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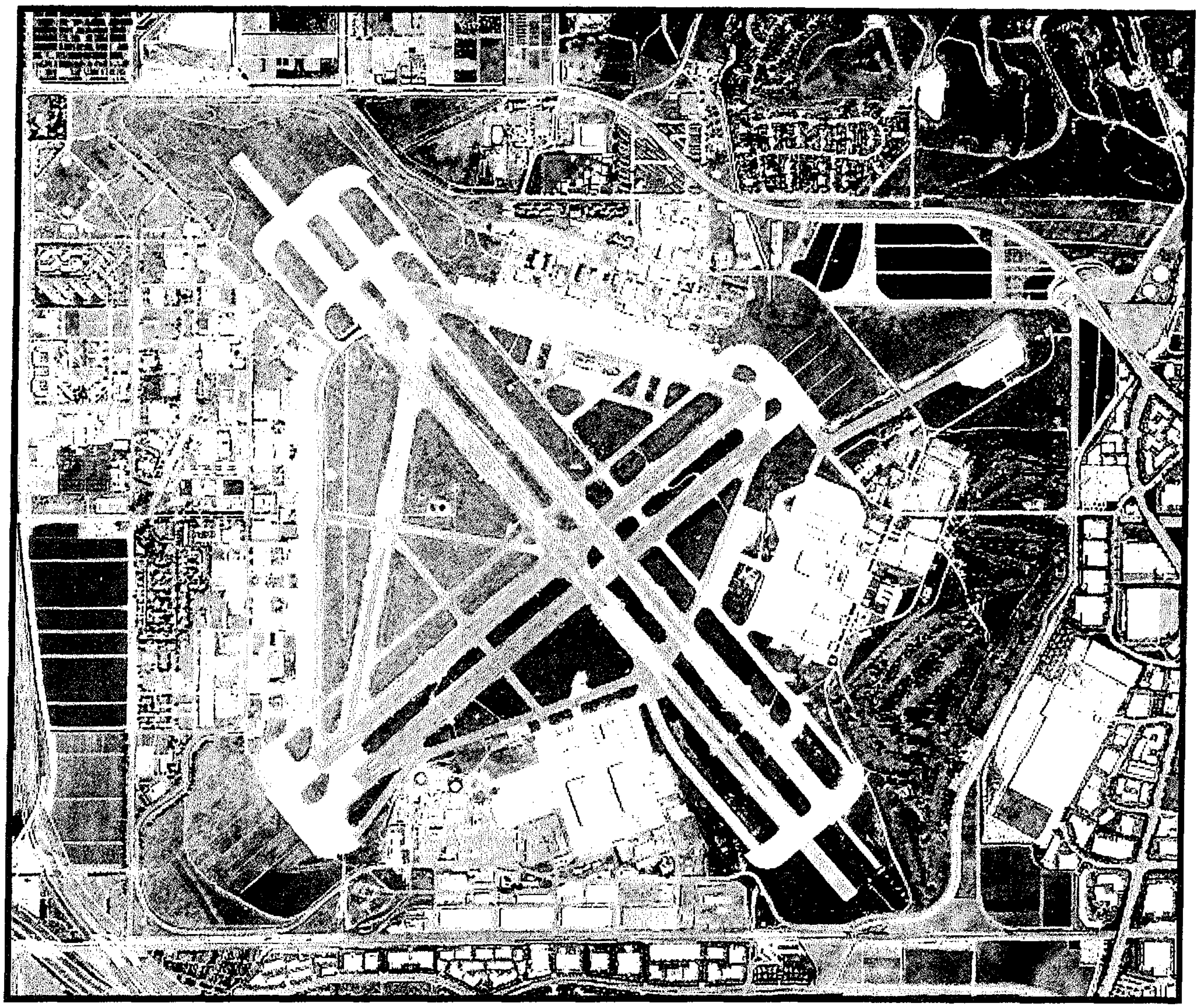

THE NAVY'S UNDERESTIMATION OF SOLVENT CONTAMINATION AT THE MCAS EL TORO, CALIFORNIA

Volume I

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LIST OF ACRONYMS

AIChE	American Institute of Chemical Engineers
AIRC	Aircraft Information Research Corporation
API	American Petroleum Institute
AOC	Areas of concern
APWA	American Public Works Association
bgs	below ground surface
BRAC	Base Realignment and Closure Act
CCPS	Center for Chemical Process Safety
COC	Chemicals of concern
DHS	State of California Department of Health Services
Navy	Department of the Navy
DTSC	State of California Department of Toxic Substances Control
gpm	gallons per minute
IRP	Installation Restoration Program
IRWD	Irvine Ranch Water District
MCAS	Marine Corps Air Station
MCL	maximum contamination level
mgd	million gallons per day
NCPI	National Clay Pipe Institute
NE	northeast
NW	northwest
OCSD	Orange County Sanitary District
OCWD	Orange County Water District
OWS	oil water separator
PCB	polychlorinated biphenyl
PCE	perchloroethylene
PES	PES Environmental, Inc.
POA	Plan of Action
SARWQCB	Santa Ana Regional Water Quality Control Board
SCAWQD	South Coast Air Quality Management District
SE	southeast
SSTP	sanitary sewage treatment plant
SW	southwest
SWMU	Solid Waste Management Unit
TCA	1,1,1 trichloroethane
TCE	trichloroethylene
TIC	The Irvine Company
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VCP	vitreous clay pipe
VOC	volatile organic compound

EXECUTIVE SUMMARY

PES Environmental, Inc. on behalf of the City of Irvine has performed an independent technical evaluation of the Department of the Navy's (Navy) "Accelerated" Base Realignment and Closure (BRAC) Cleanup programs at the recently closed Marine Corps Air Station (MCAS) El Toro, California. The findings from PES' evaluation indicate the Navy has failed to adequately investigate a vast network of subsurface piping that represents potentially hundreds of release points for hazardous materials including volatile organic compounds (VOCs) to soil and groundwater beneath the site. This network of piping consists of approximately 26 miles of the sanitary sewer system that was used for the discharge of hazardous materials from former industrial operations at MCAS El Toro.

The inadequate investigation and remediation of hazardous materials from the sanitary sewer system will adversely affect groundwater cleanup plans in and around the vicinity of MCAS El Toro, including surrounding communities. Additionally, the presence of hazardous materials including VOCs in such broad areas that are occupied by the approximate 26 miles of the sanitary sewer system represents significant liabilities to future land-reuse plans at MCAS El Toro.

Releases of VOCs at MCAS El Toro have been demonstrated to be a significant threat to human health and the environment due to their toxicity, mobility in soil and groundwater, and volume of use from historical industrial operations. Consequently, soil and groundwater cleanup has been required to address the presence of VOCs identified in other areas at MCAS El Toro that have been investigated (i.e., Site 24). According to the Navy, Site 24 (which largely represents the southwest quadrant of the base) is the sole source of regional VOC groundwater contamination in and around the vicinity of MCAS El Toro. An analysis of past activities at the base for the years 1943 to 1996 shows, though, that significant quantities of solvents were used and discharged to the sanitary sewer system within the other three quadrants of the base – the northwest, northeast, and southeast quadrants. The releases in these other quadrants may far exceed the releases documented at Site 24.

The Navy estimates that approximately 8,000 pounds of VOCs have escaped into the soil and groundwater at Site 24. Based on various assumptions related to VOC use throughout the base, PES estimated that between 70,000 to 700,000 pounds of VOCs may have been released to subsurface soils from the sanitary sewer system. This calculated range of releases is about 8 to 80 times that estimated by the Navy. Although there are inherent uncertainties associated with estimating the amount of VOCs released over time, the fact that 26 miles of sanitary sewer system have not been investigated is a significant flaw in the Navy's closure activities.

The Navy's misconceptualization of the solvent contamination problem stems from the Navy's failure to focus on the solvent-using activities at the base and their geographic distribution at the base, and the Navy's focus, instead, on the results of its limited soil and groundwater sampling. The Navy has not pursued the possibility that the maintenance of vehicles and airplanes, commercial dry cleaning, use of industrial degreasers, and other industrial operations, all of which utilized substantial volumes of solvents, may have contributed to releases into the environment. More importantly, the Navy also has not investigated the manner in which the waste solvents from these activities were disposed and, in particular, the consequences of the disposal of the waste solvents into the sanitary sewer system.

Three major consequences follow from the Navy's misconceptualization of the solvent contamination problem.

First, the cost of remediating the contamination will likely be substantially higher than that estimated by the Navy. The Navy currently estimates the overall cleanup costs for the base as $115 million. This estimate covers the entirety of the environmental problems identified by the Navy, and it includes $27 million for the remediation of solvents at Site 24. It is probable that additional remediation costs due to releases of VOCs from the sanitary sewer system will be substantially above what the Navy has estimated for the base. Although investigation and definition of the extent of the problems are required to evaluate cost impacts, it is conceivable that remediation costs at the base could increase by tens of millions to hundreds of millions of dollars due to releases from the sanitary sewer system.

Second, the presence of solvent contamination will affect construction projects from moving forward – until the soil is thoroughly investigated and remediated. Development of the proposed commercial airport includes the construction of terminals, parking garages, a hotel, maintenance facilities, utilities, and roadways. All of these structures will require the excavation of soils, either for below-grade construction or for support pilings. There is a very high potential that impacted soil will be encountered during many of these excavations particularly in the proximity of the sanitary sewer system. This will result in significant delays in construction schedules and cost overruns.

The third major problem is potential harm to the health and safety of construction workers. Construction workers, unlike hazardous waste contractors, do not normally wear protective equipment or respirators; and, they are not trained to minimize their exposures. During their initial work at the site, they can easily be exposed to contamination via inhalation of vapors, incidental ingestion of soil, and direct adsorption through the skin. TCE, the main VOC of concern, is considered by the State of California to cause cancer. Accordingly, if construction proceeds without investigating and remediating solvent contamination along the sanitary sewer system, construction workers may be exposed to significant levels of a carcinogen and other hazardous materials.

The Navy should be required to investigate and remediate sources of hazardous materials associated with the approximately 26 miles of the sanitary sewer system at MCAS El Toro, so that stakeholders of the community are not burdened with the liabilities and costs associated with undiscovered sources of contamination that will continue to adversely affect sources of drinking water throughout the community.

1.0 INTRODUCTION

This report examines the Navy's characterization of sources of volatile organic compounds (VOCs) associated with soil and groundwater contamination identified at the Marine Corps Air Station (MCAS) El Toro, California. In particular, this report examines the historical use of significantly greater quantities of VOCs at locations outside the particular area analyzed by the Navy, and the implications of the Navy having "missed" these other sources of VOC contamination.

This report is organized as follows:

Section 1.0 – Introduction. The introduction describes the scope of work performed by PES. This section also presents summary information regarding the Navy's "expedited and accelerated" site characterization and cleanup program and the Navy's focus on Site 24.

Section 2.0 – Expanded Study Area Examined in this Report. Information presented in this section describes the historical activities at the former air station outside of Site 24.

Section 3.0 – Hazardous Materials/Waste Disposal Management Practices in the Expanded Area. This section discusses the use of the sanitary sewer system as an integral part of the historical disposal practices for hazardous wastes – particularly during the first several decades of the operation of the base.

Section 4.0 – MCAS El Toro Sanitary Sewer System. A general description of the sanitary sewer system at MCAS El Toro is provided in this section with a discussion of conditions that result in standard rates of exfiltration (leakage).

Section 5.0 – Magnitude of VOCs Discharged to the Sanitary Sewer. This section contains a detailed examination of rates of VOC use on the base, estimates VOC disposal to the sanitary sewer system, and calculates exfiltration from the sewer system into the environment.

Section 6.0 – Subsurface Soil Investigations. This section summarizes the limited scope of the Navy site characterization activities of VOCs in the soil.

Section 7.0 – Groundwater Investigations. The section summarizes the investigation of groundwater contamination and demonstrates the inadequacy of the groundwater monitoring and sampling program to detect contamination due to releases from the sanitary sewer system.

Section 8.0 – Implications of the Navy's Underestimation of VOC Contamination. This section sets forth the impacts of the Navy's underestimation in three areas: remediation costs, construction disruption, and worker health and safety.

Section 9.0 – Conclusions and Recommendations. A summary of the significant findings developed by PES is presented in this section, along with PES' recommendations.

1.1 Scope of Work

As part of its technical evaluation, PES acquired and reviewed the following reports and information:

- Base Realignment and Closure (BRAC) Program documents from the Administrative Record File listed in Appendix A to determine the facilities associated with the use of VOCs and the generation of hazardous wastes containing VOCs.

- U.S. Environmental Protection Agency (USEPA) Region IX files listed in Appendix B regarding the BRAC Cleanup Program, permit applications, environmental management plans, environmental reports, environmental incident reports, spill reports, notice of violations in regard to deviations from permitted conditions, and general correspondence on environmental topics involving MCAS El Toro officials.

- State of California Department of Toxic Substances Control (DTSC), Santa Ana Regional Water Quality Control Board (SARWQCB), and South Coast Air Quality Management District (SCAQMD) files listed in Appendix C regarding permit applications, operating permits, environmental management plans, environmental reports, environmental incident reports, spill reports, notice of violations in regard to deviations from permitted conditions, and general correspondence on environmental topics involving MCAS El Toro officials.

- Orange County Health Care Agency (OCHCA), Orange County Fire Authority (OCFA) and Orange County Sanitation District (OCSD) files listed in Appendix D regarding permit applications, operating permits, environmental management plans, environmental reports, environmental incident reports, spill reports, notice of violations in regard to deviations from permitted conditions, and general correspondence on environmental topics involving MCAS El Toro officials.

- Navy operations records for MCAS El Toro stored at the Naval Historical Center in Washington, D. C. relating to aviation training and support activities.

- MCAS El Toro facility engineering files and drawings including design drawings, stored at Building 368, MCAS El Toro concerning facility operations that may have involved hazardous material use, hazardous waste generation and disposal, and the sanitary sewer system.

- Nationally accepted standards and engineering practices listed in Appendix E regarding the design and construction of vitrified clay pipe sanitary sewer systems.

- Interviews with individuals listed in Appendix F representing national professional, industry, and trade associations and technical support staff specialists with chemical and equipment manufacturers.

Based on the data collected and reviewed during the initial phase of the work, PES performed the following tasks:

- Established a reference system using geographic quadrants for the former MCAS El Toro site as shown at Plate 1 to accommodate locating industrial facilities and processes.

- Identified and described industrial facilities and processes throughout the base associated with aircraft and vehicle equipment maintenance, degreasing, washing and painting, and laundry and dry cleaning that operated during the period of 1943 through 1996.

- Developed a method for estimating the mass of VOCs used and discharged to the sanitary sewer system from facility process operations.

- Developed a conceptual model describing potential releases of VOCs to the subsurface based on the design and construction of the MCAS El Toro sanitary sewer system, the level of industrial activities and their contribution to the sewer system during the period of 1943 to 1996, and the design rate of maximum allowable exfiltration from the sanitary sewer system.

- Analyzed documents regarding BRAC process subsurface soil investigations, on-site and off-site groundwater investigations, and groundwater monitoring programs to determine their consistency with the potential discharge of VOCs from non-Site 24 activities via the sanitary sewer system.

- Assessed the likelihood that the potential subsurface contamination significantly exceeds the Navy's estimate of 8,000 lbs. of VOCs released.

1.2 Background of VOC Contamination

In 1985, the Orange County Water District (OCWD) identified the presence of trichloroethylene (TCE) in groundwater near MCAS El Toro at concentrations in excess of drinking water standards. The Navy estimated the contamination at Site 24 to be approximately 1,500 pounds of TCE as soil gas, approximately 4,000 pounds of TCE in soil moisture, approximately 500 pounds of TCE adsorbed to soil, and approximately 2,000 pounds of TCE in the groundwater. In the Navy's view, the contamination originated from industrial activities that occurred at Site 24. According to Navy, the historical activities that generated the VOCs identified in soil and groundwater included aircraft and vehicle equipment washing, degreasing, maintenance, and painting associated with aircraft and vehicles used at MCAS El Toro.

In its assertion that the activities at Site 24 were the sole source of the identified areas of subsurface VOC contamination, including the 3-mile long plume of TCE in the deep groundwater acquifer, the Navy ignored the potential contribution of the same VOC-using activities that occurred elsewhere throughout the active parts of the base. The Navy also dismissed the potential for the sanitary sewer system at MCAS El Toro to be a significant pathway by which contaminants reached the subsurface and, ultimately, the groundwater. PES was charged with evaluating the basis of the Navy's analysis and the potential for alternative sources and pathways of contamination that may significantly impact the cleanup program at the former air station.

Concentrations of VOCs in groundwater exceeding USEPA Maximum Contaminant Levels (MCLs) exist in shallow and deeper aquifers on- and offsite MCAS El Toro extending approximately 3 miles downgradient to the west and northwest of the recently closed base. The 3-mile long plume is over 1-mile wide. This plume of contamination presents an exposure risk to the general public through the use of groundwater from this area that has been designated as a beneficial use groundwater basin. As a result of the accelerated site characterization program, the Navy attributed Site 24 as the sole source area of the groundwater contamination.

The Navy has proposed a two step remedial process to address the contamination at Site 24 and the 3-mile plume of contamination in the groundwater. As the first step, soil remediation of Site 24 by soil vapor extraction (SVE) is planned to prevent or significantly minimize further impact to the groundwater. Once operational, SVE will continue until monitoring tests indicate soil remediation has been successful. Current Navy projections are that this may occur in mid-year 2002. In the second step, the Navy, the Orange County Water District (OCWD) and the Irvine Ranch Water District (IRWD) intend to negotiate an agreement to design and implement a cooperative water supply treatment project to remove contaminants from the groundwater plume to residual levels acceptable to the regulatory agencies.

1.2.1 Navy's Representation of the Volatile Organic Compound Source Area

In the Navy's "Draft Final Phase II Remedial Investigation Report, Operable Unit 2A - Site 24" (Bechtel 1996), Site 24 was identified as the sole source of regional VOC groundwater contamination from MCAS El Toro in the Irvine Groundwater Sub-Basin. Extracts from this report, consisting of the Executive Summary, several illustrations, and a portion of the conclusions and recommendations are provided in Appendix G. As shown in Figure 3-6, Appendix G, Site 24 is located in the SW quadrant of the base.

Calculations by the Navy's environmental contractor demonstrated that two areas of VOCs in the vadose zone beneath Site 24 were capable of causing concentrations of VOCs in groundwater to exceed USEPA MCLs. The report attributed this contamination to the process of degreasing, washing, maintaining, and painting aircraft and vehicle equipment and component parts, and to the direct discharges of liquid hazardous wastes onto the ground surface. According to the report, these activities resulted in discharges to the storm drain system and spills or runoff to the ground surface, all of which resulted in the subsurface contamination.

Although the report specifies discharges to the storm drain system, MCAS El Toro engineering records and correspondence between the Navy and regulatory agencies clearly document that such discharges were not normally to the storm drain system, but were typically to the sanitary sewer system. This issue is discussed in further detail in Section 3.0 below. These discharges, as shown in the illustration, were likely released to the subsurface through breaches in the integrity of the sanitary sewer line.

According to the Navy report, the principal VOC compound associated with these activities was TCE. Other chlorinated VOC compounds such as PCE (perchloroethylene), TCA (1,1,1-trichloroethane) and carbon tetrachloride were detected in groundwater at concentrations lower than MCLs with less frequency than TCE. The report identified the primary source area as TCE-contaminated soil located in the general vicinity of Buildings 296 and 297 in Site 24. Further, the report inferred that releases of TCE originated from degreasers in each of these buildings as shown in Figures 3-2 and 3-3 in Appendix G. The report identified a secondary source area of PCE-contaminated soil located approximately 500 feet west of Building 297 in Site 24.

1.2.2 Navy's Estimated Mass of Volatile Organic Compound Contaminants in the Subsurface

As represented in the Executive Summary of the Navy's report (Bechtel 1996) in Appendix G and discussed in further detail in the report, the Navy estimated that approximately 1,500 pounds of TCE were present as soil gas in the primary TCE source area underlying Buildings 296 and 297 in Site 24. The Navy cited an additional source in the same report of approximately 4,000 pounds of TCE present in soil moisture. Illustrations depicting these contaminant conditions are provided as extracts from the "Draft Final Engineering Design Report, Vadose Zone Remediation, Site 24" (Bechtel 1998) in Appendix H as Figures 1-2, 1-3, and 1-4. In the Navy's Draft Phase I FS Report for OU2A-Site 24, the Navy lists an additional 500 pounds of TCE as adsorbed onto the soil, and 2,000 pounds of TCE in the groundwater beneath Site 24. Overall, then, the Navy estimates the mass of TCE at Site 24 to be 8,000 pounds.

The Navy used a one-dimensional, finite difference mathematical simulation, known as "VLEACH," to model the movement of VOC compounds through the vadose zone and estimate the value of contaminant mass transported from the vadose zone to the underlying groundwater (Bechtel 1996, Section 5.2.4.1). Based on the results of the VLEACH simulation and the local hydrogeological conditions underlying the area of Site 24, the Navy concluded that: (1) the vertical extent of TCE contamination in groundwater is limited to approximately the top 100 feet of the shallow groundwater bearing zone; and (2) the TCE plume migrated horizontally approximately 2,800 feet to the northwest as the soil source of TCE depleted over time.

While the Navy attributed the TCE contamination to activities at Site 24, the same activities occurred at other areas on the base with a similar potential for release of VOCs to the subsurface. The Navy has not evaluated the potential for additional VOC contributions to the groundwater from non-Site 24 industrial activities.

2.0 EXPANDED SOURCE AREA INVESTIGATED IN THIS REPORT

2.1 Historical Perspective

PES identified specific facilities across all quadrants (NW, NE, SE and SW [Site 24]) of MCAS El Toro that were associated with aircraft and vehicle equipment washing, parts degreasing, oil-water separators (OWSs), maintenance, and painting activities. Using the Navy's "Installation Restoration Program Final Resource Conservation and Recovery Act (RCRA) Facility Assessment Report" (Jacobs Engineering 1993), PES correlated industrial activities with specific building numbers, facilities, Installation Restoration Program (IRP) sites, Areas of Concern (AOC) and Solid Waste Management Unit (SWMU) sites (see Tables 2-1 through 2-4). These facilities and the associated industrial activities are illustrated on Plates 1a through 1d for the NW, NE, SE and SW quadrants of MCAS El Toro, respectively and presented in Table 2-5. Using this information on other potential VOC source areas, PES then evaluated historical and contemporary activities in the NW, NE and SE quadrants of MCAS El Toro.

2.2 Industrial Activities Outside Site 24

2.2.1 Northwest Quadrant

As shown on Plate 1a and Table 2-5, the NW quadrant of MCAS El Toro had 78 industrial facilities that hosted aircraft wash areas, vehicle wash racks, degreasing, OWSs, maintenance, and painting operations during the period of 1943 through 1996. These facilities accounted for approximately 30 percent of the industrial activities at the former air station.

Areas within the NW quadrant (specified in Table 2-1) that raised potential concerns include facilities 31, 245, 625, 626 765, 850 and 851 located near, or adjacent to, IRP Sites 13, 14,15, 16 and 20. Additional facilities within the NW quadrant that also raised concerns included 5, 10, 31, 51, 240, 244, 626, 651, 765, and 766 located near, or adjacent to, 21 AOCs and/or SWMUs (Jacobs Engineering 1993). Ten facilities (85, 86, 99, 100, 101, 102, 102A, 103, 225 and 286) appeared on the "U.S. Marine Corps Air Station, Public Works Department, Station Map" dated October 15, 1953 (MCAS El Toro PWD 1953) and on the legend from the same document (extract provided at Appendix I). However, these facilities did not appear on the "Department of the Navy, U.S. Marine Corps Air Station, Station Map" dated February 27, 1973 (MCAS El Toro USN 1973), indicating that they were removed from service and demolished sometime between 1953 and 1973. In its analysis, PES has assumed that these facilities were in full operation until 1973.

2.2.2 Northeast Quadrant

As shown on Plate 1b and Table 2-2, the NE quadrant of MCAS El Toro had 86 industrial facilities that hosted aircraft wash areas, vehicle wash racks, degreasing, OWSs, maintenance and painting operations during the period of 1943 through 1996. These facilities accounted for approximately 33 percent of the industrial activities at the former air station.

None of these facilities were near or adjacent to IRP sites. Facilities 114, 115, 127, 130, 143, 574, 575, 576, 577, 602, 605, 606, 658, 763, and 764 were located near or adjacent to 32 AOCs and/or SWMUs (Jacobs Engineering 1993) as shown in Table 2-2. Fourteen facilities (106, 108, 109, 110, 112, 118, 128, 143, 144, 229, 232, 352, 353, and 436) appeared on the "U.S. Marine Corps Air Station, Public Works Department, Station Map" published on October 15, 1953 (MCAS El Toro PWD 1953) and on the map legend (Appendix I). However, these facilities did not appear on the "Department of the Navy, U.S. Marine Corps Air Station, Station Map" dated February 27, 1973 (MCAS El Toro USN 1973), indicating that they were removed from service and demolished sometime between 1953 and 1973. In its analysis, PES has assumed that these facilities were in full operation until 1973.

2.2.3 Southeast Quadrant

As shown on Plate 1c and Table 2-3, the SE quadrant of MCAS El Toro had 37 industrial facilities that hosted aircraft wash areas, vehicle wash racks, degreasing, OWSs, maintenance and painting operations during the period of 1943 through 1996. These facilities accounted for approximately 14 percent of the industrial activities at the former air station.

Facility 727 is near IRP Site 6. Facilities 371, 390, 447, 453, 454, 461, 462, 463, 673, 761, 762, and 817 were located near 30 AOCs and/or SWMUs (Jacobs Engineering 1993) as shown in Table 2-3. Two facilities (785 and 845) appeared on the "MCAS El Toro Building Guide." This guide, dated April 22, 1996, is provided in Appendix J. These same facilities did not appear on the "Department of the Navy, U.S. Marine Corps Air Station, Station Map" dated February 27, 1973 (MCAS El Toro USN 1973), indicating that they were constructed sometime between 1973 and 1996. PES's analysis assumed that these facilities were in operation for the full period between 1973 and 1996. The Navy reported two facilities (896 and 897) to the SCAQMD in 1994 (SCAQMD 1994) as operational aircraft wash areas. These facilities did not appear on either the "MCAS El Toro Building Guide," dated April 22, 1996 or the "Department of the Navy, U.S. Marine Corps Air Station, Station Map" dated February 27, 1973 (MCAS El Toro USN 1973). The facility numbers are contemporaneous with those assigned to other structures and facilities by the MCAS El Toro Public Works Department (circa 1973). In its analysis, PES assumed that the absence of these facilities in the Building Guide and Station Map was an administrative oversight by the Navy and that they were in operation during the period of 1973 through 1996.

2.2.4 Southwest Quadrant

As shown on Plate 1d and Table 2-4, the SW quadrant of MCAS El Toro had 60 industrial facilities that hosted aircraft wash areas, vehicle wash racks, degreasing, OWSs, maintenance, and painting operations during the period of 1943 through 1996. These facilities accounted for approximately 23 percent of the industrial activities at the former air station.

In addition to aircraft and vehicle related operations, the SW quadrant was the site of an industrial laundry and dry cleaning facility. This is contrary to the Navy's claim that an industrial laundry and dry cleaning facility did not exist (see question "B1d2" on page 11 of 16 in Appendix L). This omission raises major questions about the adequacy of the Navy's analysis. The Navy operated the industrial laundry dry cleaning facility at Building No. 307 from 1944 through 1972 (see Appendix K, NAVCOMPT Form 277, Class II Station Property Record(s) dated June 1970 and October 1971and Drawing 321099 "Laundry Building/Laundry Equipment Layout" dated April 2, 1944). The laundry facility, as shown in NAVFAC Drawing No. 6314057, "Area 27 Sanitary Sewers" (also provided in Appendix K) was connected to the sanitary sewer system. The laundry and dry cleaning operations ended in 1972 when the Navy closed the sanitary sewage treatment plant (SSTP) following receipt of "Cease and Desist Order No 67-25" from the SARWQCB for discharging excessive concentrations of ether soluble materials (e.g. fats, oils, greases) from the SSTP. The sanitary sewer system at MCAS El Toro was designed to allow bypassed flow to discharge directly to the Bee Canyon Wash and/or treated effluent to discharge to the San Diego Creek.

2.2.5 Summary

Table 2-5 summarizes, by geographic quadrant, the industrial activities at MCAS El Toro that had the potential to cause subsurface VOC contamination at the former air station. The Navy has not assessed the potential contribution of the activities located in the non-SW quadrants (NW, NE and SE) despite evidence that: (1) VOC uses in the NE, SE, and NW quadrants were essentially equivalent to those acknowledged by the Navy to have been the source of TCE groundwater contamination; (2) hazardous material and hazardous waste management practices appeared similar among the quadrants; and (3) there is no evidence that base policies and process procedures varied from quadrant to quadrant during the period of 1943 through 1996. Therefore, the Navy has not evaluated a significant number of potential VOC source areas at MCAS El Toro.

3.0 HAZARDOUS MATERIAL AND WASTE DISPOSAL MANAGEMENT PRACTICES IN THE EXPANDED AREA - 1943 TO 1996

A critical issue in assessing potential releases from the sanitary sewer system is whether or not direct discharges of liquid hazardous waste to the sanitary sewer system routinely occurred. The Navy has stated in response to two EPA questions ("A3" and "B1e6" on pages 3 of 16 and 13 of 16, respectively at Appendix L) that the sanitary sewer system at MCAS El Toro did not routinely receive discharges of liquid hazardous wastes. However, PES' research indicates that hazardous waste was routinely discharged through the sanitary sewer system for many years during the air station's active life.

Several BRAC documents, including the "Final RCRA Facility Assessment Report" (Appendix L) and the "Final Baseline Survey Report" (Appendix N) describe the routine practice of liquid hazardous waste disposal to the sanitary sewer system. This practice continued up until the early 1980s. The Navy has acknowledged this was standard operating procedure at the base in the following documents:

- Navy documents (pages 5 though 9, pages 13 through 15, and page 18 of 19 in Appendix N), state that the practice of direct discharges of liquid hazardous wastes into the sanitary sewer system and onto the ground surface was common and accepted through the late 1970s and early 1980s. The Navy has acknowledged that direct discharge of liquid hazardous waste to the ground surface was conducted through the early 1980s (page 3-21 in Appendix N). Interviews with past MCAS El Toro employees demonstrate that this disposal practice was common (page 4 of 19 in Appendix N).

- As shown in an extract from MCAS El Toro engineering and construction drawings in Appendix M, aircraft wash areas, vehicle wash racks, maintenance area drains, degreaser and OWS drains, and drains in painting operation areas are connected to the sanitary sewer system, not the storm drain system, contrary to the Navy's Figure 4-2 in Appendix G.

- Plates 3a through 3c illustrate the MCAS El Toro sanitary sewer system relative to the location of industrial activities in the NW, NE and SE quadrants of the former air station. PES's technical review of engineering and construction drawings demonstrates that little has changed in the alignment and connections of this system since its construction in the early 1940s and 1950s. As the drawings show, the facilities hosting industrial activities that the Navy attributes to being the principal cause of subsurface VOC contamination are connected to the sanitary sewer system.

- The Navy's response to a DTSC question (number 28 on page 25 of 33 in Appendix L) states that solvents were discharged directly to the storm drainage system. However, the connections referred to by the Navy, according to public records and sanitary sewer system drawings, discharged to the sanitary sewer system.

- On page 2-8 in its "Final RCRA Facility Assessment Report" (dated 7 July 1993, extracts provided in Appendix L), the Navy reported that effluent water from wash rack operations was discharged to the sanitary sewer system or the storm drainage system. The Navy made the same statement on page 2-5 in its "Final Environmental Baseline Report" (dated April 1, 1995, extracts in Appendix N).

- The SSTP at MCAS El Toro received a "Cease and Desist Order" from SARWQCB in 1972 for violating its discharge permit conditions by exceeding the limits for ether-soluble materials (page 2-10 of the Order, extract in Appendix L).

Despite the Navy's statements, the evidence from the design and construction of base utility systems, the testimony of base personnel, and the regulatory response to excessive hazardous materials in the system supports the view that the standard operating practices at MCAS El Toro were to discharge hazardous waste liquids into the sanitary sewer system throughout all four quadrants of the former air station.

4.0 MCAS EL TORO SANITARY SEWER SYSTEM

4.1 General Description

The MCAS El Toro sanitary sewer system is shown on Plate 2a through 2d for the respective NW, NE, SE, and SW quadrants. The system was constructed during the period of the mid-1940s through the early 1950s and consists of approximately 26 miles of vitrified clay pipe (VCP) with more than 40,000 joints (Malcolm Lewis, 1986). Each individual section of VCP is approximately 40 inches long, ranges in diameter from 4 inches to 18 inches, and is connected to another section with cement mortar (Jacobs Engineering, 1995). As explained in Appendix O, typical sanitary sewer systems constructed of VCP in that era were designed to allow a specified rate of exfiltration of liquids flowing through the system to the subsurface.

A simplified schematic depicting the MCAS El Toro sanitary sewer system is shown on Plate 4. The system was designed for influents to flow by gravity from the NE quadrant to either the NW or SE quadrants (Malcolm Lewis, 1986). Influent from the NW quadrant (including any influent collected from the NE) flowed by gravity directly to the SSTP. The influent from the SE quadrant (including any influent collected from the NE) first flowed by gravity to the SW quadrant where additional influents were collected and then were conveyed to the SSTP. The SSTP used physical, biological and chemical treatment processes to treat the receiving waste stream for discharge to the San Diego Creek (Navy, 1971). As noted above, operation of the SSTP and associated discharges to the San Diego Creek terminated in 1972 following receipt of a "Cease and Desist Order" from the SARWQCB. In lieu of on-site treatment, the base was connected to the Irvine Ranch Water District (IRWD) and the Orange County Water District (OCSD) sanitary sewer systems. With the exception of the industrial wastewater conveyance line connecting

Building 296 and the former SSTP located at IRP Site 24 (SW quadrant), no separate industrial wastewater conveyance system existed at MCAS El Toro.

The performance of the MCAS El Toro sanitary sewer system is affected by:

- State and condition of pipe,
- Soil conditions,
- Method of installation,
- Sewer system layout,
- Design assumptions for calculating flow in sewers,
- Soundness of the VCP joint mechanics and joining techniques in the early 1940s and 1950s,
- Flow characteristics and flow regime, and
- Testing of installed VCP.

A detailed discussion of the factors identified above and how they affect the performance of a VCP sanitary sewer system is in Appendix O. Installation of VCP requires numerous steps: excavating to a specific depth; preparing the soil bedding to receive the VCP; cleaning the bell and spigot ends of the pipe sections and applying the joint compound; fitting the adjoining sections together; and, after a required pipe run was made up, back-filling the ditch (NCPI, 1998). Provided at Appendices P, Q, and R are relevant extracts from National Clay Pipe Institute (NCPI), American Society of Testing and materials (ASTM) standard specifications, and "Standard Specification for Public Works Construction" documents, respectively. These documents provided guidance in the design and installation of VCP sanitary sewer systems.

4.2 Vitrified Clay Pipe Performance

A 1992 report prepared for the Central Valley Regional Water Quality Control Board entitled "Dry Cleaners - A Major Source of PCE in Groundwater" (see Appendix S), by Victor J. Izzo discusses in detail how chemical contaminants exfiltrate through VCP to the surrounding subsurface. The report shows that under certain conditions, VOCs such as PCE, TCE, and TCA will vaporize, escape through VCP to the subsurface, and re-condense. Case studies cited by Izzo have established that:

- Heavier than water chlorinated solvents such as TCE, TCA, PCE, and methylene chloride will escape from unsound VCP.

- VCP is not vapor tight and will allow VOC compounds volatilizing in a VCP line to escape to the soil and condense.

- VOC compounds present in the sanitary sewer line may attack VCP surfaces and damage the structural integrity of the VCP line.

- Cement mortar is inflexible and prone to rupture.

- Soil having poor load bearing qualities or being prone to expansion or contraction as soil moisture fluctuates will adversely affect the structural integrity of the VCP line.

- Static and dynamic load conditions at any point along the length of the VCP line may damage its structural integrity.

During its construction from 1940 through 1950, the priority for MCAS El Toro was to get the base operational for national defense. PES could not identify any records documenting any testing during or after construction completion, or at any time since, for the sanitary sewer system. Failure of the VCP at the joint or barrel of the pipe section(s) may occur if it was installed incorrectly or exposed to dynamic loads that exceed its design capacity. At best, the structural integrity of the MCAS El Toro sanitary system is unknown. Even if intact, allowable exfiltration will result in leakage from the system.

4.3 Exfiltration in Vitrified Clay Pipe Sanitary Sewer Systems

Calculating the rate of exfiltration depends on the flows through the VCP system as well as design characteristics of the VCP itself (APWA, 1997; NCPI, 1998). A sanitary sewer system serves two main functions: (1) to carry the peak discharge for which it is designed; and (2) to transport suspended solids so that deposits in the sewer are kept to a minimum. It is essential, therefore, that the sanitary sewer system has adequate capacity for the peak flow and that it functions properly at minimum flows.

Peak flow determines the hydraulic capacity of the sanitary sewer system and treatment facilities. Minimum flows must be considered in the design of sewers and siphons to ensure reasonable cleansing velocities, while avoiding abrasion and scouring of the system.

Although PES could not document the criteria used for sizing the MCAS El Toro sanitary sewer system, its technical review indicated that the base was permitted to discharge 1.5 million gallons per day (mgd) of sanitary wastewater to the IRWD and OCSD in 1972. These discharge permits were negotiated after termination MCAS El Toro SSTP operations (IRWD "Negotiated Sewer Service Contract" is provided in Appendix T and OCSD "Industrial Wastewater Permit" is in Appendix U).

The discharge value in the permits does not necessarily equate to system capacity. To arrive at that value, PES, in the absence of information from the Navy, reviewed the design and construction drawings (Malcolm Lewis, 1986). For each of the quadrants and the conveyance line interconnecting the quadrants (Tables 4-1 and 4-2), PES determined: (1) length of VCP line; (2) weighted average diameter of VCP based on length of line in regard to each line diameter; and (3) differential head. Using these parameters, PES calculated the maximum flow rate (A. W. Loomis, 1981) for the entire system to be 3,231 gallons per minute (gpm) (see Appendix V). Assuming the system experiences peak flow during a 16-hour period each day, the daily maximum flow rate (F_{max}) would be 3.1 million gallons per day (mgd). The construction code (APWA, 1997) for VCP less than 15 inches in diameter calls for a design flow rate (F_{design}) of half of F_{max}; therefore, F_{design} is approximately 1.5 mgd. Plate 4 presents a simplified flow diagram of the MCAS El Toro sanitary sewer system at the design flow rate. This flow rate corresponds to the allowable permitted flow rates to the IRWD and OCSD in 1972.

4.3.1 Description and Method of Estimating Rate of Exfiltration

Engineering design practice of VCP sanitary systems constructed during the 1940s and 1950s allowed for exfiltration of a portion of the contents to the subsurface (NCPI, 1998).[1] The rate of exfiltration of liquid is accounted for in the design standards and process known as the maximum allowable rate of exfiltration (APWA, 1997). PES used two separate methods to estimate the rate of exfiltration in gallons per minute for the MCAS El Toro sanitary sewer system.

The first method was taken from Section 306-1.4.2 of the 1997 edition of "Standard Specifications for Public Works Construction" (provided in Appendix R). The worksheet using this method for estimating the rate of exfiltration for each quadrant is included in Appendix V. Use of this method resulted in an estimated maximum allowable rate of exfiltration of approximately 272 gpm.

The second method used to estimate the exfiltration rate was equation "(2)" taken from Appendix OII-A "Calculation Sheets" of the "Draft Final Phase II Remedial Investigation Report, Operable Unit 2A - Site 24" prepared by Bechtel National, Inc. (Bechtel, 1996) included in Appendix G of this report. Using this methodology and Bechtel's assumptions from the referenced report, PES developed a worksheet for estimating the sanitary sewer system's rate of exfiltration for each quadrant at MCAS El Toro (also in Appendix V). This method resulted in a PES estimated maximum allowable rate of exfiltration of approximately 221 gpm.

The average estimated maximum allowable rate of exfiltration derived from the two methodologies is 246 gpm or 7.6 percent of F_{max}.

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[1] Telephone interview with Mr. Edward Sikora, President, NCPI, 8-17-99.

4.3.2 Volatile Organic Compound Transport to the Subsurface at the MCAS

The MCAS El Toro sanitary sewer system allowed VOCs from liquid hazardous waste discharges to escape into adjacent soils for the following reasons:

- The hazardous waste management practices at the MCAS included discharges of liquid hazardous wastes into the system;
- The system had an average calculated maximum allowable exfiltration rate of 7.6 percent;
- The potential adversities experienced by the system during more than 50 years of domestic and industrial service have almost surely resulted in breaches of the sewer line; and
- The absence of documentation for the structural integrity of the system.

5.0 MAGNITUDE OF VOLATILE ORGANIC COMPOUNDS DISCHARGED TO THE SANITARY SEWER SYSTEM

After identifying the sanitary sewer system as a potential pathway for the migration of VOCs to the subsurface, PES conducted an independent research effort of the NW, NE and SE quadrants of MCAS El Toro to identify operations and processes associated with the use of VOCs. These included aircraft and vehicle equipment degreasing, maintenance, washing, and painting operations. PES also evaluated the use of VOCs in the industrial dry cleaning facility operated in the SW quadrant. During this research effort, process models were developed for each of the following industrial processes: aircraft and vehicle washing, degreasing, maintenance, aircraft painting, and dry cleaning. Using these models, PES then estimated the volumes and mass of: (1) solvents used in the identified processes; (2) liquid hazardous waste generated by these processes in each facility; and (3) the influent discharged to the sanitary sewer system. As part of the VOC quantification estimate process, risk sensitivity cases were conducted using the process models to more accurately establish a range of values representing estimates of VOC influent discharged to the sanitary sewer system.

The Navy has refused to provide PES with information in the Navy's records that would permit PES to fine-tune its estimates of the VOCs used at the MCAS. For example, the Navy has refused to provide PES with copies of purchase orders and requisitions for solvents.

In the absence of PES being provided with this more specific information, PES has, necessarily, developed assumptions that may need to be revised. We believe, though, that the analysis in this section fairly characterizes the dynamics of the releases of solvents into the sanitary system, even if the quantitation of these releases – upon the receipt of further information from the Navy – may need to be revised.

5.1 Historical Perspective on Solvent Use

Many of the processes used to clean and maintain aircraft and vehicles on the base required the use of solvents and solvent solutions containing one or more chlorinated solvents and other constituents in a mixture (Jacobs Engineering, 1995). These mixtures changed over time as chlorinated solvents became more expensive and regulations controlling their use and disposal increased.[2] Table 5-1 compares the constituents of solvent solutions used during the periods of: 1943 to 1980, 1981 to 1992, and 1993 to today. During the 1980s, the percentage of chlorinated solvents in the solutions constantly diminished.[3] As a result, it is difficult to assign a single value for the period of 1981 to 1992 and one is not shown in Table 5-1. For this report, PES assumed a conservative 3 percent by weight average percent of chlorinated solvents during the 1981 to 1992 period. As a result of interviews with chemical manufacturing industry representatives, a weight percent of 0.5 for chlorinated solvents for the period of 1993 to 1996 was assumed.[4] Today, this value typically represents impurities from recycling processes.[5]

PES was unable to determine the specific chlorinated compounds used in solvent cleaning solutions during the 1943 to 1980 time period since multiple chemicals were available (see Table 5-2). Therefore, a "notional" solvent, with average physical and chemical VOC properties was assumed and used to estimate volumes and mass of VOCs that may have been released from industrial activities within the NW, NE, and SE quadrants of MCAS El Toro. Table 5-2 presents the names and densities of VOCs used at MCAS El Toro; the notional chlorinated solvent represents an average of these densities, 12.6 pounds per gallon.

5.2 Assumptions

The following is a summary of the assumptions used to estimate loss of VOC mass while conducting the industrial processes mentioned above. Also summarized below are the assumptions that were incorporated into the development of each process model used to estimate the generation of VOC liquid waste mass that may have been discharged to the sanitary sewer system.

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[2] Telephone interview with Mr. Les Wittenberg, Technical Editor, CCPS, AIChE, 9-14-99.

[3] Ibid. 2.

[4] Telephone interview with Mr. Patrick Smith, Executive, Eldorado Specialty Chemicals, 9-13-99; Mr. Greg Lainilo, Safety Kleen Corporation, 8-23-99; Ibid 2.

[5] Ibid. 4.

5.2.1 Mass Loss Assumptions

Solvent losses may occur as a result of volatilization, runoff to the ground surface, slop and spills, fixation to sludge material in OWSs, recovery of solvents from the OWS, incineration, and disposal at a landfill. Plates 6 through 11 are schematic descriptions of each VOC using process on the base and PES's estimates of the percent of solvent lost during each process. The values shown on these plates rest on the following assumptions:

Loss to Volatilization

- A 5 percent loss was assumed for aircraft and vehicle wash processes. PES believes personnel applied solvent cleaning solutions in a water stream to degrease the soiled surfaces. Interviews with cleaning equipment manufacturers indicates that surfactants and demulsifiers were added to the solvent solution to maximize contact time between the solvent and grime/grease particles and to minimize the volatilization of the solvents to the atmosphere.[6] A 5 percent loss is estimated for these processes and is generally consistent with SCAQMD Rule 1171 (Solvent Cleaning Operations).

- A 5 percent loss was assumed for degreasing aircraft and vehicle repair parts. Considering the design and operation of large and bench-top degreasers, the low partial pressures of the VOCs in solvent solution, solution temperature and the degree of turbulence, PES believes the volatilization of the VOCs would have been minimal and is generally consistent with SCAQMD Rule 1122 (Solvent Degreasers).

- A 15 percent loss was assumed for dry cleaning operations. Interviews with dry cleaning equipment manufacturers and dry cleaning industry spokespersons indicate that even though distillation units were available for installation with dry cleaning units manufactured and operated from the late 1940s through 1960s, the majority of operators chose not to use them.[7] According to the interviews, not using a distillation process was typically the result of high equipment and process cost, the availability of inexpensive solvent and the absence of regulatory pressures requiring recovery and reuse.[8] Unlike closed distillation systems used today, the typical dry cleaning unit extractor of the vintage believed to have been used at MCAS El Toro removed as much solvent as possible for re-use until the solvent was unserviceable and changed-out. Clothing was removed from the extractor in a damp condition and allowed to air-dry. In consideration of this, PES believes the assumption of 15 percent loss to volatilization is reasonable.

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[6] Telephone interviews with customer service representatives at American Kleaner Company and Briggs-Stratton Corporation, 8-25-99.

[7] Telephone interview with Mr. Bob Blackburn, spokesperson, California Cleaners Association, 9-16-99.

[8] Ibid. 7.

- A 95 and 90 percent loss was assumed for thinner and solvent solutions, respectively, in aircraft painting operations. Considering the controlled environment where painting typically occurred, the partial vapor pressures of VOCs present in thinner and solvent solutions used in the aircraft painting process, process temperature, and degree of vapor turbulence during the process, PES believes the values used are appropriate.

Loss to Runoff to Ground Surface

- A 5 percent loss to the ground surface was assumed for aircraft wash processes. According to station records (Navy, 1991; Jacobs Engineering, 1995), the aircraft washing was typically conducted on engineered concrete aprons that were sloped to direct process rinsate to a drain (Navy, 1991; Jacobs Engineering, 1995). Station records indicate that run-off to the ground surface would have been incidental and relatively small resulting from inadvertent or misdirected flow, cracks in the concrete, or washings in unauthorized areas.

- A 20 percent loss was assumed for vehicle wash racks. According to station records (Navy, 1991; Jacobs Engineering, 1995), vehicle wash racks were located either on concrete aprons sloped to direct the flow of process rinsate to a drain, or located on asphalt surfaces where the surface was not engineered and sloping to a drain may not have been as controlled. Since rinsate may have seeped through cracks on the asphalt surface or flowed to the ground surface, a loss value of 20 percent is believed to be appropriate.

- Less than 1 percent loss was assumed for aircraft painting operations. According to station records, the aircraft painting process was typically conducted in enclosed areas, such as hanger facilities constructed with floor drains connected to the sanitary sewer. According to interviews with military personnel, under normal conditions and proper process implementation, these facilities usually did not present an opportunity for materials to flow to the ground surface. As such, a nominal value of less than 1 percent loss is believed to be appropriate.

Loss to Slop and Spills

- A 5 percent loss to slop and spills was assumed for degreaser operations. PES' experience with industrial activities indicates that a shop degreaser can result in small spills and slop. These typically result from: (1) loading solvent solution into the degreaser; (2) the action of degreasing parts; (3) removing spent solvent from the degreaser; and (4) minor accidents on the shop floor involving a spillage of solvent.

- A 5 percent loss to slop and spills for workstation/bench-top maintenance activities. As above, PES' experience with industrial activities indicates that workstation/bench-top degreasing operations can also result in small spills from immersing, cleaning and rinsing repair parts in small solvent containers, or in carrying small containers of solvent solution from the source area to the workstation.

- A 5 percent loss to slop and spills for dry cleaning unit operations. According to industry and industry association spokespersons, dry cleaning units of the vintage as those that may have been in service at MCAS El Toro were largely manually operated.[9] Activities included loading solvent into and unloading it from the unit, and moving cleaned clothing articles damp from solvent from the extractor to a drying rack. According to persons interviewed, spills and slop from these operating activities were common. Information received from the interviews indicates that the assumed loss rate is reasonable.

<u>Loss to Sludge</u>

Less than 1 percent loss for fixation to sludge was assumed during OWS operations. Chlorinated solvents entering an OWS would typically dilute any grime, grit and soil (sludge) that had drained to the OWS. High levels of sludge in an OWS can result in retention of some solvent. However, experience indicates that sludge levels typically allowed for in the design of the OWS are likely to result in solvents passing unabated through the OWS to the outfall (sanitary sewer).

<u>Loss to Solvent Recovery from the OWS</u>

Less than 1 percent loss was assumed for flow of solvents from the OWS to a recovery system. According to API design guidelines (API, 1990), OWSs are designed to recover oils and other lighter than water substances from the top of the OWS to avoid discharge of oil and grease to the sanitary sewer system. Given the heavier than water density of solvents used during the 1943 to 1980 time period, solvents flowing to the OWS were much more likely to have migrated through the OWS to the outfall (sanitary sewer).

<u>Loss to Incineration, Boilers, Burn Pit, and Landfills</u>

An 85 percent loss to disposal by incineration, burn-pit or landfill was assumed for solvent recovered from degreasing/maintenance operations. According to reports reviewed by PES (Jacobs Engineering 1993, 1995) station personnel disposed of unknown quantities of "spent" solvent from shop degreasers and maintenance activities at the station incinerator, one or more of the operating boilers on the station, the landfill operating at that time, or the crash crew burn-pit. PES' assumption reflects that: (1) it was easier for personnel to occasionally drain spent solvent from bench-top operations to the OWS; (2) solvent spills and slop were rinsed to the OWS; and (3) larger volumes of spent solvent from shop degreasers were drained to containers for transport to the incinerator or disposal at a landfill.

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[9] Ibid 7.

5.2.2 Process Assumptions

The development of each industrial process model to estimate the quantity of VOC mass consumed and discharged was based on specific sets of process parameters. Some parameters were provided by factual authoritative sources, some were derived through engineering analysis, while others were assumed on the basis of industrial practice and professional judgement. Provided below is a summary of the parameters associated with each process.

<u>Aircraft Washing</u>

- Aircraft population. The number of aircraft assigned to MCAS El Toro or attached for operational control are based on Navy aviation records (see Appendix W), and BRAC Administrative Record.

- Aircraft wash rate. The number of aircraft washed per week are based on interviews with U.S. Navy personnel at the U.S. Navy Aviation Systems Command/Weapons Center, Patuxent River, Maryland.[10]

- Aircraft Wash Areas/Availability. The number and location of aircraft wash areas and percent available are based on station records and BRAC Administrative Record (Navy, 1991).

- Wash Cycle Duration. An historical duration of average time required to wash each aircraft is based on station records, and interviews with military aviation support personnel and government contractor services personnel (Navy, 1989, 1991, 1994, 1997).[11]

- Wash Equipment and Consumption Rates. The volume of water, detergents, and solvents used during each wash cycle are based on interviews with equipment vendors, equipment manufacturers and equipment specifications.[12]

- Types of solvents, solvent densities, and weight percents of solvent solutions are based on vendor/manufacturer specification, MSDSs, BRAC Administrative Record, professional literature, Air Toxic Inventory Reports, air emission quantification records, hazardous waste management plan, and hazardous waste generation records[13] (Navy 1989, 1991, 1994, 1997; Jacobs Engineering, 1995).

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[10] Telephone Interview with Mr. Bob Roland, Naval Aviation Systems Command, 9-23-99.

[11] Ibid 10; Telephone interview with technical representatives at Raytheon Aircraft Systems Company and Camp Pendleton Public Works Office, 9-14/23-99.

[12] Ibid 6.

[13] Ibid 6.

Vehicle Washing

- Wash Rack Population/Availability. The number and location of wash racks and percent available are based on station records and BRAC Administrative Record (Navy, 1989, 1991, 1994, 1997).

- Wash Rack Operational Cycle. The number of hours operated per week and the number of vehicles washed per week are based on station records and interviews with military and civilian support personnel (Navy, 1991).[14]

- Wash Cycle Duration. The historical duration of average time required to wash each vehicle is based on station records, and interviews with military and civilian support personnel (Navy, 1991).[15]

- Wash Equipment and Consumption Rates. The volume of water, detergents, and solvents used during each wash cycle are based on interviews with equipment vendors, equipment manufacturers and equipment specifications.[16]

- Types of solvents, solvent densities, and weight percents of solvent solutions are based on vendor/manufacturer specification, MSDSs, BRAC Administrative Record, and professional literature, Air Toxic Inventory Reports, air emission quantification records, hazardous waste management plan, and hazardous waste generation records (Navy, 1989, 1991, 1994, 1997; Jacobs Engineering, 1995).[17]

Degreasing Operations

- Population of degreasers. The number and location of degreasers and degreasing operations are based on station records and BRAC Administrative Records (Navy 1989, 1991, 1994, 1997).

- Degreaser capacity. The size and volume of the degreaser population are based on BRAC Administrative Record, station records, industry manuals/catalogs, and equipment manufacturer/vendor specifications.

- Frequency of solvent change-out. The degreaser consumption rate of solvent is based on industry practice, equipment manufacturer/vendor specifications, standard maintenance/operating procedures.

- Types of solvents, solvent densities, and weight percents of solvent solutions are based on vendor/manufacturer specification, MSDSs, BRAC Administrative

[14] Ibid 11.
[15] Ibid 11.
[16] Ibid 2, 4, 6.
[17] Ibid 2, 4, 6.

Record, professional literature, Air Toxic Inventory Reports, air emission quantification records, hazardous waste management plan, and hazardous waste generation records.

Bench-top Maintenance

- Maintenance facilities. The number, location and type of maintenance facilities are based on station records and BRAC Administrative Record (Navy 1989, 1991, 1994, 1997; Jacobs Engineering 1995).

- Solvent consumption. The volume of solvent and rate of solvent consumption at each maintenance facility are based on industry practice, equipment manufacturer/ vendor specifications, standard maintenance/operating procedures, Air Toxic Inventory Reports, air emission quantification records, hazardous waste management plan, and hazardous waste generation records (Navy 1989, 1991, 1994, 1997; Jacobs Engineering 1995).

- Types of solvents, solvent densities, and weight percents of solvent solutions are based on vendor/manufacturer specification, MSDSs, BRAC Administrative Record, professional literature, Air Toxic Inventory Reports, air emission quantification records, hazardous waste management plan, and hazardous waste generation records (Navy 1989, 1991, 1994, 1997; Jacobs Engineering 1995).[18]

Dry Cleaning

- Dry cleaning business volume. The quantity/throughput of clothing processed at the dry cleaning facility over periods of time are based on operator/owner interviews with industrial drying cleaning enterprises of comparable size, interviews with industry association representatives, and military planning guidelines.[19]

- Solvent change-out (duty). The quantity of clothing processed per gal of solvent is based on industry practice, and interviews with industry association representatives.[20]

- Types of solvents, solvent densities, and weight percents of solvent solutions are based on vendor/manufacturer specification, MSDSs, BRAC Administrative Record, professional literature, Air Toxic Inventory Reports, air emission quantification records, hazardous waste management plan, and hazardous waste generation records (Navy 1989, 1991, 1994, 1997; Jacobs Engineering 1995).[21]

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[18] Ibid. 2, 4, 6.
[19] Ibid. 7.
[20] Ibid. 7.
[21] Ibid. 2, 4, 6.

Aircraft Painting

- Aircraft population. The number of aircraft assigned to MCAS El Toro or attached for operational control are based on Navy aviation records (see Appendix W), and BRAC Administrative Record.

- Annual painting rate. The number of aircraft painted per year is based on interviews with U.S. Navy personnel at the U.S. Navy Aviation Systems Command/Weapons Center, Patuxent River, Maryland.[22]

- Painting facilities and availability. The number and location of painting facilities and percent available are based on station records and BRAC Administrative Record (Navy 1989, 1991, 1994, 1997; Jacobs Engineering 1995).

- Thinner and solvent consumption. The quantity of thinner and solvent consumed annually by painting operations are based on interviews with U.S. Navy personnel at the U.S. Navy Aviation Systems Command/Weapons Center, Patuxent River, Maryland; Air Toxic Inventory Reports, air emission quantification records, hazardous waste management plan, and hazardous waste generation records (Navy 1989, 1991, 1994, 1997; Jacobs Engineering 1995).[23]

- Types of solvents, solvent densities, and weight percents of solvent solutions are based on vendor/manufacturer specification, MSDSs, BRAC Administrative Record, professional literature, Air Toxic Inventory Reports, air emission quantification records, hazardous waste management plan, and hazardous waste generation records (Navy 1989, 1991, 1994, 1997; Jacobs Engineering 1995).

5.3 Aircraft Wash Area Operations

During the operative life of MCAS El Toro, a variety of aircraft were associated with U.S. Marine tactical air squadrons, squadron headquarters, logistical support units, and air station headquarters. Data collected by Aviation Information Research Corporation (AIRC), shown in the table in Appendix W (see also Appendix X), indicate that the average number of aircraft at MCAS El Toro was 225 for 1943 to 1980 period and 154 for the 1981 to 1996 period.

5.3.1 Process Description

Today, U.S. Marine Corps aircraft are degreased and cleaned according to the corrosion control manual (NA01-1A-509) published by the Naval Aviation Systems Command. Typically, each aircraft is washed at least once every 14 days (26 washings per year) and after each military mission flown when a weapon system is used. According to military

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[22] Ibid. 10.

[23] Ibid. 10.

authorities at the Naval Weapons Center in Patuxent River, Maryland, this occurs approximately 30 times per year.[24] This results in each aircraft being washed approximately 56 times each year.

The basic process for washing an aircraft has not changed substantially from 1943, although the current process employs greater mechanization and sophisticated technology. Aside from this mechanical evolution, the principal change has been in the nature of solvents used as shown in Table 5-1.

The process began with a team of personnel rinsing the aircraft using pressurized warm water pumped from the water source through a mechanical cleaner equipped with a small heater, a pump, and an external storage tank containing a solvent solution. Following the initial rinse, a solvent solution was siphoned from the external storage tank, blended with the pressurized warm water stream and applied to the aircraft to loosen grime from all surfaces. The siphon rate varied among the manufacturers of the cleaner units with a typical range between 5 to 15 percent of the pump rate. PES interviews with these manufacturers found that the pump rate was generally 4 gpm.[25] The grimier and more difficult to reach areas of the aircraft were cleaned manually using soft brushes, rags and a more concentrated solvent solution. When the aircraft appeared clean, it was rinsed, inspected and, if necessary, the cycle repeated until the aircraft was considered clean. This process typically took one hour to accomplish correctly, with the pump unit operating for about 20 minutes. Under this scenario, consumption of solvent solution per aircraft wash cycle was in the range of 4 to 12 gallons.

5.3.2 VOC Discharge Estimate

Shown on Plate 6 is a schematic of the aircraft wash process describing all pathways for waste solvent solutions after use. This illustration depicts the estimated percent of solvent lost as a result of volatilization, runoff to the ground surface, fixation to sludge material in the OWS, recovery of solvents from the OWS, and the resulting estimated net percent of solvent mass that entered the sanitary sewer system.

Using the loss rates described above, a net of 89 percent of the total solvent mass used in the aircraft wash process is estimated to have exited to the sanitary sewer system. Shown in Table 5-3 are assumptions, variables, and factors used to estimate the solvent mass discharged from this industrial activity to the sanitary sewer system for the time periods of 1943 to 1980, and 1981 to 1996. PES differentiated between the two time periods because of the advent of RCRA enforcement during the early 1980s that had a positive effect on waste management practices and the diminishing use of chlorinated compounds in solvent solutions after 1980. Based on these assumptions, PES calculated the amount of VOCs that appears to have entered the sanitary sewer system from aircraft wash operations to be about 21 gallons per day or about 4,300,000 pounds over a 53-year period.

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[24] Ibid. 10.

[25] Ibid. 6.

5.4 Vehicle Wash Rack Operations

PES was unable to collect sufficient data to determine the number and type of vehicles used at MCAS El Toro during its operative life. In the absence of this data, PES assumed that vehicle wash racks were operated on a regular basis, averaging at least two hours of operation per wash rack per day. This assumption is based on typical military standard operating procedures requiring: vehicles operating in the vicinity of operational aircraft to be as clean as possible; any vehicle being loaded onto a transport aircraft be sufficiently clean to satisfy the inspection of the transport aircraft loadmaster; and, general military standards for high levels of cleanliness in a station environment.

5.4.1 Process Description

The basic process of washing a vehicle did not change substantially from 1943 to 1980. As with cleaning aircraft, what began as a manual process using unsophisticated equipment evolved into a largely mechanical process employing more sophisticated technology. Aside from this mechanical evolution, the principal change has been in the nature of solvents used as shown in Table 5-1.

Generally, the process began with the operator rinsing the vehicle, then applying a solvent cleaning solution by hand to loosen dirt, grit, and grime from the more soiled and difficult to reach areas. Depending on construction of the wash rack facility, the next step was either to apply pressurized warm water blended with solvent cleaning solution from a cleaning unit similar to that used to wash aircraft or to direct the flow of pressurized water and solvent cleaning solution through a stationary system of water nozzles and jets onto the vehicle. When the vehicle appeared clean, it was inspected and, if necessary, the cycle was repeated until the vehicle was considered clean by operator and/or the supervisor.

Depending on the size of the vehicle, this process took between 30 to 60 minutes to accomplish with the pump unit operating for about 15 minutes. This resulted in an average consumption of solvent solution per vehicle wash cycle in the range of 3 to 9 gallons.

5.4.2 VOC Discharge Estimate

Shown on Plate 7 is a schematic of the vehicle wash process describing all pathways for waste solvent solutions after use. This illustration depicts estimated percent of solvent lost as a result of volatilization, runoff to the ground surface, fixation to sludge material in the OWS, recovery of solvents from the OWS, and the resulting estimated net percent of solvent that may have entered the sanitary sewer system.

Using the losses described above, a net estimate of 74 percent of the total solvent used in the vehicle wash process exited to the sanitary sewer system. Shown in Table 5-4 are assumptions, variables, and factors used to estimate the solvent mass discharged from this industrial activity to the sanitary sewer system for the time periods of 1943 to 1980, and

1981 to 1996. Based on these assumptions, PES calculated the mass of VOCs that appears to have entered the sanitary sewer system from vehicle wash operations to be an average of about 6 gallons per day or 1,500,000 pounds over a 53-year period.

