the Bechtel Environmental Integrated Data Management System (BEIDMS) database for effective and rapid recovery during analysis.

Forms and field logs will be completed in indelible ink, assembled into bound notebooks, and stored in locked file cabinets on-site. Completed records will be copied at least once a week and the duplicates stored off the Station at the CLEAN II Program San Diego office. The Environmental Site Manager will be responsible for maintaining and controlling forms and logs, except as noted below.

6.1.1.1 FORMS AND RECORDS

Staff sign-in forms will be initialed in the field administration office every working day. Visitor sign-in logs will be available in the field administration office. Visitors, including company and project staff not included on the staff sign-in forms, will be asked to sign these sheets. Visitors at specific field sites will be noted by the field team leader in the appropriate field logs.

Equipment rental and provided services records, including receipts for materials, will be the responsibility of the Equipment Manager. Equipment sign-out and return sheets will also be the responsibility of the Equipment Manager.

Other forms and records will be retained in the field administration trailer, and will be the responsibility of the Field Manager. These forms include the daily staff sign-in form, visitor sign-in form, field logbooks, three-ring binders containing drilling, development, or pilot testing information, and miscellaneous records of progress. Records will be copied weekly and backup copies will be moved to the CLEAN II Program San Diego office for safe-keeping. Records pertaining to sample custody, sample shipping, and receipt at the laboratory will be retained by the Sample Manager.

6.1.2 Field Logbooks

Pertinent work and sampling information will be recorded in a logbook during each day of the field effort and will follow the guidelines described in CLEAN II SOP 17, Logbook Protocol. The Field Team Leader on a task is responsible for completing the log book and assuring its custody when the logbook is outside the field administration office.

Health and safety information, including measurement of parameters made strictly for personnel protection, personnel decontamination, and notes on potential health or safety problems, will be recorded in a separate health and safety logbook.

Logbooks will be used by the Field Team Leaders to document types of sampling and work. The logbooks record all field methods used at a given site, including shallow soil sampling, drilling and sampling, well construction, well development, aquifer testing, soil vapor extraction (SVE) and air-sparging pilot testing, initial groundwater sampling, waste handling, and decontamination of equipment.

Strict custody procedures will be maintained with the field logbooks. While being used in the field, the logbook will remain with the assigned Field Team Leader.

Each logbook will contain sufficient information for the field activity to be reconstructed without relying on the memory of the field crew. Information consists both of typical information and any additional information necessary for reconstructing the field record.

Two types of logbooks will be used: site-specific sampling logbooks and health and safety logbooks. Site-specific sampling logbooks will be used for activities such as drilling and sampling and will be maintained through well completion to the first round of groundwater sampling. A surveyor's logbook will be prepared by a California-certified land surveyor.

When a new logbook is opened, it will be assigned a unique document control number, which will be written on the inside cover and on the top of page 1. Each page in the book will be prenumbered sequentially.

The record for the day will be kept sequentially, beginning below the information on the stamped portion of the page. Entries will be made in indelible ink. The entries for each page will be initialed and dated at the bottom of the page. At the end of the day, a line will be drawn through any blank space on the page, and the author will sign and date the bottom of the final page. All corrections will consist of lined-out deletions that are initialed.

At the end of the day, the entries for that day will be copied and placed in the field files in the field administration office. The logbook will be checked-in and locked in a filing cabinet until needed for the next field day.

6.1.3 Standard Logs

Standard logs will be used by field staff and also in RI/FS reports. Examples of these standard logs are found in Section 7 and include:

- Chain-of-Custody Record,
- Custody Seal,
- Borehole Log,
- Soil Sampling Records,
- Borehole Abandonment,
- Well Construction Details,
- Well Development Logs,
- Water-Level Measurement,
- Well Sampling Record,
- Trench Logs,
- Field Change Notice,
- Daily Field Reports, and
- Photograph Logs.

6.1.4 Field Photographs

Photographs have proven to be the most accurate documentation of field observations. They should be taken with a camera-lens system having a perspective similar to that afforded by the human eye and should include two or more reference points to allow relocation of the sample point at a later date. Telephoto or wide-angle lenses should not be used. A photograph must be properly documented to provide a valid representation.

Project cameras that print a date stamp on the print or slide will be used for all project photographs. Personal cameras cannot be used on-Station. A camera pass may be required for photography, depending on the location at MCAS El Toro. When photographing in sensitive areas, an individual may be asked to be accompanied by a MCAS El Toro representative. The following five-step procedure will be used for photographic documentation:

1. Sign out a project camera from the Equipment Manager.
2. Make a copy of the project (generic) photograph authorization form that is on the field administration office bulletin board. Carry the form at all times when in possession of a camera on the Station.

3. Take the photographs. Record the required information in the field logbook.
4. Return the camera to the Equipment Manager at the end of each day.
5. When a roll of film is finished, give the film to the Equipment Manager for development, along with the field logbook.

The following information related to the photography will be recorded in the field logbook:

- name of photographer,
- date and time,
- sequential number of the photograph,
- site identification and field task,
- compass direction faced, and
- description of the subject, including names of identifiable individuals in the photo.

At the end of each day, using the information in the logbook, the Photograph Log form will be completed for the film used. The Equipment Manager will have the film developed and will place the slides or prints in the task files in the field administration office along with the completed Record of Photographs forms.

6.1.5 Access to Sensitive Military Areas

Access to certain areas of the Station is restricted. These areas are primarily along and on the flight line. Certain remote areas, such as those at Sites 1 and 16, or areas of sensitive habitats, such as Sites 2 and 16, are also restricted. The Field Manager, working through the Station Environmental Coordinator and/or Construction Engineer, will be responsible for obtaining access to these areas. The procedures for obtaining access to restricted areas vary, depending on the area and the persons involved, and must be coordinated well in advance. Only project vehicles are allowed in certain areas of the Station; private vehicles must remain outside restricted areas.

Radios are the only special equipment that may be needed. Two types of radios are available. A military-frequency radio to be used at Site 1, the Explosive Ordnance Disposal (EOD) Range, may be obtained at the EOD Management Building. The larger-sized radios have a second channel used to contact the tower prior to crossing an active runway.

As soon as it is known that access to a restricted area will be required, the Site Manager must be notified and provided with the following information: the time and duration access will be needed, what equipment will be used, and how many people will be involved.

The Environmental Site Manager will make the initial contacts for access and will provide the function team leader with the information and protocol for access. This team manager will follow through with the steps needed to obtain and retain access during the work at the restricted site.

Information concerning access to and operations in restricted areas will be documented in the site field logbook. Names and telephone numbers of contacts, times, and discussions with contact persons should be recorded.

6.1.6 Radio Protocol

Each field team will have an outside communication device. Though several portable telephones may be available, two-way radio will be the primary method of communicating between the field administration office and the field sites. Radios used by MCAS El Toro RI field teams will have either one or two channels. Channel 1 will be used for communications between the field administration office and a field team. Radios that are equipped with the second frequency (used to contact the MCAS El Toro tower) cannot be taken off the Station. The smaller, single-channel radios will be used for work off the Station work.

The radios are for professional use. Conversations should be kept at a professional level and to a minimum. The radio frequency is public and, in theory, anyone can listen. Any highly sensitive material should be communicated to the field administration office from a telephone or in person.

Each field team will have a radio. Each day, one member of the team will sign out a radio. As soon as the team is at its first field location, the radio operator will check radio operation by calling the base. Calling involves first addressing the station called, then giving the assigned identification. When transmitting is finished, the term "over," or literally "over to you," is used.

At the end of the day, the radio is to be turned off, placed on the charger, and signed back into the custody of the Equipment Manager. The radio must be turned off when it is placed on the charger or it will not be fully charged in the morning.

If a radio is checked out from a military unit for use in an area with restricted access (such as Site 1, the EOD range), it must be treated carefully and returned as soon as practical after use.

The Sampling Team Leader will sign his or her name on the daily radio sign-out sheet (use Form 6.1b, customized for radios) in the morning when the radio is checked out. The same person will re-sign when the radio is returned at the end of the workday.

6.2 MOBILIZATION

Procedures that are performed during initial field activities are discussed in this section. Mobilization generally consists of field staking of sampling locations, marking utility clearances for sampling locations, calibrating field instruments, and acquiring permits.

6.2.1 Field Staking

"Staking" is the physical marking on the ground of each site where one or more samples will be collected. Each sample location will be staked in the field prior to moving equipment onto a site or prior to beginning any sampling. Where practical, staking will be done by driving rebar or a wood stake into the ground. Both types of stakes will be painted with a highly visible color. On concrete or in traffic areas, a sample location may be staked by spray painting the surface.

Permission to enter is needed for access to restricted areas. In nonrestricted areas, the tenant command will be contacted and notified of the reason for the staking and asked that the stakes be protected.

Preliminary staking may be completed prior to utility clearances. Utility clearances must be conducted at all sampling locations that use powered equipment to reach the sample depth.

A map-and-scale survey will be used to locate the sampling point from key landmarks such as building corners or fences. A tape measure will be used to scale the distance on the ground. If practical, it will be scaled from at least two directions to locate the point on the ground as closely as possible to the map location. If the site has not been surveyed prior to sample collection, the location marker must be retained or replaced until the survey is complete.

If stakes can be placed at the site, the stake will be driven into the ground. The stake should be driven so that it is at least 5 inches, but no more than 12 inches into the ground. It should then be spray painted a highly visible color. The sampling location identification will be marked on the stake. If a stake cannot be placed at the site, a small circle will be spray painted on the ground and crossed with an "X." The location identification will also be painted on the ground.

If drilling will be completed at a location after the utility clearance has been performed, the Resident Officer in Charge of Construction (ROICC) will be notified and given a copy of the geophysical results. Arrangements must be made for the ROICC to provide field clearance and approve the location.

Records of field staking will be made in the field logbook. An index at the front of the logbook will be included, listing locations sequentially for cross-referencing the sites with pages. A sketch of the location, showing pertinent cultural or natural features and the distances from them, should be made. The type of staking (rebar, wood, or paint) will be noted, and adequate information will be provided to allow the location to be restaked, if needed. Any photographs taken should be logged and filed as described in Section 6.1.4.

6.2.2 Utility Clearance

Utility clearances will be made prior to collecting any sample that uses power equipment to reach the sample depth. Utility clearances may also be made at locations where samples are being collected using a hand auger. The utility clearances will be completed by a subcontractor accompanied by CLEAN II Program site field personnel.

Once the stake or the paint mark is set, the Station utilities maps of the area will be rechecked for underground utilities. Geophysical methods (through a subcontractor) will be used to help identify locations of underground lines, tanks, or other belowground items that may cause a hazard during drilling.

Nearby utilities will be marked on the ground by spray painting along the centerline of the utility. The type of utility will be marked next to the line. Forms showing the results of the geophysical survey will be completed in the field.

A copy of the Station utility map of the area and the geophysical record will be provided to the ROICC, who will inspect the area with a representative of the Site Manager. A site that is to be drilled using a power auger or drilling rig will be explored by hand augering to a depth of 5 feet, except in areas with no known utilities. Variances to the hand augering requirement must be approved by the ROICC and the project Health and Safety Manager.

If a stake is moved for any reason and relocated 2 feet or more in any direction, or if the location has a large number of underground utilities, a replacement geophysical survey and ROICC clearance will be completed for the new location. Records will be kept for both locations, with the original and replacement locations clearly differentiated. Working copies of the geophysical sketch will be available in a three-ring binder for use in the field during drill-rig setup.

Field utility clearance will be documented in the field logbook. The site identification, personnel, type of equipment used, log of the borehole, and markings left at the site will be recorded. In addition, the original geophysical records will be filed sequentially by site in a permanent file in the field administration trailer, along with a sign-off sheet documenting that the ROICC cleared the site.

6.2.3 Field Instrument Calibration

Prior to field investigations, field instrumentation must be properly calibrated. A record of each calibration must be maintained in a field logbook. The most recent version of the CLEAN II Program SOP 6, Instrument Calibration and Use, discusses the general procedures to be employed for the calibration and use of equipment commonly used for field measurements and sample screening. This procedure is complete when supplemented with the manufacturer's calibration and maintenance instructions for the specific instrument.

Most field measurement instruments used will involve the following steps:

- remove the instrument from its container, assemble as necessary, and calibrate for field use according to manufacturer's instructions;
- clean and decontaminate the instrument prior to first field use;
- clean and decontaminate the instrument subsequent to each measurement;
- perform calibration checks that are made at specific time intervals daily or when there are changes in environmental conditions (as specified by the manufacturer);
- return the instrument to its storage location at the end of each day after cleaning and decontamination; and
- perform factory maintenance and necessary calibration, at the intervals specified by the manufacturer; repairs; trained individuals will perform maintenance and calibration according to the manufacturer's requirements.

Though each instrument manufacturer has instrument-specific calibration, the following sections offer general procedures that apply to most common field instruments.

6.2.3.1 FIELD WATER QUALITY PARAMETERS

CLEAN II Program SOP 6 describes calibration and operation procedures for instruments to be used for measuring the field water quality parameters pH, electrical conductivity (EC), temperature, oxidation-reduction potential, dissolved oxygen, and turbidity. Sample filtration is also addressed. Instrument manuals should be consulted to for proper calibration and operation of all field analytical instruments.

The pH measurements are generally expressed as pH units. Readings shall be recorded to the nearest 0.1 pH unit. For pH measurements used to test the stabilization of a sample, pH values shall differ by no more than 0.5 pH units.

Specific conductance (EC) results will be expressed in micromhos/centimeter (µmhos/cm) corrected to 25 degrees Centigrade (°C). Results shall be reported to the nearest 10 units for readings under 1,000 µmhos/cm and the nearest 100 units for readings over 1,000 µmhos/cm. Duplicate field analyses should agree within 10 percent.

Temperature measurements shall be expressed in either °C or °F, depending on need, to the nearest 0.5 degree. Duplicate field analyses should agree within 10 percent.

Dissolved oxygen results should be expressed in milligrams per liter (mg/L) and should be reported to the nearest 0.1 mg/L.

Turbidity results should be reported in nephelometric turbidity units (NTUs).

6.2.3.2 FIELD SCREENING INSTRUMENTS

A number of field instruments are available for sample screening purposes such as detecting and/or measuring organic vapors, or measuring oxygen levels in confined spaces. Each of these field instruments usually requires daily calibration. These individual instruments will be calibrated according to the manufacturer's procedures.

These include, but are not limited to, instruments equipped with FIDs or PIDs, oxygen meters, and lower explosive limit meters.

6.2.4 Permits

Few permits will be required for the fieldwork associated with the RI/FS. Two permits are needed from regulatory agencies: a monitoring well permit and an air emission permit. One general well permit application will be filed with the Orange County Health Agency for any new monitoring wells. Payment for well permit fees will not be required because MCAS El Toro is an NPL site. The well permit provided to the agency will include the number and location of the borings and groundwater monitoring wells to be installed. Also included will be information on well construction such as screening intervals and total depths. Information regarding boring backfill and monitoring well abandonment will also be provided. When the fieldwork is finished, a map illustrating all locations of borings and monitoring wells will be submitted.

The SCAQMD may require an air permit for the proposed SVE tests and air sparging tests. However, acquisition of a permit is not anticipated as subcontractors who hold SCAQMD multisite permits for test equipment will most likely be used.

6.2.5 Land Surveying

Each sampling point will be located by survey, using the California Plane Coordinate System, with northings and eastings determined to the nearest 0.1 foot. The surface elevation will be determined to the nearest 0.01 foot. The survey may be completed prior to or following sample collection, except for monitoring wells. For monitoring wells, the ground elevation and measuring point elevation of each well will be determined after installation of the surface completion, and after pump installation, if a dedicated pump is installed. The reference point on wells will be a notched point on the casing.

Surveying will be performed by a qualified surveyor, working under the supervision of a California-licensed land surveyor. Survey equipment will be used, operated, and calibrated in accordance with the manufacturer's recommended procedures.

Surveyors will be on-site only at selected times. Each point to be surveyed during the round will be marked on the ground and on field maps supplied to the survey crew prior to their arrival at MCAS El Toro. Each point will be identified by the Station identification on the map and on flagging attached to the rebar or wooden stake marking the sampling location. The Station identification for monitoring wells will be marked on the casing or on the surface completion.

Because surveyors will be working independent of other field crews, they will coordinate work with the site manager, who will inform them of sensitive military areas and obtain any special clearances needed while they are at MCAS El Toro.

Survey field notes will be kept in the land surveyors logbook. Copies of the logbook will be provided to the field administration office by the land surveyor. Calculations and other survey reduction data completed in the office will be placed in the office project files.

Surveying will be completed during more than one field session. The final survey data (sample location identification, northing, easting, ground elevation, and measuring point elevation, if applicable) will be placed in the BEIDMS database for MCAS El Toro (BNI 1995c). The survey data will also include the date that the datum was established. This data must be provided in an electronic format compatible with DOS AutoCAD or microstation.

6.3 SOIL SAMPLING AND DRILLING

The information in this section describes soil and sediment sampling procedures. The listed methods and procedures follow CLEAN II Program SOPs 3, 4, and 13. Any boring deeper than 2 feet that is not converted to a groundwater monitoring, piezometer, SVE, or air-sparging well will be abandoned and destroyed (backfilled) according to the method outlined in Section 6.3.3.4.

6.3.1 Soil Logging and Description

All soil samples will be classified according to the Unified Soils Classification System (USCS). Soil logging will be completed by a CLEAN II Program geologist. Soil descriptions will follow protocol documented in CLEAN II Program SOP 3.

Records of soil borings will be kept in the field logbook and on a boring log form. An example of the soil boring log is presented in Section 7.

6.3.2 Surface Samples

Surface soil sampling includes the collection of samples up to 1 foot bgs. Special care must be taken in areas where samples will be collected so that the staking and setup operations do not contribute contamination. Prior to use, the trowel, hand auger, and other sampling equipment must be decontaminated (Section 6.12). If sample equipment is transported, it must be wrapped in plastic while en route to the sampling locations.

Surface debris, grass, and vegetation will be cleared from the sampling location using a decontaminated shovel. Spray paint or any other marking materials will be removed prior to sampling.

Depending on the soil integrity, either a hand trowel or hand auger will be used to collect the sample. Part of the collected sample will be directly transferred to the appropriate sample container and placed into the sample cooler. The other part of the sample will be placed in a plastic bag for field determination of vapor in the headspace.

The surface indentation that is left from the sampling event will be filled in with surrounding material prior to leaving the site so that it is not a safety hazard. A marked stake will be left at the site for the surveyors (Section 6.2.1).

The sample label and chain-of-custody record will be completed (Section 6.14). In addition, information on the site and sample identification number, location and depth, soil classification under USCS, field organic vapor value (if measured), and any deviation from described sampling procedures will be noted on a soil sampling record.

6.3.3 Soil Borings

Several different methods are available to advance, sample, and complete soil borings (see CLEAN II Program SOP 2). Based on site conditions, the following soil boring technologies were selected: hand auger borings, hollow-stem auger borings, air-rotary, mud-rotary borings, and cone penetration testing (CPT).

All equipment will be steam-cleaned (Section 6.12.1) prior to moving to the drilling location. The location and orientation of the drilling rig and supporting equipment shall be determined jointly by the drilling subcontractor and the Health And Safety Coordinator. Plastic sheeting will be laid over the area of work in the exclusion zone. Unless otherwise indicated by the Site Manager, an initial hole will be augered by hand to a depth of 5 feet.

After reaching total depth and the final sample is collected, the boring will be backfilled (Section 6.3.3.4) or a monitoring well will be constructed (Section 6.4.1). After completion of the above operations, the drilling rig and ancillary equipment will be removed and decontaminated with steam following the procedures described in Section 6.12.1. Drilling waste will be disposed as described in Section 6.13.1.

6.3.3.1 HAND AUGER BORINGS

Hand augering will be advanced to the target sampling depth of approximately 10 feet bgs in soft sediments and soils. A handheld hammer sampler will be used to collect soil samples at selected sampling intervals down to a depth of 10 feet bgs. This may not be possible in gravelly soil or in tight clays.

Surface debris must be cleared from the location using a shovel or trowel that has been decontaminated using methods described in Section 6.12. Spray paint used for marking the location must also be removed. Plastic sheeting will be laid over the area of work in the exclusion zone.

A decontaminated auger must be used to begin the boring. If the auger has been decontaminated before going into the field, it must be wrapped in plastic for transportation. Upon reaching the desired sample depth, the hand auger must be removed from the boring and decontaminated, and a soil sample will then be taken using a handheld hammer equipped with an appropriate stainless steel tube sampler. The soil sample will be split into three portions with part of each sample going for USCS soil classification (Section 6.3.1), field screening (VOC headspace, immunoassay, etc.)

(Section 5.2), and laboratory analysis (Section 5.1). Soil cuttings not used for sampling will be placed in a 55-gallon drum for transport to the waste storage area. The boring will be backfilled with cement grout (Section 6.3.3.4) and marked for later survey (Section 6.2.5). The sample label and chain-of-custody record will be completed (Section 6.14). The soil boring log (Section 7) and field logbook will document activities associated with hand auger borings.

6.3.3.2 HOLLOW-STEM AUGER BORINGS

Continuous-flight hollow-stem augers will be used to drill boreholes in unconsolidated soil. On the Station, hollow-stem auger drilling has been used for borings to depths of 180 feet; however, these drill rigs have been some of the most powerful hollow-stem auger drill rigs available. Such rigs will be required to complete the Phase II RI.

Water may not be added to the borehole without approval of the Site Manager. If water is added, this addition will be documented in a field notebook and discussed in the final report. All water must be from a potable source, and a sample of the water must be analyzed for the same parameters as groundwater at the drilling site. The amount of water used and the depth at which the water was introduced will be noted and included in the field notebook and final report.

The hollow-stem auger consists of continuous-flight edges welded to hollow drill pipe with a cutter head at the bottom. As the cutter head rotates and advances the hole, cuttings are lifted to the surface along the flights. At the predetermined depths or intervals, augering will be stopped, and the sample will be collected. A modified California split-barrel sampler will be decontaminated (Section 6.9) and fitted with decontaminated stainless steel sleeves. Four to six individual sleeves will be used. The sampler will be lowered to the bottom of the hole, then driven into undisturbed soil with the hammer.

The number of blows required per 6-inch depth will be recorded for each soil sampling. Because the modified California sampler (and not the standard penetration sampler) will be used, blow counts will not represent standard penetration test results. The sampler will be retrieved and opened, and the sampling sleeves will be numbered from the top in a manner similar to that for sample recovery for hollow-stem auger borings (Section 6.3.3.2). If sloughed material is in the hole or if the sample does not appear to be representative of undisturbed samples, all sleeves of material will be discarded, and a second sampling assembly will be used to repeat the process.

The lower sleeve will be described using the USCS system as detailed in CLEAN II Program SOP 3 and Section 6.3.1. The sleeve will be emptied into a plastic bag, and the soil will be field-screened. The next lowest (second from the bottom) sleeve will be marked for laboratory analysis.

Soil samples that are taken for laboratory analysis will have Teflon™ sheeting placed over each end of the sleeve and a plastic cap placed over the Teflon™. Capped sleeves will be put in a sealable plastic bag and placed in the sample cooler.

The sample label and chain-of-custody record will be completed (Section 6.14). The boring log and field logbook will be used to record soil conditions and task activities.

6.3.3.3 AIR-ROTARY BORINGS

The air-rotary drilling method will be used to drill borings to depths not attainable by hollow-stem auger drilling or when a predetermined depth is specified that will require air-rotary drilling (approximately 200 feet bgs). Air-rotary borings will be completed as deep groundwater monitoring or air sparging wells.

One or both of the following air-rotary methods will be used to progress borings and take soil samples. The dual-tube percussion hammer method uses a flush-threaded dual-wall casing that is driven into the ground with a high-capacity percussion hammer. The force of the hammer is transmitted to the base of the dual-wall casing, thereby breaking the geologic formation into small pieces, which are lifted to the surface by air. Air circulation may be normal or reversed. Air used for lifting cuttings from the borehole will be filtered to prevent compressor oil from potentially introducing contamination.

The drill-through casing driver method is similar, except that conventional drill pipe is assembled together with an outer drive casing. Typically, the drill pipe is advanced by rotation while an air hammer advances the drive casing. Cuttings are lifted by air circulation. With all variations of the method, the center of the casing is open at all times, and a soil sample or a downhole hammer or bailer can be lowered to the bottom of the borehole at any time to recover soil or groundwater samples.

At the predetermined depths or intervals, borings will be stopped at the top of the depth at which the sample will be collected. A modified California sampler will be decontaminated (Section 6.12) and fitted with decontaminated stainless steel sleeves. Four to six individual sleeves will be used. The sampler will be lowered to the bottom of the hole, then driven into undisturbed soil with the hammer. Sample-retrieval procedures, soil classification, field-screening, sample preparation, and handling procedures will be performed as described in Section 6.3.3.2.

6.3.3.4 BACKFILLING OF BORINGS

A boring that is sampled but not completed as a monitoring piezometer well will be abandoned by backfilling in a manner that prevents vertical movement of fluids along the borehole. For this section, borings deeper than 2 feet include all holes advanced with drilling equipment and constructed for sampling. Borings, similar to wells, will be backfilled to meet pertinent requirements of the California Department of Water Resources, California Well Standards, Bulletins 74-81 and 74-90, Part II, Section 23 (DWR 1988).

Borings less than 5 feet deep will be filled with hydrated bentonite chips with a 1- to 2-foot surface seal of concrete rated at 3,000 pounds per square inch (psi) if pavements are present. Borings deeper than 5 feet will be filled with grout to 5 feet below the surface and filled with bentonite chips from 5 to 3 feet below the surface and a surface seal of 3,000 psi concrete to the surface.

Acceptable grout for backfilling borings is defined as follows: neat cement grout shall be composed of a ratio of one 94-pound sack of portland Type II cement to 4.5 to 6.5 gallons of potable water. Sand-cement grout shall be composed of not more than two parts (by weight) of sand and one part (94-pound sack) of portland Type II cement to 4.5 to 6.5 gallons of potable water. Up to 5 percent bentonite powder, by weight, may be added to these mixtures. No other additives will be used.

The amount of grout needed to fill the borehole will be calculated prior to mixing or ordering the grout from a supplier. If the boring is 30 feet deep or less and is completely above the water table, the grout may be allowed to free fall. If the boring is greater than 30 feet deep, grout will be emplaced using a tremie pipe or its equivalent, proceeding upward from the bottom of the boring in a single pour. The amount of grout used will be as much as is needed to fill the boring to a depth of approximately 2 feet below grade where a high-strength concrete surface seal will be placed.

Excess grout and potable water used for cleaning grouting equipment may be contained with the drill cuttings from the site or may be contained separately. Tremie pipe and other mixing or emplacement equipment may be steam-cleaned on the decontamination pad.

The Borehole Abandonment form will be used to record abandonment activities.

6.3.4 Cone Penetrometer Tests

The CPT unit will be used to gather soil and soil gas data. The CPT unit uses a metal probe to measure tip resistance (to penetration) and friction. From these values, lithologic data can be inferred. The technique is most reliable in clay and sand layers of clastic soils. Soil and soil gas samples can be taken using samplers pushed into the soil by the CPT rig.

The CPT rig will hydraulically push a stainless steel probe into the ground while tip resistance and friction are measured. The friction ratio and tip resistance values can be correlated to sand and clay profiles. Refusal of the CPT probe may indicate gravel or possible foreign objects. The probe should be withdrawn and decontaminated (Section 6.12), and the testing should be retried adjacent to the initial point.

Soil or soil gas samples can be taken by removing the stainless steel probe and inserting the appropriate sampler. Soil sampling and handling procedures are equivalent to those described in Section 6.3.3.2, except blow counts are not applicable, and the CPT sampler contains three 1.5-inch-diameter sleeves. Soil gas sampling procedures should be followed as described in Section 6.6.

The sample label and chain-of-custody record will be completed (Section 6.14). The field logbook will be used to document field observations.

6.3.5 Test Pits

Surface debris, grass, and vegetation will be cleared from the location using a decontaminated shovel, if needed. Spray paint or any other marking materials will be removed prior to sampling. Plastic sheeting will be laid adjacent to the work area to support stockpiling of excavated soil.

The backhoe bucket will be decontaminated as described in Section 6.12.1. Upon reaching the desired sample depth, a soil sample may be collected from the backhoe bucket. The soil sample will be split into three portions; one portion will be used for each of the following:

- USCS soil logging (Section 6.3.1),
- field-screening, and
- laboratory analysis (Section 5.1).

The test pit will be backfilled with excavated soil, and the surface indentation that is left from the sampling event will be leveled off with surrounding material prior to leaving the site (to eliminate a potential safety hazard). If excavated soil is not suitable backfill, then clean, imported fill will be used to backfill the pit. A marked stake will be left at the site for the surveyors (Section 6.12.1).

The sample label and chain-of-custody record will be completed (Section 6.14). The field logbook will be used to document field activities.

6.3.6 Sediment Sampling

Sediment sampling includes collecting samples to 1 foot bgs in stream courses. Special care must be taken in areas where samples will be collected so that the staking and setup operations do not contribute to contamination. Prior to use, sampling equipment must be decontaminated as described in Section 6.12. Sampling equipment must be wrapped in plastic if it is to be transported to the sampling location.

Surface debris, grass, and vegetation will be cleared from the location using a decontaminated shovel, if needed. Spray paint or any other marking materials will be removed prior to sampling.

Depending on soil integrity and sample depth, either a hand trowel or shovel will be used to collect the sample. Part of the collected sample will be directly transferred to the sample jar and placed into the sample cooler. The other part of the sample will be placed in an appropriate container for field-screening and soil classification according to the USCS.

The surface indentation that is left from the sampling event will be leveled off with surrounding material prior to leaving the site to eliminate a potential safety hazard. A marked stake will be left at the site for the surveyors (Section 6.2.1).

The sample label and chain-of-custody record will be completed (Section 6.14). Field activities will be documented in the field logbook and a sediment sampling record will be completed.

6.4 HYDROGEOLOGICAL INVESTIGATIONS

The information in this section describes groundwater investigation procedures. The listed methods and procedures follow CLEAN II Program SOPs 5 and 13.

