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# MARINE CORPS AIR STATION EL TORO
# EL TORO, CALIFORNIA
# INSTALLATION RESTORATION PROGRAM
# FINAL SAMPLING VISIT WORK PLAN

## 10 MARCH 1992

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# EL TORO
# EL TORO, CALIFORNIA
## INSTALLATION RESTORATION PROGRAM
## FINAL SAMPLING VISIT
## WORK PLAN

**10 MARCH 1992**


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## TABLE OF CONTENTS


Page

EXECUTIVE SUMMARY . . . . . ES-1

1.0 OBJECTIVE . . . . . 1-1

2.0 BACKGROUND INFORMATION . . . . . 2-1

2.1 Historical Description of MCAS El Toro . . . . . 2-1

2.2 Site Location . . . . . 2-1

2.3 Site Operations and Hazardous Waste Generation, Handling, and Disposal . . . . . 2-2

2.4 Previous Site Investigations and Regulatory History . . . . . 2-5

2.5 Environmental Setting . . . . . 2-11

2.5.1 Setting and Topography . . . . . 2-11

2.5.2 Surface Water . . . . . 2-12

2.5.3 Climate . . . . . 2-13

2.5.4 Geology . . . . . 2-13

2.5.5 Hydrogeology . . . . . 2-15

2.5.6 Groundwater Chemistry . . . . . 2-17

2.5.7 Ecology . . . . . 2-18

3.0 MAPS AND FIGURES . . . . . 3-1

4.0 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND RECOMMENDED ANALYTICAL PARAMETERS . . . . . 4-1

4.1 Preliminary Activities . . . . . 4-2

4.1.1 Establish Exact Boring Locations . . . . . 4-3

4.1.2 Procure Subcontractors and Field Equipment . . . . . 4-33

## TABLE OF CONTENTS (Continued)

Page

4.1.3 Prepare Waste Management Plan . . . . . 4-33

4.2 Sampling Strategy . . . . . 4-34

4.2.1 Shallow Soil Borings . . . . . 4-35

4.2.2 Twenty-Five-Foot Soil Borings . . . . . 4-35

4.2.3 Angle Borings . . . . . 4-36

4.3 Analytical Parameters . . . . . 4-37

4.3.1 Areas Proposed for Analysis for a Wide Range of Parameters . . . . . 4-38

4.3.2 Areas Proposed for Analysis for TPH (or TFH) and Volatile Organics Only . . . . . 4-65

4.3.3 Areas Proposed for Analysis for PCBs, TPH, and Volatile Organics Only . . . . . 4-65

5.0 REQUEST FOR ANALYSIS . . . . . 5-1

5.1 Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans Homologs . . . . . 5-1