5.5 Aircraft and Vehicle Parts Degreasing Operations

According to records received and reviewed by PES, approximately 28 degreasers and associated OWSs were used to support maintenance activities from 1943 through 1980. Capacity of the degreasers ranged from 150 to 750 gallons. PES assumed the degreasers were filled to 85 percent of capacity with solvent solution. Depending on the maintenance schedule, the solvent solution contained in each degreaser was periodically removed and replace with fresh solvent. PES assumed that this occurred approximately once per month per degreaser.

5.5.1 Process Description

Degreasing was a relatively simple process. Solvent solution was hand pumped into the degreasing tanks from 55-gallon containers or poured from 5-gallon containers. Aircraft or automotive vehicle parts requiring repair or inspection, were immersed, cleaned and rinsed in the solvent solution. When the solvent became too dirty to clean efficiently ("spent"), it was either pumped to a waste container or drained to the OWS, which in turn drained to the sanitary sewer. Prior to the early 1980s, PES assumed that waste solvent stored in containers was incinerated on-site at either the station incinerator, one of the operating boilers, the landfill operating at that time, or the crash crew burn-pit.

5.5.2 VOC Discharge Estimate

Shown on Plate 8 is a schematic of the degreasing/OWS process describing all pathways for waste solvent after use. This illustration depicts estimated percent of solvent lost during the process resulting from volatilization, slop or spills, fixation to sludge material in the OWS, incineration or landfilling of waste solvent, and estimated net percent of solvent that may have entered the sanitary sewer system.

Using the loss rates described above, a net estimate of 4 percent of the solvent mass used in the degreasing process exited to the sanitary sewer system. Shown at Table 5-5 are assumptions, variables, and factors used to estimate the solvent mass discharged from this industrial activity to the sanitary sewer system for the time period of 1943 to 1980. Based on these assumptions, PES calculated the mass of VOCs that appears to have entered the sanitary sewer system from degreasing operations to be an average of about 5.3 gallons per day or 913,000 pounds over this time period.

5.6 Aircraft and Vehicle Maintenance Operations

Shown at Table 5-6 are the aircraft, vehicle, and facility maintenance buildings that are believed to have operated in the NW, NE, and SE quadrants of MCAS El Toro during the periods of 1943 to 1972, 1944 to 1980, and 1973 to 1980. These time periods represent facilities constructed in 1943 that were demolished prior to 1972, facilities that were constructed in 1943 that functioned through 1980, and facilities that were constructed after 1973 that functioned through 1980.

5.6.1 Process Description

The maintenance activities occurring at each of the facilities noted at Table 5-6 were assumed to be those that typically occur at a work station (bench top, work bay, work stand, etc.) where individual maintenance personnel or maintenance teams conducted operator, organizational, or overhaul maintenance level activities. These activities typically involved the consumption of approximately 1-gallon of solvent solution per week per facility (Navy 1989, 1991, 1994, 1997; Jacobs Engineering 1995).

5.6.2 VOC Discharge Estimate

Shown on Plate 9 is a schematic of solvent use and losses in regard to maintenance operations. This illustration depicts the estimated percent of solvent lost as a result of volatilization, slop and spills, fixation to sludge material in the OWS, incineration or landfilling of waste solvent, and the resulting estimated net percent of solvent that may have entered the sanitary sewer system.

Using the losses described above, a net estimate of 4 percent of the total solvent mass used in maintenance processes exited to the sanitary sewer system. Shown at Table 5-7 are assumptions, variables and factors used to estimate the solvent mass discharged from this industrial activity to the sanitary sewer system for the time periods of 1943 to 1972, 1943 to 1980, and 1973 to 1980. Based on these assumptions, PES calculated the mass of VOCs that appears to have entered the sanitary sewer system from maintenance activities to be an average of about 0.4 gallons per day or 73,000 pounds over this time period.

5.7 Industrial Dry Cleaning Operations

As previously shown, PES determined that an industrial dry cleaning plant operated at MCAS El Toro from 1943 to 1972. This facility most likely processed military flight suits, overalls worn by maintenance personnel, military uniforms, and civilian clothing.

5.7.1 Process Description

Chlorinated solvents were widely used for dry cleaning during the 1943 to 1972 period. The solvent of choice was PCE (Izzo, 1992). The soiled clothing was immersed in an enclosed bath of PCE to remove dirt, grime, grease, etc., after which the clothing article(s) were drained and dried. A gallon of solvent could be used to clean 250 to 350 pounds of clothing before it became spent (known as its "mileage"). When solvent reached its "mileage" point, it was removed from the dry cleaning tumbler, which was then loaded with fresh solvent. As studies have demonstrated (Izzo, 1992), spent solvents were usually poured into a nearby drain connected to the sanitary sewer. During PES' research of the dry cleaning facility, there was no evidence encountered to suggest that solvent recycling was conducted on site.

5.7.2 VOC Discharge Estimate

Shown on Plate 10 is a schematic of the solvent use and losses associated with dry cleaning operations. This illustration depicts the estimated percent of solvent mass lost as a result of volatilization, slop and spills, and the resulting estimated net percent of solvent mass that appears to have entered the sanitary sewer system.

Using the loss rates described above, a net estimate of 80 percent of the solvent mass used in the dry cleaning process exited to the sanitary sewer system. Shown in Appendix U is an estimate of solvent "mileage" associated with dry cleaning operations at MCAS El Toro. Shown in Table 5-8 are the assumptions, variables, and factors used to estimate the solvent mass discharged from this industrial activity to the sanitary sewer system for the time periods of 1943 to 1972. Based on these assumptions, PES calculated the amount of PCE discharged to the sanitary sewer system from dry cleaning operations to be about 12.5 gallons per day or 1,700,000 pounds over this period.

5.8 Aircraft Painting Operations

The painting of military aircraft is a necessary and recurring industrial activity for training and readiness facilities such as MCAS El Toro. Changes in military missions and training objectives frequently require the painting of aircraft. The same naval document (NA01-1A-509) that governs the cleaning of naval aircraft also provides guidance in the painting of naval aircraft for corrosion control. Typically, an aircraft is painted once every year and as required by a training or deployment mission.

5.8.1 Process Description

Painting of naval aircraft is conducted in several phases. First, the old paint is removed from the aircraft. Next, the skin or surface of the aircraft is degreased, cleaned and prepared for priming using solvent solutions to ensure that no residue is present on the aircraft's surface that would inhibit the bonding of the paint. Third, the surface of the aircraft is primed. Last, a primary and topcoat of paint are applied. The basics of the process have not changed substantially over the years, although there are new techniques, equipment and materials that have reduced hazardous materials use and waste generation in the last decade.

5.8.2 VOC Discharge Estimate

Shown on Plate 11 is a schematic of the use and losses of solvents and thinners associated with painting operations. This illustration depicts the estimated percent of solvent/thinner lost during the process as a result of volatilization, overspray, fixation to sludge material in the OWS, recovery of solvents from the OWS, and estimated net percent of solvent mass that entered the sanitary sewer system.

Using the loss rates described above, a net estimate of 3 percent of total thinner mass and 9 percent of total solvent mass used in the process are calculated to have entered the sanitary sewer system. Shown in Table 5-9 are assumptions, variables, and factors used to estimate the solvent mass discharged from this industrial activity to the sanitary sewer system for the time periods of 1943 to 1980, and 1981 to 1996. Based these assumptions, PES calculated the mass of VOCs that appears to have been discharged to the sanitary sewer system from aircraft painting operations to be an average of about 2 gallons per day or 490,000 pounds over this period.

5.9 Summary of Volatile Organic Compound Discharges to the Sanitary Sewer System

Shown in Table 5-10 is a summary of estimated discharges to the MCAS El Toro sanitary sewer system from all major solvent using activities at the base. PES calculated that between 1943 and 1996 an average of about 36 gallons per day or 9 million pounds of VOCs appears to have been discharged to the sanitary sewer system during this time period. It should be noted that there are inherent uncertainties associated with estimating the volume of VOCs used and discharged to the sanitary sewer system. However, even if the actual range of VOCs released was an order of magnitude less than estimated above, such releases would still be significant.

In consideration of the age and conditions of the VCP sanitary sewer lines, substantial releases of VOCs are likely to have occurred within the NW, NE, and SE quadrants of MCAS El Toro. The primary releases of VOCs associated with the sanitary system are expected to be associated with fractures, loss of joint integrity, and low spots (where liquids accumulate) in the VCP pipe, which represent source areas of VOCs (i.e., "hot spots") in the vadose zone. Such conditions are expected to have occurred at various, discrete locations along the approximate 26 miles of the sanitary sewer system.

6.0 SUBSURFACE SOIL INVESTIGATIONS

In its effort to identify potential sources of subsurface contamination, the Navy did not adequately evaluate the sanitary sewer system at MCAS El Toro as a significant source area. Consequently, in the design and implementation of its site characterization program, the Navy avoided specific approaches that might have identified evidence of contamination likely to be associated with releases from the sanitary sewer system.

In addition to the limited subsurface investigations conducted by the Navy during the BRAC Cleanup Program, subsurface investigations were conducted throughout the base during the RCRA Facility Assessment (Jacobs Engineering, 1993). Provided in Appendix Z are extracts from Appendices A and B of the "Final Resource Conservation and

Recovery Act Facility Assessment Report" that correspond to subsurface investigations in the NW, NE, and SE quadrants of the air station. As shown on Plate 5, the investigations involved drilling 161 soil borings consisting of: (1) 80 hand auger soil borings drilled to a depth of 5 feet below the ground surface (bgs); (2) 24 soil borings drilled to a depth of 25 feet (bgs); and (3) 57 angle soil borings 60-foot long at an angle of 30 degrees drilled to an approximate depth of 52 feet (bgs).

These soil borings were drilled at specific AOC/SWMU sites selected by the Navy after reviews of aerial photographs, visual inspections throughout the facility, and evaluation of historical activities. Soil samples were collected at the following intervals for each type of boring: 2 and 5 feet (bgs) for each 5-foot hand auger soil boring, every 5 feet for each 25-foot soil boring, and every 10 feet for each 60-foot long angle soil boring.

Each soil sample was analyzed for VOCs, semi-VOCs, pesticides, polychlorinated biphenyls (PCBs), and metals. As shown on each plate in Appendix Z:

- Hand auger soil borings were conducted at locations where, on the basis of judgment, a release of hazardous substance might have occurred and typically included wash racks with cracks, unpaved drum storage areas, and unpaved spill areas (Jacobs Engineering, 1993).

- 25-foot soil borings were generally conducted at UST and OWSs having a capacity greater than 2,000 gallons (Jacobs Engineering, 1993).

- 60-foot long angle soil borings were drilled towards (see direction of arrow on each plate) the invert of above ground storage tanks, underground storage tanks (USTs), open channels, hazardous waste storage locations, drum storage areas, and the Mark Arrest System.

Shown on Plate 5 and in Appendix Z are the locations of each of the 161 soil borings in the NW, NE and SE quadrants, and a small portion the SW quadrant (Building 307 at Site 24) relative to the location of the sanitary sewer system. Since the sanitary sewer system was deeper than 5 feet below grade and the maximum hand auger soil sampling depth was 5 feet, none of the hand auger soil borings was adequate to detect releases from the sanitary sewer system. Excluding the hand auger soil sampling points, only 15 of the remaining soil borings - representing less than 10 percent of the soil sampling program - were located within 10 feet of the sanitary sewer system. Twelve of these 15 soil borings were located to check for releases from the OWSs. This information is summarized on Plate 5.

In regard to the two outfall points of the sanitary sewer system system/sanitary sewer treatment plant (SSTP) (the Bee Canyon Wash and the San Diego Creek), the soil sampling episodes conducted there were inadequate to detect VOCs. This is due to:

- The sanitary sewer system outfall at the Bee Canyon Wash was downstream of the soil sampling locations except for boring sample location No. 18BEAB226 drilled during the Phase I investigation. This location was drilled beneath the Bee Canyon Wash in the vicinity of the outfall weir and indicated the presence of reportable concentrations of TPH-diesel and TPH-gasoline above 1,000 mg/kg. Analysis for VOCs was not conducted.

- Soil samples from sampling locations at the confluence of the Bee Canyon Wash and the San Diego Creek, downstream of the sanitary sewer system outfall at Bee Canyon Wash, were analyzed for the presence of inorganic materials and semi-volatile organic compounds (SVOCs) only.

- Soil samples were not taken at the SSTP outfall at San Diego Creek nor along the alignment of conveyance to the outfall point.

Overall, then, while the Navy has conducted substantial soil sampling at MCAS El Toro, none of this soil sampling was designed to check for releases from the sanitary sewer system. The Navy's soil sampling program has simply overlooked the very likely presence of substantial VOCs at numerous junctures along the 26 miles of sanitary sewer system pipeline.

7.0 GROUNDWATER INVESTIGATIONS

7.1 OCWD Investigations

OCWD initially identified TCE in The Irvine Company (TIC) well 47, located near MCAS El Toro, on June 17, 1985 at a concentration of 10.1 micrograms per liter (μg/l) (OCWD, 1989). The drinking water standard established by USEPA and the California Department of Health Service (DHS) for TCE is 5.0 μg/l. OCWD then contracted William R. Mills & Associates to investigate the presence of TCE in the vicinity of the base. In their November 1985 report to the OCWD (Appendix AA), William R. Mills & Associates concluded that two separate groundwater contamination events occurred:

- TCE from a 1975 spill migrated downward to deep groundwater lenses well below the groundwater table ranging in depth from 50 to 100 feet bgs where its presence was confirmed.

- The detection of PCE at several shallow locations represented a more recent contamination event that had not yet reached the groundwater table.

Following a request from OCWD, SARWQCB required that the Navy conduct a study to identify the sources of TCE and to characterize any groundwater contamination. In response to the request from SARWQCB, the Navy prepared a "Perimeter Investigation Plan of Action, Verification Step, Confirmation Study," (POA) dated April 1987 (an extract is in Appendix AB). SARWQCB rejected the POA because its scope of work did not extend beyond the boundaries of MCAS El Toro. The agency then issued a Cleanup and Abatement Order (No. 87-97) that required the Navy to expand its POA to include offsite sampling. The Navy failed to comply.

Comments by the Navy in the POA indicated that direct discharges of hazardous materials to the sanitary sewer system occurred, TCE and PCE may have escaped through exfiltration, and this may have been the cause of the problem discovered by OCWD (see the large arrows in Appendix AB). The Navy indicated that once in the subsurface, the contaminants could have found transport pathways to major groundwater resources as demonstrated in Figure 1-5, "Generalized Geologic Cross Section of the Tustin Plain" in Appendix AB.

In response to the Navy's noncompliance with the SARWQCB order, OCWD initiated a groundwater investigation to characterize the horizontal and vertical extent of the TCE plume. Following their investigation, OCWD prepared a report presenting the results of their investigation (extract provided in Appendix AC). As the report states, OCWD found TCE in MCAS wells -1, -2, and -7, and in TIC wells 68, 74, and 83 with maximum concentrations ranging from 25 to 52 μg/l, affecting an area of approximately 2,900 acres. Figure 8 of the report (see Appendix AC) illustrates OCWD's approximation of the extent of TCE contamination. As shown in this figure, OCWD approximated the horizontal area covered as follows:

- The southern edge of the TCE plume extended along San Diego Creek and Agua Chinon Wash.
- OCWD believed the northern boundary to be fairly well defined as shown in Figure 8 in the extract in Appendix AC.
- The western boundary, which is downgradient of the TCE plume, extended beyond MCAS well-7 to an approximate location bounded by TIC 78 on Culver Drive, TIC 76 at North Lake in Woodbridge, and TIC 76 in the vicinity of Stone Creek Avenue in Woodbridge;
- On the basis that TCE was detected in wells PS-4, -6, -8, TIC 55, and DW-135, but not detected in wells PS-5 and PS-7, the eastern upgradient boundary, originating from a northeasterly direction from MCAS El Toro, appeared less defined.

As reported, OCWD determined the vertical extent of TCE found in groundwater to be between the depths of 200 and 450 feet bgs, with the highest concentration below 300 feet bgs. Further, OCWD determined that:

- TCE was present in cluster wells DW-135, -450, and -450 at MCAS El Toro at depths of 135, 450, and 540 feet, respectively.

- Each of the perimeter wells installed at MCAS El Toro were less than 150 feet deep and could not provide reliable groundwater data for determining the presence of deeper contamination.

- The presence of TCE was not detected in the MP monitoring wells at shallow depths above 200 feet indicating that surficial sources of TCE did not exist at these locations.

- The presence of TCE was not detected in the MP monitoring wells at depths below 450 feet, indicating that groundwater below this depth is relatively immobile connate water not hydraulically connected to the overlying aquifer.

- Data derived from this investigation, in conjunction with other known information, indicate that the TCE flowpath from MCAS El Toro is vertically downward in recharge areas and then laterally in a northwesterly direction through the major groundwater production zones.

From the above investigation, OCWD concluded: (1) TCE was present at MCAS El Toro at shallow depths and deeper depths to 540 feet; (2) downward piezometric gradients, the greater density of TCE, and the reduced extent of aquitards at MCAS El Toro provided the driving force and potential pathway for the vertical downward migration of TCE to the principal aquifer zone; (3) shallow zone TCE contamination at MCAS El Toro was hydraulically connected to the deeper TCE contaminated aquifer zones extending to the Woodbridge area of the City of Irvine; and (4) authorities at MCAS El Toro needed to identify source areas and the vertical and horizontal limits of TCE contamination at MCAS El Toro by installing deep clustered, multi-screened wells to a depth of 450 feet to evaluate the vertical distribution of TCE properly.

7.2 Groundwater Monitoring Locations and Sanitary Sewer Alignment

PES reviewed all available construction data for groundwater monitoring wells and compared it to reported groundwater levels and the alignment of the sanitary sewer system. Prior to initiating this review, PES determined that SARWQCB had not reviewed construction data of groundwater monitoring wells to determine their ability to intercept VOCs and other chlorinated compounds.

Illustrated on Plate 5 are the groundwater monitoring well locations relative to facilities associated with industrial activities and the sanitary sewer system for the NW, NE, SE and SW quadrants.

In response to the OCWD recommendation that deep clustered, multi-screened wells were required at MCAS El Toro to define the extent of groundwater contamination, it appears that the Navy installed one cluster well in each of the four quadrants of MCAS El Toro: 18DGMW135, 250, 350, 450, and 540 in the NW quadrant; 18BDMW01A, B, C, D, and

E in the NE quadrant; 18 BGMW02A, C, D, and E in the SE quadrant; and 18GBMW3A, B, C, and E in the SW quadrant.

In regard to the NW, NE and SE quadrants, all three of the cluster wells (as shown on Plate 5) were installed either up- or cross-gradient of the industrial activities that may have contributed to groundwater contamination. Thus, **few of these wells were installed in locations that would be likely to intercept potential groundwater contaminants.** As a result, PES believes that these wells are not effective for assessing potential VOC releases from the sanitary sewer system.

PES reviewed the construction details of available wells relative to the level of groundwater and the location of the sanitary sewer system and identified substantial deficiencies:

- All but two groundwater monitoring wells (18BGMW12 and 15DBMW51) in the NW quadrant are located upgradient of the sanitary sewer system alignment. 18BGMW12 is relatively remote from facilities with industrial activities and cross-gradient of the sanitary sewer system alignment.
- All groundwater monitoring wells in the NE quadrant are located upgradient of the sanitary sewer system alignment.
- Relative to the general groundwater gradient and industrial activities in the SE quadrant of MCAS El Toro, the five groundwater monitoring wells that appear downgradient are actually crossgradient and not located optimally to intercept a contaminant plume from the sanitary sewer system alignment.

Overall, then, as in the case of the Navy's soil sampling program, the Navy's design of its groundwater monitoring program has been inadequate to detect releases from the sanitary sewer system.

8.0 IMPLICATIONS OF THE NAVY'S UNDERESTIMATION OF VOC CONTAMINATION

The Navy's failure to fully assess past site activities that utilized solvents and to fully characterize the soil and groundwater contamination beneath the base will result in incomplete remediation. This lack of complete remediation will result in numerous impacts on the future development of the site. The following is a discussion of three major areas of concern: (1) additional remediation costs; (2) construction delays; and (3) worker health and safety.

8.1 Remediation Costs

When unknown areas of contamination associated with the releases of VOCs from the sanitary sewer system are encountered during development of the base, it will be necessary to characterize the extent of the contamination and to remediate it. The areas of this additional contamination have not yet been defined. However, one approach to estimating remediation costs is to use the costs associated with the known contamination. Based on the Navy's "Draft Feasibility Study Report for Operable Unit 2A", there are 6,000 pounds of VOCs in the soil associated with Site 24, and the cost to remediate the soil to acceptable levels is $500 per pound of VOCs. Assuming the same unit cost for remediation and 70,000 to 700,000 pounds of VOCs released from the sanitary sewer system are in the soil, the total additional remediation costs for the soil would be $35 million to $350 million. This calculation does not include the costs to characterize the contamination. This calculation also does not include any costs to remediate the groundwater. Based on our experience with sanitary sewer systems, these other costs are likely to add $10 million or more to the range of soil remediation costs.[26]

An alternative way of estimating the increased remediation costs is to assume that the remediation costs for each of the three additional quadrants will be equal to the remediation costs for Site 24, which largely occupies the Southwest quadrant. This would produce additional solvent remediation costs of $27 million times three - or $81 million.

This expansion in solvent remediation costs of tens of millions of dollars to hundreds of millions of dollars can be put into perspective by comparing these remediation costs to the Navy's 1999 estimate of the total cost of remediating the base. This total cost, as of February of last year, was estimated to be (including $27 million for Site 24) $115 million.

8.2 Disruption of Construction Activities

The failure to characterize and remediate the contamination associated with the sanitary sewer line, prior to conversion of the property, will result in numerous construction delays and added construction costs (excluding the added remediation costs). The current plans for the reuse of the base are for the construction of a commercial airport with terminals, parking garages, a hotel, maintenance facilities, utilities, and roadways. All of these structures will require excavation of soils, either for below grade construction or for support pilings. Impacted soil will almost surely be encountered during excavation. Since most construction companies are not equipped to handle contamination, they will simply stop work until they can safely resume their normal activities.

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[26] This estimate of an additional $10 million or more for characterization studies and groundwater remediation takes into consideration a reduction of the previously estimated soil remediation costs due to some of the contamination no longer being resident in the soil.

Hazardous waste contractors then will be called in to assess the area and determine the amount and type of remediation needed. Since construction delays are costly, the most expeditious means of remediation is often used. Impacted soil is simply dug up and hauled off site for treatment and disposal.

This approach is vastly more expensive than the soil vapor extraction implemented at Site 24. Excavation and disposal of VOC contaminated soil currently costs about $100 to $250 per cubic yard, while the soil vapor extraction system at Site 24 will cost approximately $3.00 per cubic yard of soil remediated. Thus, when contaminated soil is encountered, all work will be stopped until the impacted area is assessed. Construction will be stopped until full cleanup is achieved, or cleanup activities may occur concurrently with operations. Either of these approaches is much more expensive than that which could have been used if the contamination had been identified and remediated by the Navy prior to transfer.

The alternative to this much more expensive remediation approach is construction delays of a half year, year, or much longer - coupled with the standby and penalty charges that are in most construction contracts. Our understanding is that these construction contracts have not yet been negotiated. But, based on our past experience, we understand that these standby and penalty charges are typically *very* high.

8.3 Worker Health and Safety

Of even greater concern than the delays and additional costs, there is the issue of the health and safety of construction workers. Construction workers are not adequately protected from exposure to soils impacted with hazardous substances, especially VOCs. Unlike hazardous waste contractors, they do not wear protective equipment or respirators and are not trained to minimize their exposures. They can be exposed to contamination via inhalation of soil vapors, incidental ingestion of soil, and direct adsorption through the skin. TCE, the main VOC of concern, is considered to cause cancer by the State of California.

Concentrations of TCE in the soil vapor at the OU-2A ranged from 0 to 6,120 μg/l, with an average concentration of 308 μg/l in the area to be remediated. The Navy's proposed cleanup level is 27 μg/l. In its risk assessment for the remediation of this area, the Navy evaluated exposures to workers who worked on the site for 1-year. The Navy estimated a risk of cancer to these workers of 5×10^{-10}. However, its evaluation only looked at the impact from vapor migration from undisturbed soils. It did not consider exposures to those who were involved in excavation activities.

Using modeling techniques similar to those used by the Navy, it was determined that workers involved in excavation activities in impacted areas will have much greater risks. The risks of cancer will range from about 1×10^{-8} for those working above ground during excavation to as high as 1×10^{-4} for those who are working in trenches.[27] The risk to excavation workers in trenches is 10 times higher than acceptable levels of cancer risk. Since the risk represents only a single year's exposure, workers on the site for longer periods will incur a higher risk of cancer.

Since the estimated exposure concentrations are well below the levels that can be detected by either smell or field monitoring equipment, it is likely that construction workers will be exposed to harmful levels – without even realizing it.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

As a result of PES' technical review and evaluation of more than 400 documents regarding historical operations and current environmental programs at MCAS El Toro, numerous historical industrial operations have been identified at MCAS EL Toro that included the use of substantial volumes of VOCs. These operations, which include: (1) aircraft and vehicle washing; (2) industrial degreaser operations; (3) aircraft and vehicle parts maintenance; (4) aircraft painting; and (5) industrial dry cleaning, were all connected to and discharged hazardous materials including VOCs to the sanitary sewer system at MCAS El Toro which consists of approximately 26 linear miles of vitrified clay pipe. The engineering design practice at the time the sanitary sewer system was constructed allowed for the leakage of hazardous waste materials at numerous release points. It therefore represents a prominent source of VOCs related to the regional presence of VOCs identified in groundwater in and around the vicinity of MCAS El Toro. To date, the Navy via implementation of their "expedited and accelerated (Navy, 1998)" site characterization and cleanup program has failed to adequately investigate the sanitary sewer system as the prominent potential source area of VOCs which it represents.

The results of PES' evaluation indicate the lack of adequate investigation of the sanitary sewer system at MCAS El Toro represents a significant deficiency in the Navy's site characterization program. Not addressing such a prominent deficiency will compromise future cleanup plans to address the regional presence of VOCs identified in groundwater in and around the vicinity of MCAS El Toro, and surrounding communities. Hence, this deficiency also represents a significant threat to human health and the environment, and a substantial liability to the City and other community stakeholders who are affected by decisions made by the Navy under their accelerated BRAC Cleanup program(s) at MCAS El Toro.

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[27] Richard Richter, Exponent Environmental, January 2000.

Overall, PES has concluded that:

- Less than 25 percent of the industrial activities at MCAS El Toro that could have been the source of subsurface contamination were located on Site 24 in the SW quadrant. More than 75 percent of the solvent using activities were located in the NW, NE and SE quadrants of the base.

- Facilities hosting these activities were connected to the sanitary sewer system and have not been adequately investigated by the Navy for contributions to subsurface contamination.

- Management practices at MCAS El Toro during the period of 1943 to 1980 included discharge of hazardous waste liquids into the sanitary sewer system throughout all four quadrants of the former air station.

- PES calculated that between 1943 and 1996 approximately 9 million pounds of VOCs are estimated to have been discharged to the sanitary sewer system. The unknown state of the system's structural integrity and the adverse conditions to which it has been exposed since its construction make it highly likely that the sanitary sewer system was a source for substantial releases of VOCs to the subsurface throughout the NW, NE and SE quadrants of MCAS El Toro.

- The Navy did not give sufficient consideration to the sanitary sewer system at MCAS El Toro as a potential source of VOCs in subsurface contamination and, as a result, has not adequately investigated this potential source.

- The failure to include the sanitary sewer system in its remedial investigations has created a flawed closure program that presents significant risks to public health and the environment.

9.2 Recommendations

We recommend that the Navy investigate the 26 miles of vitrified clay piping in the sanitary sewer system for releases of solvents and other hazardous materials into the soil and groundwater. This investigation of potential releases typically involves assessing the condition of the piping, and then performing subsequent sampling of the surrounding soil and/or soil gas to evaluate where releases have occurred.

An "in-pipe" video camera is usually used to visually assess the condition of the interior of the pipe. Portions of the piping that exhibit cracks and/or significant deterioration are identified as suspect release points and are located for subsequent investigation. A Work Plan then needs to be prepared for documenting the extent and degree of investigation at each of the suspect release areas, including the number and type of samples (soil and/or soil gas) and the recommended chemical analysis program. The Work Plan also needs to provide for the taking of additional groundwater samples and the installation of additional groundwater monitoring wells.

Upon implementation of each successive phase of the field investigation and chemical analysis program, the results must be analyzed so that the contamination from the verified release points is adequately characterized. The overall objective is to define the lateral and vertical extent of contamination in the soil and assess whether the releases have impacted groundwater.

After this demarcation of each of the additional solvent releases, the additional contamination should, of course, be remediated. This RI/FS process for the 26 miles of pipeline clearly needs to be performed before the site is transferred by the Navy.

10.0 REFERENCES

American Petroleum Institute, 1990. *Design and Operation of Oil-Water Separators, Washington, D.C.* February.

American Public Works Association, 1997. *Standard Specifications For Public Works Construction, Anaheim, California.*

American Society of Civil Engineers, 1985. *Advances in Underground Pipeline Engineering, New York, New York.*

Bechtel National, Inc., 1996. *Draft Final Phase II Remedial Investigation Report, Operable Unit 2A-Site 24, San Diego, California.* June.

Bechtel National, Inc., 1998. *Draft Final Engineering Design Report, Vadose Zone Remediation, Site 24, San Diego, California.* December 15.

CH2M HILL, Inc., 1998. *Draft Final Operable Unit 1 Interim Remedial Investigation/Feasibility Study Report, Executive Summary.* August 8.

Crane Company, 1969. *Flow of Fluids Through Valves, Fittings and Pipe, Chicago, Illinois.*

Department of the Navy, Naval facilities Engineering Command, Western Division, 1971. *Sewage Treatment Plant Schematic Plan.*

Department of the Navy, 1989. *Air Toxic Inventory Report, El Toro, California.*

Department of the Navy, March 1991. *MCAS El Toro Hazardous Waste Assessment Report.*

Department of the Navy, 1994. *Air Toxic Inventory Report, El Toro, California.*

Department of the Navy, 1997. *Air Toxic Inventory Report, El Toro, California.*

Victor J. Izzo, 1992. *Dry-Cleaners A Major Source of PCE Contamination, Sacramento, California.* March 27.

Jacobs Engineering Group, 1993. *Installation Restoration Program Final Resource Conservation and Recovery ACT (RCRA) Facility Assessment Report, San Diego, California.* July 16.

Jacobs Engineering Group, 1995. *Final Environmental Baseline Survey Report, San Diego, California.* April 1.

A.W. Loomis, 1981. *Cameron Hydraulic Data, Woodcliff Lake, New Jersey.*

Malcolm Lewis Engineers, 1986. *Sanitary Sewers, Sheets 1 through 29, MCAS El Toro, California.* September 30.

National Clay Pipe Institute, 1998. *Vitrified Clay Pipe Engineering Manual, Lake Geneva, Wisconsin.*

Orange County Water District, 1989. *Investigation of Trichloroethylene Contamination, Fountain Valley, California.* March.

Syed R. Qasim, 1994. *Wastewater Treatment Plants, University of Texas, Arlington, Texas.*

TABLES

TABLE 2-1, HISTORICAL VOC USE SITES, MCAS EL TORO, CALIFORNIA

Location (Base Quad): NW **Sheet No.: 1 of 2**

Bldg No/ *Facility*	**IRP/ *AOC-SWMU* Site**	**Industrial Activity(s)**	**Facility Plan Reference Year**	**Aircraft Wash Area**	**Vehicle Wash Rack**	**Degreaser**	**OWS**	**Maint.**	**Paint**
2		Aircraft **Maintenance** Hanger (Station Order: Aircraft **Wash Area** w/**OWS**; AQMD: **Degreaser)**	1953	X		X	X	X	
3		Line **Maintenance**	1953					X	
4		Line **Maintenance**	1953					X	
5		Aircraft **Maintenance** Hanger (Station Order: Aircraft **Wash Area** w/**OWS)**	1953	X			X	X	
5	*26*	Automobile Organizational **Maintenance** Shop (AOC 26: <90 day Accum. Area)	1973					X	
7		Aircraft **Maintenance** Hanger	1953					X	
8		Line **Maintenance**	1953					X	
9		Line **Maintenance**	1953					X	
10	*27, 28*	Aircraft **Maintenance** Hanger (AOC 27: <90 day Accum. Area; AOC 28: **Fuel** Spill; AQMD: **Degreaser)**	1953-1973			X		X	
15		Electrical & Communications Equipment **Maintenance** Shop	1973					X	
17		Electrical & Communications Equipment **Maintenance** Shop	1973					X	
22		Electrical & Communications Equipment **Maintenance** Shop (AQMD: **Degreaser)**	1973			X		X	
25		Construction Equipment **Maintenance** Shop	1973					X	
26		Communication Equipment **Maintenance** Shop	1973					X	
31	**15**/*272, 273, 274*	Utilities Equipment **Maintenance** Shop (AOC 272: <90 day Accum Area; AOC 273: Automotive Vehicle **Wash Rack**; AOC 274: stockpiled soil)	1973		X			X	
47		Dope and Spray **Surface Coating/Painting**	1953						X
47		Construction & Heavy Material Handling Equipment **Maintenance** Shop	1973					X	
48		Dope & Spray **Surface Coating/Painting**	1953						X
49		Aircraft **Maintenance** Hanger	1953					X	
51		Electrical and Ordnance Equipment **Maintenance** Shop	1953					X	
51	*33*	Automobile Organizational **Maintenance** Shop (AOC 33: <90 day Accum. Area; Station Order: Aircraft **Wash Area** w/**OWS**; AQMD: **Degreaser)**	1973	X		X	X	X	
52		Engine Repair/**Maintenance** Shop	1953					X	
85*		Special Services **Maintenance** Garage	1953					X	
86*		Special Services **Maintenance** Garage	1953					X	
94		Gynasium (Station Order: Automotive Vehicle **Wash Rack)**	1953-1973		X				
99*		Line **Maintenance** Shop	1953					X	
100*		Line **Maintenance** Shop	1953					X	
101*		Line **Maintenance** Shop	1953					X	
102*		Line **Maintenance** Shop	1953					X	
102A*		Line **Maintenance** Shop	1953					X	
103*		Line **Maintenance** Shop	1953					X	
225*		Ordnance Equipment **Maintenance** Shop (adjacent to Bldg 31/IRP Site 13)	1953					X	

*** Building Demolished Between 1953 and 1973.**

TABLE 2-1 (Cont'd), HISTORICAL VOC USE SITES, MCAS EL TORO, CALIFORNIA

Location (Base Quad): NW

Sheet No.: 2 of 2

Bldg No/ *Facility*	IRP/ *AOC-SWMU* Site	Industrial Activity(s)	Facility Plan Reference Year	Aircraft Wash Areas	Vehicle Wash Areas	Degreasers	OWS	Maint.	Paint
240	*64,66, 268*	Contract **Refueling Facility** (AOC 64:<90day Accum. Area; AOC 66: 100 gal steel **OWS**; AOC 268: Vehicle **Washrack**)	1973		X		X		
244	*68*	Aircraft **Maintenance** Hanger (AOC 68: 100 gal concrete **OWS**; AQMD: **Surface Coating/Painting**)	1953				X	X	X
245	**14**	Electronics & Camera Equipment **Maintenance** Shop	1953					X	
286*		Electronics **Maintenance** Shop	1953					X	
288		Aircraft **Maintenance** Hanger	1973					X	
289	*70*	Aircraft **Maintenance** Hanger (Station Order: Aircraft **Wash Area** w/**OWS**; AOC 70: <90 Accum. Area; AQMD: **Degreaser, OWS**)	1953-1973	X		X	X	X	
347		Base Exchange **Maintenance** and **Fuel** Service Station	1953					X	
625	**20**	Automotive Hobby/**Maintenance** Shop	1973					X	
626	**20**/*157, 158, 159*	Automotive Hobby/**Maintenance** Shop (AOC 157: Automotive Vehicle **Wash Rack**; AOC 158: <90 day Accum. Area; AOC 159: **OWS**; AQMD: **Degreaser,** concrete **OWS**; note: 4 – OWSs, 3 – concrete (600, 835, 560 gal), 1 – 580 gal steel)	1973		X	X	X	X	
651	*164,165*	Base Exchange **Maintenance** and **Fuel** Service Station (AOC 164: Automotive Vehicle **Wash Rack**; AOC 165: <90 day Accum. Area; AOC 169: 280 gal concrete **OWS**; AQMD: **Degreaser**)	1973		X	X	X	X	
744		Weapons **Maintenance** Shop (AQMD: **Degreaser**, 500 gal concrete **OWS**)				X	X	X	
765	**13**/*216, 218*	Automotive Vehicle **Wash Rack** (AOC 216: **Wash Rack**; AOC 218: 100 gal steel **OWS**)	1973		X		X	X	
766	*219, 220*	Automotive Vehicle **Wash Rack** (AOC 219: **Wash Rack**; AOC 220: 100 gal steel **OWS**)	1973		X		X		
850	**16**	Crash Crew **Burn Pit**; unk **OWS**	1973				X		
851	**16**	Crash Crew **Burn Pit**	1973						
1702		Self-Service Automotive Vehicle **Wash Rack**; 550 gal steel **OWS**	1973		X		X		
1815		Line **Maintenance** Shelter	1973					X	

* **Building Demolished Between 1953 and 1973.**

TABLE 2-2, HISTORICAL VOC USE SITES, MCAS EL TORO, CALIFORNIA

Location (Base Quad): NE **Sheet No.: 1of 2**

Bldg No/ *Facility*	IRP/ *AOC-SWMU* Site	Industrial Activity(s)	Facility Plan Reference Year	Aircraft Wash Area	Vehicle Wash Rack	Degreaser	OWS	Maint.	Paint
108*		Line **Maintenance** Shelter	1953					X	
106*		Aircraft **Maintenance** Hanger (aka Bldg 606 in 1973)	1953					X	
107		Line **Maintenance** Shelter	1953					X	
109*		Aircraft **Maintenance** Hanger (aka Bldg 605 in 1973)	1953					X	
110*		Aircraft **Maintenance** Hanger (aka new Bldg 115 in 1973)	1953					X	
112*		Line **Maintenance** Shelter	1953					X	
114	*13, 38, 193*	Aircraft **Maintenance** Hanger(AOC 13: Drop **Tank** Storage Area, AOC 38:<90 day Accum. Area; Station Order: Aircraft **Wash Area**; AOC 193: **OWS**)	1973	X			X	X	
115	*13, 39*	Aircraft **Maintenance** Hanger(On site of old 115; AOC 13: Drop **Tank** Storage Area, AOC 38:<90 day Accum. Area)	1973					X	
118*		Aircraft **Maintenance** Hanger (aka new Bldg 114 in 1973; Station Order: Automotive **Wash Rack**)	1953		X			X	
119		Aircraft **Maintenance** Hanger	1973					X	
120		Aircraft **Maintenance** Hanger	1973					X	
121		Aircraft **Maintenance** Hanger	1973					X	
122		Aircraft **Maintenance** Hanger	1973					X	
123		Aircraft **Maintenance** Hanger	1973					X	
124		Aircraft **Maintenance** Hanger	1973					X	
125		Aircraft **Maintenance** Hanger (Station Order: Automotive Vehicle **Wash Rack**)	1973		X			X	
126		Aircraft **Maintenance** Hanger (aka Bldg 914 in 1973; AQMD: **Degreasers**)	1973			X		X	
127	*41*	Engine Repair/**Maintenance** Shop (AOC 41: Automotive Vehicle **Wash Rack**)	1953		X			X	
127		Aviation **Surface Coating** Shop (Paint)	1973						X
128*		Aircraft **Maintenance** Hanger (aka Bldg 634 in 1973)	1953					X	
129		Organizational **Maintenance** Shop	1953					X	
129		Aviation Armament **Maintenance** Shop (AQMD: **Surface Coating;** Station Order: Aircraft **Wash Area**)	1973	X					X
130	*42*	Dope & Spray **Surface Coating** Shop (AOC 42: <90 day Accum. Area)	1953						X
130	*293, 294, 295*	Aviation **Surface Coating** (Paint Shop; AOC 293: Cleaning Tank; AOCs 294, 295: <90 day Accum Areas)	1973						X
132		Electronics **Maintenance** Shop (AQMD: **Degreaser**)	1953			X		X	
132		Aviation Armament **Maintenance** Shop	1973					X	
137		Storage Facility (AQMD: **Degreaser**)	1953 & 1973			X			
138		Electronics **Maintenance** Shop (AOC 43: Drum Storage Area located at adjacent Bldg 137)	1973					X	
142		Line **Maintenance** Shelter	1953					X	
143*	*44*	Line **Maintenance** Shelter (AOC 44: Drum Storage Area)	1953					X	
144*		Aircraft **Maintenance** Hanger	1953 & 1973					X	
229*		Line **Maintenance** Shelter	1953					X	
232*		Line **Maintenance** Shelter	1953					X	
308		Ground Support Equipment Storage & **Maintenance**	1973					X	
341		GSE **Maintenance** Shop	1973					X	
352*		Line **Maintenance** Shelter	1953					X	

*** Building Demolished Between 1953 and 1973.**

TABLE 2-2 (Cont'd), HISTORICAL VOC USE SITES, MCAS EL TORO, CALIFORNIA

Location (Base Quad): NE

Sheet No.: 2 of 2

Bldg No/ ***Facility***	**IRP/** ***AOC-SWMU*** **Site**	**Industrial Activity(s)**	**Facility Plan Reference Year**	**Aircraft Wash Area**	**Vehicle Wash Rack**	**Degreaser**	**OWS**	**Maint.**	**Paint**
353*		Line **Maintenance** Shelter	1953					X	
392	*124, 271*	Aircraft Equipment **Maintenance** Shop(AOC 124, 271:<90day Accum. Areas; AQMD: **Surface Coating**; Station Order: Automotive Vehicle **Wash Rack**)	1973		X			X	X
436*		Post **Maintenance** Turbo-Jet Engine Test Stand	1953					X	
574	*16*	Aircraft **Fueling Station** (AOC 16: **Wash Rack**/Wash Rack Water Runoff)	1973		X				
575	*257*	Aircraft **Fueling Station** (AOC 257: **Wash Rack**/Wash Rack Water Runoff)	1973		X				
576	*15*	Aircraft **Fueling Station** (AOC 15: **Wash Rack**/Wash Rack Water Runoff)	1973		X				
577	*258*	Aircraft **Fueling Station** (AOC 258: **Wash Rack**/Wash Rack Water Runoff)	1973		X				
602	*147, 148*	Automotive Van **Maintenance** Shop (AOCs 147:<90 day Accum Area, AOC 148: unk **OWS**)	1973				X	X	
605	*149, 150, 151,267*	Aircraft **Maintenance** Hanger (AOC 149: <90 day Accum. Area; AOC 150: Aircraft **Wash** Area; AOC 151: 300 gal steel **OWS**; AOC 267: Drop Fuel **Tank** Storage Area)	1973	X			X	X	
606	*14,152, 163, 255*	Aircraft **Maintenance** Hanger (AOC 14: Drop Tank Fuel Storage Area; AOC 152: Aircraft **Wash** Area; AOC 163: 100 gal concrete **OWS**; <90 day Accum. Area; AOC 255:)	1973	X			X	X	
634		Aircraft **Maintenance** Hanger/Engine Maintenance/Avionics **Maintenance**(AQMD: **Degreaser**; **OWS**; **Surface Coating**)	1973			X	X	X	X
643		Fixed Aircraft Start System; 100 gal steel **OWS**	1973				X		
658	*171*	Post **Maintenance** Aircraft Engine Test Cell (adjacent to IRP Site 4; AOC 171: <90 day Accum. Area; AQMD: **Wash Area**; 400 gal concrete **OWS**)	1973	X			X	X	
695		Line **Maintenance** Shelter	1973					X	
696		Line **Maintenance** Shelter; unk **OWS**	1973					X	
697		Line **Maintenance** Shelter	1973				X	X	
698		Line **Maintenance** Shelter	1973					X	
716		Post **Maintenance** Jet Engine Test Cell (AQMD: 100 gal steel **OWS**)	1973					X	
745		Aviation Armament **Maintenance** Shop	1973				X	X	
763	*210, 211*	Aircraft **Wash** Area (AOC 210: Automotive Vehicle **Wash Rack**; AOC 211: 100 gal steel **OWS**)	1973	X	X		X		
764	*213, 215*	Automotive Vehicle **Wash Rack** (AOC 213: **Wash Rack**; AOC 215: 100 gal steel **OWS**)	1973		X		X		
892		Aircraft **Wash** Area; 1,375 gal **OWS**	1973	X			X		
923		**Fuel** Drop Tank Rinse Facility	1973	X					
1804		Aircraft **Maintenance** Hanger	1973					X	

*** Building Demolished Between 1953 and 1973.**

TABLE 2-3, HISTORICAL VOC USE SITES, MCAS EL TORO, CALIFORNIA

Location (Base Quad): SE **Sheet No.: 1of 1**

Bldg No/ *Facility*	**IRP/ *AOC-SWMU* Site**	**Industrial Activity(s)**	**Facility Plan Reference Year**	**Aircraft Wash Areas**	**Vehicle Wash Rack**	**Degreaser**	**OWS**	**Maint.**	**Paint.**
371	*107, 242*	Aircraft **Maintenance** Hanger (AOCs 107, 242: <90 day Accum. Areas; Station Order: Aircraft **Wash Area**; 2,350 gal steel **OWS**)	1973	X			X	X	
389		Loading/Unloading Ramp (Station Order: Automotive Vehicle **Wash Rack**)	1953 & 1973		X				
390	*120, 121, 122,261*	Golf Cart **Maintenance** Shop (AOC 120: Automotive Vehicle **Wash Rack**; AOC 121: Drum Storage Area; AOC 122: <90 day Accum. Area; AOC 261: <90 day Accum. Area; AQMD: **Degreaser**)	1953			X		X	
447	*130, 131, 132*	Post **Maintenance** Jet Engine Test Cell (AOC 130: <90 day Accum. Area; AOC 131: Engine Test Cell; AOC 132: 800 gal concrete **OWS**; AQMD: **Wash Rack**)	1973		X		X	X	
453	*133*	Aircraft **Maintenance** Hanger (AOC 133: <90 day Accum. Area)	1973					X	
454	*134*	Aircraft **Maintenance** Hanger (AOC 134: <90 day Accum. Area)	1973					X	
461	*136,138*	Aircraft **Maintenance** Hanger (AOC 136 (AQMD): Aircraft **Wash** Area; AOC 138: <90 day Accum. Area; 50 gal steel **OWS**)	1973	X			X	X	
462	*140*	Aircraft **Maintenance** Hanger (AOC 140: <90 day Accum. Area; 50 gal steel **OWS**)	1973				X	X	
463	*141, 142, 248*	Aircraft **Maintenance** Hanger (AOC 141: Aircraft **Wash** Area; AOC 142: Drum Storage Area; AOC 248: **OWS**; AQMD: **Surface Coating**)	1973	X			X	X	X
673	*178, 179, 181,182, 183,184, 185, 186*	Aircraft Ground Support Equipment **Maintenance** Shop (AOC 178: Automotive Vehicle **Wash Rack**; AOC 179:895 gal concrete **OWS**; AOC 181: Landfarming Area; AOCs 182, 183, 184, 185: Drum Storage Areas; AOC 186:<90 day Accum. Area; AQMD: **Degreaser, Wash Rack**)	1973		X	X	X	X	
711		Aircraft Post **Maintenance** Test Cell (AQMD)	1973					X	
714		Line **Maintenance** Shelter (adjacent to Site 6)	1973					X	
715		Line **Maintenance** Shelter	1973					X	
726		Line **Maintenance** Shelter	1973					X	
727	6	Line **Maintenance** Shelter (adjacent to Site 6)	1973					X	
761	*204, 205*	Aircraft **Wash** Area (AOC 204: Automotive Vehicle **Wash Rack**; AOC 205: 100 gal steel **OWS**)	1973	X	X		X		
762	*208*	Automotive Vehicle **Wash Rack** (AOC 208: 100 gal steel **OWS**)	1973		X		X		
782		Golf Course Equipment **Maintenance** Shop	1973					X	
785		Aviation **Maintenance** Building	1973					X	
786		Aviation Armament **Maintenance** Shop (located adjacent to AOC 256: <90 day Accum. Area)	1973					X	
817	*233, 270*	Automotive Vehicle **Wash Rack** (located adjacent to AOC 47: <90 day Accum. Area; AOC 233:1,500 gal concrete **OWS**; AOC 270: Automotive Vehicle **Wash Rack**)	1973		X		X		
845		**Wash Rack** Utility Building; 2,000 gal steel **OWS**	1973		X		X		
848		Utility Building (AQMD: **OWS**)	1973				X		
854		**Paint Booth** (AQMD: **Surface Coating**)	1973						X
896		Aircraft **Wash Area** (Listed in ATIR filed at AQMD: Orphan Site, location not listed on facility map; 600 gal steel **OWS**)	1973	X			X		
897		Aircraft **Wash Area** (Listed in ATIR filed at AQMD: Orphan Site, location not listed on facility map; unk steel **OWS**)	1973	X			X		

TABLE 2-4, HISTORICAL VOC USE SITES, MCAS EL TORO, CALIFORNIA

Location (Base Quad): SW — **Sheet No.: 1of 2**

Bldg No/ *Facility*	**IRP/ *AOC-SWMU* Site**	**Industrial Activity(s)**	**Facility Plan Reference Year**	**Aircraft Wash Area**	**Vehicle Wash Rack**	**Degreaser**	**OWS**	**Maint.**	**Paint.**
96	**24**,*35, 243, 291*	Heavy Duty Equipment **Maintenance** Shop (AOC 35: <90 day Accum. Area; AOC 243: Automotive Vehicle **Wash Rack**; AOC 291: unk **OWS**)	1953		X		X	X	
295	**24**,*71*	Aircraft **Maintenance** Hanger (adjacent to IRP Site 7; AOC 71: <90 day Accum. Area; AQMD: **Degreaser**)	1953 & 1973			X		X	
296	**24**, *72*	Aircraft **Maintenance** Hanger; Ground Support Equipment **Maintenance** Shop; Radium Paint Shop (adjacent to IRP Site 7; AOC 72: <90 day Accum. Area; Station Order: Aircraft **Wash Area**)	1953 & 1973	X				X	
297	**24**, *73,74,76, 78 to 82*	Aircraft **Maintenance** Hanger; Boiler Room (AOC 73: <90 day Accum. Area; AOC 74: Aircraft **Wash** Area (north and east sides; AOC 76: 100 gal steel **OWS**; AOCs 78 to 82: Drum Storage Areas)	1953 & 1973	X			X	X	
298	**24**	Public Works Transportation **Maintenance** Shop (AQMD: Automotive Vehicle **Wash Rack**; **Degreaser**); 100 gal steel **OWS**	1953		X	X	X	X	
299	**24**	Public Works Transportation **Surface Coating** Shop (Paint & Spray Booth)	1953						X
300	**24**	Public Works Carpenter Shop	1953						X
301	**24**	Public Works **Surface Coating** Shop (Paint & Spray Booth)	1953						X
302	**24**	Public Works Tool Shop	1953					X	
302	**24**	Public Works Electrical **Maintenance** Shop	1973					X	
306	**24**	Public Works Electrical **Maintenance** Shop	1953					X	
306	**24**, *88*	Public Works Pipe, Heating, and Refrigeration **Maintenance** Shop (AOC 88: <90 day Accum. Area; located adjacent to AOC 222 - <90 day Accum. Area)	1973					X	
307	**24**	Base Laundry and **Dry Cleaning Plant** (located adjacent to: AOC 144 - <90 day Accum. Area)	1953						
312	**24**	Base Photographic **Laboratory**; unk **OWS**	1953 & 1973				X		
313	**24**	Field **Maintenance** Shop	1973					X	
314	**24**	Storage Facility (Heating Plant, 1953); 2,000 gal concrete **OWS**	1953 & 1973				X		
315	**24**	Aircraft **Maintenance** (Machine) Shop (adjacent to Site 7)	1953					X	
324	**24**, *95*	Post **Maintenance** Aircraft Engine Test Cell (AOC 95: Engine Test Cell); 2 - unk **OWSs**	1973				X	X	
333	**24**	Field **Maintenance** Shop	1973					X	
338A, B, C*	**24**	Post **Maintenance** Aircraft Engine Test Stand	1953					X	
357	**24**	Hazardous/Flammable material Storage Facility; 200 gal steel **OWS** (Garbage House, 1953)	1953& 1973				X		
359	**24**, *98, 99, 100, 101, 103, 254,304*	MTIS Building (AOC 98: Automotive Vehicle **Wash Rack**; AOC 99: <90 day Accum. Area; AOC 100: TCE **Degreaser**; AOC 101: 100 gal concrete **OWS**; AOC 103: Drum Storage Area; <90 day Accum. Area; AOC 304: Trenches Inside Bldg)	1953 & 1973		X	X	X		
370	**24**	Public Works **Surface Coating** (Paint) Shop; Carpentry Shop; Metal Trades Shop	1973						X
386	**24**	Public Works Transportation **Maintenance** (Lubrication) Shop (Station Order: Automotive Vehicle **Wash Rack**); 100 gal steel **OWS**	1953		X		X	X	
386	**24**, *110, 112,114*	Construction Equipment **Maintenance** Shop (AOC 110: Automotive Vehicle **Wash Rack** (AQMD); AOC 112: **OWS**; AOC 114: <90day Accum. Area; located adjacent to AOC 223 - <90day Accum Area; AQMD: **Degreaser**)	1973		X	X	X	X	

*** Building Demolished Between 1953 and 1973.**

TABLE 2-4 (Cont'd), HISTORICAL VOC USE SITES, MCAS EL TORO, CALIFORNIA

Location (Base Quad): SW **Sheet No.: 2of 2**

Bldg No/ ***Facility***	**IRP/** ***AOC-SWMU*** **Site**	**Industrial Activity(s)**	**Facility Plan Reference Year**	**Aircraft Wash Area**	**Vehicle Wash Rack**	**Degreaser**	**OWS**	**Maint.**	**Panit.**
388	**24** *116, 118, 251*	Field **Maintenance** Shop (AOC 116: <90 day Accum. Area; AOC 118: 100 gal steel **OWS**; AOC 251: <90 day Accum. Area; AQMD: **Degreaser**; Station Order: Automotive Vehicle **Wash Rack**)	1953 & 1973		X	X	X	X	
445		Post **Maintenance** Engine Test Cell; unk **OWS**	1953				X	X	
655	**24**, *170*	Field **Maintenance** Shop (AOC 170: Drum Storage Area; AQMD: **Degreaser**)	1973			X		X	
671		Refueling Administrative Facility (Automotive Vehicle **Wash Rack**; AQMD: **OWS**)	1973		X				
672	**24**, *174, 176*	Refueling Vehicle **Maintenance** Shop (AOC 175: 400 gal steel **OWS**; AOC 177: < 90 day Accum Area.; located adjacent to: AOC 172 - <90 day Accum. Area, and AOC 173 – **OWS**)	1973				X	X	
675	**24**	1,400 gal steel **OWS**	1973				X		
674	**24**	1,400 gal steel **OWS**	1973				X		
758	**24**, *195, 196*	Automotive Vehicle **Wash Rack** (AOC 195: **Wash Rack**; AOC 196: 100 gal steel **OWS**)	1973		X		X		
759	**24**, *198, 199, 200*	Automotive Vehicle **Wash Rack** (AOC 198: **Wash Rack**; AOC 199: 100 gal steel **OWS**; AOC 200: UST)	1973		X		X		
760	**24**, *201, 202*	Automotive Vehicle **Wash Rack** (AOC 201: **Wash Rack**; AOC 202: 100 gal steel **OWS**)	1973		X		X		
800	**24**, *229, 230,299*	Automotive Vehicle **Maintenance** Shop (AOC 229: <90 day Accum. Area; AOC 232: 1,500 gal concrete **OWS**; AOC 299: Automotive Vehicle **Wash Rack**; AQMD: **Degreaser**)	1973		X	X	X	X	
802	**24**	Automotive Vehicle **Wash Rack** (AQMD; aka AOC 299); 1,000 gal concrete **OWS**	1973		X		X		
875	**24**	Heavy Equipment **Maintenance** Shop (adjacent to Site 22)	1973					X	
1595	**11/24**	Public Works **Maintenance** Storage	1953 & 1973					X	

*** Building Demolished Between 1953 and 1973.**

TABLE 2-4

TABLE 2-5
SUMMARY OF HISTORICAL VOC USE SITES

Activity	Number of Facilities By Quadrant				Total Number Of Facilities	Percent Of Total In NW, NE, SE
	Northwest	Northeast	Southeast	Southwest		
Aircraft Wash Area	4	8	6	2	**20**	**90**
Vehicle Wash Rack	8	10	7	12	**37**	**68**
Degreasers	8	4	2	7	**21**	**67**
Oil Water Separators[1]	14	12	13	11	**50**	**78**
Maintenance	41	46	17	23	**127**	**82**
Painting Operations	3	6	2	4	**15**	**73**
Laundry . Dry Cleaning	0	0	0	1	**1**	**0**
Total	**78**	**86**	**37**	**60**	**261**	77
Percent of Total	**30**	**33**	**14**	**23**		

Note: 1 – Count of OWSs does not include those associated with Aircraft Wash Areas or Vehicle Wash Racks

Table 4-1

VCP Diameter and Length Data
MCAS El Toro Sanitary Sewer System

Quadrant	VCP Diameter (in.)	Total Length (ft)	
	4	2,370	
	6	14,910	
	8	28,400	
	10	4,850	
NW	12	1,870	
	15	6,530	
	18	250	
Line No. 1	8	1,150	
Line No. 4	18	1,495	
Total:			61,825
	4	1,260	
	6	4,600	
NE	8	10,880	
	10	1,020	
Line No. 1	8	1,150	
Line No. 2	8	1,700	
Total:			17,760
	4	970	
	6	5,120	
SE	8	2,700	
	10	4,730	
Line No. 2:	8	1,700	
Line No. 3:	8	3,600	
Line No 5:	12	1,655	
Total:			20,475
	4	1,980	
	6	2,850	
	8	13,800	
	10	3,180	
	12	7,850	
SW	15	1,350	
	18	1,400	
Line No 4:	18	1,495	
Line No. 5:	12	1,655	
Terminus:	12	750	
Total:			36,310
Total Length		136,370	

Table 4-2

Differential Head Estimation
MCAS El Toro Sanitary Sewer System

Line Number[1]	VCP Diameter (in.)	Line Length (ft)	Differential Head (ft, H_2O)
1	8	2,300	63
2	8	3,400	35
3	8	3,600	50
4	18	2,990	7
5	12	3,310	48

Note: 1 Line Numbers correspond to the arbitrary line designation illustrated in Plate 4-1

Table 5-1

Historical Solvent Constituencies
By Weight Percent

Constituency	Weight Percent By Time Period	
	1943 to 1980	1993 to 1996
Water	0 to 75	0 to 75
Chlorinated Component[1]	10 to 15	<1
Carrier (Aromatics)	0 to 75	0 to 95
Detergent	2	2
Soap	2	2
Surfactant (Demulsifier)	1	1
Total	100	100

Note: 1 – Any one of the COCs

Table 5-2

Notional Chlorinated Solvent

Chlorinated Compound	Density (lbs/gal)
Methylene Chloride	11.1
PCE	13.6
TCA	12.8
TCE	12.2
Carbon Tetrachloride	13.3
Notional	**12.6**

Table 5-3, Estimated Solvent Discharge, Aircraft Wash Areas (NW, NE, SE)

	Parameter	Value	Notes
A.	Period of Use (yrs):	37.0	(1943 to 1980)
B.	Aircraft Population:	225.0	(weighted average)
C.	Aircraft Wash Rate (wash/acft/wk):	1.08	(56 washings per aircraft per year)
D.	Wash Area Available (%):	0.82	(for NW,NE,SE; Appendix U)
E.	Wash Cycle Duration (min):	20.0	(cleaning equipment time of use only)
F.	Steam Cleaner Pump Rate (pgm):	4.0	(equipment manufacturer specification)
G.	Solvent Solution Used per Wash Cycle (gal.):	8.0	(average of pump rate range - 10%)
H.	Approximate Solvent Density (lbs/gal):	12.61	(see Table 5-2)
I.	Weight % of Chemicals of Concern (%):	12	
J.	Annual Solvent Solution Used (gal):	82,753	
K.	Annual Solvent Solution Dschrg (lbs):	1,043,521	
L.	Less Losses (lbs):	114,787	(loss prior to sanitary sewer: ~11%)
M.	Net Annual Solvent Solution Dschrgd (lbs)	928,733	
N.	Total Solvent Solution Dschrgd (lbs)	34,363,131	(for the period of 1943 to 1980)
O.	**Total COC Dschrgd to Sewer (lbs):**	**4,123,576**	(for the period of 1943 to 1980)

Table 5-3, Estimated Solvent Discharge, Aircraft Wash Areas (NW, NE, SE)

	Parameter	Value	Notes
P.	Period of Use (yrs):	15.0	(1981 to 1996)
Q.	Aircraft Population:	154.0	(weighted average)
R.	Aircraft Wash Rate:	1.08	(56 washings per aircraft per year)
S.	Wash Area Available (%):	0.82	(for NW,NE,SE; see Appendix U)
T.	Wash Cycle Duration (min):	20.0	(cleaning equipment time of use only)
U.	Steam Cleaner Pump Rate (pgm):	4.0	(equipment manufacturer specification)
V.	Solvent Solution Used per Wash Cycle(gal.):	8.0	(average of pump rate range - 10%)
W.	Approximate Solvent Density (lbs/gal):	9.49	(weighted chemical manufacturer spec)
X.	Weight % of Chemicals of Concern (%):	3	
Y.	Annual Solvent Solution Use (gal):	56,640	
Z.	Annual Solvent Solution Dschrg(lbs):	537,326	
AA.	Less Losses (lbs):	59,106	(loss prior to sanitary sewer: ~11%)
AB.	Net Annual Solvent Solution Dschrg(lbs)	478,220	
AC.	Total Solvent Solution Dschrgd (lbs):	7,173,300	
AD	**Total COC Dschrgd to Sewer (lbs):**	**215,199**	(for time period fo 1981 to 1996)
AE.	**Grand Total COC Dschrgd (lbs):**	**4,338,775**	(for time period of 1943 to 1996)

Table 5-4, Estimated Solvent Discharge, Vehicle Wash Racks (NW, NE, SE)

	Parameter	Value	Notes
A.	Period of Use (yrs):	37.0	(1943 to 1980)
B.	Wash Rack Population:	12	(weighted average; see Appendix U)
C.	Wash Racks Available (%):	22.00	(inuse at any one time in NW,NE,SE)
D.	Wash Rack Operational Cycle (hrs/day)	2.0	(cummulative period of time used per day)
E.	Wash Cycle Duration (min):	15.0	(cleaning equipment time of use only)
F.	No. of Vehicle Wash Cycles per Day:	20	
G.	Steam Cleaner Pump Rate (pgm):	4.0	(equipment manufacturer specification)
H.	Daily Use of Solvent Solution gal.):	123	(average of pump rate range - 10%)
I.	Approximate Solvent Density (lbs/gal):	12.61	(see Table 5-2)
J.	Weight % of Chemicals of Concern (%):	12	
K.	Annual Solvent Solvent Used (gal):	31,870	
L.	Annual Solvent Solution Dschrg(lbs):	401,887	
M.	Less Losses (lbs):	104,491	(loss prior to sanitary sewer: ~26%)
N.	Net Annual Solvent Solution Dschrgd (lbs)	297,396	
O.	Total Solvent Solution Dschrgd (lbs):	11,003,664	(for the period 0f 1943 to 1980)
P.	**Total COC Dschrgd to Sewer (lbs):**	**1,320,440**	(for the period 0f 1943 to 1980)