6.4.1 Installation of Monitoring and Extraction Wells

Procedures for the installation of monitoring and extraction wells are covered in CLEAN II Program SOP 5. A monitoring or extraction well boring that is drilled using a hollow-stem auger or an air-rotary rig will be installed through the drill stem or temporary outer casing. The drill stem or casing will be raised as the materials used to fill the annulus are emplaced. A typical monitoring well is illustrated in Figure 6-1. Field construction details will be documented on the well construction record.

The screen slot size and the filter pack sand will be determined on location based on grain-size analysis results from a soil sample collected within the proposed screened intervals. Centralizers will be placed at approximate 20-foot intervals on the screened section and at 40-foot intervals thereafter. Typically, 4-inch-diameter polyvinyl chloride (PVC) piping will be used for the blank casing, and a blank section of casing will be installed below the screened interval as a sediment trap, and the bottom of the pipe will be capped.

No water will be used during emplacement of annulus fill materials, unless approved by the site manager. If water is used, the reason for its use, source, and amount must be recorded.

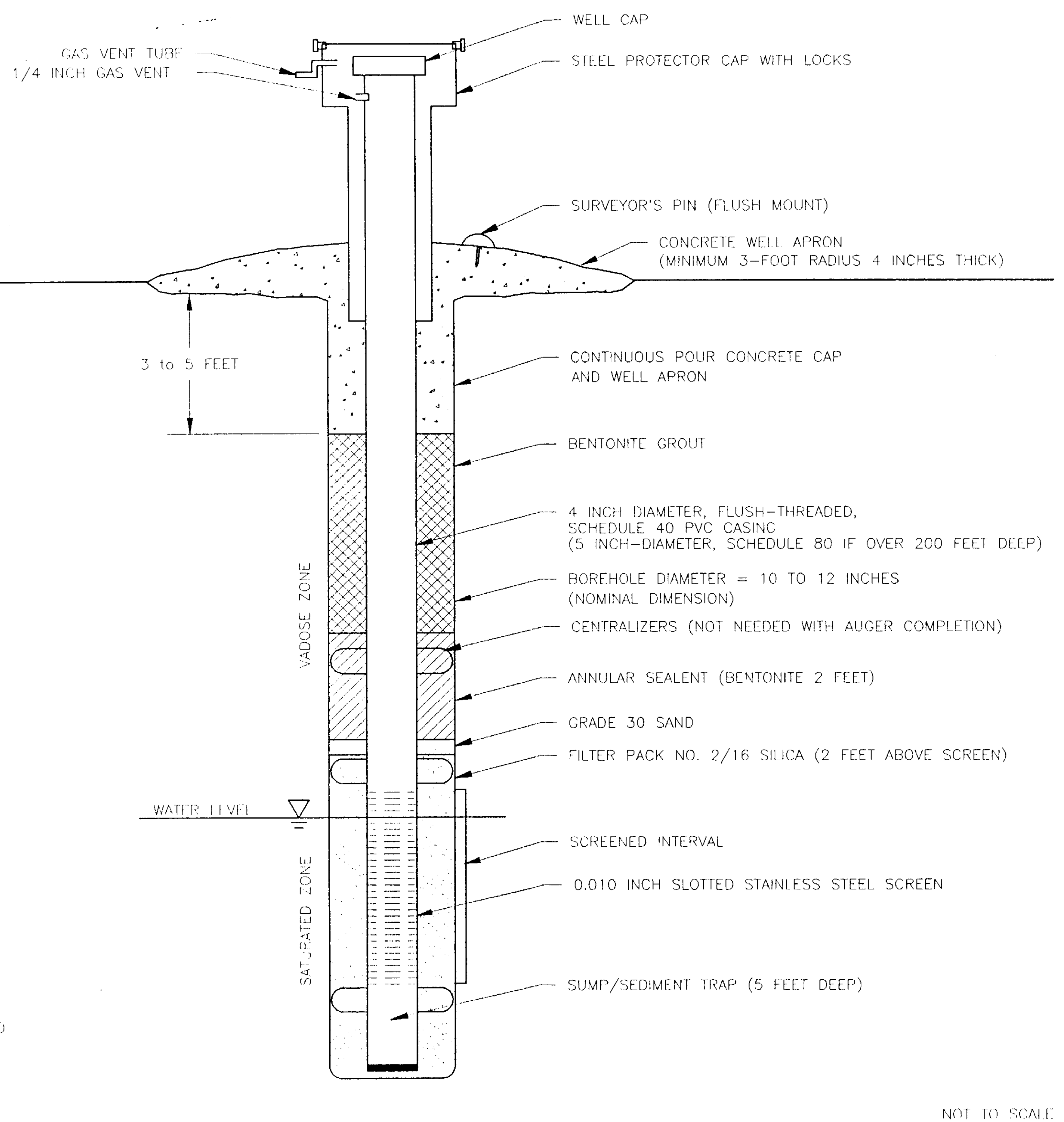
The well will be constructed in the following sequence:

1. The casing string will be emplaced.
2. The filter pack will be emplaced below and around the casing string to above the screened area.
3. The silica sand and bentonite seals will be emplaced.
4. The sand-cement grout will be tremied within 3 to 5 feet of the ground surface.

The estimated volume of filter pack sand, bentonite, and grout will be calculated; and all materials, except the final grout, will be on-site before well construction. The materials will be new and remain in their shipping containers until ready for use.

6.4.1.1 CASING AND SCREEN ASSEMBLY

The well casing, screen, sediment trap, and end cap will be assembled and installed with care to prevent damage to the sections and joints. No glue, solvents, or pipe dope will be used. Rubber O-rings will be used between well casing sections. Monitor well casing and screen material and construction will consist of the following:



NOTES:

1. O-RINGS WILL BE USED TO SEAL JOINTS IN CASING.
2. INSTALLATION OF WELLS IN HOLLOW-STEM AUGER BORINGS WILL OCCUR THROUGH THE AUGER.
3. INSTALLATION OF WELLS IN AIR-ROTARY BORINGS WILL OCCUR IN DRIVEN CASING.
4. IF NEEDED, INSTALLATION OF WELLS IN MUD ROTARY BORINGS WILL BE DISCUSSED WITH BCT.

Field Sampling Plan Figure 6-1 Monitoring Well Construction	
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- 4-inch Schedule 40 PVC for monitor wells when they are less than 200 feet,
- 5-inch Schedule 80 PVC for monitor wells when they are greater than 200 feet,
- 2-inch Schedule 40 PVC for both piezometers and air space wells,
- all screens will be constructed of stainless steel,
- monitor wells have 40-foot screens for water table installations, and
- when monitoring wells are installed to monitor zones deeper than the upper portion (40 feet) of the water table, 20-foot screens will be used.

The bottom cap of the casing will be suspended a minimum of 2 feet above the bottom of the borehole. The casing will remain suspended until placement of the filter pack and transition seal (fine silica sand and bentonite) is completed and set. The well casing opening will be fitted with a temporary cap during the installation of annulus materials.

6.4.1.2 FILTER PACK INSTALLATION

After the casing and screen assembly is set at the appropriate depth, the filter pack will be emplaced. Water will not be used unless approved by the Site Manager and the field team leader. If water must be used, the least possible amount of potable water will be used and the amount used during the process will be documented.

The filter pack will be emplaced in approximately 2-foot lifts to reduce the potential of bridging. The auger flights or outer casing will be lifted as the annulus is filled. The depth to the top of the filter pack must be measured (tagged) periodically using a weighted measuring tape. The weight must not be attached with duct tape or electrical tape.

The filter pack will be installed to a depth of 2 feet above the top of the well screen. After the initial filter pack is installed, a drill rod with a surge block or air-left mechanism is attached, and inserted into the casing. The well will be surged for 15 to 20 minutes to reduce filter pack voids caused by bridging. If settlement occurs, additional filter pack will be added so that there is a minimum of 2 feet of filter pack above the well screen. Compression of the filter pack may occur in wells deeper than 150 feet. Consequently, filter packs may be installed to 5 feet below the screen. The calculated and measured filter pack will be documented, and any significant discrepancies will be discussed with the Site Manager.

6.4.1.3 TRANSITION SEAL

The drill rod may be left in the well during emplacement of the transition seal and the bottom part of the annular seal to prevent the casing from "floating." Alternatively, the auger cap may be placed on the casing to hold it in place during transition and annular seal emplacement. A minimum of 2 feet of No. 0/30 silica sand, or mixture of fine sands, silica sand will be placed directly above the filter pack to reduce the potential of high pH solutions from the annular seal from reaching the screened section of the filter pack. The sizing of this sand transition seal will be based on the size of the filter pack.

Approximately 5 feet of bentonite transition seal will be placed on the silica sand above the filter pack. A bentonite slurry will be used. Unless stated otherwise in the manufacturer's specifications, the bentonite grout will consist of 1 gallon of water per 2 pounds of bentonite. If use of a tremie pipe is not possible during pullback, the filter pack or grout materials must be maintained at a minimum of 2 feet in the auger or casing. The depths to the bottom and the top of each type of seal will be tagged and documented to assure that thickness of the transition seal meets the design requirements.

If the pH of the groundwater (or the circulated water) is less than 7.0, a minimum of 45 minutes will be allowed for the bentonite to hydrate prior to beginning emplacement of the grout. If the pH of the water is greater than 7.0, a minimum of 30 minutes will be allowed.

6.4.1.4 ANNULAR GROUT SEAL

The expected volume of each ingredient in the grout mixture will be precalculated and documented. Acceptable grout for an annular seal is defined as follows: neat cement grout shall be composed of one 94-pound sack of portland Type II cement to 4.5 to 7.5 gallons of potable water; and sand cement grout shall be composed of not more than two parts (by weight) of sand and one part (94-pound sack) of portland Type II cement to 4.5 to 7.5 gallons of potable water. Bentonite powder, up to 5 percent by weight, (4 pounds per sack) may be added to these mixtures. No other additives will be used.

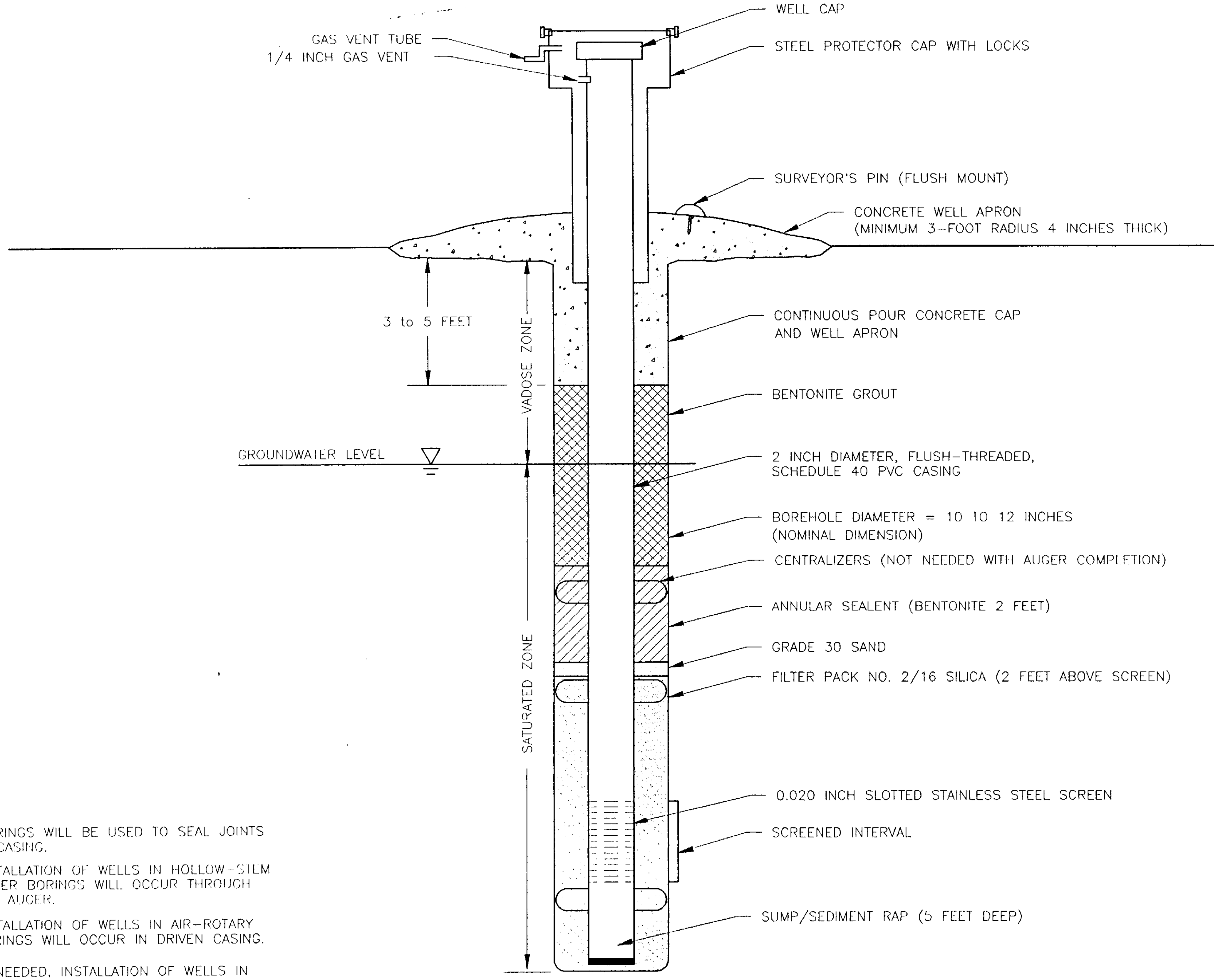
The grout will be emplaced through the augers or outer casing sections, as they are withdrawn. If possible, a tremie pipe will be used to reduce the possibility that the transition seal will be breached and grout introduced into the filter pack. The auger or outer casing will be submerged and will continue to be submerged in the grout during the time the grout is being emplaced. The grout will be placed in lifts not exceeding 50 feet without documentation of the casing temperature resistance from the casing manufacturer.

Information on well construction will be documented in the field logbook and on a well construction diagram (Section 7).

6.4.2 Air-Sparging Well Installation

This procedure is similar to the monitoring well installation as discussed in CLEAN II Program SOPs. The design of an air-sparging well is illustrated in Figure 6-2. The well will be constructed in the following sequence.

1. The casing string will be emplaced.
2. The filter pack will be emplaced below and around the casing string to above the screened area.
3. The silica sand and bentonite seals will be emplaced.
4. The sand-cement grout will be added.



NOTES:

1. O-RINGS WILL BE USED TO SEAL JOINTS IN CASING.
2. INSTALLATION OF WELLS IN HOLLOW-STEM AUGER BORINGS WILL OCCUR THROUGH THE AUGER.
3. INSTALLATION OF WELLS IN AIR-ROTARY BORINGS WILL OCCUR IN DRIVEN CASING.
4. IF NEEDED, INSTALLATION OF WELLS IN MUD ROTARY BORINGS WILL BE DISCUSSED WITH BCT.

NOT TO SCALE

Field Sampling Plan

Figure 6-2
Air Sparging Well Construction

MCAS El Toro, California

CLEAN II Program

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The screen slot will be 0.01 inches and the filter pack sand will be Number 2-16 sand, unless modified in the field by the Site Manager. Centralizers will be used below and above the screened interval and at a minimum of 40-foot intervals above the screened area. A sediment trap will be installed below the screened area and the bottom of the pipe will be capped.

The estimated volumes of pack sand, bentonite, and grout will be calculated prior to beginning the well construction. All materials, except the final grout, will be on-site before construction begins. The materials will be new and will remain in their shipping containers until used.

6.4.2.1 CASING AND SCREEN ASSEMBLY

The well casing, screen, sediment trap, and end cap will be assembled and installed with care to reduce the potential for damage to the sections and joints. No glue, solvents, or pipe dope will be used. Rubber O-rings will be used between well material sections. Centralizers will be placed to allow a tremie pipe to be inserted between the borehole wall and the casing.

The bottom cap of the casing will be suspended a minimum of 2 feet above the bottom of the borehole. The casing will remain suspended until placement of the filter pack and transition seal (silica sand and bentonite) is completed and set. The top of the casing will have temporary cap during the installation of annulus materials.

6.4.2.2 FILTER PACK INSTALLATION

After the casing and screen assembly is set at the appropriate depth, a tremie pipe will be inserted alongside the casing to a depth no more than 10 feet above the bottom of the hole (2 feet below the bottom of the casing string). The filter pack will be inserted using a potable water slurry; the excess water will be allowed to circulate upward around and through the casing and will be recycled for further emplacement. The least possible amount of water will be used, and the total amount used during the process will be documented.

The filter pack will be emplaced in approximately 2-foot lifts to reduce the potential for bridging. The tremie pipe will be moved upward as the annulus is filled, but will be no more than 10 feet higher than the top of the fill at any given time. The depth to the top of the filter pack must be measured (tagged) periodically using a weighted measuring tape. The weight must not be attached with duct tape or electrical tape.

The filter pack will be installed to a depth of 2 feet above the top of the well screen. Following initial filter pack installation, the drill pipe, with an attached surge block or air-lift mechanism, will be inserted into the casing, and the well will be surged for 5 to 10 minutes to assure that the filter pack contains no voids caused by bridging. If settlement occurs, additional filter pack will be added. The drill stem will be left on top of the casing during emplacement of the transition seal and the bottom part of the annular seal to keep the casing from "floating." The calculated and measured filter pack will be documented. Any discrepancies will be discussed with the Site Manager.

6.4.2.3 TRANSITION SEAL

A minimum of 2 feet of No. 0/30 or greater silica sand will be placed directly above the filter pack to prevent high pH solutions from the annular seal from reaching the screened section of the filter pack.

Approximately 5 feet of bentonite transition seal will be placed on the silica sand above the filter pack. Bentonite grout will be used for the seal. Unless stated otherwise in the manufacturer's specifications, the bentonite slurry will consist of 1 gallon of water per 2 pounds of bentonite.

If the pH of the groundwater (or the circulated water) is less than 7.0, a minimum of 45 minutes will be allowed for the bentonite to hydrate before beginning emplacement of the grout. If the pH of the water is greater than 7.0, a minimum of 30 minutes will be allowed.

6.4.2.4 ANNULAR GROUT SEAL

The expected volume of each ingredient in the grout mixture will be precalculated and documented. Acceptable grout for an annular seal is defined as follows: neat cement grout shall be composed of one 940-pound sack of portland Type II cement to 4.5 to 7.5 gallons of potable water. Bentonite powder, up to 5 percent by weight, (4 pounds per sack of cement) may be added to these mixtures. No other additives will be used.

The grout will be emplaced by a side-discharge tremie pipe initially inserted within 5 feet of the transition seal. A side-discharge pipe will be used to lessen the possibility that the transition seal will be breached and grout introduced into the filter pack. The pipe will be submerged and remain submerged in the grout during the time the grout is being emplaced. The grout will be placed in lifts not exceeding 50 feet without documentation from the casing manufacturer of the casing's temperature resistance. Information on well construction will be documented in the field logbook and on a well construction diagram.

6.4.3 Completion of Monitoring Wells

If practical, wells will be completed with an aboveground surface completion. In areas of traffic, or in other areas where the ROICC or other station representative requests no aboveground completions, flush-mounted vaults will be used for monitoring well surface completion.

The completion boxes will be approved by the ROICC prior to installation. After construction of the well, the type of surface completion will be determined jointly by the Site Manager and the ROICC. The aboveground, locking wellhead box is the preferred completion method.

If a dedicated pump is not installed, the casing will be capped when the well is not in use. If a dedicated pump is installed, a modified cap will be used with sealable through-holes for pump electrical and discharge lines and depth-to-water measurement.

For aboveground completion, any conductor casing will be cut off 3 inches above the ground surface, and the well casing will be cut off approximately 1 foot 4 inches above the ground surface. A platform of 4 inches will be formed to support the wellhead box. The platform will be a minimum of 4 inches larger than any box side dimension. Concrete, either hand-mixed or commercially mixed, will be poured to make a single monolith slab that extends from the top of the well boring to the outer edge of the platform. The pad will be sloped slightly away from the well casing in all directions.

The surface completion box will be centered over the well casing. A hasp will be provided for locking the box. Three 3-inch-diameter posts will be installed radially from the wellhead. The guard posts will be set in concrete approximately 2 feet into the ground outside the well base. Each guard post will be filled with concrete.

For below-grade installations, a 3-foot^2 concrete pad will be poured at a depth that will allow the vault surface to be flush with the surrounding ground surface when the bottom of the vault is set a minimum of 1 inch into the concrete. The pad will slope away from the well and have a drain at the lowest point. Any conductor casing will be cut off at a point approximately level with the support pad. The casing will be cut off a minimum of 9 inches bgs inside the vault or valve box. Nine inches of clearance is needed to allow adequate room for installation of sampling equipment.

Locks will be provided for both aboveground and flush-well completion assemblies. The locks will be keyed alike, using a master padlock that matches the Phase I locks and keys.

An identification plate will be affixed permanently to the inside of each monitoring well completion assembly. The information on the plate will include the following:

- well identification number,
- measuring point,
- depth of well,
- depth of screened interval, and
- date of construction.

6.4.4 Well Development

Procedures for well development are covered in CLEAN II Program SOP 5. The well development record will be used to document this process.

Wells will be developed as soon as practical after completion, but no sooner than 48 hours after the grout annular seal has been installed in accordance with RWQCB Los Angeles Region requirements (RWQCB 1993). Development will be completed at least one week prior to an initial groundwater sampling round. Groundwater sampling will occur only after temperature, pH, and specific conductance (EC) have stabilized to within 10 percent of previous measurements. Wells are developed to remove drilling residuals, to restore the natural hydraulic conductivity of the formation, to further develop the filter pack, and to assure that turbid-free groundwater is available for sampling. Effective development requires surges and reversals of flow to dislodge the particles and prevent bridging of sediment.

No water or additives (dispersing agents, acids, or disinfectants) will be added during development without approval by the technical field manager. Authorization for, and the amounts of, any water or additives will be recorded in the logbook. Twice the amount of water added must be removed and documented in the field logbook.

All components of the development equipment will be decontaminated (Section 6.12) prior to use in each well. All development water will be contained and disposed as described in Section 6.13. Before beginning development, the depth to static water level and total depth of the well will be measured to determine the volume of water in the casing. A minimum of five casing volumes plus twice the volume of any introduced water will be removed during development. (In most instances, development of the MCAS El Toro Phase I monitoring wells required removal of 20 or more casing volumes.)

Key observations that will be noted during development are turbidity and specific capacity. The volume of water removed since the last time of measurement, cumulative water removed, temperature, pH, and EC will be documented in the field logbook and on the Well Development form. Monitoring of these values should be done frequently during well development.

Wells will be developed by surging or swabbing, bailing, and pumping. Air lifting will not be allowed unless authorized by the Site Manager. In general, the procedures followed will be as detailed in the subsections below.

6.4.4.1 INITIAL PROCEDURES

- Remove the well cap and measure the vapors at the well head with the PID or FID using the instrument(s) listed for the site.
- If necessary, upgrade level of health and safety protection.
- Obtain a depth-to-water measurement. Use the mark incised at the top of the casing for the reference measuring point.
- Bail out any mud (mud rotary only). Check the temperature, pH, and EC.
- Take depth-to-water measurement. Take depth to bottom of well measurement. Check the total depth against the construction log.
- Measure the capacity of the bailer. Bail until water is relatively clear (10 or more bailers). Note the time at which bailing began and ended.
- Measure depth to water. Calculate approximate yield (gallons per minute) and specific capacity (gallons per minute/foot of drawdown).
- Collect water samples from the first and last bailers (in clean glass jars) and measure turbidity, temperature, pH, and EC.

6.4.4.2 SWABBING AND BAILING PROCEDURES

- Begin swabbing from the top of the screen down. Swab in either 5-foot or 1.5-foot increments for 5 to 10 minutes at each level. Manually swab the entire length of the screen.
- Measure depth of well (to check for fill in) and depth to water.
- Bail. Collect a sample from the first bailer and measure turbidity, temperature, pH, and EC.
- Continue bailing until 5 to 15 full bailers have been removed. Collect a sample and measure turbidity, temperature, pH, and EC.
- Measure depth to water. Calculate approximate specific capacity. Continue to monitor organic vapors at the top of the casing.
- Repeat swabbing and bailing, as above. Continue to record groundwater parameters and specific capacity. If possible, try to bail the well dry.

6.4.4.3 PUMP DEVELOPMENT PROCEDURES

- Place pump in well only after the water appears clean, there is no grit, and parameters have stabilized.
- Choose the appropriate pump for the estimated specific capacity. Use a pump without a check valve.
- Install the intake area of the pump about 1 foot below the top of the screen. Install water-level sounder. Have adequate on-site storage for pumped water.
- Start pump against a closed valve. Pump slowly at first, opening the valve about 1/8 to 1/4 of the way open. Catch samples and measure parameters.
- Measure drawdown. Make sure the well can sustain the discharge rate without dewatering the well.
- When the water clears up, open the pump to 1/2. Catch samples and measure groundwater parameters. Continue monitoring parameters.
- Open the pump to the maximum sustainable discharge rate (full, if possible). Measure parameters, including drawdown, until the pumping level stabilizes. This wide-open pumping drawdown will be used to determine whether the specific capacity is increasing (drawdown is decreasing).
- When water is clear, turn the pump off and surge the well by alternating pump on and pump off. Leave the pump off long enough so that there is no "backspin" on the pump. Continue this surging procedure until there is no "slug" of suspended sediment upon startup.
- Move the pump down the screen no more than 4 feet. Repeat the previous two steps. Continue looking for decreases in drawdown (increases in specific capacity) and stable values in turbidity temperature, EC, and pH.
- Continue as above to the bottom of the screen.

- If practical, hoist and lower the pump slowly along the length of the screen (or along a 20-foot section of drop pipe) while pumping.
- Make final pH, EC, and temperature readings. Shut off and remove pump from well.
- Measure total depth of well. Remove any sediment fill by bailing.

In addition to the information placed in the field logbook, the Well Development Data form (Section 7) will be completed and placed in the binder in the administration trailer. The following information will be included in the log:

- well identification;
- dates and time of well development;
- static water levels, before, during, and after development;
- calculated specific capacities;
- quantity of water removed;
- quantity of sediment removed and the physical description (e.g., color, size) of that sediment;
- types and sizes of surge blocks, bailers, and pumps; and
- authorization for and description of air lifting techniques, if used.

6.4.5 Water Level and Well Depth Measurements

Depth-to-water measurements are used to construct potentiometric surface maps, and ultimately to determine direction and speed of groundwater and related contaminant movement. Measurement of the total depth of the well provides information on the amount of fill that has settled in the bottom of the well. The Water/Product Level Measurement Record documents this process.

Before the water level is measured, a handheld FID or PID will be held at the top of the casing for wells without dedicated pumps, or at the depth-to-water measuring port for wells with dedicated pumps. If organic vapors are recorded at the top of the well, the breathing zone will be monitored during the depth-to-water measurements. The decontaminated electric sounder will be lowered into the well and measured against the marked measuring point or the north side of the top of the casing.

If depth to water is an ongoing measurement, such as during pumping tests, the electric sounder will be left in the well until a group of measurements are completed. The electric sounder will be decontaminated, using the wipe method (Section 6.12.3), as it is removed from the well. Rinseate will be collected and disposed of properly.

Organic vapors at the top of the well will be remeasured, even if there was no reading during the initial measurement. The well will be closed and locked when it is completed. If the well is not completed, it will be temporarily secured before the field team leaves.

Information on incidental depth-to-water measurements during drilling, development, and aquifer testing will be recorded in the field logbook. Depth-to-water measurements will be recorded in the logbook. Documented information will be recorded on the Water/ Product Level Measurement form (Section 7).

6.4.6 Field Detection of Immiscible Components in Groundwater

No free-floating immiscible compounds or dense immiscible compounds were detected in groundwater during the MCAS El Toro Phase I RI/FS field investigation (Jacobs Engineering 1993c). Such compounds may exist, however, and may be recognized during measurement of water levels and total well depths. Before a groundwater quality sample is collected, the occurrence of immiscible compounds will be examined using the procedure described below.

Organic vapors will be measured at the top of the well casing or at the water-level sounding port when the well is first opened. An interface probe or water-level indicator coated with hydrocarbon-sensitive paste will be used to investigate the presence of immiscible compounds.

6.4.6.1 LIGHT IMMISCIBLE COMPOUNDS

The possibility of the existence of a light immiscible component will be investigated first. The interface probe will be lowered down the well casing until it indicates that it is in contact with water. If floating product is present, the depth to product will be recorded. The interface probe will be lowered until it contacts groundwater, and the depth to water will be recorded. The difference will be recorded as product thickness. If hydrocarbon-sensitive paste is used, the water-level indicator probe will be coated with a thin layer of paste and lowered into the well until it contacts water. The probe will be retrieved and checked for the presence of floating product (paste color change). The thickness will be recorded, if present.

If a light immiscible component is identified, the probe will be decontaminated (Section 6.12) by using the soap-impregnated pad, a potable water rinse, a methyl alcohol rinse, and a deionized water rinse. The probe will be lowered slowly to the exact previously recorded depth to water. After the probe is held at that level for 5 seconds, it will be retracted, and the thickness of the layer will be measured on the probe to the nearest 0.01 foot.

6.4.6.2 HEAVY IMMISCIBLE COMPOUNDS

To investigate the presence of heavy or dense immiscible compounds, the probe will be lowered to the bottom of the casing. The depth to product and total well depth will be recorded with the interface probe. The difference will be recorded as product thickness. If hydrocarbon-sensitive paste is used, the probe will be lowered to the bottom of the well and retrieved, and the product thickness (past color change) will be recorded.

The upper depth of a light immiscible surface and a heavy immiscible layer will be recorded in the field logbook in addition to depth-to-water and total borehole depth measurements and decontamination records. Thickness calculations will be shown. A copy of the logbook pages documenting the finding of an immiscible layer will be given to the field technical advisor.