5.1.1 Analyses . . . . . 5-1

5.1.2 Sample Matrices . . . . . 5-2

5.1.3 Analytical Procedure and Detection Limits . . . . . 5-2

5.1.4 Contract Holding Times . . . . . 5-6

5.1.5 Calibration Procedure and Criteria . . . . . 5-6

5.1.6 Internal Quality Control Checks, Control Limits, and Corrective Action . . . . . 5-8

## TABLE OF CONTENTS (Continued)

Page

5.2 Analysis of Total Petroleum Hydrocarbons by CA LUFT Method .... 5-10

5.2.1 Analyses .... 5-10

5.2.2 Sample Matrices .... 5-10

5.2.3 Analytical Procedure and Detection Limits .... 5-10

5.2.4 Contract Holding Times .... 5-11

5.2.5 Calibration Procedure and Criteria .... 5-11

5.2.6 Internal Quality Control Checks, Control Limits, and Corrective Action .... 5-12

5.2.7 Data Calculations and Reporting Units .... 5-13

5.2.8 Documentation and Deliverables .... 5-13

5.3 Analysis of Total Fuel Hydrocarbons by EPA Method 418.1 .... 5-14

5.3.1 Analyses .... 5-14

5.3.2 Sample Matrices .... 5-14

5.3.3 Analytical Procedure and Detection Limits .... 5-14

5.3.4 Contract Holding Times .... 5-14

5.3.5 Calibration Procedure and Criteria .... 5-15

5.3.6 Internal Quality Control Checks, Control Limits, and Corrective Action .... 5-15

5.3.7 Data Calculations and Reporting Units .... 5-16

5.3.8 Documentation and Deliverables .... 5-16

6.0 FIELD METHODS AND PROCEDURES .... 6-1

6.1 Drilling .... 6-1

6.1.1 Soil Boring Drilling .... 6-1

## TABLE OF CONTENTS (Continued)


Page

6.1.2 Soil Boring Logging . . . . . 6-2

6.2 Sample Collection . . . . . 6-4

6.2.1 Subsurface Soil Samples . . . . . 6-4

6.2.2 Shallow Soil Samples . . . . . 6-6

6.2.3 Organic Vapor Monitoring and Soil Vapor Headspace Analysis . . . . . 6-7

6.3 Disposal of Waste Materials . . . . . 6-9

6.3.1 Drill Cuttings and Subsurface Soils . . . . . 6-10

6.3.2 Decontamination Rinsate . . . . . 6-11

6.3.3 Disposable Protective Equipment . . . . . 6-11

6.4 Equipment Decontamination . . . . . 6-12

6.4.1 Drilling and Soil Sampling Equipment . . . . . 6-12

6.5 Sample Containers, Preservation, Packaging, and Shipping . . . . . 6-13

6.5.1 Sample Preservation . . . . . 6-13

6.5.2 Shipping . . . . . 6-14

6.5.3 Sample and Shipping Containers . . . . . 6-19

6.6 Sample Custody and Sample Labeling . . . . . 6-19

6.6.1 Chain-of-Custody . . . . . 6-21

6.6.2 Sample Labels . . . . . 6-21

6.6.3 Chain-of-Custody Record . . . . . 6-22

6.6.4 Transfer of Custody and Shipment . . . . . 6-22

6.7 Sample Documentation . . . . . 6-23

6.7.1 Sample Identification . . . . . 6-23

## TABLE OF CONTENTS (Continued)

Page

6.7.2 Field Record Keeping . . . . . 6-24

6.7.3 Corrections to Documentation . . . . . 6-24

6.8 Quality Control Samples . . . . . 6-25

6.8.1 Field Quality Control Sampling . . . . . 6-25

6.8.2 Laboratory Quality Control Sampling . . . . . 6-26

7.0 REFERENCES . . . . . 7-1

Appendix A

Quality Assurance Program Plan . . . . . A-1

Appendix B

Site Health and Safety Plan . . . . . B-1

List of Tables

4-1 SWMUs and Areas of Concern . . . . . 4-5

4-2 Sampling Scheme and Analytical Parameters for SWMUs and Areas of Concern . . . . . 4-23

4-3 Proposed Laboratory Analyses for RFA Sampling Visits . . . . . 4-39

4-4 Target Compound List and Contract Required Quantitation Limits . . . . . 4-51

5-1 Analyses Requested: Soil . . . . . 5-3

6-1 Sample Quantities, Bottles, Preservatives, and Packing for Samples from MCAS El Toro . . . . . 6-15