Table 5-4, Estimated Solvent Discharge, Vehicle Wash Racks (NW, NE, SE)

	Parameter	Value	Notes
Q.	Period of Use (yrs):	15.0	(1981 to 1996)
R.	Wash Rack Population:	12	(weighted average; see Apendix U)
S.	Wash Racks Available (%):	22.00	(inuse at any one time in NW,NE,SE)
T.	Wash Rack Operational Cycle (hrs/day)	4.0	(cummulative period of time used per day)
U.	Wash Cycle Duration (min):	15.0	(cleaning equipment time of use only)
V.	No. of Vehicle Wash Cycles per Day:	41	
W.	Steam Cleaner Pump Rate (pgm):	4.0	(equipment manufacturer specification)
X.	Daily Use of Solvent Solution (gal.):	245	(average of pump rate range - 10%)
Y.	Approximate Solvent Density (lbs/gal):	9.49	(MSDS survey of solvents currently used)
Z.	Weight % of Chemicals of Concern (%):	3	
AA.	Annual Solvent Solution Used (gal):	63,741	
AB.	Annual Solvent Solution Dschrg(lbs):	604,690	
AC.	Less Losses (lbs):	157,219	(loss prior to sanitary sewer: 26%)
AD.	Net Annual Solvent Solution Dschrgd (lbs):	447,470	
AE.	Total Solvent Solution Dschrgd (lbs):	6,712,054	
AF.	**Total COC Dschrgd to Sewer (lbs):**	**201,362**	(for the period of 1981 to 1996)
AG.	**Grand Total COC Dschrgd (lbs):**	**1,521,801**	(for the period of 1943 to 1996)

Table 5-5, Estimated Solvent Discharge, Degreasers/OWS (NW, NE, SE)

	Parameter	Value	Notes
A.	Period of Operations (yrs):	37.0	(1943 to 1980; Advent of RCRA)
B.	Degreaser/OWS Population:	14	(not associated w/aircraft or vehicle wash ops)
C.	Anuual Solvent Solution Used (gal):	29,988	(Capacity varies from 150 gal to 750 gal; solvent changed-out every month)
D.	Approximate Solvent Density (lbs/gal):	12.61	(weighted average for the period)
E.	Weight % of Chemicals of Concern (%):	100	
F.	Annual Solvent Discharge (lbs):	378,149	
G.	Less Losses (lbs):	359,241	(loss prior to sanitary sewer: ~95%)
H.	Net Annual Solvent Solution Dschrgd (lbs):	18,907	
I.	Total Solvent Solution Dschrgd (lbs):	699,575	
J.	**Total COC Dschrg to Sewer (lbs):**	**699,575**	(for the time period of 1943 to 1980)

Table 5-5, Estimated Solvent Discharge, Degreasers/OWS (NW, NE, SE)

	Parameter	Value	Notes
K.	Period of Operations (yrs):	15.0	(1981 to 1996)
L.	Degreaser/OWS Population:	14	(not associated w/aircraft or vehicle wash ops)
M.	Anuual Solvent Solution Used (gal):	29,988	(Capacity varies from 150 gal to 750 gal; solvent changed-out every month)
N.	Approximate Solvent Density (lbs/gal):	9.49	(weighted average for the period)
O.	Weight % of Chemicals of Concern (%):	100	
P.	Annual Solvent Discharge (lbs):	284,586	
Q.	Less Losses (lbs):	270,357	(loss prior to sanitary sewer: ~95%)
R.	Net Annual Solvent Solution Dschrgd (lbs):	14,229	
S.	Total Solvent Solution Dschrgd (lbs):	213,440	
T.	**Total COC Dschrg to Sewer (lbs):**	**213,440**	(for the time period of 1981 to 1996)
U.	**Grand Total COC Dschrgd (lbs):**	**913,015**	(for the time period of 1943 to 1996)

Table 5-6, Number of Maintenance Facilities (NW, NE, SE)

	Time Period	Time Period	Time Period	
	1944 to 1972	1944 to 1980	1973 to 1996	
No. Years:	28	42	24	
Quadrant	**No. Maint Bldgs**	**No. Maint Bldgs**	**No. Maint Bldgs**	**Total No. Facilities**
NW	15	12	14	**41**
NE	15	12	19	**46**
SE	2	1	14	**17**
Total	**32**	**25**	**47**	**104**

Table 5-7, Estimated Solvent Discharge, Maintenance Facilities (NW, NE, SE)

	Time Period	Time Period	Time Period	Total
	1944 to 1972	1944 to 1980	1973 to 1996	
No. Years:	28	42	24	
Assume: Solvent use/bldg is 1 gal/week; annual solvent used is:				52.0
Weighted solvent density in lbs/gal (1944 to 1996):				11.5
Weight % of Chemicals of Concern				100.0
Total Estimated Use of Solvent Solution (lbs)				
NW	250,921	301,105	200,737	**752,763**
NE	250,921	301,105	272,429	**824,455**
SE	33,456	25,092	200,737	**259,285**
Total	**535,298**	**627,302**	**673,902**	**1,836,503**
Total COC Discharged to Sewer Less Losses (lbs):				**73,460**

Table 5-8, Estimated Solvent Discharge, Dry Cleaning Plant

	Parameter	Value	Notes
A.	Period of Operations (yrs):	29.0	(1943 to 1972)
B.	Anuual Solvent Use (gal):	5,500	(see Appendix U)
C.	Approximate Solvent Density (lbs/gal):	13.6	(perchloroethylene)
D.	Weight % of Chemicals of Concern (%):	1.0	(100% cleaning solution - perchloroethylene)
E.	Annual Solvent Discharge (lbs):	74,867	
F.	Less Losses (lbs):	14,973	(loss prior to sanitary sewer: 20%)
G.	Net Annual Solvent Dschrgd (lbs):	59,894	
H.	Total Solvent Dschrgd (lbs):	1,736,916	
I.	**Total COC Loading of Sewer (lbs):**	**1,736,916**	(for the period of 1943 to 1972)

Table 5-9, Estimated Solvent/Thinner Discharge, Aircraft Painting Operations (NW, NE, SE)

Parameter	Value	Notes
A. Period of Use (yrs):	37.0	(1943 to 1980)
B. Aircraft Population:	225.0	(weighted average for time period)
C. Annual Annual Painting Rate:	1.25	(Once per year for corrsosion control & once every 4th year for mission needs)
D. Paint Facilities Available (%):	57.00	(weighted time average for NW,NE,SE)
E. Thinner Use per Paint Cycle (gal.):	30.0	(Prime & Finish)
F. Approximate Paint Density (lbs/gal):	6.9	(survey of available MSDSs)
G. Wt % of Cemicals of Concern-Thinner(%):	55	
H. Annual Thinner Use (gal):	4,809	
I. Annual Thinner Mass Discharge (lbs):	33,185	
J. Less loss (lbs):	32,189	(mass estimated to be ~97%)
K. Annual Thinner Dschrgd to Sewer (lbs):	996	
L. Total Thinner Dschrgd to Sewer (lbs):	**36,835**	(for the time period 1943-1980)
M. Solvent Use per Paint Cycle (gal):	55.0	
N. Solvent Density (lbs/gal):	12.61	
O. Wt % of Chemicals of Concern-Solvent (%):	1.00	(undiluted solvent used)
P. Annual Solvent Use (gal):	8,817	
Q. Annual Solvent Dschrg to Sewer (lbs):	111,185	
R. Less Loss (lbs):	101,178	(loss estimated to be ~91%)
S. Annual Solvent Dschrgd to Sewer (lbs):	10,007	
T. Total Solvent Dschrgd to Sewer (lbs):	**370,245**	(for the time period 0f 1943 to1980)
U. Total COC Dschrg to Sewer(lbs):	**390,504**	

Table 5-9, Estimated Solvent/Thinner Discharge, Aircraft Painting Operations (NW, NE, SE)

Parameter	Value	Notes
V. Period of Use (yrs):	15.0	(1981 to 1996)
W. Aircraft Population:	154.0	(weighted average)
X. Annual Aircraft Coating Rate:	1.25	(Once per year for corrsosion control & once every 4th year for mission needs)
Y. Paint Facilities Available (%):	66.0	(weighted time average for NW,NE,SE)
Z. Thinner Use per Paint Cycle (gal.):	30.0	(Prime & Finish)
AA. Approximate Paint Density (lbs/gal):	6.9	
AB. Wt % of Chemicals of Concern-Thinner(%):	55.0	
AC. Annual Thinner Use (gal):	3,812	
AD. Annual Thinner Discharge (lbs):	26,299	
AE. Less Loss (lbs):	25,510	(losses estimated to be ~97%)
AF. Annual Thinner Dschrgd to Sewer (lbs):	789	
AG. Total Thinner Dschrgd to Sewer (lbs):	**11,835**	
AH. Solvent Use per Paint Cycle (gal):	55.0	
AI. Solvent Density (lbs/gal):	9.49	(survey of available MSDS)
AJ. Wt % of Chemicals of Concern-Solvent (%):	100.00	
AK. Annual Solvent Use (gal):	6,988	
AL. Annual Solvent Dschrg to Sewer (lbs):	66,314	
AM. Less Loss (lbs):	60,346	(loss estimated to be ~91%)
AN. Annual Solvent Dschrgd to Sewer (lbs):	5,968	
AO. Total Solvent Dschrgd to Sewer (lbs):	**89,524**	
AQ. Total COC Dschrgd (lbs):	**96,033**	
AR. Grand Total COC Dschrgd (lbs):	**486,537**	

Table 5-10

Estimated VOC Mass Discharge to Sanitary Sewer System and Mass Losses NW, NE, SE Quadrants, MCAS El Toro

Industrial Activity		Mass Loss (lbs-e)[1]						Mass Discharge (lbs-e)[1]
		Volatilized	Runoff	Spills/Slop	Sludge	Incinerate/ landfill	Recovery	
Aircraft Wash Areas		72,455	72,455		14,490		14,490	4,439,000
Vehicle Wash Racks		50,330	201,315		503		503	1,522,000
Degreasers		33,000		33,000	330	557,460	330	913,000
Maintenance		91,825		91,825	920	1,516,000	920	73,500
Dry Cleaning		6,240		18,700				1,.737,000
Painting	Thinner	51,600	540		540		540	487,000
	Solvent	160,000	585		585		585	
Sub Total Mass Losses		465,450	274,895	143,525	17,370	2,073,460	17,370	
Total Net Mass Lost:							**2,992,440**	
Total Estimated Mass Discharged to Sanitary Sewer								**9,171,500**

Note: 1 – Estimated values

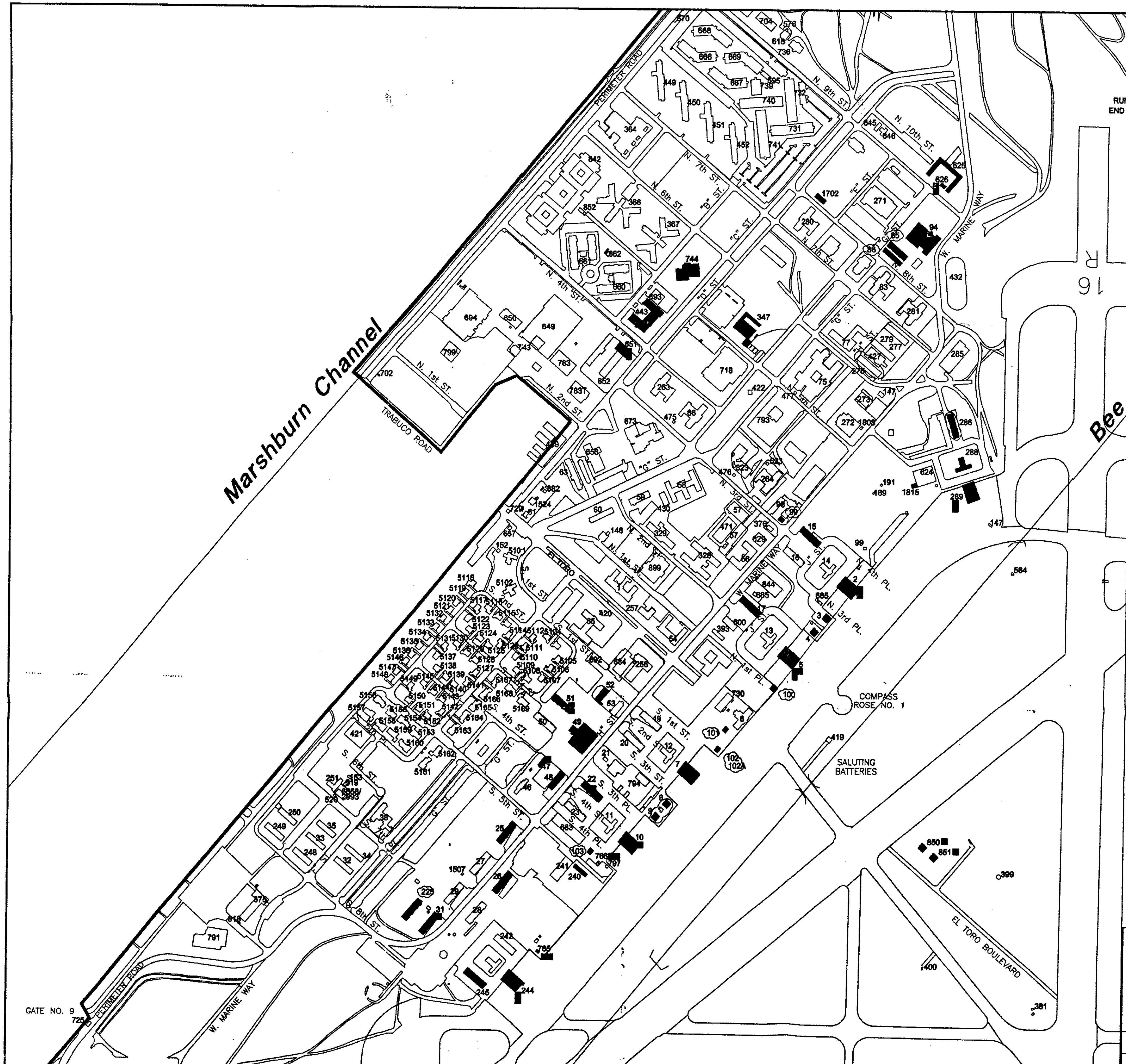
ILLUSTRATIONS

PES Environmental, Inc.
Engineering & Environmental Services

Site Location Map and Bridge Reference System
MCAS, El Toro, California

PLATE
1

680_plates	680-001-01-002		10/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



LEGEND

- 318 — BUILDING OR PAD
- IMPROVED/UNIMPROVED ROADS
- AIRFIELD
- WASH OR STREAM
- MCAS EL TORO BOUNDARY
- CULVERT
- DRAINAGE FLOR DIRECTION
- STORM DRAIN LINE
- CATCH BASIN
- JUNCTION
- DS#001 — DISCHARGE SERIAL

SOURCE: ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1988

- FACILITY NO LONGER EXISTS
- MAINTENANCE
- AIRCRAFT WASH AREA
- VEHICLE WASH ROCK
- OWS/DEGREASERS
- PAINTING FACILITIES

N

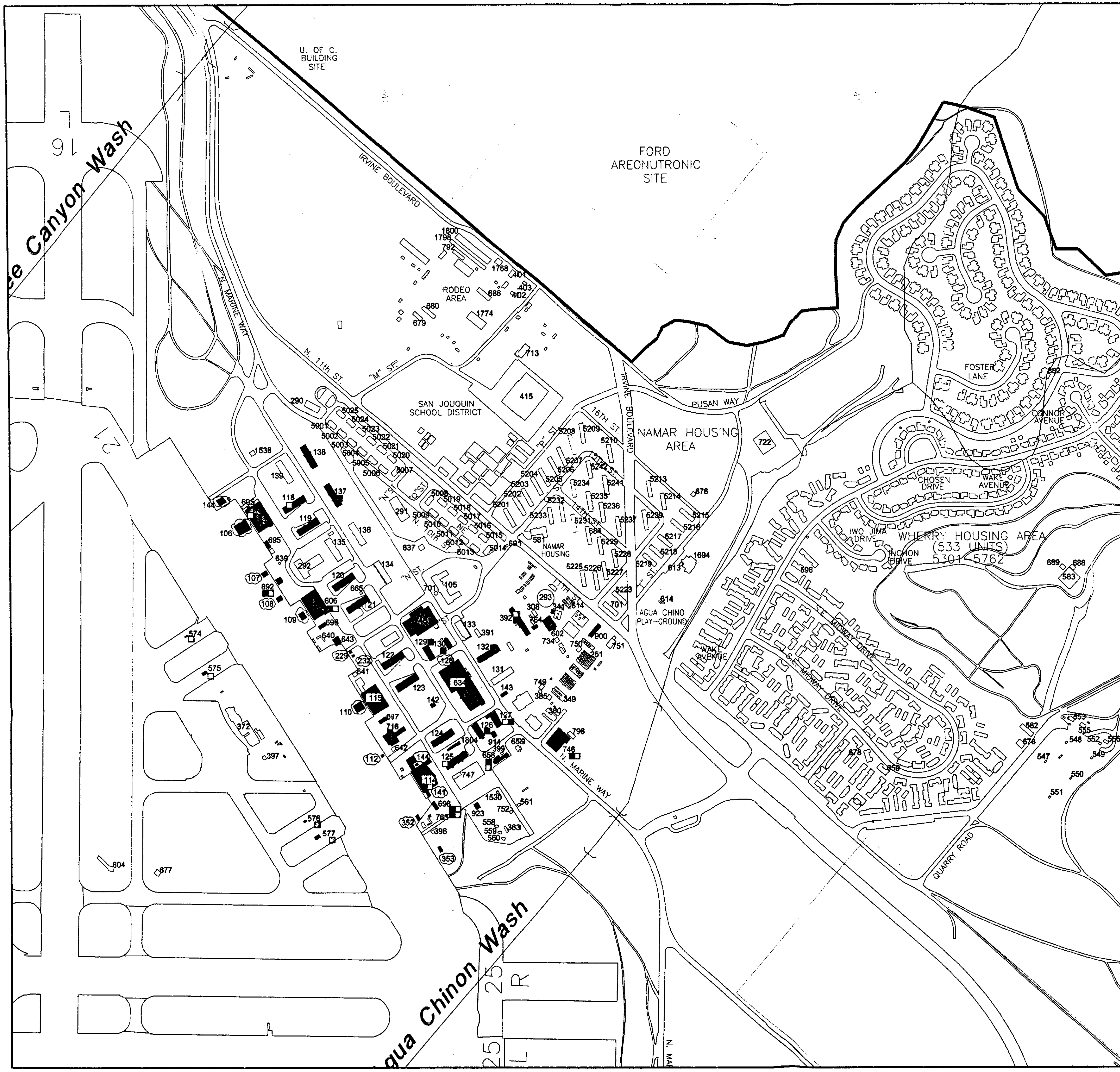
0 300 600
Scale in Feet

FES Environmental, Inc.
Engineering & Environmental Services

Industrial Activities Area
MCAS, El Toro, California

Plate 1-a-NW
Revision 0

DWG NUMBER | JOB NUMBER | APPROVED | DATE



LEGEND

318	BUILDING OR PAD
	IMPROVED/UNIMPROVED ROADS
	AIRFIELD
	WASH OR STREAM
	MCAS EL TORO BOUNDARY
	CULVERT
	DRAINAGE FLOR DIRECTION
	STORM DRAIN LINE
	CATCH BASIN
	JUNCTION
DS#001	DISCHARGE SERIAL
	5ft HAND AUGER
	25ft BORING
	80ft ANGLE BORING

SOURCE: ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986

	MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS
	MAINTENANCE
	AIRCRAFT WASH AREA
	VEHICLE WASH ROCK
	DWS/DEGREASERS
	PAINTING FACILITIES

N

0 300 600
Scale in Feet

PES Environmental, Inc.
Engineering & Environmental Services

Industrial Activities Area
MCAS, El Toro, California

Plate 1-b-NE
Revision 0

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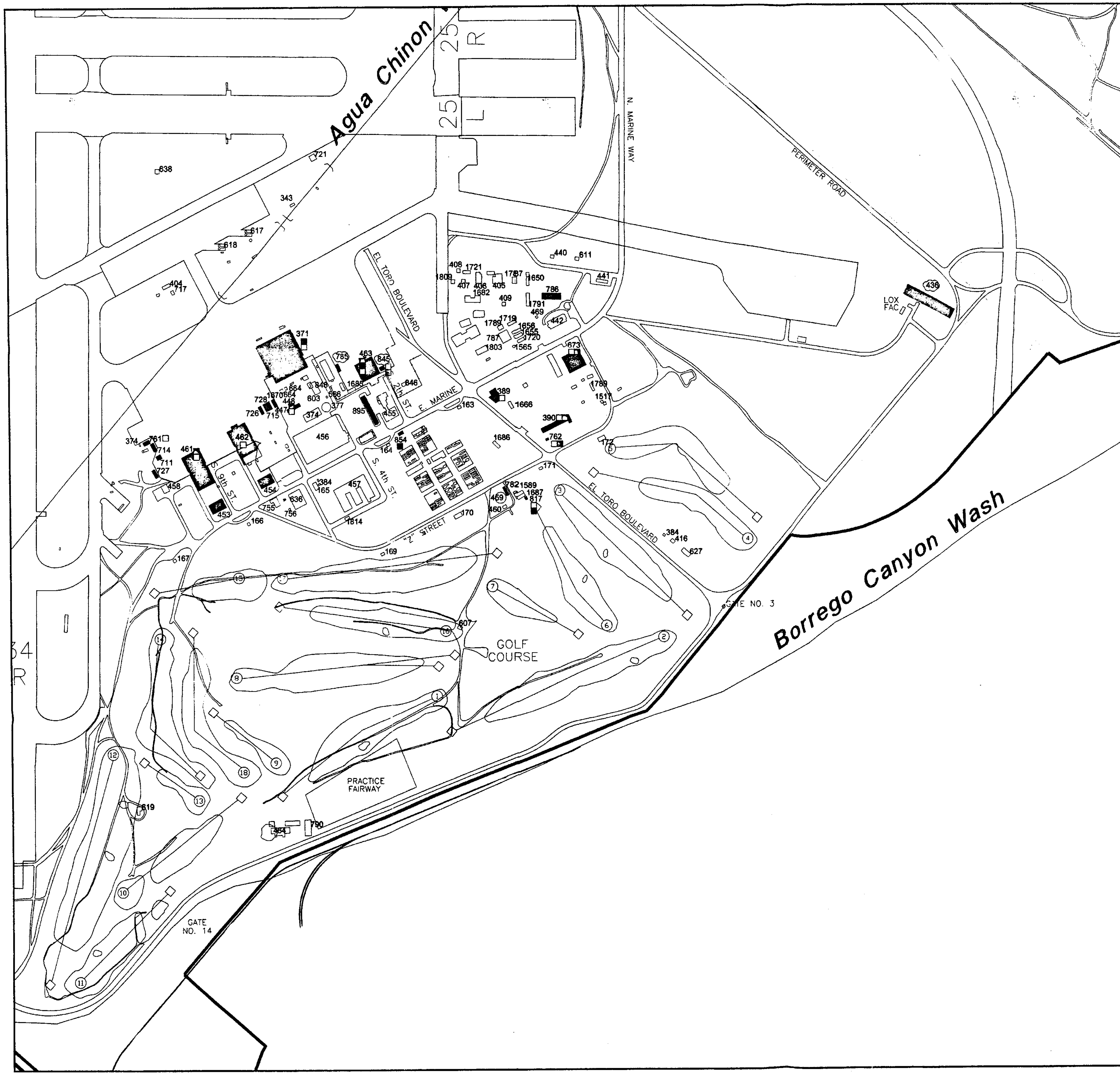

LEGEND

- BUILDING OR PAD
- IMPROVED/UNIMPROVED ROADS
- AIRFIELD
- WASH OR STREAM
- MCAS EL TORO BOUNDARY
- CULVERT
- DRAINAGE FLOR DIRECTION
- STORM DRAIN LINE
- CATCH BASIN
- JUNCTION
- DS#001 DISCHARGE SERIAL

SOURCE: ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986

- MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS
- MAINTENANCE
- AIRCRAFT WASH AREA
- VEHICLE WASH ROCK
- DWS/DEGREASERS
- PAINTING FACILITIES

N

0 300 600
Scale in Feet

PES Environmental, Inc.
Engineering & Environmental Services

Industrial Activities Area
MCAS, El Toro, California

Plate 1-c-SE
Revision 0

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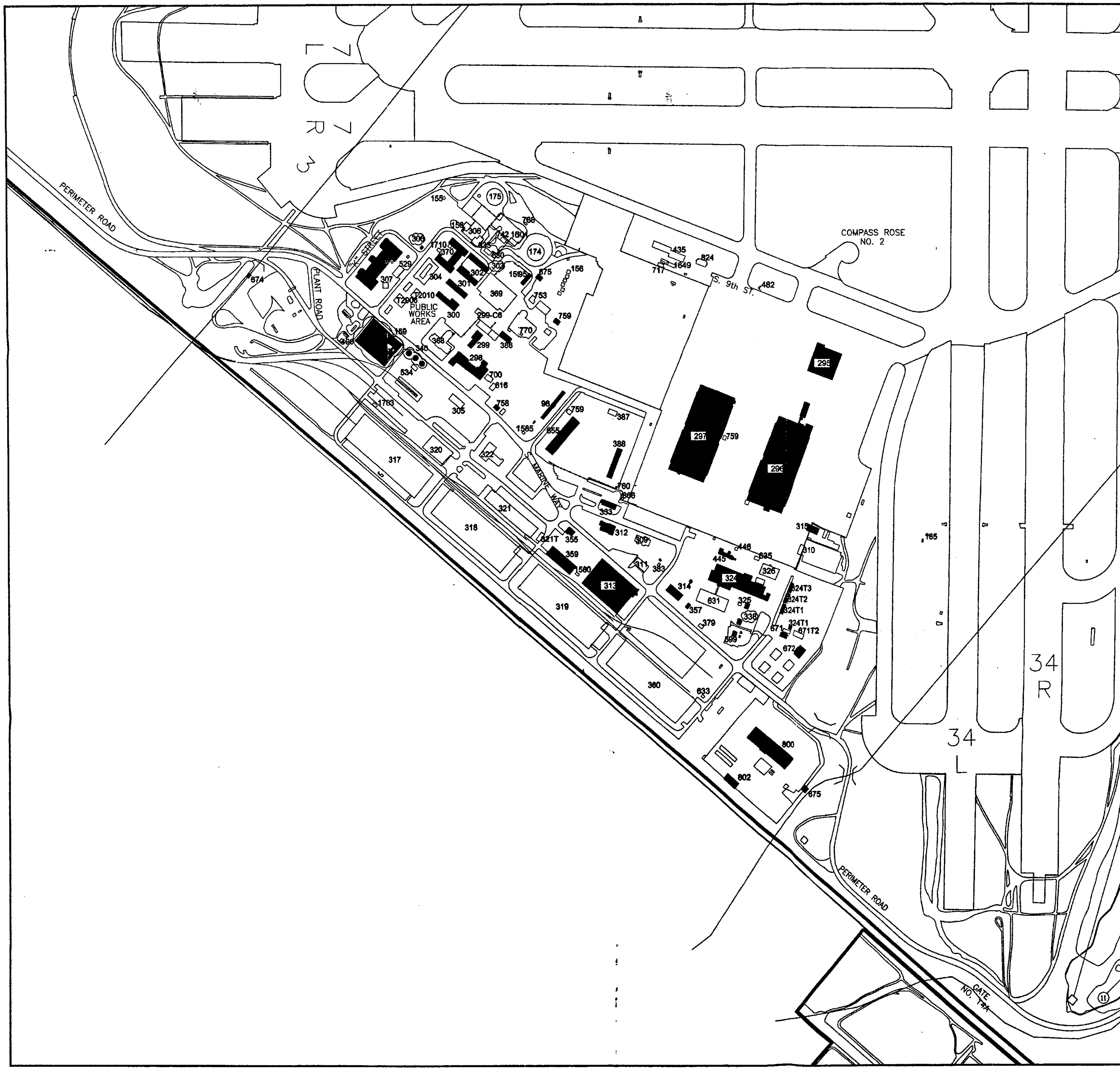

LEGEND

318	BUILDING OR PAD
	IMPROVED/UNIMPROVED ROADS
	AIRFIELD
	WASH OR STREAM
	MCAS EL TORO BOUNDARY
	CULVERT
	DRAINAGE FLOW DIRECTION
	STORM DRAIN LINE
	CATCH BASIN
	JUNCTION
DS#001	DISCHARGE SERIAL

SOURCE: ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986

	MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS
	MAINTENANCE
	DRY CLEANING

N

0 300 600
Scale in Feet

PES Environmental, Inc.
Engineering & Environmental Services

Industrial Activities Area
MCAS, El Toro, California

Plate
1-d-SW
Revision
0

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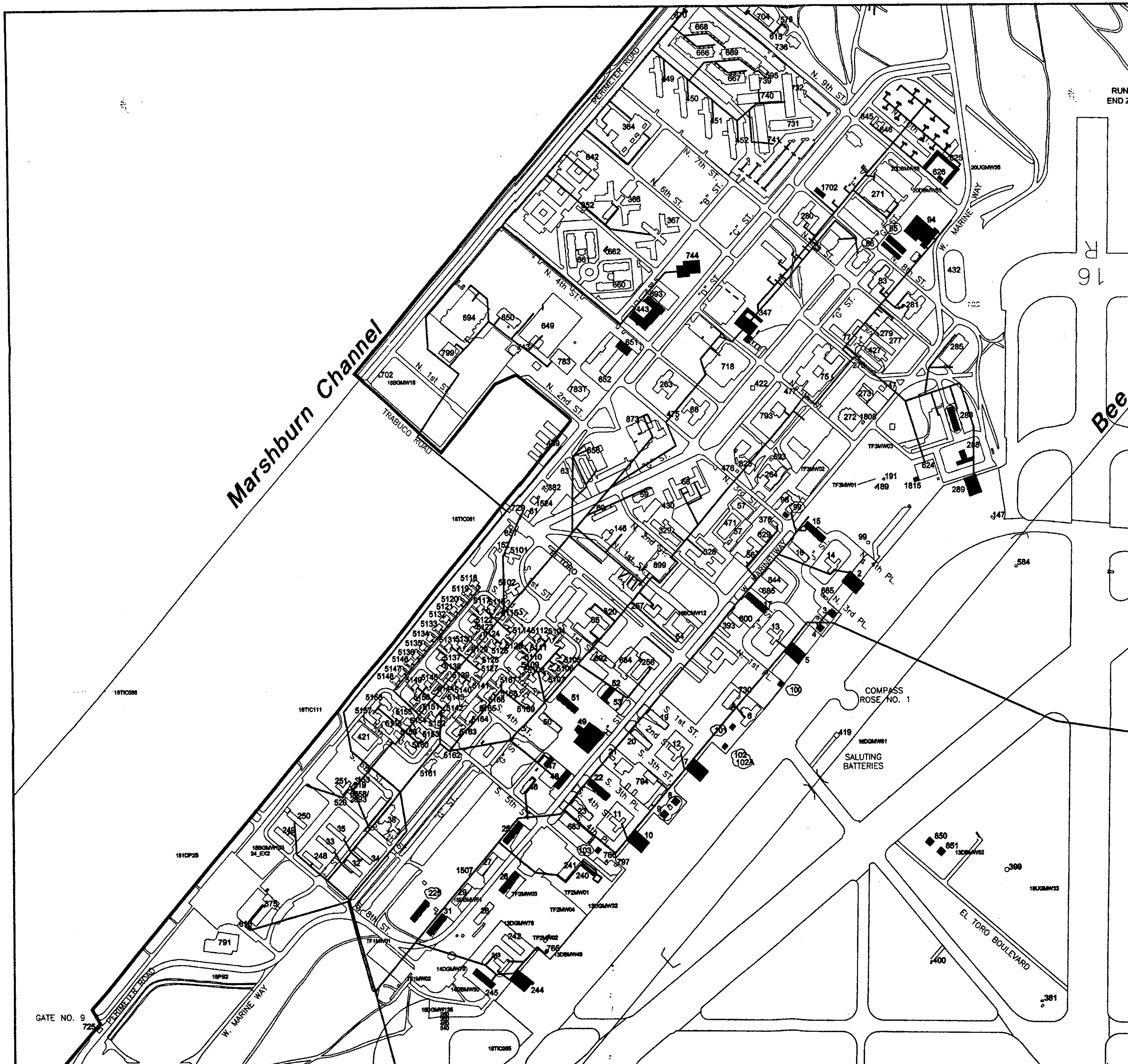

LEGEND

318	BUILDING OR PAD
	IMPROVED/UNIMPROVED ROADS
	AIRFIELD
	WASH OR STREAM
	MCAS EL TORO BOUNDARY
	SANITARY SEWER
	CULVERT
	DRAINAGE FLOR DIRECTION
	STORM DRAIN LINE
	CATCH BASIN
	JUNCTION
DS001	DISCHARGE SERIAL
SOURCE:	ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986
	MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS
	MAINTENANCE

0 300 600
Scale in Feet

PES Environmental, Inc.
Engineering & Environmental Services

Sanitary Sewer System
MCAS, El Toro, California

Plate 2-a-NW
Revision 0

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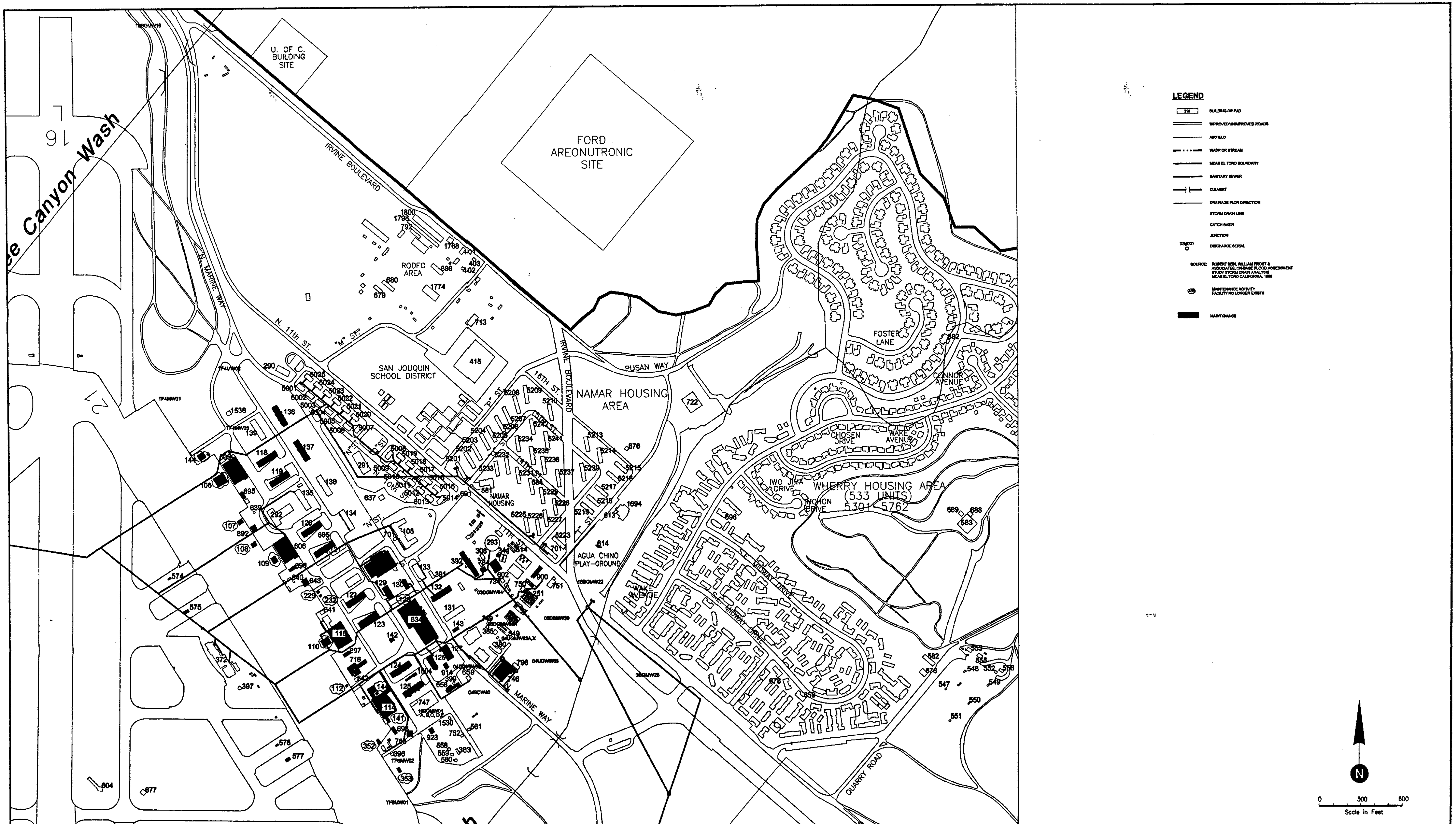

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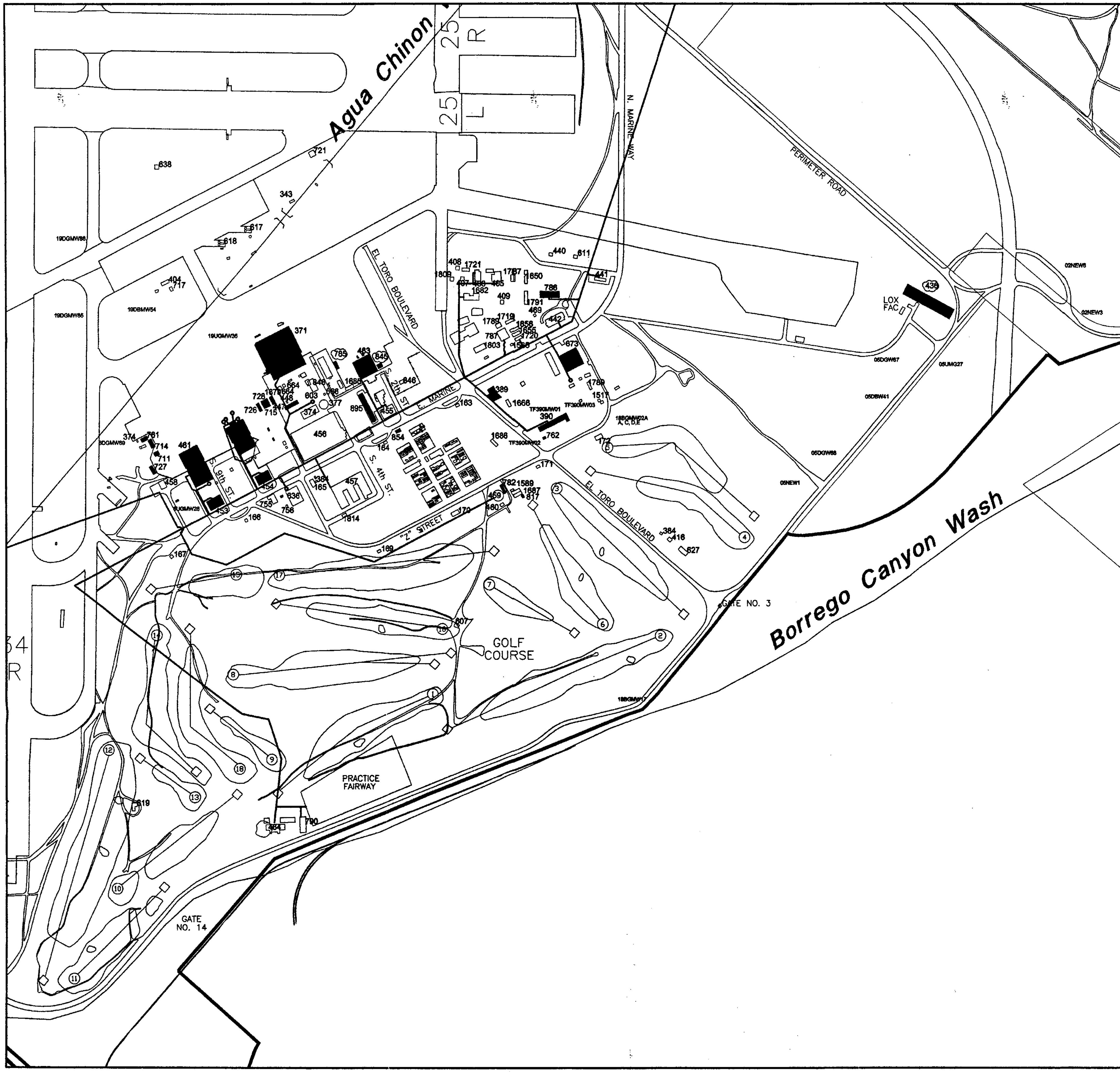
Sanitary Sewer System
MCAS, El Toro, California

Plate 2-b-NE
Revision 0

DWG NUMBER | JOB NUMBER | APPROVED | DATE



LEGEND

BUILDING OR PAD
IMPROVED/UNIMPROVED ROADS
AIRFIELD
WASH OR STREAM
MCAS EL TORO BOUNDARY
SANITARY SEWER
CULVERT
DRAINAGE FLOR DIRECTION
STORM DRAIN LINE
CATCH BASIN
JUNCTION
DS#001 DISCHARGE SERIAL

SOURCE: ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986

MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS

MAINTENANCE

N

0 300 600
Scale in Feet

PES Environmental, Inc.
Engineering & Environmental Services

Sanitary Sewer System
MCAS, El Toro, California

Plate 2-c-SE
Revision 0

DWG NUMBER	JOB NUMBER	APPROVED	DATE
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LEGEND

- BUILDING OR PAD
- IMPROVED/UNIMPROVED ROADS
- AIRFIELD
- WASH OR STREAM
- MCAS EL TORO BOUNDARY
- SANITARY SEWER
- CULVERT
- DRAINAGE FLOR DIRECTION
- STORM DRAIN LINE
- CATCH BASIN
- JUNCTION
- DS#001 DISCHARGE SERIAL

SOURCE: ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986

- MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS
- MAINTENANCE

0 300 600
Scale in Feet

PES Environmental, Inc.
Engineering & Environmental Services

Sanitary Sewer System
MCAS, El Toro, California

Plate 2-d-SW
Revision 0

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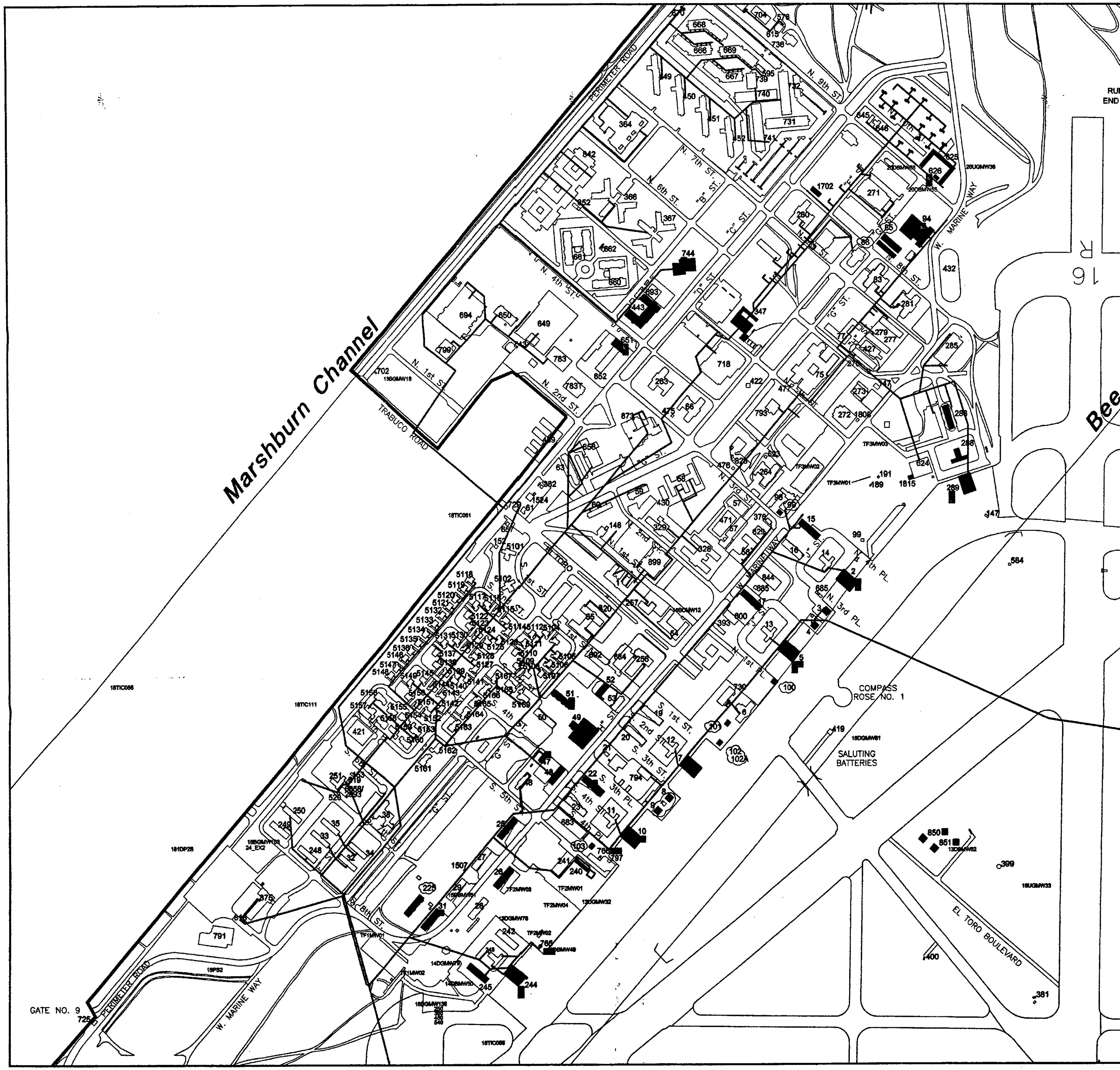

LEGEND

316	BUILDING OR PAD
	IMPROVED/UNIMPROVED ROADS
	AIRFIELD
	WASH OR STREAM
	MCAS EL TORO BOUNDARY
	SANITARY SEWER
	CULVERT
	DRAINAGE FLOW DIRECTION
	STORM DRAIN LINE
	CATCH BASIN
	JUNCTION
DS#001	DISCHARGE SERIAL

SOURCE: ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986

MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS

	MAINTENANCE
	AIRCRAFT WASH AREA
	VEHICLE WASH ROCK
	DWG/DEGREASERS
	PAINTING FACILITIES

N

0 300 600
Scale in Feet

PES Environmental, Inc.
Engineering & Environmental Services

Industrial Discharge to the Sanitary Sewer System
MCAS, El Toro, California

Plate 3-a-NW
Revision 0

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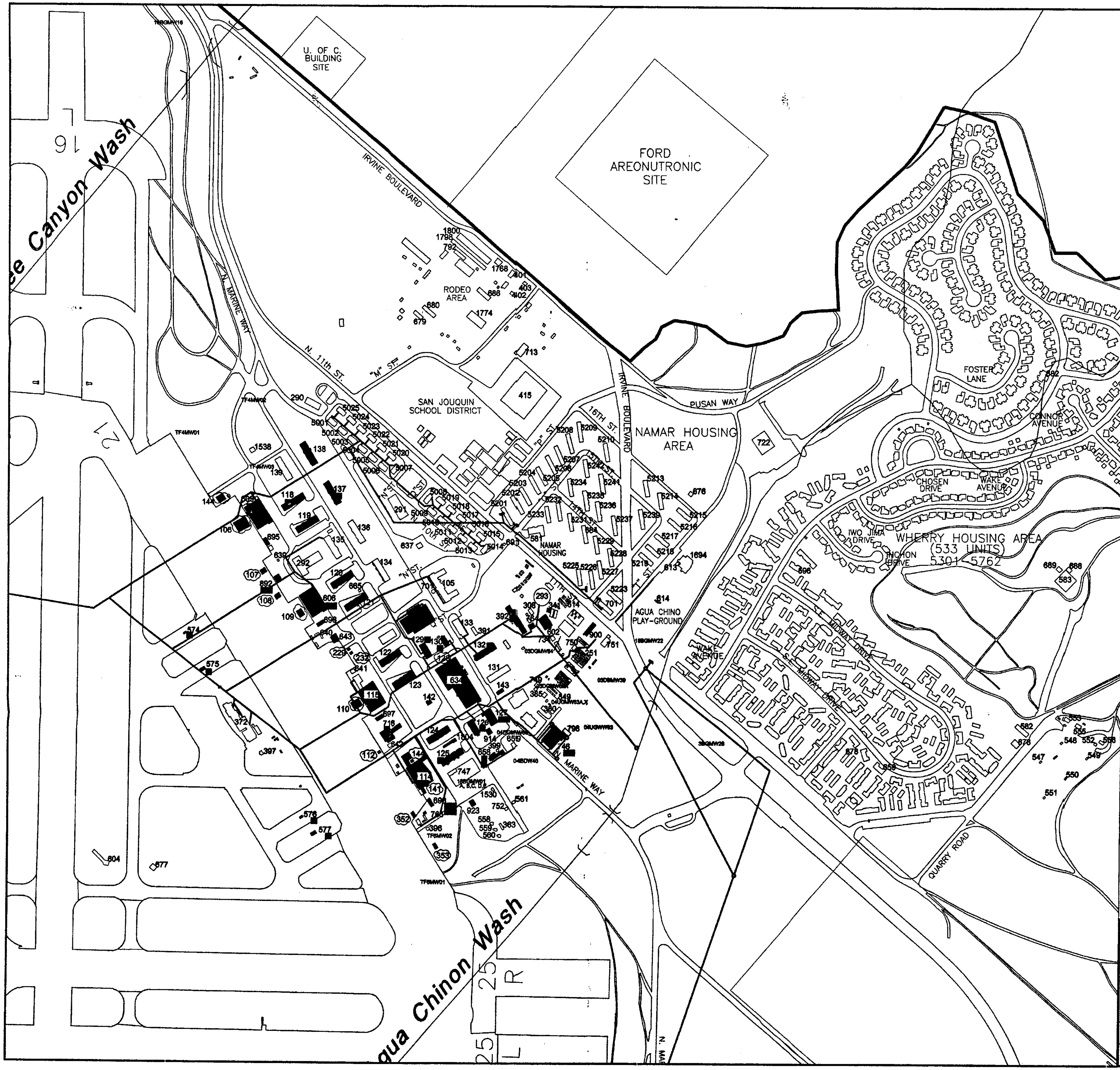


LEGEND

- 318 — BUILDING OR PAD
- IMPROVED/UNIMPROVED ROADS
- AIRFIELD
- WASH OR STREAM
- MCAS EL TORO BOUNDARY
- SANITARY SEWER
- CULVERT
- DRAINAGE FLOR DIRECTION
- STORM DRAIN LINE
- CATCH BASIN
- JUNCTION
- DS#001 — DISCHARGE SERIAL

SOURCE: ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986

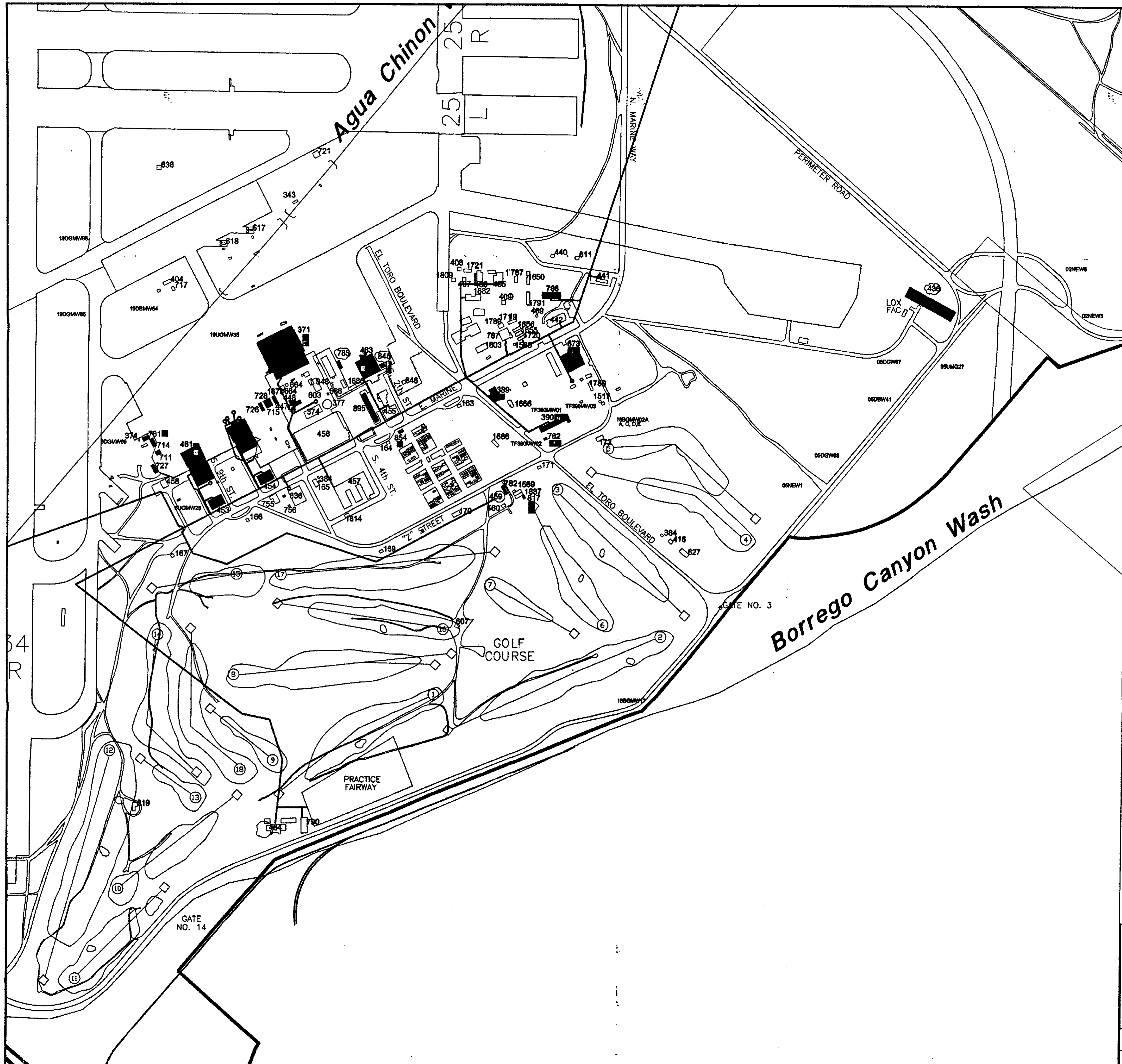
- MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS
- MAINTENANCE
- AIRCRAFT WASH AREA
- VEHICLE WASH ROCK
- OWS/DEGREASERS
- PAINTING FACILITIES

PES Environmental, Inc.
Engineering & Environmental Services

Industrial Discharge to the Sanitary Sewer System
MCAS, El Toro, California

Plate 3-b-NE
Revision 0

DWG NUMBER | JOB NUMBER | APPROVED | DATE



LEGEND

318	BUILDING OR PAD
	IMPROVED/UNIMPROVED ROADS
	AIRFIELD
	WASH OR STREAM
	MCAS EL TORO BOUNDARY
	SANITARY SEWER
	CULVERT
	DRAINAGE FLOR DIRECTION
	STORM DRAIN LINE
	CATCH BASIN
	JUNCTION
DS#001	DISCHARGE SERIAL
SOURCE:	ROBERT BEIN, WILLIAM FROST & ASSOCIATES, ON-BASE FLOOD ASSESSMENT STUDY STORM DRAIN ANALYSIS MCAS EL TORO CALIFORNIA, 1986
	MAINTENANCE ACTIVITY FACILITY NO LONGER EXISTS
	MAINTENANCE
	AIRCRAFT WASH AREA
	VEHICLE WASH ROCK
	OWS/DEGREASERS
	PAINTING FACILITIES

N

0 300 600
Scale in Feet

PES Environmental, Inc.
Engineering & Environmental Services

Industrial Discharge to the Sanitary Sewer System
MCAS, El Toro, California

Plate 3-c-SE
Revision 0

DWG NUMBER	JOB NUMBER	APPROVED	DATE
000_plates	000-001-01-002		0/00

PES Environmental, Inc.
Engineering & Environmental Services

Plate 3-d-SW

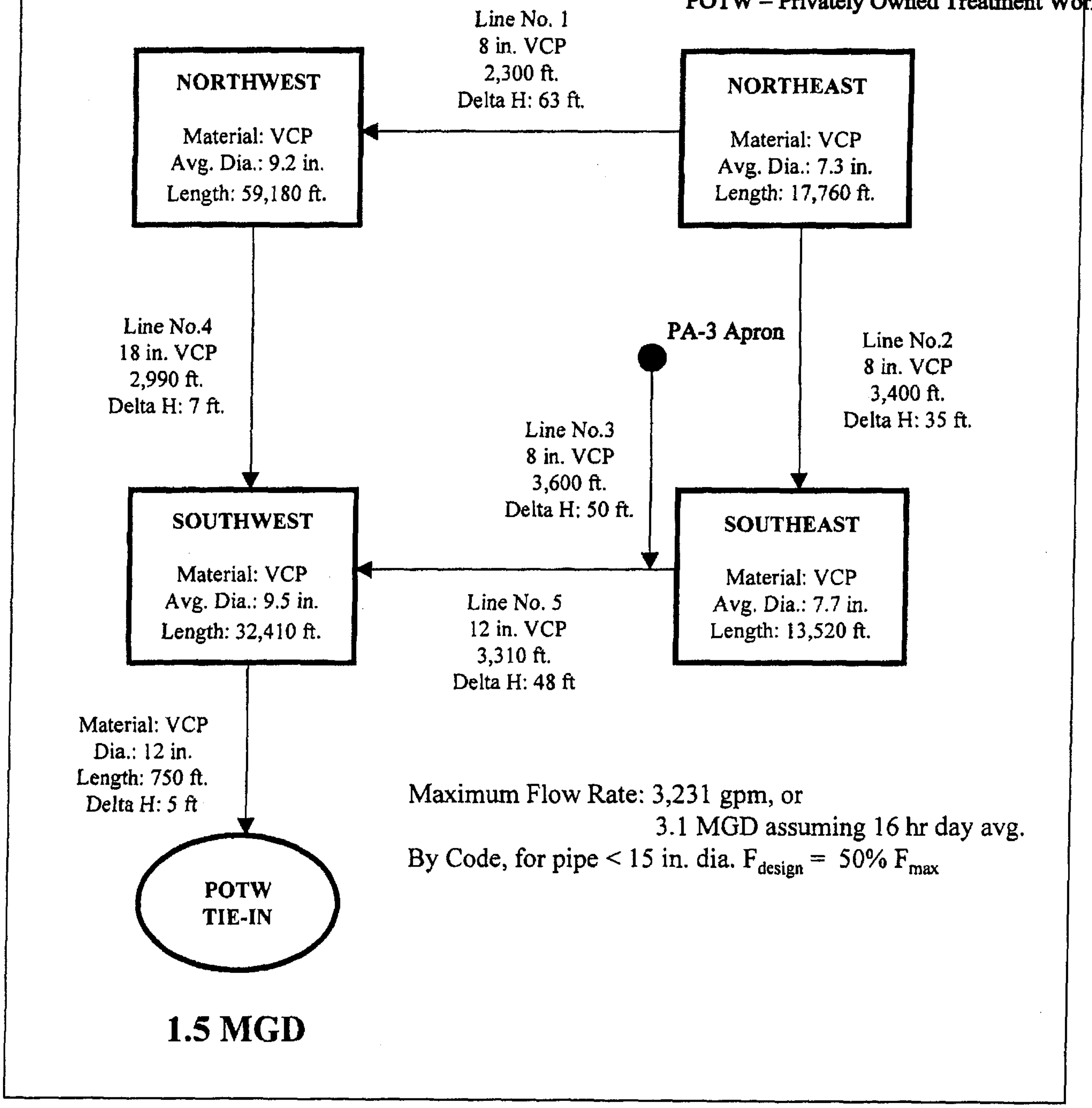
Revision 0

Industrial Discharge to the Sanitary Sewer System
MCAS, El Toro, California

DWG NUMBER	JOB NUMBER	APPROVED	DATE
[illegible]	[illegible]	[signature]	[illegible]

Explanation

VCP = Vitrified Clay Pipe
Delta H = Change in Elevation
F_{design} = Design Flow Rate
F_{max} = Maximum Flow Rate
gpm = gallons per minute
MGD = Million Gallons per Day
Dia = Diameter
ft. = Feet
in. = Inch
POTW = Privately Owned Treatment Works

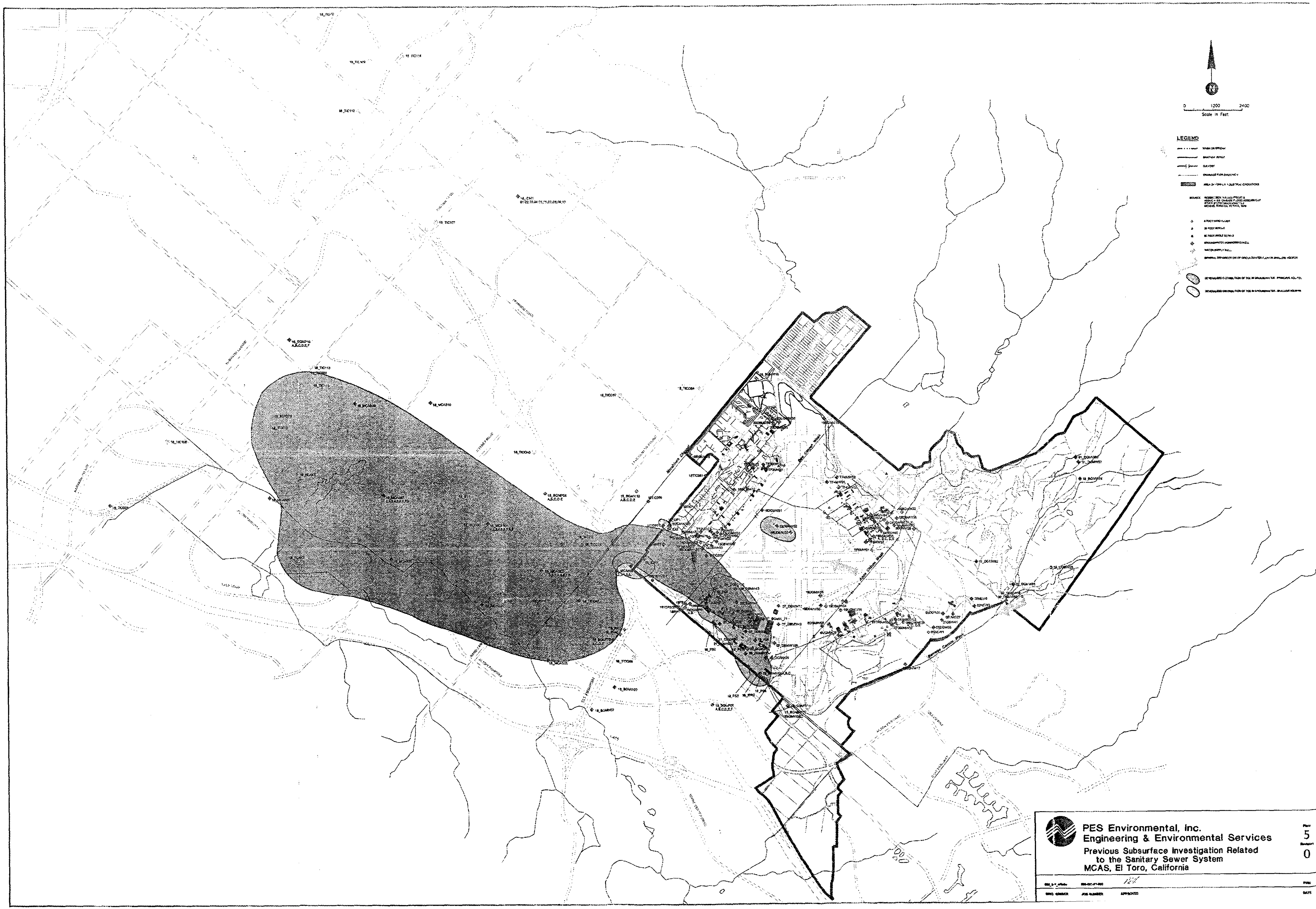


PES Environmental, Inc.
Engineering & Environmental Services

Simplified Flow Diagram
MCAS El Toro Sanitary Sewer System
MCAS, El Toro, California