6.4.7 Field Measurement of Water Quality Parameters

The water quality parameters measured in the field during sampling events will be temperature, pH, EC, and organic vapors. These measurements will be recorded and maintained in a field logbook. The air in the headspace of a well will be monitored with a handheld FID or PID whenever the cap is removed or when work is being completed in the open (cased or uncased) hole. Monitoring is conducted as a safety measure, but it also provides information on possible contaminants.

Temperature, pH, and EC of waters will be measured in the field for all samples. The instrument(s) to be used for field measurement of organic vapors from wells are discussed in the Site-Specific Health and Safety Plan (BNI 1995f).

6.4.7.1 MEASUREMENT OF TEMPERATURE

Temperature will be measured using a mercury (or other) thermometer reading in °C. The thermometer will be immersed in the liquid long enough to permit complete equilibration. Most specific conductance meters have a built-in thermometer that is adequate for temperature measurement.

6.4.7.2 MEASUREMENT OF pH

Meters used for measurement of pH will have temperature and slope adjustments with a minimum of +0.1 unit repeatability. They will use a combination electrode, which will remain immersed in pH 7 buffer solution when not in use. Calibration buffer solutions will bracket the expected pH of the water to be tested. The manufacturer's recommendations for calibration will be followed. The operator will be familiar with the use and calibration of the instrument. Samples will not be filtered prior to determining pH.

The instrument will be calibrated daily prior to measuring the sample from a given source. The temperature compensation knob will be set to the temperature of the sample.

The electrode will be rinsed with deionized water and with an aliquot of the sample. The electrode will be immediately immersed in the solution, and the stabilized value will be recorded. If the sample is being pumped through a closed container, the pumping will stop, and the temperature and pH will be allowed to stabilize before taking the reading. Following the measurement, the electrode will be rinsed with deionized water, and the electrode will be returned to in the buffer solution.

6.4.7.3 MEASUREMENT OF SPECIFIC CONDUCTANCE

Meters used to measure specific conductance will have a precision of 5 percent reproducibility. The operator will be familiar with the meter use and calibration. The instrument will be checked against the calibration standard at least once a day. Samples will not be filtered prior to analysis.

The sample will be placed in a container large enough to maintain the specific conductance probe a minimum of 1 inch from the walls and bottom of the container. The temperature of the sample will be measured and recorded. The conductivity probe will be placed in the container and allowed to stabilize; its value recorded.

6.4.7.4 MEASUREMENT OF TURBIDITY

A portable turbidity meter (also called a nephelometer) will be used to measure groundwater clarity. The turbidity meter measures the amount of light scattered at right angles from a beam of light passing through the test sample. Readings are recorded in NTUs. Water samples should be collected at turbidity level of 5 NTUs, if achievable. The glass test sample container must be kept clean to obtain an accurate measurement.

6.4.7.5 MEASUREMENT OF ORGANIC VAPORS

Because of the large number of instruments that can be used, details of operation are not provided here. The information on operation and calibration and the calibration gasses required will be available in the field administration area. Instruments will be checked out daily from the equipment manager.

Instrument calibration and use will be according to manufacturer's recommendations. The operator will be thoroughly familiar with the instrument, its capabilities, and its limitations. One or more meters will be used at the top of the boring or the well during drilling, well construction, any time the well cap (or the cap on the measuring port) is removed from an existing well, or periodically when sampling or working over an open well.

The following calibration and operation information for each instrument used and each measurement made will be logged in the field logbook for QA documentation: instrument model and serial number, lamp voltage, calibration gas or solution concentrations or values, temperatures of solutions, temperature of sample, time of calibration, initial span setting (if appropriate), actual reading, measurement conditions, comments on adjustments, and cleaning requirements.

6.4.8 Pump and Packer Installation

Two types of pumps (4-inch-diameter Grundfos fixed-speed, single-phase, submersible pump with 3/4-horsepower motor; and 2-inch-diameter, variable speed Grundfos Redi-Flo 2 pumps) have been installed in monitoring wells at MCAS El Toro. Pumps installed in Phase II will complement these pump types and allow use of two controller types.

Where packers are installed to reduce the amount of water purged prior to collecting a groundwater sample, the packer will be set approximately 3 feet above the top of the screen. Final packer selection will be done by the Site Manager.

Some existing wells do not have dedicated pumps. A decontaminated 2-inch-diameter Redi-Flo 2 pump or a 4-inch-diameter variable-speed pump will be used to develop, purge, and sample these wells.

The decontaminated pump will be installed by coupling each joint of pipe or hose, using Teflon™ thread tape (no joint compound will be used), and lowering the pump and drop-pipe string down the well. The bottom of a sounding tube installed with a 2-inch-diameter pump will be set along the top lip of the pump. The bottom of a sounding tube installed with a 4-inch-diameter pump will be set no more than 1 foot above the top of the pump. Stainless steel clamps, spaced no more than 10 feet apart, will be used to hold together wire, drop pipe or hose, and sounding tube. Plastic ties may be used to clamp wire to the drop pipe only. Black electrical tape and duct tape shall not be used, even during development.

When the pump is at the correct depth, the wire and pipe will be threaded through the correctly sized well seal, which will be placed at the top of the casing. The seal will be expanded to provide a water-tight seal; and an appropriate cap, plug, or sampling tee will be used to close the openings.

If packers are installed, the pump procedure will be modified to include the packer and related apparatus along the drop-pipe string. Manufacturer's recommendations will be followed for packer installation.

Specific items recorded in the field logbook are the following: type; model; nominal gallons per minute; horsepower of pump, model, and location of packer, if any; diameter and length of drop pipe; and documentation of pump and drop-pipe decontamination.

6.4.9 Activating and Deactivating Installed Packers

The Aardvark Model 36 pneumatic packers were installed in certain wells constructed during the El Toro Phase I RI/FS. They are inflatable devices that expand radially as pneumatic pressure is applied. The packer is installed in the well just above the well screen, thereby preventing vertical flow of water in the well and effectively reducing the volume of water required to purge prior to sampling. The packers are "Viton clad," making them resistant to degradation from hydrocarbons.

The depth to the static water level will be measured as described in Section 6.4.5. The depth to the top of the packer is shown on the well records. The water-level sounder will be left in the well during purging and sampling to test for packer integrity. The purge volume will be calculated using the value of three times the volume of water in the casing below the packer.

Packers must be inflated with enough pressure to hold the head of water above them and allow purging and sampling to take place without water leaking past the packer and entering the sample. Because the head of water over the packer is different in each well, determining the pressure required for packer inflation must be calculated on a well-to-well basis.

The required packer pressure to isolate the pump and screened area with no leakage is calculated as follows:

$$G = [(D_p - D_w) \times 0.43] + S_p + [((D_p - D_w) \times 0.43) \times 0.2]$$

where:

G = inflation pressure at the gauge (psi)
D_p = depth to the top of the packer (feet)
D_w = depth to the static water level (feet)
S_p = unconfined packer pressure rating for the well size (psi)

Note: G must not exceed the confined packer pressure rating for the well size.

The following steps are required to inflate the packer.

- Remove the protective cover from the nitrogen tank valve, install the nitrogen regulator on the nitrogen tank, and connect the quick connect on the nitrogen-supply system to the quick connect on the packer installation.
- Unscrew the regulator control all the way to the left. Failure to follow this step may result in gauge damage.
- Open the tank valve slowly. (High-pressure gauge will read tank pressure; low-pressure gauge should read zero.)
- Turn the regulator control valve slowly to the right (clockwise) until the desired pressure is reached.
- Wait for the pressure to stabilize.
- If gas continues to flow, the system has a leak. Deflate the packer (see below), shut down the system, and try again. If gas still continues to flow, deflate the packer and proceed as if there is no packer in the well: Recalculate the purge volume, and purge and sample the well as if it had no packer (Section 6.4.10). Use the total volume of water in the casing for calculating the volume needed for purging.
- If the pressure stabilizes, continue with the following packer procedure:
  - With the packer inflated to the desired pressure, close the valve between the quick connect and the gauge.
  - Turn the regulator adjustment control to the far left (counter clockwise) and disconnect the pressure line at the quick connect.
  - Purge the well and collect the sample (Section 6.4.10).
  - Continue to measure and record the depth to water in the well above the packer at periodic intervals. Note: During previous purging and sampling in the wells equipped with Aardvark packers, it was found that the water

levels rose in the casing above the packer. The reason most likely is leakage at the joints in the discharge pipe. This condition will not change sampling results, but the amount of rise must be recorded.

- When sampling is complete, deflate the packer by opening the valve by the gauge and bleeding the pressure to zero psi.
- In addition to information on purging and sampling, the following information will be recorded in the logbook: depths to water above the packer prior to and during purging, calculation for purge volume, calculation for packer inflation pressure, and packer inflation valve.

6.4.10 Groundwater Sampling to Evaluate Water Quality

This procedure is covered in CLEAN II Program SOP 8. Groundwater will be sampled for submittal to the laboratory after well construction and development. The Well Sampling Record documents this process.

The pH meter, turbidity meter, conductivity meter, and the PID or FID will be calibrated daily according to manufacturer's specifications. The well cover will be opened, and a handheld PID or FID reading will be made at the well head.

The total well depth and the depth to water will be measured and the well volume will be calculated by multiplying the length of the water column by the appropriate value:

- 4-inch-diameter Schedule 80 PVC casing = 0.66 gallons per foot
- 5-inch-diameter Schedule 80 PVC casing = 0.93 gallons per foot
- 6-inch-diameter steel casing = 1.5 gallons per foot

Note: If the well has an inflatable packer, the casing volume will be the volume between the packer and the bottom of the well. The packer will be inflated as described in Section 6.4.9.

Depth to groundwater will be measured to the nearest 0.01 foot. The reference measurement point is the top of the sounding tube for a well with a permanently installed pump and the north side of the top of the casing for a well without a sounding tube.

If the well does not have a sampling tee, the discharge pipe plug will be removed and a decontaminated sampling tee will be attached. The generator and controller will be attached to the pump electrical connection. Adequate storage for discharged groundwater will be set in place. The sampling side of the tee will remain closed until just before the sample is collected.

Before the groundwater is sampled, each well will be purged to bring formation water into the well. Purge water will be discharged through the larger discharge valve on the sampling tee. Depth to water will be monitored to assure that the well is not dewatered.

Purging will continue until field measurements of temperature, pH, and specific conductance stabilize or until three casing volumes of water have been removed, whichever occurs first. Additional casing volumes (up to a total of five casing volumes) may need to be purged if field measurements have significant variability and do not appear to be stabilizing. If the well is not capable of being continuously pumped, it will be purged three times and sampled after it has recharged. Field measurements are considered stable when successive measurements, 2 to 5 minutes apart, show the following: pH measurements that agree within 0.2 pH units, temperature within 1 degree Celsius, and specific conductance within 5 percent.

The purge volume pumped will be calculated by determining the pumping rate and elapsed time (Section 6.4.13) or will be directly measured by determining the total volume pumped from the well. Purge water will be pumped into a trailer-mounted tank or into 55-gallon drums (low-yield wells or wells with packers). The purge water will be transported to the Station waste staging area for treatment.

After adequate purging has occurred, the sample will be collected from the sampling side of the tee. The valve to the sampling side will be opened a small amount while the purge side continues to discharge. Groundwater sample aliquots will be collected in the following order (ignoring any listed analysis not specified for that sample): VOCs, total petroleum hydrocarbons (TPH)-gasoline, SVOCs, pesticides/PCBs, TPH-diesel, herbicides, total recoverable petroleum hydrocarbons (TRPH), inorganic parameters, total cyanide, metals (filtered), and gross alpha and beta (filtered).

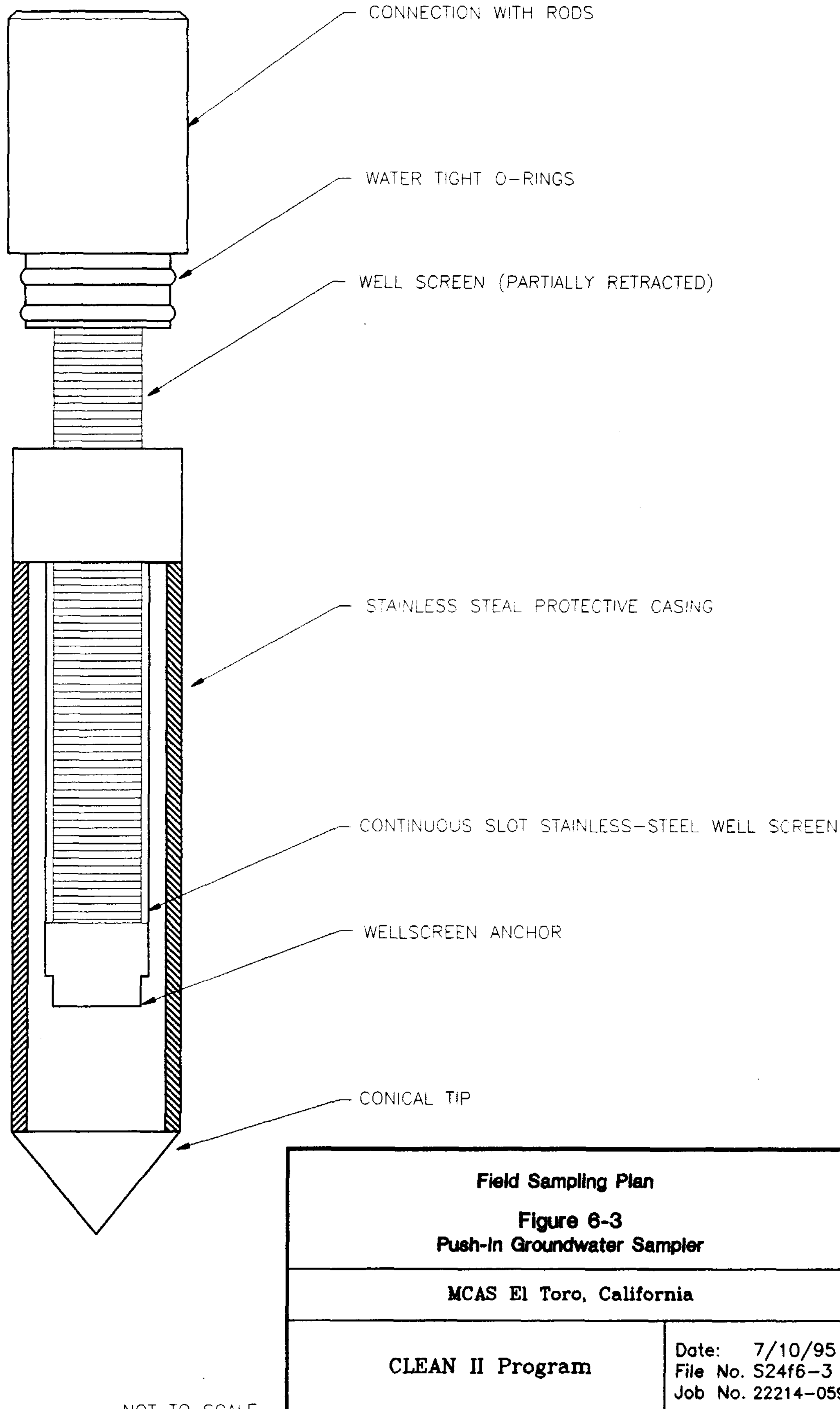
The pumping unit will be shut down and the equipment will be disconnected if the pump is permanently installed. All equipment to be reused will be decontaminated (Section 6.12). If the pump is temporary, it will be removed from the well and decontaminated with the equipment.

Field measurements, observations, and calculations will be recorded in the field logbook and on the Well Sampling Record.

6.4.11 Push-In Groundwater Sampler

The drilling procedures in this FSP are capable of using a push-in groundwater sampler. Several push-in sampling devices are available but generally consist of a 1-foot long, 1.25-inch-diameter stainless steel screen with 0.004-inch slots. Figure 6-3 illustrates the push-in groundwater sampler. When the drill rig is pushing the screen, a section of the sampler will be protected by the sleeve. The function of the sleeve is to protect the screen and prevent cross-contamination of the sampler as it is advanced through the soil.

The push-in water sampler will be pushed into the ground hydraulically using the CPT rig. After it penetrates 1 foot below the target zone, the sampler will be pulled back 1 foot to expose the screen to the water-bearing zone. Groundwater samples will then be collected with a decontaminated bailer. If vertical characterization is desired, the sampler will be retrieved, decontaminated, and pushed to the next desired depth for sampling. After groundwater samples are collected, the sampling device will be pulled out and the borehole will be backfilled as described in Section 6.3.3.4.



Field Sampling Plan

Figure 6-3
Push-In Groundwater Sampler

MCAS El Toro, California

CLEAN II Program

Date: 7/10/95
File No. S24f6-3
Job No. 22214-059

6.4.12 Field Filtration of Groundwater Samples

Groundwater samples (and related QC samples using potable or deionized water) for analysis of metals or gross alpha and beta will be filtered in the field immediately after collection and before storage in a bottle containing nitric acid (or before addition of nitric acid) for preservation. For aliquots of surface water samples that are filtered, the same procedures will be followed as those for groundwater. Samples will be filtered using a disposable 0.45-micron filter. If another pore size is used, a 0.45-micron filtered sample will be collected in parallel.

Filtered samples will be collected last following attempts to reduce turbidity to its lowest level. When a groundwater sample is collected from a well with an installed pump, an in-line filter will be used for filtering. The smaller end of the sampling tee will be closed. The inlet side of a 0.45-micron filter will be attached to the sampling tee, using a short length of inert tubing. A second piece of tubing will be attached to discharge end of filter. The tee discharge will be opened slowly and the filtered water will be discharged directly into the sample bottle containing the preservative (if used). The filter and tubing will be used for only one sample and will be discarded with the personal protective equipment (PPE) from the sampling site.

For samples that are not discharging under pressure (primarily potable water, deionized water, and rinseate samples), the sample will be poured into the top of the aspirator filter while the vacuum pump, connected to the lower portion of the jar, is operating. When adequate filtered sample is available, the pump will be shut off and disconnected from the bottle. The sample will be poured into the sample bottle containing the preservative (if used). The jar filter will be used for only one sample and will be discarded with the PPE from the sampling site (Section 6.13.3).

The following QA information will be recorded in the field logbook: well identification, notes on turbidity and color, type of filter apparatus used and the pore size of the filter, and any pertinent information concerning filtering.

6.4.13 Estimating Groundwater Discharge

The rate of groundwater discharge may need to be calculated during pumping tests and during purging prior to collecting a groundwater sample. The equipment below allows for measurement of flows up to about 50 gallons per minute or down to a few milliliters per minute.

For larger flows, a 55-gallon drum and a flowmeter will be used for measurement. Flowmeter readings should be confirmed with 55-gallon drum or 5-gallon bucket readings. The 5-gallon bucket will be used to measure discharges during purging prior to collecting a water sample. If the bucket is not calibrated to exactly 5 gallons, the gallon-measuring pitcher will be used to fill the bucket to 5 gallons. A line will be marked on the outside of the bucket at the five-gallon level. A 2-liter beaker can be used to measure low flows during water quality sampling.

The person directing the discharge into the container will instruct the watch reader when to start reading the second hand (or to start the stopwatch). When the water reaches the predetermined mark on the container, the person will tell the watch reader to stop. The readings will be made three times and averaged.

If water is discharged into a container too small for the flow, it will splash and the final calculation will be too low. A large container may be used, if needed, and the water may be allowed to flow into it for a longer period of time.

The information recorded in the field logbook will include the well identification, reason for making the measurement, container size, and number of seconds required to fill the container during each of the three trials. For larger flows, gallons per second will be converted to gallons per minute.

6.4.14 Collecting Data From Multiple-Port Wells

Multiple-port well inserts were installed by Westbay Instruments, Inc., during the MCAS El Toro Phase I RI field investigation. These wells require special equipment to determine the potentiometric surface at a port or to obtain a water quality sample from a port. The directions for the mechanical portion of the work is included in the Westbay Operations Manual and is not repeated here. A copy of the Westbay procedures will be available at the field office. A technician trained and certified by Westbay will measure potentiometric surfaces and collect water quality samples from Westbay wells.

Potentiometric surface-pressure data will be collected from screen-interval pressure ports prior to collecting any water samples. Because the Westbay sampling system is closed to the atmosphere, the groundwater collected from the sampling port should be representative of the aquifer. Thus, the port will not be purged. Manufacturer's procedures and recommendations will be followed.

The sampling cable holding the sample container will be lowered and connected to the port to be sampled. The port will be opened, and the container will be allowed to fill. The container will be brought to the surface and emptied into the appropriate sample bottle or bottles.

The cable and Westbay sampling containers will continue to be lowered, filled, and raised, and the collected groundwater will be transferred until all required sampling bottles are filled. Groundwater sample aliquots will be collected in the following order, ignoring any listed analysis not specified for that sample: VOCs, TPH-gasoline, SVOCs, pesticides/PCBs, TPH-diesel, herbicides, TRPH, inorganic parameters, total cyanide, metals (filtered), and gross alpha and gross beta (filtered). Physical parameters will be collected prior to and subsequent to filling sample bottles.

Upon completion of sample collection at a given port, the equipment will be decontaminated, using the wash and rinse method (Section 6.12.2). The procedure will be repeated for the next sampling port.

Multiple-port Westbay well-pressure measurements and water quality sampling will be documented in a field logbook dedicated to the Westbay systems. The following information items will be recorded: well identification, well condition, pressure port identification and pressure reading, calculation of the potentiometric elevation for the sampling port identification, sample identification and related sampling information, designation of QA and QC samples, documentation of decontamination of equipment between use at differing sampling ports, and any pertinent observations.

6.4.15 Abandonment and Destruction of Wells

Well abandonment and destruction procedures are covered in CLEAN II Program SOP 13. No wells are currently planned for abandonment at MCAS El Toro. However, wells completed as monitoring wells, but not suitable for that purpose, will be classified as abandoned and will be destroyed prior to the end of the Phase II field sampling season. The final decision to abandon and destroy a well will be made by the Site Manager and approved by the BCT. Wells will be destroyed to meet requirements of the California Department of Water Resources, California Well Standards, Bulletins 74-81 and 74-90, Part II, Section 23 (DWR 1988).

Any pumping equipment and downhole debris will be removed and a downhole video will be made of the well. The well will be sounded. The monitoring well will be destroyed by removing all materials within the original borehole, including the well casing, filter pack, and annular seal. Material to be removed from the borehole will be extracted by pulling, drilling, and overdrilling, as needed. Bulk material removed from the hole will be treated as drill cuttings and solid waste.

The entire boring, from the bottom of the original hole to 3 to 5 feet bgs, will be backfilled with an acceptable grout. Acceptable grout for backfilling is defined as follows: neat cement grout shall be composed of a ratio of one 94-pound sack of portland Type II cement to 4.5 to 6.5 gallons of potable water. Sand-cement grout shall be composed of not more than two parts, by weight, of sand and one part (94-pound sack) of portland Type II cement to 4.5 to 6.5 gallons of potable water. Up to 5 percent bentonite powder, by weight, may be added to these mixtures. No other additives will be used.

The near-surface hole will be finished with bentonite chips and sealed with 3,000-psi-strength concrete to the surface. The amount of grout needed to fill the borehole will be calculated before mixing or ordering the grout from a supplier. All sealing material will be emplaced using a grout pump and tremie pipe or equivalent, proceeding upward from the bottom of the boring in a single, continuous pour. The tremie pipe shall never be more than 10 feet above the grout surface in the hole.

Excess grout and potable water used for cleaning grouting equipment may be contained with the drill cuttings from the site. Tremie pipe and other mixing or emplacement equipment may be steam-cleaned on the decontamination pad.

The information will be recorded in the field logbook and the Borehole/Well Abandonment form (Section 7).

6.5 SURFACE WATER QUALITY SAMPLING

Surface water sampling will occur only after a rain, when there is stream flow. Sampling will occur after the first rain, if possible. Because this flow is short-lived, surface water sampling must be preplanned, and other work may stop during the period of sampling. Depending on the number of stations, more than one team may be assembled. Members of each team will be assigned prior to the need for sampling. Dedicated supplies will be stored at the field administration office and will not be used for other sampling efforts.

Suites of sample bottles will be preassembled. No preservatives will be used for metals until samples have been filtered (if metal samples cannot be field filtered, then existing preservative will be rinsed thoroughly from the sample container before it is filled or a clean container will be used). Samples for metals may be field-filtered or marked for filtration in the laboratory. The metals sample bottle will be marked as to whether sample has been filtered or not. Volatile organic analyte (VOA) sample containers will be dipped in the stream and acidified following filling. The unfiltered VOA samples will be the first ones collected.

To avoid introduction of downstream contaminants during sampling, surface water sampling will progress from the farthest downstream sampling point to the farthest upstream sampling point. For stream flows less than 2 feet deep, a sample-collection container (dipper) will be used to collect surface water samples. For larger flows, a depth-integrated sampler will be used. The dipper or depth-integrated sampler will be submerged as close as possible to the center of the flow, although safety is a more important consideration than exact sample location point. A Teflon™ churn splitter will be used to subsample composite samples obtained with the depth-integrated sampler. The water in the collection container will be used to fill the sampling bottles (other than the VOA bottles). The procedure for VOA bottles will be as follows. Select the appropriate bottles as per Section 6.14.1, and check that a Teflon™ liner is present in the cap (if required). Submerge the vial with the mouth of the container upstream, fill slowly, continuously with a minimum entry turbulence. Record pH, conductance, and temperature information in the logbook; and complete the chain-of custody form. A photograph of the sample location should be taken if possible. If photography is not possible, a sketch or description of the sampling location should be made in the field logbook.

Following collection of the water quality sample, the surface water flow velocity and volumetric flow rate at the sampling point will be estimated. Velocity is normally the highest in the center of the flow and in the deeper parts of the channel.

A float will be dropped at the upper end of a predetermined distance. The number of seconds required for the float to travel the distance will be noted. This procedure will be conducted three times, with the float placed in the middle and near each of the two banks. The velocity will be calculated for each float by dividing the distance by the time (feet per second). The value will be averaged.

The width of the cross section will be measured or estimated visually. The depth of water at three or more points along the cross section will be determined by measurement or estimation.

The cross-sectional area will be calculated by averaging the water depths and multiplying that value times the width of the channel (square feet). The volume of flow will be determined by multiplying the velocity by the cross-sectional area by 70 percent to obtain flow in cubic feet per second. (Note: Average surface water velocity is typically 70 percent of the surface velocity.)

6.6 SOIL GAS

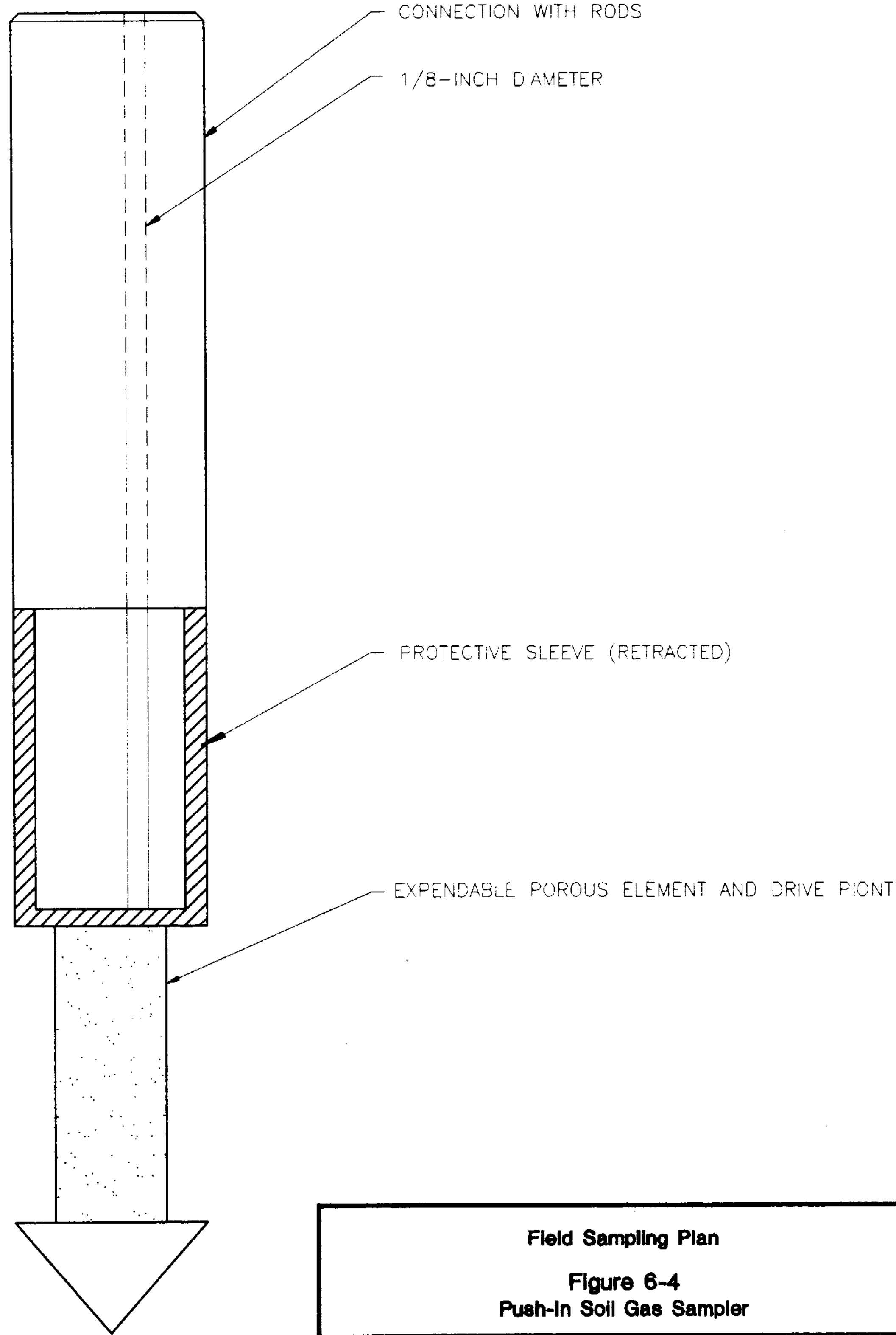
The proposed soil gas investigation will generally follow the California RWQCB Los Angeles Region Requirements for Active Soil Gas Investigation (RWQCB 1994). Presented as an appendix to the QAPP (Appendix C), these guidelines recommend a 10- to 20-foot grid pattern and 5- to 10-foot spacing for vertical samples in the soil gas hot spots. A 100-foot-or-less grid pattern is recommended for the rest of the site. This level of detail is not needed to support the feasibility study or to define the horizontal and vertical extent of VOC contamination at MCAS El Toro. All other guidelines will be followed.