6-2 Holding Times for Soil Samples, By Analysis . . . . . 6-17

6-3 Summary of Quality Control Procedures . . . . . 6-27

## TABLE OF CONTENTS (Continued)

Page

List of Figures


1 Location Vicinity Map . . . . . 3-3

2 Site Boundary . . . . . 3-4

3 Solid Waste Management Units and Areas of Concern . . . . . 3-5

4 Sampling Plan for SWMU/AOC Number 3 . . . . . 3-6

5 Sampling Plan for SWMU/AOC Numbers 4, 187, and 189 . . . . . 3-7

6 Sampling Plan for SWMU/AOC Number 5 . . . . . 3-8

7 Sampling Plan for SWMU/AOC Number 6 . . . . . 3-9

8 Sampling Plan for SWMU/AOC Number 7 . . . . . 3-10

9 Sampling Plan for SWMU/AOC Number 8 . . . . . 3-11

10 Sampling Plan for SWMU/AOC Number 9 . . . . . 3-12

11 Sampling Plan for SWMU/AOC Number 11, 107, and 242 . . . . . 3-13

12 Sampling Plan for SWMU/AOC Numbers 11, 188, and 292 . . . . . 3-14

13 Sampling Plan for SWMU/AOC Number 13 . . . . . 3-15

14 Sampling Plan for SWMU/AOC Number 14 . . . . . 3-16

15 Sampling Plan for SWMU/AOC Numbers 15 and 258 . . . . . 3-17

16 Sampling Plan for SWMU/AOC Numbers 16 and 257 . . . . . 3-18

17 Sampling Plan for SWMU/AOC Number 20 . . . . . 3-19

18 Sampling Plan for SWMU/AOC Number 26 . . . . . 3-20

19 Sampling Plan for SWMU/AOC Numbers 27, 220, and 221 . . . . . 3-21

20 Sampling Plan for SWMU/AOC Number 30 . . . . . 3-22

21 Sampling Plan for SWMU/AOC Number 33 . . . . . 3-23

## TABLE OF CONTENTS (Continued)

Page


22 Sampling Plan for SWMU/AOC Number 39 . . . . . 3-24

23 Sampling Plan for SWMU/AOC Number 41 . . . . . 3-25

24 Sampling Plan for SWMU/AOC Number 46 . . . . . 3-26

25 Sampling Plan for SWMU/AOC Numbers 48, 49, 67, 217, and 218 . . . . . 3-27

26 Sampling Plan for SWMU/AOC Numbers 57, 59, 277, 278, 279, and 280 . . . 3-28

27 Sampling Plan for SWMU/AOC Numbers 65 and 66 . . . . . 3-29

28 Sampling Plan for SWMU/AOC Number 70 . . . . . 3-30

29 Sampling Plan for SWMU/AOC Number 72 . . . . . 3-31

30 Sampling Plan for SWMU/AOC Numbers 73, 76, and 77 . . . . . 3-32

31 Sampling Plan for SWMU/AOC Numbers 83, 84, and 85 . . . . . 3-33

32 Sampling Plan for SWMU/AOC Numbers 88 and 222 . . . . . 3-34

33 Sampling Plan for SWMU/AOC Number 90 . . . . . 3-35

34 Sampling Plan for SWMU/AOC Numbers 91, 92, 269, and 296 . . . . . 3-36

35 Sampling Plan for SWMU/AOC Number 95 . . . . . 3-37

36 Sampling Plan for SWMU/AOC Numbers 98, 99, 100, 101, and 102 . . . . . 3-38

37 Sampling Plan for SWMU/AOC Numbers 110, 112, 113, and 223 . . . . . 3-39

38 Sampling Plan for SWMU/AOC Numbers 116, 201, 202, and 203 . . . . . 3-40

39 Sampling Plan for SWMU/AOC Numbers 120, 208, 209, 261, and 262 . . . . . 3-41

40 Sampling Plan for SWMU/AOC Numbers 124, 213, 214, 215, 271, and 298 . 3-42

41 Sampling Plan for SWMU/AOC Number 125 . . . . . 3-43

42 Sampling Plan for SWMU/AOC Numbers 129 and 226 . . . . . 3-44

43 Sampling Plan for SWMU/AOC Numbers 130, 131, and 132 . . . . . 3-45

44 Sampling Plan for SWMU/AOC Numbers 137 and 138 . . . . . 3-46

## TABLE OF CONTENTS (Continued)

Page


45 Sampling Plan for SWMU/AOC Number 139 . . . . . 3-47

46 Sampling Plan for SWMU/AOC Numbers 144 and 145 . . . . . 3-48

47 Sampling Plan for SWMU/AOC Number 147 . . . . . 3-49

48 Sampling Plan for SWMU/AOC Numbers 149 and 151 . . . . . 3-50

49 Sampling Plan for SWMU/AOC Number 160 . . . . . 3-51

50 Sampling Plan for SWMU/AOC Numbers 162, 163, and 255 . . . . . 3-52

51 Sampling Plan for SWMU/AOC Numbers 164 and 169 . . . . . 3-53

52 Sampling Plan for SWMU/AOC Number 171 . . . . . 3-54

53 Sampling Plan for SWMU/AOC Numbers 172, 173, 175, and 176 . . . . . 3-55

54 Sampling Plan for SWMU/AOC Numbers 179, 180, and 186 . . . . . 3-56

55 Sampling Plan for SWMU/AOC Numbers 181 and 264 . . . . . 3-57

56 Sampling Plan for SWMU/AOC Number 193 . . . . . 3-58

57 Sampling Plan for SWMU/AOC Numbers 194 . . . . . 3-59

58 Sampling Plan for SWMU/AOC Numbers 195, 196, and 197 . . . . . 3-60

59 Sampling Plan for SWMU/AOC Numbers 198, 199, 200, and 250 . . . . . 3-61

60 Sampling Plan for SWMU/AOC Numbers 204, 205, and 206 . . . . . 3-62

61 Sampling Plan for SWMU/AOC Numbers 211, 212, and 252 . . . . . 3-63

62 Sampling Plan for SWMU/AOC Numbers 224, 275, and 276 . . . . . 3-64

63 Sampling Plan for SWMU/AOC Number 225 . . . . . 3-65

64 Sampling Plan for SWMU/AOC Number 227 . . . . . 3-66