PLATE
4

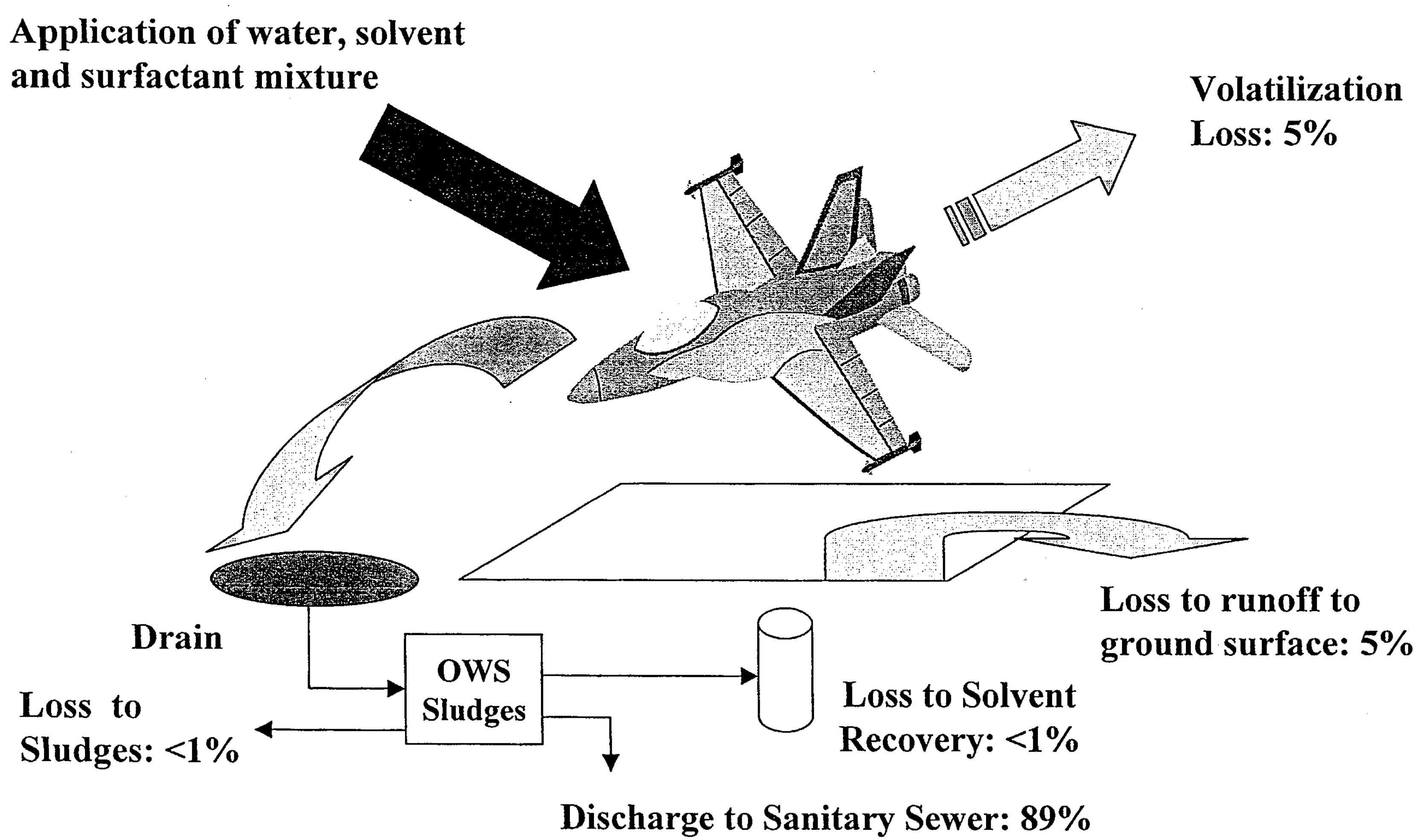
680-001-01-002	680_plates	BR	11/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



PES Environmental, Inc.
Engineering & Environmental Services

Previous Subsurface Investigation Related to the Sanitary Sewer System
MCAS, El Toro, California

Plate 5
Revision 0

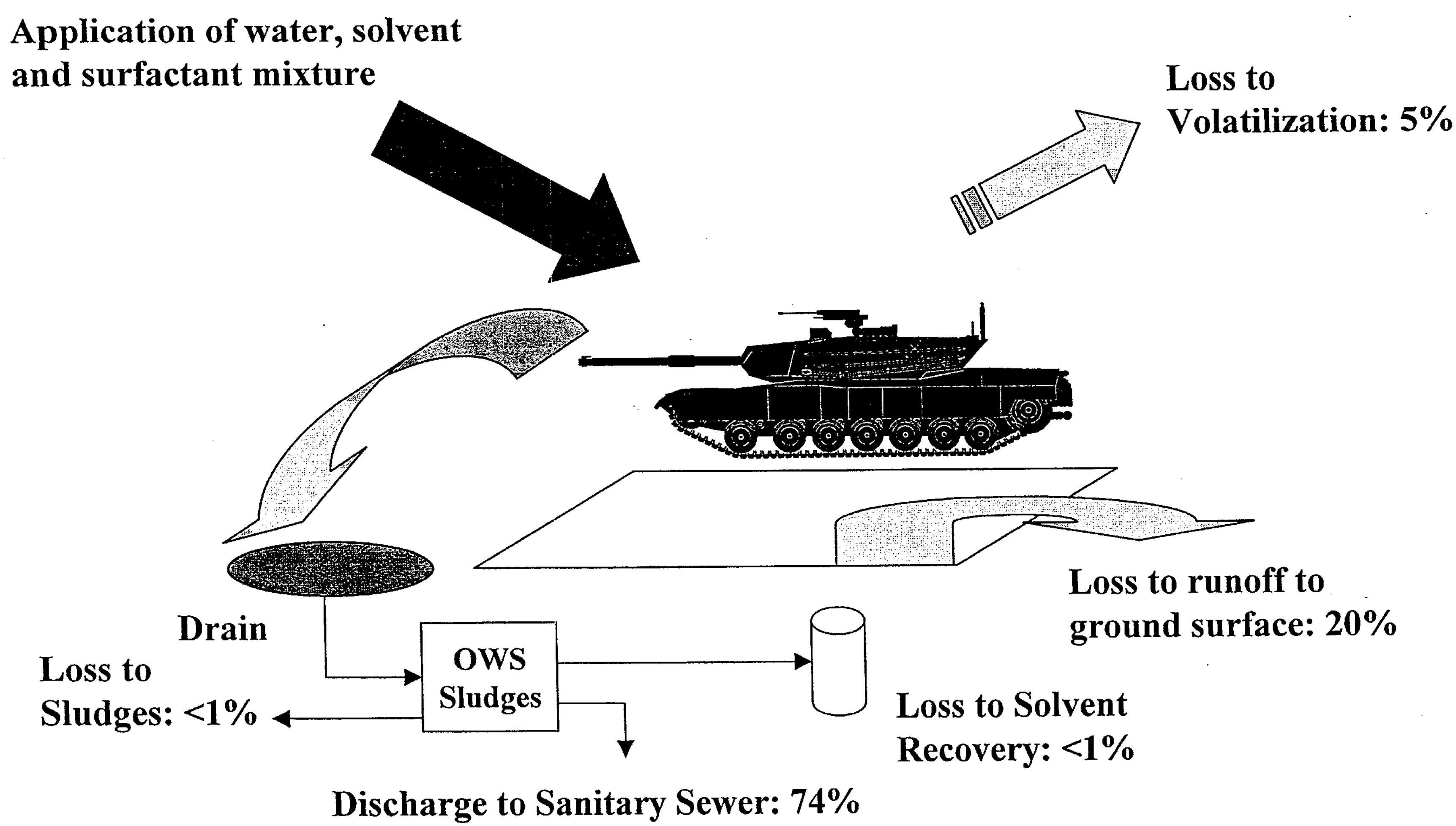


PES Environmental, Inc.
Engineering & Environmental Services

Aircraft Wash Process and Estimated Solvent Loss
MCAS, El Toro, California

PLATE 6

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
680-001-01-002	680_plates		11/99

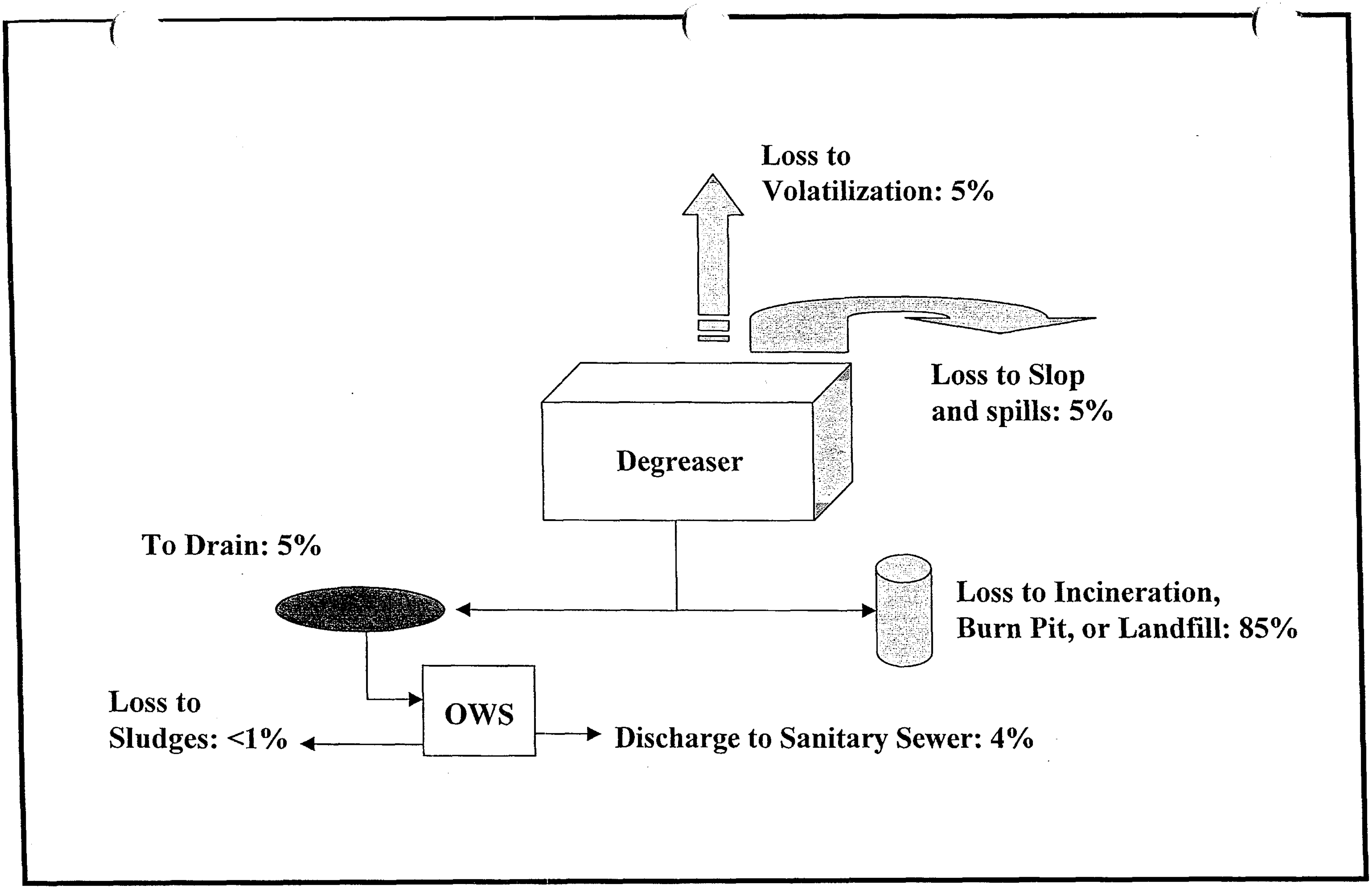


PES Environmental, Inc.
Engineering & Environmental Services

Vehicle Wash Process and Estimated Solvent Loss
MCAS, El Toro, California

PLATE 7

680-001-01-002	680_plates		11/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

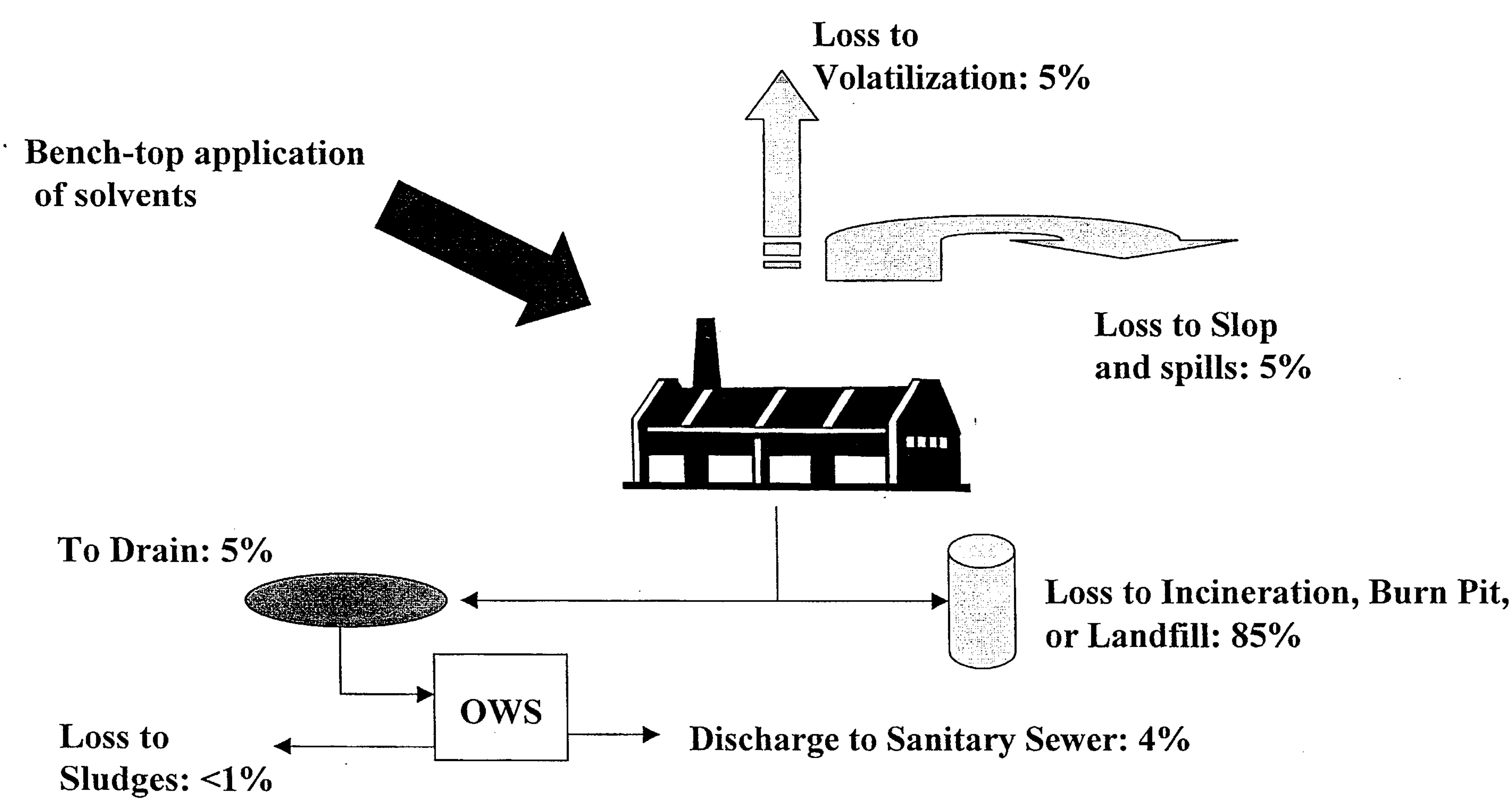


PES Environmental, Inc.
Engineering & Environmental Services

Degreasers and OWS and Estimated Solvent Loss
MCAS, El Toro, California

PLATE 8

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
680-001-01-002	680_plates		11/99

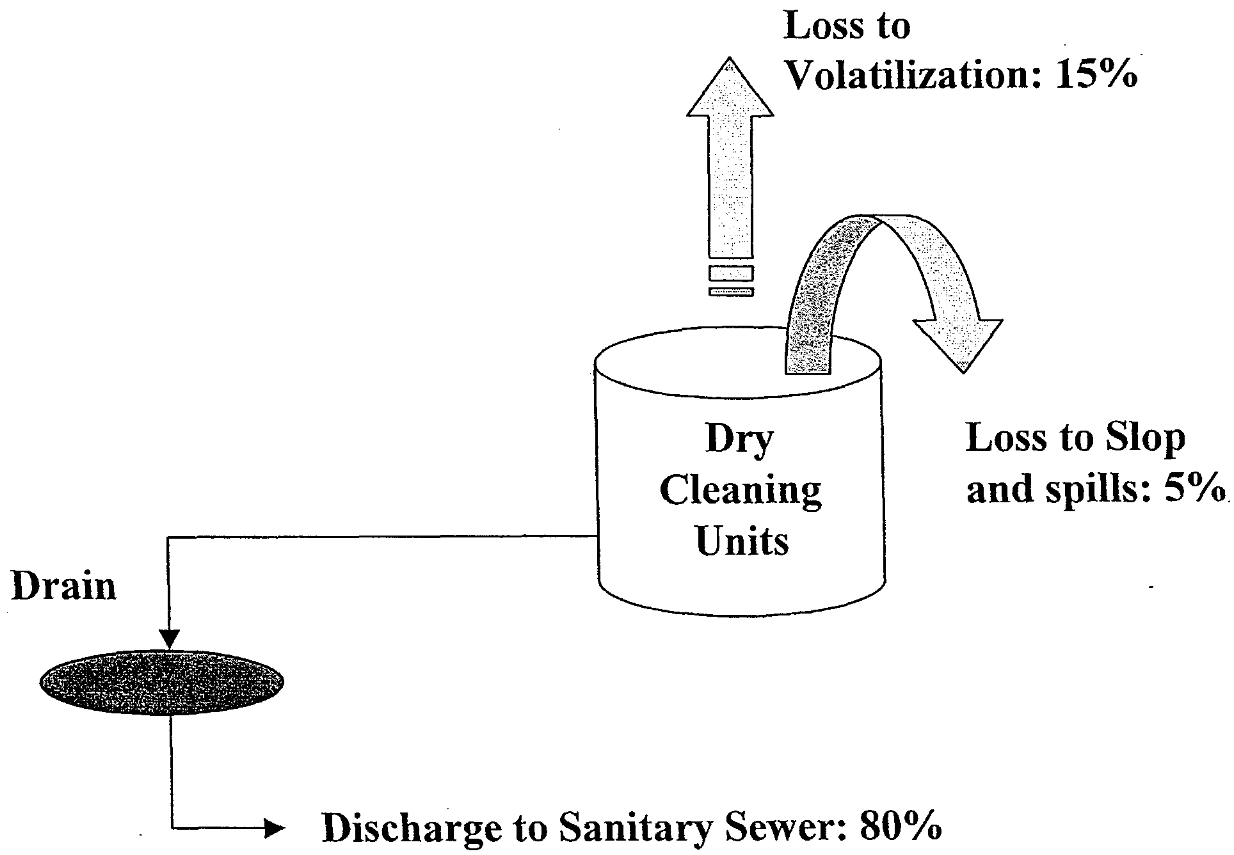


PES Environmental, Inc.
Engineering & Environmental Services

Maintenance Facilities and Estimated Solvent Loss
MCAS, El Toro, California

PLATE
9

680-001-01-002	680_plates		11/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

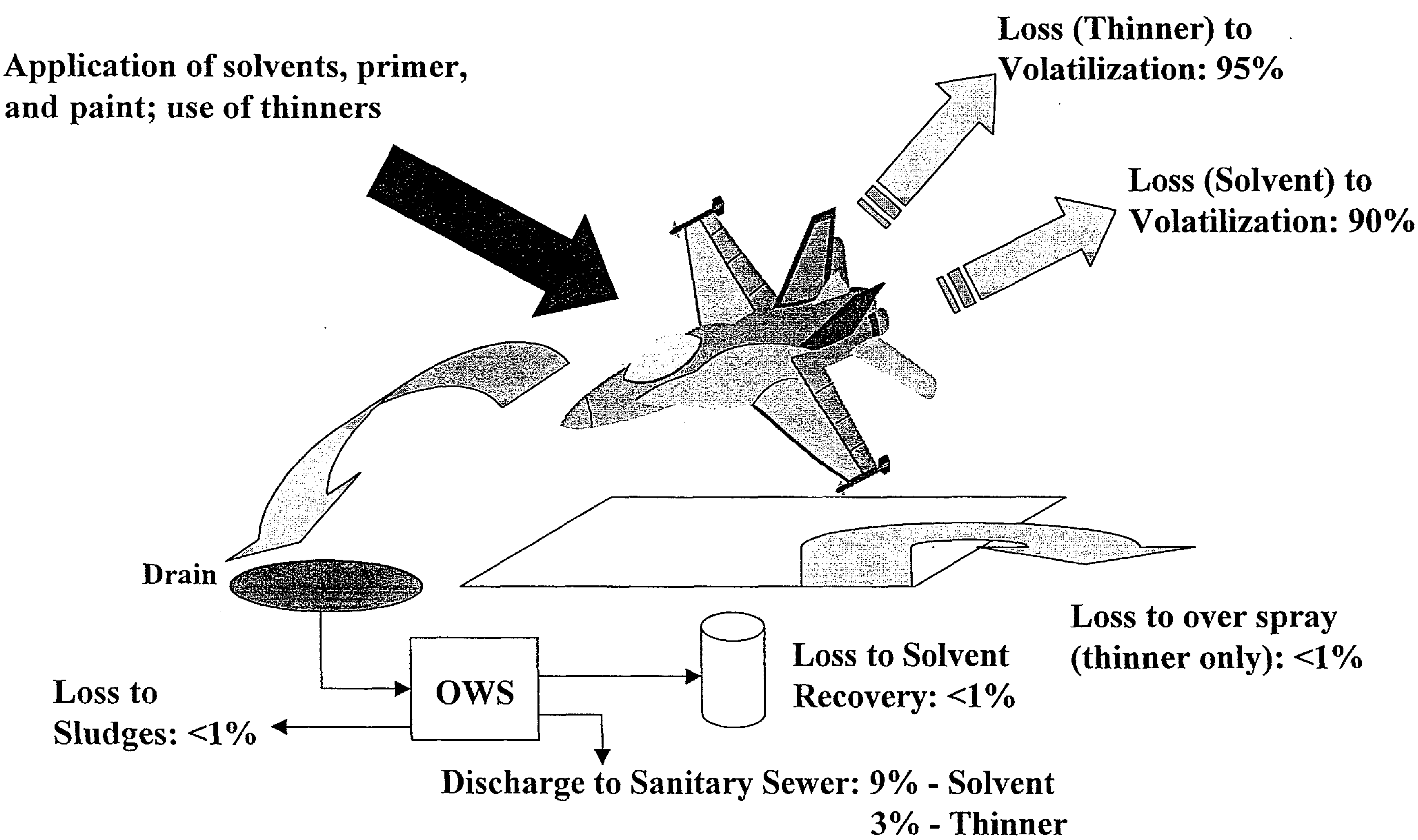


PES Environmental, Inc.
Engineering & Environmental Services

Dry Cleaning Plant and Estimated Solvent Loss
MCAS, El Toro, California

PLATE
10

680-001-01-002	680_plates		11/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

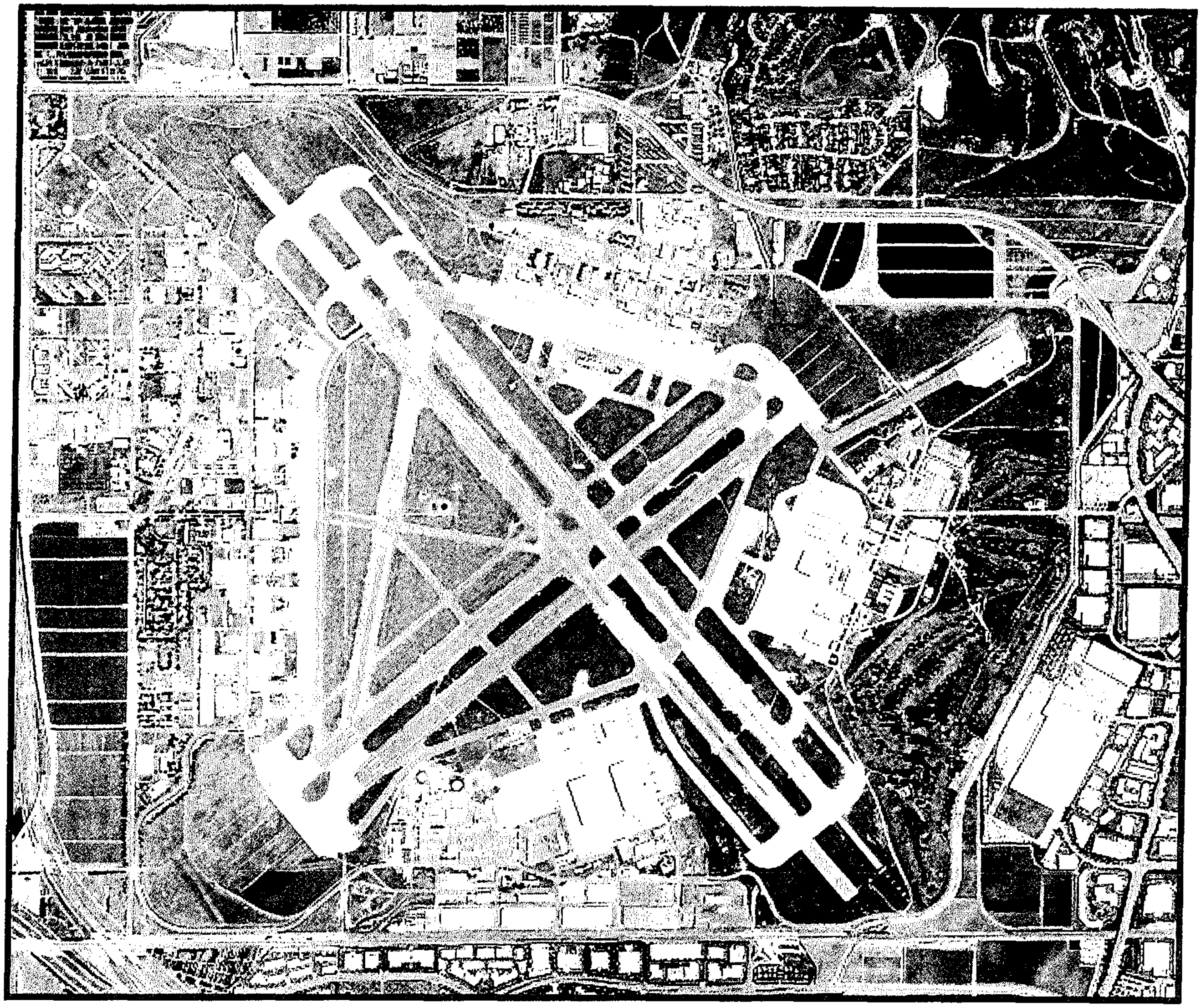


PES Environmental, Inc.
Engineering & Environmental Services

Aircraft Painting Process and Estimated Solvent/Thinner Loss
MCAS, El Toro, California

PLATE 11

680-001-01-002	680_plates		11/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



THE NAVY'S UNDERESTIMATION OF SOLVENT CONTAMINATION AT THE MCAS EL TORO, CALIFORNIA

Volume II (Appendices A through AC)

January 2000

THE NAVY'S UNDERESTIMATION OF SOLVENT CONTAMINATION AT THE MCAS EL TORO, CALIFORNIA

Volume II (Appendices A through AC)

January 2000

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Prepared for

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On behalf of

The City of Irvine

APPENDIX A

BRAC
ADMINISTRATIVE RECORD FILE
REVIEW LISTING

BRAC
ADMINISTRATIVE RECORD FILE
REVIEW LISTING

Document Title	Document Author	Document Date
Preliminary Initial Assessment Study of MCAS El Toro	DON	09-05-85
Initial Assessment Study of MCAS El Toro	DON	09-11-85 05-01-86
Federal facility Agreement Under CERCLA	EPA/DON	10-01-90
MCAS El Toro Installation Restoration Program, Site History	DON	11-01-90
Final Community Relation Plan	JE	04-26-91
EOD, CERCLA Investigation	DON	04-09-92
Final Resource Conservation and Recovery Act Facility Assessment Report, Vols. I thru V w/Final Addendum (05-01-95)	JE	07-16-93
Final Report, Aerial Photograph Assessment, MCAS El Toro	SAIC	08-02-93
Final Base Realignment and Closure Cleanup Plan	DON	03-21-94 03-03-95 03-01-96 01-30-97 03-01-98
Interview w/ Active & Retired MCAS El Toro Personnel	JE	06-28-94
Final Hazardous Material/Hazardous Waste Management Plan	SAIC	08-01-94
Final Community Response Facilitation Act Report	JE	04-01-95
Final Environmental Baseline Survey Report w/ replacement pages	JE	04-01-95
RI/FS Final Groundwater Monitoring Plan	JE	04-28-95
Final Work Plan Phase II RI/FS	BNI	07-01-95
Final Field Sampling Plan Phase II RI/FS	BNI	08-16-95
Final Risk Assessment Work Plan	BNI	08-01-95
Draft Final Engineering Analysis/Cost Estimate, Site 4, Unit 1 – Site 7, Site 11, Site 13, Unit 1 – Site 14, Unit 2 – Site 19, and Units 2 & 3 – Site 20	BNI	09-01-95
Draft Final Phase II RI Report, OU2A-Site 24, Vols. I thru IV	BNI	06-12-96
Draft Final OU1 Interim RI/FS Report, Vols. I thru IX	JE/CH2MH	08-09-96
Draft Final Phase II RI Report OU2B-Site17, Vols. I & II	BNI	09-06-96
Draft Final Phase II RI Report OU2B-Site 2, Vols. I & II	BNI	09-06-96
Draft Final Phase II RI Report OU2C-Site 3, Vols. I & II	BNI	09-23-96
Draft Final Phase II RI Report OU2C-Site 5, Vols. I & II	BNI	09-25-96
Technical Memorandum Background and reference Levels, Remedial Investigations	BNI	10-09-96
Final MCAS El Toro Community Reuse Plan	PDC	12-01-96
Final Proposed Plan, Operable Units 2B & 2C Sites 2, 3, 5, & 17 Closure of Inactive Landfills	BNI	01-27-97
Draft Final Phase II Feasibility Study Report Operable Unit 2C-Site 3	BNI	02-12-97
Draft Final Phase II Feasibility Study Report Operable Unit 2C-Site 5	BNI	02-12-97
Draft Final Phase II Feasibility Study Report Operable Unit 2C-Site 17	BNI	02-12-97
Draft Final Phase II Feasibility Study Report Operable Unit 2C-Site 2	BNI	03-06-97
Draft Final Phase II Vadose Zone Feasibility Study Report Operable Unit 2A-Site 24	BNI	03-11-97

BRAC
ADMINISTRATIVE RECORD FILE
REVIEW LISTING
(continued)

Document Title	Document Author	Document Date
Draft Final Phase II Remedial Investigation Report Operable Unit 2A-Site 24, Vols. I thru III	BNI	03-11-97
Draft Final Phase II Remedial Investigation/Feasibility Study Addendum Site 25 Major Drainages	BNI	04-28-97
Final Proposed Plan, Operable Units 2B & 2C Sites 2, 3, 5, & 17, Closure of Inactive Landfills	BNI	05-11-98
Draft Final Phase II Remedial Investigation Report Operable Unit 2B-Site 2, Vols. I thru VI	BNI	05-15-97
Draft Final Phase II Remedial Investigation Report Operable Unit 2C-Site 3, Vols. I thru V	BNI	05-15-97
Draft Final Phase II Remedial Investigation Report Operable Unit 2C-Site 5, Vols. I thru V	BNI	05-15-97
Draft Final Phase II Remedial Investigation Report Operable Unit 2B-Site 17, Vols. I thru V	BNI	05-17-97
Draft Final Phase II Remedial Investigation Report Operable Unit 3A Sites, Vols. I thru IX	BNI	06-01-97
Draft Final Phase II Groundwater Feasibility Study Report OU2A-Site 24	BNI	12-05-97
Draft Final Phase II Feasibility Study Report Operable Unit 2C-Site 2	BNI	08-14-97
Draft Final Phase II Feasibility Study Report Operable Unit 2C-Site 3	BNI	08-14-97
Draft Final Phase II Feasibility Study Report Operable Unit 2C-Site 5	BNI	08-19-97
Draft Final Phase II Feasibility Study Report OU2C-Site 17	BNI	08-19-97
Draft Final Interim Record of Decision Operable Unit 2A-Site 24, VOC Sources Area	BNI	09-01-97 09-18-97
Draft Final Record of Decision Operable Units 2A & 3A, No Action Sites	BNI	09-26-97
Capture Zone Modeling and Geologic Cross Sections to Assist in Locating Extraction Well 24EX4	BNI	10-03-97
Step Down Aquifer Test at Extraction Well 24EX4, Step Buildup Test at Injection Well 24IN1	BNI	10-08-97
Landfill Remediation and Habitat Restoration at MCAS	DON	10-07-97
Draft Final Phase II Feasibility Study Report Operable Unit 3A Sites	BNI	01-12-98
Draft Final Soil Vapor Extraction System Design Work Plan, Site 24	BNI	05-07-98
Final Field Sampling Plan for Groundwater Monitoring of Perchlorate	BNI	09-18-98
Technical Memorandum, Summary of Perchlorate Test Results, Site 24	BNI	12-17-98
Draft Proposed Plan for Groundwater Remediation at Operable Unit 1-Site 18 and Operable Unit 2A-Site 24	BNI	11-23-98
Draft Final Engineering Design Report, Vadose Zone Remediation, Site 24, Vols. I thru IV.	BNI	12-14-98

Notes:

Notes:	**BNI:**	Bechtel National, Inc.
	CH2MH:	CH2MHill
	DON:	Department of the Navy
	EPA:	U.S. Environmental Protection Agency
	JE:	Jacobs Engineering
	PDC:	P & D Consulting
	SAIC:	Science Applications International Corporation

APPENDIX B

US EPA FILE REVIEW LISTING

US EPA FILE REVIEW LISTING

Document Title	Document Author	Document Date
Letter, Federal Facility Agreement Issues	DON	02-14-92
Letter, EOD Range Investigation	DON	04-09-92
Letter, Use of California Cancer Potency Factors	DON	09-24-93
Letter of Concern, Management of MCAS El Toro CERCLA Cleanup	EPA	07-11-94
Letter, Draft Operable Unit 1 Baseline Human Health Risk Assessment	EPA	09-28-94
Meeting Minutes, Site 13 EE/CA	BNI	01-16-95
Letter, Uncontaminated Property Identification	EPA	03-24-95
Meeting Minutes, Phase II RI/FS Work/Sampling Plans	BNI	04-24-95
Meeting Minutes, Reclassification of OU-3 Site to NFA	BNI	05-02-95
BCT Meeting Minutes	BNI	05-31-95
BCT Meeting Minutes	BNI	06-06-95
BCT Meeting Minutes	BNI	08-11-95
RAB Meeting Minutes	DON	09-28-95
Letter, Final Risk Assessment Work Plan	EPA	10-05-95
Letter, Remediation of Site 18	EPA	01-22-96
BCT Meeting Minutes	BNI	04-24-96
Letter, Comments on Technical Memorandum, Background and Reference Levels Remedial Investigation, MCAS El Toro	EPA	07-24-96
BCT Meeting Minutes	BNI	02-06-97
BCT Meeting Minutes	BNI	07-01-97
Letter, Request for Changes, Federal Facilities Agreement	DON	09-03-97
Letter, Technical Memorandum, Catch Basin West of IRP Site 21	DON	09-24-97
Letter, Proposed "Drinkable Leachate" Cleanup Standard and SVE "Shut-off" Criteria	DON	10-03-97
Letter, Draft Proposal Plan for Closure of Inactive Landfills	EPA	11-03-97
RAB Meeting Minutes	DON	12-03-97
RAB Meeting Minutes	DON	09-30-98
Roundtable Meeting Minutes, SVE Shut-off Criteria	BNI	10-13-98

Notes:

BNI: Bechtel National, Inc.
DON: Department of the Navy
EPA: U.S. Environmental Protection Agency

APPENDIX C

STATE OF CALIFORNIA
REGULATORY AGENCY
FILE REVIEW LISTING

STATE OF CALIFORNIA
REGULATORY AGENCY FILE REVIEW LISTING

Document Title	Document Author	Document Date
Regional Water Quality Control Board, Santa Ana		
Station Order 11345.1D	USMC	03-19-69
Resolution 67-25	SARWQCB	10-26-72
Letter, OWS Operations	USMC	07-16-82
Inspection Report	SARWQCB	05-21-85
Inspection Report	SARWQCB	06-04-86
Spill Report	USMC	02-18-88
Internal Office Note, Waste Discharge, MCAS El Toro	SARWQCB	04-20-88
Internal Memorandum, Aircraft Washing Operations	USMC	11-27-90
Internal memorandum, Aircraft and Vehicle Washing Operations	USMC	12-07-90
Order No. 92-51, Industrial and Process Water Discharge	SARWQCB	12-09-92
Letter, Notice of Violations, Waste Discharge Requirements	SARWQCB	12-23-92
Response to Proposed Order No. 93-16	USMC	02-11-93
Letter, Soil Cleanup Levels, MCAS El Toro	SARWQCB	06-11-93
Internal Office Memorandum, Waste Discharge Requirements, MCAS El Toro	SARWQCB	08-09-85
Public Notice, Proposed Amendment of the Basin Plan for the Santa Ana Region	SARWQCB	09-04-96
Groundwater Monitoring Report, Nov – Dec, 1996	CDM	02-27-97
Groundwater Monitoring Report, Mar, 1997	CDM	06-30-97
Groundwater Monitoring Report, Jul, 1997	CDM	10-01-97
Groundwater Monitoring Report, Oct, 1997	CDM	03-02-98
Letter, Draft Proposed Plan for Groundwater Remediation of Operable Unit 1 Site 18 and Operable Unit 2A Site 24	DON	11-25-98
Cal EPA, Department of Toxic Substances Control		
Hazardous Waste Permit Application, MCAS El Toro	USMC	11-19-80
Notice of Violations	DTSC	05-15-86
Report, Perimeter Investigation Plan of Action, Verification Step Confirmation Study, MCAS El Toro and Tustin, California	DON	04-87
Technical Enforcement Support, Hazardous Waste Sites, MCAS El Toro	SAIC	05-87
Hazardous Waste Management Course, MCAS El Toro	DON	05-88
Warning Letter, Hazardous Waste Investigation	EPA	08-17-89
Part A Permit Application, MCAS El Toro	USMC	10-05-90
Final Hazardous Waste Assessment Report, MCAS El Toro	DON	03-29-91
Hazardous Waste Investigation, MCAS El Toro	EPA	04-05-91
Report, Groundwater Sampling for TCE Analysis, MCAS El Toro	DON	04-12-91
Final Waste Minimization Plan, MCAS El Toro	DON	07-15-91
Technical Enforcement Support, Hazardous Waste Sites, MCAS El Toro	SAIC	08-02-91
Hazardous Waste Manifest Log, MCAS El Toro	USMC	1992
Technical Enforcement Support, Hazardous Waste Sites, MCAS El Toro	SAIC	07-92
Letter, Use of California Cancer Potency factors	DTSC	06-28-93
Hazardous Waste Manifest Log, MCAS El Toro	DTSC	1994
Hazardous Waste Management Plan, MCAS El Toro	DON	08-94

STATE OF CALIFORNIA
REGULATORY AGENCY FILE REVIEW LISTING
(continued)

Document Title	Document Author	Document Date
Letter, Draft Operable Unit 1, Baseline Human health Risk Assessment	DON	09-24-94
Letter, Principal Aquifer Cleanup Objectives	DTSC	02-28-96
Memorandum, Applicable or Relevant and Appropriate Requirements for MCAS El Toro	DTSC	08-14-96
Memorandum, Applicable or Relevant and Appropriate Requirements for Operable Units 2B and 2C	DTSC	08-19-96
Letter, Final Report Approval, Anthropegenic PAH Reference-Level Study	DTSC	09-13-96
Letter, Final Action Memorandum, Critical Removal Actions	DON	10-07-96
Letter, Responsiveness Summary, Proposed Plan, Operable Unit 2A and 3A, No Action Sites	DTSC	10-29-97
Letter, Comments on Draft CERCLA Groundwater Monitoring Plan for MCAS El Toro	DTSC	09-22-98
South Coast Air Quality Management District		
Report, Air Toxic Inventory	DON	1989
Report, Air Toxic Inventory	DON	1994
Report, Air Toxic Inventory	DON	1996

Notes:

CDM:	CDM Federal
DON:	Department of the Navy
DTSC:	Department of Toxic Substances Control
EPA:	U.S. Environmental Protection Agency
SAIC:	Science Applications International Corporation
SARWQCB:	Santa Ana Regional Water Quality Control Board
USMC:	United States Marine Corps

APPENDIX D

LOCAL REGULATORY AGENCY
FILE REVIEW LISTING

LOCAL REGULATORY AGENCY
FILE REVIEW LISTING

Document Title	Document Author	Document Date
Orange County Health Care Agency		
Hazardous Waste Inspection Report	OCHCA	06-04-85
Hazardous Waste Inspection Report	OCHCA	04-29-88
Hazardous Waste Inspection Report	OCHCA	05-03-88
Hazardous Waste Inspection Report	OCHCA	06-06-88
Well Boring Logs	LE	11-29-88
Well Boring Logs	LE	08-28-89
Hazardous Waste Inspection Report	OCHCA	10-24-89
Well Boring Logs	LE	01-22-90
Letter, Quarterly Release/Contamination Reports	USMC	05-30-90
Well Boring Logs	GSC	10-30-90
Well Boring Logs	ITC	12-19-90
Hazardous Waste Inspection Report	OCHCA	01-23-91
Well Boring Logs	ITC	04-15-91
Hazardous Waste Inspection Report	OCHCA	07-24-91
Well Boring Logs	JE	04-16-92
Hazardous Waste Inspection Report	OCHCA	10-05-92
Well Boring Logs	ITC	01-06-93
Hazardous Waste Inspection Report	OCHCA	09-21-93
Hazardous Waste Inspection Report	OCHCA	04-19-93
Hazardous Waste Inspection Report	OCHCA	12-30-93
Hazardous Waste Inspection Report	OCHCA	11-14-94
Well Boring Logs	BNI	02-22-95
Hazardous Waste Inspection Report	OCHCA	03-27-95
Hazardous Waste Inspection Report	OCHCA	04-11-95
Well Boring Logs	BNI	08-15-95
Well Boring Logs	OHM	12-01-95
Well Boring Logs	OHM	03-29-96
Well Boring Logs	OHM	05-14-96
Hazardous Waste Inspection Report	OCHCA	05-24-96
Well Boring Logs	OHM	06-04-96
Well Boring Logs	OHM	06-20-96
Well Boring Logs	OHM	06-27-96
Well Boring Logs	OHM	07-03-96
Well Boring Logs	OHM	07-09-96
Well Boring Logs	OHM	07-10-96
Letter, Completion of Tank Removal Project, Tank Farm No. 1	OCHCA	01-17-97
Letter, Case Closure, Former UST 463, 276	SARWQCB	01-22-97
Letter, Case Closure, Former UST 285	SARWQCB	04-21-97
Letter, Case Closure, Former UST 375, 262A, and 262B	SARWQCB	04-22-97
Letter, Case Closure, Former UST 14	SARWQCB	06-06-97
Letter, Completion of Tank Removal Project, Tank #T-10	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank #T-9	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank #773D	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank 651-5, 651-6, and 651-7	OCHCA	07-11-97

STATE OF CALIFORNIA
REGULATORY AGENCY FILE REVIEW LISTING
(continued)

Document Title	Document Author	Document Date
Letter, Completion of Tank Removal Project, Tank 643A and OWS 643B	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank 297C and OWS 297B	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank OWS 280A	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank 278B	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank 246	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank 247	OCHCA	07-11-97
Letter, Completion of Tank Removal Project, Tank 627	OCHCA	07-11-97
Hazardous Waste Inspection Report	OCHCA	08-06-97
Hazardous Waste Inspection Report	OCHCA	08-18-97
Letter, Case Closure, Former UST 54A	SARWQCB	08-22-97
Well Boring Logs	OHM	03-05-98
Well Boring Logs	OHM	07-15-98
Well Boring Logs	OHM	10-16-98
Well Boring Logs	FWEC	05-06-99
Orange County Water District		
Report, Phase I Investigation of Trichloroethylene Contamination in the Vicinity of the El Toro MCAS	OCWD	03-29-89
Resolution No. 89-5-95, Guideline Policy Encouraging the Production and Beneficial Use of Groundwater Not Meeting Drinking Water Standards	OCWD	05-03-89
Resolution No. 91-3-81, Policy Regarding Water Quality Treatment Goals for Groundwater Programs and Projects	OCWD	03-20-91
Inter-Office Memorandum, Irvine Desalter's Relation to District Policies	OCWD	07-24-91
Letter, Offer to Settle, Off-site TCE Groundwater Contamination	DON	10-26-94
Meeting Minutes, OCWD Board of Directors	OCWD	01-12-95
Chronological Summary, Off-site Groundwater Contamination	OCWD	03-14-95
Letter, Remediation Alternatives, Off-site TCE Groundwater Contamination	OCWD	03-30-95
Letter, Comments on Final MCAS El Toro Draft Final Operable Unit 1 Interim RI/FS Report	OCWD	10-16-96
Letter, Preliminary Review of Settlement Agreement	DON	08-08-97
Orange County Fire Authority		
Hazardous Material/Hazardous Waste Management Plan, MCAS El Toro	DON	08-94
Community Right to Know Information, Material Safety Data Sheets, MCAS El Toro	OCFA	09-23-99
Orange County Sanitation District		
Negotiated Sewer Service Contract w/Irvine Ranch Water District	DON	06-05-72
Discharge Logs	OCSD	1975
Letter, Wastewater Discharge Permit	OCSD	05-25-76
Letter, Negotiated Sewer Service Contract Modification	OCSD	03-25-77
Letter, Use of Separation Equipment and Three-Stage Clarifiers	OCSD	04-27-82
Sewer Service Contract Modifications	OCSD	06-19-84

STATE OF CALIFORNIA
REGULATORY AGENCY FILE REVIEW LISTING
(continued)

Document Title	Document Author	Document Date
Wastewater Analysis	OCSD	04-15-85
Modification to Sewer Service Contract	OCSD	12-10-86
Wastewater Discharge Permit Application, Class I and II	OCSD	07-13-87
Letter, Discharge Compliance Requirements	OCSD	02-02-89
Memorandum, Sewage Discharge Corrective Action Notice	OCSD	02-15-89
Letter, Monthly Monitoring Report	USMC	10-30-89
Memorandum, El Toro MCAS Sewag Flow	OCSD	07-26-90
Inspection report	OCSD	08-20-90
Source Control Division Inspection Report	OCSD	04-08-91
Industrial Flow Rate	OCSD	04-29-91
Letter, Monthly Monitoring Report	USMC	05-15-91
Report of Solvent Discharge to Sewer	OCSD	05-29-91
Letter, Monthly Monitoring Report	USMC	08-07-91
Letter, Monthly Monitoring Report	USMC	09-10-91
Fuel Spill Report	USMC	10-30-91
Industrial Wastewater Class I Permit	OCSD	11-15-91
Letter, Monthly Monitoring Report	USMC	01-06-92
Inspection report	OCSD	02-25-92
Annual Permit Evaluation Report	OCSD	02-25-92
Letter, Monthly Monitoring Report	USMC	02-27-92
Source Control Division Inspection Report	OCSD	03-30-92
Source Control Division Inspection Report	OCSD	05-26-92
Source Control Division Inspection Report	OCSD	06-15-92
Letter, Self-Monitoring for Total Toxic Organics	OCSD	06-24-92
Letter, Monthly Monitoring Report	USMC	10-05-92
Letter, Guidelines for Preventing Sewer Discharge of Surface Runoff	OCSD	10-15-92
Inspection Report	OCSD	10-21-92
Report, Self-Monitoring	USMC	01-26-93
Letter, Industrial wastewater Permit Application	USMC	03-23-93
Industrial Wastewater Class I Permit	OCSD	04-28-93
Source Control Division Inspection Report	OCSD	06-17-93
Meeting Minutes, MCAS El Toro and Water Features in District 14	OCSD	06-24-94
Report, Self-Monitoring	USMC	04-05-95
Industrial Wastewater Class I Permit	OCSD	05-01-95
Self-Monitoring Notice of Violation	OCSD	07-06-95
Effluent Monitoring Report	OCSD	07-95 to 07-99
Industrial Wastewater Class I Permit	OCSD	05-01-97
Wastewater Analysis	OCSD	04-15-85

Notes:
- **BNI:** Bechtel National, Inc.
- **DON:** Department of the Navy
- **FWEC:** Foster Wheeler Environmental Corporation
- **GSC:** Goephysical Services Corporation
- **ITC:** IT Corporation
- **JE:** Jacobs Engineering
- **LE:** Layton Environmental Services
- **OCFA:** Orange County Fire Authority

OCHCA:	Orange County Health Care Agency
OCSD:	Orange County Sanitation District
OCWD:	Orange County Water District
OHM:	OHM Remediation, Inc.
SARWQCB:	Santa Ana Regional Water Quality Control Board
USMC:	United States Marine Corps

APPENDIX E

NATIONAL STANDARDS AND ENGINEERING PRACTICE REVIEW LISTING

NATIONAL STANDARDS AND ENGINEERING PRACTICE REVIEW LISTING

Document Title	Document Author	Document Date
American Sewage Practice	M&E	1972
American Society for Testing and Materials (ASTM) C12-95, Standard Practice for Installing Vitrified Clay Pipe Lines	ATSM	01-15-95
ASTM C301-98, Standard Test Methods for Vitrified Clay Pipe	ASTM	03-10-98
ASTM C425-98b, Standard Specification for Compression Joint for Vitrified Clay Pipe and Fittings	ASTM	09-10-98
ASTM C828-98, Standard Test Method for Low-Pressure Air test of Vitrified Clay Pipe Lines	ASTM	03-10-98
ASTM C1091-98, Standard Test Method for Hydrostatic Infiltration and Exfiltration Testing of Vitrified Clay Pipe Lines	ASTM	04-10-98
Evolution of Jointing Vitrified Clay Pipe	ASCE	08-27-85
Standard Specifications for Public Works Construction	AGCC	1998
Vitrified Clay Pipe Engineering Handbook	NCPI	1982

Notes:

AGCC: Association of General Contractors of California
ASCE: American Society of Civil Engineers
OCWD: Orange County Water District
M&E: Metcalf and Eddy
NCPI: National Clay Pipe Institute

APPENDIX F

INDIVIDUALS INTERVIEWED BY PES

INDIVIDUAL INTERVIEWED BY PES

Individual	Occupation
Michael Adackapara	Senior WRC Engineer SARWQCB
John Aguilar	Facility Manager Former MCAS El Toro & Former MCAF Tustin
Fred Barnes	Customer Representative Van Waters & Rogers
Bob Blackburn	Spokesperson California Cleaners Association
Carol DeAngelo	Technical editor Chemical and Engineering News
Ray Grosnick	Records Custodian Naval Aviation History Office
Mark Hoke	Manager Association of Metro Sewer Agencies
Karen Kirkpatrick	Engineering Support Technician Former MCAS El Toro
Steven Melvin	Hazardous Materials Specialist OCFA
Stephanie Osborne	Manager American Public Works Association
Tom Pedlico	Aviation Supply Officer NAS Miramar
Robert Roland	Engineer Naval Aviation Systems Command
Ed Sikora	Director National Clay Pipe Institute
Patrick Smith	Executive Eldorado Specialty Chemicals
Don Stickel	Technician Chemical Abstract Services
Flor Tumabing	Engineer SCAQMD
Charly Weimert	Environmental Support technician Former MCAS El Toro
Les Wittenberg	Technical Editor Center for Chemical Process Safety

Notes: **AICHE:** American Institute of Chemical Engineers
MCAF: Marine Corps Air Facility
NAS: Naval Air Station
OCFA: Orange County Fire Authority
SARWQCB: Santa Ana Regional Water Quality Control Board

APPENDIX G

EXTRACT
DRAFT FINAL PHASE II
REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 2A – SITE 24

DUPLICATE

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

DRAFT FINAL PHASE II REMEDIAL INVESTIGATION REPORT OPERABLE UNIT 2A – SITE 24 MARINE CORPS AIR STATION EL TORO, CALIFORNIA

Volume I

CTO-0073/0146

Prepared by:

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STATE OF CALIFORNIA

June 1996

Signature: G. Patrick Brooks Date: 6-12-96
G. Patrick Brooks, R.G., CTO Leader

EXECUTIVE SUMMARY

This report presents the results of the Phase II Remedial Investigation (RI) conducted at Site 24, the Volatile Organic Compound (VOC) Source Area designated as one of the two sites in Operable Unit (OU) 2A, for the Marine Corps Air Station El Toro in Orange County, California. The investigation was conducted on behalf of the United States Department of the Navy, Southwest Division Naval Facilities Engineering Command. It was performed in accordance with the Navy Installation Restoration Program under the Comprehensive Long-Term Environmental Action Navy II Program, contract No. N68711-92-D-4670.

Site 24 has been identified as a potential source of regional VOC groundwater contamination in the Irvine Groundwater Subbasin. A number of investigations suggested a link between VOC sources in the shallow soil at Site 24 and the regional groundwater contamination. However, these Phase I investigations (1992 to 1993) did not fully characterize the VOC sources, the nature and extent of contamination, or the mechanism by which VOCs in the shallow soil contaminated the groundwater. These tasks are the subject of the Phase II RI. Any potential non-VOC soil source areas are considered part of the RI/Feasibility Study (FS) for OU-3.

The scope of the OU-2A investigation included assessment of the Major Drainages (Site 25). This portion of the investigation has not been completed because precipitation required for collecting water samples in the drainages occurred late in the rainy season (31 January 1996). The results of the Site 25 RI will be provided as an addendum to this report.

The Phase II RI findings will support the OU-1 Interim-Action Feasibility Study leading to a Record of Decision for OU-1, the regional VOC groundwater plume. The Phase II findings will also support the OU-2A Feasibility Study and Record of Decision.

BACKGROUND

Marine Corps Air Station El Toro lies in a semiurban agricultural area in southern California, approximately 8 miles southeast of the city of Santa Ana and 12 miles northeast of the city of Laguna Beach. Land northwest of the Station is used for agricultural purposes. The land to the south and northeast is used mainly for commercial, light industrial, and residential purposes. Surrounding residential areas are the cities of Lake Forest, Irvine, and Laguna Hills.

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

Site 24 encompasses approximately 200 acres. The site contains two large aircraft hangars and several smaller buildings used for aircraft and vehicle maintenance and repair. Industrial activities such as dust suppression with waste liquids, paint stripping, degreasing, and vehicle and aircraft washing may have involved solvents containing trichloroethene (TCE) and tetrachloroethene (PCE). Wastes from these practices may have reached the surface or subsurface through leakage, runoff, storm drains, or direct application to the soil and are believed to be the source of VOCs detected at Site 24 and in the regional groundwater.

PHASE I INVESTIGATION

The Phase I RI groundwater characterization identified a plume of TCE in groundwater originating beneath Site 24 that extended approximately 3 miles off-site and downgradient of Marine Corps Air Station El Toro. The area of highest TCE concentrations in groundwater was located at Site 24, approximately 1,500 feet northwest of Building 297. The Phase I Soil Gas Survey identified potential VOC sources by collecting soil gas samples from the upper 30 feet of soil at Site 24. TCE in soil gas was detected throughout a large area beneath Buildings 296 and 297, but the area of highest TCE concentrations in groundwater was separated from this apparent vadose zone source by approximately 1,500 feet.

PHASE II REMEDIAL INVESTIGATION SCOPE

The overall goal of the Site 24 Phase II RI is to collect sufficient data to support decisions regarding the need for and scope of future remediation at the site. Specific goals are:

- to characterize the nature and extent of the VOCs in the vadose zone;
- to characterize the on-site horizontal and vertical extent of VOC-contaminated groundwater;
- to investigate whether there are active VOC sources contributing to the regional groundwater contamination;
- to assess the on-site risks to human health; and
- to conduct pilot testing necessary to support the evaluation of remedial alternatives.

To efficiently complete the characterization, applicable data and results from previous investigations (especially the Phase I RI) were incorporated into the Phase II RI.

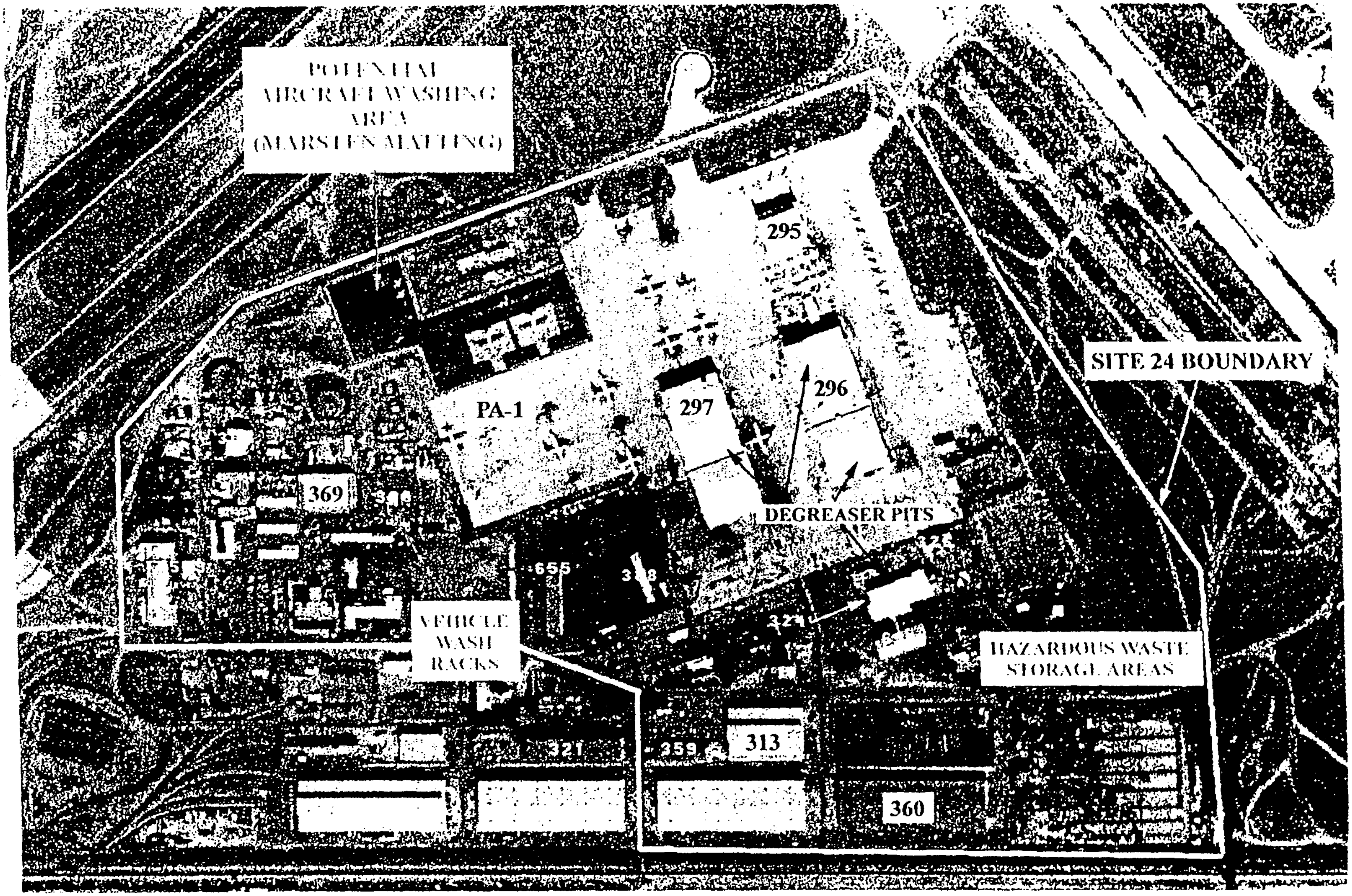
Results of the pilot testing will be included in the Phase II Feasibility Study.

SUMMARY OF RESULTS

The findings of the Site 24 RI are summarized below, including nature and extent of contamination, active VOC source areas, potential release and transport mechanisms, and human-health risk assessment. A 1980 aerial photograph of the site illustrating major features is included as Figure ES-1.

Nature and Extent of Contamination

The contaminants investigated during the Phase II RI are VOCs. The VOC detected most often and with the highest concentrations was TCE. TCE in the vadose zone is found in soil gas at concentrations up to 6,120 micrograms per liter (µg/L) (Phase II), and in soil at concentrations up to 400 micrograms per kilogram (µg/kg) (Phase I). The highest TCE soil concentration detected during Phase II was 190 µg/kg. TCE was found in groundwater samples as high as 2,000 µg/L during Phase I and 3,100 µg/L in Phase II. The United States Environmental Protection Agency



1980 Aerial Photograph

Figure ES-1
Aerial Photograph of Site 24 (1980)

(U.S. EPA) maximum contaminant level (MCL) for TCE in groundwater is 5 µg/L. Other chlorinated VOCs, such as PCE, carbon tetrachloride, and related organic chemicals, were also detected in the soil and groundwater, but with less frequency and at much lower concentrations.

The horizontal and vertical extent of VOCs in the vadose zone is adequately characterized by Phase I and Phase II soil and soil gas analytical results. A primary TCE source is present beneath Buildings 296 and 297, extending to the south with decreasing concentrations to the southern Station boundary. The TCE concentrations in soil gas generally increase with depth, with the highest concentrations near the water table. VOCs in the area of Buildings 296 and 297 extend vertically to groundwater directly beneath those buildings. The trend of increasing concentration with depth suggests a depleting source at the surface that is consistent with the end of TCE usage in approximately 1975. Freon 113 has a soil gas volume nearly as large as that of TCE, but it is not considered a threat to groundwater due to relatively low concentrations and toxicity. Other VOCs are also present, but over smaller areas and at lower concentrations.