The soil gas samples will be collected using a CPT rig to hydraulically advance the sample probe to the desired depth. Sampling depths will be determined after analyzing CPT lithologic logs, as well as the soil and geophysical logs from the proposed mud-rotary borings. Relatively permeable soils will be targeted for soil gas sampling.

The soil gas sampling probe consists of an expendable porous element and drive point (Figure 6-4). A protective sleeve, which is connected to the drive pipe, fits over the porous element and onto the drive point. Sample tubing runs through the drive pipe to the CPT rig. When the desired sampling location is reached, the drive pipe is pulled back several inches, exposing the porous element to the unsaturated soil.

A mobile laboratory approved by the California RWQCB for soil gas investigations will provide the vacuum device to withdraw a sample of soil gas for analysis. A purge volume versus contaminant concentration test will be performed at the beginning of the soil gas investigation to determine the optimum purge volume and purge rate necessary to collect a representative sample of soil gas. The purge volume and purge rate will be varied to maximize the detected VOC concentrations. TCE and PCE will be the target compounds chosen for the test. The optimum purge volume and purge rate will be used as a guide to collect future samples, recognizing that the soils with different permeabilities will affect the attainable flow rate. Purge volume will be calculated in volume purged per foot of sample tubing to allow for sampling at different depths.

Soil gas samples will be collected with a sampling device provided by the mobile laboratory after purging has been completed. The sample will be taken immediately from the CPT rig to the mobile laboratory for analysis.



Field Sampling Plan

Figure 6-4
Push-In Soil Gas Sampler

MCAS El Toro, California

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After the sample is collected, the drive pipe will be pulled back leaving the expendable porous element and drive point in the ground. The borehole will then be backfilled with bentonite and patched with asphalt or concrete, if necessary.

In the event that the desired soil gas sampling depth cannot be reached using the CPT, a hollow-stem auger boring will be advanced to no less than 10 feet above the sample point, and the CPT will be used to take the sample through the hollow-stem auger annulus. The same sampling procedure described above will be used.

6.7 PILOT TESTS

To evaluate potential response alternatives, several pilot tests will be evaluated at MCAS El Toro. These include:

- SVE,
- air sparging,
- aquifer pump tests, and
- bioremediation.

6.7.1 Soil Vapor Extraction

SVE is a U.S. EPA-approved presumptive remedy for sites with VOCs in soils (U.S. EPA 1993). It is a remedial technique that removes contaminants from unsaturated soils by inducing air flow through the soil matrix. This causes VOCs in the dissolved and adsorbed phases to transfer to the vapor phase. In contaminated soil, an equilibrium is established among the dissolved, adsorbed, and vapor phases. SVE works by drawing relatively cleaner air into the soil and upsetting the equilibrium. To reestablish the equilibrium, a mass transfer of VOCs occurs from the dissolved and adsorbed phases to the vapor phase. Once in the vapor phase, the SVE equipment removes VOCs from the soil, again upsetting the equilibrium, causing mass transfer from the adsorbed and dissolved phases. The process continues until the VOCs are removed from the soil. An SVE pilot test will be performed to evaluate the feasibility of SVE as a remedial alternative at MCAS El Toro.

6.7.1.1 INSTALLATION OF SOIL VAPOR EXTRACTION WELLS

To facilitate the implementation of an SVE pilot test, SVE wells will be installed in areas characterized by elevated soil and soil gas concentrations. The SVE wells will be constructed in hollow-stem auger borings. The wells will be screened in a manner that maximizes VOC removal from the soil. In general, the screened length of a vapor extraction well will not exceed 30 feet (Figure 6-5). This is to avoid pressure loss in the well, which results in most of the extracted soil gas being drawn from a relatively small portion of the screen. Where the contaminated soil interval exceeds 30 feet, nested SVE wells will be installed. Lithologic analysis and field screening for VOCs in the SVE well borings will be key in placing the SVE well screens. Selected borings will be equipped with SVE piezometers to measure induced vacuum pressure. The piezometers will be constructed of nylon tubing (or the equivalent) and set at multiple depths in the test area. Other construction techniques may be used, depending on the expected application of the piezometer. The SVE wells and piezometer network will be designed based on the nature and extent of VOCs encountered in the test area, the stratigraphy, and anticipated permeability of the soil (based on lithologic analysis).

6.7.1.2 SOIL VAPOR EXTRACTION PILOT TESTING

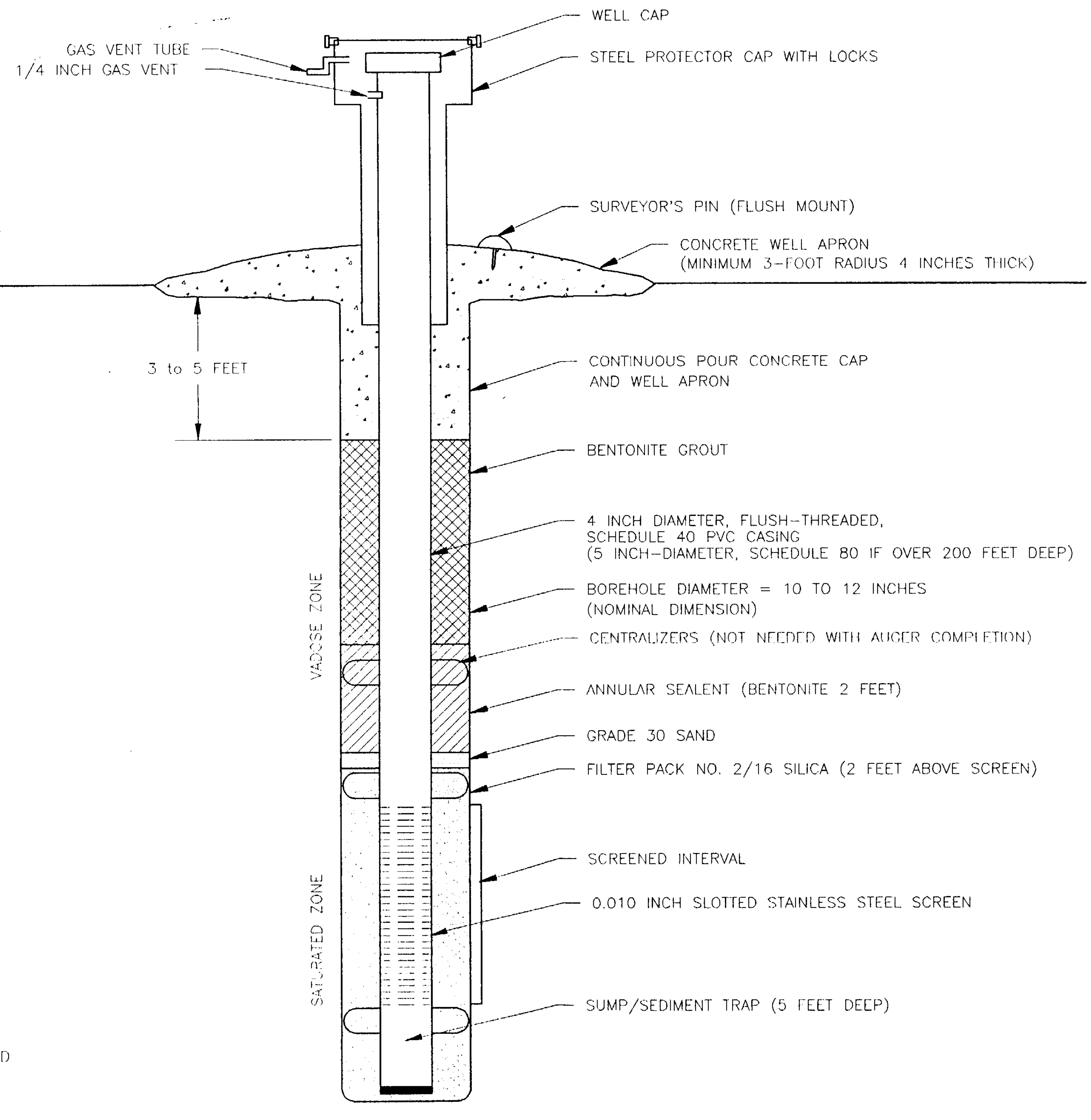
The U.S. EPA has identified SVE as one alternative to remove VOCs from contaminated soil (U.S. EPA 1993). A review of information collected during the Phase I RI noted that an extensive VOC soil gas plume is present beneath Site 24 to at least 30 feet bgs. These data are the clearest indication to date that the source of the VOC groundwater plume may be the contaminated soil beneath Site 24. Before SVE can be implemented, additional site-specific data are required to evaluate potential SVE design alternatives, system efficiency, and cost. The SVE pilot testing will bridge the gap between what is known about SVE technology in general and how a system would operate to remove VOCs from Site 24. Figure 6-6 presents a generalized illustration of an SVE pilot test setup.

Before the pilot tests are conducted, Phase I and Phase II RI data will be reviewed, and the site stratigraphy and contaminant distribution in the soil will be characterized. Areas with high concentrations of VOCs in the soil and soil gas will be targeted for pilot testing. The pilot test data will augment geological and geochemical data by providing information specific to the operation of a SVE system at Site 24. The SVE pilot test objectives are identified below.

6.7.1.3 SOIL VAPOR EXTRACTION PILOT TEST OBJECTIVES

The SVE pilot test objectives are the following:

- evaluate the feasibility of using SVE to remove VOCs from contaminated soil;
- assess site-specific variability in soil gas conductivity, and VOC concentrations in the extracted soil gas;
- characterize the relationship between applied vacuum, volumetric air flow, and radius of influence;
- estimate the effort required to remove VOCs from contaminated soil using SVE (removal efficiency);
- determine treatment requirements for the extracted soil gas;
- reduce cost and performance uncertainties so a decision can be made whether to implement SVE at Site 24; and
- if feasible, provide sufficient data so that an SVE system capable of removing VOCs from contaminated soil beneath Site 24 can be designed.



NOTES:

1. O-RINGS WILL BE USED TO SEAL JOINTS IN CASING.
2. INSTALLATION OF WELLS IN HOLLOW-STEM AUGER BORINGS WILL OCCUR THROUGH THE AUGER.
3. INSTALLATION OF WELLS IN AIR-ROTARY BORINGS WILL OCCUR IN DRIVEN CASING.
4. IF NEEDED, INSTALLATION OF WELLS IN MUD ROTARY BORINGS WILL BE DISCUSSED WITH BCT.

NOT TO SCALE

Field Sampling Plan

Figure 6-5
Soil Vapor Extraction Well Construction

MCAS El Toro, California

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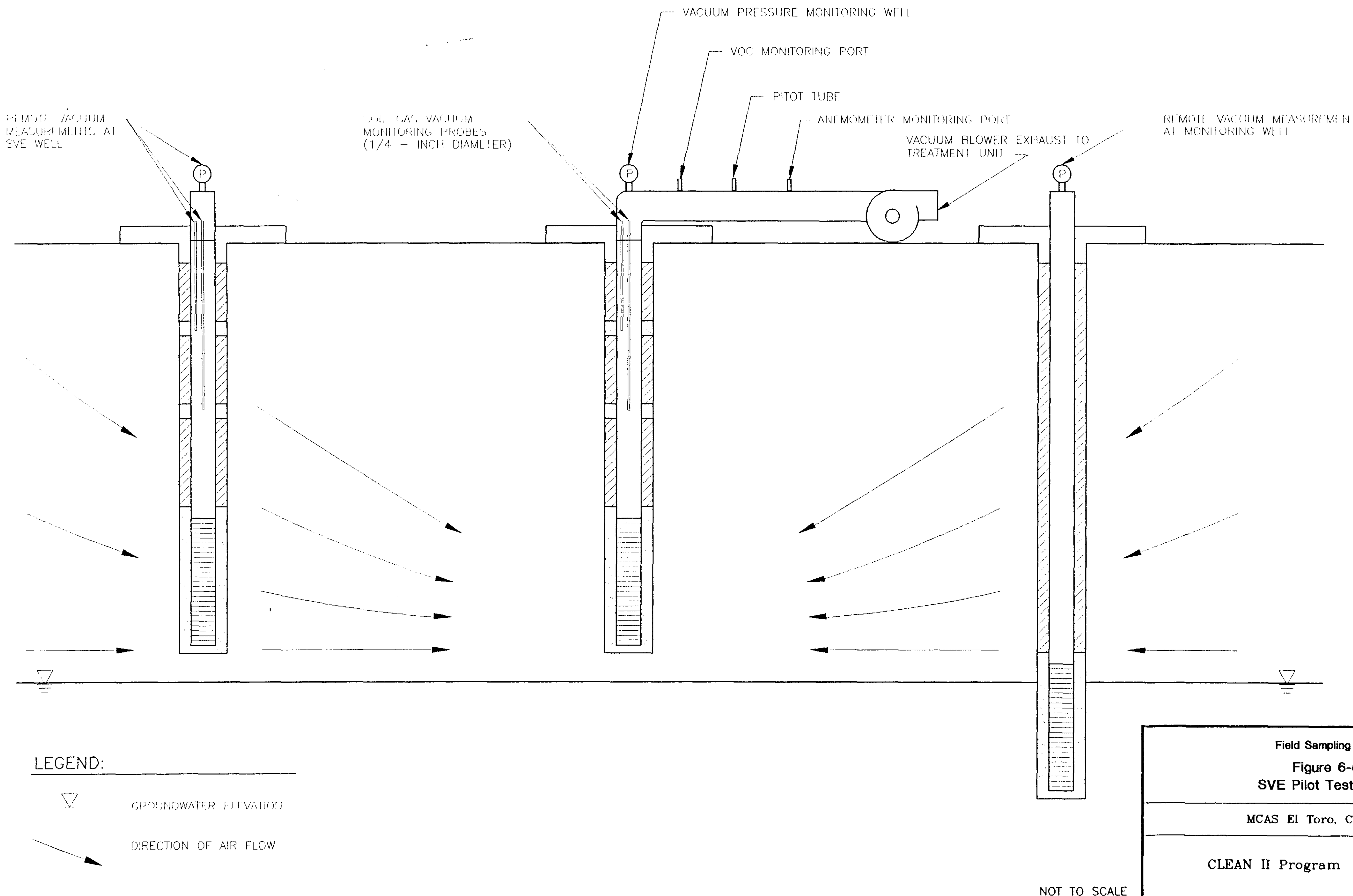

Field Sampling Plan

Figure 6-6
SVE Pilot Test Setup

MCAS El Toro, California

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6.7.1.4 SOIL VAPOR EXTRACTION PILOT TEST DATA REQUIREMENTS

Data collected during the pilot test will be recorded on the SVE Pilot Test Worksheet. Figure 6-6 presents a generalized illustration of an SVE setup. A portable vacuum blower and generator will be used to conduct the pilot test. The vacuum blower will be connected to the SVE well using PVC piping. Sampling ports will be installed in the PVC piping between the SVE well and the vacuum blower to measure vacuum pressure, air flow, and VOC concentrations. Vacuum pressure will be measured with a standard pressure gauge, chosen to cover the range of pressures expected given the size of the vacuum blower and the anticipated soil permeability. Air flow will be measured with a pitot tube, and a portable anemometer. VOC concentrations will be measured in the field with a portable PID, FID, and/or portable GC.

The following information will be recorded in the field logbook:

- description of vacuum blower (i.e., manufacturer, model number, electrical requirements, rated air-flow capacity);
- name of SVE well connected to SVE blower;
- diameter of piping at air-flow measurement sample port;
- names of SVE piezometers used for remote vacuum measurements;
- distance in feet from SVE piezometers to SVE well connected to SVE blower;
- type of device used to measure applied vacuum (i.e., vacuum gauge, 0 to 100 inches water);
- type of measuring device used to measure remote vacuum (e.g., Magnehelic® gauge, 0 to 5 inches water);
- type of device used to measure air flow (i.e., pitot tube, portable anemometer including manufacturer's name and model number);
- type of device used to measure organic vapor concentrations and documentation of calibration;
- drawing or photograph(s) of pilot test equipment showing sampling locations;
- applied vacuum and time of measurement;
- remote vacuum and time of measurement;
- air flow in feet per minute;
- vapor concentration (influent to carbon canisters), time of measurement, and instrument used;
- vapor concentration (effluent from carbon canisters), time of measurement, and instrument used;
- pressure at entrance to first carbon canister;
- pressure at entrance to second carbon canister; and
- sample name and time collected for samples to be submitted to laboratory.

Soil gas samples to be submitted for laboratory analyses will be collected in Suma canisters that have been precleaned and preevacuated (under vacuum) by the laboratory. Soil gas samples will first be collected in a Tedlar™ bag. After the Tedlar™ bag is filled, a small length of new tubing will be attached from the Tedlar™ bag sampling port to the canister sampling port. The valve of the canister will be opened allowing the vacuum in the canister to draw soil gas from the Tedlar™ bag into the canister. In this way, the sample will be collected at atmospheric pressure, and the volume of the canister may be compared to the volume of gas removed from the Tedlar™ bag. The canister valve will then be closed, and the soil gas sample will be delivered to the laboratory.

The effects of the applied vacuum at the SVE well on nearby wells and soil gas piezometers will be monitored with a set of portable pressure gauges capable of measuring vacuum as low as 0.01 inches of water. The duration of the pilot test will be determined based on the rate of decline of VOC concentrations over time. The extracted air will be passed through vapor-phase carbon canisters to control emitted VOC concentrations and to comply with SCAQMD air emissions regulations and permit requirements.

The information obtained from the pilot test that will be used in the feasibility study includes the following:

- effective radius of influence;
- preferential flow paths, if any;
- optimum SVE well spacing;
- extraction air-flow rate vs. applied vacuum;
- VOC concentrations in the extracted air;
- VOC mass removal rate;
- air emission treatment requirements;
- estimated volume of soil to be treated during pilot test; and
- expected time of cleanup.

6.7.2 Air Sparging

Air sparging is a remedial technique that is used to remove VOCs from a contaminated aquifer. In a contaminated aquifer, assuming the absence of dense nonaqueous-phase liquid (DNAPL), VOCs are present in the dissolved and adsorbed phases. Air sparging removes the VOCs by introducing clean air to the aquifer. Because the introduced air is clean, VOCs transfer to the sparging bubbles from the dissolved and adsorbed phases trying to establish an equilibrium with the vapor phase. Air sparging relies on the same mechanism to remove VOCs as SVE, which is a U.S. EPA-approved presumptive remedy for VOC-contaminated soil. VOC mass transfer is initiated in SVE by drawing relatively clean air past contaminated soil; in air sparging, clean air is introduced to the contaminated aquifer. When the sparging bubbles reach the water table, the VOC vapor is captured by an SVE well and treated to meet air quality permit requirements.

6.7.2.1 INSTALLATION OF AIR SPARGING WELLS

A preliminary evaluation of Phase II data suggests that the sparging wells will be drilled approximately 20 feet west of well 09_DBMW45 (the upgradient direction). The proximity is necessary so well 09_DBMW45 can be used as a monitoring point for air-sparging bubble flux. The actual location of the sparging wells will be determined after the stratigraphy and vertical extent of VOC-contaminated groundwater have been characterized. The sparging wells will be completed at a depth to intercept contaminated groundwater. The wells will be constructed of flush-threaded, nominal 2-inch-diameter, Schedule 80, PVC blank casing and 5 feet of flush-threaded, nominal 2-inch-diameter, stainless steel screen with 0.010-inch slots.

SVE wells will also be installed in the sparging well borings. The SVE wells will be set immediately above the water table and will be constructed of flush-threaded, 2-inch-diameter, Schedule 40, PVC blank casing and screen (0.020-inch slots).

6.7.2.2 AIR-SPARGING PILOT TESTING

An air-sparging pilot test is tentatively proposed for the area near monitoring well 09_DBMW45 (Figure 6-7). This currently is the highest known area of VOC contamination at MCAS El Toro. The pilot test area was chosen to demonstrate the effectiveness of air sparging in treating the groundwater hot spot. Before the pilot test is conducted, the vertical extent of VOC-contaminated groundwater will be determined by collecting HydroPunch™ groundwater samples and drilling and sampling the proposed deep well(s) near 09_DBMW45. Groundwater samples will also be collected and analyzed for VOCs from well 09_DBMW45 to characterize initial groundwater conditions before pilot testing. The depth of the sparging wells will be determined based on HydroPunch™ groundwater sample analyses, an analysis of the deep well(s) VOC concentrations in groundwater, and stratigraphy in the test area.

6.7.2.3 AIR-SPARGING PILOT TEST OBJECTIVES

The air-sparging pilot test objectives are the following:

- evaluate the feasibility of using air sparging to remove VOCs from the contaminated aquifer;
- assess VOC concentrations in the extracted soil gas prior to and during the air-sparging pilot test, and estimate the mass of VOCs removed from the contaminated aquifer;
- assess VOC concentrations and dissolved oxygen in groundwater prior to, during, and after the air-sparging pilot test;
- characterize the relationship between air flow, bubble, flux, and radius of influence;

- estimate the effort required to remove VOCs from the contaminated aquifer using air sparging (removal efficiency);
- reduce cost and performance uncertainties so a decision can be made whether to implement air sparging at Site 24; and
- if feasible, provide sufficient data so that an air-sparging system capable of removing VOCs from the contaminated aquifer beneath Site 24 can be designed.

6.7.2.4 AIR-SPARGING PILOT TEST DATA REQUIREMENTS

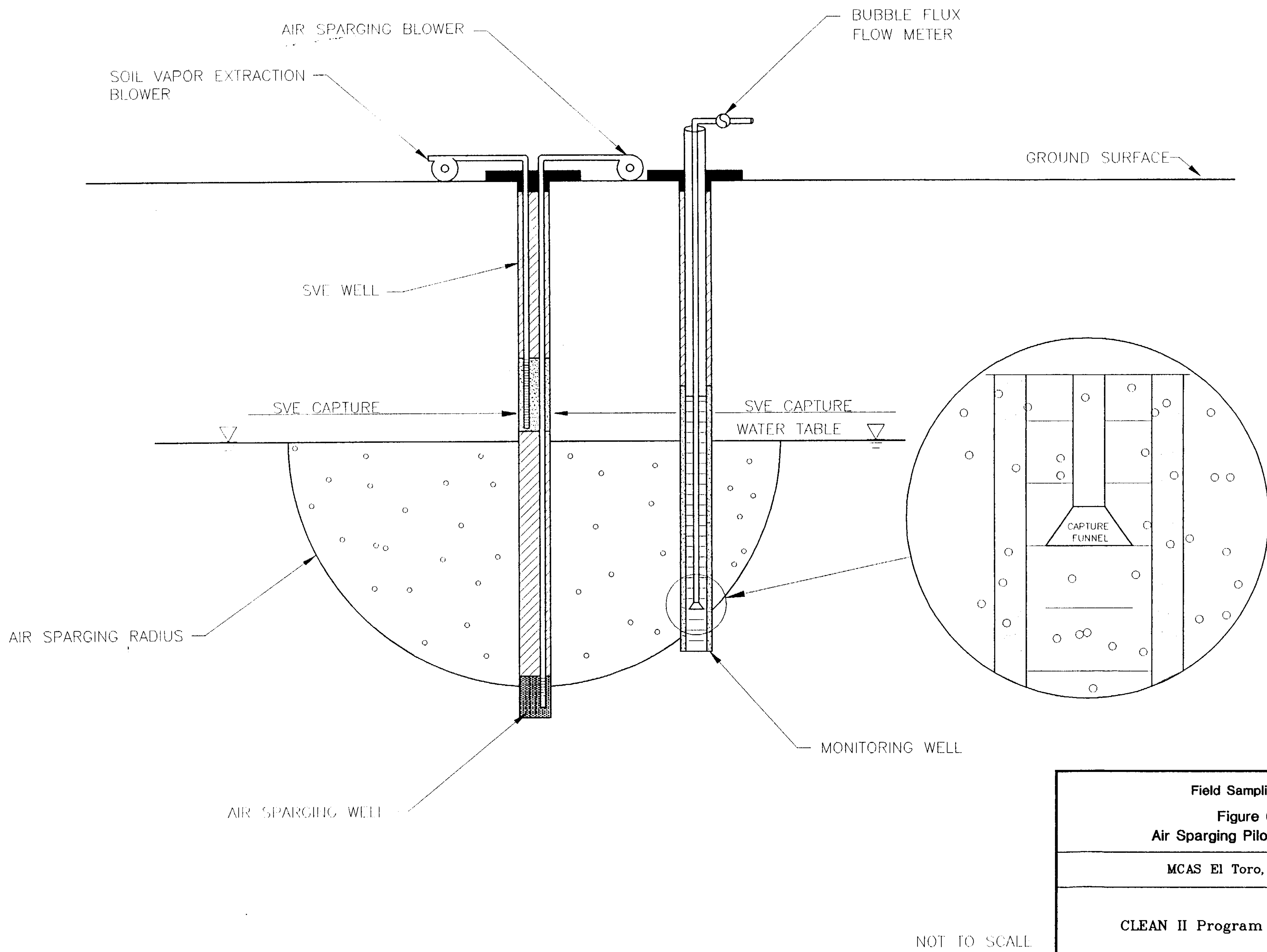
Data collected during the pilot test will be recorded on the Air-Sparging Pilot Test Worksheet. An example of the worksheet is included in Section 7 of this report. Figure 6-7 presents a generalized illustration of an air-sparging pilot test setup.

Air-sparging bubble flux can be used to measure active partitioning in groundwater. Bubble flux is measured by lowering a conduit into the monitoring well near the air-sparging wells. An inverted funnel is attached to the bottom of the conduit to capture the air-sparging bubbles. The conduit is raised and lowered in the monitoring well, where bubbles (under hydrostatic pressure) are captured at the various depths. Bubble flux can then be plotted graphically as bubble flux versus depth. In a homogeneous matrix, the bubble flux curve is expected to be smooth and continuous approaching an asymptotical point at the water table. Erratic flux readings can be used to indicate gaps in sparging coverage due to low permeable lenses. This method can also be used to identify high permeable layers that act as sparging conduits.

The air-sparging pilot test will be conducted using a portable generator and blower. The sparging blower will be connected to the air-sparging wells using PVC piping. Monitoring ports will be installed in the piping to measure air flow and pressure. Air flow will be measured using a pitot tube and portable anemometer. Pressure will be measured with a pressure gauge. Bubble flux will be measured with a rotameter-type flowmeter. A vacuum switch will be conducted to the SVE line such that the sparging blower will be deenergized if a loss of vacuum occurs.

The following information will be recorded in the field logbook:

- description of air-sparging blower (i.e., manufacturer's name, model number, electrical requirements, rated air-flow capacity);
- name of air-sparging well connected to blower;
- diameter of piping at air-flow measurement sample port;
- names of monitoring wells used in the test;
- distance in feet from monitoring wells to the air-sparging wells;
- type of measuring device to measure applied pressure (i.e., pressure gauge, 0 to 50 psi);
- type of measuring device to measure bubble flux (i.e., rotameter, including manufacturer's name, model number, and rated flow capability);



Field Sampling Plan

Figure 6-7
Air Sparging Pilot Test Setup

MCAS El Toro, California

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- drawing or photograph(s) of pilot test equipment showing sample locations;
- applied pressure and time of measurement;
- bubble flux, depth of capture funnel (in 1-foot increments), and time of measurement;
- depth to water in nearby monitoring wells; and
- dissolved oxygen concentration in nearby monitoring wells.

The SVE measurements will be performed (as described in Section 6.7.1.2) and recorded on the SVE Pilot Test Worksheet. Soil gas VOC concentrations will be measured before and after sparging is initiated to assess the contribution of sparging gas to the recovered vapor.

The duration of the pilot test will be based on the rate of decline in VOC concentration in groundwater. The information obtained from the pilot test that will be used in the feasibility study includes the following:

- effective sparging radius of influence;
- preferential flow paths, if any;
- optimum air-sparging well spacing;
- estimated volume of contaminated aquifer treated during pilot test;
- injection air-flow rate vs. bubble flux;
- VOC mass removal rate; and
- expected time of cleanup.

6.7.3 Aquifer Pumping Test

Pumping rates for wells at MCAS El Toro may range from about 20 gpm to about 80 gpm. Drawdown during pumping test will be measured with data loggers, using electric sounder data collected for backup. Temperature, pH, and EC will be measured. Flow will be measured with a meter and/or a container of known volume and watch. The pumping test duration is estimated to be approximately 24 hours. A test duration of 24 hours will provide the data required by the Interim Feasibility Study.

6.7.3.1 EQUIPMENT AND SUPPLIES

The following pumping equipment will be used:

- 4-inch nominal diameter pumps;
- appropriate piping, wiring, and controls for pumps; and
- portable generators.

Measurement equipment will include:

- well-head flow control systems with flowmeter and sampling port,
- flow meters,
- 2-channel data loggers,
- 8-channel data logger,
- 10-pounds per square inch gauge (psig) transducers,
- 20-psig transducers,
- 50-psig transducer, and
- electronic water-level meters.

Miscellaneous items include:

- a stopwatch,
- semilog paper,
- straight edge for plotting during the test,
- pH meter,
- conductivity meter, and
- thermometer.

6.7.3.2 AQUIFER PUMP TESTING

Procedures for performing aquifer pumping and recovery tests relate to four steps: 1) planning, 2) setting the equipment, 3) conducting the test, and 4) posttest "wrap up." The following paragraphs describe the steps involved in each part of the procedure.