65 Sampling Plan for SWMU/AOC Numbers 229, 231, and 232 . . . . . 3-67

66 Sampling Plan for SWMU/AOC Numbers 233 and 270 . . . . . 3-68

67 Sampling Plan for SWMU/AOC Number 234 . . . . . 3-69

## TABLE OF CONTENTS (Continued)

Page


68 Sampling Plan for SWMU/AOC Number 241 . . . . . 3-70

69 Sampling Plan for SWMU/AOC Numbers 243 and 291 . . . . . 3-71

70 Sampling Plan for SWMU/AOC Number 244 . . . . . 3-72

71 Sampling Plan for SWMU/AOC Numbers 248 and 249 . . . . . 3-73

72 Sampling Plan for SWMU/AOC Number 253 . . . . . 3-74

73 Sampling Plan for SWMU/AOC Number 256 . . . . . 3-75

74 Sampling Plan for SWMU/AOC Number 260 . . . . . 3-76

75 Sampling Plan for SWMU/AOC Number 263 . . . . . 3-77

76 Sampling Plan for SWMU/AOC Numbers 272 and 273 . . . . . 3-78

77 Sampling Plan for SWMU/AOC Number 283 . . . . . 3-79

78 Sampling Plan for SWMU/AOC Numbers 286 and 287 . . . . . 3-80

79 Sampling Plan for SWMU/AOC Number 265 . . . . . 3-81

80 Sampling Plan for SWMU/AOC Number 45 . . . . . 3-82

81 Boring Log Form . . . . . 3-83

82 Sample Collection Log -- Soil . . . . . 3-84

83 Chain-of-Custody Record . . . . . 3-85

84 Soil and Sediment Sample Packaging . . . . . 3-86

85 Sample Label and Custody Seal . . . . . 3-87

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# ACRONYMS

| | |
|---|---|
| AOC | Area of Concern |
| APR | Air Purifying Respirators |
| B&C | Brown and Caldwell |
| BRA | Baseline Risk Assessment |
| Cal-OSHA | California Occupational Safety and Health Act |
| CARB | California Air Resources Board |
| CDFG | California Department of Fish and Game |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Commonly known as Superfund) |
| CLEAN | Comprehensive Long-term Environmental Action, Navy |
| CLP | Contact Laboratory Program |
| CNDDB | California National Diversity Data Base |
| CNS | Central Nervous System |
| COMCABWEST | Commander Marine Corps Air Bases, Western Area |
| CPR | Cardiopulmonary Resuscitation |
| CRDL | Contract Required Detection Limits |
| CRP | Community Relations Plan |
| CSF | Cancer Slope Factor |
| CTO | Contract Task Order |
| DCA | Dichloroethane |
| DCE | Dichloroethylene |
| DI | Deionized Water |
| DHS | California Department of Health Services |

| | |
|---|---|
| DPBA | Dual Purpose Breathing Apparatus |
| DQO | Data Quality Objectives |
| DRMO | Defense Reutilization and Marketing Office |
| DSA | Drum Storage Area |
| ELSA | Emergency Life Support Apparatus |
| EPA | U.S. Environmental Protection Agency |
| FFA | Federal Facilities Agreement |
| FFCA | Federal Facilities Compliance Agreement |
| GAC | Granular Activated Carbon |
| GIS | Geographical Information System |
| GPR | Ground-penetrating Radar |
| HWSA | Hazardous Waste Storage Area |
| IAS | Initial Assessment Study |
| IRP | Installation Restoration Program |
| IRWD | Irvine Ranch Water District |
| JEG | Jacobs Engineering Group, Inc. |
| JMM | James M. Montgomery Engineers, Inc. |
| LEL | Lower Explosion Limit |
| MAGs | Marine Air Groups |
| MCAS | Marine Corps Air Station |
| msl | Mean Sea Level |
| NACIP | Navy Assessment and Control of Installation Pollutants |
| NAVFACENGCOM | Naval Facilities Engineering Command |
| NCP | National Contingency Plan |
| NEESA | Naval Energy and Environmental Support Activity |

| | |
|---|---|
| NIOSH | National Institute of Occupational and Health |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| OCEMA | Orange County Environmental Management Agency |
| OCHCA | Orange County Health Care Agency |
| OCWD | Orange County Water District |
| OSHA | Occupational Safety and Health Administration |
| OU | Operable Unit |
| OVA | Organic Vapor Analyzer |
| PA/SI | Preliminary Assessment Site Investigation |
| PAHs | Polynuclear Aromatic Hydrocarbons |
| PAO | Public Affairs Office |
| PCB | Polychlorinated biphenyl |
| PCE | Perchloroethylene or Tetrachloroethylene |
| PEL | Permissible Exposure Limit |
| ppb | Parts Per Billion |
| PPE | Personnel Protective Equipment |
| ppm | Parts Per Million |
| PR | Preliminary Review |
| PRP | Potentially Responsible Party |
| QA/QC | Quality Assurance/Quality Control |
| QAPP | Quality Assurance Program Plan |
| RA | Remedial Action |
| RAP | Remedial Action Plan |
| RAS | Routine Analytical Services |