Although much of the contamination present at Site 24 is believed to have entered the soil at or close to the surface, the current contamination level near the surface is low. The soil samples collected from the upper 10 feet of soil at Site 24 contained VOC concentrations less than 21 µg/kg. Low TCE concentrations in soil near the surface may be due to continued flushing by infiltrating water after TCE use was discontinued and by volatilization of the TCE into the atmosphere in the past.

New data collected during Phase II refine the geometry of the groundwater hot spot beneath Site 24. The hot spot is defined as the area of TCE in groundwater that exceeds 500 µg/L. The characterization of groundwater during Phase II demonstrates that the horizontal extent of the groundwater TCE hot spot extends from beneath Building 296 approximately 2,800 feet to the northwest. The horizontal extent of VOCs in groundwater is adequately defined at Site 24 with Phase I and Phase II data.

The vertical extent of VOCs in groundwater is limited to approximately the top 100 feet of the shallow aquifer. This was demonstrated by collecting HydroPunch® groundwater samples at different depth intervals within the aquifer, and by installing deep monitoring wells to assess groundwater conditions at the base of the VOC plume. The HydroPunch data show that most TCE concentrations within the hot spot are fairly uniform (560 to 1,300 µg/L) in the top 40 feet of the shallow aquifer. Silt and clay layers separate the generally sandy, upper 40 feet of the shallow aquifer from deeper sands. TCE concentrations decrease markedly beneath the silt and clay layers. The exception to this observation is a HydroPunch sample collected beneath Building 296 with a TCE concentration of 3,100 µg/L. Monitoring wells were installed at depths beyond the capabilities of the HydroPunch (i.e., 100 feet beneath the water table). Samples collected from these wells did not contain detectable concentrations of TCE.

Because solvents were formerly used at the Station in nonaqueous liquid phase as cleaning and degreasing agents, the potential for the existence of dense nonaqueous-phase liquid (DNAPL) at the site was investigated during the Phase I and Phase II RIs. The conclusions reached by both investigative teams are consistent: there is little evidence for DNAPLs at Site 24. The VOC concentrations detected in soil, soil gas, and groundwater are well below the levels expected if an active DNAPL source were present at the site (U.S. EPA 1991a). Even though no direct evidence was found, it is possible that some residual DNAPL may be trapped between soil grains in the vadose zone or within the aquifer skeletal material.

VOC Source Term

Site 24 has been and continues to be an active source of the regional VOC groundwater contamination. Calculations performed for the Phase II RI show that two areas of VOC contamination in the vadose zone are capable of loading groundwater beneath Site 24 at concentrations above the U.S. EPA MCLs: a primary source area of TCE-contaminated soil beneath the general area of Buildings 296 and 297, and a smaller, secondary source consisting of PCE-contaminated soil located approximately 500 feet west of Building 297. The data collected during Phase I and Phase II support the presence of VOC contamination in the soil dissolved in soil moisture as a vapor and sorbed to soil particles. The data do not support the presence of TCE as a DNAPL in the vadose zone.

It is estimated that approximately 1,500 pounds of TCE are present as soil gas in the primary TCE source area beneath Buildings 296 and 297. Assuming the soil pore space is equally shared by soil gas and soil moisture, approximately 4,000 pounds of TCE would be present in the soil moisture.

Potential Release and Transport Mechanisms

Chlorinated solvents used at the site for cleaning and degreasing are the likely sources of VOC contamination in the soil and groundwater. The use of TCE at the Station is not well documented. Based on common industrial practices of the time, it is assumed that TCE was used from about the time the Station was commissioned in 1943 until about 1975.

Potential VOC sources include subsurface and surface sources. It appears likely that most of the contamination resulted from subsurface sources, such as storm drains, that exposed the site to frequent, small releases over a long period of time. Building plans show that at least some of the degreaser pits discharged directly to the storm drain system. Although the actual degreasing solvent was held in a steel tank within the degreaser pit, occasional spillage into the pit would have been washed into the storm drain system. Such practices as aircraft washing, discharge of solvent-contaminated liquids onto unpaved areas, and spraying of solvent-contaminated liquids for dust suppression released VOCs onto surface soils. The VOCs were subsequently transported downward by infiltrating liquids.

Transport in groundwater is principally by advection. The TCE hot spot in groundwater extends from the primary source beneath Buildings 296 and 297 to the northwest (the same direction as groundwater flow beneath the site). The groundwater gradient is estimated at 0.0075 feet per foot to the northwest, and the linear groundwater velocity is estimated to be approximately 200 feet per year.

The primary VOC source, composed mostly of TCE, is present in the soil beneath Buildings 296 and 297. Historical and ongoing releases from this source have contaminated groundwater at concentrations above the MCL for TCE. Based on estimates of infiltration and groundwater mixing, the primary source area will continue to adversely impact groundwater.

Besides TCE, there is one additional contaminant on-site, PCE, that has the capacity to impact groundwater above the MCL. The soil contaminated with PCE is located west of Building 297 and is smaller in areal extent and concentration than the primary source. PCE was detected in groundwater at Site 24 above the MCL at 3 of the 18 locations sampled during the Phase II RI.

Human-Health Risk Assessment

A human-health risk assessment was conducted to assess the potential risk from VOCs found at Site 24. Five ~~Four~~ receptors were evaluated: 1) a resident adult living in a house on-site, 2) a resident child living in the same house, 3) an office worker employed at the site, 4~~3~~) a construction worker performing excavation work at the site, and 5~~4~~) a child playing at an on-site park. Risk estimates for these receptors were calculated based on exposure to soil (e.g., inhalation, ingestion, dermal). Only the resident was assumed to be exposed to groundwater.

The results of the risk assessment are consistent with the low VOC soil concentrations found at the site, especially in the upper 10 feet. The risk assessment concluded that the lifetime excess upper-bound cancer risk to a resident adult presented by the VOCs in the soil is ~~less than~~ approximately 22 ~~five~~ chances in one billion. This is well below the U.S. EPA target risk threshold of one in ten thousand to one in a million. Concentrations of VOCs in the soil are not high enough to cause noncarcinogenic effects to the same receptors.

The lifetime excess upper-bound cancer risk to a resident adult presented by exposure to VOCs in groundwater ~~to the resident~~ is on the order of two ~~one~~ chances in one thousand (2.0~~1.3~~ $\times 10^{-3}$), only if the groundwater from the contaminated aquifer was used for all consumptive uses (e.g., drinking, washing). The results also showed that VOC concentrations are high enough to cause potentially noncarcinogenic effects to the resident.

CONCLUSIONS

The Phase II RI was conducted using a seven-step data quality objectives (DQO) process developed by the U.S. EPA. Using the DQO process, the investigation team developed seven decisions that formed the basis for the investigation. The goals of the Phase II RI were accomplished by successfully addressing each of the seven decisions as discussed below.

Is VOC-contaminated soil beneath Site 24 an active source of the regional VOC groundwater contamination?

Yes. VOC-contaminated soil beneath Site 24 is an active source of the regional VOC groundwater contamination. The existing groundwater plume was traced back to contaminated soil beneath Buildings 296 and 297. This soil will continue to act as a VOC contamination source in the future. There are two areas of contaminated soil that have the ability to elevate groundwater above the MCL: a primary source beneath the Building 296 and 297 area and a secondary source west of Building 297. The primary source is composed mostly of TCE and apparently is the source of the regional VOC groundwater contamination. The secondary source represents an area of PCE contamination that has the potential to contaminate groundwater above its MCL.

Does the continued release of VOCs from subsurface soil to groundwater contribute to an unacceptable risk to human health or the environment?

Yes. The continued release of VOCs from subsurface soil to groundwater does contribute to a risk to human health but only if a receptor uses the groundwater for all consumptive purposes. The primary source of TCE-contaminated soil beneath Buildings 296 and 297 and the smaller, secondary source of PCE-contaminated soil located approximately 500 feet west of Building 297 are capable of contaminating groundwater above the MCLs.

Does VOC-contaminated shallow soil present an unacceptable risk to human health or the environment?

No. VOCs present in shallow soil do not present an unacceptable risk to human health. The risk to an adult associated with the contaminated shallow soil is an excess cancer risk of 2.2~~5~~ $\times 10^{-9\not{8}}$. The risk to an office worker is 5.4×10^{-9}. Both values are ~~This is~~ well below the U.S. EPA target risk threshold of 1×10^{-4} to 1×10^{-6}.

Is the horizontal and vertical extent of VOC-contaminated groundwater sufficiently characterized to evaluate response actions?

Yes. The horizontal and vertical extent of VOC-contaminated groundwater on-site is sufficiently characterized to evaluate response actions. Horizontally, the TCE groundwater hot spot extends from beneath Building 296 approximately 2,800 feet to the northwest site boundary. Vertically, the hot spot is limited to the top 100 feet of the shallow aquifer on Site 24.

Does VOC-contaminated groundwater beneath Site 24 contribute to an unacceptable risk to human health or the environment?

Yes. The risk associated with groundwater beneath the site is an excess cancer risk of 2.0~~1.3~~ $\times 10^{-3}$ for a resident adult. VOC concentrations are also high enough to cause noncarcinogenic effects for the same resident. Again, this is only true if the resident uses groundwater for all consumptive purposes.

Does the area being evaluated for a response action qualify for Early Action?

No. Site 24 is being recommended for long-term remedial action.

Are pilot tests necessary to evaluate remedial alternatives as part of the RI/FS process?

Yes. Pilot tests are recommended to evaluate soil vapor extraction and air sparging for their potential to remove VOCs from the vadose and saturated zones, respectively. The data collected during these pilot tests will be used to support the Phase II Feasibility Study. Groundwater injection and capture pilot tests will be performed to evaluate their potential to contain the VOC-contaminated groundwater on-Station.

Section 7
CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the results of the Phase I and Phase II RIs conducted at Site 24; furnishes responses to the seven DQO decisions that provided the framework for the investigation; and provides conclusions, including data limitations, recommendations for future work, and potential remedial action objectives.

7.1 SUMMARY

Building on the Phase I investigation performed in 1993 and 1994, the Phase II RI confirmed Site 24 as the source of regional VOC groundwater contamination and identified the mechanism by which the VOCs present in the soil beneath the area of Buildings 296 and 297 are entering the groundwater and being transported off-site.

This section summarizes key findings of the Phase I and II investigations. It includes discussions of the nature and extent of VOC contamination in the vadose zone and groundwater, documents VOC fate and transport mechanisms, and provides the results of the on-site HRA.

7.1.1 Nature and Extent of Contamination

Soil and soil gas data indicate that a primary source of TCE is present in the soil beneath Buildings 296 and 297. Groundwater data show that this source of TCE is physically linked to the TCE groundwater hot spot and regional TCE groundwater contamination. The following descriptions summarize soil and groundwater conditions beneath Site 24.

- The contaminants investigated during the Phase II RI are VOCs. The VOC detected most often and with the highest reported concentrations was TCE. TCE in the vadose zone was found in soil gas at concentrations up to 6,120 µg/L; and in soil at concentrations up to 400 µg/kg (Phase I). The highest TCE soil concentration reported during Phase II was 190 µg/kg. TCE was found in groundwater samples as high as 2,000 µg/L during Phase I and 3,100 µg/L in Phase II. The total mass of TCE in the vadose zone in this area is estimated to be approximately 5,500 pounds. Other chlorinated VOCs (e.g., PCE, CT, and related organic chemicals) were also detected in the soil and groundwater, but with less frequency and at much lower concentrations.
- The horizontal and vertical extent of VOCs in the vadose zone is adequately characterized with Phase I and Phase II soil and soil gas analytical results. The results show a primary TCE source beneath Buildings 296 and 297 that extends to the south at progressively lower concentrations to the southern Station boundary. The total mass of TCE in the vadose zone in this area is estimated to be approximately 5,500 pounds. TCE concentrations in soil gas generally increase with depth, with the highest concentrations occurring near the water table. These data indicate that VOCs released in the area of Buildings 296 and 297 migrated to the groundwater directly beneath those buildings. The trend of increasing concentration with depth suggests a depleting source at the surface

that is consistent with a cessation in TCE usage around 1975. Freon 113 has a soil gas volume nearly as large as that for TCE, but it is not considered a threat to groundwater because of its relatively low concentration and toxicity. Other VOCs are also present in soil gas, but over smaller areas and at lower concentrations.

- Although much of the contamination present at Site 24 is believed to have entered the soil at or close to the surface, the current contamination level near the surface is very low. All soil samples collected from the upper 10 feet of soil at Site 24 contained VOC concentrations of less than 21 μg/kg. Over time, the contamination has been flushed out of surface soils by infiltrating water and/or has volatilized to the atmosphere.

- The characterization of groundwater during Phase II demonstrates that the horizontal extent of the groundwater TCE hot spot extends from beneath Building 296 approximately 2,800 feet to the northwest. Phase II data are used to refine the geometry of the groundwater hot spot beneath Site 24, while Phase I data are used to characterize the boundaries of the plume on Site 24 and its off-Station extent. The horizontal extent of VOCs in groundwater is adequately defined with Phase I and Phase II data.

- The vertical extent of VOCs in groundwater has been defined. Most of the TCE contamination occurs in the upper 40 feet of the shallow aquifer. One sample location beneath Building 296 had a TCE concentration of 3,100 μg/L at approximately 50 feet below the water table. TCE concentrations decrease below this level and fall below detectable levels at about 100 feet below the water table. This was demonstrated by collecting HydroPunch groundwater samples at different depth intervals within the aquifer, and by installing deep monitoring wells to assess groundwater conditions at the base of the VOC plume. The HydroPunch data show that TCE concentrations within the hot spot are fairly uniform (560 to 3,100 μg/L) in the top 50 feet of the shallow aquifer. Silt and clay layers separate the generally sandy, top 40 feet of the shallow aquifer from deeper sands within the shallow aquifer. TCE concentrations decrease markedly beneath the silt and clay layers. Monitoring wells were installed at depths of 100 feet beneath the water table. Samples collected from these wells did not contain detectable TCE.

- The potential for the existence of DNAPL at the site was investigated during the Phase I and Phase II RIs because solvents were formerly used at the Station as cleaning and degreasing agents. The conclusions reached during the Phase I and Phase II investigations are consistent; there is little evidence for DNAPLs at Site 24. The VOC concentrations reported in soil, soil gas, and groundwater samples are below those expected if a DNAPL source were present. The saturated TCE vapor concentration is approximately 433,000 μg/L, compared to a maximum TCE soil gas concentration of 6,120 μg/L detected during Phase II. Equilibrium calculations that compare TCE concentrations in groundwater with expected TCE concentrations in soil indicate that the soil concentrations are within the expected range; the presence of DNAPL is not suggested.

7.1.2 Fate and Transport

The fate and transport analysis assessed potential release mechanisms that may have introduced VOCs into the vadose zone, characterized the migration pathways through the vadose zone to the water table, defined VOC sources in the vadose zone, and described VOC transport in the groundwater. The major findings of the analysis are summarized below.

- Chlorinated solvents used for cleaning and degreasing are the likely sources of VOC contamination in the soil and groundwater. The use of TCE at the Station is not well documented. Based on common industrial practices of the time, it was assumed that TCE was used from about the time the Station was commissioned in 1943 until about 1975.
- Potential VOC sources include subsurface and surface sources. It appears likely that most of the contamination resulted from subsurface sources, such as storm drains, that exposed the site to frequent, small releases over a long period of time. Even though rainfall of MCAS El Toro is approximately 12 inches per year, the storm drain system received wastewater from activities inside Buildings 296 and 297, including those related to the degreaser pits. The building plan reviewed for Building 296 showed that the degreaser pits were tied to the storm drain system. Plumbing details for Building 297 were not available, but it was assumed that the layout was similar to Building 296. Although the actual degreasing solvent was held in a steel tank within the degreaser pit, occasional spillage into the pit could have been washed into the storm drain system. Surface contamination could have resulted from practices such as aircraft washing, waste disposal onto unpaved areas, and liquid waste sprayed for dust suppression.
- Most releases of TCE involved the use of water (e.g., washing and cleaning). It is likely that VOCs were introduced into the vadose zone in the dissolved phase; small amounts of DNAPL may also have been released but the magnitude of these releases was probably small. Collection of soil gas samples from the SVE will provide additional data to evaluate the potential presence of DNAPL in the vadose zone.
- Transport of VOCs through the vadose zone to groundwater with infiltrating surface water and leakage from storm drain piping was primarily vertical. Lateral spreading of contamination with depth also occurred, most likely due to heterogeneities in the stratigraphic sequence.
- Advective transport of TCE in groundwater has resulted in a TCE hot spot in groundwater that extends from the primary source beneath Buildings 296 and 297 to the northwest boundary of Site 24, and then continues off-Station at lesser concentrations for a distance of approximately 3 miles. The groundwater gradient was estimated at 0.0075 ft/ft to the northwest, and the linear groundwater velocity is estimated to be approximately 200 feet per year.

- A primary VOC source, composed mostly of TCE, is still active in the soil beneath Buildings 296 and 297. The primary source has contaminated groundwater at concentrations above the MCL for TCE. Based on estimates of infiltration and groundwater mixing, the primary source area will continue to adversely impact groundwater in the future.
- Besides TCE, there is one additional contaminant on-site (PCE) that has the capacity to impact groundwater above the MCL. The soil contaminated with PCE is located west of Building 297 and is smaller in areal extent and concentration than the primary source.

7.1.3 Human-Health Risk Assessment

The results of the HRA are summarized below:

- A risk assessment was conducted to estimate the potential risk to <u>five</u>~~four~~ different receptors exposed to VOCs from Site 24. Those receptors are 1) a<u>n</u> <u>adult</u> ~~resident~~ living in a house on the site, <u>2) a child living in the same house,</u> <u>3</u>~~2~~) an office worker employed at the site, <u>4</u>~~3~~) a construction worker occasionally called upon to repair underground utilities at the site, and <u>5</u>~~4~~) a child playing at an on-site park. Risk estimates for all of the receptors were calculated based on direct contact exposure to soil. Only the resident <u>adult and child were</u> ~~was~~ assumed to be exposed to groundwater.
- The results of the risk assessment are consistent with the low VOC soil concentrations found at the site, especially in the upper 10 feet. The risk assessment concluded that the lifetime excess upper-bound cancer risk <u>to a resident adult</u> presented by the VOCs in the soil would be no more than about <u>22</u> ~~five~~ chances in one billion (<u>2.2</u>~~5~~ $\times 10^{-\underline{9}8}$). The results also indicate that the concentrations of VOCs in the soil are not high enough to cause noncarcinogenic effects to the same people.
- The lifetime excess upper-bound cancer risk presented by exposure to VOCs in groundwater to the resident would be on the order of <u>two</u> ~~one~~ chance<u>s</u> in one thousand (<u>2.0</u>~~1.3~~ $\times 10^{-3}$) if all water used in the home for consumptive purposes in the home was derived from the contaminated aquifer. The results also indicate that VOC concentrations are high enough to cause noncarcinogenic effects to the resident.

7.2 CONCLUSIONS

The Phase II RI was conducted using the seven-step U.S. EPA DQO process. Using this process, the investigation team developed seven decisions that formed the basis for the investigation. The Phase II RI has successfully answered each of the seven decisions as discussed below.

1. *Is VOC-contaminated soil beneath Site 24 an active source of the regional VOC groundwater contamination?*

   Yes. VOC-contaminated soil beneath Site 24 is an active source of the regional VOC groundwater contamination. The existing groundwater plume was traced back to contaminated soil beneath Buildings 296 and 297. This soil will continue to act as a source in the future. There are two areas of contaminated soil that have the ability to contaminate groundwater above the MCL: a primary source beneath the Buildings 296 and 297 area and a secondary source west of Building 297. The primary source is composed primarily of TCE and is the source of the regional VOC groundwater contamination. The secondary source represents an area of PCE contamination that has the potential to contaminate groundwater above the MCL.

2. *Does the continued release of VOCs from subsurface soil to groundwater contribute to an unacceptable risk to human health or the environment?*

   Yes. The continued release of VOCs from subsurface soil to groundwater does contribute to an unacceptable risk to human health, but only if the receptor utilizes groundwater for all consumptive purposes. Analysis shows that a TCE hot spot in the vicinity of Buildings 296 and 297 and a PCE hot spot located west of Building 297 are both capable of contaminating the groundwater above the MCL.

3. *Does VOC-contaminated shallow soil present an unacceptable risk to human health or the environment?*

   No. VOCs present in shallow soil do not present a risk to human health. The risk to a resident adult associated with the contaminated shallow soil is an excess cancer risk of 2.2~~5~~ $\times 10^{-9}$~~8~~. The risk to an office worker is 5.4×10^{-9}. Both values are ~~This is~~ well below the U.S. EPA target risk threshold of 1×10^{-4} to 1×10^{-6}.

4. *Is the horizontal and vertical extent of VOC-contaminated groundwater sufficiently characterized to evaluate response actions?*

   Yes. The horizontal and vertical extent of VOC-contaminated groundwater is sufficiently characterized to evaluate response actions. Horizontally, the TCE groundwater hot spot extends from beneath Building 296 approximately 2,800 feet to the northwest site boundary. Vertically, the hot spot is limited to the top 100 feet of the shallow aquifer on Site 24.

5. *Does VOC-contaminated groundwater beneath Site 24 contribute to an unacceptable risk to human health or the environment?*

   Yes. The risk associated with groundwater beneath the site is an excess cancer risk of 2.0~~1.3~~ $\times 10^{-3}$ for a resident adult. Again, this is only true if the resident utilizes groundwater for all consumptive purposes.

6. *Does the area being evaluated for a response action qualify for Early Action?*

   No. Site 24 is being recommended for long-term remedial action.

7. *Are pilot tests necessary to evaluate remedial alternatives as part of the RI/FS process?*

   Yes. Pilot tests are recommended to evaluate SVE and air sparging for their potential to remove VOCs from the vadose and saturated zones, respectively. The data collected during these pilot tests will be used to support the Phase II FS. Groundwater injection and capture tests will be performed to evaluate their potential to contain the VOC-contaminated groundwater on the Station.

7.2.1 Data Limitations and Recommendations for Future Work

The data collected during the Phase I and Phase II RIs are sufficient to characterize the nature and extent of VOCs at the site characterize potential HRA and support the development, evaluation, and selection of remedial action alternatives. Additional work recommended includes:

- performing pilot tests to evaluate the applicability of SVE and air sparging to remove VOCs at the site;
- performing pilot tests to evaluate groundwater extraction and injection wells;
- decommissioning abandoned well No. 4 by a licensed well driller to reduce the potential of cross contaminating the shallow and deeper aquifers; and
- refining the groundwater monitoring network based on the selected remedial action at Site 24.

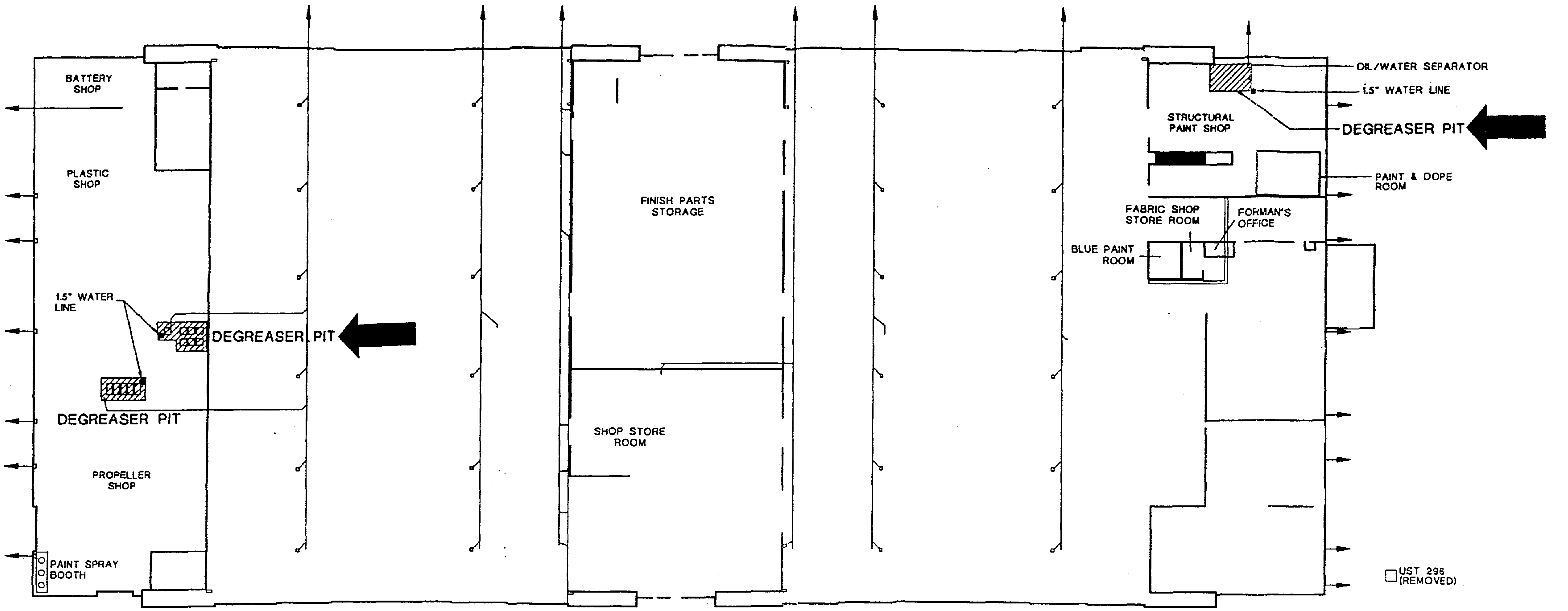
The results of the SVE and air-sparging pilot tests will be reported in the Phase II FS. The results of pilot testing the groundwater extraction and injection wells will be submitted as a separate report.

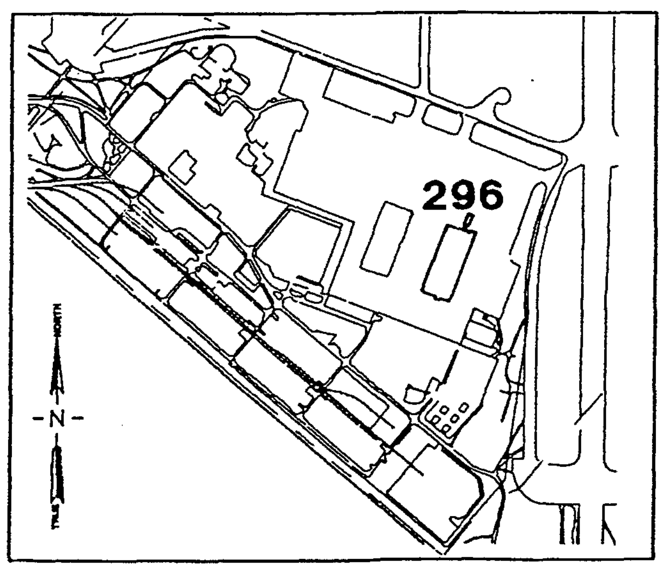
7.2.2 Recommended Remedial Action Objectives

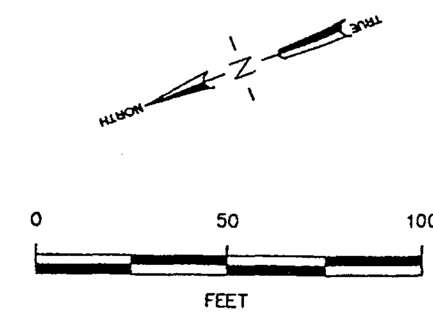
A Phase II FS report will be prepared that addresses VOCs in the soil and groundwater at OU-2A. The scheduled date for completion of the Draft Phase II FS report is 25 July 1996. An IAFS report is being prepared for OU-1 that addresses VOCs in the regional groundwater. The two FS reports are being coordinated to maintain consistency in the evaluation of remedial alternatives. To compare the relative benefits of potential remedial alternatives, the studies for OU-1 and OU-2A are utilizing equivalent groundwater models that simulate the infiltration of VOCs from the vadose zone to groundwater and the transport of VOCs in the Irvine groundwater subbasin. The OU-1 groundwater model has been modified to incorporate Phase II investigation data, such as the horizontal extent of the TCE groundwater hot spot and the VOC source in the vadose zone.

The OU-2A FS will consider remedial alternatives that add source removal to VOC groundwater plume containment alternatives that are described in the IAFS. The OU-2A FS will also describe no-action alternatives and OU-2A stand-alone alternatives that address both containment of the groundwater VOC plume and source removal.

Figures







NOTE:

THE FEATURES DEPICTED ON THIS FIGURE WERE TAKEN FROM A NAVY DOCUMENT, BUREAU OF AERONAUTICS ENGINEERING DRAWING 311466, DATED DECEMBER 22, 1944. THIS DRAWING WAS PROVIDED COURTESY OF THE MCAS EL TORO PUBLIC WORKS CENTER. DRAWING 311466 IS TITLED DELETION OF DISPENSARY CHANGES IN GROUND FLOOR PLUMBING. IT SHOWS THE LOCATIONS OF DEGREASER PITS AND SUBFLOOR STORM DRAIN LAYOUT THAT WAS DESIGNED INTO BUILDINGS 296 AND 297.

LEGEND

Symbol	Description
←	4" STORM DRAIN (ARROW SHOWS DIRECTION OF FLOW) SEE FIGURE 3.1 FOR STORMDRAIN NETWORK
•	1 1/2" COLD WATER DROP TO DEGREASER
UST 296 □	UNDERGROUND STORAGE TANK

Phase II RI Report

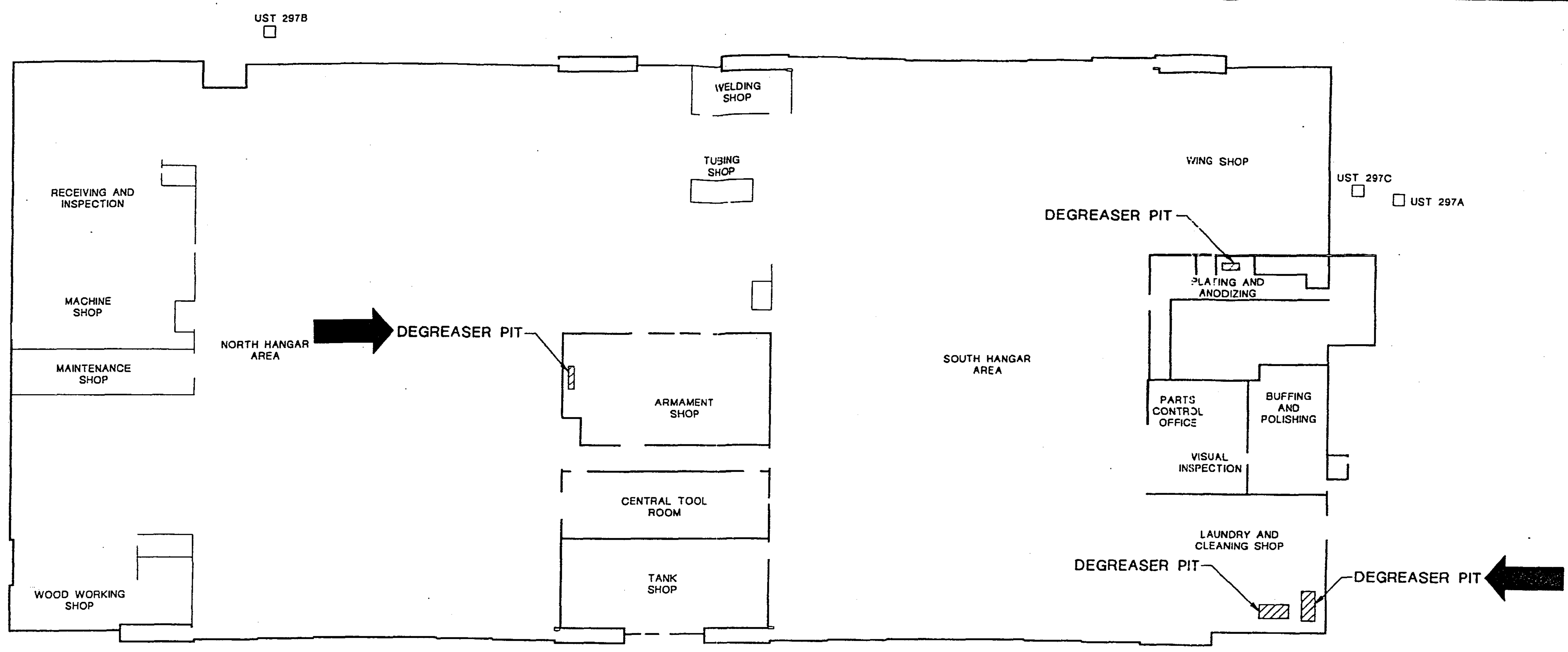
Figure 3-2

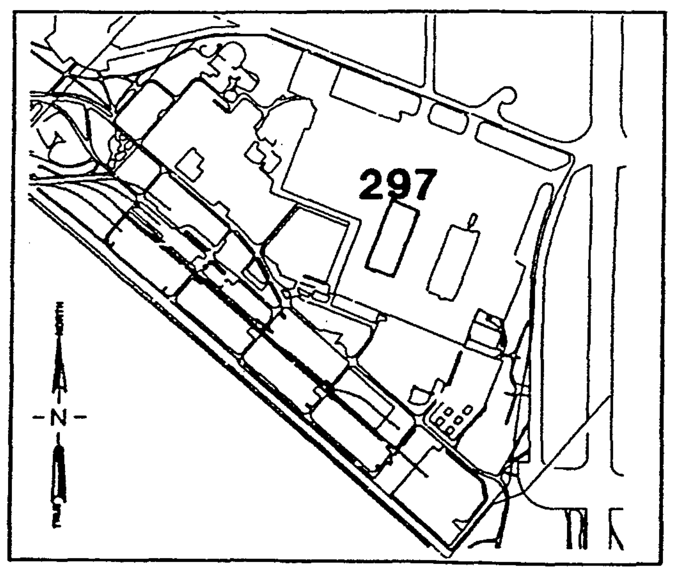
Floor Plan of Hangar Bldg (296)
Site 24

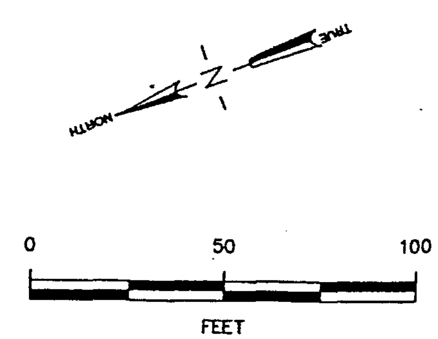
MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 2/6/96
File No: 073L0305
Job No: 22214-073
Rev No: D







NOTE:

THE FEATURES DEPICTED ON THIS FIGURE WERE TAKEN FROM A NAVY DEPARTMENT, BUREAU OF AERONAUTICS ENGINEERING DRAWING 311,496, DATED MAY 30, 1944. THIS DRAWING WAS PROVIDED FOR REVIEW COURTESY OF THE MCAS EL TORO PUBLIC WORKS CENTER.

DRAWING 311,496 IS TITLED GROUND FLOOR PLAN. IT SHOWS THE LOCATIONS OF DEGREASER PITS AND GENERAL USE, HOWEVER, IT DOES NOT SHOW THE SUBFLOOR STORM DRAIN LAYOUT. THE ORIGINAL FLOOR PLAN DOES REFER TO AN ACCOMPANYING FLOOR PLAN, DRAWING 311,498 FOR ADDITIONAL DETAILS INCLUDING PLUMBING. DRAWING 311,498 WAS NOT AVAILABLE FOR REVIEW.

PLEASE REFER TO FIGURE 3-2, FLOOR PLAN OF BUILDING 296, WHICH DOES INCLUDE THE SUBFLOOR STORM DRAIN LAYOUT. BUILDINGS 296 AND 297 WERE BUILT DURING THE SAME PERIOD AND ARE ASSUMED TO BE OF SIMILAR CONSTRUCTION. THEREFORE, BUILDING 297 IS ASSUMED TO HAVE STORMDRAINS PLUMBED INTO THE DEGREASER PITS THAT DISCHARGE TO THE MAIN STORMDRAIN NETWORK, SEE FIGURE 3-1. BUILDING 297 IS ALSO ASSUMED TO HAVE 1.5" COLD WATER DROP LINES PLUMBED INTO THE DGREASER PITS.

LEGEND

UST 297B □ UNDERGROUND STORAGE TANK

Phase II RI Report

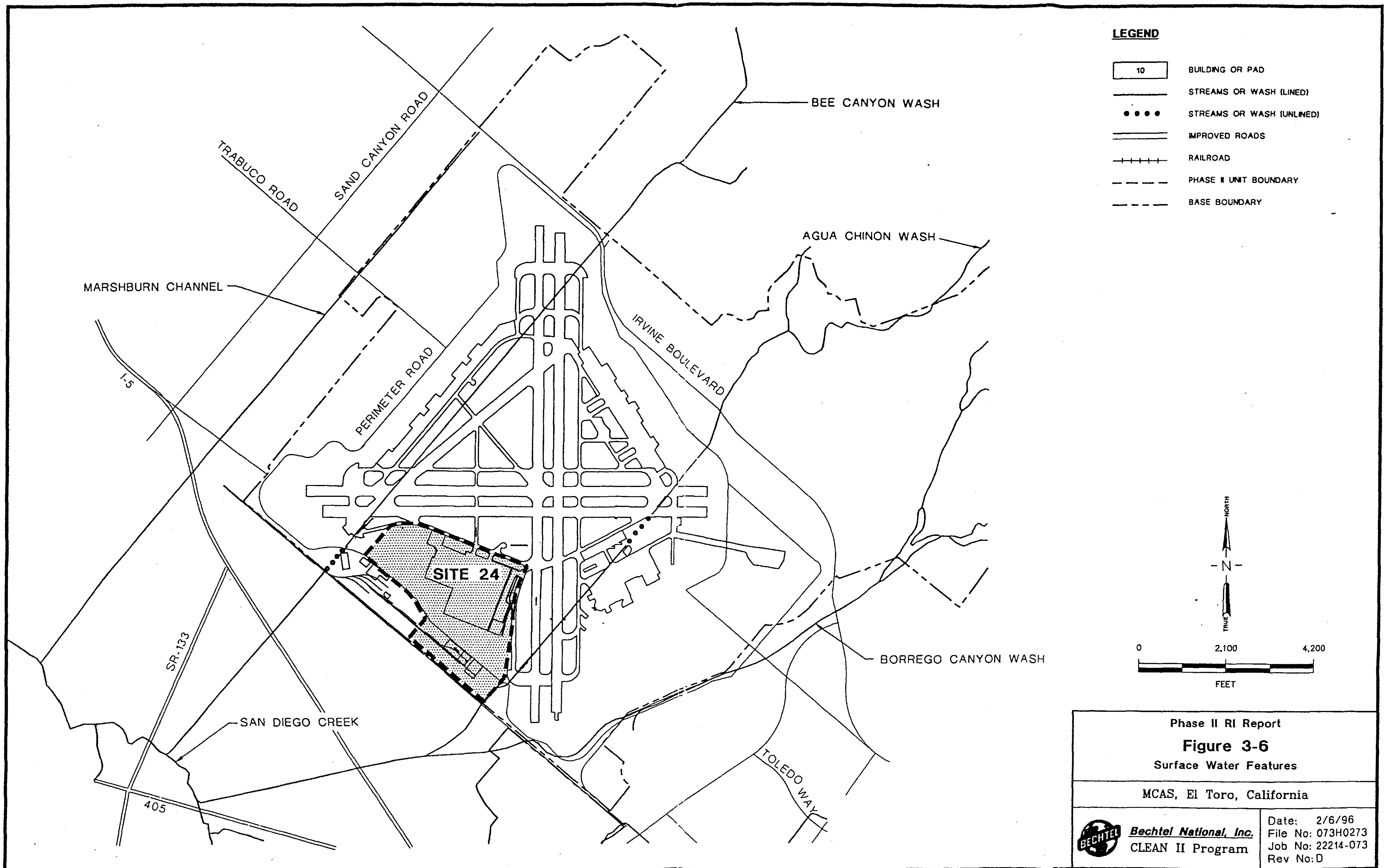
Figure 3-3

Floor Plan of Hangar Bldg (297)
Site 24

MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 2/6/96
File No: 073L0306
Job No: 22214-073
Rev No: D



Phase II RI Report

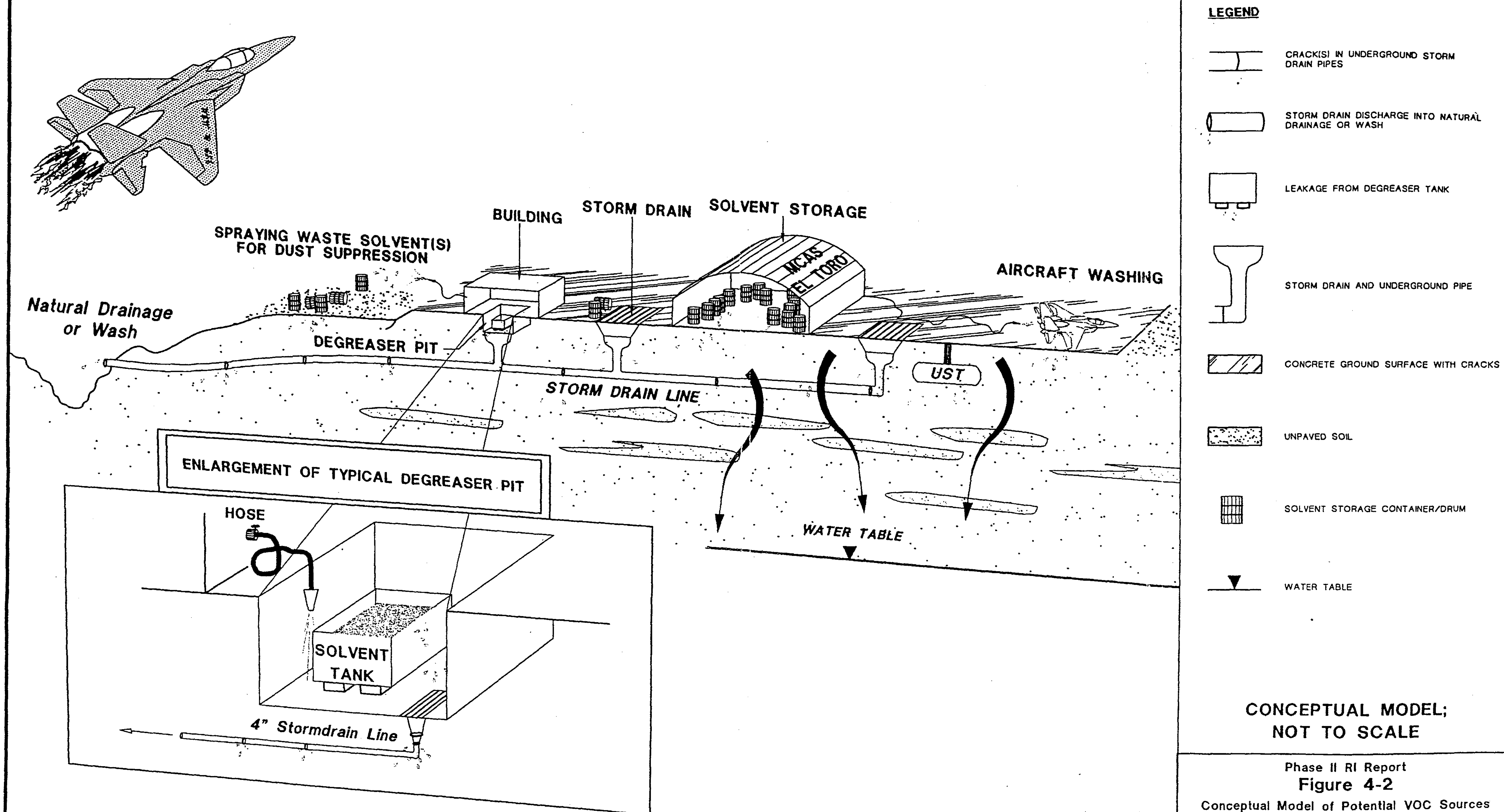
Figure 3-6

Surface Water Features

MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 2/6/96
File No: 073H0273
Job No: 22214-073
Rev No: D



CONCEPTUAL MODEL; NOT TO SCALE

Phase II RI Report

Figure 4-2

Conceptual Model of Potential VOC Sources
Site 24

MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 5/17/96
File No: 073S0400
Job No: 22214-073
Rev No: C

7.1.2 Fate and Transport

The fate and transport analysis assessed potential release mechanisms that may have introduced VOCs into the vadose zone, characterized the migration pathways through the vadose zone to the water table, defined VOC sources in the vadose zone, and described VOC transport in the groundwater. The major findings of the analysis are summarized below.

- Chlorinated solvents used for cleaning and degreasing are the likely sources of VOC contamination in the soil and groundwater. The use of TCE at the Station is not well documented. Based on common industrial practices of the time, it was assumed that TCE was used from about the time the Station was commissioned in 1943 until about 1975.
- Potential VOC sources include subsurface and surface sources. It appears likely that most of the contamination resulted from subsurface sources, such as storm drains, that exposed the site to frequent, small releases over a long period of time. Even though rainfall of MCAS El Toro is approximately 12 inches per year, the storm drain system received wastewater from activities inside Buildings 296 and 297, including those related to the degreaser pits. The building plan reviewed for Building 296 showed that the degreaser pits were tied to the storm drain system. Plumbing details for Building 297 were not available, but it was assumed that the layout was similar to Building 296. Although the actual degreasing solvent was held in a steel tank within the degreaser pit, occasional spillage into the pit could have been washed into the storm drain system. Surface contamination could have resulted from practices such as aircraft washing, waste disposal onto unpaved areas, and liquid waste sprayed for dust suppression.
- Most releases of TCE involved the use of water (e.g., washing and cleaning). It is likely that VOCs were introduced into the vadose zone in the dissolved phase; small amounts of DNAPL may also have been released but the magnitude of these releases was probably small. Collection of soil gas samples from the SVE will provide additional data to evaluate the potential presence of DNAPL in the vadose zone.
- Transport of VOCs through the vadose zone to groundwater with infiltrating surface water and leakage from storm drain piping was primarily vertical. Lateral spreading of contamination with depth also occurred, most likely due to heterogeneities in the stratigraphic sequence.
- Advective transport of TCE in groundwater has resulted in a TCE hot spot in groundwater that extends from the primary source beneath Buildings 296 and 297 to the northwest boundary of Site 24, and then continues off-Station at lesser concentrations for a distance of approximately 3 miles. The groundwater gradient was estimated at 0.0075 ft/ft to the northwest, and the linear groundwater velocity is estimated to be approximately 200 feet per year.

CALCULATION COVER SHEET

PROJECT CLEAN II Program	JOB NO. 22214-067	CALC NO. 2	SHEET 1
SUBJECT Order of Magnitude Estimation of the Storm Drain Leakage Rate at Site 24 MCAS El Toro, California		DISCIPLINE Geotechnical	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	x			

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	YES [ ] NO [x]				

Abstract

The purpose of this calculation is to provide an order of magnitude estimate of the leakage rate from the storm drainage system at Site 24 at MCAS El Toro, California. To assess the validity of this calculation, the flow rate through the drain was also estimated using the Manning Equation and compared to the computed leakage rate. Both values were then compared to industry standard design criteria and local annual rainfall.

Prepared by Nadim Copty
Checked by John Turbeville
Reviewed by Angelos Findikakis

		8	8				
No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date

Record of Revisions

Table of Contents

1. Introduction

In support of transport modeling efforts performed for Site 24 at MCAS El Toro, California, this calculation provides an order of magnitude estimate of the leakage rate from the storm drainage system at the site. For all key parameters whose actual values were missing, ranges of typical values are defined. Leakage through the storm drain is assumed to be through the joints connecting the pipe sections. Furthermore, the storm drain is assumed to be flowing half-full for 30 days per year. As a check, the flow rate through the drain is estimated using the Manning Equation and compared to the computed leakage rate. These values are also compared to annual rainfall and standard industry criteria.

CALCULATION SHEET

		PROJECT	*Clean II*
		JOB NUMBER	*22214-067*
		CALC NO.	*2*
SUBJECT	*Order of Magnitude Estimation of the Storm Drain Leakage Rate*	SHEET NO.	*4 of 8*
BY	*Nadim Copty* DATE *22 January, 1996*	SHEET REV	*0*

1. Mathematical Formulae

1.1. Leakage Rate

Leakage from the storm drain is assumed to be limited to the joints connecting the pipe line sections. Assuming that the pipe is circular, the leakage rate through one joint is:

$$Q_{L,1} = DwK_v i_v \qquad (1)$$

where

$Q_{L,1}$ leakage rate through one joint [L^3/T]

D diameter of the pipe [L]

w width of the joint (or crack) [L]

K_v Vertical hydraulic conductivity of the underlying material [L/T]

i_v vertical hydraulic gradient across the joint.

The total leakage rate through the entire length of the pipe line is:

$$Q_L = DwK_v i_v \frac{L}{S} \qquad (2)$$

where

L total length of drain system [L]

S Spacing between adjacent joints [L]

1.2. Flow Rate Through Storm Drain

The flow rate (in cfs) through the storm drain is estimated using the Manning Equation (Daugherty and Franzini):

$$Q_S = \frac{1.49}{n} A R_h^{2/3} S_h^{1/2} \qquad (3)$$

where

Q_S flow rate through the storm drain in units of cfs [L^3/T]

n Manning's roughness coefficient

A flow area [L^2]

R_h hydraulic radius [L]

S_h pipe line slope.

The hydraulic radius is defined as:

$$R_h = \frac{A}{P} \quad (4)$$

where P is the wetted perimeter. For example, for a half-full circular pipe:

$$P = \frac{1}{2}\pi D \quad (5)$$

$$A = \frac{1}{8}\pi D^2 \quad (6)$$

$$R_h = \frac{D}{4} \quad (7)$$

$$Q_S = \frac{0.232}{n} D^{8/3} S_h^{1/2} \quad (8)$$

Finally, the percentage of leakage ψ is given by:

$$\psi = \frac{Q_L}{Q_S} \times 100 = \frac{nwK_v i_v L}{0.232 D^{8/3} S_h^{1/2} S} \times 100$$

3. Input Parameters

A list of the input parameters used in the model is presented in Table 1. For all unknown parameters, a conservative range of values was defined:

- The storm drain is assumed to be circular, flowing half-full for 30 days of the year. In reality, the drain flow rate may be higher during intense rainfall events and lower during dry periods. The 30 day period represents the number of rainfall days per year. Leakage from the storm drain, however, will occur over longer periods, assumed in this calculation to be 90 days.
- The storm drain diameter is equal to 18 inches, obtained from available plans.
- The storm drain slope is also assumed to vary between 0.001 and 0.01. This range is considered typical for most sewer systems (Steel and McGhee, 1985).
- The storm drain length is estimated from available plans as approximately 10,000 feet.
- The joint spacing is equal to 20 feet, obtained from available plans.
- The width of joints (cracks) was arbitrarily assumed to range between 0.5 and 2 inches.
- The vertical hydraulic conductivity of the near surface material at the site was assumed to be 15 ft/day.
- Because the strom drain is located in the unsaturated zone, the hydraulic gradient was assumed to be approximately 1.
- Manning roughness coefficient was set to an average value of 0.013 which is typical of concrete and sewer pipelines (Table 11.1, Daugherty and Franzini, 1977).

Table 1: Input Parameters

Storm Drain		Circular, on average half-full for 30 days per year.
Storm Drain Diameter	D	1.5 feet
Storm Drain Slope	S_h	0.001 - 0.01
Strom Drain Length	L	10,000 ft
Joint Width	w	0.5 - 2 inches
Joint Spacing	S	20 ft
Vertical Hydraulic Conductivity	K_v	15 ft/day
Vertical Hydraulic Gradient	i_v	1

Manning Roughness Coefficient	n	0.013

2. Results

Using Equation (2), Equation (8) and the parameter ranges defined in Table 1, upper and lower limit leakage rates and drain flow rates are calculated. These results, along with the leakage percentage and storm drain velocities are presented in Table 2. The storm drain velocities were calculated by dividing the pipe line flow rate by the flow area.

The results presented in Table 2 are consistent with the amount of local rainfall and the general design criteria of sewer systems:

- The average annual rainfall at the site is approximately 1 ft/year. Assuming that drainage area is 2000 by 2000 feet, the total amount of rainfall feeding the storm drain is 4 x 10^6 ft^3/year, which is consistent with the estimated drain flow rate.
- The velocity range of 1.6 to 5.2 ft/s is in good agreement with the 2 to 8 ft/s generally required in the design of storm sewers (Steel and McGhee, page 357, 1979).
- Linsley and Franzini (page 460, 1979) also note that a common leakage rate from water distribution systems is 50-250 liters/day/cm pipeline diameter/kilometer of pipe which is equivalent to 6-30 ft^3/year/ft diameter/ft length. Based on the parameter values defined in Table 1, the expected leakage rate should vary between 60,000 and 600,000 ft^3/year which is again in agreement with the estimates presented in Table 2.

Table 2: Estimated Leakage Rates and Storm Drain Flow Rates

			Range[1]
Leakage Rate Equation (2)	Q_L	ft^3/year gpm	40,000 - 170,000 0.6-2.5
Storm Drain Flow Rate Equation (8)	Q_S	ft^3/year gpm	3,000,000-13,000,000 50-200
Strom Drain Flow Velocity	V_S	ft/s	1.6-5.2
Leakage Percentage Equation (9)	ψ		0.3-4 %

[1] computed based on the combination of input parameters that will produce the maximum and minimum value for each term.

3. List of References

Daugherty, R. L., and J. B. Franzini, 1977, Fluid Mechanics with Engineering Applications, Seventh Edition, McGraw-Hill International Book Company.

Linsley, R. K., and J. B. Franzini, 1979, Water-Resources Engineering, Third Edition, McGraw-Hill International Book Company.

Steel E. W., and T. J. McGhee, 1979, Water Supply and Sewerage, Fifth Edition, McGraw-Hill International Book Company.