Planning the Pumping and Recovery Test

Select the appropriate pump for the test by using the data recorded during well development or previous investigations. Using the estimated pumping rate, select an appropriate pump size and container for holding pumped water. Use the pump curves and friction-loss tables to assure that the pump can maintain the required pumping rate throughout the test.

Check to make sure the equipment needed matches that available and does not interfere with other tests. The pump model, number of drop pipes, sounding pipes, and volume of water to be produced must be given to the drilling subcontractor to assure that the pumping and water-storage equipment is ready and available.

Setting and Checking the Equipment Before the Test

At the site, remove the well cap and monitor for organic vapors. If needed, work with drilling subcontractor to set up an exclusion zone that takes into account the level of organic vapor findings and prevailing wind direction. Design the setup for obtaining manual measurements of flow discharge using a 5-gallon bucket for wells producing 0.5 to 20 gpm, and a flowmeter for wells producing more than 20 gpm.

The drilling subcontractor will set up the pump at the correct depth, using steel drop pipe and PVC sounding pipe. Document that any previously used pump, wire, or drop pipe have been decontaminated. (Note: check valves should be left in pumps.)

Measure and record the length of each drop pipe to confirm the depth setting. A nominal 1-inch-diameter PVC sounding pipe will be attached to the steel discharge pipe. The bottom of the sounding pipe should be about 1 foot above the top of the pump. Attach the electrical wire and the sounding pipe to the drop pipe with plastic ties.

Make sure that the appropriate transducer is used and that the transducer is set at an appropriate depth below the water surface. Secure the transducer cable so that it does not slip during the test. The expected drawdown must be in a range that can be handled by the transducer. Maximum drawdowns (and consequent setting below the water surface) are:

- 10-psig transducer = 23.1 feet,
- 20-psig transducer = 46.2 feet, and
- 50-psig transducer = 115.4 feet.

Set the depth-to-water readings on the data logger using the manual water-level sounder. Set the logger to use "actual readings." Reference depth to water (top of casing). Do not set the recorder at starting water level = 0.00.

Use the reference point (notched or unmarked) on the north side of the PVC casing as the mark from which all measurements are made.

When everything is ready, set the data logger to record depth to water at 15-minute intervals. Call this period, TEST 0, STEP 0. Use the data logger to record background water levels until the following day when the test begins.

Where a separate data logger is used in an observation well (as opposed to be a transducer attached to the same data logger), set the data logger in the monitoring well to record every 15 minutes. Do not change it during the monitoring, pumping, or recovery test.

Procedures During the Pumping and Recovery Test

The day prior to the aquifer test, perform a short pretest following equipment setup to check well development data versus actual discharge, and to assess proper valve position. On the morning of the test, calibrate the pH and EC meters and the air-monitoring equipment. Bring all portable equipment, groundwater sample containers (with labels and custody forms completed as much as possible), and paperwork to the site. Make sure the stopwatch, containers for manual flow calibration, semilog paper, and straight-edge are available.

Make sure ancillary equipment (tanks for water, generator, flow-measuring device or equipment, and pump controls) is in place. Recheck the depth to water, using the water-level sounder. Unless measuring observation wells, leave the electric sounder in the pumping well for additional readings.

TEST 0 has to be stopped to change the log scale. Reset for TEST 1, STEP 0. Set Data logger using the LOG SCALE OPTION. Rest the data logger and start the pump simultaneously.

Start the pumping with the discharge-control valve partially closed. Adjust the pumping rate (using the gate valve) to the targeted flow rate. Measure the flow (discharge rate, Q) using the flowmeter and double-check the flow with a calibrated container and stopwatch, if possible. The initial flow adjustment should be completed as soon as possible and maintained constant throughout the test. As the water level drops in the well, the pumping rate will naturally decline. The gate valve will be gradually opened during the test to compensate for this head loss. The pumping rate must remain constant. Record all information in the field logbook.

Begin (or continue) pumping. Test discharge Q at a minimum in 10-minute intervals for the first hour. Check at 15-minute intervals during the rest of the test. (If the flowmeter appears accurate, divide the total gallons by total minutes and check change in gallons for a 1- or 2-minute period.)

After the first hour, continue to measure and record Q at 15-minute intervals and adjust the valve as needed to keep Q constant. Measure and record drawdown with the proper sounder and compare those measurements with the data logger in the logbook in case these electronic data are lost. Record information in the field logbook. As the data are collected, plot the information on semilog graph paper in the field.

For each well being monitored during the test, plot drawdown on the y (linear) axis, with 0 at the top of the page, against time on the x (logarithmic) axis. Calculate transmissivity (T) for the segment that appears to be the most representative of the test using the following formula:

$$T = 264Q/\Delta h$$

where:

Q = discharge in gpm
Δh = the drawdown in feet

Calculations should be in feet over one log cycle.

Identify the well and show calculations on the log sheet. Indicate Q and variations in Q on the graph.

Procedures for the Recovery Test

At the end of the pumping phase, reset for TEST 1, STEP 1 (or STEP 2). Keep the data logger on the log scale setting. Simultaneously, turn the pump off and step the data logger to measure recovery. The recovery will be measured manually at the end of the first minute and every 30 minutes for the first 4 hours.

Where practical, leave the data logger operating overnight. Record the depth to water against the data logger one final time, and press the STOP control. Disconnect the equipment. Bring the control unit to the field office trailer for the transfer of data. Where practical, bring in the data unit prior to completing other fieldwork.

6.7.3.3 PUMPING TEST RECORDS

Information will be documented at each step in the field logbook. In the field administration trailer, the data will be transferred to 3.5-inch diskettes. One diskette will be left in the field trailer and the second will be stored in the CLEAN II Program San Diego office project files. Each set of pumping test data will be labeled according to the number of the well that was pumped, the type of data, and the date.

6.7.4 Bioremediation

Other remedial alternatives that will be evaluated will include anaerobic and aerobic biodegradation of organic compounds.

6.8 SURFACE EMISSIONS SAMPLING

Surface emissions from the subsurface into the air will be sampled as described in the sections below.

6.8.1 Instantaneous Sampling Survey

This test gives an indication of the landfill gas concentration that is present in the air immediately above the ground surface. Continuous monitoring will be performed by traversing the landfill area in approximately 200-foot intervals with a portable FID held no more than 3 inches above the surface of the ground.

Using the provided landfill topographic drawing as a base, the detected surface measurements will be recorded in a pattern that illustrates the walking course followed during the monitoring sweep. The date, time, and testing conditions will be included on the drawing.

The technician will record instantaneous FID measurements of surface concentrations of total organic vapor. The portable FID will be calibrated to methane and will have a lower detection limit of 0.2 parts per million (ppm).

6.8.1.1 EQUIPMENT DESCRIPTION

The portable FID that will be used to instantaneously measure the concentration of organic vapor on the landfill surface should meet the following recommended specifications:

- range: 0 to 1,000 ppm (volume per volume [v/v]) linear scale or 0 to 10,000 ppm (v/v) logarithmic scale;
- minimum detectable limit: 5 ppm (or lower);
- response time: 15 seconds (or shorter);
- flame out indicator: audible and visual;
- accuracy: ± 4 percent (or better);
- precision: ± 3 percent (or better); and
- ambient temperature: 0 to 50°C;

6.8.2 Integrated Surface Sampling

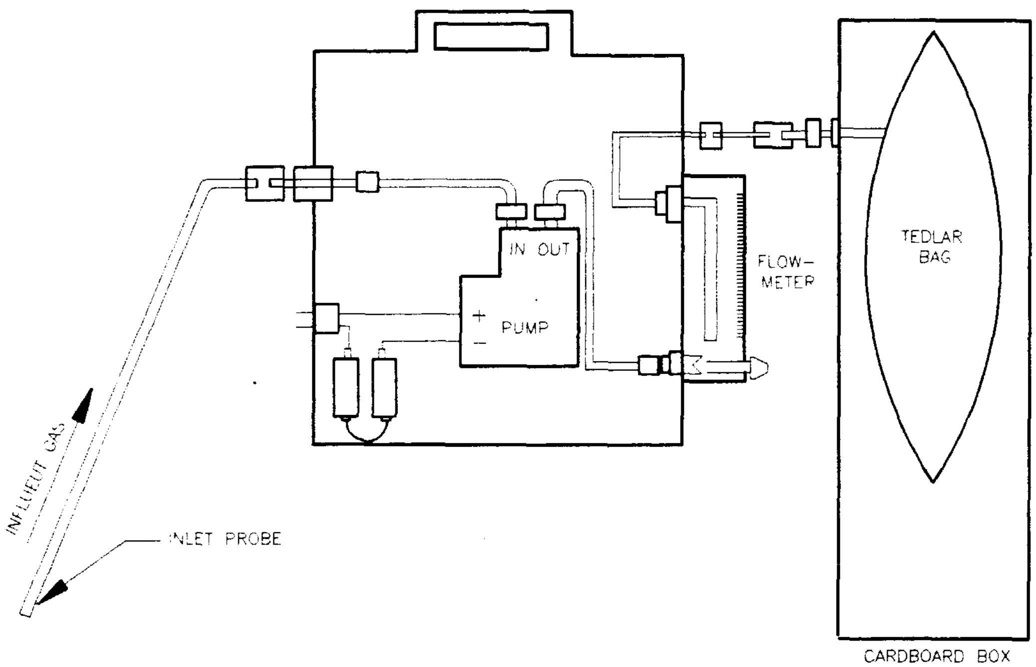
The integrated surface sampler is designed to draw in samples of landfill gas immediately after passing through the disposal site surface cover and entering the atmosphere. The sampler is a portable, handheld unit with its own internal power source that discharges the sample into a Tedlar™ bag (Figure 6-8). The integrated sampler consists of a stainless steel collection probe, a flowmeter, a pump, and a 10-liter Tedlar™ bag enclosed in a light-sealed cardboard box.

One integrated surface sample will be collected in a 10-liter Tedlar™ bag from each 50,000-foot^2 grid using the portable bag sampler. The sampler flow rate will be set at approximately 333 cubic centimeters per minute. During sampling, the probe will be placed approximately 2 to 3 inches above the ground surface. The samples will be enclosed in light-shielded containers at all times.

To measure wind speed throughout the sampling period, a wind-speed monitor with a continuous recorder will be installed in an area with unobstructed wind flow from all quadrants. Sampling will be conducted during a period when the average wind speed is less than 5 miles per hour, as determined on a 10-minute average. Surface sampling will terminate if the average wind speed exceeds 5 miles per hour or the instantaneous wind speed exceed 10 miles per hour. Surface monitoring will be conducted when the site is dry and no rain has fallen during the preceding 72 hours.

Equipment Description

An integrated surface sampler is a portable self-contained unit with an internal power source. The integrated sampler consists of a stainless steel collection probe, a flowmeter, a pump, and a 10-liter Tedlar™ bag enclosed in a light-sealed cardboard box. The physical layout of the sampler is shown in Figure 6-9.



NOT TO SCALE

Field Sampling Plan

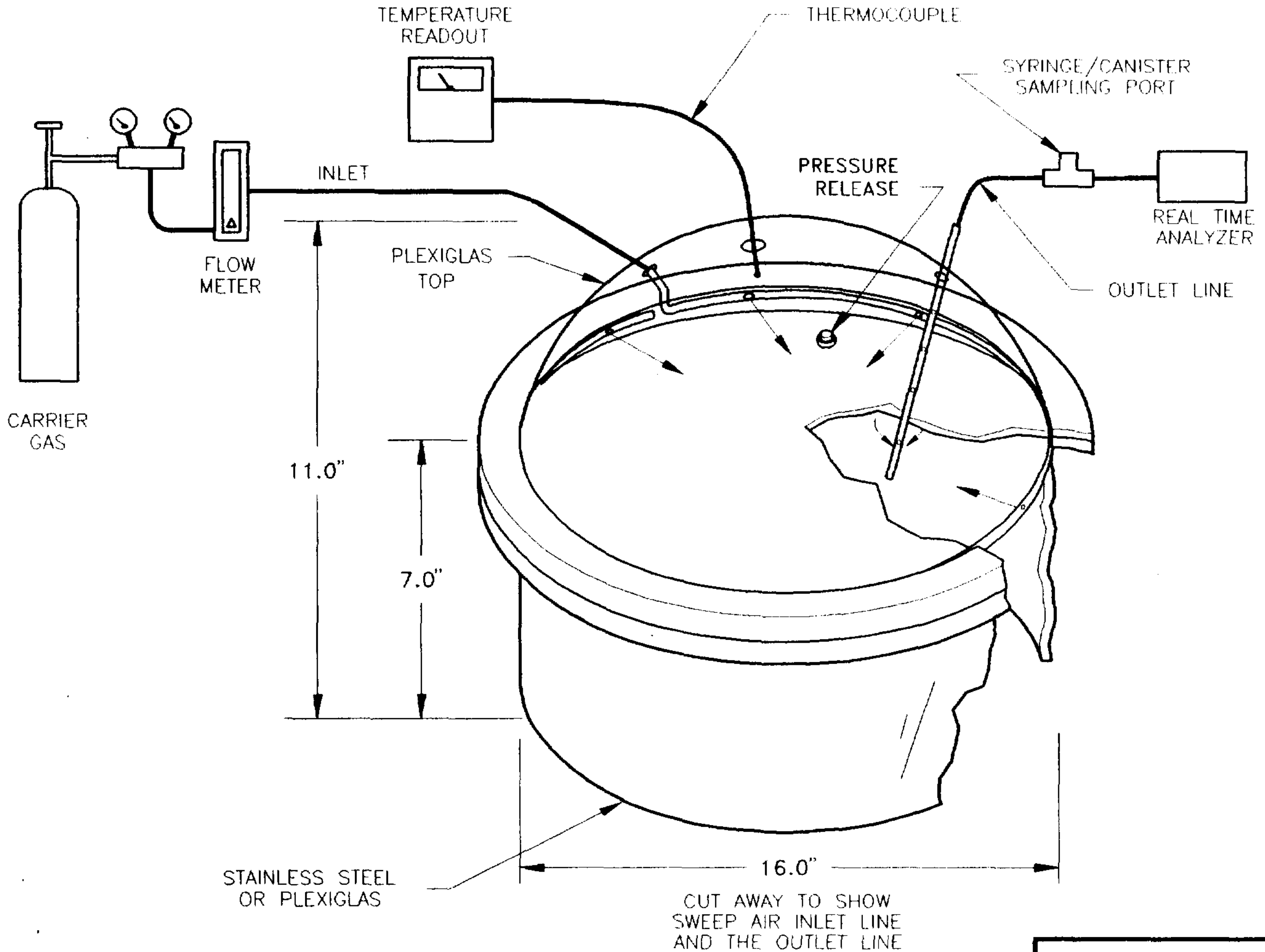
Figure 6-8

Integrated Surface Sampler

MCAS El Toro, California

CLEAN II Program

Date: 7/10/95
File No. s24f6-5
Job No. 22214-064



Field Sampling Plan

Figure 6-9
Emission Isolation Flux Chamber Setup

MCAS El Toro, California

CLEAN II Program

Date: 7/10/95
File No. S24f6-10
Job No. 22214-059

Equipment Specifications

- Power: two 9-volt batteries.
- Pumps: one 12V-DC pump. The diaphragm is made of nonlubricated Viton™ (Dupont trade name for copolymer of hexafluoropropylene and vinylidene fluoride) rubber. The maximum pump unloaded flow rate is 4.5 liters per minute.
- Bag: one 10-liter Tedlar™ bag with a valve. The Tedlar™ bag is contained in a light-sealed cardboard box to prevent photochemical reactions from occurring during sampling and transportation. The valve is a push-pull type constructed of aluminum and stainless steel, with a Viton™ or Buna-N (butadiene acrylonitrile copolymer) O-ring seal.
- Rotameter: The rotameter is made of borosilicate glass and has a flow range of 0 to 1 liter per minute. The scale is in milliliters with major graduations (labeled) every 5 milliliters and minor graduations every 1 milliliter.
- Air flow control orifice: needle valve in the flow meter.
- Funnel: 316 stainless steel.
- Fittings, tubing, and connectors: 316 stainless steel or Teflon™.
- Wind-speed monitor with a continuous recorder: three-cup assembly, range 0 to 50 miles per hour, with a threshold limit of 0.75 miles per hour or less.

6.8.3 Flux Chamber

The volatilization rate of organic compound emission from the subsurface into the air will be directly measured using an emission isolation flux chamber. Specifications for the emission isolation flux chamber are provided in Table 6-1, and the setup of the chamber is illustrated in Figure 6-9. All exposed chamber surfaces will be cleaned with water and wiped dry prior to use. The sampling apparatus will be assembled to check for malfunctions and leaks.

The flux chamber will be placed over the surface area to be sampled and worked into the surface to a depth of 2 to 3 centimeters. Flux chamber sampling procedures are as follows: Initiate the weep air and set the flow rate a 5 liters per minute (L/min). Record data at time intervals defined by residence times or τ, where 1τ = flux chamber volume (30L)/sweep air flow rate (5L/min). One τ then has the value of 6 minutes under normal operating conditions. At $\tau = 0$ (flux chamber placement), record the following: time, sweep air rate, chamber air temperature, ambient air temperature, and exit gas concentration (real-time analyzer). The data will be recorded in the field logbook. At each residence time (τ, 6 minutes), the sweep air rate shall be checked (and corrected to 5 L/min if necessary), and the gas concentration shall be recorded (real-time analyzer). After four residence times (24 minutes), initiate sample collection. At this time, record the following data: time, sweep air rate, air temperatures inside and outside, exit gas concentration, and sample number(s). If sulfonated organic compounds are of specific interest, then measurements should be taken after 10 residence times (1 hour).

Table 6-1
Equipment Specifications

Item	Description	Specification
Carrier Gas Lines		
Inlet/Outlet	Teflon™	1/4-inch OD[a], 5 to 8 feet long, thin walled, 1/4-inch stainless steel fittings
Sweep Air Wrap Perforation[b]	stainless steel	1/4-inch OD, 54 inches long, perforated
	four equidistant holes	hole no. 1 (nearest input), 5/64-inch ID[c], holes no. 2-4, 3/32-inch ID
	jetting direction	axially, horizontally
Fittings[d]	stainless steel	1/4-inch bulkheads with Teflon™ washers for chamber penetration
	stainless steel	1/4-inch cap to seal-wrap line end
Thermocouples Air (1)	fine wire, K type	36-inch-long, bead tip, Teflon™ (extensions optional), penetrate flux chamber 3-inch, support with 1/4-inch bulkhead with septa
Flux Chamber		
Base	stainless steel column	16-inch ID, 7 inches tall, welded to a support ring flange
Support Ring Flange	stainless steel	16-inch ID, 20-inch OD, 1/4 inches thick
Dome	acrylic	spherical, 4-inch displacement at center, 16-inch ID at seal, 2-inch lip for seal, 1/4 inches thick, molded
	four holes	equidistant, 4 inches from aluminum gasket
	inlet/outlet	1/2-inch ID with 1/4-inch stainless steel bulkhead
	air temperature	1/2-inch ID with 1/4-inch stainless steel bulkhead
	pressure release	13/16-inch ID with 3/4-inch stainless steel bulkhead
Seal		
Dome to Base	top gasket	aluminum 16-inch ID, 20-inch OD, 1/4 inches thick
	dome lip	below aluminum gasket is the acrylic lip of dome
	sealing washer	Teflon™, 16-inch ID, 20-inch OD, 1/32 inches thick
	bottom gasket	stainless steel support ring
	fasteners	20, 1/4-inch bolts equidistant around lip
Volume	1-inch soil penetration	0.03 $meters^3$ (30 liters)
Surface Area	enclosed by chamber	0.130 $meters^2$
Exit Line Probe	Teflon™	1/4-inch OD, 6 inches long, stainless steel fitting, perforated
Perforation	2 rows of holes	3/32-inch ID, five holes per row, 1-inch separation, rows are orthogonal

Notes:
[a] OD – outside diameter
[b] avoid placement of exit line probe in jetting path of sweep air inlet holes
[c] ID – inside diameter
[d] all fittings are manufactured by Swagelok® or equivalent; (bulkheads use Teflon™ washers for sealing)

When real-time monitoring is required, the sample is collected by the real-time analyzer directly from the exit gas line. When discrete samples are collected, the sample collection should not exceed a flow rate of 2 L/min.

Sample collections with syringes should be performed after purging the syringe three times with sample gas. This should be performed without removing the syringe from the sampling line manifold. To assure a fresh sample at each purge, the sampling manifold should be positioned upstream of a real-time analyzer. The analyzer will then draw the sample past the manifold for sampling.

The emission rate is calculated as:

$$E_i = Y_i \times Q/A$$

where:

E_i = emission rate of component i (mass/area-time),
Y_i = concentration of component i in the air flowing from the chamber (mass/volume),
Q = flow rate of air into the chamber (volume/time),
A = surface area enclosed by the chamber (area).

All parameters in the equation are measured directly.

6.8.4 Ambient Air Sampling

The ambient air monitoring program was designed to meet the requirements of California Health and Safety Code Section 41805.5. The program is based on geographical and meteorological profiles constructed from existing data prepared by the SCAQMD, as well as a site inspection and evaluation of meteorological characteristics, landfill configuration, and area topography. A preliminary 3-day meteorological survey will be conducted to aid in the sampling program design.

The ambient air sampling program was derived from Option Two in the Air Resources Board ambient air-sampling guidelines (CARB 1990). This option provides for 24-hour and less-than 24-hour ambient air sampling to be conducted on three different, not necessarily consecutive, days. The exact sample locations within these areas will be determined based on the results of the meteorological survey.

Using the portable sampling units, a 10-liter ambient air sample will be collected in a Tedlar™ bag from each station over each of the 24-hour periods, beginning at approximately 10 a.m. The sampling locations will be marked on a landfill topographic map that is drawn to scale. The samples will be removed from the samplers immediately after each 24-hour sampling period.

The sampling equipment will be located at or near the perimeter of the site in the clear and away from surrounding obstructions. The inlet probes for the ambient samplers will be located between 6 and 9 feet above the ground and a minimum of 60 feet from obstacles such as trees, shrubbery, and buildings. Air flow around the inlet probe will be unrestricted in an arc of at least 270 degrees, with the predominant wind direction for greatest expected pollutant concentration potential included in the 270-degree arc. The sampler locations will be carefully selected to assure the predicted prevailing wind patterns for the sampling dates will flow across the main body of the disposal site to the downwind sampling station.

Ambient air sampling will be conducted on three days when stable (offshore flow) and unstable (onshore sea breeze) meteorological conditions are characterized by:

- stable nights with average wind speeds of 5 miles per hour or less, and
- daytime conditions with average wind speeds of 10 miles per hour or less.

No sampling will be conducted when it is raining or when the average 24-hour wind speed exceeds 10 miles per hour.

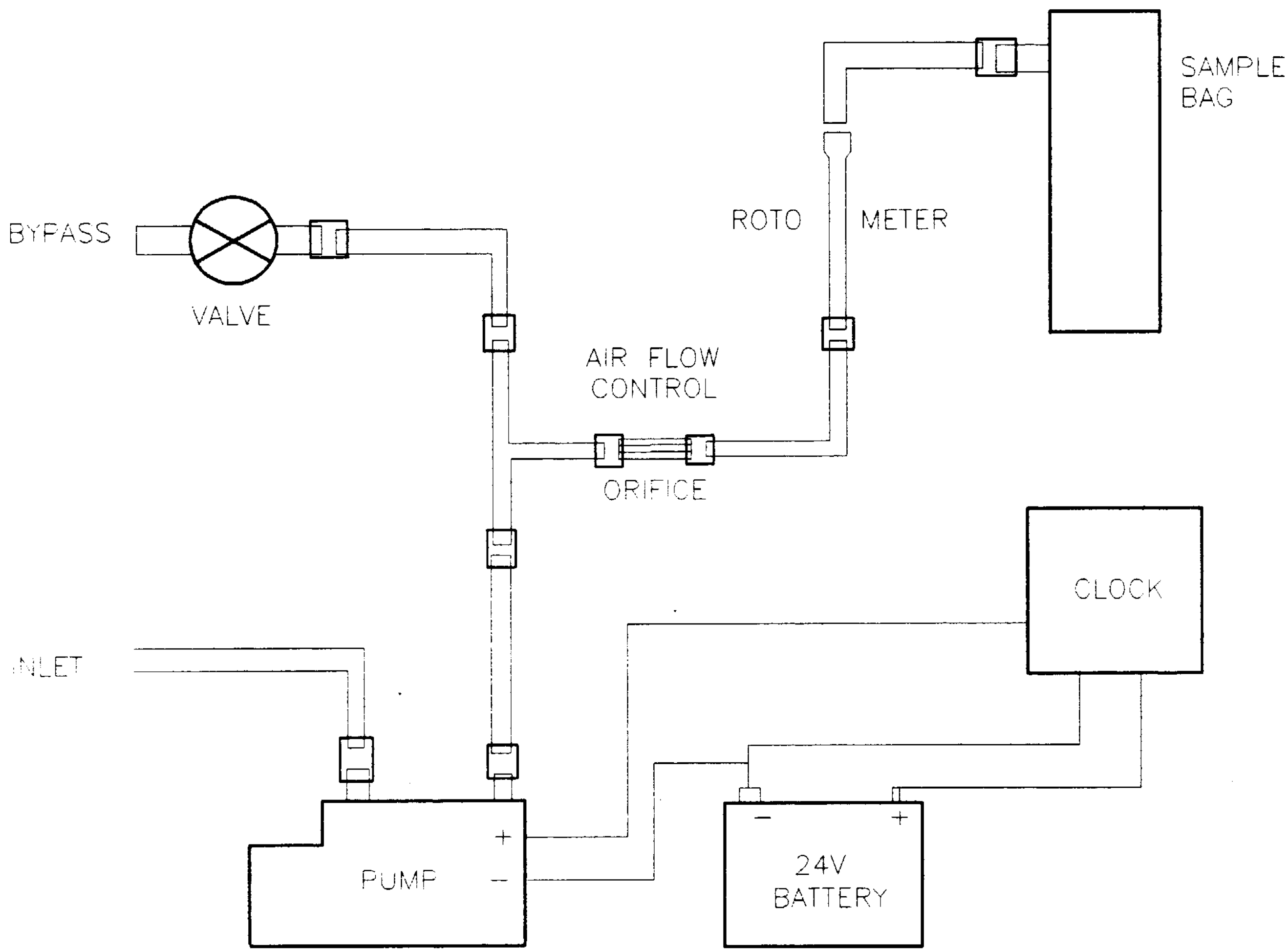
Each complete sampling system will be vacuum leak tested before being sent to the field. Between uses, the integrated ambient air sampler will be decontaminated by flushing the system with ambient air for 5 minutes followed by zero air for 5 minutes. Before sampling, the sampler will be purged with ambient air so that the sample will not be diluted with zero air.

6.8.4.1 EQUIPMENT DESCRIPTION

An ambient air sampling unit consists of a 10-liter Tedlar™ (Dupont trade name for polyvinyl fluoride) bag, a direct current (DC)-operated pump, stainless steel capillary tubing to control the sample rate to the bag, a bypass valve to control the sample flow rate (and minimize back pressure on the pump), a rotameter for flow indication to aid in setting the flow, a 24-hour clock timer to shut off the sampler at the end of the 24-hour sampling period, and associated tubing and connections (made of stainless steel, Teflon™, or borosilicate glass to minimize contamination and reactivity). The physical layout of the sampler is shown in Figure 6-10.

6.8.4.2 EQUIPMENT SPECIFICATIONS

- Power: one 12V-DC marine battery.
- The marine battery provides 12V-DC to the pump and the clock.
- Pump: one 12V-DC pump.
- The diaphragm is made of nonlubricated Viton™ (Dupont trade name for copolymer of hexafluoropropylene and vinylidene fluoride) rubber. The maximum pump unloaded flow rate is 4.5 L/min.
- Bag: one 10-liter Tedlar™ bag with a valve.
- The Tedlar™ bag is enclosed in a light-sealed cardboard box to prevent photochemical reactions from occurring during sampling and transportation. The valve is a push-pull type constructed of aluminum and stainless steel, with a Viton™ or Buna-N (butadiene acrylonitrile copolymer) O-ring seal.



Field Sampling Plan

Figure 6-10
Ambient Air Sampling Device

MCAS El Toro, California

CLEAN II Program	Date: 7/10/95 File No. S24F6-9 Job No. 22214-059

- Rotameter: rotameter is made of borosilicate glass and has a flow range of 3 to 50 cubic centimeters per minute. The scale is in millimeters with major graduations (labeled) every 5 millimeters and minor graduations every millimeter.
- Air-flow control orifice: 316 stainless steel capillary tubing.
- Bypass valve.
- Fittings, tubing, and connectors: 316 stainless steel or Teflon™.
- Clock timer.
- Wind speed and direction monitor with continuous recorder.
  1. Wind speed: three-cup assembly, range 0 to 50 miles per hour with a threshold of 0.75 miles per hour or less.
  2. Wind direction: vane, range 0 to 540 degrees with a threshold of 0.75 miles per hour or less.

6.8.5 Meteorological Data

Meteorological surveys will be performed over a 3-day period prior to ambient air sampling in order to determine and verify the local wind flow patterns. Wind data will be representative of typical meteorological conditions expected for the time of the year the sampling program will be initiated. The results will be used to assist in identifying the optimum number and locations of samplers and the duration of drainage conditions (hours per day) to conduct an effective ambient air-monitoring program. A wind-recording system will be placed at the site boundary for three 24-hour periods to verify the prevailing daily and nightly wind patterns and to determine the total hours of local nighttime drainage conditions.

6.9 SURFACE GEOPHYSICS

Geophysical survey methods are nonintrusive surveys of physical and chemical properties of a site. Many geophysical methods require minimum mobilization and field efforts to identify physical anomalies. These parameters are then used in the calculation of porosity, permeability, fluid saturation, density, and lithology. Surface geophysics will be used primarily in the landfill areas to delineate excavated and refilled areas and to locate buried metallic objects. These geophysical tools are usually hand-carried, rolled, or pulled by hand.