| | |
|---|---|
| RCRA | Resource Conservation and Recovery Act of 1978 |
| RFA | RCRA Facility Assessment |
| RfD | Reference Dose |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| RME | Reasonable Maximum Exposure |
| ROD | Record of Decision |
| RWQCB | California Regional Water Quality Control Board, Santa Ana Region |
| SAP | Sampling and Analysis Plan |
| SARA | Superfund Amendments and Reauthorization Act |
| SCAQMD | South Coast Air Quality Management District |
| SI | Site Investigation |
| SIPOA | Site Inspection Plan of Action |
| SPCC | Spill Prevention Control and Countermeasure |
| SSC | Site Safety Coordinator |
| SSHP | Site Safety and Health Plan |
| STEL | Short-term Exposure Limit |
| SWAT | Solid Waste Assessment Test |
| SWMU | Solid Waste Management Unit |
| TCA | Trichloroethane |
| TCE | Trichloroethylene |
| TDS | Total Dissolved Solids |
| TFH | Total Fuel Hydrocarbons |
| TIC | The Irvine Company |

| | |
|---|---|
| TLV | Threshold Limit Value |
| TPH | Total Petroleum Hydrocarbons |
| TSA | Transformer Storage Area |
| USMC | United States Marine Corps |
| UST | Underground Storage Tank |
| VOC | Volatile Organic Compound |
| VSI | Visual Site Inspection |

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# PREAMBLE

This Sampling Visit Work Plan (SVWP) was implemented during September through November 1992 and is included as Volume 5 of the Final RFA Report. While the field work for the RFA Sampling Visit was in progress, several revisions to the SVWP were made to accommodate changes in field conditions and new information about SWMUs/AOCs. These modifications are discussed in Section 5.0 of the Final RFA Report and are also presented below.

A total of one-hundred forty (140) SWMUs/AOCs were recommended for sampling visits in the SVWP. During the sampling visits, five new SWMUs/AOCs were identified at the Station. Of these, four were recommended for a sampling visit. In addition, four SWMUs/AOCs were removed from consideration for a sampling visit during this time period because they fell within the revised boundaries of the RI/FS sites. Therefore, the resulting number of SWMUs/AOCs recommended for a sampling visit based on these adjustments remained at 140.

The following four SWMUs/AOCs were added:

SWMU/AOC 300 - Spill Area, East of SWMU/AOC 194

SWMU/AOC 301 - Mark 21 Arrest System (with Storage Tank)

SWMU/AOC 302 - Mark 21 Arrest System (with Storage Tank)

SWMU/AOC 303 - Underground Storage Tank

Descriptions of these four SWMUs/AOCs are provided in the Final RFA Report (Section 5.0) and in the Preliminary Review/Visual Site Inspection (PR/VSI) Report.

Four SWMUs/AOCs were removed from consideration for sampling because they were determined to be located within the revised boundaries of the RI/FS sites at the Station. These four SWMUs/AOCs include:

SWMU/AOC 67 - Drum Storage Area

SWMU/AOC 72 - Hazardous Waste Storage Area

SWMU/AOC 217 - Underground Storage Tank

SWMU/AOC 218 - Oil/Water Separator

Descriptions of these four SWMUs/AOCs removed from the Sampling Visit are included in the PR/VSI Report.

During the field effort, modifications to the boring locations and/or types of borings at individual SWMUs/AOCs were made to accommodate field conditions (e.g., utility lines, new site features). Because of these modifications, some of the plot plans in the SWVP may not be accurate. The plot plans in Appendix B of Final RFA Report present the actual boring locations and, therefore, supersede the plot plans in this Work Plan.

# EXECUTIVE SUMMARY

In February 1990, the U.S. Environmental Protection Agency (EPA) placed the Marine Corps Air Station (MCAS) El Toro on the National Priority List (NPL). Subsequently, the Marine Corps agreed to conduct their Remedial Investigation/Feasibility Study (RI/FS) at MCAS El Toro in accordance with a Federal Facilities Agreement (FFA) signed by the Navy (on behalf of MCAS El Toro), EPA and the State of California in September 1990. Twenty-two sites grouped into three operable units (OUs) are currently included in the RI/FS program.

In addition to the RI/FS, the United States Marine Corps is currently conducting a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) at the facility. The objective of the RFA is to identify additional sites at MCAS El Toro for inclusion into a fourth operable unit (OU) in the RI/FS program.