APPENDIX H

EXTRACT
DRAFT FINAL
ENGINEERING DESIGN REPORT
SITE 24

Southwest Division
Naval Facilities Engineering Command
Contracts Department
1220 Pacific Highway, Building 127, Room 112
San Diego, California 92132-5187

Contract No. N68711-92-D-4670

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

CLEAN II

DRAFT FINAL ENGINEERING DESIGN REPORT
VADOSE ZONE REMEDIATION
SITE 24
MARINE CORPS AIR STATION
EL TORO, CALIFORNIA

Volume II of IV
Appendices B – E
CTO-0162/0085
December 1998

Prepared by:

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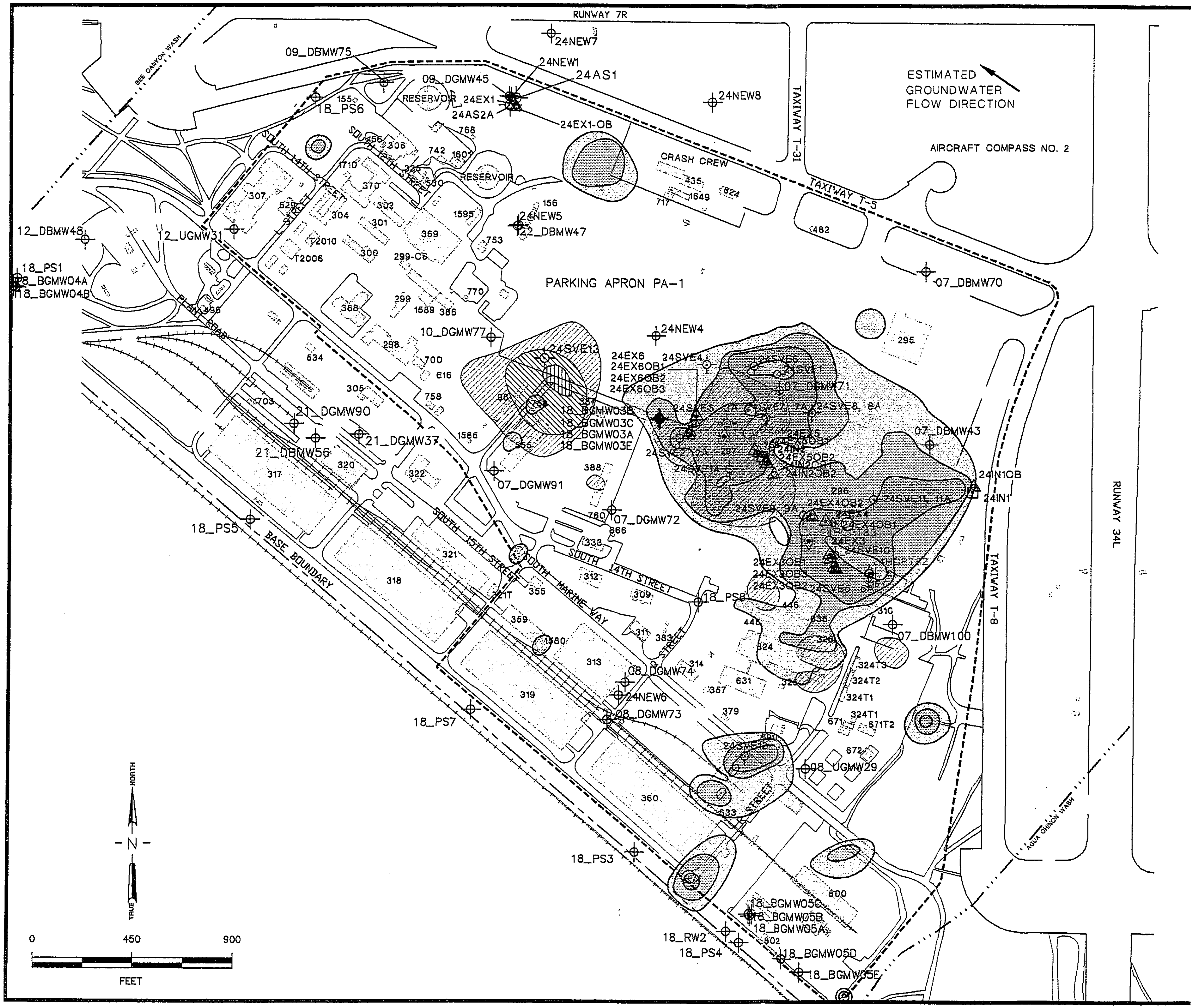
REGISTERED GEOLOGIST
EXP. 9/99
G. Patrick Brooks
No. 6347
STATE OF CALIFORNIA

Signature: G. Patrick Brooks Date: 12/15/98
G. Patrick Brooks, R.G., CTO Leader



LEGEND

- BUILDING OR PAD
- STREAMS OR WASH
- IMPROVED ROADS
- RAILROAD
- SITE 24 BOUNDARY
- BASE BOUNDARY

SOIL GAS CONCENTRATIONS IN THE SHALLOW ZONE (0-30 ft. bgs)

- 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
- 1.0 TO 5.0 ug/L PCE
- 5.0 TO 50.0 ug/L PCE
- 50.0 TO 500.0 ug/L PCE

EXISTING:

- MONITORING WELL
- AIR SPARGING WELL
- SOIL VAPOR EXTRACTION WELL
  - 24SVE7 - SCREENED NEAR WATER TABLE
  - 24SVE7A - SCREENED IN INTERMEDIATE ZONE

NOTE:

SOIL GAS SAMPLES COLLECTED DURING PHASE I RI (JUNE 1994)

Engineering Design Report

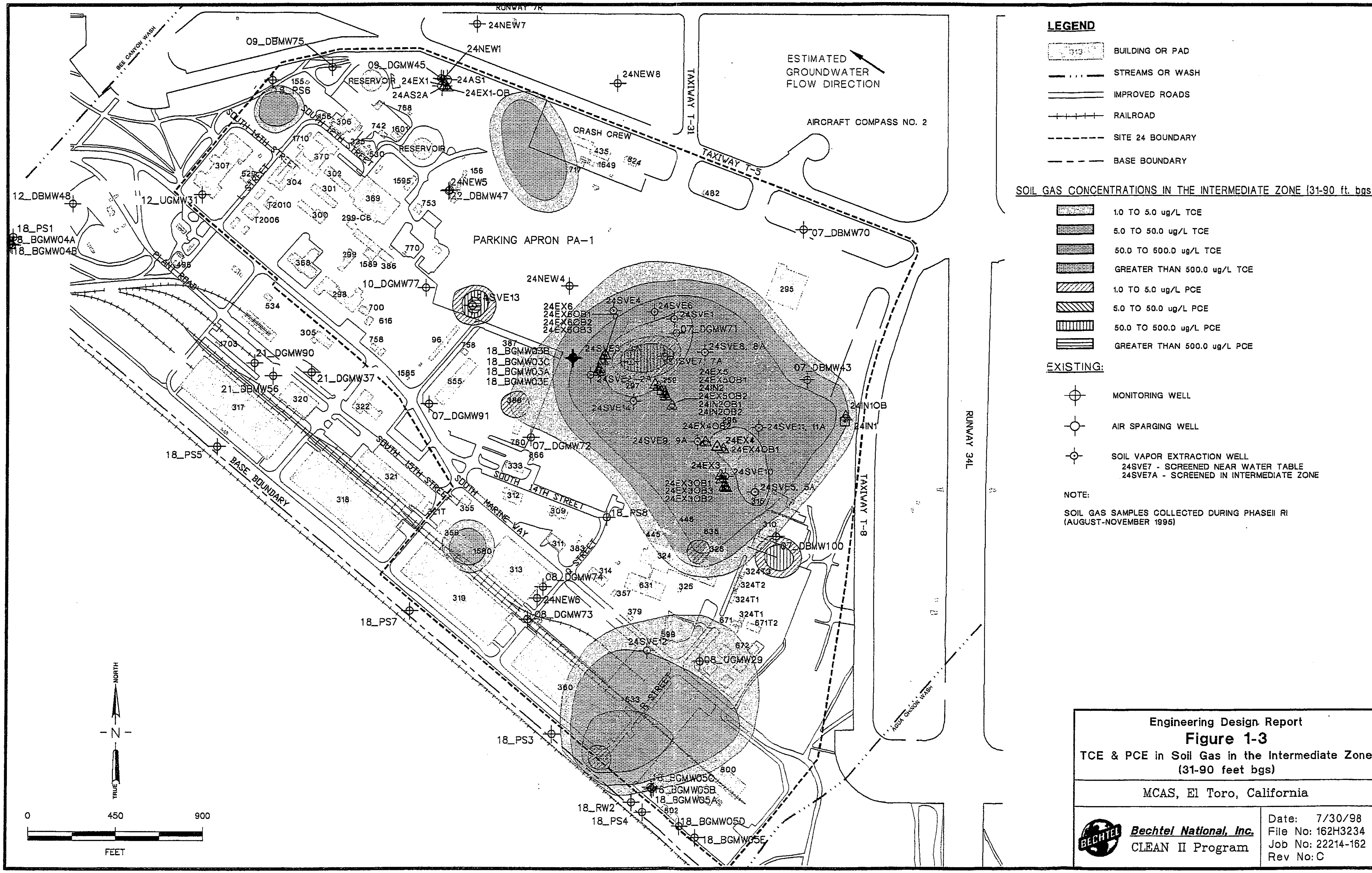
Figure 1-2

TCE & PCE in Soil Gas in the Shallow Zone (0 - 30 feet bgs)

MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 8/3/98
File No: 162H3235
Job No: 22214-162
Rev No: D



Engineering Design Report

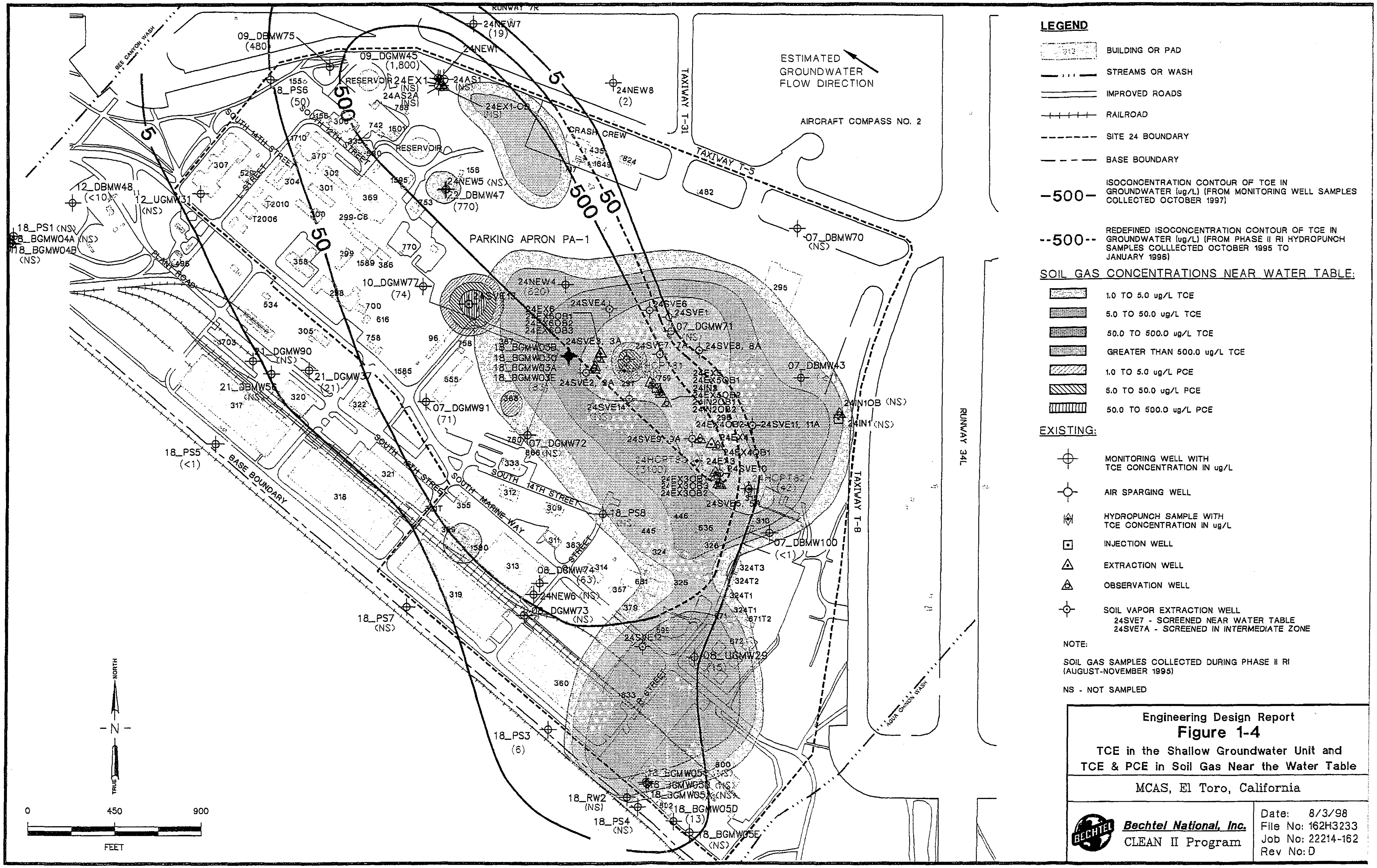
Figure 1-3

TCE & PCE in Soil Gas in the Intermediate Zone (31-90 feet bgs)

MCAS, El Toro, California

Bechtel National, Inc.
CLEAN II Program

Date: 7/30/98
File No: 162H3234
Job No: 22214-162
Rev No: C


LEGEND
BUILDING OR PAD
STREAMS OR WASH
IMPROVED ROADS
RAILROAD
SITE 24 BOUNDARY
BASE BOUNDARY
-500- ISOCONCENTRATION CONTOUR OF TCE IN GROUNDWATER (ug/L) (FROM MONITORING WELL SAMPLES COLLECTED OCTOBER 1997)
--500-- REDEFINED ISOCONCENTRATION CONTOUR OF TCE IN GROUNDWATER (ug/L) (FROM PHASE II RI HYDROPUNCH SAMPLES COLLLECTED OCTOBER 1995 TO JANUARY 1996)
SOIL GAS CONCENTRATIONS NEAR WATER TABLE:
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
1.0 TO 5.0 ug/L PCE
5.0 TO 50.0 ug/L PCE
50.0 TO 500.0 ug/L PCE
EXISTING:
MONITORING WELL WITH TCE CONCENTRATION IN ug/L
AIR SPARGING WELL
HYDROPUNCH SAMPLE WITH TCE CONCENTRATION IN ug/L
INJECTION WELL
EXTRACTION WELL
OBSERVATION WELL
SOIL VAPOR EXTRACTION WELL
24SVE7 - SCREENED NEAR WATER TABLE
24SVE7A - SCREENED IN INTERMEDIATE ZONE
NOTE:
SOIL GAS SAMPLES COLLECTED DURING PHASE II RI (AUGUST-NOVEMBER 1995)
NS - NOT SAMPLED
ESTIMATED GROUNDWATER FLOW DIRECTION
AIRCRAFT COMPASS NO. 2
PARKING APRON PA-1
RUNWAY 34L
TAXIWAY T-8
TAXIWAY T-31
TAXIWAY T-5
SOUTH 14TH STREET
SOUTH 12TH STREET
SOUTH MARINE WAY
BASE BOUNDARY
BEE CANYON WASH
AGUA CHINON WASH
09_DBMW75 (480)
09_DGMW45 (1,800)
24NEW7 (19)
24NEW8 (2)
22_DBMW47 (770)
07_DBMW70 (NS)
10_DGMW77 (74)
07_DBMW43
07_DGMW91 (71)
07_DGMW72
18_PS5 (<1)
18_PS6 (50)
18_PS7 (NS)
18_PS3 (6)
18_PS4 (NS)
18_RW2 (NS)
08_UGMW29 (15)
07_DBMW100 (<1)
18_BGMW05D (13)
12_DBMW48 (<10)
12_UGMW31 (NS)
21_DGMW37 (21)
21_DGMW90 (NS)
21_DBMW56 (NS)
08_DGMW74 (63)
08_DGMW73 (NS)
0 450 900
FEET
N
TRUE NORTH
Engineering Design Report
Figure 1-4
TCE in the Shallow Groundwater Unit and TCE & PCE in Soil Gas Near the Water Table
MCAS, El Toro, California
Bechtel National, Inc.
CLEAN II Program
Date: 8/3/98
File No: 162H3233
Job No: 22214-162
Rev No: D

APPENDIX I

EXTRACT, STATION MAP LEGEND
U.S. MARINE COPRS AIR STATION
PUBLIC WORKS DEPARTMENT

F2	(
32	DO
32	DO
32	DO
G2	DO
32	GROUP PARACHUTE BLDG.
32	GROUP ENGINE SHOP
32	HANGAR (GROUP)
31	GROUP MAINT. SHOP
31	GROUP DOPE & SPRAY BLDG.
31	STOREHOUSE
G1	GROUP ELECTRONICS SHOP
G1	TACTICAL PHOTO LAB.
F1	STOREHOUSE
F1	DO
F1	STOREHOUSE
F1	DO
E1	TRAINING BLDG (NAMT)
E1	STOREHOUSE
31	INCINERATOR (SECURED)
31	DO DO
32	LINE MAINTENANCE
32	GROUP OXYGEN SHOP
31	LINE MAINTENANCE
E2	DO
	NOT CONSTRUCTED
A4	GENERATOR BLDG.
B2	PUMPHOUSE BOOSTER
B2	WATER PRESSURE TANK-10,000 GAL
A5	WELL-IRVINE CO.
A5	PUMPHOUSE BOOSTER (IRVINE CO.)
A5	DO.
A5	STORAGE (P.W.)
C7	PUMP PIT (IRVINE CO)
F7	PUMPHOUSE-WELL NO 1
F8	PUMPHOUSE-WELL NO 2
D8	PUMPHOUSE-STANDBY

268	B3	DO
269	A3	DO
270	B3	DO
271	A1	THEATRE
272	B3	BOWLING ALLEY
273	B2	POST OFFICE
274	A2	BARRACKS (ENLISTED)
275	B2	DO
276	A2	DO
277	B2	DO
278	A2	DO
279	B2	DO
280	A2	SPECIAL SERVICES & EDUCATION BLDG.
280A	A2	GARBAGE HOUSE (SECURED)
281	B2	MESSHALL (ENLISTED)
281A	B2	GARBAGE HOUSE

373	AA-2	ELEV WATER TANK 300,000 GA
374	I-5	UTILITY BLDG
374A	I-5	FUEL OIL STOR TANK - 1,000 BB
374B	I-5	WATER PRESS TANK - 10,000 GA
375	A-7,8	BACHELOR OFFICERS' QTRS
375A	A-8	SEWAGE LIFT STATION
376	B-3	FIRE ALARM HDQTRS BLDG
377	I-5	WATER STOR TANK - 316,000 GAL
378	F-3	FIELD LIGHING VAULT
379	G-9	MOTOR TRUCK SCALE - 50 TON
380	H-1	GENERATOR BLDG.
381	E-5	CRASH CREW SHELTER
382	A-4	SUBSTATION NO. 1 (ELECTRIC)
383	F-9	DO. 2 DO.
384	J-6	DO. 3 DO.
385	H-1	DO. 4 DO.
386	E-8	LUBRICATION BLDG (P.W. TRANS

P.W. DRAWING NO. PS-1537

U. S. MARINE CORPS AIR STATION

EL TORO, CALIFORNIA

PUBLIC WORKS DEPARTMENT

AREA E-7 [41] + E-3 [9]

STATION MAP

PROP. ARRESTING GEAR RUNWAYS 25L + 34R

DRAWN BY: J. SIMMON

TRACED BY: J. SIMMON

DESIGNED BY E. T.

CHECKED BY [signature]

SUBMITTED BY [signature]

MGR 2+5 BRANCH

APPROVED [signature] DESIGN DIRECTOR

APPROVED [signature] PUBLIC WORKS OFFICER

DATE 15 OCT. 5

SATISFACTORY TO [signature]

DATE 15 OCT 53

SCALE 1" = 600'

SPEC

SHEET 1 OF 1

NO

Y & D DRAWING NO

LEGEND OF FACILITIE

NO	LOC	USE
A	A5	OFFICERS' QUARTERS
B	A5	OFFICERS' QUARTERS
1	A4	ADMIN (TA.) & TELEPHONE RM
2	C3	HANGAR (SQDN)
3	C4	LINE MAINT
4	C4	LINE MAINT
5	C4	HANGAR (SQDN)
6	C4-5	ADMINISTRATION (- [illegible]C)
7	C5	HANGAR (SQDN)
8	C5	LINE MAINT
9	C5	LINE MAINT
10	C6	HANGAR (SQDN.)
11	B6	ADMINISTRATION (SQDN.)
12	B5	DO
13	B4	DO
14	B3	DO
15	B3	STOREHOUSE
16	B3	DO
17	B4	STOREHOUSE
18		REMOVED
19	B5	STOREHOUSE
20	B5	DO
21	B5	GROUP [illegible] SHOP
22	B6	STOREHOUSE
23	B5	DO
24	B6	COLDSTORAGE BLDG
25	B6	STOREHOUSE
26	B6	DO
27	B6	DO
28	B7	DO
29	B7	DO
30	B7	SALES COMMISSARY
30A	B7	STOREHOUSE
31	B7	STOREHOUSE
32	A7	BACHELOR OFFICERS' QTRS
33	A7	DO
34	A7	DO
35	A7	DO
36	A7	DO
37		SURVEYED
38	A7	OFFICERS' MESS (CLOSED)
39	A7	OFFICERS' CLUB
40	A6	BACHELOR OFFICERS' QTRS
41	A6	DO
42	A6	DO
43	A6	DO
44	A6	DO
45	A6	DO

NO	LOC	USE
156	D8	PRESSURE TANK - [illegible]0,000 GAL
157		REMOVED INC IN BLDG 306
158		NOT CONSTRUCTED
159	D9	SEWAGE DISPOSAL GROUP
159A	D9	CHLORINE BLDG
159B	D9	PUMPHOUSE
159C	D9	CHLORINE CONTACT
159D	D9	SECONDARY SETTLING TANK
159E	D9	CLARIGESTER
159F	D9	SECONDARY CLARIFIER
159G	D9	SLUDGE DIGESTER
159H	D9	TRICKLING FILTER
159I	D9	PRIMARY SETTLING TANK
159J	D9	TRICKLING FILTER
159K	D9	STOREHOUSE
159L	D9	STANDBY POWER BLDG
159M	D9	PUMP SUMP EFFLUENT
159N	D9	BOOSTER PUMPHOUSE EFFLUENT
159O	D9	PARSHALL FLUME & METER BLDG
159P	D9	GRIT COLLECTOR
159Q	D9	GAS HOLDER
159R	D9	HEAT EXCHANGER
160		REMOVED
161		DO.
162		DO.
163	J5	READY SERVICE STOR MAGAZINE
164	J5	STORAGE WAREHOUSE
165	J6	DO.
166	I6	DO.
167	I7	DO.
168		REMOVED
169	J6	READY SERVICE STOR MAGAZINE
170	JK5	DO.
171	K5	DO.
172	K4	DO.
173		REMOVED
174	E8	1,000,000 GAL RESERVOIR
175	D8	DO
176	B6	[illegible] STORAGE TANK 25,000 GAL.
177	B6	DO 50,000 GAL
178	B6	DO 50,000 GAL
179	B6	DO 25,000 GAL
180	B6	MOGAS STORAGE TANK 25,000 GAL.
181	B6	DO 50,000 GAL
182	B6	DO 50,000 GAL
183	B6	DO 25,000 GAL
184	B7	AVGAS STORAGE TANK 25,000 GAL.
185	B7	DO 50,000 GAL
186	B7	DO 50,000 GAL
187	B7	DO 50,000 GAL
188	B3	DO 25,000 GAL
[illegible]	B3	DO 50,000 GAL

44	A6	DO
45	A6	DO
46	B6	TRAINING BLDG (CLERICAL SCH.)
47	B6	GROUP DOPE & SPRAY BLDG.
48	B6	GROUP MAINT. SHOP
49	B5	HANGAR (GROUP)
50	B5	STOREHOUSE
51	B5	GROUP ELEC. & ORD. SHOP
52	B5	GROUP ENGINE SHOP
53	B5	GROUP PARACHUTE BLDG.
54	B4	STATION BRIG
55	—	REMOVED
56	B4	TRAINING BLDG (NAMT)
57	B4	SWIMMING POOL
58	A4	BARRACKS & AD 4-
59	A4	ADMINISTRATION (MRI-5)
60	A4	DO (NAVY RELIEF)
61	A4	GUARD HOUSE
62	A4	ADMINISTRATION (SECURITY)
63	A4	FAMILY DISPENSARY
64	A4	STATION HOSPITAL
64A	A4	BOILER HOUSE
64B	A4	GARBAGE HOUSE
65	A5	ADMINISTRATION (AIR FMF PAC.)
66	A3	ADM. (MARINE DISBURSING)
66A	A3	STORAGE BLDG
67	A3	ENLISTED MEN'S CLUB
67A	A3	GARBAGE HOUSE
68	A3	BARRACKS (ENLISTED)
69	A3	DO
70	A3	DO
71	A3	DO
72	A3	DO
73	A3	DO
74	A2-3	TRAINING BLDG. (BASIC)
75	A2-3	MARINE EXCHANGE
75A	A3	GARBAGE HOUSE
76	-	REMOVED (INC IN BLDG 75)
77	A2	BARRACKS (ENLISTED)
78	A2	BARRACKS (ENLISTED)
79	A2	DO
80	A2	DO
81	A2	DO
82	A2	DO
83	A2	~~WELFARE BUILDING~~
83A	A2	STORAGE
84	A2	STAFF NCO CLUB
84A	A2	GARBAGE HOUSE
85	A2	SPECIAL SERVICES GARAGE

187	B7	DO	50,000 GAL
188	B3	DO	25,000 GAL
189	B3	DO	50,000 GAL
190	B3	DO	50,000 GAL
191	B3	DO	25,000 GAL
192	B3	JET FUEL STORAGE TANK 25,000 GAL.	
193	B3	DO	50,000 GAL
194	B3	DO	50,000 GAL
195	B3	DO	25,000 GAL
196	E2	DO	25,000 GAL
197	E2	DO	50,000 GAL
198	E2	DO	50,000 GAL
199	E2	DO	25,000 GAL
200	E3	AVGAS STORAGE TANK 25,000 GAL.	
201	E3	DO	50,000 GAL
202	E3	DO	50,000 GAL
203	E1	DO	25,000 GAL
204	H2	JET FUEL STORAGE TANK 50,000 GAL.	
205	H3	DO	25,000 GAL
206	H2	DO	50,000 GAL
207	H2	DO	50,000 GAL
208	H2	DO	50,000 GAL
209	H2	DO	25,000 GAL
210	H2	DO	25,000 GAL
211	H2	DO	50,000 GAL
212	H2	DO	50,000 GAL
213	H2	DO	25,000 GAL
214	H2	DO	25,000 GAL
215	H2	DO	50,000 GAL
216	E1	FUEL OIL TANK	50,000 GAL
217	E1	DO	25,000 GAL
218	E1	DO	25,000 GAL
219	B3	DO	50,000 GAL
220	B3	DO	25,000 GAL
221	B3	DIESEL FUEL STOR. TANK 25,000 GAL	
222	A2	ELEV WATER TANK 200,000 GAL	
223	A5	SENTRY HOUSE	
224	B7	ADMINISTRATION (STA. ORD.)	
225	B7	ORDNANCE MAINTENANCE BLDG.	
226	B7	STORAGE	
227	B7	TRAINING BLDG. (ORD)	
228	A3	ADM. (REENLISTING OFF [illegible])	
229	F2	LINE MAINTENANCE	
230	F2	STORAGE	
231	F2	DO	
232	F2	LINE MAINTENANCE	
233	F2	STORAGE	
234	-	REMOVED	
235		DO	
236		DO	

84	A2	STAFF NCO CLUB
84A	A2	GARBAGE HOUSE
85	A2	SPECIAL SERVICES GARAGE
86	A2	DO
87	K7-8	GOLF COURSE CLUB HOUSE
88		REMOVED (INC IN BLDG 91)
89		REMOVED (INC IN BLDG 96)
90	E8	~~LABOR SHOP (P.W.)~~
91	D8	GROUNDS BLDG
92	A1	ADM. (SPECIAL SERVICES)
93		REMOVED
94	A1	GYMNASIUM
95		REMOVED
96	E9	HEAVY DUTY SHOP (P.W. TRANS.)
97	E8	STOREHOUSE
98	B3	FIRE STATION NO. 1
99	B3	LINE MAINTENANCE
100	C4	DO
101	C5	LINE MAINTENANCE
102	C5	DO
102A	C5	DO
103	B6	DO
104	A5	STORAGE BLDG. (P.W.)
105	G1	ADMINISTRATION (GROUP)
106	E2	HANGAR (SQDN.)
107	F2	LINE MAINTENANCE
108	F2	DO
109	F2	HANGAR (SQDN.)
110	G2	DO
111	G2	A.A.G.M. BUILDING
112	G2	LINE MAINTENANCE
113	G2	HANGAR (SQDN.)
114	G2	ADMINISTRATION (SQDN)
115	G2	DO
116	F2	DO
117	E-F2	DO
118	E1	STOREHOUSE
119	F1	DO
120	F2	DO
121	F2	DO
122	B2	DO
123	G2	DO
124	G2	DO
125	G2	DO
126	G2	GROUP PARACHUTE BLDG.
127	G2	GROUP ENGINE SHOP
128	G2	HANGAR (GROUP)
129	G1	GROUP MAINT. SHOP
130	G1	GROUP DOPE & SPRAY BLDG.

233	F2	STORAGE
234		REMOVED
235		DO
236		DO
237		DO
238	B5	STORAGE
239	A6	HOMOJA HUTS
240	B6	STOREHOUSE
241	B6	A[illegible] (SUP) & STORAGE
242	B7	STOREHOUSE
243	B7	ADM [illegible] (SQDN)
244	C7	HANGAR (SQDN)
245	B7	[illegible]NICS & CAMERA SHO
246	B7	MARINE EXCHANGE STORAGE
247	A7	BACHELOR OFFICERS' QTRS
248	A7	DO
249	A7	DO
250	A7	DO
251	A7	OFFICERS' MESS (OPEN)
251A	A6	GARBAGE HOUSE
252		REMOVED
253	A6	MARRIED OFFICERS' QTRS
254	A6	DO
255	A6	BACHELOR OFFICERS' QTRS
256	B5	TRAINING BLDG (A T [illegible])
257	B4	ADMINISTRATION (LEGAL)
258	A4	HOSTESS HOUSE
259	A4	BARRACKS (ENLISTED)
260	A-B4	DO
261		REMOVED
262	A4	MESSHALL (ENLISTED)
262A	A4	GARBAGE HOUSE
263	A3	MESSHALL (ENLISTED)
263A	A3	GARBAGE HOUSE
264	B3	HOBBY SHOP (SPL. SERV.)
264A	B3	MARINE EXCHANGE STORAGE
265	A3	BARRACKS (ENLISTED)
266	B3	DO
267	A3	DO
268	B3	DO
269	A3	DO
270	B3	DO
271	A1	THEATRE
272	B3	BOWLING ALLEY
273	B2	POST OFFICE
274	A2	BARRACKS (ENLISTED)
275	B2	DO
276	A2	DO
277	B2	DO
278	A2	DO

128	G2	HANGAR (GROUP)
129	G1	GROUP MAINT. SHOP
130	G1	GROUP DOPE & SPRAY BLDG.
131	G1	STOREHOUSE
132	G1	GROUP ELECTRONICS SHOP
133	G1	TACTICAL PHOTO LAB.
134	F1	STOREHOUSE
135	F1	DO
136	F1	STOREHOUSE
137	F1	DO
138	E1	TRAINING BLDG (NAMT)
139	E1	STOREHOUSE
140	G1	INCINERATOR (SECURED)
140A	G1	DO DO
141	G2	LINE MAINTENANCE
142	G2	GROUP OXYGEN SHOP
143	G1	LINE MAINTENANCE
144	E2	DO
145		NOT CONSTRUCTED
146	A4	GENERATOR BLDG
147	B2	PUMPHOUSE BOOSTER
148	B2	WATER PRESSURE TANK-10,000 GAL
149	AA5	WELL-IRVINE CO.
150	AA5	PUMPHOUSE BOOSTER (IRVINE CO.)
151	AA5	DO.
152	A5	STORAGE (P.W.)
153	C7	PUMP PIT (IRVINE CO)
153A	F7	PUMPHOUSE - WELL NO 1
154	E8	PUMPHOUSE - WELL NO 2
155	D8	PUMPHOUSE - STANDBY

275	B2	DO
276	A2	DO
277	B2	DO
278	A2	DO
279	B2	DO
280	A2	SPECIAL SERVICES & EDUCATION BLDG
280A	A2	GARBAGE HOUSE (SECURED)
281	B2	MESSHALL (ENLISTED)
281A	B2	GARBAGE HOUSE

P.W. DRAWING NO. PS-1537

U. S. MARI

PUBLI

AREA

S

PROP.

RUN

DRAWN BY: J. SIMMON

TRACED BY: J. SIMMON

DESIGNED BY E. T.

CHECKED BY [signature]

SUBMITTED BY [signature]

MGR 2.5 BRANCH

APPROVED [signature] DESIGN DIRECTOR

APPROVED [signature] PUBLIC WO

SATISFACTORY TO [signature]

DATE 15 OCT 53

S

NO	LOC	USE
282	A2	BARRACKS (ENLISTED)
283	A1	DO
284	A1	MARRIED ENLISTED MEN'S QTRS
285	B2	PASTRY SHOP & STORAGE
285A	B2	BOILER HOUSE
285B	B2	GARBAGE HOUSE
286	B2	ELECTRONICS SHOP & STOR.
~~287~~	~~B2~~	STOREHOUSE
288	C2	ADMINISTRATION ([illegible])
289	C2	HANGAR (SQDN.)
290	E1	MEDICAL STORAGE BLDG
291	F1	STOREHOUSE
292	F2	ADMINISTRATION (GROUP)
293	G1	WATER RESERVOIR 1,000,000 GAL
294	H5	ADMINISTRATION (GROUP)
294A	H5	GENERATOR BLDG.
295	F-G7	HANGAR (AIR FMF PAC) 3RD MAW)
296	G8	HANGAR (MWSG-37)
297	F8	HANGAR (MWSG-37-TRANS2 [illegible]-352)
298	E9	MAINT. SHOP & ADM. (P.W. TRANSP.)
299	E9	PAINT & SPRAY SHOP (PW TRANS)
300	D9	CARPENTER SHOP (P.W)
301	D8	PAINT SHOP (PW)
302	D8	TOOL RM & SHOPS
303	D8	MATERIAL CONTROL (PW)
304	D8	ADMINISTRATION (IRD)
305	E9	STORAGE
306	D8	ELECTRIC SHOP (P.W.)
306A		REMOVED
306B		REMOVED
307	D8-9	STATION LAUNDRY
307A	D9	LAUNDRY BOILER PLANT
308	G1	PUMPHOUSE BOOSTER
309	F9	ADMINISTRATION BLDG
310	G8	STOREHOUSE
311	F9	FIRE STATION NO. 2
312	F9	STATION PHOTO LAB.
313	F9	GENERAL WAREHOUSE
314	G9	HEATING PLANT
315	G8	GROUP MACHINE SHOP
316	G8	COMPRESSOR BLDG
317	E-F9-10	WAREHOUSE
318	E-F9-10	DO
319	F9-10	DO
320	E9	PAINT & CHEMICALS STOREHOUSE
321	E-F9	NAVY SUPPLY ADM. & RECEIVING
322	E9	CIVILIAN CAFETERIA
323	D-E9	UNLOADING PLATFORM
324	G9	STORAGE (SECURED TEST CELLS)

324	G9	STORAGE (SECURED TEST CELLS)
325	G9	HAZARDOUS MATERIALS BLDG
326	G8-9	STORAGE (SECURED TEST CELLS)
327	B4	BARRACKS (ENLISTED-WM)
328	B4	ADMINISTRATION (WING)
329	A4	STORAGE
330	D8	GROUNDS BLDG (PW)
331	D8	PUMP PIT (WELL NO. 5-SURVEYED)
332	E8	PUMPHOUSE WELL NO 6
333	F9	ADMINISTRATION (GROUP)
334	F2	DO (SQDN.)
335	D8	~~PUMPHOUSE~~
335A	D8	WATER PRESS TANK - 10,000 GAL
336	A9	SENTRY HOUSE
337	A2	CHAPEL
338A	G9	ENGINE TEST STAND "K" TYPE
338B	G9	DO.
338C	G9	DO.
339	G1	SENTRY HOUSE
340A	D9	SLUDGE SUMP IND WASTE PLANT
340B	D9	SETTLING BASIN IND WASTE PLANT
340C	D9	DO
340D	D9	CHEMICAL STOR IND WASTE PLANT
341	G1	PUMPHOUSE-NAMAR BOOSTER
342	G1	WATER PRESSURE TANK 10,000 GAL
343	H4	STORAGE
344		RECESS[illegible] SEE DWG 81586
345	EFGI	MARRIED ENLISTED MEN'S QTRS
346	A5-6	MARRIED OFFICERS' QTRS
347	A3	SERVICE STA-MAR EXCHANGE
348	D8	GREENHOUSE
349	H-1	ROTATING LIGHT BEACON
350A	I6	EFFLUENT TANK 420,000 GAL.
350B	I6	DO
350C	I6	PUMPHOUSE-EFFLUENT
351	B7	NAVY THRIFT SHOP
352	G2	LINE MAINTENANCE
353	H2	LINE MAINTENANCE
354	K4	SKEET RANGE
355	F9	TRANS & EQUIP OFF-NAVY-SUPPLY
356	[illegible]	PISTOL RANGE
357	G9	GARBAGE HOUSE
358	A-10	MWD PUMPHOUSE
358A	A-10	WATER PRESS TANK - 700 GAL
359	F-9	PRESERVATION-BLDG
360	G-9,10	WAREHOUSE
361A	M-102	MAGAZINE, HIGH EXPLOSIVE
361B	L-102	DO.
361C	L-103	DO.
361D	L-104	MAGAZINE-FUSE & DETONATOR
361E	M-104	DO.
361F	M-105	MAGAZINE-SMOKE DRUM STORAGE
361G	M-106	MAGAZINE-HIGH EXPLOSIVE
361H	L-105	DO.
361-I	L-105	DO.

361J	K-104	MAGAZINE-SML. ARMS & PYRO.
361K	L-104	DO.
362A	J-101	JET FUEL TANK - 15,500 BBLS
362B	J-101	DO.
362C	K-101	DO.
362D	JK-101	DO.
362E	JK-102	DO.
362F	JK-101	FUEL FARM OFFICE
362G	J-101	CONTAMINATED FUEL STOR TANK
362H	J-101	DO.
362I	J-101	FUEL FARM OFFICE
362J	K-101	PIPELINE MANIFOLD STATION
363	H-2	METERING STATION
363A	H-2	TANK TRUCK LOADING STAND
363B	H-2	DO.
363C	H-2	DO.
363D	H-2	DO.
363E	H-2	DO.
363F	H-2	DO.
363G	H-2	DO.
363H	H-2	DO.
364	AA-BB2	MESSHALL
365	AABB-23	BARRACKS (ENLISTED)
366	AA-2-3	DO.
367	AA 2-3	DO.
368	D-9	ADMINISTRATION (PW)
369	D,E-8	WAREHOUSE
370	D-8	METAL TRADES SHOP
371	I-5	HANGAR (GROUP)
372	F-3	OPER BLDG & CONT TOWER
373	AA-2	ELEV WATER TANK - 300,000 GAL
374	I-5	UTILITY BLDG
374A	I-5	FUEL OIL STOR TANK - 1,000 BBL
374B	I-5	WATER PRESS TANK - 10,000 GAL
375	A-7,8	BACHELOR OFFICERS' QTRS
375A	A-8	SEWAGE LIFT STATION
376	B-3	FIRE ALARM HDQTRS BLDG
377	I-5	WATER STOR TANK - 316,000 GAL
378	F-3	FIELD LIGHING VAULT
379	G-9	MOTOR TRUCK SCALE - 50 TON
380	H-1	GENERATOR BLDG.
381	E-5	CRASH CREW SHELTER
382	A-4	SUBSTATION NO. 1 (ELECTRIC)
383	F-9	DO. 2 DO.
384	J-6	DO. 3 DO.
385	H-1	DO. 4 DO.
386	E-8	LUBRICATION BLDG (P.W. TRANSP.)

NE CORPS AIR STATION

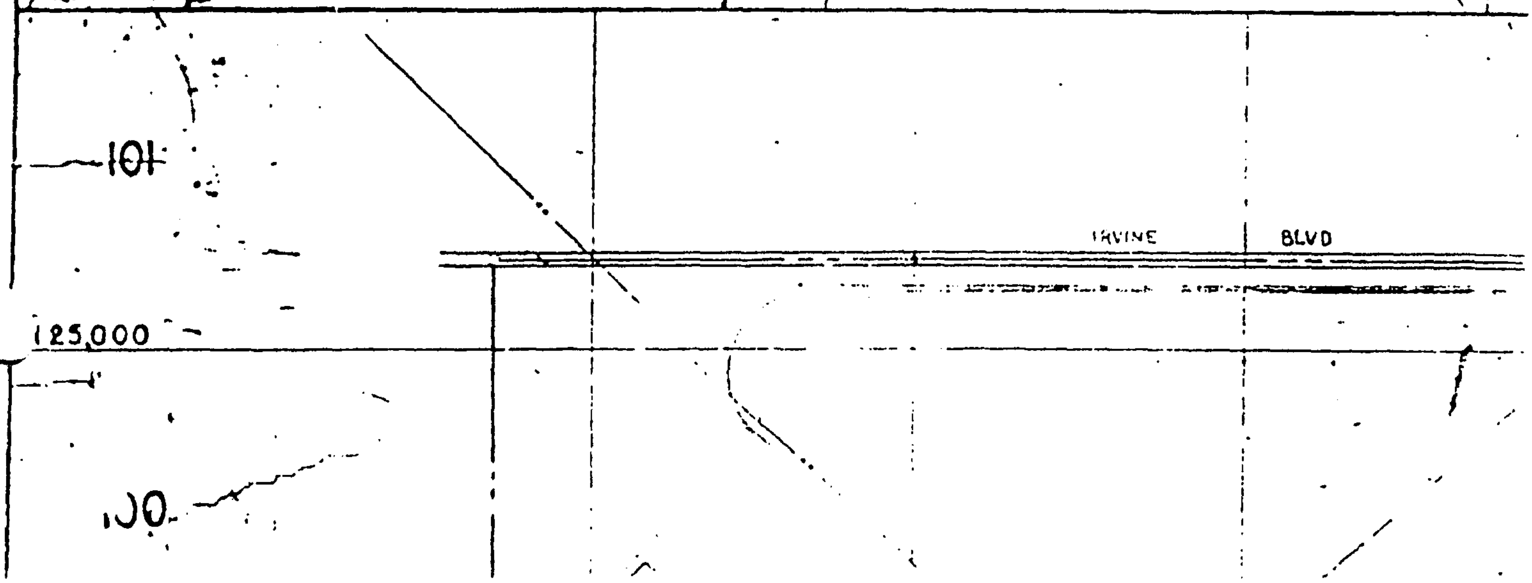
EL TORO, CALIFORNIA

; WORKS DEPARTMENT

LEGEND OF FACILITIES

NO.	LOC.	USE	NO.	LOC.	USE
387	F-5	LOADING PLATFORM	433	D-3	GCA
388	F-8,9	Field MAINTENANCE SHOP	433A	C-3	LOW FREQUENCY HOMER
389	J-4	LOADING PLATFORM	434	B-3	BASKET BALL COURT
390	K-4	[illegible] MAINTENANCE SHOP	435	E-7	CRASH CREW FACILITY
391	G-1	LOADING PLATFORM	436	L-2	TURBO JET ENGINE TEST STAND
392	[illegible]	[illegible] MAINTENANCE SHOP	437	[illegible]	WHERRY HOUSING
393	E-4	RECREATION BLDG (NM)	438	G-100	NAMAR HOUSING
394	K-101	RADIO RECEIVER BLDG	439	AA-4	STATION HOSPITAL
394A	K-101	GENERATOR BLDG			
394B	K-101	RADIO HIGH FREQ ANTENNA			
394C	K-101	DO.			
394D	K-102	DO.			
394E	K-101	RADIO LOW FREQ ANTENNA			
394F	K-101	DO.			
395		NOT ASSIGNED			
395A	E/F-3	HIGH SPEED FUELING STATION			
395B	F-3	DO.			
395C	G-3	DO.			
395D	G-3	DO.			
396	H-2	CONTAMINATED FUEL LOADING RACK			
397	F-3	HIGH SPEED FUEL PUMP HSE. & OFFICE			
398	F-3	HIGH SPEED FUELING DAY TANK			
399	E-4	VOR FACILITIES			
400	E-5	TACAN FACILITY			
401	F-101	STABLES TACK ROOM			
402	"	" TOILET			
403	"	" BUNK HOUSE			
404	H-5	TRANSMITTER BLDG.			
405	J-4	ASSEMBLY BLDG. (SW)			
406	"	TRAINING BLDG. (SW)			
407	"	GUARD HOUSE (SW)			
408	"	" TOWER (SW)			
409	"	" TOWER (SW)			
410	AA&B-1	BASE BALL FIELDS			
411	A-B-1	TENNIS COURTS			
412	[illegible]	VOLLEY BALL COURTS			
413	AA-1	HAND BALL COURTS			
414	H-5	GENERATOR BLDG. (TRANSMITTER)			
415	E-100	WAREHOUSE			
416	L-4	SHORT RANGE RATCC			

416-A	" "	GENERATOR BLDG. (RATCC)
416-B	" "	RATCC ANTENNA TOWER
417	F-3	GENERATOR BLDG. (RATCC)
418	D-3	PRECISION RATCC
419	C-4	SALUTING BATTERIES
420	A-5	STATION FLAG POLE
421	A-6	TENNIS COURTS
422	A-3	" "
423	" "	" "
424	" "	" "
425	L-3-4	TRASH BURNING PIT
426	A 1	TENNIS & HANDBALL COURTS
427	B-2	" " "
428	A-3	" " "
429	A-2	TENNIS COURTS
430	A-4	" "
431	L-102	OBSTRUCTION LIGHT
432	B-1-2	FOOTBALL FIELD & TRACK



APPENDIX J

BUILDING GUIDE
MCAS, EL TORO
APRIL 22, 1996

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
1	P3	Telephone Exchange	Sta/G-6	13140	EBMO	327[illegible]
1	P3	Admin(A&R,Compt,G-1,Insp)	Station	61010	EBFO	340[illegible]
1	P3	Squadron Headquarters	H&HS	61010	EBFO	9084 SF
2	O5	Hangar Bay (SAR)	SOMS	21105	EBVO	6740 SF
2	O5	Crew/Equipment Space	SOMS	21106	EBVO	3630 SF
3	P5	Material/IMRL	SOMS	21106	EBVO	1560 SF
4	P5	Search and Rescue (SAR)	SOMS	14120	EBNO	1560 SF
5	P5	Auto Organizational Shop	MWCS-38	21451	EBBO	10370 SF
6	P5	Provost Marshal/Secur. Hdqrts	Sta/PMO	73020	EBLO	9226 SF
7	Q5	Storage Out of Stores	MWHS-3	44112	EBDO	10370 SF
8	Q5	Storage Out of Stores	MTACS-38	44112	EBDO	1560 SF
9	Q5	Storage Out of Stores	MTACS-38	44112	EBDO	1560 SF
10	R5	Aero Club Hangar	MWR/Rec	74075	EBLO	10370 SF
11	R4	Squadron Headquarters	MTACS-38	61072	EBFO	3960 SF
12	Q4	Group Headquarters	MWHS-3	61072	EBFO	3960 SF
13	P4	Group Headquarters	MWCS-38	61072	EBFO	3960 SF
14	O4	Squadron Headquarters	MWCS-38	61072	EBFO	3960 SF
15	O4	Elec/Comm Maint Shop	MWCS-38	21710	EBBO	3120 SF
15	O4	Radio Supply	MWCS-38	44112	EBDO	3120 SF
16	O4	Storage out of Stores	MWCS-38	44112	EBDO	6240 SF
17	P4	Elec/Comm Maint Shop	MWCS-38	21710	EBBO	6240 SF
19	Q4	Squadron HQs	MWHS-3	61072	EBFO	6240 SF
20	Q4	Maintenance/Storage	13th Dental	21871	EBBO	1560 SF
20	Q4	Storage out of Stores	MWHS-3	44112	EBDO	4680 SF
21	Q4	General Storage Shed	MWCS-38	44135	EBDO	640 SF
22	R4	Elec/Comm Maint Shop	MTACS-38	21710	EBBO	6240 SF
23	R4	Storage out of Stores	MTACS-38	44112	EBDD	6240 SF
25	R4	Construction Shop	MWSS-373	21820	EBDO	6240 SF
26	R4	Communication Shop	MWSS-373	21820	EBBO	6240 SF
27	R4	Food Services Storage	MWSS-373	21820	EBFO	4160 SF
27	R4	PMO Storage	PMO	73020	EBFO	2080 SF
28	S4	Food Services	MWSS-373	21820	EBBO	4160 SF
29	S4	Storage	3rd MAW G-2	17177	EBAO	480 SF
29	S4	NIS Field Office	NIS	61010	EBFO	5760 SF
31	S4	Utilities Shop/TAFDS	MWSS-373	21820	EBBO	6240 SF
32	S3	BOQ, W-1/O-2	Sta/G-4	72411	EBKO	20 PN
33	S3	BOQ, W-1/O-2 Transients	Sta/G-4	72411	EBKO	20 PN
34	S3	BOQ, W-1/O-2	Sta/G-4	72411	EBKO	20 PN
35	S3	BOQ, W-1/O-2 Transients	Sta/G-4	72411	EBKO	20 PN
38	S3	Young Marines/Boy Scouts/CAP	Sta/G-4	61010	EBFO	9290 SF
38	S3	Museum Storage	Sta/G-4	76010	ECNO	100 SF
46	R4	Reproduction	Sta/G-4	61010	EBFO	2280 [illegible]
47	R4	Constr/Wt. Handlg Equip Shop	Vacant	21820	EBBO	2980 [illegible]
48	R4	FIIU Headquarters	MWHS-3	61072	EBFO	5148 [illegible]
49	Q4	Storage out of Stores	MWSS-373	44112	EBDO	12000 SF
49	Q4	Squadron Headquarters	MWSS-373	61072	EBFO	5088 [illegible]
49	Q4	Academic Instruction	MWSS-373	61072	EBFO	4978 [illegible]
50	Q4	Academic Instruction	Vacant	17110	EBAO	312[illegible]
50	Q4	Squadron Headquarters	Vacant	61071	EBFO	3120 [illegible]
51	Q4	Auto Organizational Shop	Vacant	21451	EBBO	6240 SF
52	Q4	Storage out of Stores	MWHS-3	44112	EBDO	4224 SF
53	Q4	Ground Safety	Env/Gr Safety	61010	EBFO	4035 [illegible]
54	P4	Law Center	SJA	61040	EBFO	11374 [illegible]

BLDG #	GRID	DESCRIPTION	TENANT	[illegible]	[illegible]	[illegible]	
56	P4	Ground Safety	Env/Safety	17110	EBAO	1928	.
56	P4	Squadron Headquarters	MWCS-38	61072	EBFO	3106	SF
56	P4	TAAC Office	MTACS-38	61072	EBFO	6440	SF
57	P4	Bathhouse	Training	74089	EBLO	9310	SF
58	P3	Admin(TBO), Billeting G-4	Station	61010	EBFO	1500	SF
58	P3	JRC/TMO/SATO/Supply/TBO	Sta/G-4	61010	EBFO	19785	SF
58	P3	Family Hsg Serv Office	Installation	71000	EBFO	1935	SF
59	P3	Admin Office	JPAO	61010	EBFO	5696	SF
60	P3	Reserve Support Unit	RSU	61010	EBFO	5376	SF
65	Q3	Station Headquarters	Sta/G-4/Compt	61010	EBFO	16320	SF
66	O3	Disbursing Office	Compt	61010	EBFO	12418	SF
75	N3	Fire Headquarters	Security	61010	EBFO	3053	SF
75	N3	Ticket Sales Office	MWR-Rec	74009	EBLO	3382	SF
75	N3	Nearly New Shop	Station	74034	EBLO	8885	SF
75	N3	Phone Center	Vacant	74082	EBLO	1363	SF
75	N3	Indoor Playing Court	MWR-Rec	74084	EBLO	1656	SF
75	N3	Admin Office	MWR-HQ	74084	EBFO	25361	SF
77	N3	Admin (MWR)	MWR-Support	61010	EBFO	10941	SF
77	N3	Exchange Maint Shop	MWR-Retail	74016	EBLO	3300	SF
77	N3	Exchange Warehouse	Vacant	74085	EBLO	4710	SF
83	N3	Religious Ministry Facilities	Chaplain	73083	EBLO	6240	SF
83	N3	Red Cross/Navy Relief	Sta/G-1	74012	EBLO	5940	SF
94	M3	Gymnasium	MWR-Rec	74043	EBLO	23123	SF
96	U7	Transportation Office	Sta/G-4	61010	EBFO	4128	SF
98	O4	Fire Station #1	Station	73010	EBLO	6732	SF
99	O4	Flight Line Storage	SOMS	21115	EBVO	79	SF
105	M9	Dental Clinic	13th Dental	54010	EBEO	330	SF
105	M9	Group Headquarters	MALS-11	61072	EBFO	11528	SF
114	N9	Maint Hangar OH Space	HMM-166	21105	EBVO	12800	SF
114	N9	Maint Hangar O1 Space	HMM-166	21106	EBVO	7291	SF
114	N9	Maint Hangar O2 Space	HMM-166	21107	EBVO	5141	SF
115	N9	Maint Hangar OH Space	HMM-161	21105	EBVO	12830	SF
115	N9	Maint Hangar 01 Space	HMM-161	21106	EBVO	7454	SF
115	N9	Maint Hangar 02 Space	HMM-161	21107	EBVO	5130	SF
118	M7	Maint Hangar O1 Space	HMM-364	21106	EBVO	5100	SF
118	M7	Maint Hangar O2 Space	HMM-364	21107	EBVO	1140	SF
119	M8	Maint Hangar O2 Space	HMM-364	21106	EBVO	5260	SF
119	M8	Maint Hangar O1 Space	HMM-364	21107	EBVO	980	SF
120	M8	Maint Hangar O1 Space	HMM-163	21106	EBVO	5928	SF
120	M8	Maint Hangar O2 Space	HMM-163	21107	EBVO	312	SF
121	N8	Maint Hangar O1 Space	HMM-163	21106	EBVO	2000	SF
121	N8	Fire Station #3	Sta/G-1	73010	EBLO	4240	SF
122	N9	Maint Hangar 01 Space	HMM-161	21106	EBVO	5340	SF
122	N9	Maint Hangar 02 Space	HMM-161	21107	EBVO	900	SF
123	N9	Maint Hangar 01 Space	HMM-161	21106	EBVO	1190	SF
123	N9	Maint Hangar 02 Space	HMM-161	21107	EBVO	5050	SF
124	N9	Maint Hangar 01 Space	HMM-166	21105	EBVO	5840	SF
124	N9	Snack Bar #14	Vacant	74005	EBLO	400	SF
125	N9	Maint Hangar 01 Space	HMM-166	21106	EBVO	4224	SF
126	N9	Maint Hangar 02 Space	HMM-166	21109	EBVO	4224	SF
127	N9	Tire Storage Paint	MALS-11	44112	EBDO	4026	SF
129	M9	Aviation Armament	MALS-11	21154	EBVO	3900	SF
130	M9	Aviation Paint Area	MALS-11	21106	EBVO	2906	SF

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
131	M9	Storage	MALS-11	44112	EBDO	6240 SF
132	M9	Aviation Armament Shop	MALS-11	21154	EBVO	6240 SF
133	M9	Housing Storage	Vacant	71477	EBBO	3390 SF
134	M8	Hangar Maint Admin	HMM-163	21107	EBVO	6240 SF
135	M8	EM Mess	Vacant/G-4	72210	EBHO	6240 SF
136	M8	NBC Storage	MAG-11	44112	EBDO	6240 SF
137	M8	Academic Instruction	MATCS-38(DETB)	17110	EBAO	3120 SF
137	M8	Storage	MAG-11	44112	EBDO	3120 SF
138	M7	Electronics Maint Div	Sta/G-6	21710	EBBO	6240 SF
139	M7	3rd MAW Embark	MWHS-3	44112	EBDO	6240 SF
142	N9	Hazardous/Flam Storage	MALS-11	44130	EBDO	640 SF
146	P3	Standby Generator Bldg	Installation	81159	EAAO	360 SF
147	N4	Post Office Boxes Bldg	CSSD-14	73085	EBLO	829 SF
152	Q3	Grnds Equip Shed	Installation	21920	EBBO	112 SF
155	T6	Grnds Equip Shed	Installation	21920	EBBO	260 SF
156	T6	Storage Tank/Potable Water	Installation	84140	EAQO	10000 GA
163	Q12	Inert Storehouse	Vacant	42132	EBDO	1250 SF
164	Q12	Inert Storehouse	Vacant	42132	EBDO	1250 SF
165	R12	Haz/Flam Storage (AVN Sup)	MALS-11	44130	EBDO	1250 SF
166	R11	Inert Storehouse	Vacant	42132	EBDO	1250 SF
167	S11	Inert Storehouse	Vacant	42132	EBDO	1250 SF
169	R12	NBC Storage	MWSS-373	44112	EBDO	140 SF
170	Q13	Inert Storehouse	Vacant	42132	EBDO	1250 SF
171	Q13	Inert Storehouse	Vacant	42132	EBDO	140 SF
172	P13	Inert Storehouse	Vacant	42132	EBDO	1250 SF
174	T7	Storage Tank/Potable Water	Installation	84140	EAQO	1000000GA
175	T6	Storage Tank/Potable Water	Installation	84140	EAQO	1000000GA
176	R4	JP-5 Tank	Vacant (DLA)	12430	ECJO	25000 GA
177	R4	JP-5 Tank	Vacant (DLA)	12430	ECJO	50000 GA
178	R4	JP-5 Tank	Vacant (DLA)	12430	ECJO	46577 GA
179	R4	JP-5 Tank	Vacant (DLA)	12430	ECJO	24424 GA
180	R4	Heating Oil	Vacant (DLA)	82160	EBPO	24490 GA
181	R4	Heating Oil	Vacant (DLA)	82160	EBPO	43368 GA
182	R4	Heating Oil	Vacant (DLA)	82160	EBPO	46388 GA
183	R4	Heating Oil	Vacant (DLA)	82160	EBPO	24495 GA
189	O4	Waste Oil Storage	Supply	41182	ECJO	50000 GA
191	O4	Waste Oil Storage	Vacant(Supply)	41182	ECJO	25000 GA
196	N7	Diesel Fuel Storage	Vacant (DLA)	12450	ECJO	25000 GA
197	N7	Diesel Fuel Storagee	Vacant (DLA)	12450	ECJO	50000 GA
198	N7	A/C Ready Fuel Storage	Vacant (DLA)	12430	ECJO	50000 GA
199	N7	A/C Ready Fuel Storage	Vacant (DLA)	12430	ECJO	25000 GA
200	M7	A/C Ready Fuel Storage	Vacant (DLA)	12430	ECJO	25000 GA
201	M7	A/C Ready Fuel Storage	Vacant (DLA)	12430	ECJO	50000 GA
202	M7	A/C Ready Fuel Storage	Vacant (DLA)	12430	ECJO	50000 GA
203	M7	A/C Ready Fuel Storage	Vacant (DLA)	12430	ECJO	25000 GA
204	N10	A/C Ready Fuel Storage	Vacant (DLA)	12430	ECJO	50000 GA
205	O10	A/C Ready Fuel Storage	Vacant (DLA)	12430	ECJO	25000 GA
206	N10	Storage Premium Gas	Supply	12450	ECJO	50000 GA
207	N10	Storage Premium Gas	Supply	12450	ECJO	50000 GA
208	N10	Storage ACFT Fuel Storage	Supply	12430	ECJO	46452 GA
209	N10	Storage ACFT Recycled Fuel	Supply	12430	ECJO	25000 GA
210	N10	Storage ACFT Fuel Storage	Vacant (DLA)	12430	ECJO	25000 GA
211	N10	Storage ACFT Ready Fuel	Supply	12430	ECJO	50000 GA

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
212	N10	Storage ACFT Fuel Storage	Vacant (DLA)	12430	ECJO	46449 GA
213	N10	ACFT Fuel Storage Recycled	Supply	12430	ECJO	24525 GA
214	N10	Storage ACFT Fuel Storage	Vacant (DLA)	12430	ECJO	24463 GA
215	N10	ACFT Ready Fuel Storage	Supply	12430	ECJO	46451 GA
216	M7	Vehicle Ready Storage	Vacant	12450	ECJO	46379 GA
217	M7	Vehicle Ready Storage	Vacant	12450	ECJO	24487 GA
218	M7	Motor Gas Fuel Storage	Vacant	12450	ECJO	24462 GA
230	M9	Paint Locker	MAG-11	21931	EBBO	78 SF
231	N8	Paint Locker	MAG-11	21931	EBBO	78 SF
240	R4	Contract Refueler Facility	Vacant (G-4)	44110	EBDO	2000 SF
241	R4	Storage	Vacant	44111	EBDO	10800 SF
241	R4	Laundry Pickup Point	Vacant	73040	EBLO	3600 SF
242	S4	Museum	Sta Training	76010	ECNO	6240 SF
243	S4	Historical Ctr	Training	76010	ECNO	4160 SF
244	S5	Historical Collection	Training	76010	ECNO	10370 SF
245	S4	Storage Air/Ground	MWSG-37	44112	EBDO	6400 SF
248	S3	BOQ Quarters	Sta/G-4	61010	EBFO	8576 SF
249	S3	VIP Quarters (Transients)	Sta/G-4	72411	EBKO	15 PN
250	S3	VIP Quarters (Transients)	Sta/G-4	72412	EBKO	2 PN
251	S3	Conference Center	Sta/G-4	61010	EBFO	1282 SF
251	S3	Recreation Pavillion	Sta/G-4	74078	EBLO	2000 SF
251	S3	Bathhouse	Training	74089	EBLO	1017 SF
256	Q4	Aviation Phy Training (APTU)	Nav Hosp	17120	EBAO	10984 SF
256	Q4	Medical Clinic	Nav Hosp	55010	EBEO	2072 SF
257	P4	Admin Office	SJA	61010	EBFO	4596 SF
263	O3	Education Service Office	Training	74088	EBLO	8679 SF
264	O4	Arts and Crafts Hobby Shop	MWR/Rec	74036	EBLO	3725 SF
264	04	MWR Rental Office	MWR/Rec	74037	EBLO	8679 SF
271	M3	Auditorium	Training	17125	EBAO	26733 SF
272	O4	Bowling Center/SB #4	MWR-Rec	74040	EBLO	14664 SF
273	N4	Post Office	CSSD-14	73085	EBLO	5104 SF
275	N4	3rd MAW Band Training	MWHS-3	17120	EBAO	12960 SF
276	N3	Storage	Vacant	72111	EBDO	12960 SF
277	N4	Barracks	Vacant	72111	EBGO	12960 SF
279	N4	Drug Alcohol Counselling	Sta/G-1	73081	EBLO	6480 SF
279	N4	Family Services	Sta/G-1	74025	EBLO	6480 SF
280	N3	Library	MWR-Rec	74076	EBLO	6480 SF
285	N4	Supply Warehouse MC	Supply	44111	EBDO	3048 SF
285	N4	Club System Warehouse	MWR-Support	74085	EBLO	12952 SF
288	N5	SOMS HQ	SOMS	14120	EBNO	1120 SF
288	N5	Maint Hangar 02 Space	SOMS	21107	EBVO	1120 SF
288	N5	Maint Hangar 01 Space	SOMS	21106	EBVO	1920 SF
289	N5	ACFT Operations - VAL	SOMS	14140	EBNO	440 SF
289	N5	Maint Hangar OH Space	SOMS	21105	EBVO	6800 SF
289	N5	Maint Hangar 01 Space	SOMS	21106	EBVO	2690 SF
289	N5	Maint Hangar 02 Space	SOMS	21107	EBVO	440 SF
290	M7	General Storage	MAG-11	44112	EBDO	4000 SF
291	M8	NBC Storage	MAG-11	44112	EBDO	14400 SF
292	N8	Admin Supply	MALS-16	17120	EBAO	9103 SF
292	N8	NASEU	3rd MAW	61010	EBFO	2012 SF
292	N8	Admin Supply	MALS-16	61072	EBFO	2011 SF
293	M9	Storage Tank/Potable Water	Installation	84140	EAQO	1000000 GA
295	S8	Maint Hangar OH Space Hangar	HMM-764	21105	EBVO	22418 SF

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
295	S8	Maint Hangar 01 Space	HMM-764	21106	EBVO	9000 SF
295	S8	Maint Hangar 02 Space	HMM-764	21107	EBVO	9000 SF
296	T9	Armory	MAG-46	14325	EBPO	1152 SF
296	T9	Maint Hangar OH Space	Vacant	21105	EBVO	38400 SF
296	T9	Maint Hangar OH Space	MALS-46	21105	EBVO	38400 SF
296	T9	Maint Hangar 01 Space	Vacant	21106	EBVO	19200 SF
296	T9	Maint Hangar 01 Space	MALS-46	21106	EBVO	43200 SF
296	T9	Maint Hangar 02 Space	Vacant	21107	EBVO	19200 SF
296	T9	Maint Hangar 02 Space	MALS-46	21107	EBVO	9728 SF
296	T9	Ground Support Equip Shop	Vacant	21860	EBBO	4400 SF
296	T9	Storage	Vacant	44112	EBDO	8720 SF
296	T9	Headquarters	MALS-46	61071	EBFO	19200 SF
297	T8	Maint Hangar OH Space	VMGR-352	21105	EBVO	43769 SF
297	T8	Maint Hangar	VMFA-212	21105	EBVO	43769 SF
297	T8	Maint Hangar 01 Space	VMGR-352	21106	EBVO	40480 SF
297	T8	Maint Hangar	VMFA-212	21106	EBVO	25806 SF
297	T8	Maint Hangar	VMFA-212	21107	EBVO	33246 SF
297	T8	Maint Hangar 02 Space	VMGR-352	21107	EBVO	20240 SF
297	T8	Boiler Room	Installation	82109	EBBO	750 SF
298	U7	GME/G-4	Installation	21420	EBBO	14559 SF
299	U7	GME/G-4	Installation	21420	EBBO	4268 SF
300	T6	Public Works Warehouse	Installation	21910	EBBO	4574 SF
300	T6	AFGE Office	Station	61010	EBFO	225 SF
300	T6	Environment Office	Environment	61010	EBFO	1220 SF
301	T6	PW Admin/Labor Shop	Installation	21910	EBBO	5120 SF
302	T6	Public Works Elec Shop	Installation	21910	EBBO	5120 SF
304	T6	Academic Instruction (EEO)	HRO	17110	EBAO	1800 SF
304	T6	Admin Office (CPO)	HRO	61010	EBFO	7218 SF
304	T6	Civilian Credit Union	Credit Union	74019	EBLO	1800 SF
305	U7	Group Headquarters	MWSG-37	61072	EBFO	4000 SF
306	T6	PW Pipe/Heat/Refrig Shop	Installation	21910	EBBO	15712 SF
306	T6	Vacant (Water Treament)	Installation	84209	EHCO	1000 SF
307	U6	EAF Wt Handling Shop	MWSS-373	21820	EBBO	23107 SF
307	U6	EOD	MWSS-374	14320	EBDO	3965 SF
307	U6	EAF Storage	MWSS-373	44111	EBDO	3965 SF
307	U6	SOMS Recovery Hqs	SOMS	61072	EBFO	4300 SF
308	M9	GSE Storage	MALS-11	21860	EBBO	720 SF
309	U8	Group Headquarters	MWSG-37	61071	EBFO	10368 SF
310	T9	MWSS-473 (HMM-769)	(JUN 96)	21106	EBVO	1796 SF
311	U8	Fire Station #2	Station	73010	EBLO	3913 SF
312	U8	Photographic Bldg	Vacant	14160	EBNO	5243 SF
313	U8	Field Maint Shop	CSSD-14	21453	EBBO	20000 SF
313	U8	Storage out of Stores	MWSS-373	44112	EBDO	30000 SF
314	U9	Highbay Storage	Supply	44110	EBDO	6123 SF
315	T9	MWSS-473 (HMM-769)	(JUN 96)	21106	EBVO	3444 SF
317	U7	Commissary Warehouse	DECA	44110	EBDO	126322 SF
317	U7	Marine Corps Supply	Supply	44110	EBDO	105460 SF
318	U8	General Warehouse Navy	Supply	44111	EBDO	81606 SF
318	U8	MTIS Bldg	Supply	44173	EBDO	40803 SF
319	U8	General Warehouse MC (DRMO)	DRMO	44111	EBDO	70150 SF
319	U8	General Warehouse Navy	Supply	44111	EBDO	56579 SF
320	U7	Hazardous/Flam Storehouse	Supply	44130	EBDD	17100 SF
321	U8	General Warehouse MC	Supply	44111	EBDO	258?8 SF

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE	
388	U8	Field Maint Shop	CSSD-14	21453	EBBO	7040	SF
389	P12	Loading/Unloading Ramp	Station	85115	EDAO	159	SF
390	P13	Golf Cart Shop	MWR	74080	EBLO	6400	SF
391	M9	Loading/Unloading Ramp	MAG-11	85115	EDAO	159	SF
392	M9	ACFT Ground Supt Equip Shop	MALS-11	21860	EBBO	6400	SF
394	K13	Transmitter(UHF/VHF COMMxMTR)	Sta/G-6	13150	EBMO	1596	SF
396	N10	Aircraft Truck Fueling	Supply	12120	ECWO	1	EA
399	P7	Vortac Facility	Sta/G-6	13325	EBUO	425	SF
402	K8	Stables Toilet	MWR	73075	EBLO	75	SF
404	Q10	Receiver Bldg	Sta/G-6	13135	EBMO	909	SF
405	P12	Applied Instruction Bldg	FREST/VMFAT101	17120	EBAO	3208	SF
406	P12	Applied Instruction Bldg	FREST/VMFAT101	17120	EBAO	2285	SF
407	P12	Squadron Headquarters	FREST/VMFAT101	61072	EBFO	400	SF
408	P12	Guard Tower	FREST/VMFAT101	87220	ECSO	64	SF
409	P12	Guard Tower	FREST/VMFAT101	87220	ECSO	64	SF
410	L2	Playing Fields, Softball	MWR-Rec	75020	ESCO	4	EA
414	Q10	Standby Generator Bldg	Sta/G-3	81159	EAAO	384	SF
415	L8	Storage out of Stores	MAG-16	44112	EBDO	40313	SF
416	P14	Storage Bldg	FAA	44110	EBDO	480	SF
419	P5	Saluting Battery	Supply	69015	ECLO	1	EA
420	Q3	Station Flagpole	Adjutant	69010	ECLO	1	EA
421	R3	Playing Courts, Tennis	MWR-Rec	75010	ECNO	2	EA
422	O3	Playing Courts, Tennis	MWR-Rec	75010	ECNO	1	EA
427	N4	Playing Courts, Hndbl/Bsktbl	MWR-Rec	75010	ECNO	1	EA
430	P3	Playing Court, Tennis	MWR-Rec	75010	ECNO	1	EA
432	M4	Foot/Soccer/Baseball Field	MWR-Rec	75020	ECNO	4	EA
435	S7	Acft Fire & Rescue Station	Sta/G-3	14120	EBNO	11440	SF
439	P2	Branch Dental Clinic	13th Dental	54010	EBEO	10680	SF
439	P2	Branch Medical Clinic	Nav Hosp	55010	EBEO	59487	SF
440	O12	Missile Magazine	Station	42172	EBQO	930	SF
441	O12	Aviation Armament/Sta Ordnanc	Station/G-4	21154	EBVO	1500	SF
442	P12	Aviation Armament/Sta Ordnanc	Station/G-4	21154	EBVO	6220	SF
443	O2	Photographic Laboratory	Training	14160	EBNO	3288	SF
443	O2	Academic Instruction Bldg	Training	17110	EBAO	4592	SF
443	O2	LTV Center	Training	17117	EBAO	1280	SF
443	O2	Academic Instruction Bldg	Training	17120	EBAO	22086	SF
445	U9	Old Test Cell	Vacant	17135	EBAO	3998	SF
445	U9	Hazardous/Waste Storehouse	Vacant	83142	EBDO	2715	SF
446	U9	Storage Tank/Nonpotable	Installation	84440	EAUO	25000	GA
447	Q11	Engine Test Cell	MALS-11	21181	EBVO	2715	SF
448	Q11	Storage Tank/Nonpotable	Installation	84440	EAUO	25000	GA
449	M1	Bachelor Enlisted Quarters	Station	72111	EBGO	126	PN
449	M1	Bachelor Enlisted Quarters	Station	72112	EBGO	24	PN
450	N2	Bachelor Enlisted Quarters	Station	72111	EBGO	126	PN
450	N2	Bachelor Enlisted Quarters	Station	72112	EBGO	24	PN
451	N2	Bachelor Enlisted Quarters	Station	72111	EBGO	126	PN
451	N2	Bachelor Enlisted Quarters	Station	72112	EBGO	24	PN
452	N2	Bachelor Enlisted Quarters	Station	72111	EBGO	126	PN
452	N2	Bachelor Enlisted Quarters	Station	72112	EBGO	24	PN
453	R11	Maint Hangar O2 Space	HMM-164	21107	EBVO	5040	SF
454	R11	Maint Hangar O2 Space	HMM-165	21107	EBVO	5040	SF
455	Q12	Operational Trainer Fac	MAG-11	17135	EBAO	9050	SF
456	Q12	Organic Storage	MALS-11	41112	EBFO	69563	SF