6.9.1 Electromagnetic Induction Profiling

The EM device induces an EM field and measures the conductivity of the subsurface. The change in the ground conductivity is due to the difference in the conductivity of buried debris versus the native soil or the disturbance of the native soils caused by excavation. A transmit coil generates an EM field, and a receiving coil in the vicinity picks up the resulting field.

The frequency of operation and spacing in the EM device are designed so that the depth determination is relatively independent of the ground conductivity, and the apparent conductivity is a direct readout. The instrument is designed so that it can differentiate between the waste with and without the metallic debris. The main applications of EM surveys are searching areas for uncontrolled and unknown waste pits and trenches, defining the landfill boundaries, and locating buried drums and other metallic objects. The limitation of the EM survey can be interference caused by the presence of metallic structures (e.g., buildings, buried utilities, metal fences, and reinforced concrete) and the lack of distinction between surface and buried debris caused by the presence of metallic debris scattered over the surface.

6.9.2 Electromagnetic Time-Domain Buried Object Detector

The time-domain EM device consists of one transmitter and two receiver coils. The instrument is designed so that the signal (due to buried objects) is enhanced and background signal is low. The time-domain EM device uses a half-duty-cycle waveform, and the measurement is made during the time that the transmitter is off. The instrument has a better lateral resolution and reduced radius of interference caused by surrounding metallic objects. The main applications of time-domain EM device are locating buried drums, USTs, and other buried metallic objects.

6.10 LEACHATE SAMPLING

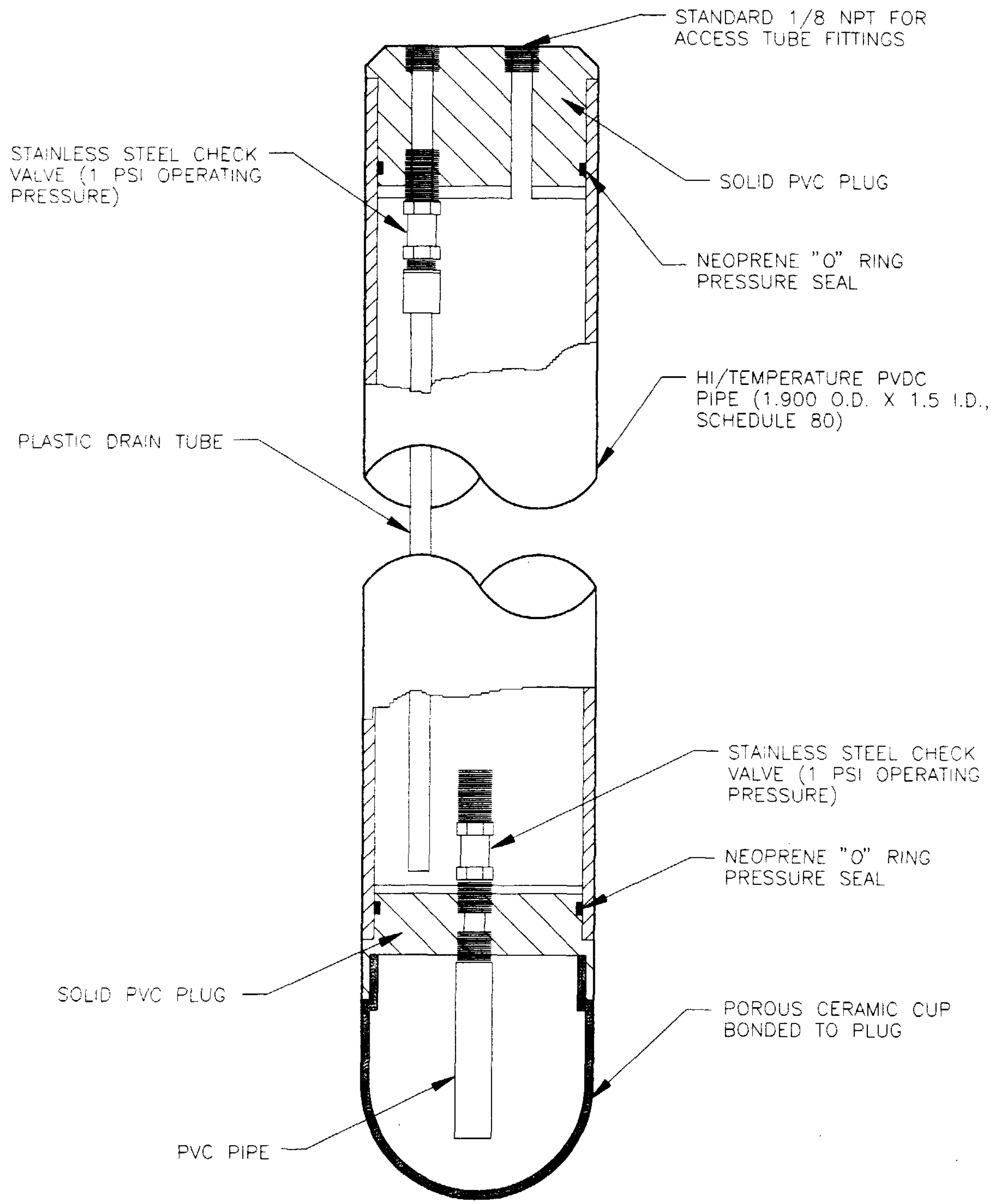
Collection of leachate or soil moisture samples will be conducted at landfill sites in conjunction with installation of a soil gas probe beneath these sites. The purpose of soil moisture sampling is to assess whether the landfill is releasing leachates to the subsurface. If soil moisture is not collected, a soil gas probe will be installed along with the soil moisture sample, which will sample for landfill gases.

6.10.1 Lysimeters

To assess whether leachate is released at Sites 3, 5, and 17, lysimeters will be installed beneath these sites to collect soil moisture. A typical lysimeter is illustrated in Figure 6-11. In general, the lysimeter consists of a porous ceramic cup that collects soil moisture. This soil moisture is then evacuated with a vacuum pump and captured in the appropriate sample container. Two lysimeters will be installed the landfills, and one upgradient lysimeter will be installed outside of the landfill to establish background/ ambient soil moisture conditions. The installation and sampling procedures are discussed below.

6.10.1.1 LYSIMETER INSTALLATION

The lysimeter will be installed in angle borings constructed with hollow-stem augers. The depth of the boring will be approximately 100 feet. The goal is to position the lysimeter beneath known or suspected landfill debris. Once the boring reaches the desired depth, a small quantity of crushed 200-mesh silica sand will be tremied to the



APPROXIMATE OVERALL DIMENSIONS:
2-INCH OUTSIDE DIAMETER BY
24-INCHES LONG

Field Sampling Plan

Figure 6-11
Lysimeter

MCAS El Toro, California

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bottom of the boring. The lysimeter with attached blank casing (to protect access and sampling tubes) will be inserted and 200-mesh crushed silica sand will be tremied around the lysimeter as the auger is withdrawn. The 200-mesh crushed silica will be tremied to approximate 2 feet above the lysimeter (Figure 6-12).

To facilitate soil gas sampling near the lysimeter, approximately 1 foot of No. 2/16 silica sand will be placed on top of the 200-mesh sand, and a soil gas probe will be installed. The soil gas probe will consist of 2-foot-long, 1-inch diameter, 0.020-slot PVC screen, which will be screw-threaded to 1-inch-diameter PVC blank casing. The filter sand pack will be placed to 2 feet above the screen, and a transition sand pack of No. 60 sand will be placed above it. Bentonite grout will be tremied from the transition seal to near the surface (approximately 2 feet) where a concrete surface seal and monitoring well head box will be constructed (Figure 6-12).

6.10.2 Lysimeter Sampling

Sampling off the lysimeter will occur as soon as possible after completion, but sooner than 48 hours after the annular grout seal has been installed. The procedure to be followed is detailed below.

1. Upon arriving at the sample station, check the neoprene rubber ends of the sample lines for dirt and dust accumulation. If necessary, flush the ends of the sample line using distilled water from a laboratory squirt bottle.
2. Connect the pressure/vacuum line to the vacuum gauge porthole of the vacuum hand pump. Open the clamp on the vacuum line and read and record the residual vacuum remaining on the lysimeter unit.
3. Connect the pressure/vacuum line to the nitrogen gas cylinder or hand air pump.
4. Open the clamp on the discharge line.
5. Open the sample bottle supplied by the laboratory. Insert the discharge line approximately 1 inch inside the top of the bottle.
6. Begin pumping or open the cylinder pressure valve to allow the air to flow into the lysimeter at approximately 20 psi. If additional pressure is needed to retrieve the sample more quickly, the pressure may be increased in increments of 2 psi until adequate flow is achieved. Never exceed 30 psi; damage may result in the system. Record the pressure necessary for that particular lysimeter for future reference. The initial 5 to 10 mL of water will be wasted to purge the sample lines.

   After the water sample has stopped flowing from the discharge line, allow the gas to purge the system approximately 1 minute while the discharge line is still inserted in the top of the sample bottle. Using inert gas will allow the gas to purge the lysimeter of residual atmospheric oxygen and water, and it will also partially purge the sample bottle headspace of air. Place cap on the sample bottle immediately.

7. Close the sample lines after the purge is completed and provide protective covering for the lysimeter lines. If necessary, place a vacuum on the unit at this time.
8. If the sample is to be split to other containers for duplicate analyses or acid preservation, it should be done at this time.
9. Excess water should be field-analyzed for pH, EC, dissolved oxygen, or other useful parameters.
10. Water samples, regardless of preservation technique, should be kept on ice in a cooler while they are in the field and during their transportation to the analytical laboratory.

The soil gas probe will be purged to maximize VOC concentrations (Section 6.6). The optimum purge volume and purge rate will be used as a guide to collect future samples. The soil gas sample will be collected with a Tedlar™ bag and submitted for analysis.

6.11 ECOLOGICAL SAMPLES

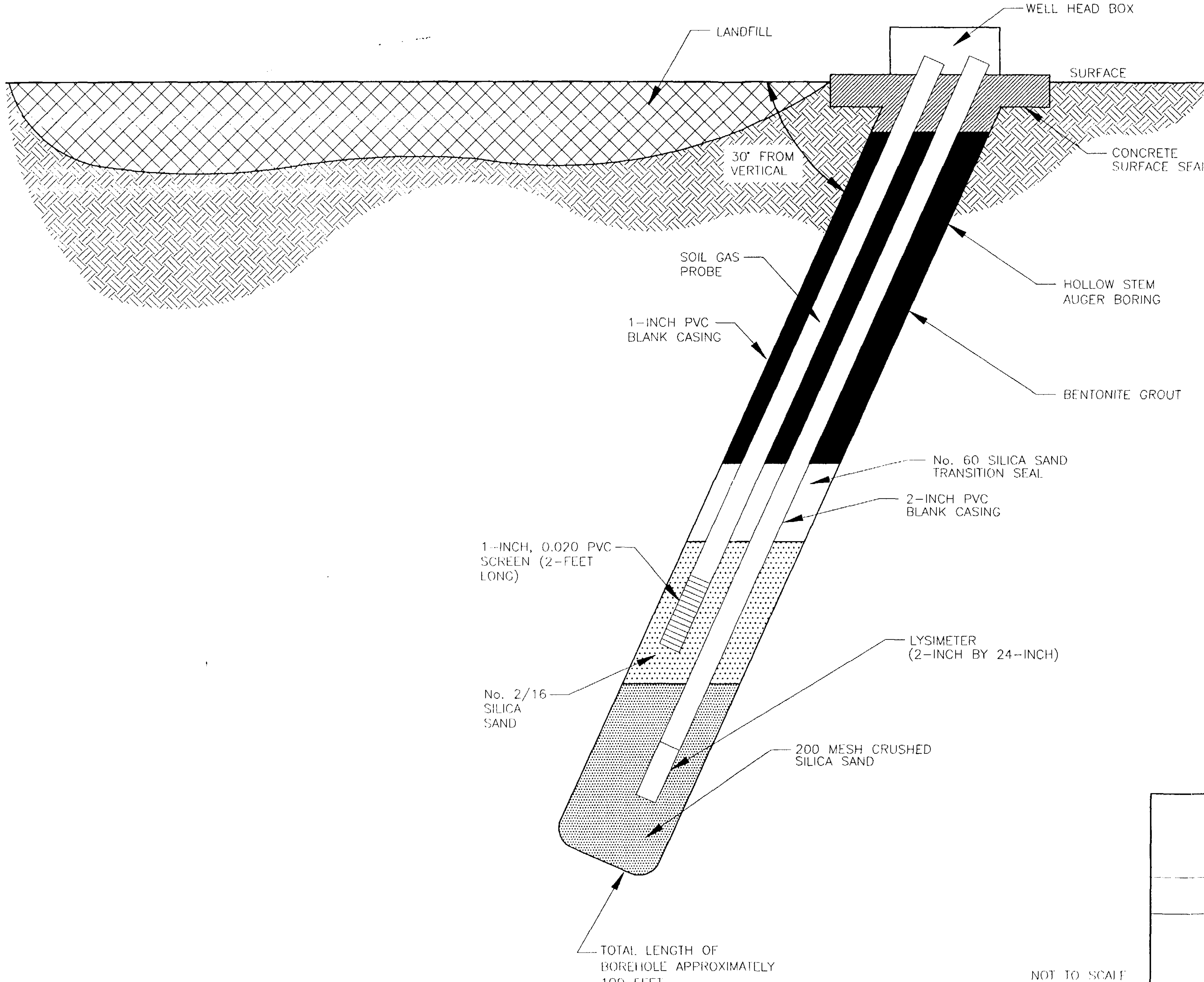
Samples of biota will be collected at Sites 2 and 17 to provide additional data to the proposed predictive model of the Phase II RI/FS ecological risk assessment (BNI 1995d). The purpose of the proposed biota is twofold:

- to provide a quantitative assessment of potential uptake of contaminants into the food chain, and
- to provide data that will be used to evaluate remedial alternatives.

The ecological risk assessment for the Phase II RI/FS will rely principally on a predictive model to assess potential ecological impacts. However, the ecosystems present at Sites 2 and 17 are known to consist of sensitive habitats and species. Because these sites are landfills with known contaminants, a potential ecological risk may be present.

To assess this potential ecological risk and provide data that will be useful for evaluation of remedial alternatives, soil invertebrates, such as earthworms or deer mice, will be collected from each site and a reference site near Sites 2 and 17 (an area that is not suspected of being contaminated). Up to 15 samples will be collected from the three sites and submitted for whole-body chemical analysis. Sampling locations will be established by constructing a grid to provide 50 evenly spaced sampling points at each site (Site 2, Site 17, and reference site). The 15 sampling locations will be randomly selected at each site. The types of biota and sampling procedures are presented in the Risk Assessment Plan (BNI 1995d).

Biota samples will be placed in clean glass jars and submitted for analyses of pesticides by U.S. EPA Method 8080, SVOCs by U.S. EPA Method 8270, and metals by U.S. EPA Method Series 6000/7000. Approximately 60 grams wet weight of tissues are required from each sample to conduct these analyses.



Field Sampling Plan

Figure 6-12
Lysimeter Installation

MCAS El Toro, California

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The following information will be recorded in the field logbook:

- date and time of sample collection,
- general meteorological data,
- location of sample,
- vegetation,
- equipment used,
- sample number,
- dimensions of soil excavation,
- number of individuals from each location,
- deviations from sampling plan,
- sampler name, and
- sampling method.

Prior to chemical analyses, the sample will be homogenized to obtain a uniform tissue sample. Homogenization will occur at the analytical laboratory thus eliminating the need for chemical preservative during shipping; however, the samples will be shipped in a chilled cooler.

6.12 DECONTAMINATION

This section describes decontamination of all material that is reused during the Phase II field investigation. It does not include personnel decontamination, which is described in the Site-Specific Health and Safety Plan (BNI 1995f).

Decontamination is the process of neutralizing, washing, rinsing, and removing contaminants from the exposed surfaces of equipment to minimize the potential for contamination migration or cross-contamination. All equipment should be decontaminated before it arrives at the site and before it leaves the site.

At MCAS El Toro, the waste staging area (WSA) has two concrete-lined decontamination areas with containment sumps for decontamination wastes. Any decontamination project that requires a large amount of wash and rinse water will be done on one of these pads, including all steam cleaning of vehicles and equipment. This will facilitate the collection and treatment of decontamination solutions.

All surfaces will be completely cleaned after equipment decontamination. The inside of large tanks should be cleaned from the outside through openings. The tank will be entered only for decontamination purposes. Only personnel trained in confined space entry procedures will be allowed to enter and decontaminate the tank.

Small sampling equipment that is submersible can be washed at the sampling location. If needed, the WSA can be used as an alternative decontamination location for small equipment. The equipment will be hand-washed, following the procedure outlined in

Section 6.12.2. The wipe method (Section 6.12.3) is used primarily for decontaminating instruments that cannot be submerged or drenched. All waste products developed away from the two main decontamination areas must be contained, labeled, and transported to the concrete decontamination area or the waste-handling facility.

6.12.1 Steam Cleaning Method

Vehicles and other large equipment used at the drilling location will be cleaned with a steam cleaner or high-pressure hot water cleaner before drilling operations and between borings. Monitoring well casings, screens, and fittings will be delivered to the site in clean condition or will be cleaned in the manner described below, before they are moved to the drilling location.

Drilling rigs and pump-pulling units will be cleaned before they are moved to the sampling location. Geophysical or video service trucks that do not appear to be clean will be decontaminated at the pad prior to going on-site. Concrete delivery trucks need not be decontaminated prior to visiting a sampling location, but they will be cleaned prior to leaving if they have entered the exclusion zone and have been in contact with contaminants.

At the sampling location, loose dirt will be brushed from the vehicle before the vehicle is moved from the plastic sheeting. Special attention will be given to the wheels so that contaminated soil will not drop off between the sampling location and the decontamination pad. This removed material will be placed in the solid waste container at the sampling location.

The vehicle and ancillary equipment will be moved to the decontamination pad. The cleaning procedure to be followed at the decontamination pad is presented below.

- Wet down the vehicle or other items with high-pressure hot water or steam.
- Turn on the soap dispenser and wash the vehicle or other items completely, with special attention to areas around the wheels and the areas that have been or will be near the drilling and sampling equipment.
- Turn off the soap dispenser and rinse the vehicle or other items completely.
- Rinse off the decontamination pad.
- Remove the vehicle or other item to the side of the pad to air dry.

Equipment, such as pumps, short pieces of pipe, bailers, and surge blocks, will be taken to the decontamination pad. Decontamination will be conducted there in the following manner.

- Rinse the items with a steam cleaner or high-pressure hot water cleaner to remove as much particulate as possible.
- Place the pump or other items in a 55-gallon drum containing an Alconox® soap solution. Where possible, operate the pump to flush solution through it. Agitate nonpowered items to run the solution through the interior portions.

- Remove the items from the Alconox® solution, and double-rinse by placing the equipment in a 55-gallon drum of clean potable water, followed by a second submersion in a second drum of clean potable water.
- Place the item in a clean area of the decontamination pad to air dry.
- Depending upon the type of analysis, additional chemical rinses may be used in decontamination procedures. For example, U.S. EPA Region IX recommends a 0.1N nitric acid rinse where metal contamination is of concern and a pesticide grade solvent rinse where SVOCs and non-VOC contamination may be present.

All decontamination procedures will be documented in the field logbook. The information recorded will include date and time of operation, sampling location at which the items became contaminated, method of decontamination, person completing and witnessing the decontamination procedure, and items decontaminated (identified by license, rig number, or serial number).

6.12.2 Wash and Rinse Method

Equipment used for surface water sampling, soil sampling, well development, pump testing, and slug testing will be decontaminated prior to and after use at each well. This equipment includes shovels, trowels, augers, California and split-spoon samplers, various development tools, pumps, bailers, and downhole piping.

Equipment used for soil sampling, surface-water sampling, and groundwater sampling that is cleaned and reused in the field without returning to the decontamination pad will be decontaminated using the procedure specified below.

- Scrub the equipment clean with Alconox® or an equivalent soap solution (i.e., low-phosphate detergent) and a stiff long-bristle scrub brush. Containerize all waste solution.
- Rinse the equipment over a rinseate tub with clean potable water.
- Spray rinse the equipment with distilled water twice and allowed to drain and air dry.
- Place the equipment on a clean sheet of plastic and cover with another sheet if it is not to be used immediately.

If trace metals are found in rinseates and not in rinse water, then decontamination procedures will be addressed and may include a nitric acid rinse.

All drummed or otherwise containerized wastes from field decontamination must be appropriately labeled for transport to the waste staging area. Incidental rinseate may be placed in containers for solid or liquid waste. If Baker tanks or roll-off bins are not available at a site, designated 55-gallons drums may be used for field rinseate collection. Any decontamination project that requires a large amount of wash and rinse water should be moved to one of the two decontamination sites to facilitate the collection and treatment of wash and rinse water.

All decontamination procedures will be documented in the field logbook. The information recorded will include date and time of operations, sampling location at which the items became contaminated, method of decontamination, person completing and witnessing the decontamination procedure, and items decontaminated.

6.12.3 Wipe Method

The wipe method of decontamination will be used at the sampling location for cleaning items that will be washed and rinsed in the field. These items include such things as steel tapes, electric sounders, transducers, and geophysical and video logging equipment.

The steel tape, electric sounder, or geophysical cable (and attachments) will be wiped with disposable soap-impregnated cloth and rinsed with potable water as it is being pulled from each well. The equipment will then be rinsed with deionized water and allowed to air dry.

Soap-pad wipes may be disposed with the PPE in the 55-gallon drum at the site. Rinse water should be placed with development water. During depth-to-water measuring, a liquid waste disposal drum should be carried in the vehicle.

Decontamination will be documented in the site field logbook for downhole geophysical equipment, downhole video equipment, and water-level measuring equipment used during well development and aquifer testing. Decontamination of water-level measuring equipment used during depth-to-water sampling rounds will be documented in the field logbook. The information will include date and time, sampling location at which the items became contaminated, method of decontamination, person completing and witnessing the decontamination procedure, and the items decontaminated.

6.13 WASTE HANDLING

The field sampling team collecting samples at a location will be responsible for the waste generated at that location until notification is given to the Waste Manager that the sealed container is ready to be moved to the WSA. Waste movement will be conducted by the subcontractor. The Phase II Waste Manager will be responsible for classifying and disposing solid wastes. A separate, detailed Investigation-Derived Waste Management Plan (IDWMP) describes waste management (BNI 1995e). Arrangement for transportation of solid waste from the sampling location, waste sampling, waste classification, and waste disposal will be the responsibility of the waste manager, following the guidance in the Phase II RI IDWMP.

6.13.1 Cuttings from Borings and Drilling Mud

Solid waste generated during drilling and sampling will be stored in a roll-off bin or 55-gallon drum. If mud-rotary drilling is used, a 21,000-gallon Baker tank will be used for mud disposal. Waste containers will be supplied by the subcontractor and will be located within the exclusion zone during drilling operations. These containers will be closed and sealed when left unattended. When full (or when the specific site work is completed), the container will be sealed at the site.

Each container (Baker tanks, roll-off bins, or 55-gallon drums) will be affixed with a unique label assigning that container a specific number. (Baker tanks and roll-off bins have painted or welded numbers.) The label will also include information identifying the site and boring(s), the depths from which the waste was produced, the date the container was first used, the date the container was last filled, the samplers' names, and the initials of the person recording the information. The waste labels will be completed with indelible ink. The same information will be recorded, along with a description of the materials, in the field logbook.

When the container is filled and sealed, the sampling team leader will notify the waste manager that the container is ready to be moved to the waste storage area. It has been predetermined that VOC, fuel, or oil-contaminated soil will be disposed by thermal desorption when metals are not present above regulatory thresholds.

6.13.2 Groundwater

Groundwater generated incidentally during drilling will be stored with cuttings and drilling mud. Groundwater produced during well development, sampling, and aquifer testing will be stored in Baker tanks, polypropylene tanks on wheels, or 55-gallon drums. All storage containers will be water-tight, lockable containers. Once filled, all storage containers will be labeled. The labels will be completed with indelible ink and will include information identifying the site, boring(s), or monitoring well(s), the depths from which the waste was produced, the date the container was first used, the date the container was last filled, the samplers' names, and the initials of the person recording the information. The same information will be documented in the field logbook and will include the amount of groundwater produced from a well during a specific procedure.

The field sampling team will be responsible for the groundwater waste generated at that location until it is moved to the WSA. Waste movement will be the responsibility of a waste management subcontractor.

The quantity of groundwater produced during the task and the opportunities to transport that water to a WSA determine the volume of storage and containers required. One or two 55-gallon drums may be adequate for purging during water quality sampling or for slug testing. A 1,000-gallon or larger polytank on wheels may be required for well development and aquifer testing. A long-term pumping test may require a 21,000-gallon Baker tank and special arrangements for transferring water to a truck for transport to the WSA.

The groundwater produced from well development or purging will be transferred by an appropriate method to the storage tank. The tank will be closed and secured anytime it is left unattended. At the completion of the field procedure, the sampling team leader will notify the Waste Manager that the groundwater in the tank is ready for transfer to the WSA.

Any tank containing groundwater will be decontaminated by steam cleaning before being used at a new well site. The tank will only be entered for decontamination purposes, and only personnel trained in confined entry procedures will perform decontamination tasks. After a storage container has been emptied, any transfer pumps and ancillary equipment must also be decontaminated before the storage container is moved to the next site.

Groundwater produced during the Phase II field program will be treated at the WSA treatment system (granular-activated carbon). To allow batch processing of wastewater through the treatment system and to keep concentrations of chemical constituents in the wastewater at relatively consistent levels (avoiding spikes of concentrated chemical constituents that could overload treatment system limits), development and purge water may be stored temporarily in Baker tanks at the WSA prior to on-site treatment and discharge to the golf course. Storage and treatment in the waste staging area will be the responsibility of the Waste Manager. A separate IDWMP further describes waste management (BNI 1995e).

6.13.3 PPE, Excess Samples, and Miscellaneous Trash

Disposable PPE, including Tyvek™ coveralls, gloves, booties, duct tape, and plastic sheeting that comes in contact with samples, will be disposed in a 55-gallon drum provided for the disposal of PPE. It is important to keep PPE and miscellaneous trash separated. PPE must be treated as potentially hazardous material until proven otherwise. Miscellaneous trash collection and disposal is a normal housekeeping process that should not be mixed with the more complex and costly PPE disposal procedures. Virtually all procedures during Phase II fieldwork will generate both PPE and nonhazardous miscellaneous trash.

A 55-gallon drum for PPE disposal will be set up at any location where drilling and related equipment are used. All disposable PPE will be placed in the drum immediately after use. The lid will be left on the drum when it is not being filled. When the drum is full, it will be transported to the WSA by the subcontractor. The PPE waste drum will be labeled in indelible ink to indicate the site, date, and contents (PPE) after it is set in place and before its use. The identification information will be recorded in the field logbook.

PPE generated at sampling locations other than those with a drilling rig may be placed in heavy-duty trash bags with ties, provided the waste material is labeled at the end of each day, transported to the waste storage area, and placed in the waste PPE storage bin or area.

Miscellaneous trash that does not come into contact with samples or PPE will be placed in heavy-duty trash bags that are left in the vehicle transporting the field team. At the end of each day, this trash will be placed in the waste bin at the field administration office site.

Samples not submitted for analysis will be left sealed in a plastic bag. The sample will be marked on the bag to indicate site identification, depth, date collected, and the person who collected it. These samples will be stored in specially marked 55-gallon drums in the WSA.

6.14 SAMPLE HANDLING, PACKAGING, AND SHIPPING

This section describes the sample containers, sample identification system, procedures for sample handling, chain-of-custody procedures, and shipping procedures. Although some of the information is duplicated in the QAPP (BNI 1995a), this section emphasizes specific procedures to be followed by the field staff.

6.14.1 Sample Containers

With the exception of subsurface soil samples collected in sampler tube sleeves (liners), the analytical laboratory shall provide the sample containers to be used. Sample containers will be shipped from the laboratory to the Sample Manager in sealed boxes and will be certified as having been decontaminated prior to being shipped. Where applicable, preservatives may be placed in the containers before their arrival at the field site.

Before leaving for the field, the Sampling Team Leader will obtain the proper containers and forms from the Sample Manager. The sample labels will be partially completed before the field activity begins. The containers will be left closed until needed for the sample.

Trip blanks will be supplied by the laboratory conducting the analyses. The blanks will be shipped with the bottles and stored in the sample trailer. A trip blank will be transported with the sample container to and from the sample collection point and to the laboratory for analysis. Only one trip blank will be shipped with each group of samples to be analyzed for VOCs.

The type and size of containers used for aqueous and solid samples will vary, depending on the type of analysis to be performed on the sample. The procedures to be followed defining which container to use for each type of sample are outlined in the CLEAN II Program SOP 9 and in the QAPP (BNI 1995a).

After a sample is collected, the sample container will be sealed, the label and chain-of-custody form will be completed in indelible ink, and a custody seal will be placed so that the lid cannot be opened without breaking the seal.

Certificates of cleanliness for glassware, including bottle lot numbers, will be cross-referenced to provide ample identification in the field logbooks. Information regarding whether preservatives are added at the laboratory (or by the Sample Manager), will be recorded in the same locations as the sample identification.

6.14.2 Sample Labeling and Numbering

Sample numbers will be assigned on the basis of a code system that provides blind samples to the laboratory with no duplication of numbers. The sample number consists of a nine-digit alpha-numeric label. The following is a summary of codes placed in each digit:

First digit	Letter designating which site the sample was taken. The letter will correspond to the letters assigned to each site in the Work Plan appendices or Field Sampling Plan attachments (i.e., A is used for Site 1).
Second and third digit	Number designating which CLEAN II Contract Task Order that the sampling is collected (i.e., 76 will indicate that sample was collected for CTO-076).
Fourth through seventh digit	Sequential number (0001 through 9999).
Eighth and ninth digit	Container number will be assigned by the analytical laboratory.