The Draft Preliminary Review/Visual Site Inspection (PR/VSI) Report (03 July 1991) presented the results of the PR and VSI conducted as the first portions of the RFA at MCAS El Toro. This report incorporated agency comments on the Draft PR Report and included the results of the VSI.

Two hundred ninety-nine sites have been identified as Solid Waste Management Units (SWMUs) and areas of concern for this RFA. The following types of sites were identified through the records review and site visits:

- Underground storage tanks (USTs) that have stored or are currently storing waste materials
- USTs whose storage contents are unknown
- Past and present hazardous waste and/or drum storage areas
- Washracks
- Sites recommended by the California Regional Water Quality Control Board, Santa Ana Region (RWQCB)
- Active sanitary sewer lines
- The four major on-station drainage channels
- The former sewage treatment plant site (including abandoned tie-in lines to the existing sanitary sewer system)
- The abandoned sewer lines associated with the former metal plating operation
- The golf course, its irrigation tank, and the pipeline between the former sewage treatment plant and the irrigation system
- The former incinerator site

- Two abandoned wells

- Other sites identified from photographs and interviews of station personnel

- Sites identified during the visual site inspection

One hundred fifty-seven SWMUs and areas of concern at MCAS El Toro were recommended for a sampling visit in the Draft PR/VSI Report. This Draft Sampling Visit Work Plan presents the proposed sampling program for these SWMUs and areas of concern, and will be submitted to the agencies for review and approval prior to implementation of the field work.

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# 1.0 OBJECTIVE

This Sampling Visit Work Plan (Plan) has been prepared as part of a RCRA[1] Facility Assessment being conducted at the Marine Corps Air Station (MCAS) El Toro (or Station). One of the major objectives of the RFA is to identify solid waste management units (SWMUs) and areas of concern that should be included into Operable Unit (OU)-4 of the Remedial Investigation/Feasibility Study (RI/FS) Program at the Station.

The purpose of this Plan is to describe the recommended sampling and analysis proposed for the SWMUs and areas of concern identified in the Preliminary Review (PR) and the Visual Site Inspection (VSI) portions of the RFA for a sampling visit. (Note: The Draft PR/VSI Report, dated 03 July 1991, provides the basis for much of the material in this Plan. Because of the size of this report (three volumes) and quantity of information contained in it, material from this report will be referenced in the Plan rather than be directly included in the Plan.)

The purpose of the sampling will be to verify whether a release has occurred at a SWMU or area of concern. An assessment of the extent of potential contamination at a site is not an objective of the sampling visits proposed in this Plan.

The results of the implementation of this Plan will be used to decide:

[1] Resource Conservation and Recovery Act of 1976

- Whether a SWMU or area of concern should be considered for inclusion into the RI/FS Program at MCAS El Toro as a site in OU-4. The decision for inclusion into the RI/FS Program will be based on evidence indicating that the nature of a release from a SWMU or area of concern makes this area a potential contributor to the volatile organic compound (VOC)-contaminated groundwater in the region.

- Whether a SWMU or area of concern should be investigated further in a RCRA Facility Investigation (RFI)

- Whether a SWMU or area of concern should be considered for interim corrective measures to alleviate especially high risks of exposure

- Whether a SWMU or area of concern should be considered for no further action

Soil is the only media proposed for sampling in this plan for the following reasons:

- Groundwater is located at a depth of about 100 feet or greater at the Station. Soil in the vadose zone is therefore the appropriate media to sample to determine if a release from a SWMU or area of concern has occurred.

- Air is not identified as a media requiring sampling at any of the SWMUs or areas of concern. In instances where there is current evidence of release to air (e.g., odors at a hazardous waste storage area), it is a temporary, nonroutine release caused by an open container or a small spill within the storage area.

- Surface water in the major drainage channels is not recommended for sampling in the RFA. The surface water in the major drainage channels is scheduled to be sampled in the RI/FS Program. It should be noted that sampling and analysis of surface water would not provide information about past releases to the drainage channels at the Station. To evaluate past and present releases at the channels, the soil below unlined portions of the channels is recommended for sampling and analysis.

- Subsurface gas is not recommended for sampling in the RFA because subsurface gas releases are not expected at any of the SWMUs or areas of concern. (The potential for subsurface gas releases may be present at the Station's four previous landfill sites. These sites, however, are being investigated in the RI/FS Program at MCAS El Toro and are therefore excluded from further consideration in the RFA.)