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
456	Q12	Aviation Supply Office	CACI	61010	EBFO	600 SF
457	Q12	Branch Dental Clinic	13th Dental	54010	EBEO	494 SF
457	Q12	Group Headquarters	MAG-11	61071	EBFO	21838 SF
457	Q12	Enlisted Mess Hall	MAG-11/G-4	72210	EBGO	2500 SF
457	Q12	Barber Shop	Vacant	74009	EBLO	168 SF
458	R11	Hazardous/Flam Storehouse	HMM-164	44130	EBDO	2000 SF
459	Q13	Storage Tank/Nonpotable	MWR-Rec	84440	EAVO	1000000GA
460	Q13	Water Sply Bldg/Nonpotable	MWR-Rec	84410	EAUO	438 SF
461	R11	Maint Hangar OH Space	HMM-164	44130	EBVO	20480 SF
461	R11	Maint Hangar 01 Space	HMM-164	21106	EBVO	11132 SF
461	R11	Maint Hangar 02 Space	HMM-164	21107	EBVO	4524 SF
462	R11	Maint Hangar OH Space	HMM-165	21105	EBVO	20480 SF
462	R11	Maint Hangar 01 Space	HMM-165	21106	EBVO	11132 SF
462	R11	Maint Hangar 02 Space	HMM-165	21107	EBVO	4524 SF
463	Q11	Maint Hangar OH Space	VMFAT-101	21105	EBVO	9760 SF
463	Q11	Engine Maintenance Shop	VMFAT-101	21121	EBVO	5759 SF
464	S13	Golf Course Clubhouse	MWR-Rec	74080	EBLO	8748 SF
469	P12	Equip Storage Bldg	MALS-11	44112	EBDO	69 SF
471	P4	Sta Training Pool/Tank	Training	17955	ECFO	1 EA
472	P4	Wading Pool	Training	17955	ECFO	1 EA
475	O3	Storage Bldg/Disbursing	Compt	61010	EBFO	192 SF
496	U6	Shop Storage Bldg	Installation	21925	EBBO	480 SF
519	S3	Sta Training Pool/Tank	Training	17955	ECFO	1 EA
520	S3	Wading Pool	Training	17955	ECFO	1 EA
523	O4	Storage	Grd Safety	44112	EBDO	192 SF
529	U6	PW Expend WIP Storage	Installation	21925	EBBO	3040 SF
530	T6	Storage Tank/Potable Water	Installation	84140	EAQO	10000 GA
534	U6	Hazardous/Flam Storehouse	Supply	44130	EBDO	800 SF
536	J15	Small Arms/Pyro Magazine	Sta Ordn	42148	EBQO	1250 SF
537	J14	Small Arms/Pyro Magazine	Sta Ordn	42148	EBQO	1250 SF
538	I14	Small Arms/Pyro Magazine	Sta Ordn	42148	EBQO	1250 SF
539	H14	Small Arms/Pyro Magazine	Sta Ordn	42148	EBQO	140 SF
540	H15	Fuse & Detonator	Sta Ordn	42112	EBQO	140 SF
542	F15	High Explosive - Magazine	Sta Ordn	42122	EBQO	1250 SF
543	G14	High Explosive - Magazine	Sta Ordn	42122	EBQO	1250 SF
544	G14	High Explosive - Magazine	Sta Ordn	42122	EBQO	1250 SF
545	H13	High Explosive - Magazine	Sta Ordn	42122	EBQO	1250 SF
546	H14	High Explosive - Magazine	Sta Ordn	42122	EBQO	1250 SF
547	K12	ACFT Ready Fuel Storage	Supply	12430	ECJO	551313 GA
548	K12	ACFT Ready Fuel Storage	Supply	12430	ECJO	549933 GA
549	K13	ACFT Ready Fuel Storage	Supply	12430	ECJO	550110 GA
550	K13	ACFT Ready Fuel Storage	Supply	12430	ECJO	550055 GA
551	K13	ACFT Ready Fuel Storage	Supply	12430	ECJO	551113 GA
552	K13	Misc POL Pipeline Facility	Supply	12520	ECJO	304 SF
555	K12	POL Sampling/Test Bldg	Supply	14375	EBPO	800 SF
556	K13	Misc POL Pipeline Facility	Supply	12520	ECJO	543 SF
558	N10	ACFT Truck Fueling Facility	Supply	12120	ECWO	1 OL
559	N10	ACFT Truck Fueling Facility	Supply	12120	ECWO	1 OL
560	N10	ACFT Truck Fueling Facility	Supply	12120	ECWO	1 OL
561	N10	ACFT Truck Fueling Facility	DLA	12120	ECWO	1 OL
566	Q11	Storage Tank/Potable Water	Installation	84140	EAQO	50000 GA
567	T3	Sewage Pump Sta Shed	Installation	83229	EHFO	80 SF
568	K13	Standby Generator Bldg	Installation	81159	EAAO	176 SF

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE	
573	K13	Antenna, Communications	Sta/G-6	13210	ECCO	1	EA
578	M2	Public Toilet	MWR-Rec	73075	EBLO	240	SF
578	M2	Water Distribution Bldg	MWR-Rec	84209	EHCO	60	SF
579	P14	General Storage Shed	Installation	44135	EBDO	176	SF
581	L9	Chaplain Annex	Vacant	73083	EBLO	3140	SF
581	L9	Navy Relief Thrift Shop	Vacant	74034	EBLO	1320	SF
582	K12	Maint Bldg/Housing	Housing	71477	EBBO	2500	SF
583	J12	Storage Tank/Potable Water	Installation	84140	EAQO	500000	GA
584	O5	Low Frequency Homer Bldg	Sta/G-6	13335	EBUO	140	SF
586	L18	Obstruction Light	Sta/G-3	13450	ECXO	1	EA
587	K17	Obstruction Light	Sta/G-3	13450	ECXO	1	EA
588	L15	Obstruction Light	Sta/G-3	13450	ECXO	1	EA
594	K14	Obstruction Light	Sta/G-3	13450	ECXO	1	EA
595	F10	Obstruction Light House	Sta/G-3	13450	ECXO	36	SF
596	I13	Obstruction Light	Sta/G-3	13450	ECXO	1	EA
597	K14	Obstruction Light	Sta/G-3	13450	ECXO	1	EA
598	L15	Obstruction Light	Sta/G-3	13450	ECXO	1	EA
599	U9	Liquid Oxygen Facility	Supply	14187	EBNO	884	SF
600	P4	Storage out of Stores	MWCS-38	44112	EBDO	4108	SF
601	K1	Public Toilet/Picnic Area #1	MWR-Rec	73075	EBLO	92	SF
602	M9	Van Maint Shop	MALS-11	21145	EBVO	4800	SF
605	N7	Maint Hangar OH Space	HMM-364	21105	EBVO	12900	SF
605	N7	Maint Hangar O1 Space	HMM-364	21106	EBVO	5350	SF
605	N7	Maint Hangar O2 Space	HMM-364	21107	EBVO	5348	SF
606	N8	Maint Hangar OH Space	HMM-163	21105	EBVO	5350	SF
606	N8	Maint Hangar O1 Space	HMM-163	21106	EBVO	12900	SF
606	N8	Maint Hangar O2 Space	HMM-163	21107	EBVO	5348	SF
607	R13	Public Toilet/Golf Course	MWR-Rec	73075	EBLO	92	SF
610	M9	Water Distribution Bldg	Installation	84209	EHCO	1126	SF
611	O12	Missile Magazine	Sta Ordn	42172	EBQO	930	SF
614	L10	Aqua Chinon Playground	Housing	75020	ECNO	2	EA
615	M2	Handball Courts	MWR-Rec	74084	EBLO	1743	SF
616	U7	Admin Office	Installation	61010	EBFO	792	SF
619	T12	Standby Generator Bldg	Installation	81159	EAAO	1329	SF
624	O4	Air Terminal	Sta/G-3	14111	EBNO	2077	SF
624	O4	Administration	Sta/G-3	61010	EBFO	9393	SF
625	M3	Hobby Shop, Automotive	MWR-Rec	74038	EBLO	6153	SF
626	M3	Hobby Shop, Automotive	MWR-Rec	74038	EBLO	480	SF
627	P14	Transmitter Building	Station	13150	EBMO	1096	SF
628	P14	Antenna Tower	Station	13165	EBMO	576	SF
629	P4	Academic Instruction Bldg	FASOTRAGRU	17110	EBAO	4260	SF
631	U9	Util/NBC Storage	MWSS-374	21820	EBAO	12870	SF
633	U9	Loading/Unloading Ramp	DRMO	85115	EDAO	68	SY
634	M9	Maint Hangar OH Space	MALS-11	21105	EBVO	5119	SF
634	M9	Maint Hangar O1 Space	MALS-11	21106	EBVO	13163	SF
634	M9	Engine Maint Shop	MALS-11	21106	EBVO	12569	SF
634	M9	Maint Hangar 02 Space	MALS-11	21121	EBVO	16629	SF
634	M9	Avionics Shop	MALS-11	21145	EBVO	675	SF
635	T9	Weighing Facility	Supply	89056	EAPO	1	EA
636	R12	Cryogenics Office	MALS-11	14187	EBNO	500	SF
636	R12	Parachute/Surv Equip Shop	MALS-11	21175	EBVO	8530	SF
637	M8	Exchange Gas Station	MWR-Ret	74031	EBLO	900	SF
638	Q10	Wind Direction Indicator	Sta/G-3	13462	ECXO	1	EA

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE	
639	N8	Electric Power Plant Bldg	Installation	81109	EAAO	144	SF
640	N8	Electric Power Plant Bldg	Installation	81109	EAAO	144	SF
641	N8	Electric Power Plant Bldg	Installation	81109	EAAO	144	SF
642	N9	Electric Power Plant Bldg	Installation	81109	ECEO	144	SF
643	N8	Fixed ACFT Start System	Installation	14915	ECEO	32	EA
644	N6	Arresting Gear	Sta/G-3	14930	ECEO	1	EA
645	N6	Arresting Gear	Sta/G-3	14930	ECEO	1	EA
646	P10	Arresting Gear	Sta/G-3	14930	ECEO	1	EA
647	P10	Arresting Gear	Sta/G-3	14930	ECEO	1	EA
649	O2	Exchange Retail Store	MWR-Ret	74001	EBLO	64191	SF
649	O2	Cafeteria	MWR-Ret	74004	EBLO	6855	SF
649	O2	Exchange Warehouse	MWR-Ret	74085	EBLO	38318	SF
650	P2	Exchange Retail Store Whse	MWR-Ret	74001	EBLO	3800	SF
651	O2	Exchange Supplmtl Gas Sta	MWR-Ret	74030	EBLO	3344	SF
651	O2	Exchange Auto Repair Sta	MWR-Ret	74030	EBLO	10495	SF
655	U8	Field Maint Shop	CSSD-14	21453	EBBO	18600	SF
656	P3	Child Development Center	Sta/G-1	74074	EBLO	12733	SF
657	Q3	Visitor/Vehicle Registration	PMO	73025	EBLO	315	SF
658	N10	Engine Test Cell	MALS-11	21181	EBVO	2894	SF
659	N10	Storage Tank/Nonpotable	Installation	84440	EAQO	25000	GA
660	O2	Bachelor Enlisted Quarters	Station	72111	EBGO	336	PN
660	O2	Bachelor Enlisted Quarters	Station	72112	EBGO	14	PN
661	O2	Transient Enlisted Quarters	Station	72111	EBGO	345	PN
661	O2	Transient Enlisted Quarters	Station	72112	EBGO	11	PN
662	O2	Heating Plant Bldg	Installation	82109	EABO	546	SF
664	P12	Substation Bldg	MALS-11	81310	EHAO	625	SF
665	N8	Fire Hose Drying Structure	Security	73011	EBLO	1	EA
666	M2	Bachelor Enlisted Quarters	Station	72111	EBGO	66	PN
666	M2	Bachelor Enlisted Quarters	Station	72112	EBGO	153	PN
667	M2	Bachelor Enlisted Quarters	Station	72111	EBGO	66	PN
667	M2	Bachelor Enlisted Quarters	Station	72112	EBGO	153	PN
668	M2	Bachelor Enlisted Quarters	Station	72113	EBGO	84	PN
669	M2	Bachelor Enlisted Quarters	Vacant	72111	EBGO	33984	SF
670	M1	Gas Storage Tanks	Supply	82320	EHGO	1	EA
671	U9	Refueler Admin	MWSS-373	61072	EBFO	840	SF
672	U10	Refueling Vehicle Maint Shop	MWSS-373	21430	EBBO	1600	SF
673	P12	Ground Supt Equip Shed	MALS-16	21860	EBBO	9200	SF
673	P12	Acft Ground Supt Equip Shop	MALS-16	21861	EBBO	4600	SF
674	U5	Oil Water Separator	Installation	87111	EEDO	1	EA
675	U10	Oil Water Separators	Installation	87111	EEDO	1	EA
676	L9	Community Storage Misc	Housing	71477	EBBO	1750	SF
677	P8	Meteorological Bldg	Sta/G-3	13471	ECXO	8	SF
678	K12	Housing/Maint Storage	Housing	71477	EBBO	1750	SF
679	L7	Stable Haybarn	MWR-Rec	74079	EBLO	1100	SF
680	K8	Recreation Pavilion	MWR-Rec	74078	EBLO	400	SF
681	L2	Rec Grounds (Area #2)	MWR-Rec	75057	ECNO	1	EA
682	P12	Gate Sentry House	AWTU-3	73025	EBLO	200	SF
683	R4	Cold Storage Warehouse	Supply	43110	EBRO	8585	SF
683	R4	General Warehouse MC	Supply	44111	EBDO	6598	SF
684	Q4	Applied Instr Bldg/FREST	Navy Hospital	17120	EBAO	804	SF
685	P4	Elec Distribution Bldg	Installation	81209	EHAO	200	SF
686	K8	Riding Stable, Tack Locker	MWR-Rec	74079	EBLO	2500	SF
687	L1	Public Toilet/Picnic Area #2	MWR-Rec	73075	EBLO	176	SF

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BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE	
688	J12	Receiver Building	Vacant	13135	EBMO	144	SF
689	J12	Receiver/Activity TV Antenna	Installation	75035	ECNO	1	EA
692	Q4	Clasif Material Incinerator	Adjutant	61030	EBFO	120	SF
693	O2	OFT (KC-130)	Training	17135	EBAO	5467	SF
694	P2	Commissary	WCCC/DECA	74023	EBLO	47120	SF
695	N8	Line Maint Shelter	HMM-364	21115	EBQO	900	SF
696	N8	Line Maint Shelter	HMM-163	21115	EBQO	900	SF
697	N9	Line Maint Shelter	HMM-161	21115	EBQO	900	SF
698	N9	Line Maintance Shelter	HMM-166	21115	EBQO	900	SF
699	N10	ACFT Ready Fuel Tank	Supply	12430	ECJO	20000	GA
700	U7	Filling Station C-Pool	Supply	12315	ECBO	36	SF
701	M9	Flagpole	MAG-11	69010	ECLO	1	EA
702	P1	Gate Sentry House #20	PMO	73025	EBLO	81	SF
703	M2	Playing Courts, Tennis	MWR-Rec	75010	ECNO	4	EA
704	M2	Basket/Volleyball Court	MWR-Rec	75010	ECNO	4	EA
707	P3	Sign, Station Activities	PMO	69010	ECLO	1	EA
708	M9	Sign, Station Activities	PMO	69010	ECLO	1	EA
709	N7	Power Ck Pad w/out Sound Supp	Vacant	21188	ECZO	1	EA
710	N7	Power Ck Pad w/out Sound Supp	Vacant	21189	ECZO	1	EA
711	S11	Power Ck Pad w/out Sound Supp	MAG-11	21189	ECZO	1	EA
712	S11	Power Ck Pad w/out Sound Supp	MAG-11	21189	ECZO	1	EA
713	L8	Hazardous/Flam Storehouse	MAG-11	44130	EBDO	3600	SF
714	R11	Line Maint Shelter	HMM-165	21115	EBBO	1000	SF
715	R11	Line Maint Shelter	HMM-164	21115	EBVO	1000	SF
716	N9	Hush House	MALS-11	21101	EBVO	8880	SF
717	S7	Crash, Fire, Rescue Storage	Sta/G-3	14120	EBNO	1000	SF
718	N3	Lampost Pizza	MWR/Ret	74004	EBLO	2400	SF
718	N3	Modular Club	MWR/Hosp	74064	EBLO	41560	SF
721	P10	Optical Landing System	Sta/G-3	13460	ECXO	1	EA
722	K9	Gen Store/Self-Help/Thrift Sh	MWR-Ret	74002	EBLO	12000	SF
725	U3	Gate Sentry House (Gate #9)	PMO	73025	EBLO	24	SF
726	Q11	Line Maint Shelter	MALS-11	21115	EBVO	1000	SF
727	R11	Line Maint Shelter	HMM-164	21115	EBVO	1000	SF
728	Q11	Acrft Line Ops Bldg	HMM-165	14130	EBNO	1000	SF
729	Q3	Main Gate Sentry House	PMO	73025	EBLO	48	SF
730	Q4	Communications Center	Sta/G-6	61010	EBFO	6500	SF
731	M2	Bachelor Enlisted Quarters	Station	72111	EBGO	186	PN
731	M2	Bachelor Enlisted Quarters	Station	72112	EBGO	66	PN
732	M2	Bachelor Enlisted Quarters	Station	72111	EBGO	186	PN
732	M2	Bachelor Enlisted Quarters	Station	72112	EBGO	66	PN
733	M2	BEQ Boiler Room	Installation	82109	EABO	1689	SF
734	M9	Public Toilet/Van Complex	MAG-11	73075	EBLO	560	SF
735	M9	Generator Bldg/Van Complex	Installation	81209	EABO	1100	SF
736	M2	Racquetball Facility	MWR-Rec	74084	EBLO	3400	SF
739	M2	Bachelor Enlisted Quarters	Station	72111	EBGO	108	PN
740	M2	Bachelor Enlisted Quarters	Station	72111	EBGO	66	PN
740	M2	Bachelor Enlisted Quarters	Station	72112	EBGO	186	PN
741	[illegible]	Bachelor Enlisted Quarters	Station	72111	EBGO	66	PN
741	M2	Bachelor Enlisted Quarters	Station	72112	EBGO	222	PN
742	T6	Electrical Shop Storage	Installations	21925	EBBO	800	SF
743	P2	Exchange/Retail	MWR/Ret	74001	EBLO	3304	SF
744	O2	Armory	MWSS-373	14334	EBPO	7706	SF
744	O2	Small Arms Shop	CSSD-14	21510	EBBO	2378	SF

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
745	M10	Warehouse	MALS-16	44112	EBDO	23396 SF
745	M10	Office Space	MALS-16	61072	EBFO	297 SF
746	M10	Flight Simulator	Training	17135	EBAO	22516 SF
747	N9	Contract Refueler Facility	Supply	61010	EBFO	1200 SF
748	M9	Public Toilet/Van Complex	MWHS-3	73075	EBLO	560 SF
749	M9	Public Toilet/Van Complex	MALS-11	73075	EBLO	560 SF
750	M9	Sentry Booth/Van Complex	MALS-11	73025	EBLO	60 SF
751	M10	Hazardous/Flam Storage	MALS-11	44130	EBDO	126 SF
752	N10	Fuel Farm #5 Office	Supply	61010	EBFO	348 SF
753	T7	Pest Control Bldg	Installation	44130	EBDO	1118 SF
755	R12	LOX/NOX Shelter	Supply	14187	EBNO	150 SF
756	R12	LOX/NOX Shelter	MALS-11	14187	EBNO	150 SF
757	M2	MARS Facility	CEO	13160	EBMO	1716 SF
758	U7	Vehicle Washrack Util Bldg	MWSG-37	89009	EAPO	228 SF
759	T7	Vehicle Washrack Util Bldg	CSSD-14	89009	EAPO	228 SF
760	U8	Vehicle Washrack Util Bldg	CSSD-14	89009	EAPO	228 SF
761	R11	ACFT Washrack Utility Bldg	MAG-11	89009	EAPO	684 SF
762	P13	Vehicle Washrack Util Bldg	MWSG-37	89009	EAPO	228 SF
763	N10	ACFT Washrack Utility Bldg	MAG-11	89009	EAPO	684 SF
764	M9	Vehicle Washrack Util Bldg	MALS-11	89009	EAPO	228 SF
765	S5	Vehicle Washrack Util Bldg	MWSS-371	89009	EAPO	228 SF
766	R5	Vehicle Washrack Util Bldg	Aero Club	89009	EAPO	228 SF
767	M7	Billboard	MAG-11	69010	ECLO	1 EA
769	T6	HW Collection Facility	Environment	83142	EAQO	204 SF
770	T7	HW Collection Facility	Environment	83142	EAQO	204 SF
771	S4	HW Collection Facility	MWSG-37	83142	EAQO	204 SF
772	P13	HW Collection Facility	Environment	83142	EAQO	204 SF
773	M2	Antenna-MARS	CEO	13210	ECCO	1 EA
774	M2	Antenna-MARS	CEO	13210	ECCO	1 EA
775	N2	Antenna-MARS	CEO	13210	ECCO	1 EA
776	M2	Antenna-MARS	CEO	13210	ECCO	1 EA
777	M2	Antenna-MARS	CEO	13210	ECCO	1 EA
778	U9	HW Collection Facility	Environment	83142	EAQO	204 SF
779	N10	HW Collection Facility	Environment	83142	EAQO	204 SF
780	G14	Ready Serv Magazine	EOD	42135	EBQO	128 SF
781	G15	Ready Serv Magazine	Sta Ordn	42135	EBQO	512 SF
782	Q13	Golf Course Maint Bldg	MWR-Rec	74080	EBLO	1320 SF
783	P2	Exchange Admin	MWR-Retail	74003	EBLO	10683 SF
783	P2	MCX Service Outlets	MWR-Retail	74009	EBLO	11037 SF
784	Q13	DRMO Field Office Lot #2	DRMO	61010	EBFO	400 SF
785	Q11	Aviation Maint Bldg	VMFAT-101	21106	EBVO	5600 SF
786	P12	Aviation Armament	MALS-11	21154	EBVO	3000 SF
787	P12	NBC Defense Training	MWHS-3	17110	EBAO	4000 SF
788	L2	Recreation Pavilion	MWR-Rec	74078	EBLO	1500 SF
789	U6	Sewage Monitoring Station	Installation	83229	EHFO	36 SF
790	S13	Golf Cart Bldg	MWR-Rec	74080	EBLO	3471 SF
791	T3	Officers Club	MWR-Hosp	74060	EBLO	22500 SF
792	K7	Stables Barn	MWR-Rec	74079	EBLO	2880 SF
793	O3	Mc Donald's	MWR-Hosp	74004	EBLO	3754 SF
794	Q4	EOD Team Bldg	Sta/G-3	14320	EBPO	3600 SF
795	E14	EOD Range Bldg	Sta/G-3	14320	EBPO	340 SF
796	M10	Substation/Chiller Bldg	Installation	82610	EBPO	1518 SF
797	R5	AVGAS Fueling Station	DLA	12120	ECDO	800 GM

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE	
798	P12	Aircrft Decontamination Trng	Wing NBC	17950	EBAO	2	AC
799	P1	U-Haul Rental	MWR/Rec	74037	EBLO	150	SF
799	P1	Package Store	MWR-Ret	74071	EBLO	9850	SF
800	U10	Vehicle Maint Facility	MWSS-373	21451	EBBO	30661	SF
801	U10	Dispatcher	MWSS-373	21451	EBBO	240	SF
802	U10	Washrack	MWSS-373	21455	EBBO	4000	SF
803	U10	Fuel Island (1)	MWSS-373	12310	ECBO	3	OL
804	U10	Fuel Island (2)	MWSS-373	12310	ECBO	3	OL
805	H15	Forklift Bldg	Sta Ordn	21860	EBBO	1922	SF
806	H15	Ammunition Assembly Shed	Sta Ordn	42510	EBQO	8320	SY
807	H15	Open Ammunition Storage	Sta Ordn	42510	EBQO	209	SY
808	H15	Open Ammunition Storage	Sta Ordn	42510	EBQO	209	SY
809	H15	Open Ammunition Storage	Sta Ordn	42510	EBQO	209	SY
810	H15	Open Ammunition Storage	Sta Ordn	42510	EBQO	209	SY
811	H15	Box Magazine	Sta Ordn	42172	EBQO	3630	SF
812	H15	Box Magazine	Sta Ordn	42172	EBQO	3630	SF
813	H15	ARCH Magazine	Sta Ordn	42122	EBQO	1250	SF
814	H15	ARCH Magazine	Sta Ordn	42122	EBQO	1250	SF
815	H15	ARCH Magazine	Sta Ordn	42122	EBQO	1250	SF
816	Q12	Computer Van Pad	MAG-11	11665	EDCO	174	SF
817	Q13	Vehicle Wash Bldg	MWR-Rec	21455	EBBO	288	SF
818	T-3	Sewage Lift Station	Installation	83230	EHFO	100	GM
819	K15	Small Arms Range Bldg	Sta Trng	17940	ECFO	1	EA
823	O3	Temporary Lodging Facility	MWR/Hosp	74020	EBLO	23800	SF
824	S7	Crash Crew & Sta Recovery	Sta/G-3	14120	EBNO	2112	SF
825	U10	Hazardous MH Locker	MWSS-373	44130	EBDO	250	SF
826	P12	Inert Weapon/Training Bldg	FREST/VMFAT101	17120	EBAO	4050	SF
827	U7	Supply Loading Ramp	Supply	85115	EDAO	1	EA
828	K7	Stables Equip Building	MWR-Rec	74079	EBLO	1120	SF
829	P4	Admin Office	NAESU	61010	EBFO	620	SF
829	P4	Wing Headquarters	3d MAW	61070	EBFO	45287	SF
830	L2	Playing Field	MWR-Rec	75020	ECNO	1	EA
831	R12	Cryrogenics	MALS-11	14187	EBNO	5074	SF
832	P12	NBC Gas Chamber	MWHS-3	17120	EBAO	2680	SF
833	N3	Chapel	Station	73083	EBLO	7228	SF
834	L10	Fam Hsg Community Center	Installation	71432	EBBO	5000	SF
835	P14	Gate #3 Sentry House	PMO	73025	EBLO	96	SF
836	T3	Aircraft Display Gate #9	Installation	76020	ECNO	1	EA
837	P2	Aircraft Display Gate #1	Installation	76020	ECNO	1	EA
838	M9	Aircraft Display Gate #2	Installation	76020	ECNO	1	EA
839	Q4	Combat Training Pool	Navy Hospital	17120	EBAO	20820	SF
840	N14	Explosive Safety Office	MALS-11	61010	EBFO	928	SF
841	O13	Open Ammunition Storage Pad	Sta Ord	42510	75RO	210	SY
842	O2	Bachelor Enlisted Quarters	Station	72111	EBGO	216	PN
842	O2	Bachelor Enlisted Quarters	Station	72112	EBGO	180	PN
842	O2	Bachelor Enlisted Quarters	Station	72113	EBGO	110	PN
843	P12	Tactical Support Van Pad	MAG-11	11665	EDCO	1044	SY
844	P4	Comm/Elect Facility	MWCS-38	[illegible]1710	EBBO	10176	SF
845	Q12	Washrack Util Bldg	VMFAT-101	89009	EAPO	832	SF
847	Q11	Pumphouse	VMFAT-101	84320	EHEO	925	SF
848	Q11	Utility Bldg	VMFAT-101	89077	EAPO	683	SF
849	Q11	Water Storage Tank	VMFAT-101	84330	EAUO	260000	GA
850	P6	Crash Crew Burn Pit	Sta/G-3	17950	ECFO	1	EA

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
851	P6	Crash Crew Burn Pit	Sta/G-3	17950	ECFO	1 EA
852	O2	BEQ·Boiler Bldg	Installation	81209	EBPO	2576 SF
853	U7	Loading Ramp	Supply	85115	EDAO	1 EA
854	Q12	Electronics Comms Maint Shop	MAG-11	21931	EBBO	940 SF
854	Q12	Paint Spray Booth	MAG-11	44130	EBDO	1008 SF
855	Q12	Electrical Distr Bldg	Installation	81320	EHAO	500 KV
856	Q12	General Storage Shed	MALS-11	44135	EBDO	64 SF
856	Q12	Sentry Building	PMO	73025	EBLO	1976 SF
856	Q12	Public Toilet	MAG-11	73075	EBLO	1550 SF
858	M11	Guard House - Gate #2	PMO	73020	EBLO	96 SF
859	U6	Rec Vehicle Dump Site	MWR-Rec	83000	EAGO	1 EA
860	O7	PAR Platform	Sta/G-6	13470	ECXO	1 EA
861	O7	Aircraft Line Opns Bldg	Sta/G-6	14130	EBDO	240 SF
862	U6	Haz Waste Storage Transf Tank	Environment	83141	EAQO	739 SF
863	N5	Sentry House #1	Security	73025	EBLO	75 SF
864	O5	Sentry House #2	Security	73025	EBLO	75 SF
865	T3	Sentry House #3	Security	73025	EBLO	75 SF
866	U8	Sentry House #4	Security	73025	EBLO	75 SF
867	T9	Sentry House #5	Security	73025	EBLO	75 SF
868	Q11	Sentry House #6	Security	73025	EBLO	75 SF
869	R11	Sentry House #7	Security	73025	EBLO	75 SF
870	P12	Sentry House #8	Security	73025	EBLO	75 SF
871	N8	Sentry House #9	Security	73025	EBLO	75 SF
872	R11	Sentry House #10	Security	73025	EBLO	75 SF
873	P3	Child Development Center	Sta/G-1	74074	EBLO	23375 SF
874	M3	Obstacle Course	SNCO Academy	17950	ECFO	1 EA
875	T7	Wt Handling Equip Shop	Station	21820	EBBO	344 SF
876	M3	Veterinary Facility	Naval Hosp	53045	EBEO	600 SF
877	S6	Arresting Gear R/W 7L	Sta/G-3	14930	ECEO	1 EA
878	R6	Arresting Gear R/W 7R	Sta/G-3	14930	ECEO	1 EA
879	S10	Arresting Gear R/W 34L	Sta/G-3	14930	ECEO	1 EA
880	S10	Arresting Gear R/W 34R	Sta/G-3	14930	ECEO	1 EA
881	L7	Horse Stables	MWR-Rec	74079	EBLO	7700 SF
882	L7	Rental Office (Stables)	MWR-Rec	74079	EBLO	1152 SF
883	L7	Tractor Shed (Stables)	MWR-Rec	74079	EBLO	965 SF
884	L8	Bunk House (Stables)	MWR-Rec	74079	EBLO	759 SF
885	L7	Sun Shade at Station Stables	MWR-Rec	74079	EBLO	585 SF
886	P11	Aircraft Direct Fueling Sta	MAG-11	12110	ECWO	600 GM
887	P11	Aircraft Direct Fueling Sta	MAG-11	12110	ECWO	600 GM
889	S4	Vintage Acft Display Shelter	Station	74078	EBLO	156 SF
890	P4	Clasif Material Destruc Bldg	Station	61030	EBFO	126 SF
891	Q10	Undergrd Storage Tanks Compd	MAG-11	12430	ECJO	62500 GA
892	N8	Aircraft Washrack	HMM-364	11610	EDCO	672 SF
893	K15	Ordnance Operation Building	Sta Ordn	21560	EBBO	800 SF
894	L2	Recreation Pavilion	MWR-Rec	74078	EBLO	1529 SF
895	Q12	Operations Trainer Facility	Station	17135	EBAO	5000 SF
898	M3	Kennel	Station/PMO	73076	EBLO	960 SF
899	P3	Base Realignment and Closure	Station	61010	EBFO	7394 SF
899	P3	Data Processing Center	Sta/G-6/RASC	61020	EBFO	14713 SF
900	M10	Haz/Flam Material Storehouse	Environment	83141	EAQO	8000 SF
901	Q12	Haz/Flam Material Storehouse	Environment	44130	EBDO	8000 SF
902	N8	Fuel Farm	Supply	12430	ECJO	1025000GA
903	O8	Shelter	Station	12520	ECJO	315 SF

BLDG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
904	N7	Aircraft Fueling Station	Supply	12110	ECWO	600 GM
905	N7	Aircraft Fueling Station	Supply	12110	ECWO	600 GM
906	N8	Aircraft Fueling Station	Supply	12110	ECWO	600 GM
907	O8	Aircraft Fueling Station	Supply	12110	ECWO	600 GM
908	O9	Aircraft Fueling Station	Supply	12110	ECWO	600 GM
909	O9	Aircraft Fueling Station	Supply	12110	ECWO	600 GM
910	O9	Aircraft Fueling Station	Supply	12110	ECWO	600 GM
911	O9	Aircraft Fueling Station	Supply	12110	ECWO	600 GM
912	N7	Haz/Flam Material Storehouse	HMM-364	44130	EBDO	150 SF
913	N8	Haz/Flam Material Storehouse	HMM-163	44130	EBDO	150 SF
914	N9	Haz/Flam Material Storehouse	HMM-161	44130	EBDO	150 SF
915	Q10	Haz/Flam Material Storehouse	VMFAT-101	44130	EBDO	150 SF
916	R11	Haz/Flam Material Storehouse	HMM-165	44130	EBDO	150 SF
917	R11	Haz/Flam Material Storehouse	HMM-164	44130	EBDO	150 SF
918	T9	Haz/Flam Material Storehouse	MALS-46	44130	EBDO	150 SF
919	T7	Haz/Flam Material Storehouse	VMGR-352	44130	EBDO	150 SF
920	T7	Haz/Flam Material Storehouse	VMGR-352	44130	EBDO	150 SF
921	M9	Haz/Flam Material Storehouse	MALS-11	44130	EBDO	150 SF
922	M9	Recreational Shelter	MWR-Rec	74054	EBLO	170 SF
923	N10	Drop Tank Rinse Facility	MAG-11	21106	EBVO	576 SF
924	L2	Recreational Shelter	MWR-Rec	74054	EBLO	170 SF
925	L2	Recreational Shelter	MWR-Rec	74054	EBLO	170 SF
926	U9	DRMO Office,Disposal Yd 1	DRMO	61010	EBFO	613 SF
927	Q13	DRMO Toilet,Disposal Yd 2	DRMO	73075	EBDO	64 SF
928	P13	DRMO Toilet,Disposal Yd 3	DRMO	73075	EBBO	64 SF
929	M3	Kennel Run	PMO	73076	EBLO	540 SF
930	P2	MWR Exchange - Video Store	MWR-Ret	74001	EBLO	1156 SF
931	M9	Haz/Waste Storehouse	MALS-11	83142	EAQO	36 SY
932	M9	Haz/Material Storehouse	MALS-11	44130	EBDO	120 SF
933	M9	Haz/Waste Storehouse	MALS-11	83141	EAQO	272 SF
934	M9	Haz/Waste Storehouse	MALS-11	83141	EAQO	272 SF
935	M9	Haz/Waste Storehouse	MALS-11	83142	EAQO	16 SY
936	N9	Haz/Waste Storehouse	HMM-161	83141	EAQO	272 SF
937	N10	Haz/Waste Storehouse	HMM-163	83142	EAQO	17 SY
938	N8	Haz/Waste Storehouse	HMM-166	83141	EAQO	272 SF
939	N7	Haz/Waste Storehouse	HMM-364	83141	EAQO	255 SF
940	N7	Haz/Waste Storehouse	HMM-364	83141	EQAO	272 SF
941	M3	Haz/Waste Storehouse	MWR/Rec	83142	EAQO	20 SY
942	R4	Haz/Waste Storehouse	Station/G-4	83142	EAQO	13 SY
943	R5	Haz/Waste Storehouse	MWR	83142	EAQO	13 SY
944	N3	Haz/Material Storehouse	MWR/Ret	44130	EBDO	253 SF
945	T8	Haz/Waste Storehouse	VMGR-352	83141	EAQO	288 SF
946	T8	Haz/Waste Storehouse	VMGR-352	83142	EAQO	9 SY
947	S8	Haz/Waste Storehouse	HMM-764	44130	EBDO	840 SF
948	S8	Haz/Waste Storehouse	HMM-764	83142	EAQO	93 SY
949	U7	Haz/Waste Storehouse	Supply	83141	EAQO	288 SF
950	U7	Haz/Waste Storehouse	Supply	83141	EAQO	288 SF
951	N11	Haz/Waste Storehouse	HMM-165	83141	EAQO	272 SF
952	N9	Haz/Waste Storehouse	MALS-11	83141	EAQO	272 SF
953	R12	Haz/Material Storehouse	MALS-11	44130	EBDO	140 SF
954	R12	Haz/Waste Storehouse	MALS-11	83141	EAQO	104 SF
955	R4	Haz/Material Storehouse	MWCS-38	44130	EBDO	1352 SF
956	R4	Haz/Waste Storehouse	MWCS-38	83141	EAQO	720 SF

BG #	GRID	DESCRIPTION	TENANT	CATCOD	CAC	SIZE
957	T9	Haz/Waste Storehouse	MWSS-374	83141	EAQO	320 SF
958	Q4	Haz/Material Storehouse	MALS-46	44130	EBDO	200 SF
959	Q4	Haz/Waste Storehouse	MALS-46	83141	EAQO	513 SF
960	Q4	Haz/Waste Storehouse	MALS-46	83141	EAQO	200 SF
961	P13	Haz/Waste Storehouse	MWR/Ret	83142	EAQO	11 SY
962	U9	Haz/Material Storehouse	MWSS-373	44130	EBDO	180 SF
963	U9	Haz/Waste Storehouse	MWSS-373	83141	EAQO	272 SF
964	P12	Haz/Material Storehouse	MALS-11	44130	EBDO	140 SF
965	P12	Haz/Waste Storehouse	MALS-11	83141	EQAO	272 SF
966	O2	Haz/Waste Storehouse	MWR/Ret	83141	EAQO	130 SF
967	Q5	Haz/Material Storehouse	MWHS-3	44130	EBDO	432 SF
968	Q5	Haz/Waste Storehouse	MWHS-3	83142	EAQO	21 SY
969	U8	Haz/Waste Storehouse	SOMS	44130	EBDO	140 SF
970	U8	Haz/Waste Storehouse	SOMS	83141	EAQO	200 SF
971	O5	Haz/Waste Storehouse	MWCS-38	83142	EAQO	31 SY
972	N8	LOX Shelter	Station	14187	EBNO	320 SF
973	R3	RV Campground	MWR/REC	75058		383200 SF
974	L2	RV CAMPGROUND	MWR/REC	75058		78750 SF
975	K9	RV PARKING SITE	MWR/REC	75058		48000 SF
977	T6	Haz/Material Storage	Installations	44130	EBDO	1824 SF
978	T6	Haz/Waste Storage	Installations	83141	EQAO	1824 SF
1538	M7	Fuel Farm #4 Office	Vacant	61010	EBBO	64 SF
1580	U8	General Warehouse Navy	Supply	44110	EBDO	375 SF
1595	T7	Public Works Maint Storage	Installation	21925	EBBO	1722 SF
1601	T6	Public Works Maint Storage	Installation	21925	EBBO	1522 SF
1650	P12	Aviation Armament	MALS-11	21154	EBVO	1680 SF
1655	P12	Squadron Headquarters	NBC	61072	EBFO	960 SF
1656	P12	Admin Storage NBC	MWHS-3	44112	EBDO	960 SF
1662	P12	NBC Applied Instruction	MWHS-3	17120	EBAO	960 SF
1702	N3	Self Service Car Wash	MWR-Ret	74032	EBLO	1980 SF
1703	U6	Hazardous/Flam Storehouse	Supply	44130	EBDO	480 SF
1710	T6	Public Works Maint Storage	Installation	21925	EBBO	560 SF
1719	P12	Applied Instruction Bldg	MWHS-3	17120	EBAO	960 SF
1720	P12	NBC Headquarters	MWHS-3	61072	EBFO	960 SF
1721	P12	Student Instructor Lounge	FREST/VMFAT101	72111	EBGO	960 SF
1752	K15	Magazine Equip Shed	Sta Ordn	44135	EBBO	576 SF
1774	LS	Rodeo Arena	MWR-Rec	75057	ECNO	1 EA
1787	P12	Aviation Armament	MALS-11	21154	EBVO	836 SF
1789	P12	Hazardous/Flam Storehouse	NBC	44130	EBDO	64 SF
1791	P12	Aviation Armament	MALS-11	21154	EBVO	1680 SF
1798	K7	Riding Stables/Pen Shelter	MWR-Rec	74079	EBLO	2700 SF
1804	N9	Maint Hangar 02 Space	VMFA-(AW)225	21107	EBVO	480 SF
1809	P12	Sentry House	FREST/VMFAT101	73025	EBLO	50 SF
1810	K15	Magazine Area Security	Sta Ordn	14347	EBPO	360 SF
1815	O4	Line Maint Shelter	SOMS	21115	EBVO	100 SF

APPENDIX K

CLASS II STATION PROPERTY RECORDS AND CONSTRUCTION DRAWING LAUNDRY/DRY CLEANING PLANT

1. ACTIVITY: MARCOR AIR STATION/EL TORO
2. ACCTG. NO.: 60050
3. TOTAL COST $: 178,173
4. DIST.: 11
5. ACTIVITY CODE: [illegible]39-875
6. BLDG. NO.: 307
7. CARD NO.: 2-00518

8. CITY:
9. CITY CODE:
10. COUNTY: ORANGE
11. CO. CODE: 059
12. STATE/COUNTRY: CALIFORNIA
13. STATE CODE: 06
14. LAND OWNERSHIP: OWNED 1 X; OTHER 2
CAT. C: 911-

15. COMPONENT/TENANT — CODE
16. NONCONTIGUOUS AREA — CODE
17. MGMT. BUR.: MARCORA — CODE: 48
18. FIN. BUR. — CODE
19. PRC NO.: 06/7

20. TYPE OF CONSTRUCTION: PERM. P; SEMI. S; TEMP. T X
21. CONDITION (USABLE): U; T X; R; C — (NOT USABLE): N
22. PRIME CONTRACT NO.
23. MAP GRID #: U6
24: 19

25. BUILDING TITLE (LOCAL DESCRIPTION): STATION LAUNDRY
26. VOLUME CU. FT.: 693650
27. DIMENSIONS: (a) LENGTH 324; (b) WIDTH 136; (c) HEIGHT 25; (d) NO OF STORIES 1; (e) IRREG.? YES X
28. MATERIAL CODES: (a) FOUND. JJP; (b) EXTER. 79; (c) F

USE	29. NAVY DESCRIPTION	30. NAVY CODE	31. AREA SQ. FT. (GROSS)	32. VACANT (SQ. FT.)	33. OTHER MEASURE QUANTITY	SYM	34. CAPACITY QUANTITY	SYM.
(a) PRI.	LNDY/DRY CLN PL	730-40	44064					
(b) SEC.								
(c) TER.								
(d) OTHR								

35. T A: 1. ACQ; 2. CAP IMPRV; 3. CORR; 4. DIS

36. ACQUISITION DATA: MO.-YR. / METHOD / CODE
37. DISPOSITION DATA: MO.-YR. / METHOD / CODE
38. A: 7

BUILDINGS *(CLASS II)* NAVCOMPT FORM 277 (4C) (REV. 5-62) UPPER

ACTIVITY: MARCOR AIR STATION/EL TORO
ACCTG. NO.: 60050
TOTAL COST $: 178,173
DIST.: 11
ACTIVITY CODE: 8139-875
BLDG. NO.: 307
CARD NO.: 2-00518

39. FLOORS →	BASEMENT	FIRST FLOOR	SECOND FLOOR	THIRD FLOOR	FOURTH FLOOR	FIFTH FLOOR	SIXTH FLOOR
(a) LIVE LOAD (LBS. PER SQ. FT.)							
(b) FLOOR MATERIAL CODE							
(c) SQ. FT. FLOOR AREA							

40. MISCELLANEOUS
(a) HEATING SYSTEM: FUEL / TYPE
(b) ELECTRICAL CURRENT: VOLTS / PHASES / CYCLES
(c) HOT WATER: FUEL / STORAGE CAPACITY
(d) CRANES: NO. OF / IDENTIFICATION NO. / TON CAPACITY
(e) ELEVATORS: NO. OF / IDENTIFICATION NO. / TON CAPACITY
(f) SPRINKLER SYSTEM: YES / NO
(g) TELEPHONE SYSTEM: YES / NO

41.
42.
43.
44.
45.
46.

47. REMARKS:

BUILDINGS *(CLASS II)* NAVCOMPT FORM 277 (4C) (REV. 5-62) LOWER

(BUILDING) CLASS 2 PROPERTY RECORD

(001) RECORD..2-00518
(002) DATE....1970 JUN

(003) ACTIVITY...MARCORPS AIR STATIONS, SANTA ANA CALIF

LOCATION

(101) COUNTRY. US UNITED STATES
(102) STATE... 06 CALIFORNIA
(103) COUNTY.. 059 ORANGE
(104) CITY....0000
(105) NO...... 11
(106) AREA.... N/A
(107) MAP GRID..U6

GENERAL INFORMATIO

(004) UIC............60050
(005) FACILITY NO.... 307
(006) FACILITY TYPE..BUILDING
(007) ACTION.........CAPITOL IMP
(008) HOUSING........NO
(009) ENG EVAL DATE..N/A
(010) FACILITY NAME..
STATION LAUNDRY

ACQUISITION

(201) ESTATE..OWNED(*******************)
(202) ACQ CONTRACT...N/A
(203) ACQ DATE.......**** ***
(204) GOVT COST...... $178,173
(205) APPR/EST.......N/A
(206) APPR/EST DATE..N/A
(207) LAND CAT CODE..911-40

MEASUREMENTS

(301) LENGTH..... 324 FT
(302) WIDTH...... 136 FT
(303) HEIGHT..... 25 FT
(304) AREA....... ~~44,064~~ SF 35
(305) STORIES.... 01
(306) HTD VOL.... 693,650 CF
(307) IRREGULAR.. YES

CONSTRUCTION

(401) YR BUILT...1944
(403) YR IMPROVED..N/A
(402) CONST TYPE.TEMPORARY
(404) ABMP CODE....N/A
(405) FOUNDATION.CONCRETE FOOTINGS (PLAIN/REINFD)
(406) EXT WALL...STUCCO ON WOOD
(407) ROOF.......BITUMINOUS MINERAL-SURFACED ROOFING ON GYPSUM
(408) INSULATION.* 4

STATUS / UTILIZATION

(501) LAUNDRY/DRY CLEANING PLANT USE 0
(502) CAT CODE............730-40
(503) USE TYPE.......CURRENT
(504) UNUSED ADEQUATE..... 0 PERCENT
(506) USED ADEQUATE..100 PERCENT
(505) UNUSED SUBSTD....... 0 PERCENT
(507) USED SUBSTD.... 0 PERCENT
(508) DEFICIENCY CODE(S)..N/A-N/A-N/A

(509) USER(S) WITH SFRL	(510) UIC	((511)) AREA/UM	(512) OTHER/UM	(513) NAVALT/UM
01 MARCORPS AIR STATIONS	60050	~~44,064~~ SF 35,337		

730-40

BUILDING) CLASS 2 PROPERTY RECORD

(004) UIC.....60050
(001) RECORD..2-00518
(002) DATE....1971 OCT

(003) ACTIVITY... MARCORPS AIR STATION, EL TORO

LOCATION
(101) COUNTRY. US UNITED STATES
(102) STATE... 06 CALIFORNIA
(103) COUNTY.. 059 ORANGE
(104) CITY....0000
(105) ND...... 11
(106) SPEC AREA.N/A
(107) MAP GRID..U6

GENERAL INFORMATION
(005) FACILITY NO.... 307
(006) FACILITY TYPE..BUILDING
(007) ACTION.........~~CORRECTION~~
(008) HOUSING........NO
(009) ENG EVAL DATE..
(010) FACILITY NAME..
STATION LAUNDRY
(011) PR REVIEW......N/A

ACQUISITION
(201) ESTATE..OWNED(MCON)
(202) ACQ CONTRACT...N/A
(203) ACQ DATE.......1944 ***
(204) GOVT COST....... ~~$178,173~~ 178,661
(205) APPR/EST.......N/A
(206) APPR/EST DATE..N/A
(207) LAND CAT CODE..911-40

MEASUREMENTS
(301) LENGTH...... 324 FT
(302) WIDTH...... 136 FT
(303) HEIGHT..... 25 FT
(304) AREA........ 35,337 SF
(305) STORIES.... 1
(307) IRREGULAR.. YES

CONSTRUCTION
(401) YR BUILT.....1944
(402) CONST TYPE...TEMPORARY
(403) YR IMPROVED..N/A
(404) ABMP CODE...N/A
(409) PROJECT NO..N/A

STATUS/UTILIZATION
(501) LAUNDRY/DRY CLEANING PLANT USE 01
(504) UNUSED ADEQUATE.....N/A
(505) UNUSED SUBSTD........N/A
(506) USED ADEQUATE........ 35,337 SF
(507) USED SUBSTD.........N/A
(502) CAT CODE.......730-40
(503) PROP USE.......N/A
(508) DEFICIENCY(S)..N/A-N/A-N/A

(509) USER(S) WITH BFRL	(510) UIC	((511)) AREA/SF	(512) OTHER/	(513) ALT/
01 MARCORPS AIR STATION	60050	35,337		

Capital Improvement
WIP 1091/75 Construct Partition and Draft Curtain. Amt. $488

3OCT19 EFD 62474 MC 00027 60050 2-00518

APPENDIX L

EXTRACTS
FINAL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY ASSESSMENT REPORT
JULY, 1993

MARINE CORPS AIR STATION EL TORO
EL TORO, CALIFORNIA
INSTALLATION RESTORATION PROGRAM
FINAL RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) FACILITY ASSESSMENT REPORT

PREPARED BY:
Southwest Division, Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

THROUGH:
CONTRACT #N68711-89-D-9296
CTO #193
DOCUMENT CONTROL NO:
CLE-C01-01F193-S2-0001

WITH:
Jacobs Engineering Group, Inc.
3655 Nobel Drive, Suite 200
San Diego, California 92122

In association with:
International Technology Corporation
CH2M HILL

M. W. Arends — 7/16/93

Mike Arends, P.E. — Date
CLEAN Project Manager
CH2M HILL, Inc.

Raoul Portillo (signature) — 15 July 1993

Raoul Portillo — Date
CLEAN Technical Reviewer
Jacobs Engineering Group Inc.

1002073B.SCO\93\MA

RESPONSE TO COMMENTS
DRAFT RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
FACILITY ASSESSMENT REPORT
MARINE CORPS AIR STATION (MCAS) EL TORO
EL TORO, CALIFORNIA

Comments By: Environmental Protection Agency (EPA)

Response By: U.S. Navy

Comment No.	Comment	Response
A3	As a general note, it appears that all of the sanitary sewers (active and inactive) should be examined as SWMUs due to the nature of known materials released into them and the high possibility of unknown hazardous materials that may have been discharged into them. What assurances can be offered that the sanitary sewer system has not leaked?	The active and abandoned (or former metal plating waste) sewer systems at the Station have each been identified as SWMUs/AOCs in the RFA (i.e., SWMU/AOC Numbers 12 and 265, respectively). After a records review and visual site inspection, a sampling visit was recommended for the abandoned sewer lines, but not for the active sewer lines. The active sanitary sewer system at MCAS El Toro is an extensive, multi-mile network of pipelines located throughout the Station. These active sewer lines have not routinely received hazardous wastes. If hazardous waste was introduced into the active sanitary sewer system (e.g., through sinks), it is likely that the quantity would be small and that dilution would take place in the lines. Given the extensive length of the active sewer lines, a sampling program for the system is neither practical nor warranted in the absence of specific information indicating where and what hazardous wastes may have been routinely dumped into the system. It should be noted that the RI/FS Program at El Toro has installed a groundwater well network at the Station comprised of over 100 wells. The monitoring of this well network will allow identification of potential source areas such as portions of the active sanitary sewer lines. A separate, independent set of sewer lines, now abandoned, received metal plating wastes for a period of about a year, in 1945, during World War II. Since these lines did routinely receive hazardous waste, a sampling visit was conducted at these abandoned lines to assess potential leakage to subsurface soil.

RESPONSE TO COMMENTS
DRAFT RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
FACILITY ASSESSMENT REPORT
MARINE CORPS AIR STATION (MCAS) EL TORO
EL TORO, CALIFORNIA

Comments By: Environmental Protection Agency (EPA)

Response By: U.S. Navy

Comment No.	Comment	Response
B1c (cont'd)		In general, these SWMUs/AOCs are located in areas with multiple buildings. The list of SWMUs/AOCs (Table 4-1 of the Draft RFA Report) may have contained a different building number than the information from the records review contained in Appendix B.
B1d	Based on EPA experience in conducting RFAs at military installations, other potential SWMUs or AOCs may be present at MCAS El Toro, for the reasons discussed below: EPA Comment B1d1 - The report does not identify any container or tank waste loading/unloading or transfer areas. Each of these areas could qualify as a SWMU.	Many of the SWMUs/AOCs were used for loading/unloading of containers and waste. Each UST in the RFA has been the site of loading/unloading activities for waste and/or hazardous materials. Each tank farm at the Station has a designated loading/unloading area with spill containment tanks which were SWMUs/AOCs in the RFA (e.g., SWMUs/AOCs 17, 18, 19, 21, 22, 23, 23, and 108). In addition, container loading/unloading has occurred at each HWSA identified in the RFA.
B1d2	Are there or have there been any dry cleaners on site? If so, there may be SWMUs/AOCs associated with storage or spills of spent dry cleaning solvents.	No dry cleaners are known to have been located on Station property.
B1d3	Are there any septic tanks present on the site? Old septic tanks (all are potential SWMUs) could be of concern because of past waste management practices which typically included the flushing of wastes down the drains.	MCAS El Toro has had a sanitary sewer system since its inception in the early 1940s. At the time of the PR/VSI, no septic tanks had been identified at the Station. Recently, the existence of three septic tanks located in remote areas of the Station was made known to the Jacobs team. None of these tanks is located in an area where hazardous materials have been managed or stored. (One is located in the far northern part of the Station near the EOD Range; the other two are in a park located in the northwest corner of the Station). Visual site inspections were performed for these tanks in June 1993. Descriptions of these septic tanks will be included as an addendum to the PR/VSI Report, which is presented in Appendix G of the Final RFA Report. Based on their remote locations, it is unlikely that hazardous waste may have been dumped into these tanks. A sampling visit would not be warranted for any of the on-Station septic tanks.
B1d4	The report identified past usage of PCB transformers. Were any of the areas that were used for the operation and maintenance of PCB transformers inspected for releases during the VSI? Such areas are typically sites of PCB-contaminated oil spills.	SWMUs/AOCs 7, 88, and 244 are areas that were used for storage of PCB transformers. Each of these was inspected during the VSI, and each was investigated with a sampling visit.

RESPONSE TO COMMENTS
DRAFT RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
FACILITY ASSESSMENT REPORT
MARINE CORPS AIR STATION (MCAS) EL TORO
EL TORO, CALIFORNIA

Comments By: Environmental Protection Agency (EPA)

Response By: U.S. Navy

Comment No.	Comment	Response
B1e5	According to the report, current operations include the draining of some batteries onsite. Where are the drained batteries stored?	Draining of batteries occurs at various locations on-Station, including at the DRMO Storage Yards and HWSAs. These areas were addressed as SWMUs/AOCs in the RFA.
B1e6	The SWMU list identifies the active sanitary sewer system lines, the abandoned lines associated with former sewage treatment plant operations and former metal plating operations, as three different SWMUs. It should be confirmed that these units together consist of all sanitary sewer lines that may have received discharges of process wastes at the facility. Historical data on waste management practices shows that solvents and other wastes were routinely discharged to the facility's sanitary sewer system (see the 1945 James M. Montgomery report included in Appendix C of the Draft PR/VSI report).	The information in the 1945 James M. Montgomery Report indicates waste streams from metal plating operations that were generated for a period of 1 year during World War II. The metal plating wastes were transferred from the metal plating shops in sewer lines dedicated to this service (i.e., separate from the Station's sanitary sewer lines). Both the Station's sanitary sewer lines and the metal plating waste lines transferred wastewater to the former sewage treatment plant in the southern part of the Station. After the metal plating operation ceased, the metal plating sewer lines were abandoned. The Station's sanitary sewer lines are still active. Therefore, the routine discharge of process wastes (as mentioned in the 1945 Montgomery report) occurred only at the abandoned metal plating sewer lines. The active sewer lines have not received routine discharges of hazardous waste. For the RFA, the abandoned metal plating sewer lines were evaluated with a sampling visit. The active sewer lines were not. For additional information, see the Navy's Response to EPA Comment A3.
B1e7	Why is the NPDES discharge point Serial No. 004 (corner of Trabuco Road and Rifle Range Road ditch) not identified as a SWMU? Section 3.2.1.2. indicates that unauthorized discharges may have occurred via this outfall.	NPDES discharge point No. 004 was not identified as a SWMU/AOC in the RFA. The other three NPDES discharge points from the Station were also not identified as SWMUs/AOCs. The receptors of the NPDES discharges (i.e., Marshburn Channel [also called Rifle Range Road Ditch], Bee Canyon Wash, and Agua Chinon Wash) are each identified as SWMUs/AOCs and were sampled during the RFA sampling visits.
B1e8	As indicated in Section 3.6.4, several darkened areas were reportedly observed in aerial photographs (specifically, the 1971 and 1982 photographs obtained from Aerial Map Industries, and the 1947 photographs obtained from Whittier College). On what basis were these areas not included as SWMUs or AOCs in the draft report?	As stated on page 3-68 of the Draft PR/VSI, "whether these darkened areas represent staining is highly speculative." These darkened areas may represent areas where the ground was simply wet (with water). Since no corroborating evidence was found to indicate that releases occurred in these areas, they were not included as SWMUs/AOCs in the RFA.

RESPONSE TO COMMENTS
DRAFT RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
FACILITY ASSESSMENT REPORT
MARINE CORPS AIR STATION (MCAS) EL TORO
EL TORO, CALIFORNIA

Comments By: Department of Toxic Substances Control (DTSC)

Response By: U.S. Navy

Comment No.	Comment	Response
25	SWMUs/AOCs 91 and 92 - USTs 314-A and 314-B, respectively (Waste Oil) For SWMU/AOC 91, Table 5-2 (Amended Sample Locations) states that due to refusal at angle boring 2, the angle boring was replaced with a 25-foot boring drilled approximately 5 feet from the south edge of the tank; however, the 25-foot boring is located at the east edge of the tank in Figure 31 of Appendix B. The Sampling Visit Results in Appendix A indicate that the refusal was at angle boring 1. Please make all necessary corrections. The PR/VSI Report indicates the presence of liquid in both tanks; have the contents been removed from these inactive units?	Table 5-2 will be revised to indicate that refusal was encountered in angle Boring 091A1. Also, the table has been revised to indicate that Boring 091B1 is located approximately 5 feet east of the tank. At the time of the sampling visit (NOV 1992), the liquid in the tanks had not been removed.
26	SWMU/AOC 95 - Engine Test Cell The PR/VSI Report recommends a sampling visit for a possible former HWSA on unpaved soil, apparently near the southeastern corner of Building 324. The three borings in Figure 32 of Appendix B are located near the northeastern corner of Building 324; please explain. Indicate the boundaries of the HWSA in Figure 32.	Building 324 is a long building which extends approximately 150 to 200 feet in a northwesterly direction beyond the boundaries of Figure 32. Thus, the location of the HWSA as described in the PR/VSI report is accurate.
27	SWMU/AOC 99 - DSA The PR/VSI Report states that a large dark stain can be found on the ground near the center of the DSA. Were Borings B1 and B2 located within the large dark stain area? Note that in Figure 33 of Appendix B, the borings appear to be located near the ends of the DSA. Please indicate the location and the extent of the large dark stain in Figure 33.	Boring 099B2 was drilled through the large dark stain. The northwest side of the DSA extends approximately 5 to 10 feet further in the northwest direction than is shown in Figure 33. The figure will be revised to reflect this change.
28	SWMU/AOC 100 - TCE Degreaser Please indicate the location of the TCE degreaser in Figure 33 of Appendix B. Also, indicate the location of the storm drain to which spent solvents were reportedly discharged as recently as 1978 (see the PR/VSI Report).	The location of the storm drain where the spent solvent was disposed was not able to be determined from interviews with Station personnel. The only storm drain observed during the VSI was located between the southwest corner of Building 359 and the railroad tracks. This storm drain is shown in Figure 33. It is also possible that the spent solvent was disposed of into the drain of the washrack adjacent to the southeast corner of the building (i.e., SWMU/AOC 98). The drain for this washrack leads to an oil/water separator (SWMU/AOC 101) and eventually into the storm sewer system.
29	SWMUs/AOCs 101 and 102 - Oil/Water Separator 359-B and UST 359-C (Spent Stoddard Solvent), respectively Please indicate the location of these units in Figure 33 of Appendix B. Please indicate the location of ancillary equipment for the spent stoddard solvent tank, including piping, vent lines, etc.	Figure 33 will be revised to show the location of SWMUs/AOCs 101 and 102. The Navy does not plan to show ancillary equipment such as piping and vent lines on plot plan figures.

The fuel storage areas generate hazardous waste when fuel storage tanks are cleaned and sludge is pumped out, or when fueling/defueling or loading/unloading operations result in spills.

Wash water from washracks is passed through oil/water separators. The effluent water is discharged to the sanitary sewer or the storm drain, and the waste oil is handled as hazardous waste.

Based on information from an Initial Assessment Study (IAS) by Brown & Caldwell Engineers (B&C) (see Subsection 2.4 for a description of this report), previous operations that are no longer in existence at MCAS El Toro that were significant in past waste generation and disposal include the following:

- Plating operations conducted in the 1940s in Buildings 295, 296, and 297.

- A sewage treatment plant that was constructed in 1943, abandoned in 1972, and demolished in the late 1970s. Although this plant was designed to treat domestic sanitary waste only, wastewater from the metal plating operations in the 1940s was also sent to the plant.

- An incinerator that was operated approximately between 1943 and 1955 to burn trash or municipal-type waste generated by Station housing and other activities. The purpose of the incinerator was to reduce waste volume. Ash from the incinerator was disposed of in the Original Landfill, which is a site in the RI/FS.

recycling of waste petroleum from the Station. Although the DRMO completes some of the manifests for the Station, the manifest files are maintained by the EO.

2.4 Previous Site Investigations and Regulatory History

The following sections briefly summarize the previous site investigations and regulatory history at MCAS El Toro. Included are discussions of the listing and current activities for programs being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and RCRA.