An example of this system of sample numbers would be:

A76012002

where:

A	=	Site 1
76	=	CTO-0076
0120	=	Sequential sample number of 0120
02	=	Soil sample in a glass jar

Sample labels convey information unique to each sample container. The sample labels also relay specific information about sample conditions at the time of sampling. Each sample label will have the project, site, and job number. Sample labels will also contain the name or initials of the sampler, sample identification number, depth bgs, analysis required, sample preservation, date of sampling, and local standard time of sample collection using a 24-hour clock notation.

The information recorded on the sample labels will also be recorded in the field logbook, chain-of-custody record, and boring logs. Additional information to be recorded in the field logbook include sample location (e.g., distances to nearest fixed reference point[s], sample matrix, sample appearance, volume of sample collected, field measurements [if applicable]), type of sampling equipment used, type and number of sample containers used per sampling site, designation of QC samples [blanks, splits, or duplicates], significant events and observations). At the end of the day's logbook narrative, the field sampler will sign and date the sample collection information.

6.14.3 Sample Custody

The field sampler is personally responsible for the care and custody of the samples until they are transferred and/or shipped to an analytical laboratory or storage facility in accordance with the CLEAN II Program SOP 10. The samples must be traceable from the time the samples are collected until they are accepted by the laboratory.

A sample is in the custody of the field sampler, shipping agent, or analytical laboratory employee/sample custody if:

- it is in his/her possession;
- it is in his/her view, after being in his/her possession;
- it was in his/her possession and then placed under lock and key; or
- it is maintained in a designated secure area.

The field sampler shall fill out a chain-of-custody record as each sample is collected. The purpose of the chain-of-custody record is to physically trace sample possession from the time of collection to its ultimate disposition. The chain-of-custody record must move with the samples. When transferring samples, the individuals relinquishing and receiving them sign, date, and note the time on the record. The time of relinquishment and receipt will be identical to avoid breaking the chain of custody. Notation of the bill of lading number, name of the shipping company, and signature of the shipping company agent on that bill of lading serves to keep the chain of custody intact during shipping. Any blank space will be lined out and initialed by the sample manager or other person relinquishing custody to the laboratory. The following information should be recorded in both the field logbook and on the chain-of-custody form:

- project name and site of sample collection;
- job number;
- names of field samplers;
- sample ID number;
- date of sampling;
- local standard time of sample collection using 24-hour notation;
- sample matrix;
- description of the sample location and depth (bgs), if applicable;
- analyses requested;
- preservation of sample containers (if applicable);
- means of transmittal to the analytical laboratory or storage facility (including carrier and airbill number, if applicable); and
- any general comments, instructions to the analytical laboratory or unusual circumstances including possible splits of particular samples with an owner, operator, or government agency, instructions to spike a sample, or problems encountered during an attempt to transfer a sample, etc.

The "COMMENTS/INSTRUCTIONS" section of the chain-of-custody form shall be used to record instructions to the analytical laboratory. The "REMARKS" section of the chain-of-custody form shall be used to record any additional unique information regarding particular samples.

Whenever samples are split with another party, the field sampler will note the split in the "REMARKS" section of the chain-of-custody section. The note will indicate with whom the samples were split and will be signed by both the sampler and the recipient. If a representative is unavailable or refuses to sign, the sampler will note this in the "REMARKS" section of the chain-of-custody form.

Any errors made on the sample label, in the field notebook, or on the chain-of-custody form shall be corrected by the method outlined in the CLEAN II Program SOP 10. The procedure consists of drawing a single line through the error and recording the correct information. This correction will then be initialed by the individual making the correction. Any sample labels or custody seals found with an error will be replaced by corrected labels or seals. All error corrections will be recorded in the field logbook.

Custody seals are to be used on each sample to show that the sample was not disturbed during transportation. When a sample has been collected, labeled, logged into the field logbook, and entered on the chain-of-custody form, a signed and dated custody seal shall be affixed to the container in such a way that it is necessary to break the seal in order to open the sample container. Two or more custody seals shall be affixed to the outside of the shipping container or cooler before it is shipped by an overnight carrier.

6.14.4 Sample Handling in the Field

This section describes the way samples are to be handled in the field from the time they are collected until they are received by the Sample Manager or are shipped by the sample team leader. The information duplicates some information in the QAPP (BNI 1995a).

The field sampler that collects the sample is responsible for the proper storage and preservation of sample until it arrives at the analytical laboratory or storage facility. Once a sample is collected, labeled, and custody sealed, it will be placed in a cooler for storage pending shipment.

The field sampler who either delivers or arranges for the delivery of samples is responsible for assuring that sufficient ice is present in the shipment container to maintain a temperature of 4°C during shipment. The temperature of the cooler will be taken before shipment. Temperature and time of measurement will be entered into the field logbook.

All samples are to be handled by as few people as possible. If one person collects the samples and another delivers them to the laboratory, the chain-of-custody record must document the change of possession by the appropriate dated signatures. The chain-of-custody record for a given group of samples will be kept with those samples and the cooler at all times. Field notebooks, labels, and the chain-of-custody record will be completed in a timely manner.

6.14.5 Sample Packaging and Shipping

The final responsibilities of the field sampling team will be to assure that each sample is properly packaged and shipped to the appropriate laboratory and that a record of the shipment is available.

Samples to be sent to the laboratory will be packaged and released to the transporting agent as described below.

Individual sample containers will be sealed with a custody seal as described in Section 6.14.3, labeled as described Section 6.14.2, and placed in a cooler at the sample collection location. Coolers will be placed in the shade during the day with adequate ice to lower the temperature of samples to 4°C.

Samples held overnight prior to shipping will be placed in a locked refrigerator or a locked and custody-sealed cooler in a locked building under the custody of the last person signed on the accompanying custody form. The temperature will be checked and recorded when the cooler is first opened.

Before shipment, each container within a cooler will be packaged and sealed in a plastic bag. Aqueous samples shall be packed individually in bubble wrap. All glass bottles and jars shall always first be wrapped in a protective layer of material before being sealed in a plastic bag. A sample rack is acceptable if the samples are being delivered to, or picked up by, representatives of the analytical laboratory at the end of each day. When samples are packed in shipping containers, cardboard separators may be placed between sample containers at the discretion of the field sampler. The use of shock-absorbent materials may also be necessary to prevent movement of sample containers during transport. The QAPP provides additional information on the process for packaging soil and sediment samples, and packaging for groundwater and surface water samples (BNI 1995a).

Coolers used for shipment will be drained, dried, and lined with a plastic bag and approximately 3 inches of Styrofoam™ "peanuts" or other packing and cushioning material. For samples believed to contain medium concentrations of hazardous constituents, the use of shipment cans and vermiculite may be required for safe transportation. The chain-of-custody and other necessary documentation shall be placed in a sealable plastic bag and taped to the inside of the cooler lid. The cooler lid will be closed and taped shut with strapping tape. A mailing label or bill of lading with the address of the laboratory and the name of the shipper will be placed on top of the container. At least two signed custody seals will be affixed over lid openings (front and back of cooler under strapping tape).

When samples are transferred by land or air through a commercial shipping courier, the field sampler shall complete an airbill, provided by the carrier, for the shipment of the samples. The name of the overnight carrier and the airbill number shall be recorded in the "RECEIVED BY" and "AIRBILL NO." blocks of the chain-of-custody form, respectively. This information with the date an time of sample pickup shall be recorded in the field logbook. The bottom two copies of the signed chain-of-custody form will be kept for field records, and the top parts of the chain-of-custody form shall accompany the samples as stated above. When the samples are relinquished to the carrier, the bottom copy of the airbill will be returned to the relinquishing party and should be retained for field records.

When samples are shipped to the laboratory by land through a noncommercial shipping courier or by the field samplers or other similar responsible party, the field sampler is responsible for transfer of the samples to the delivering party. Both parties (the relinquisher and receiver of the samples) must sign, date, and note the time of transfer on the chain-of-custody form. Again, the bottom two copies of the signed chain-of-custody form will be kept for field records and the top parts of the chain-of-custody form shall accompany the samples as stated above.

As outlined in the CLEAN II Program SOP 10, the field sampler shall be aware of all regulations concerning the shipment of environmental samples prior to the field-sampling event. The field sampler shall also be aware of the shipping agent's limitations.

Upon sample arrival at the analytical laboratory, the designated sample custodian shall take custody of all samples and inspect all sample labels and custody forms to assure consistent information. The custodian shall also inspect all samples for signs of damage or tampering. Any discrepancies shall be documented and noted on the chain-of-custody form. The custodian shall then sign and date the chain-of-custody form for receipt. Each sample will receive a unique laboratory identification number and will be distributed to the appropriate areas for analysis or to secured storage areas. All sampler transfers within the laboratory shall be recorded.

Laboratory analysts shall be responsible for the care and custody of samples from the time they are received for analysis until the samples are exhausted or returned to the laboratory sample custodian for disposal. The laboratory shall retain all written records of laboratory handling and analysis as part of a permanent laboratory file.

Samples that are collected and archived for future chemical or physical analysis shall be documented and treated in the same manner as described above. The field sampler must check the "ARCHIVE" on the chain-of-custody form to designate samples to be archived.

Tedlar™ bag samples will be shipped in light-sealed containers (cardboard boxes) to avoid photochemical reactions.

These same procedures will be used to label, handle, package, and transport samples to the on-site mobile laboratory.

6.15 WIPE SAMPLES

Wipe samples may be need to be collected from USTs for PCBs. If a UST to be sampled contains fluid, the fluid will be sampled and a wipe sample will not be collected. The fluid sample would be collected by lowering a clean glass tube into the UST to collect the fluid. If the UST is empty, wipe samples will be collected with a cotton gauze as the wipe medium. Because the bottom of the UST is not accessible to the gloved hand, the bottom of the UST will be wiped with the cotton gauze with the aid of an extension pole. All wipe sampling procedures will follow guidelines outlined in the U.S. EPA, "Wipe Sampling and Double Wash/Rinse as Recommended by the EPA PCB Spill Cleanup Policy, June 23, 1987, Revised and Clarified on April 18, 1991," and U.S. EPA "Draft PCB Disposal Amendment, December 6, 1994." The wipe will be placed in a glass sample jar and submitted for PCB analysis.

SECTION 7

REFERENCED FORMS AND DATA SHEETS

Section 7
REFERENCED FORMS AND DATA SHEETS

This section presents many of the standard forms currently used by CLEAN II. The format or contents of the forms may change before or during Phase II RI/FS fieldwork. Therefore, these forms are for reference but may not be the final form used.

- Chain-of-Custody Record
- Custody Seal
- Borehole Log
- Soil Sampling Records
- Borehole Abandonment
- Well Construction Details
- Well Development Logs
- Water Level Measurement
- Well Sampling Record
- Trench Logs
- Field Change Notice
- Daily Field Reports
- Photograph Logs

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BECHTEL CLEAN II

62[illegible]

CHAIN-OF-CUSTODY RECORD

Site Name: ____________________
CTO Number: ____________________

Sampler's Name(s): ____________________
Sampler's Signature(s): ____________________

Site Contact/Supervisor: ____________________

Analytical Laboratory Name: ____________________
Analytical Laboratory Address: ____________________
Field QC Package Number: ____________________
Field Logbook/Page Number: ____________________
Date: ____________________

Pay Items/Analyses Required

QC Level

C	D	E

TAT (in days)

2	7	14	30

Sample ID Number (7 digit)	Date/Time Collected	Station Description	Sample Matrix	Archive	Type of Container	Preservation / Container Nos. (2 digit)										Remarks (e.g., MS, MSD)

Relinquished By	Received By	Date	Time	Reason for Transfer

Comments/Instructions:

Method of Shipment:

Airbill No.:

Total No. of Coolers Shipped:

f:/forms/cocrecor.doc

ATTACHMENT C

Custody Seal

SAMPLE

BECHTEL	Project Name: ____________	Signature: ____________	
	Project Number: ____________	Date: ____________	

BECHTEL — BOREHOLE LOG	PROJECT and JOB NUMBER *CLEAN II* 22214		SHEET NO. 1 OF	HOLE NO.
DRILLER	SITE and LOCATION		OVERBURDEN	BEGUN
DRILL MAKE AND MODEL	COORDINATES	LOGGED BY:	ROCK (FT)	COMPLETED
HOLE SIZE and/or CORE SIZE/DIAMETER	GROUND EL. & DEPTH/EL. GROUND WATER	CHECKED BY:	TOTAL DEPTH	UPDATE

Organic Vapor Reading (ppm)	Core RQD %	Core/Soil Recovery (%)	Core Length/ Smplr Advance	Blow Counts or Recovery (ft)	Core Run No./ Sampler Type	Elevation in Feet	Depth in Feet	Graphics	Sample	Description and Classification	(Template: NAVY) Remarks:

	SITE and LOCATION	HOLE NO.

BOREHOLE LOG

PROJECT and JOB NUMBER		SHEET NO.	HOLE NO.
CLEAN II	22214	OF	

(Template: NAVY)

Organic Vapor Reading (ppm)	Core RQD %	Core/Soil Recovery (%)	Core Length Smplr Advance	Blow Counts or Recovery (ft)	Core Run No./ Sampler Type	Elevation in Feet	Depth in Feet	Graphics	Sample	Description and Classification	Remarks:

SITE and LOCATION	HOLE NO.

SOIL SAMPLING RECORD

JOB NO./FACILITY
22214-
MCAS El Toro

STATION ID	STATION TYPE	FIELD LOGBOOK(S)/PAGES

SAMPLE ID	SAMPLE TYPE	MATRIX	DATA LOGBOOK(S)/PAGES

GRID PLANE	— STATION SURVEY DATA (including units) —			SAMPLE DATE START: END:
	EASTING	NORTHING	ELEVATION	SAMPLE DEPTH (feet) BEGIN: END:

TRIP BLANK ID	EQUIP. RINSATE ID	FIELD BLANK ID	SOURCE BLANK ID	OTHER

LAB D.O.	SAMPLING METHOD	REMARKS: ______

USE FOR QC SAMPLES ONLY	THIS QC SAMPLE ID:	TYPE OF QC SAMPLE (Check one)
	REFERENCE SAMPLE ID:	Equip. Rinsate ☐ Duplicate ☐ Field Blank ☐ Source Blank ☐

ALL SAMPLES ARE ICED TO 4° C **Initial Here** ______

CONTAINER NUMBER	ANALYSIS	CONTAINER TYPE	PRESERV.	COC NO.	DATE	TIME	COMMENTS

DATA RECORDED BY		CHECKED AND REVIEWED BY	
SIGNATURE	DATE	SIGNATURE	DATE

BOREHOLE/WELL ABANDONMENT RECORD

Borehole/Well Identification No. ____________

Facility:	**Site:**	**Job No:** 22214-
Recorded By:	**Date:**	**Checked By:**

Borehole/Well Abandonment Permit No: ____________

Permitting Agency: ____________ Contact: ____________ Phone #: ____________

Condition of Borehole/Well at Ground Surface Prior to Abandonment:

____

____

Maximum Depth Sounded in Borehole/Well: ____________ Datum: ____________

Original Borehole/Wellbore Depth: ____________

Downhole Obstruction Indicated? ______ Yes ______ No

If yes, describe the method(s) used to assess the nature of the obstruction and/or methods to remove it:

____

____

____

Depth (ft) to Water Prior to Borehole/Well Abandonment: ____________ Datum: ____________

Date of water level measurement: ____________

Any Indications of Borehole/Well Contamination? ______ Yes ______ No

If yes, describe field evidence suggesting borehole/well contamination: ____________

____

Date of cessation of abandonment activities and notification of enforcing agency:

Stop Date	Enforcing Agency	Contact	Date of Contact

Describe Method(s) of Casing Removal/Disposition (if applicable): ____________

____

____

Sealing Material Used for Abandonment and Corresponding Depth Intervals:

	From	To	# Sacks Cement	# Sacks Sand	# Sacks Bentonite	# Sacks Aggregate	# Gal. Water
Neat Cement grout							
Sand-Cement grout							
Cement/bentonite							
Bentonite							
Concrete							
Other (describe):							

Backfill Materials (describe): ____________ from: ____________ to: ____________

____

____

WELL CONSTRUCTION DETAILS

PROJECT and JOB NUMBER	*CLEAN II*	22214	SHEET NO. 1 OF 1	HOLE NO.
SITE and LOCATION			HOLE SIZE	BEGUN
DRILLER	COORDINATES	LOGGED BY:	TD OF WELL	COMPLETED
TOP of CASING ELEV. / GROUND ELEV.	GROUND WATER DEPTH/ELEVATION ▼ /	CHECKED BY:	TD of HOLE	UPDATE

Well Construction Details	Elevation in Feet	Depth in Feet	Well Graphics	Graphics	Geologic Description and Classification (Template: AWELL)

SURFACE COMPLETION, Dia. & Type:

Bottom Depth = _____._____ft.

CONDUCTOR CASING, Dia. & Type:

Bottom Depth = _____._____ft.

GROUT SEAL, Type:

RISER CASING, Dia. & Type:

BENTONITE SEAL

Top of Seal = _____._____ft.

Type:

FILTER PACK

Top of Filter Pack = _____._____ft.

Type:

SCREEN

Top of Screen = _____._____ft.

Dia. & Type:

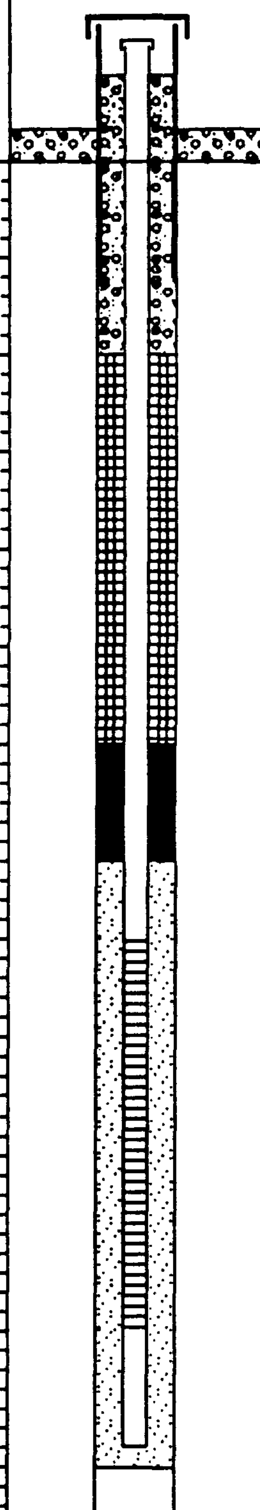
Slot Size & Type:

Bottom of Screen = _____._____ft.

SUMP

Type:

Bottom of Sump = _____._____ft.



See key for graphic symbols.	SITE and LOCATION	HOLE NO.

Bechtel
WELL DEVELOPMENT

PROJECT		WELL NO.
CLEAN II		
JOB NO. 22214	SITE	PREPARED BY

METHOD

- PUMP ______
- BAILER ______
- GAS ______
- OTHER ______

DEVELOPMENT CRITERIA ______

REMARKS

HOLE DIAMETER d_h = ______

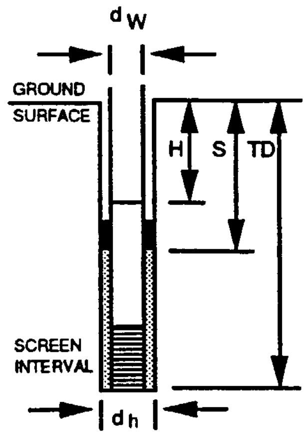
WELL CASING

- INSIDE DIAM $d_W ID$ = ______
- OUTSIDE DIAM $d_W OD$ = ______

DEPTH TO:

- WATER LEVEL H = ______
- BASE OF SEAL S = ______
- BASE OF WELL TD = ______

EST. FILTER PACK POROSITY P = ______



WELL VOLUME CALCULATION

CASING VOLUME =

$$V_c = \pi\left(\frac{d_W ID}{2}\right)^2 (TD - H) = 3.14\left(\frac{\quad}{2}\right)^2(\quad - \quad) =$$

FILTER PACK PORE VOLUME =

$$V_f = \pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_W OD}{2}\right)^2\right](TD - (S \text{ or } H))(P)$$

$$= 3.14\left[\left(\frac{\quad}{2}\right)^2 - \left(\frac{\quad}{2}\right)^2\right](\quad - \quad)(\quad) =$$

(If S > H use S. If S < H, use H)

TOTAL WELL VOLUME =

$$V_T = V_c + V_f = \quad + \quad = \quad ft^3 \times 7.48 = \quad GAL$$

DEVELOPMENT LOG					CUMULATIVE TOTAL REMOVED		WATER CHARACTER				COMMENTS
DATE	TIME BEGIN	TIME FINISH	METHOD	WATER REMOVED GAL	GAL	WELL VOLUMES	pH	CONDUCTIVITY µ mhos	TEMP °F	TURBIDITY NTU	

Bechtel

WELL DEVELOPMENT

PROJECT	WELL NO.
CLEAN II	

JOB NO.	SITE	PREPARED BY
22214		

DEVELOPMENT LOG					CUMULATIVE TOTAL REMOVED		WATER CHARACTER				COMMENTS
DATE	TIME BEGIN	TIME FINISH	METHOD	WATER REMOVED GAL	GAL	WELL VOLUMES	pH	CONDUCTIVITY µ mhos	TEMP °F	TURBIDITY NTU	

WATER LEVEL MEASUREMENTS

BECHTEL

CLEAN II WELL NO: ____________________

PAGE ___ OF __

FACILITY:	JOB NO: 22214-

REFERENCE PT: (CIRCLE) TOC GRND SURFACE OTHER:

MEASUREMENT DATE	TIME	CALIBRATED BY: / INSTRUMENT SERIAL NO.	SURVEYED REFERENCE POINT ELEVATION (FT)	DEPTH TO WATER (FT)	WATER LEVEL ELEVATION (FT)	REMARKS	MONITORED BY: / CHECKED BY:

WATER/PRODUCT LEVEL MEASUREMENTS

CLEAN II

WELL NO. ____________________

Page ___ of ___

FACILITY:

JOB NO: 22214-

REFERENCE PT: (CIRCLE) TOC GRND SURFACE OTHER:

MEASUREMENT DATE	TIME	CALIBRATED BY: / INSTRUMENT SERIAL NO.	SURVEYED REFERENCE POINT ELEVATION (FT)	DEPTH TO PRODUCT (FT)	DEPTH TO WATER (FT)	APPARENT PRODUCT THICKNESS (FT)	UNCOR-RECTED WATER LEVEL ELEVATION (FT)	REMARKS	MONITORED BY: / CHECKED BY:

CLEAN II	# WELL SAMPLING RECORD	FACILITY:		WELL ID. NO.:
		JOB NO. 22214-	SITE:	PREPARED BY: ______ CHECKED BY: ____

	PURGE METHOD (X)	SAMPLING METHOD (X)
HAND PUMP		
SUBMERSIBLE PUMP		
BAILER		
OTHER		

PURGING CRITERIA:

REMARKS (Include depth of pump inlet, if used):

BOREHOLE DIAMETER: ____________

CASING DIAMETER: ____________

REF. POINT: ____________

DEPTH TO:

WATER LEVEL at t_0: ____________

TOP OF FILTER PACK: ____________

TOP OF SCREEN: ____________

BOTTOM OF SCREEN: ____________

TOTAL BOREHOLE DEPTH: ____________

DATE OF PURGING:	DATE AND TIME OF SAMPLING:
WEATHER:	AMBIENT AIR TEMPERATURE:

CALCULATED BOREHOLE VOLUME:

SUBCONTRACTOR FOR PURGING:

ANALYSES TO BE PERFORMED:

NUMBER/TYPE OFSAMPLE CONTAINERS:

LABORATORY:

DATE SHIPPED:	VIA:

SPECIAL HANDLING/PRESERVATIVES:

PURGING DATA			CUMULATIVE TOTAL REMOVED		FIELD PARAMETERS				COMMENTS
TIME		WATER REMOVED (gal.)							
BEGUN	FINISH		GAL	BOREHOLE VOLUMES	pH	CONDUCTIVITY	TEMP.	TURBIDITY	

DEPTH IN FEET

DEPTH IN FEET	MATERIAL DESCRIPTION

CLEAN II

	LOG OF TEST PIT NO.	PLATE
PREPARED BY: DATE:		
CHECKED BY: DATE:	PROJECT NO.	

BECHTEL	FIELD CHANGE REQUEST/FIELD CHANGE NOTICE JOB NO. 22214	Page 1 of DOCUMENT NO.

DRAWING, SOP, OR SPECIFICATION NUMBER	REV NO.	DRAWINGS OR SPECIFICATION CHANGES	PREPARED BY AND DATE

EXISTING CONDITION

REASON FOR CHANGE

DESCRIPTION OF CHANGE

	CHANGE APPROVED YES ☐ NO ☐	REQUESTED DATE OF FCR DISPOSITION	PTR/DATE
FCN APPROVED ☐ YES ☐ NO	FCN INCORPORATION	TECHNICAL ASSESSMENT MANAGER/DATE	

REMARKS

BECHTEL	**FIELD CHANGE REQUEST/FIELD CHANGE NOTICE** **JOB NO. 22214** **CONTINUATION**	Page 2 of DOCUMENT NO.

CLEAN II — DAILY FIELD REPORT	DATE: ______ Page ___ of ______ JOB NO. 22214-______ FACILITY: ______ SITE: ______ GEOLOGIST/ENGINEER:

ADDITIONAL CLEAN II FIELD STAFF:

SUBCONTRACTOR:	WEATHER CONDITIONS:

EQUIPMENT	HOURS WORKED	WORK PERFORMED

FIELD ACTIVITIES/COMMENTS:

DATA TRANSMITTED WITH THIS REPORT:

CLEAN II

PHOTOGRAPH LOG

FACILITY: MCAS EL TORO, CA

JOB NO: 22214

CTO NO:

SITE	ROLL #	PHOTO #	DATE	TIME	DESCRIPTION / ACTIVITY	DIRECTION FACING	INITIALS

SECTION 8

REFERENCES

Section 8
REFERENCES

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Southwest Division
Naval Facilities Engineering Command
Contracts Department
1220 Pacific Highway, Room 135
San Diego, California 92132-5187

Contract No. N68711-92-D-4670

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

CLEAN II

FIELD SAMPLING PLAN ATTACHMENT A OPERABLE UNIT 3 – SITE 1 – EXPLOSIVE ORDNANCE DISPOSAL RANGE MCAS EL TORO, CALIFORNIA

CTO-0059

Prepared by:

BECHTEL NATIONAL, INC.
401 West A St., Suite 1000
San Diego, California 92101

August 1995

TABLE OF CONTENTS

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Section Page

TABLES

Table

ACRONYMS/ABBREVIATIONS

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	chemical of potential concern
DQO	data quality objective
EOD	Explosive Ordnance Disposal
FS	Feasibility Study
FS smoke	military designation for sulfur trioxide chlorosulfonic acid
FSP	Field Sampling Plan
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
µg/L	micrograms per liter
mg/L	milligrams per liter
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
PAH	polynuclear aromatic hydrocarbons
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SVOC	semivolatile organic compound
TAL	target analyte list
TFH	total fuel hydrocarbons
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

ACRONYMS/ABBREVIATIONS (continued)

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Section 1
OBJECTIVES

This Field Sampling Plan (FSP) for Site 1, the Explosive Ordnance Disposal (EOD) Range, outlines the field procedures and methodology to be used during the Remedial Investigation (RI)/ Feasibility Study (FS) for this site. The purpose of this FSP is to enable field personnel unfamiliar with the site to gather the required samples and field data. It is also intended to assure that data collection will be comparable to and compatible with previous data collected at the site and with other sampling activities at other sites at the Marine Corps Air Station (MCAS) El Toro.

Site 1 remains active. Therefore, contaminants continue to be introduced into the environment during site EOD operations. The FSP will be implemented when Site 1 is closed, except for the construction of three groundwater monitoring wells. As an interim measure, the three proposed groundwater monitoring wells will be constructed and sampled during the Phase II RI/FS. Two existing groundwater monitoring wells constructed during the Phase I RI will be sampled concurrent with the three new wells to monitor groundwater conditions at Site 1.

1.1 SAMPLING OBJECTIVES

The specific objectives for sampling at Site 1 are as follows:

- verify boundaries of waste disposal activities;
- characterize the nature and extent of contamination;
- estimate the vertical and horizontal extent of contamination; and
- characterize site-specific groundwater contamination, if soil contamination extends to groundwater.

1.2 DATA USAGE

To satisfy the RI/FS objectives for Site 1, data to be collected, compiled, and analyzed will be used to perform the following:

- characterize subsurface soils;
- establish stratigraphic controls;
- establish geotechnical parameters;
- confirm the presence of methane or other potentially explosive gases;
- characterize groundwater conditions and quality, if soil contamination extends to groundwater;
- determine the types of contaminants in soil and/or groundwater;
- estimate the extent of contaminants in soil and/or groundwater;
- evaluate human health and ecological risks;
- evaluate the mass of contaminants;
- evaluate remedial alternatives;

- characterize the feasible removal or remedial actions, if necessary; and
- evaluate cleanup levels.

Section 2
BACKGROUND

This section generally describes and discusses the results of previous investigations at Site 1. This section also provides a brief compilation of the data used to develop the site-specific FSP for Phase II RI/FS activities. Previous investigations and reports provide a more thorough discussion of site history, activities, and summaries of previous investigations.

2.1 SITE DESCRIPTION

Site 1 is an oval-shaped area of approximately 40 acres, located in the northeast region of MCAS El Toro (Map A3-1). The site is located in the foothills of the Santa Ana Mountains at an elevation of approximately 625 feet above mean sea level, about 300 feet higher than the main portion of the Station. Site 1 is situated along a minor canyon that is tributary to the Borrego Canyon Wash (Jacobs Engineering 1993a).

2.1.1 History

Disposal and detonation of small munitions have been conducted at this site for more than 40 years. Munitions destruction, including burning, continues to be conducted in pits and trenches, using petroleum fuels for ignition of the burns. In 1982, approximately 2,000 gallons of sulfur trioxide chlorosulfonic acid (FS smoke) were disposed in trenches at the northern region. The disposal method consisted of partially burying the drums containing the FS smoke and then rupturing them with a small explosive charge. Undetonated explosives or drums may still be present at Site 1 buried beneath the soil. Site 1 remains in operation; thus, munitions are exploded in trenches and pits that are continually filled with soil and then reexcavated. Topsoil is frequently disked for weed control, which mixes the shallow soils and removes identifiable site features (Jacobs Engineering 1993a).