This Plan has been organized into a format similar to the RI/FS Sampling and Analysis Plan (SAP). Section 1.0 presents the objectives of the sampling visits to be conducted under the RFA at MCAS El Toro. Section 2.0 presents background information on the Station. Maps and figures for the Plan are all contained in Section 3.0. Section 4.0 presents rationale for sample locations, number of samples, and recommended analytical parameters. Section 5.0 describes the analytical parameters for the samples collected in the RFA. Section 6.0 presents a description of the field methods and procedures to be followed for the sampling program. Section 7.0 is a bibliography. A Quality Assurance Project Plan (QAPP) is provided in Appendix A. A Health and Safety Plan for the RFA field activities is presented in Appendix B.

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# 2.0 BACKGROUND INFORMATION

## 2.1 Historical Description of MCAS El Toro

In July 1942, construction of a U. S. Marine Corps (USMC) pilots' fleet operational training facility began on approximately 2,320 acres in Orange County, California. On 17 March 1943, that facility was commissioned as MCAS El Toro. In 1950, MCAS El Toro was selected for development as a master jet air station and permanent center for Marine aviation on the West Coast to support the operations and combat readiness of Fleet Marine Forces, Pacific. Between 1944 and 1988, additional land was acquired to bring MCAS El Toro to its present size of approximately 4,740 acres.

The mission of MCAS El Toro is to maintain and operate facilities and provide services and material to support the operation of aviation activities and units of the operating forces of the USMC, Navy, and other activities as designated by the Commandant of the Marine Corps, in coordination with the Chief of Naval Operations.

## 2.2 Site Location

The MCAS El Toro is located in southern California in Orange County, about 8 miles southeast of the City of Santa Ana and 12 miles inland (north-northeast) of the coastal City of Laguna Beach as shown in Figure 1. (All of the figures in this Plan are presented in Section 3.0.) The exact location of MCAS El Toro is 33 degrees 38 minutes to 33 degrees 41 minutes north latitude, 117 degrees 41 minutes to

117 degrees to 45 minutes west longitude, T 6S/R 8W (Sections 2-5, 7-11, 16-17, 20-21) and T 5S/R 8W (Sections 32-33, 35).

Historically, the land use around MCAS El Toro has been largely agricultural. To the south, southeast, and southwest, however, the land has recently been developed as commercial, light industrial, and some residential usage. The commercial and light industrial usage is directly adjacent to the southwest and southeast boarders of the Station. Nearby off-Station residences are located about three-fourths of a mile from the Station.

A map showing the Station's boundaries and location with respect to local freeways is presented in Figure 2.

## 2.3 Site Operations and Hazardous Waste Generation, Handling, and Disposal

The primary mission of MCAS El Toro is to maintain and operate facilities and provide services and materials to support the operation of aviation activities. The mission involves operation and lower echelon maintenance of a relatively large number of military aircraft and ground support equipment. Operations at the following locations result in the generation of hazardous wastes:

- Aircraft maintenance hangars

- Maintenance shops for auto vehicles, aircraft ground support equipment, vehicle equipment, and construction equipment

- Auto hobby shop and Marine Corps Exchange auto repair station

- Washracks and steam cleaning facilities

- Hazardous, flammable, and unused chemical materials storage

- Aircraft fueling stations, tactical airfield fuel dispensing systems (TAFDS), and fuel farms

Hazardous wastes typically generated from aircraft and vehicle maintenance, degreasing processes, and painting include waste oil, fuels, hydraulic fluid, lube oil, antifreeze, cleaning solvents, paints, paint stripper, paint thinner, batteries, and contaminated rags and absorbents.

The unused chemical materials storage areas typically do not generate hazardous waste. Chemical products with expired shelf life that cannot be recertified are handled as hazardous waste.

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 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 between about 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.

Currently, hazardous waste are accumulated in containers at generator accumulation areas and are held for less than 90 days. Containers are then transferred to the on-Station Interim Status Storage Facility (Building 673T) for ultimate off-Station disposal. Bulk petroleum recyclables such as waste oil and fuel are pumped from generator accumulation containers and transferred to waste storage tanks until pickup by an outside contractor for recycling. Waste oil pumped from oil/water separators is also collected in waste storage tanks. The Facilities Management Department (FMD) pump

truck is used to pump the waste oil and fuel. Waste solvents are picked up from the generator accumulation areas or from the storage facility by an outside contractor for recycling.

The MCAS El Toro contracts with transporters and treatment, storage, or disposal facilities (TSDFs) to ship, recycle, treat, or dispose of hazardous wastes. The contracts are established through either the Defense Reutilization and Marketing Office (DRMO) or through the Environmental Office (EO).