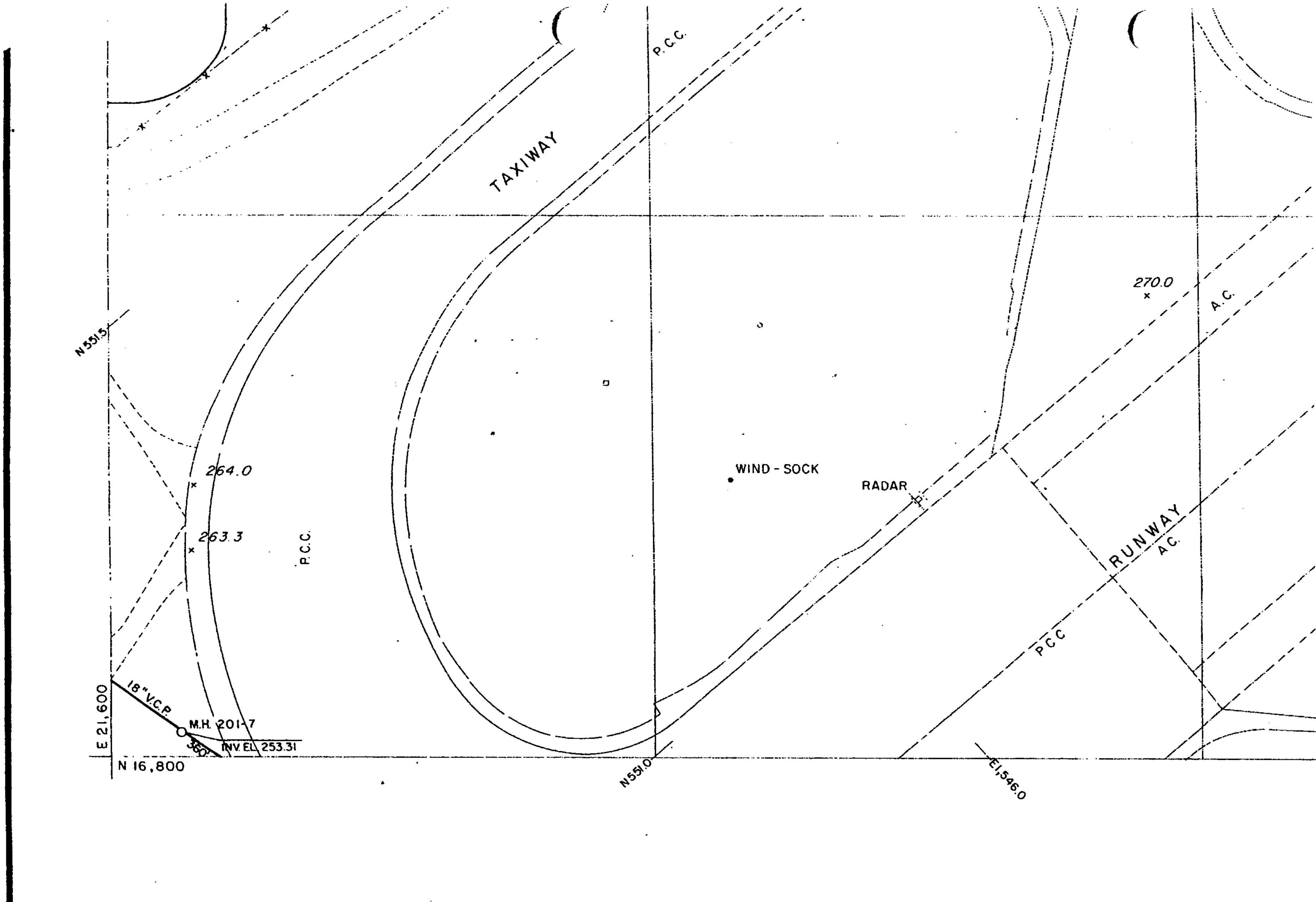
2.4.1 General

In 1972, MCAS El Toro received a Cease and Desist Order from the California Regional Water Quality Control Board (CRWQCB), Santa Ana Region, for violations of the discharge requirements established for the Station's former sewage treatment plant. The Order cited two violations: 1) exceeding limits for ether-soluble materials, and 2) discharging sufficient quantities of water to allow surface flows to reach Newport Bay during dry weather conditions. To comply with this Order, the Station shut down its sewage treatment plant and connected its sanitary sewer system to the Irvine Ranch Water District (IRWD).

In 1985, B&C began work on an IAS to locate potentially contaminated sites on MCAS El Toro property. This work was conducted for the Naval Facilities Engineering Command (NAVFACENGCOM) under the Navy Assessment and Control of Installation Pollutants (NACIP) Program, which was the Navy's version

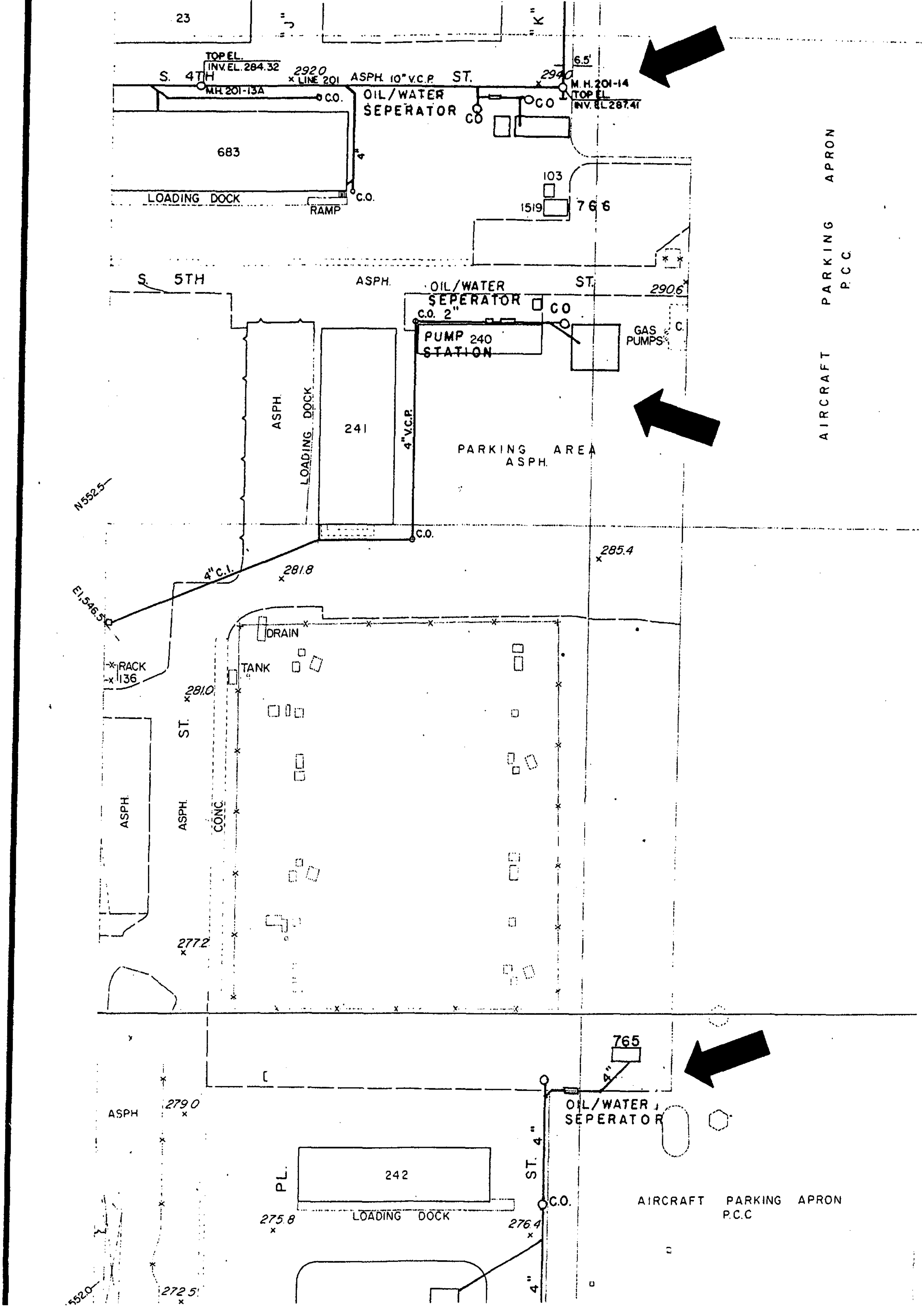
APPENDIX M

EXTRACTS
SANITARY SEWER SYSTEM CONSTRUCTION DRAWINGS
MCAS, EL TORO
SEPTEMBER, 1996



COMPILED BY
American
AERIAL SURVEYS, INC.
564 SOUTH STEWART DRIVE • COVINA, CALIFORNIA
Photography dated 10 - 29 - 76

MALCOLM LEWIS
ASSOCIATES/ENGINEERS INC
CONSULTING ENGINEERS
IRVINE, CA. 92718
MAP UPDATED AS OF 9-30-86



23
"J"
"K"
TOP EL.
INV. EL. 284.32
S. 4TH
292.0
LINE 201
ASPH. 10" V.C.P.
ST.
294.0
6.5'
M.H. 201-14
TOP EL.
INV. EL. 287.41
M.H. 201-13A
C.O.
OIL/WATER
SEPERATOR
CO
CO
683
4"
103
1519
766
LOADING DOCK
RAMP
C.O.
APRON
PARKING
P.C.C
AIRCRAFT
S. 5TH
ASPH.
OIL/WATER
SEPERATOR
ST.
290.6
C.O. 2"
CO
PUMP 240
STATION
GAS
PUMPS
C.
ASPH.
LOADING DOCK
241
4" V.C.P.
PARKING AREA
ASPH.
N552.5
C.O.
285.4
4" C.I.
281.8
E1,546.5
DRAIN
RACK
136
TANK
281.0
ST.
ASPH.
ASPH.
CONC.
277.2
765
4"
ASPH
279.0
OIL/WATER
SEPERATOR
ST. 4"
242
PL.
C.O.
AIRCRAFT PARKING APRON
P.C.C
LOADING DOCK
275.8
276.4
4"
272.5
552.0

APPENDIX N

EXTRACTS
FINAL ENVIRONMENTAL BASELINE SURVEY REPORT
MCAS, EL TORO
MARCH, 1995

MARINE CORPS AIR STATION EL TORO
EL TORO, CALIFORNIA
INSTALLATION RESTORATION PROGRAM
FINAL ENVIRONMENTAL BASELINE SURVEY REPORT

01 April 1995

Revision 0

PREPARED BY:
Southwest Division, Naval Facilities
Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

THROUGH:
CONTRACT #N68711-89-D-9296
CTO #284
DOCUMENT CONTROL NO:
CLE-C01-01F284-S2-0004

WITH:
Jacobs Engineering Group Inc.
401 West A Street, Suite 1905
San Diego, California 92101

In association with:
International Technology Corporation
CH2M HILL

M. W. Arends 3/31/95

Mike Arends, P.E. — Date
CLEAN Project Manager
CH2M HILL, Inc.

Max Pan 3-31-95

Max Pan, P.E. — Date
CLEAN Technical Reviewer
IT Corporation

SCO100217CD.WP5\95\MA

Hazardous waste is also generated at the fuel storage areas when fuel storage tanks are cleaned and sludge is pumped out, or when fueling/defueling or loading/unloading operations result in spills.

Wash water from washracks is passed through oil/water separators (OWSs). The effluent water is discharged to the sanitary sewer or the storm drain, and the waste oil is handled as hazardous waste. OWSs are located at various locations throughout the Station.

Previous operations that are no longer in existence at MCAS El Toro, but that were or may have been significant in past waste generation and disposal procedures, include the following:

- For approximately 6 months during the 1940s, aircraft refurbishing operations were conducted in the southwest portion of the Station, and were centered in Buildings 296, 297, and 324. Refurbishing operations consisted of cleaning and plating activities that may have included the use of solvent materials (the types of materials used in the tanks are unknown). Wastewater from these operations was discharged to currently abandoned industrial wastewater sewer lines and treated at the former Industrial Wastewater Treatment Plant. Based on aerial photographs, this plant was present in the 1940s and was demolished by 1965.

- Sewage was treated at a plant that was constructed in 1943, abandoned in 1972, and demolished in the late 1970s.

In addition to releases of hazardous materials in the airfield operations area, interviews with current and former long-term Station employees (refer to Subsection 3.1.11) indicate that waste petroleum and other miscellaneous liquid wastes generated at the Station were applied to the unpaved portions of the airfield operations area for dust control. The waste materials were generated at various locations on-Station and collected in portable aboveground storage tanks (bowsers). The wastes were picked up by a vacuum truck and sprayed on the unpaved areas adjacent to the runways and taxiways. This practice was conducted up until the early 1980s.

It is possible that hazardous substances releases and applications to the airfield operations area may have affected surface and/or subsurface soil at various locations within the airfield operations area. Based on available information, portions of the airfield operations area that are identified as an LOC are as follows:

- o The current unpaved areas

- o The new (i.e., post-1940s) runway extensions may possibly reside over previously unpaved areas that received oil application.

These areas are delineated in Figure 3-1.

PROJECT NOTE NO.	PROJECT NO.
PN-0284-07 CLE-C01-01F284-I3-0002	01-F284-H6

CONFIRMATION OF:	CONFERENCE		DATE HELD	26 May 1994
	TELECOM		DATE ISSUED	27 June 1994
	OTHER	X	RECORDED BY	Daryl Hernandez/CH2M HILL
			PLACE	El Toro, California

SUBJECT: Contract Task Order (CTO) No. 284
Interviews with Active and Retired Personnel from MCAS El Toro
Marine Corps Air Station (MCAS) El Toro

PARTICIPANTS: (* DENOTES PART-TIME ATTENDANCE)

See below

ACTION REQ'D. BY	ITEM

BACKGROUND

On Thursday, 26 May 1994, an all-day meeting was held at the Marine Corps Air Station (MCAS) El Toro (Station) to interview active and retired personnel from the Station's Fuel Operations Division and Facility Management Department (currently the Installations Department) who would have a strong knowledge of Station operations and the Station's procedures for storage/disposal of hazardous materials and waste. Participating as interviewers during the meeting were agency personnel, Navy and Station personnel, and personnel from the contractors for the Navy and the U.S. Environmental Protection Agency (EPA).

Although previous interviews with Station personnel had been conducted in the past on an individual basis, an interview arrangement allowing the dynamics of interaction between the interviewees was thought to have potential advantages. Also, it was desired to have additional members of the El Toro Team participate as interviewers in the process.

The team of interviewers included:

Albert Arellano	DTSC
Jason Ashman	SWDIV (Code 1843.JA)
John Broderick	RWQCB
David Crawley	SWDIV (Code 1831.DC)
Daryl Hernandez	CH2M HILL
Chrisa Mitchell	MCAS El Toro
Bret Raines	SWDIV (Code 1831.BR)
Sebastian Tindall	Bechtel

PROJECT NOTE NO.
PN-0284-07
CLE-C01-01F284-I3-0002

PROJECT NO.
01-F284-H6

ACTION REQ'D. BY | ITEM

The panel of interviewees included:

Name	Years at MCAS El Toro	Department
Lee Amador(2)	> 10 years (active)	Production Division
Philip Bohn(2)	> 10 years (active)	Fuel Operations
Douglas Campbell(2)	22 years (active)	Planning & Estimating
Jim Carson	25 years (retired)	Facility Management Department (FMD)
Jacob Kormos(1)	46 years (retired)	FMD
Paul Maize	19 years (retired)	ROICC
Joe Saen(1)	> 10 years (active)	Planning & Estimating
Eugene Silva(1)	41 years (retired)	FMD
Vernon Zepp(2)	> 10 years (active)	Fuel Operations

(1) Previously interviewed in 1991 as part of the RFA conducted at MCAS El Toro.

(2) Previously interviewed in early 1994 as part of the BCP prepared for the Station.

OBJECTIVES

Some of the objectives of the meeting were to:

- Supplement and/or confirm information obtained from past interviews with current and former long-term Station personnel.
- Interview personnel in a group environment to pool the collective knowledge of the various individuals.
- Obtain a better understanding of current and historical operations at the Station.
- Confirm current information regarding releases and the environmental condition of property.
- Identify new areas of potential environmental concern at the Station.

PROJECT NOTE NO.	PROJECT NO.
PN-0284-07 CLE-C01-01F284-I3-0002	01-F284-H6

ACTION REQ'D. BY	ITEM

purpose of establishing a compliance monitoring program for currently-active tanks and a removal and closure schedule for all tanks (USTs and ASTs) on-Station.

ASTs. J. Carson identified the northeast side of Building 314 as an AST area. He said that two or three small ASTs with sulfuric acid were maintained at this location. Some boiler chemicals were dumped into the sewer drains that lead to the former sewage treatment plant. After the water was treated, it was pumped to the golf course for irrigation purposes.

RI/FS Sites. The interview panel was asked for their general comments on the four landfill areas located on-Station. RI/FS Site 3/4 (Original Landfill) was in operation from approximately 1943 through 1947. There were several burn pits associated with this landfill, as well as an incinerator. The interview panel could not generally agree as to the exact locations of the burn pits. However, the panel concurred that many types of waste were burned at the landfill, including waste solvents, waste oils, and miscellaneous solid wastes.

RI/FS Site 5 (Perimeter Road Landfill) began disposal activities in the early 1950s and was closed in approximately 1975. E. Silva said that throughout the operating life of this landfill, the Station had contracted with an outside recycler to collect scrap metal from the landfill and dispose of it off-Station. The interview panel suggested that despite the relative longevity of this landfill, its lateral size was kept limited because refuse was buried to a depth of approximately 30 feet and refuse burns frequently occurred. Liquid wastes were also commonly disposed of at this landfill. E. Silva described episodes of emptying 55-gallon drums of waste liquids into the landfill.

RI/FS Site 2 (Magazine Road Landfill) was in operation from about 1970 through 1981. Similar types of materials were disposed of into this landfill, as were at the previous two landfills. Refuse burns were typically not allowed at this landfill. However, some infrequent refuse burns did occur at Site 2.

RI/FS Site 17 (Communication Landfill) was in operation from 1981 through approximately 1983. This landfill was used mainly for construction generated wastes. The panel said that FMD did not have control over the type of wastes the Marines disposed of into the landfill. Therefore, the panel said that it is possible that waste chemicals could have been disposed of into the landfill. No refuse burns were allowed at this landfill.

The interview panel referred to the Agua Chinon Wash as the East Ditch and Bee Canyon Wash as the West Ditch. J. Carson said that liquid wastes were commonly disposed of from Buildings 295 and 296 into the storm drains that eventually emptied into the West Ditch.

P. Maize suggested contacting his father, who was an auto mechanic for 18 years at MCAS El Toro. P. Maize said that his father spread crankcase oil, brake fluid, and solvents over the unpaved areas of the flightline area for dust control. This technique of dust control was commonly practiced from the mid-1940s through 1970. P. Maize said that his father could probably identify the most commonly used disposal areas.

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	PN-0284-07 CLE-C01-01F284-I3-0002	01-F284-H6

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Other Disposal Areas. S. Tindall asked the panel if they could identify other disposal areas on-Station.

J. Kormos said that carbon tetrachloride was commonly disposed of at RI/FS Site 13 (Oil Change Area). J. Kormos concurred with the boundaries of RI/FS Site 13 shown in Figure 3-1 of the BCP.

J. Carson identified a former laundromat located in Building 307. He said that there was a leaking UST located northeast of the building. J. Carson was unaware of the contents of the UST.

D. Hernandez said that Solid Waste Management Unit/Area of Concern (SWMU/AOC) 145 is a UST that is located northeast of Building 307, and that samples were collected from beneath this UST during the RFA. High concentrations of total fuel hydrocarbons (TFH) were detected in every sample and additional investigation of this UST was recommended.

J. Carson said that from early the 1940s through the early 1980s, sodium dichromate was used for corrosion protection in boiler systems present in numerous buildings throughout the Station. Every year, a contractor was responsible for flushing the boiler units and replacing the water. It was common practice to release the water into the storm drain system that leads to the East and West Ditches. Approximately 5 to 7 pounds per year of sodium dichromate was used for each unit.

Tank Farm Information. The panel provided a brief history on tank farms 1, 2, and 3.

Tank Farm 1 was used to store aviation fuel only. Originally, two tanks were installed at Tank Farm 1, however, two additional tanks were installed after leaks were detected in the first two tanks. All four tanks at Tank Farm 1 are out of service, but are still in place.

Tank Farm 2 stored JP-4, JP-5, aviation gas, and waste oils. Tank Farm 2 was closed and turned over to the Station Environmental Office in 1987. Sludge was pumped from the tanks soon after the tank farm was closed. The tanks are still in place.

Tank Farm 3 stored aviation gas. When the tank farm was closed, oil and sludge was found inside the tanks. Since then, the oil and sludge has been removed. The tanks at Tank Farm 3 are still in place. Currently, the former tank farm area is unpaved (i.e., covered by a lawn).

J. Broderick asked the Fuel Operations personnel to identify areas where piping associated with abandoned, closed, or removed USTs is still in place. V. Zepp said that all piping associated with the fuel farms is still in place. P. Bohn said that for UST removals, the general practice of the Station is to flush and cap piping that is located beneath asphalt and/or concrete surfaces. Piping beneath unpaved surfaces is generally removed when the tank is removed.

P. Bohn recommended interviewing A. Hernandez, who was responsible for the fuel division at El Toro for over 30 years.

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Department of Toxic Substances Control (DTSC) Questionnaire Responses

Joe Zarnoch/DTSC (not present during the 26 May meeting) had previously prepared a detailed list of questions that was mailed to most of the members of the interview panel prior to the meeting. The following section presents the question in bold type followed by the panel's response to each question in regular type. Panel responses represent the general overall response of the entire panel. In some instances, an individual member's response has been highlighted because of specific knowledge that the panel member had with respect to the question.

1. **Describe operations at Buildings 295, 296, 297, and 324.**

These are aircraft hangars where overhaul and rebuild (O&R) activities were conducted. O&R activities included: metal plating shops, aircraft painting, paint removal, parts cleaning, and aircraft refurbishing. Some of these activities were conducted on the parking apron, as well as within the hangars.

2. **Were other buildings or areas used for rework or refurbishing operations?**

Squadron level O&R activities are conducted at all Marine aircraft hangars.

3. **How long were the plating shops in Buildings 296 and 297 in operation? Was it just 1 year or so or actually longer?**

J. Kormos: Metal plating activities were conducted for a period of approximately 4 to 6 months. There was no central accumulation area for the waste generated. Therefore, it was common to dump cleaning fluids down the drains (industrial waste lines) or onto the ground surface around these buildings. The industrial waste treatment plant was in operation for approximately 1 year.

The industrial waste sewer lines are constructed of cast iron and cold jointed together. The sanitary sewer lines are made of clay with concrete connections, and the storm sewer lines consist of concrete and clay material.

J. Kormos recommended speaking with Tom Head, who was the plating mechanic at the time of its operation. T. Head currently lives in Santa Ana.

4. **Were there other plating shops?**

According to the panel, some plating operations occurred in Building 309. Building 309 is currently a photographic development facility for aerial photographs of field exercises, war situations, and the Station itself.

D. Hernandez: Aerial photograph development activities are conducted at Building 309. During the Visual Site Inspection (VSI) portion of the RFA, personnel at Building 309 were interviewed and efforts were made to review this file of aerial photographs of the Station. The personnel said that the photographs were classified information and could not be reviewed.

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This facility was inspected during the VSI in 1991 for storage and potential releases of hazardous materials and/or waste. The photograph department uses an outside contractor that delivers unused photographic development products and recycles the used chemicals. Therefore, the facility does not store waste materials. No evidence of a release was observed during the inspection.

5. **Describe solvent, plating shop solution handling practices at Buildings 295, 296, 297, and 324. Describe disposal of spent plating bath solutions and solvents. Were they dumped onto the ground or discharged through the industrial waste sewer line?**

Refer to response to question number 3.

6. **Describe the condition of sumps at the plating shops. Were the sumps deteriorated?**

The panel was unaware of the condition of the sumps. The sumps were filled with sand and capped with concrete before most of them had started working on the Station. J. Kormos said that some of the sumps in these buildings were usually filled with liquid.

7. **Were solvents routinely or periodically dumped in the area of Buildings 295, 296, 297, or 324?**

Refer to response to question number 3.

8. **Were solvents drained to the east of Building 296 and onto a drainage ditch that eventually led to Agua Chinon Wash?**

Yes. Waste fluids were dumped all around the building.

9. **How was TCE/PCE handled for the degreaser in Building 324?**

Waste liquids were generally disposed of down the drain.

J. Kormos: Some squadrons commonly stored waste fluids at their facility and then transferred the full barrels to Building 324. The drums were stored on three sides of the building on top of marsdon matting. Usually, there were 50 to 100 drums at this location; however, not all of the drums were constantly full.

10. **Were there other TCE/PCE, carbon tetrachloride degreaser pits, tanks, washers that you remember?**

A TCE degreaser tank was located inside Building 359. Other degreasers could have been located at the squadron hangars where general aircraft maintenance activities occurred.

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11. Were solvents, in addition to fuels, used in the burn pit at RI/FS Site 9? If so, what solvents were used and how were they transported to the burn pit?

Probably not. Only out-of-spec fuel was burned at the burn pits.

12. In your opinion, what could account for the high concentration of TCE in the groundwater at the burn pit area of RI/FS Site 9?

Generally, the panel had no idea of what could be the cause/source of the contamination since only fuels were supposed to have been burned at the pits.

J. Kormos: Recommended reviewing former purchase order records from various squadrons to see what type of materials were used for their operations.

J. Carson: FMD did not have control over the activities of the Marines. He suggested that the Marines could have disposed of waste solvents into what were supposedly "contaminated fuel" drums that were burned at the crash crew pits.

13. Describe activities at the former Heavy Duty Maintenance Shop in Building 1589.

Heavy duty vehicle maintenance. Waste fluids were kept in bowsers that were located outside the building. When the bowser was filled with waste liquids (crank case/transmission oil, hydraulic fluid, possibly used solvents) the fluid was emptied onto the unpaved soil in areas around the building and within the flightline for dust control.

14. Was oil sprayed for dust suppression in the area of RI/FS Site 10? If so, in what other areas? Did the oil contain solvents? If so, where did the solvents originate?

Yes. Refer to response to question number 13.

15. Why was the area at RI/FS Site 10 excavated? For expansion of the apron or was the site, in your opinion, contaminated? Was soil in the area dark from the dust suppression application? Area excavated in 1971 to a depth of 2 feet. What happened to the excavated soil?

This area was graded for expansion of the parking apron for Hangars 295, 296, and 297. West Division, Naval Facilities Engineering Command (WESTDIV), in San Bruno CA., was responsible for executing the contract for the tarmac expansion. During the grading activities, they encountered dark, petroleum-contaminated soil that was transported to a landfarming area located west of Perimeter Road and north of Bee Canyon Wash. The soil was stored at this location for a period of approximately 6 months. After this time, the soil was graded over the entire landfarming area.

D. Hernandez: The landfarming area was investigated during the RFA program as SWMU/AOC 6. Eight samples were collected from four hand auger holes at various locations within the landfarming site. The samples were analyzed for total petroleum

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hydrocarbons (TPH), TFH (gasoline and diesel), and volatile organic compounds (VOCs). No further action was recommended as a result of the analytical data.

16. Describe activities at the paint shop or adjacent to Building 1589. How were paint sludges handled? Disposed of onto the ground or trenched? Was degreasing conducted at the paint shop?

Painting operations were conducted at this building until approximately 1985. The panel was generally unaware of the activities/operations at this facility. They recommended contacting Isaac Curtis, a former auto paint foreman at this building.

17. Can you offer an explanation for the discovery of TCE in the groundwater east of RI/FS Site 8? Were there other areas east of RI/FS Site 8 where solvents were handled?

RI/FS Site 8 is a regional DRMO storage yard for various installations located across the nation. All types of equipment have been stored at this storage yard. The panel recommended contacting Rudy Lopez, who worked at RI/FS Site 8 for many years. No one knew R. Lopez's phone number, however, he may still live in the Orange County area.

E. Silva: The storage area was unpaved for a long time. On numerous occasions, there was dark, oily soil within the storage area. E. Silva specifically remembered excavating "contaminated" soil from the site and transporting the soil to RI/FS Site 2. New "clean" soil replaced the soil.

18. In general, do you remember solvents being poured on the ground or dumped into storm drains?

Yes - It was common to pour waste fluids onto the ground surface or down the floor drain. Panel members remembered removing sludge from the sewer sumps and disposing of the sludge into the landfills.

19. Are you familiar with the former Wastewater Treatment Plant?

Yes - The sewage treatment plant was in operation from the early 1940s through early 1970s.

J. Carson: One time, acid was accidently dumped into the sanitary sewer system that eventually killed all the biomass at the sewer plant.

P. Maize: Most dumping occurred into the storm drain system because there is limited access to the sanitary sewer drains. Storm drains are usually open to the streets or surface drains located near buildings.

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RI/FS Site 5 - Perimeter Road Landfill

41. Did disposal of radioactive material/waste occur at this landfill?

Members of the panel had no knowledge of radioactive material ever being disposed of into the landfill.

42. Any knowledge of liquid chemicals being disposed of there? Quantities? In drums?

Yes. All different types of waste were disposed of into the landfill, including solid waste and liquid chemical waste.

J. Kormos: J. Kormos remembered emptying 55-gallon drums of miscellaneous waste fluids onto the unpaved ground.

J. Carson: Some of the burn pits were as deep as approximately 30 feet below the ground surface. He remembered driving semi-trucks and tractors into the pits and not being able to see the tops of the tractors from the ground surface outside the pits.

43. Do you feel that the landfill boundaries, as currently defined, are accurate?

J. Carson: The general location of the landfill appears to be accurate. The southern tip of the landfill should be extended further south to include the tee box of the fifth hole and the fourth green of the Station golf course. There was an unpaved access road that led from approximately the corner of El Toro Road and Perimeter Road to the disposal area. The width of the landfill could also be expanded to approximately twice the width shown in Figure 3-1 of the BCP.

RI/FS Site 7 - Drop Tank Drainage Area No. 2

44. A 1970 aerial photograph indicates that a tank was located on the grassy area northeast of Building 295. Are you aware of such a tank?

Members of the panel were unaware of the tank identified in the SAIC photograph.

D. Hernandez: The hazardous waste storage area (SWMU/AOC 71) associated for Building 295 was visually inspected during the RFA program. At the time of the VSI, an approximate 500-gallon bowser was observed near the hazardous waste storage area. The hazardous waste storage area was not recommended for a sampling visit since it was located within the boundaries of RI/FS Site 7. Mobile bowser tanks were commonly used throughout the Station to store waste oils collected from maintenance activities. A common practice was to spread the waste oil collected in these tanks onto unpaved areas of the Station for dust control. It is possible that some of these bowsers could have been misinterpreted as vertical tanks in the SAIC aerial photo report.

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45. Storage areas east of RI/FS Site 7. What were the practices?

Various types of equipment and waste were stored in this area. Some of the equipment included paint lockers, compressors, and pilot seat ejection charges. Types of chemical wastes included waste solvents, flammable materials, waste oils, etc.

46. Do you think there are any other sources of TCE we are finding in the groundwater?

The panel agreed that there could be other sources of TCE contamination; however, they did not suggest any other possible source locations.

RI/FS Site 8 - DRMO Storage Yard

47. Do you believe that the storage activities at RI/FS Site 8 could have impacted groundwater? Were solvent spills common?

Yes. All different types of equipment were stored at the DRMO storage yard. The DRMO facility at MCAS El Toro is a regional facility and stores equipment from other installations. Solvent spills frequently occurred at the RI/FS Site 8 storage yard.

D. Campbell: The Marines could have stored small quantities of radium painted parts and gauges at this storage yard since it is a regional storage yard.

48. What do you know about the degreaser in Building 359? Was TCE dumped into the storm drain?

The degreaser emptied into a recovery tank that was located outside the building. The panel members were unaware of specific operation procedures for the degreaser tank.

D. Hernandez: Both the degreaser and the recovery tank were investigated during the RFA program (SWMUs/AOCs 100 and 102, respectively). Samples were collected from beneath the degreaser tank and adjacent to the recovery tank. No further action was recommended for both SWMUs/AOCs based on the analytical data indicating no significant VOCs in the soil samples. The recovery tank was removed in mid-1993.

RI/FS Site 10 - Petroleum Disposal Area

49. Were there trenches at RI/FS Site 10? For what purpose?

Panel members could not recall a specific trench in this general area. When this area was graded for the extension of the tarmac, petroleum- contaminated soil was excavated and transported to the landfarm area northwest of Bee Canyon Wash (SWMU/AOC 6) and to the landfill at RI/FS Site 2. Refer to question number 15 for additional discussions about SWMU/AOC 6.

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J. Kormos: J. Kormos said that a storm drain trench was located adjacent to the northwest edge of the original parking apron. The drain was used to divert surface runoff away from the apron. Also, a fuel bladder (RI/FS Site 22) was located near the same edge of the parking apron.

50. There apparently was a parts dip tank at Building 1589. The spent solvent was used to wash the cement decks and the lube racks. Are you familiar with this practice?

Building 1589 is a Heavy Duty Vehicle Maintenance Shop. Members of the panel had little knowledge of the operating procedures of this facility. They were unaware of solvents used to clean the work bays.

51. Do you think the solvent/waste oil applications for dust suppression could have contributed to the groundwater contamination in this quadrant of the Station?

Yes - Spreading waste liquids over unpaved soil was a common practice for dust control for many years. The panel generally thought it reasonable that this practice could have contributed to groundwater contamination.

52. Do you know of seven former vertical tanks west of Crash Crew Building 435?

Members of the panel had no information concerning seven former vertical tanks.

RI/FS Site 11 - Transformer Storage Area

53. Do you know if PCB transformers or equipment were stored in the dirt lot behind Building 369?

D. Campbell: This area was used to store equipment that needed repair work. Many transformers were refilled with PCB oil at this location. He estimated that approximately 4 to 10 gallons per year of PCB oils were spilled onto the ground surface.

54. Do you know about the PCB spill that occurred on September 29, 1982 between Buildings 369 and 335?

Yes. One transformer fell off a truck and spilled approximately 5 gallons of PCB-containing fluid onto the asphalt surface. The impacted asphalt was removed, along with the top 18 inches of soil beneath the asphalt. The excavated material was disposed of into the Station landfill.

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68. Do you remember a trench at this site, just north of Stratum 1?

Members of the panel could not recall a specific trench at this site. However, the panel noted that there were several surface drainage ditches within this general area that directed runoff toward Agua Chinon Wash.

RI/FS Site 21 - Materials Management Group, Building 320

69. Do you remember drums being stored next to a parking lot across the street from Building 320.

Building 320 is a warehouse for receiving new product material onto the Station. Many drums of product material are stored adjacent to the west side of the building. The panel assumed that the drums located across the street from the building were probably new material that was temporarily being stored. The panel could not provide any specific information.

RI/FS Site 22 - Tactical Air Fuel Dispensing System

70. On April 18, 1978 and March 23, 1979, and April 13, 1979, JP-5 was spilled onto the parking area next to Building 369 and washed into the storm drain that leads to Bee Canyon. Can you give us any additional information on these spills?

J Carson: Building 369 is the Serv Mart facility. J. Carson was responsible for making sure the skimmer at Bee Canyon Wash was working whenever a spill was reported. It was common practice for the Marines to wash the jet fuel tanks at this location and let the runoff flow into the storm drains. The fuel bladder was checked for leaks on a daily basis, however spills were usually reported once or twice a year. According to J. Carson, there was usually a strong petroleum odor present in this general area.

J. Carson said that for approximately 30 years, there was no spill protection at the washes. In the early 1970s, the Station installed a primitive recovery system that could only recover a portion of the spill (about 30 to 40 percent of the fuel in the wash). Later, a more advanced recovery system was installed that was able to recover a higher percentage of each spill.

Buildings 288 and 289 (Aircraft Maintenance Department)

71. Can you describe the activities and waste handling procedure at these buildings? *(There was some confusion about this question related to the building numbers specified. Buildings 288 and 289 are located near the northwest corner of the airfield. Building 288 is an administrative building and Building 289 is an aircraft hangar where the Station Commander's aircraft is stored. Since this is an area of little activity or concern, it was assumed that the question is referring to the activities at Building 388.)*

APPENDIX O

FACTORS AFFECTING PERFORMANCE OF VCP

VITRIFIED CLAY PIPE

Characteristics of Vitrified Clay Pipe Performance

VCP has been in use as a conveyance mechanism for sanitary wastes for over 100 years. VCP will not rust, shrink, elongate, bend, deflect, erode, oxidize or deteriorate. VCP is structurally sound with permanently fused body independent of chemically reactive bonding agents. It is considered a good material for sewer line construction because it has a 100-year life expectancy, it is chemically inert to many standard chemicals and reagents, and it demonstrates a low coefficient of friction. Today VCP joint tightness is resistant to root penetration and leakage in most situations. The internal surface of VCP is exceptionally resistant to abrasion and scour. Economically, VCP is the best total value considering cost of material, installation, maintenance and useful life. Thus, VCP is selected by many communities and industries to carry most liquid to treatment or collection facilities.

Each section of pipe is fabricated with one end formed in a bell shape and the other end straight (known as the "spigot"). The "spigot" of a VCP section is forced-fit into the bell end of the previous section. In the period when the MCAS El Toro sanitary sewer system was constructed, cement mortar was used as a joining/sealing compound to join the two VCP sections together. During installation, the route of the sewer system is staked out, excavated, braced (as needed), the VCP installed, fit up and joined, and then back-filled (NCPI, 1998).

VCP is a unique piping material. The clay pipe is manufactured from specialized clays and shales (hydrous alumina silicates) produced when soluble and reactive minerals leach from certain rocks and soils leaving an inert substance. These materials are characterized by: (1) plasticity essential for accurate extrusion during pipe manufacturing; (2) suitable drying and firing properties; and (3) stability at high temperatures (NCPI. 1998). The clay material is vitrified through a firing process in kilns at temperatures about 2,000 degrees Fahrenheit and becomes fused into an inert, chemically stable compound, integrally bonded by its very nature without the addition of supplemental agents (NCPI, 1998).

Prior to firing, clay pipe manufacturers blend the clays and shales to develop the inherent strength and load bearing performance attributes of the pipe. A committee of the American Society of Testing and Materials (ASTM) composed of consulting, governmental, laboratory, testing and academic engineers prepares national standards for quality and performance which it continuously reviews and upgrades, based on the latest manufacturing methods and automated processes.

VCP sanitary sewer systems are typically designed and installed by public work agencies and contractors in accordance with National Clay Pipe Institute (NCPI), ASTM standard specifications, and "Standard Specifications for Public Works Construction." Extracts from these documents are provided at Appendices P, Q, and R, respectively.

Adverse Conditions Affecting Vitrified Clay Pipe Performance

Despite its inherent advantages, VCP can be adversely affected by loss of joint integrity, soil mechanics, flow chemistry, and static and dynamic loads. Proper engineering requires determining if the soil conditions where VCP will be laid are stable enough to accept the weight of the pipe and its anticipated load. Theoretically, the soil mechanics and load-bearing conditions of soil local to where the VCP is being installed should be defined along the entire length of the VCP sanitary sewer system by conducting subsurface investigations. In practice, this is not always done and only the general load-bearing soil mechanics are known along the alignment of the system.

At MCAS El Toro, the VCP sections were joined with cement mortar (page 6 of 19 at Appendix N). Engineering standards at the time took into account a known exfiltration rate through the joints when this material was used (NCPI, 1998). Any deficiency in the manner by which the VCP sections were set into position, the process of joining VCP sections together, and the soundness of the joining material would increase the exfiltration of fluids flowing through the VCP. Breaks in the wall of the VCP could occur after installation if a void formed under a section of VCP line causing a collapse, or a heavy weight passed over the VCP line and crushed it. A void may occur following storm events if water is channeled under a section of VCP line. Any subsequent movement of the soil could cause a shift in the VCP and place undo stresses on the joints. In this circumstance, VCP pipe joint(s), especially a cement mortar joint, would fracture or fail. This failure would create a pathway by which the contents of the VCP could escape directly into the subsurface.

In the 1940's the installation of VCP was primarily a manual process (NCPI, 1998). The variability of manual operations introduced a potential for joint failure from incorrect compression of the sections, awkward lay-downed of the pipe, or the application of stress to joined sections while the cement mortar was curing.

Joint Integrity

The structural integrity of the joint is the single most important element in a leak scenario. The following was the generally accepted practice of installing sections of VCP (NCPI, 1998):

- Manual installation occurred in the excavation trench with each section set into the excavation trench onto bedding material as local soil conditions require,

- The "bell" (facing upstream) and "spigot" ends of two section were cleaned of any dirt or debris,

- Cement mortar, typically mixed in the field at the site, was applied by hand to the "spigot" end of the two ends to be joined together,

- The "bell" end of the VCP section was compression joined into the "spigot" end of the other section of VCP,
- The two adjoining sections of VCP were then allowed to set in place with little or no external support to aid in the cement mortar curing process,
- The excavation was back-filled.

Because incentives rewarded speed in construction, it was customary to join several sections of VCP together at one time; after which, sections of joined VCP were connected to each other. Pressure to complete the installation increased the likelihood that the application of the cement mortar was not applied in a complete enough manner to be structurally sound after setting. From its initial use in the 1880s through the late 1950s, sanitary sewer lines were routinely tested to ensure that the rate of exfiltration did not exceed the design maximum.

The rigid cement joint converted the individual sections of VCP into a fixed inflexible string of VCP line. As a result of the rigid nature of the entire line, any subsurface anomaly could flex the rigid pipeline creating a breach in the line at individual joints or in the barrels of sections. A breach in the rigid pipeline would mean that the weakest portion of any particular section or joint would fail thereby allowing the contents to escape to the adjacent soil. Because the joint-to-joint cement mortar seal is very brittle, the slightest movement of one or more sections of the VCP pipe will cause a fracture. In comparison to current flexible joint materials, there is a higher probability for a joint leak due to the use of cement mortar.

Soil Mechanics

Current practices for the design of the VCP systems call for careful evaluation of local soil conditions. Buried VCP is susceptible to 360-degree soil interaction, which under a variety of circumstances, can create the conditions that result in it structural failure. Failure to design and construct VCP lines in accordance with ASTM guidelines greatly increases the risk of future structural failure. If improper bedding material is used, then both the barrel and the joint may fail and contents escape to adjacent soil. In cases where local soils present a low load bearing capacity, it is usually necessary to amend the soil with engineered soil and fill. If improper cover material is used, then heavy traffic or surface conditions may result in crushing forces that damage the VCP and allow the content to escape. As such, surface cover overlying VCP lines often needs to be engineered to reduce the potential adverse impacts of crushing forces.

PES is not aware of records that identify the standards or guidelines used for the design and construction of the MCAS El Toro sanitary sewer system. Local soil conditions in the shallow subsurface where VCP was installed at MCAS El Toro are prone to expansion and contraction as soil moisture content seasonally fluctuates. Under these circumstances, VCP is not forgiving to soil movement. This movement by expansion or contraction may create compressive, tension, shear, and/or torsion forces that result in the separation of VCP sections from one another.

Flow Chemistry

The theory of how chemical contaminants escape from sanitary sewer lines may be partially attributed to the nature of their solvency. If soils become saturated and liquids infiltrate the sewer line, then a case can be made that chemical contaminants inside the VCP can exfiltrate from it when soils are not saturated. The chemical contaminants are likely to flow along the external interface between the VCP and bedding materials until a pathway into the subsurface soil is found. Contaminants then typically migrate farther downward into the subsurface. Some VOCs such as PCE, TCE, and TCA are heavier than water and will leak from unsound joints of VCP directly into the subsurface or, in the case of PCE, under conditions, vaporize, escape to the subsurface, and re-condense (Victor Izzo, 1992; full report provided at Appendix S).

Small bore VCP (4- 15 inch) sanitary sewer systems are designed for a maximum flow design point when half full of liquid. Large bore VCP (larger than 15-inch) systems use a maximum flow of three-quarters full. Using gravity flow, sanitary sewer systems such the one at MCAS El Toro are designed to for approximately 2 feet per second, whereas in commercial and process applications, flows are typically 5-7 feet per second (Crane, 1969). The flow in VCP sanitary sewer piping acts very much like atmospheric open channel flow of non-viscous fluids. Since flow through VCP does not represent a pressure flow, flow friction becomes a design parameter to preclude the dropout of solids along the route of flow. Therefore, it can be assumed that the VCP sanitary sewer system, when constructed MCAS El Toro, was not manufactured or installed to provide a leak tight system. The design and construction standard for leak tightness for sanitary sewer systems emerged in the late 1950s and early 1960s.

Static and Dynamic Loads

A critical factor for design of VCP systems is the anticipated compressive load. If the terrain and subsurface conditions do not allow for a solid foundation to support the weight of fully loaded VCP engineered soil must be imported to provide a stable bed and support for the weight of the system.

The ability of the shallow subsurface to support static and dynamic loads depends upon the load bearing capacity of the soil. The limits of weight that soil will support range from 0 to 30 tons per square foot (NCPI, 1998). There is a considerable quantity of data that the designers of sanitary sewer systems must assemble and evaluate during the process of determining whether natural local soils are suitable for the bedding of a VCP system or if the bedding must be engineered. These data include local geology and hydrogeology, the resistance of the rocks, the possibility of slips, and the danger of disintegration of the rock. Often it is necessary to have soil boring samples collected and analyzed along the alignment of the system. This is done to ensure the soil will support the anticipated static load generally presented by the dead weight of the VCP system and its overburden, and dynamic loads generally presented by the weight of fluids being conveyed and surface traffic along or adjacent to the alignment of the system.

PES is not aware of any record of subsurface investigation or soil engineering report used during the design and construction of the MCAS El Toro sanitary sewer system. As illustrated in Plates 2a and 2d, the MCAS El Toro sanitary sewer system crosses beneath numerous vehicular roads and runways 7 R/L, 16 R/L, and 34 R/L. Given frequent traffic of heavy military vehicles throughout the network of roads at the air station and numerous daily landings and takeoffs of military aircraft including heavily loaded cargo transporters, the exposure of the sanitary sewer system to substantial dynamic surface loads could have been large enough to present a credible probability for loss of structural integrity.

Testing of VCP Sanitary Sewer Systems

VCP sanitary sewer lines must be tested to determine the integrity of newly constructed sanitary sewer lines and/or systems. Accepted practice is to test each section from manhole to manhole after the trench is back-filled. The first section of newly constructed sewer system is tested immediately upon completion to ensure that the installation process produced the results required by the specifications; i.e., that exfiltration does not exceed the allowable design maximum. Experience dictates that continuous testing throughout the construction of the sanitary sewer system improves future performance. When many lines are involved, construction should not be completed before testing begins.

The generally accepted methods of testing are the infiltration test and/or the low-pressure air test. When the measured water table is 2 feet or greater above the pipe barrel at the midpoint of the test sections, infiltration testing is the preferred and least expensive method of testing. The infiltration test measures the groundwater entering the pipeline and manholes. The allowable amount of infiltration is specified by the design engineer and is commonly expressed in gallons per inch of pipe diameter per mile per day.

Low pressure air testing is an accurate method of testing the tightness of newly laid sanitary sewer lines or determining the presence of a leak in existing lines. The responsible engineer determines an acceptable drop in air pressure for a manhole-to-manhole section. Any deviation indicates a leak in the section.

Use of either test at MCAS El Toro would determine the structural integrity of the current system and give an indication of its past performance. Leak testing would also be useful in determining sampling and testing strategies to identify potential solvent contamination.

APPENDIX P

EXTRACTS
NATIONAL CLAY PIPE INSTITUTE
ENGINEERING MANUAL

Lateral Sewers

A lateral sewer is a continuation of the municipal sanitary sewerage system. This installation demands the same special care and experience as municipal sewerage construction for the line to be permanent and trouble free. Installation should be performed by experienced and competent workmen.

Lateral sewers must be resistant to the action of corrosive chemicals. Ordinary sewage contains quantities of acetic, citric , sulfuric and lactic acid as well as organic acids. These sewers pass thou-sands of gallons of hot, soapy water, vegetable and fruit juices, a variety of cleansers and drain cleaners which are highly corrosive. In addition, the wide-spread use of garbage grinders introduces into sewers a large amount of organic matter. Dishwashers and wash-ing machines contribute large quantities of hot water which greatly increase the sewage temperature.

Lateral sewer pipe should not deflect, deform, soften, rust, decompose or disintegrate from the effect of domestic wastes, high sewerage temperatures, moisture saturation, sustained trench loading or cleaning.equipment.

Trench Excavation

Pipe trenches should be dug with the same care required for main lines. Trenches should be straight and to the required slope, with width held to a minimum.

Where the soil is sufficiently firm to provide a solid foundation for the pipe, the trench bottom should provide uniform support for the barrel of the pipe. Bell or coupling holes should be dug at the proper intervals so that the weight is supported by the barrel of the pipe.

Care should be taken to excavate no deeper than necessary, unless there is a supply of angular crushed stone or other suitable coarse material available to bring the trench bottom to grade and provide uniform support for the barrel of the pipe. Rock or other unyielding material which is encountered should be removed. The pipe foundation should be free of all lumps and irregularities.

Where the bottom of the trench is either of rock, unyielding, or unstable material, it is advisable to excavate below grade and backfill to grade with angular crushed stone or similar material.

Installation

Each section of pipe should be laid to a specified line and grade. All pipe should be laid with bells or couplings upgrade.

As the installation progresses, the interior of the pipe should be cleared of all dirt and foreign material. The trench should be kept as dry as possible while the pipe is being laid. The specific manufacturers' recommendations should be carefully followed.

Backfilling

Normally the excavated earth is satisfactory for backfilling purposes. The trench should be backfilled as soon as i· ·ection is completed. To protect the line from lateral movement, the backfill should be carefully placed around a. . to at least one foot above the top of the pipe.

NCPI

Vitrified Clay Pipe is Chemically Inert

Because vitrified clay pipe is chemically inert, it is not vulnerable to damage due to domestic sewage, sulfide attack, most industrial wastes and solvents or aggressive soils.

Hydrogen Sulfide

The relationship between the chemistry of sewage to the pipe materials conveying it is of primary concern in the design of sanitary sewer systems. A brief outline of the factors involved in the ever-present generation of hydrogen sulfide gas is provided to point out the variety of conditions which can exist and must therefore be anticipated in sanitary sewers. The protection of the sewer system from the ravages of sewer gas attack is of fundamental importance in designing and providing permanent, trouble-free lines. Failure to fully and properly evaluate any of the contributing factors may lead to subsequent failure of the sewer line. Factors contributing to sulfide generation and evolution are:

1. Temperature of sewage
2. Strength of sewage
3. Velocity of flow
4. Age of sewage
5. pH of sewage
6. Sulfate concentration

Sulfides are generated in the slime layer which forms between the sewer pipe and the flowing sewage. This action takes place by the bacterial conversion of sulfates in sulfides. The sulfides form hydrogen sulfide gas which first diffuses into the sewage and then, unless destroyed or neutralized, escapes into the sewer atmosphere.

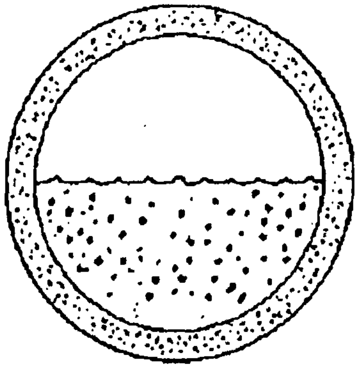
Once the gas is created within the line and released to the atmosphere above the sewage, it comes in contact with the moist surface in the upper part of the pipe and is oxidized very rapidly, by the action of bacteria, into dilute sulfuric acid. The sulfuric acid collects on the exposed arch of the pipe and begins a chemical attack unless the pipe material is chemically inert and invulnerable to corrosive acid action.

In solution, H_2S is in equilibrium with its partly ionized form HS. The two comprise what is called "dissolved sulfide". The proportion of dissolved sulfide existing as H_2S varies with pH. At pH = 6, the H_2S concentration is 91% of the dissolved sulfide; at pH = 7, the proportion is 50%; and at pH = 8, the proportion is 9.1%. Actual field investigations of hydrogen sulfide and acid formation in sewers reveal the crown moisture to have a pH = 2 even though the pH of the sewage was close to neutral (pH = 7).

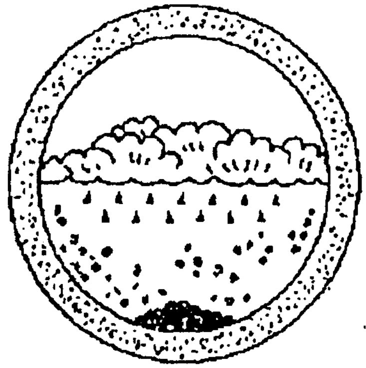
Under certain conditions, the sulfides which originally form in the slime layer, and which diffuse into the sewage, are destroyed more rapidly than they are formed. Under other conditions, accumulation, or "build-up" takes place.

From the chemical standpoint it is recognized that for hydrogen sulfide gas generation to occur, there must be a supply of sulfate present. Sulfate is always present in sewage. Even in a community where the water supply contains no sulfate, the sewage will contain sulfate in sufficient concentration to produce severe sulfide conditions. It has been amply demonstrated that sulfide is produced just as rapidly where there is little or no sulfate in the water supply or where a large amount is available. Sulfide generation will continue until all sulfate and other sulfur compounds in the sewage have been converted to sulfide.

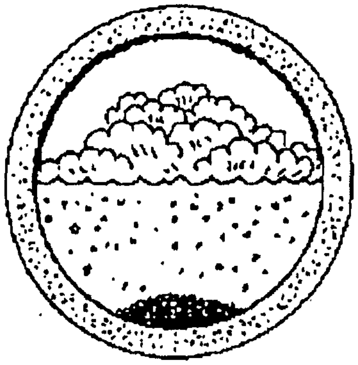
The factor which determines whether sulfide build-up occurs in a stream of sewage is whether or not oxygen is absorbed at the surface of the stream fast enough to oxidize the hydrogen sulfide diffusing out of the slime. The oxygen demand varies from one sewage to another. Oxygen absorption depends principally upon flow velocity. A high flow velocity may reduce sulfide build-up depending upon the strength and temperature of the sewage.



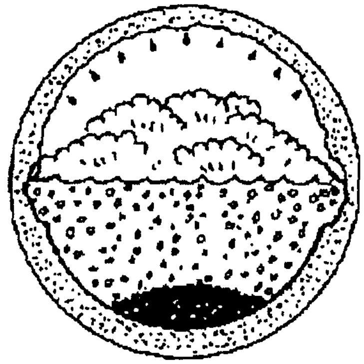
A. Bacteria in the slime under flowing sewage converts to sulfides.



B. Sulfides in the liquid make their way to the surface and are released into the sewer atmosphere as hydrogen sulfide gas.



C. Hydrogen sulfide gas in atmosphere makes contact with moisture in arch in pipe which contains more bacteria. Bacterial action converts gas to sulfuric acid.



D. If pipe is of corrodible material, sulfuric acid attacks it causing ultimate failure. Vitrified clay pipe is chemically inert and not vulnerable to acid attack.

However, high velocity may also be damaging if any hydrogen sulfide is present in a stream of sewage. The rate of sulfide release increases with increased flow rate. Turbulence, due to junctions, changes of pipe size, drops, etc., will cause a relatively rapid release of hydrogen sulfide gas.

One of the major causes for the increasing sulfide damage in modern sewer systems is the dumping of vast quantities of organic matter from household garbage grinders into such systems. This condition increases deposits in sewer lines, thus retarding the flow and providing a source of increased sulfide generation. It also substantially increases the B. O. D. which increases the difficulty of meeting the oxygen required to limit sulfide build-up.

Force mains are a cause of sulfide problems in sewers, particularly if the sewage is retained for any appreciable length of time. High sulfide concentrations will not damage the interior of the filled pipe, but may cause odor nuisances and damage to downstream structures.

Sewage temperature is a contributing factor in the rate of development of sewer gas. Household appliances such as dishwashers, washing machines, etc., have resulted in large quantities of hot water being discharged into the sewer system. When consideration is given to the fact that for every increase of 10 degrees in sewer temperature, there is a 100% increase in the effective B.O.D., it shows why it is difficult to prevent hydrogen sulfide generation in sewers.

en corrodible pipe materials are attacked by sulfuric acid, disintegration begins on the upper surface of the pipe aving a soft residue. Sometimes the soft or pasty material is washed away by high water exposing new surfaces to corrosive attack. Even when this does not occur, acid formed at the exposed surface continues to diffuse through this residue and attacks the underlying pipe material. When the arch is too weak to support the earth load, it collapses and the sewer becomes inoperable.

Some sanitary sewers are subject to constant attack by a multitude of wastes from industry, homes and businesses. Ordinary domestic sewage includes detergents, drain openers, scouring powders, bleaches and other household chemicals. From business and industry come other and more violent chemicals, solvents, acids and alkalis.

Sanitary sewer pipe may also be subject to corrosion from acidic or alkaline soils, electrolytic decomposition attack and temperature induced damage. Different pipe materials display various levels of resistance to these factors. Cement bonded and metallic pipe materials may require special protection.

Temperature and solvent sensitive plastic materials should be avoided where the potential exists for these factors to occur.

Preliminary soils and site investigation should be required if conditions in the area selected for installation are unknown or suspected to cause damage to candidate materials.

Clay Pipe Engineering Manual

Chapter 9, Inspection and Testing

Inspectors are an important link between the engineer's design and the completed project. They assist all of the parties involved during the actual construction.

Qualifications

Inspectors should be able to transfer levels from reference stakes to trench bottoms. It is important that they have a knowledge of how to set up and check laser alignment equipment.

Inspectors must also be thoroughly familiar with good practice in sewer construction, have the ability to read construction drawings and make such computations necessary to interpret the

drawings. They should have knowledge of safety regulations for construction sites and see that all regulations and proper procedures are followed.

On the Job

The resident engineer has the overall responsibility for inspection, but the immediate responsibility rests with the onsite inspectors. It is therefore neces-sary that they be fully acquainted with the construction contract. They must be sufficiently experienced to note serious differences between actual construction procedures and those methods contained in the drawings and specifications.

Duties

The inspectors have many duties included in their work. They should make a complete record of all occurrences incident to the construction.

These records are most important especially if changes must be made in the original construction plans. Such changes may involve extra work and payment for this can be computed only after the work is done. Any important deviation between design work and actual construction should be noted.

The day-to-day records of all satisfacto-rily completed work is the basis for interim payments to the contractor.

Among the important items noted by inspectors are the precise locations of all sewer connections by station and depth. These locations are transferred to the permanent records of the project.

The long-term efficiency of sewer sys-tems depends upon the combined efforts of the engineers, the inspectors, the contractors and the material suppliers.

The inspector must be familiar with the job specifications in order to assure that the requirements include proper trench bottom preparation, proper control of design trench widths, bedding material selection and placement, line and grade transfer, pipe installation, initial back-filling, compaction, trench restoration and witnessing of acceptance testing.

ACCEPTANCE TESTING

Testing is done to determine the integri-ty of the completed sewer line. Good practice is to test each section from manhole to manhole after it is back-filled. The first section of any sewer pro-ject should be tested immediately upon completion to insure that the installation procedure will produce the results required by the specifications. Experience dictates that continual testing as a job progresses will improve procedures and keep the job under proper control. When many lines are involved, the project should never be completed before testing begins.

Test Methods

The generally accepted methods of test-ing are the infiltration test or the low pressure air test.

Infiltration Testing

Where the measured water table is 2 ft. or greater above the pipe barrel at the midpoint of the test section, infiltration testing is the preferred and least expen-sive method of testing. The infiltration test measures the ground water enter-ing the pipeline and manholes. The allowable amount of infiltration is specified by the design engineer and is commonly expressed in gallons per inch of pipe diameter per mile per day. ASTM C 1091 Standard Test Method for Hydrostatic Infiltration and Exfiltration Testing of Vitrified Clay Pipe Lines describes the procedure for Infiltration Testing.

To get an accurate infiltration reading, it is necessary to isolate the section of pipeline being tested from the upstream side. All pumping of ground water should be discontinued 24 hours prior to testing.

The critical measurement for determin-ing the infiltration in a sewer system is the rate of flow at the furthest down-stream point of the section being tested.

It has been customary to use a direct reading V-notch weir to determine the flow in the pipeline. Experience has shown, however, that the direct reading V-notch weir is not sufficiently accurate to measure small infiltration amounts. A more accurate method is to actually collect and measure the flow over a specified time period. This can be done with flow-through plugs, dams or troughs. These quantities, usually measured in ounces per minute or another suitable measure of volume per time unit can be converted to gallons per day or to gal-lons per inch of diameter per mile per day.

The set up in the diagram is recommended to achieve this result. After the leakage for the pipe is determined, the lower plug in the upstream manhole can be removed and the combined infiltration from the pipeline and the manhole can be measured. The manhole infiltration is calculated by simply subtracting the pipeline infiltration from the combined pipeline and manhole infiltration. Other procedures for infiltration testing may be equally satisfactory.

Calculation of Infiltration Rate

Pipe Size 8 inch

Quantity Collected 1.1 gals.

Length of Test Section 485 ft.

Elapsed Time 1 hour

Solution

Infiltration Rate in Gallons/Inch Dia/ Mile/Day

AIR TESTING

The low pressure air test is an accurate method of testing a sewer line. This test is used either for line acceptance or leak location.

The line acceptance test is generally per-formed to establish the tightness of a section of newly laid sewer pipe. A specific drop in air pressure within a pipe section over a specified length of time determines acceptance or failure of the line in question.

The test time and the acceptable pres-sure loss are determined by the engineer having the responsibility for the partic-ular job. All acceptance tests should be performed with authorized personnel present to observe the results.

Clean the sewer line by flushing before testing to wet the pipe surface and clean out any debris. A wetted interior pipe surface will produce more consistent results. Plug all pipe outlets to resist the test pressure. All stoppers in laterals should be braced.

Continue

Summary of Method

[illegible] section of sewer to be tested is plugged. Low pressure air is introduced into this section of line. The rate of air [illegible]oss is used to determine the acceptabil-ity of the section being tested.

Preparation of the Sewer Line

ASTM C 828 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines describes the procedure for air testing sewer lines. Air test tables derived from C 828 are available from NCPI.

Procedures

The pressure-holding time is based on an average holding pressure of 3 psi gauge or a drop from 3.5 psi to 2.5 psi.

Add air until the internal air pressure of the sewer line is approximately 4.0 psi gauge. After an internal pressure of approximately 4.0 psi is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.

When the pressure has stabilized above the 3.5 psi gauge reading, reduce the pressure to 3.5 psi gauge and start test. Record the drop in pressure for the test period. If the pressure has dropped not more than 1.0 psi gauge during the test period, the line is presumed to have passed.

The test procedure can be used as a presumptive test which enables the installer to determine the acceptability of the line before backfill and subsequent con-struction activities.

[illegible]ety

The air test can be dangerous if a line is improperly prepared due to a lack of understanding or carelessness.

Before attempting to plug any sewer pipe, calculate the amount of back pressure the plug must withstand and be certain the plug being used is designed to withstand this pressure. Always use a pressure gauge and regulator when inflating a sewer plug. Underinflated plugs will not be able to withstand the required back pressure. Overinflated plugs can rupture causing possible damage and injury.

It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. In as-much as a force of 250 lbf is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized tha sudden expulsion of a poorly installed plug, or of a plug that is partially deflated before the pipe pressure is released, can be dangerous.

As a safety precaution, pressurizing equipment should include a regulator or relief valve set at perhaps 10 psi to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.