2.1.2 Geology

A review of the Phase I RI boring logs for Site 1 indicates that the subsurface geology is characterized by sandy soil, with some silt and clay overlying bedrock at variable depths. Bedrock was encountered at a depth of 70 feet in monitoring well boring 01_DGMW57 and at 21 feet below ground surface (bgs) in well boring 01_DGMW58 (Jacobs Engineering 1993b).

2.1.3 Hydrogeology

The EOD Range is situated within a tributary canyon to Borrego Canyon Wash. A small impoundment has been constructed near the upstream end of Site 1 to contain storm runoff. The depth to groundwater beneath the site has ranged from approximately 45 to 65 feet bgs. The site recharges groundwater rapidly following storm events (Jacobs Engineering 1993b). Groundwater levels rose approximately 8 to 11 feet after the above-average January 1993 rainfall (Jacobs Engineering 1994b). At Site 1, groundwater is presumed to flow to the south, along the axis of the canyon.

2.2 PHASE I REMEDIAL INVESTIGATION RESULTS

The site consists of one stratum. The following field investigation activities (Map A3-2) were conducted as part of the Phase I RI (Jacobs Engineering 1993b):

- four surface (0 to 6 inches bgs) soil samples were collected, one upgradient and three within Site 1;
- two downgradient monitoring wells (01_DGMW57 and 58) were drilled, installed, and sampled (for subsurface soils and groundwater);
- soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total recoverable petroleum hydrocarbons (TRPH), total fuel hydrocarbons (TFH), target analyte list (TAL) metals, general chemistry, and dioxins and furans; and
- groundwater samples were analyzed for VOCs, SVOCs, TRPH, TFH, TAL metals, pesticides/polychlorinated biphenyls, general chemistry, dioxins and furans, and gross alpha and gross beta.

The concentrations of chemicals of potential concern (COPCs) detected in shallow soil were compared to United States Environmental Protection Agency (U.S. EPA) Region IX Preliminary Remediation Goals (PRGs) and ecological screening criteria. No COPCs detected in shallow soil (upgradient and within the site) exceeded PRGs or ecological screening criteria.

The following COPCs detected in groundwater samples were compared to PRGs and maximum contaminant levels (MCLs):

- arsenic (1.4B micrograms per liter [μg/L]), nitrate-N (7.66 milligrams per liter [mg/L]) exceed PRGs; and
- nickel (110 μg/L), manganese (2.4B to 74.7 μg/L) and total dissolved solids (429 to 808 mg/L) exceed MCLs.

Petroleum hydrocarbons, detected in shallow soil samples, were compared to the California Leaking Underground Fuel Tank (LUFT) Field Manual guidelines (LUFT 1989) to evaluate their potential to migrate to the groundwater. According to the LUFT guidelines, the levels of petroleum hydrocarbons detected in shallow soil do not appear to pose a threat to groundwater at this site, nor do any COPCs detected in subsurface soil samples appear capable of reaching the groundwater (Jacobs Engineering 1993a).

Section 3
MAPS

The maps on the following pages illustrate the site location at MCAS El Toro, site boundaries, site units, physical features of the site, previous sampling locations, and proposed Phase II sampling locations (where known). These maps are referenced in other sections of this FSP.

The proposed Phase II sampling locations presented on these maps are intended to illustrate the type of sampling strategy proposed for each unit. Other considerations (e.g., randomly selected starting points, underground utilities/pipelines, or any overhead obstacles) could result in adjustments to sampling locations. The actual field sample locations will be accurately recorded by field personnel relative to surveyed coordinates, and if any sampling points require relocation, the reasons for such changes will be described in the field notebook.

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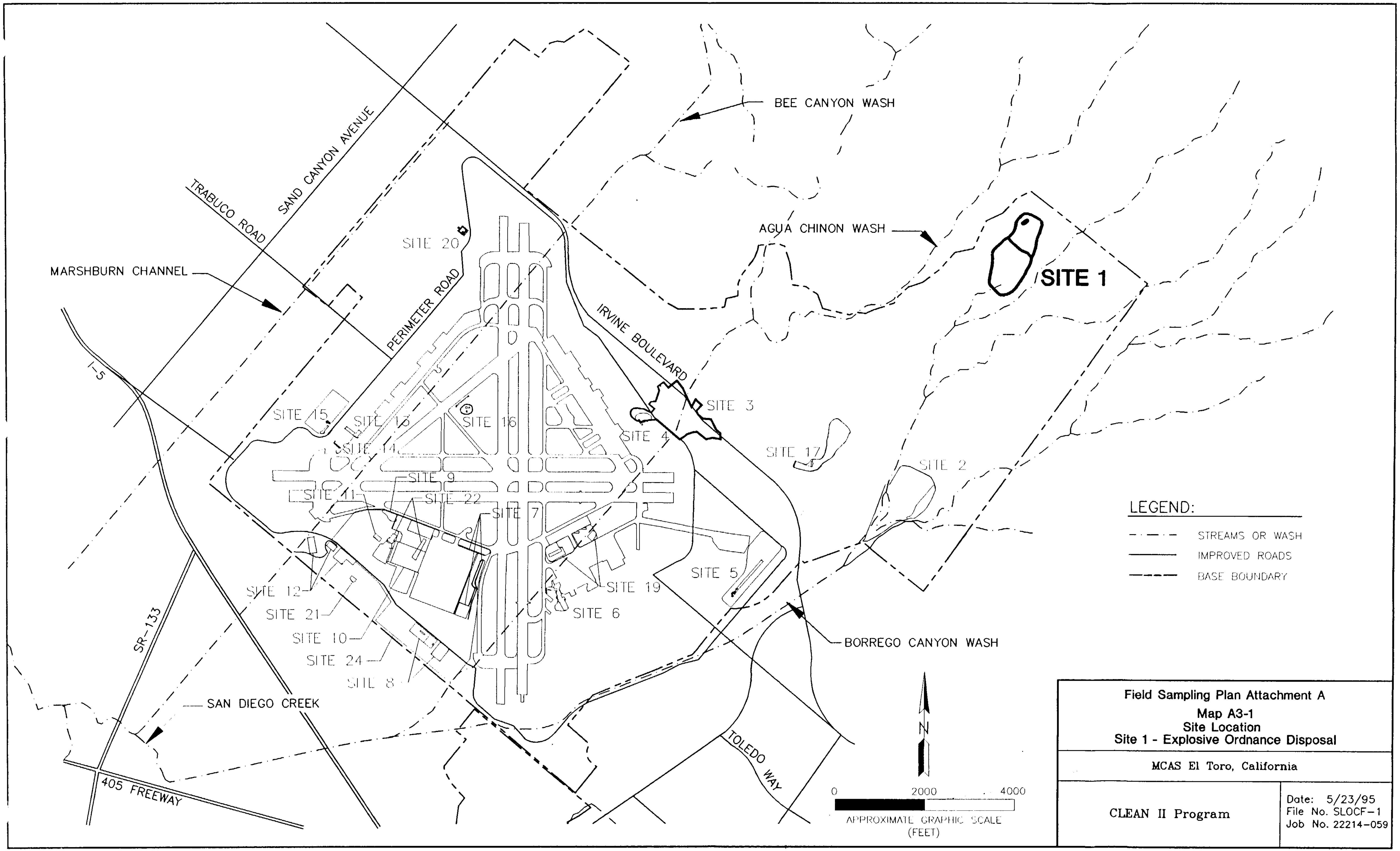
BEE CANYON WASH
AGUA CHINON WASH
SITE 1
MARSHBURN CHANNEL
TRABUCO ROAD
SAND CANYON AVENUE
PERIMETER ROAD
IRVINE BOULEVARD
I-5
SR-133
405 FREEWAY
TOLEDO WAY
SAN DIEGO CREEK
BORREGO CANYON WASH
SITE 2
SITE 3
SITE 4
SITE 5
SITE 6
SITE 7
SITE 8
SITE 9
SITE 10
SITE 11
SITE 12
SITE 13
SITE 14
SITE 15
SITE 16
SITE 17
SITE 19
SITE 20
SITE 21
SITE 22
SITE 24
LEGEND:
STREAMS OR WASH
IMPROVED ROADS
BASE BOUNDARY
N
0
2000
4000
APPROXIMATE GRAPHIC SCALE
(FEET)
Field Sampling Plan Attachment A
Map A3-1
Site Location
Site 1 - Explosive Ordnance Disposal
MCAS El Toro, California
CLEAN II Program
Date: 5/23/95
File No. SLOCF-1
Job No. 22214-059

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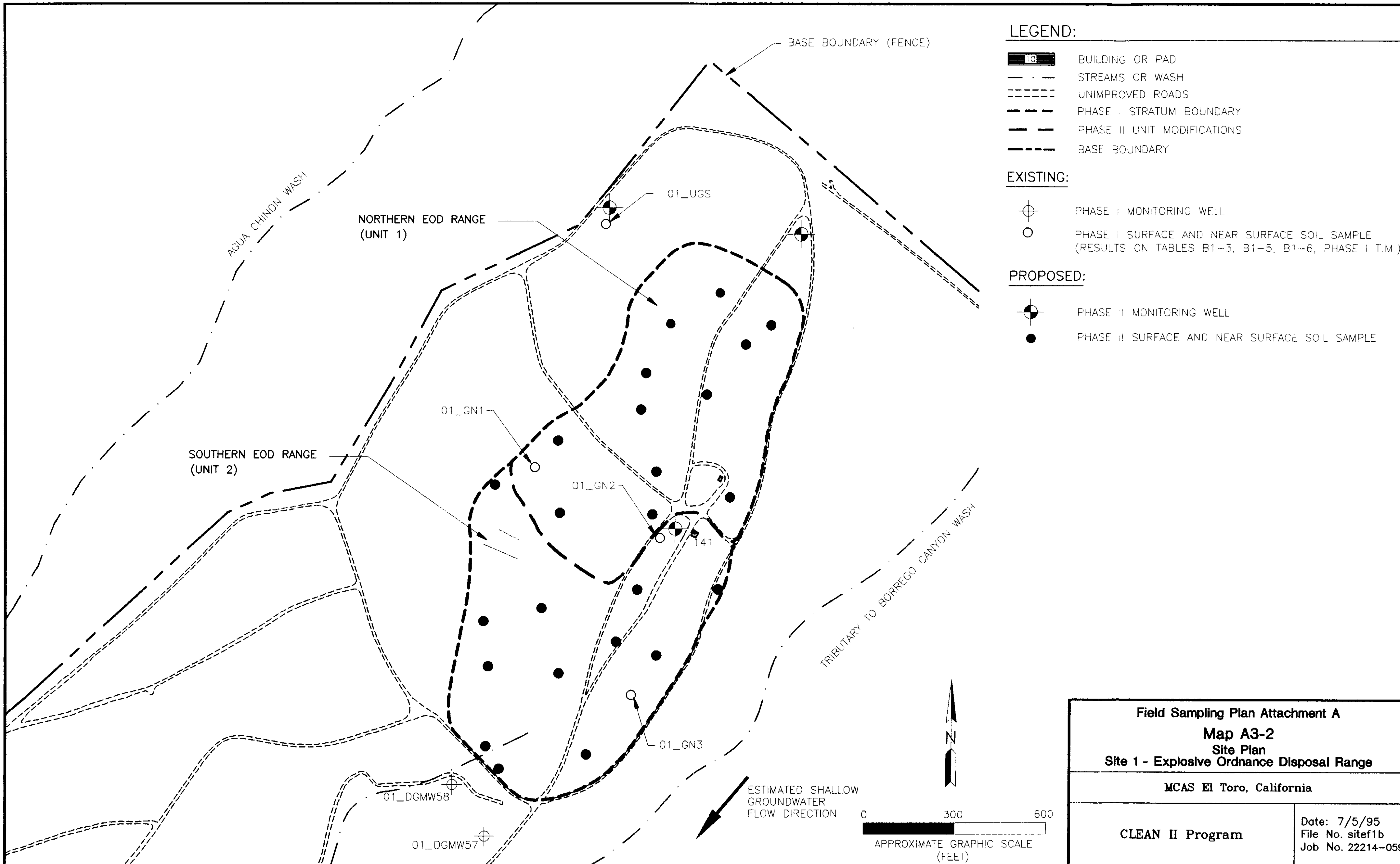

Field Sampling Plan Attachment A

Map A3-2

Site Plan

Site 1 - Explosive Ordnance Disposal Range

MCAS El Toro, California

CLEAN II Program

Date: 7/5/95
File No. sitef1b
Job No. 22214-059

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Section 4
RATIONALE FOR SAMPLING LOCATIONS

This section explains the rationale for the number of sampling programs, types of samples, locations of samples, and analytical parameters. The rationale for sampling is based on site conditions, previous investigations, and data quality objectives as presented in the appendices of the Phase II RI/FS Work Plan (BNI 1995a).

4.1 SAMPLING PROGRAMS, SAMPLE TYPES, AND LOCATIONS

The sampling programs, types of samples, and locations are presented based on the smallest area of study. For some sites, the smallest area of study is a site unit; for others, the area of study may be the entire site. Selection of sampling programs, sample types, and locations is based on:

- site activities and history;
- types of media suspected or known to be impacted from previous investigations;
- objectives of site-specific RI/FS efforts; and
- site-specific initial surveys.

A considerable number of trenches, pits, and craters are present in the northern area of Site 1. The military munitions destruction and burning activities are conducted at this area. The southern area of Site 1 is used by the Orange County Sheriff's Department to dispose of confiscated civilian explosives. In addition, this area is also used by several federal agencies for munitions training. The intensive military disposal activities in the northern area of the site and civilian items disposed in the southern area of the site may have introduced different contaminants. Accordingly, for the Phase II RI/FS, Site 1 has been divided into two field investigation units (Map A3-2):

- Unit 1 - Northern Range; and
- Unit 2 - Southern Range.

Because Site 1 is active, the Tier 1 soil sampling plan detailed below, will not be implemented at this time. This plan will be implemented when Site 1 is closed. As an interim measure, three groundwater monitoring wells will be installed to provide some indication of whether EOD operations have adversely impacted soil and groundwater at the site.

4.2 TIER 1

The purpose of the Tier 1 sampling plan will be to estimate whether the unit poses a risk to human health or the environment. The Tier 1 sampling approach will consist of collecting shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations within the unit. The number of sampling locations has been proposed in a manner that will allow accurate comparison of the Phase I and II data to estimate risk for the unit. An explanation of the proposed sampling designs for Tier 1 soil sampling can be found in Section 4 of the Phase II RI/FS Work Plan (BNI 1995a).

4.2.1 Unit 1: Northern Range

Unit 1 occupies the northern portion of Site 1 (northeast region of MCAS El Toro), where most of the military disposal activities are conducted.

4.2.1.1 SOIL SAMPLES

For the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at 12 areal systematic random sampling locations, based on a grid spacing of 276 by 215 feet (Map A3-2).

4.2.2 Unit 2: Southern Range

Unit 2 occupies the southern portion of Site 1. This location is used by the Orange County Sheriff's Department to dispose of confiscated civilian explosives. In addition, this area is also used by several federal agencies for munitions training.

4.2.2.1 SOIL SAMPLES

For the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at 12 areal systematic random sampling locations, based on a grid spacing of 244 by 237 feet (Map A3-2).

4.3 TIER 2

The Tier 2 sampling program will also focus exclusively on shallow soil (0 to 10 feet) conditions. The primary objective of this program will be to refine the data on the extent of shallow soil contamination identified during the Tier 1 sampling. Tier 2 sample locations will be based on these sample results. The process by which the Tier 2 sample locations will be selected is detailed in Appendix A of the Phase II RI/FS Work Plan (BNI 1995a).

4.4 TIER 3

The objective of a Tier 3 soil sampling program is to estimate the extent of a contaminant plume in deeper subsurface soils. To accomplish this goal, a series of boreholes will be drilled and sampled. The location of Tier 3 boreholes is intended to minimize the number of boreholes required to define the lateral and vertical extent of the contaminant plume in deeper subsurface soils. Groundwater samples will be collected only when a contaminant plume in deeper subsurface soils has been traced (through a drilling and soil sampling program) downward to the water table. At such units/sites, the objectives of the sampling program must then be expanded to include a determination of whether groundwater has been adversely impacted as a result of the historic activities at this unit/site.

A Tier 3 sampling program usually locates groundwater monitoring wells based on contamination concentrations in soil just above the water table at a site. Site 1 remains active; thus, the Site 1, Tier 1, sampling program will not begin until site closure. However, three groundwater monitoring wells have been proposed for installation at the site during the Phase II RI/FS (BNI 1995a). During drilling of these wells, soil samples will be collected and analyzed at 5-foot intervals, beginning at the ground surface.

These three wells will be sampled in conjunction with the two wells constructed in the Phase I RI to monitor groundwater conditions beneath the site. The two wells constructed in the Phase I RI are located south of Site 1 in the likely downgradient groundwater flow direction. Two of the proposed wells will be located in the northern portion (upgradient) of the Site 1, and the other will be an intermediate well located in the middle of the Site 1 between the four other wells. These wells will allow for monitoring of groundwater conditions at Site 1 while the site is still active.

The new wells will be constructed with 4-inch polyvinyl chloride casing and 4-inch stainless steel screen. The wells will be constructed with approximately 10 feet of screen above and approximately 20 feet below the water table. Based on historic groundwater monitoring data, this construction detail will accommodate seasonal, as well as year-to-year, fluctuations in the water table.

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Section 5
REQUEST FOR ANALYSES

Requests for analyses are based on:

- site activities and history,
- results of previous investigations, and
- objectives of site-specific RI/FS efforts.

The analytical methods referenced in this section are from the Phase II RI/FS Quality Assurance Project Plan (QAPP) (BNI 1995b). Section 6 in the QAPP specifies the number and/or frequency for collection of field duplicate and blank samples during the Phase II RI/FS field activities.

5.1 TIER 1

The purpose of the Tier 1 sampling plan will be to estimate whether the unit poses a risk. The Tier 1 sampling approach will consist of the collection of shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations within the unit. Table A5-1 lists all soil samples and associated analyses for the units in Site 1.

5.1.1 Unit 1: Northern Range

The 36 Tier 1 soil samples that will be collected at Site 1, Unit 1, will be analyzed according to the methods listed below.

5.1.1.1 FIELD SCREENING

All soil samples will be field-screened for polynuclear aromatic hydrocarbons (PAH) with immunoassay test kits (U.S. EPA Method 4035); and for benzene, toluene, ethylbenzene, and xylenes (BTEX) (U.S. EPA Method 8020); total petroleum hydrocarbons (TPH)-diesel and -gasoline (U.S. EPA Method 8015M); and TAL metals (U.S. EPA Method 6000/7000) using an appropriately equipped mobile laboratory.

5.1.1.2 FIXED-BASE ANALYTICAL LABORATORIES

All soil samples will be analyzed using a fixed-base laboratory for analysis of dioxins/dibenzofurans (U.S. EPA Method 8280), explosives (U.S. EPA Method 8330), nitrate (U.S. EPA Method 353.2), and phosphorus (U.S. EPA Method 365.2) under Naval Facilities Engineering Service Center (NFESC, formerly known as Naval Energy and Environmental Support Activity [NEESA]) Level D protocols. Eight samples will be submitted to the fixed-base laboratory to confirm field screening results. The fixed-base laboratory analyses are PAH (U.S. EPA Method 8310), BTEX (U.S. EPA Method 8020), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols.

Table A5-1
Soil Sampling and Analysis

Tier	Unit/Name	PHASE II RI/FS SAMPLE NUMBERS			FIELD[a] - IMMUNOASSAY OR MOBILE LABORATORY					OFF-SITE LABORATORY[b]		
		No. of Locations	Samples/ Location	Total Samples	PAH[c,d]	PCBs[c,e]	BTEX[f,g]	TPH[b]-Gasoline and -Diesel[f]	Target Analyte List - Metals[f]	Pesticides and PCBs	Herbicides	Others: Explosives, Dioxins/Furans Nitrate, and Total Phosphate
Tier 1	Unit 1 Northern EOD Range	12	3	36	X		X	X	X			X
	Unit 2 Southern EOD Range	12	3	36	X		X	X	X			X
Tier 1 Subtotals				72	72		72	72	72			72
Tier 2	Optional: Scope of Tier 2 would be to define extent of shallow soil contamination; based on Tier 1 data and Phase I RI findings, with approval of Base Closure and Realignment (BRAC) Cleanup Team (BCT).											
Tier 3	Optional: Scope of Tier 3 would be to characterize horizontal and vertical extent of contamination below 10 feet depth; based on Tier 1 and 2 data and Phase I RI findings, with approval of BCT.											

Notes:
- a at a minimum, 10 percent of detects and 5 percent of nondetects will be sent to the off-site laboratory for confirmation analyses
- b these constituents cannot be determined in the field; all samples to be analyzed for these constituents will be sent to the off-site laboratory
- c immunoassay analyses
- d PAH – polynuclear aromatic hydrocarbons
- e PCB – polychlorinated biphenyl
- f mobile laboratory analyses
- g BTEX – benzene, toluene, ethylbenzene, and xylenes
- h TPH – total petroleum hydrocarbons

5.1.2 Unit 2: Southern Range

The 36 Tier 1 soil samples that will be collected at Site 1, Unit 2, will be analyzed according to the methods listed below.

5.1.2.1 FIELD SCREENING

All soil samples will be field screened for PAH with immunoassay test kits (U.S. EPA Method 4035), for BTEX (U.S. EPA Method 8020), for TPH-diesel and -gasoline (U.S. EPA Method 8015M), and for TAL metals (U.S. EPA Method 6000/7000) using an appropriately equipped mobile laboratory.

5.1.2.2 FIXED-BASE ANALYTICAL LABORATORIES

All soil samples will be analyzed using a fixed-base laboratory for dioxins/dibenzofurans (U.S. EPA Method 8280), explosives (U.S. EPA Method 8330), nitrate (U.S. EPA Method 353.2), and phosphorus (U.S. EPA Method 365.2) under NFESC Level D protocols. Eight samples will be submitted to the fixed-base laboratory to confirm field screening results. The fixed-base laboratory analyses are PAH (U.S. EPA Method 8310), BTEX (U.S. EPA Method 8020), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols.

5.2 TIER 2

A Tier 2 request for analysis, if necessary, will be contingent upon the Tier 1 sample results.

5.3 TIER 3

A Tier 3 analytical request, if necessary, will be contingent upon the Tier 1 and Tier 2 sample results. During drilling of the three interim groundwater monitoring wells proposed for Site 1, soil samples will be collected every 5 feet.

5.3.1 Units 1 and 2

During groundwater monitoring well construction and after completion, soil and groundwater samples, respectively, will be analyzed in the estimated numbers and for the parameters included in Table A5-2.

5.3.1.1 FIELD SCREENING

All soil samples will be field screened for PAH with immunoassay test kits (U.S. EPA Method 4035), and for BTEX (U.S. EPA Method 8020), TPH-diesel and -gasoline (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) using an appropriately equipped mobile laboratory.

Table A5-2
Monitoring Well Sampling and Analysis

Media	PHASE II RI/FS SAMPLE NUMBERS		FIELD[a] - IMMUNOASSAY OR MOBILE LABORATORY				OFF-SITE LABORATORY[b]								
	Number of Locations	Estimated Total Samples	PAH[c,d]	BTEX[e,f]	TPH[g]-Gasoline and -Diesel[e]	TAL[h] Metals[e]	PAH	BETX	TPH-Gasoline and -Diesel	TAL Metals	Explosives	Total Phosphate	Dioxins, Dibenzofurans	Nitrate	General Chemistry
Soil	3	45	X	X	X	X					X	X	X		
Ground-water	5	5					X	X	X	X	X	X	X	X	X
Subtotals		50	45	45	45	45	5	5	5	5	50	50	50	5	5

Notes:
- [a] at a minimum, 10 percent of detects and 5 percent of nondetects will be sent to the off-site laboratory for confirmation of the field screening results
- [b] for soil analyses, these constituents cannot be determined in the field so the analyses will be performed in the off-site laboratory; for groundwater, all analyses will be performed at the off-site laboratory
- [c] immunoassay analyses
- [d] PAH – polynuclear aromatic hydrocarbons
- [e] mobile laboratory analyses
- [f] BTEX – benzene, toluene, ethylbenzene, and xylenes
- [g] TPH – total petroleum hydrocarbons
- [h] TAL – target analyte list

5.3.1.2 FIXED-BASE ANALYTICAL LABORATORIES

All soil samples will be analyzed using a fixed-base laboratory for dioxins/dibenzofurans (U.S. EPA Method 8280), explosives (U.S. EPA Method 8330), nitrate (U.S. EPA Method 353.2), and phosphorus (U.S. EPA Method 365.2) under NFESC Level D protocols. At least 10 percent of the total number of positives and 5 percent of the nondetects will be submitted to the fixed-base laboratory to confirm field screening results. The fixed-base laboratory analyses are PAH (U.S. EPA Method 8310), BTEX (U.S. EPA Method 8020), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols.

All groundwater samples will be analyzed using a fixed-base laboratory for dioxins/dibenzofurans (U.S. EPA Method 8280), explosives (U.S. EPA Method 8330), nitrate (U.S. EPA Method 353.2), phosphorus (U.S. EPA Method 365.2), PAH (U.S. EPA Method 8310), BTEX (U.S. EPA Method 8020), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols.

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Section 6
FIELD METHODS AND PROCEDURES

This section presents the site-specific field methods that will be used to collect samples and other field data. The field methods referenced in this section are from Section 6 of the FSP and Comprehensive Long-Term Environmental Action Navy (CLEAN) II Standard Operating Procedures, which discuss specific field methods and procedures.

6.1 INITIAL SURVEYS

Before collection of Phase II RI/FS soil samples, the site will be scaled, and sampling locations will be staked or paint-marked. Once a sampling point is marked, utility clearances will be made before using any power equipment to reach the required depth. Utility clearances may also be made at locations where soil samples are being collected by using a hand auger. Nonintrusive utility clearances will be completed by a subcontractor, using geophysical methodology in conjunction with site activities.

Each sampling point will be located by survey, using the California Plane Coordinate System, with northings and eastings determined to the nearest 0.1 foot. The surface elevation will be determined to the nearest 0.01 foot.

6.2 TIER 1

All samples in Tier 1 will be collected at the locations and depths described in Section 4.2. More information on soil sampling procedures is provided in Section 6 of the FSP.

6.2.1 Unit 1: Northern Range

The 36 Tier 1 soil samples will be collected at Site 1, Unit 1, at depths of 0, 5, and 10 feet bgs in 12 borings as indicated below.

6.2.1.1 SOIL SAMPLES

All soil samples will be collected with a modified California split-spoon sampler fitted with stainless steel sleeves. The sampler will be advanced into the ground by a hollow-stem auger drilling rig equipped with a 140-pound hammer.

6.2.2 Unit 2: Southern Range

The 36 Tier 1 soil samples will be collected at Site 1, Unit 2, at depths of 0, 5, and 10 feet bgs in 12 borings as indicated below.

6.2.2.1 SOIL SAMPLES

All soil samples will be collected with a modified California split-spoon sampler fitted with stainless steel sleeves. The sampler will be advanced into the ground by a hollow-stem auger drilling rig equipped with a 140-pound hammer.

6.3 TIER 2

If Tier 2 soil sampling is conducted at Site 1, shallow soil samples will be collected as described above.

6.4 TIER 3

During drilling of the proposed groundwater monitoring wells, soil samples will be collected at 5-foot intervals beginning at the ground surface, with a modified California split-spoon sampler equipped with stainless steel sleeves. The sampler will be driven into the ground by a hollow-stem auger drilling rig equipped with a 140-pound hammer. When drilling is required to depths of greater than 130 feet bgs, the hollow-stem auger drilling rig will be replaced by an air-rotary drilling rig. Groundwater sampling will follow procedures presented in Section 6 of the FSP.

Section 7
REFERENCES

Bechtel National, Inc. 1995a. *Final Work Plan, Phase II Remedial Investigation/Feasibility Study.* Marine Corps Air Station El Toro, California.

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BNI. *See* Bechtel National, Inc.

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LUFT. *See* State of California Leaking Underground Fuel Tank Task Force.

State of California Leaking Underground Fuel Tank Task Force. 1989. *Leaking Underground Fuel Tank Field Manual: Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure.*

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COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

CLEAN II

FIELD SAMPLING PLAN
ATTACHMENT B
OPERABLE UNIT 2 –
SITE 2 – MAGAZINE ROAD LANDFILL
MCAS EL TORO, CALIFORNIA

CTO-0059

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TABLES

ACRONYMS/ABBREVIATIONS

Air SWAT	Air Solid Waste Assessment Test
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	chemical of potential concern
CPT	cone penetrometer test
DDT	dichlorodiphenyltrichloroethane
DQO	data quality objective
EM	electromagnetic
FID	flame ionization detector
FS	Feasibility Study
FSP	Field Sampling Plan
GC	gas chromatograph
GC/MS	gas chromatography/mass spectroscopy
GPR	ground-penetrating radar
MCPP	2-methyl-4-chlorophenoxyproprionic acid
MCAS	Marine Corps Air Station
$\mu g/kg$	micrograms per kilogram
$\mu g/L$	micrograms per liter
mg/kg	milligram per kilogram
mph	miles per hour
ND	nondetect
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
$\%_V$	percent by volume
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
pCi/L	picocuries per liter
PID	photoionization detector
ppb	parts per billion
ppb_V	parts per billion by volume
ppm_V	parts per million by volume

Continue

ACRONYMS/ABBREVIATIONS (continued)

PRG	U.S. EPA Region IX Preliminary Remediation Goal
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RWQCB	(California) Regional Water Quality Control Board
SCAQMD	South Coast Air Quality Management District
SVOC	semivolatile organic compound
TAL	target analyte list
TCE	trichloroethene
TFH	total fuel hydrocarbons
TOC	total organic compounds
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compounds