The DRMO was set up originally in 1973 as the Defense Property Disposal Office (DPDO). It is currently a civilian operation that is responsible for transferring surplus military waste materials and components out of military custody to civilian ownership. The DRMO has stored surplus hazardous materials in the past in storage yards directly north of Building 360 and to the northeast of this building. These yards are being investigated as Site 8 in the RI/FS Program. Currently, the DRMO and the EO share responsibility for coordinating the hazardous waste handling and disposal at the Station. The EO contains a recycling department, which is primarily involved with the 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

In 1972, MCAS El Toro received a Cease and Desist Order from the California Regional Water Quality Control Board, Santa Ana Region (RWQCB) 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 of DOD's Installation Restoration Program (IRP). The IAS report was completed in May 1986 and identified 17 potential sources of contamination. No sampling was performed as part of the IAS, and the identification of potentially contaminated sites was based solely on the results of record searches and employee interviews. The IAS report supplied recommended sampling locations and analytical parameters to provide confirmation of suspected contamination at the sites of concern.

In June and July 1985, while the IAS study was underway, the Orange County Water District (OCWD) discovered trichloroethylene (TCE) in agricultural wells TIC[2] 47 and TIC 35 located downgradient of MCAS El Toro. They then launched their own offsite investigation to determine the source and extent of the TCE contamination. After installing a network of monitoring wells and soil-vapor probes and reviewing the results of independent investigations by Cannon, Inc. and Wilma Pacific, Inc., OCWD concluded that MCAS El Toro was the source of the contamination. The OCWD investigations

[2]The Irvine Company

have spanned the period from the initial discovery of TCE in 1985 and continue to the present. (Herndon and Reilly, 1989; Herndon, 1990).

In 1987, James M. Montgomery Engineers, Inc. (JMM) was contracted by the USMC to review the work done by B&C and to produce a Site Inspection Plan of Action (SIPOA). In July 1987, while the SIPOA study was underway, RWQCB issued a Cleanup and Abatement Order requiring the USMC to prepare a supplement to the plan to address off-Station TCE contamination and to submit a draft report on the results. The SIPOA was released in August 1988 and included a recommendation of 19 sites for study and amended sampling plans proposed in the IAS report for each site. One site, designated Site 18, was intended to address the off-Station contaminant plume of VOCs.

In 1988, JMM was again contracted by the USMC to conduct a Perimeter Study Investigation (PSI) to study VOC contamination along the southwestern boundary of the Station. This study was initiated to address RWQCB's concerns that MCAS El Toro was a potential source of a VOC plume that extended four miles off-Station. The PSI was performed, and the results indicated that VOCs were present in the shallow groundwater (i.e., about 100-feet deep) near the Station boundary. In addition to TCE, the following VOCs were detected: perchloroethylene (PCE), chloroform, and carbon tetrachloride.

As a consequence of the findings of the PSI, an interim groundwater pump and treatment system was installed at the southwestern Station boundary. This system, which began operation on 15 June 1989, is capable of pumping and treating approximately 30 gallons per minute (gpm) of groundwater from three extraction wells. VOC contaminated water is sent to an on-Station granular activated carbon (GAC) unit

for treatment, and the effluent is used to irrigate the Station golf course. TCE and PCE composite concentrations in the influent to the treatment system have been in the range of 10-160 and 25-100 parts per billion (ppb) respectively.

The discovery of TCE and PCE so close to the downgradient Station boundary prompted the USMC to contract with JMM to prepare an off-Station RI Work Plan. This Plan was completed in March 1990 and included recommendations for monitoring well installations to further delineate the extent of contamination by complementing the OCWD network of monitoring wells. The recommendations of the off-Station RI Work Plan were not implemented by the USMC but served as a starting point for the regional groundwater VOC investigation currently being conducted under the RI/FS program.

In June 1988, EPA recommended listing MCAS El Toro on the National Priorities List (NPL) of the Superfund Program. The listing was predicated on the presence of VOC contamination at the Station boundary and the detection of VOCs in the agricultural wells to the west of the Station. The MCAS El Toro was listed on the NPL in February 1990. A Federal Facilities Agreement (FFA) among EPA, RWQCB, California Department of Health Services (DHS), and the Navy (on behalf of USMC) was signed in September 1990.

In November 1989, the Jacobs Engineering Group, Inc. (JEG) was contracted to prepare an RI/FS Work Plan and associated documents for MCAS El Toro. The project team reviewed the reports mentioned above, as well as other documents pertinent to past disposal practices at the Station. During this process, three sites, in addition to the 19 sites identified earlier, were recommended for investigation under the RI/FS process.

This brought the total number of sites to be investigated to 22, including the regional VOC investigation (Site 18).

The FFA has grouped the 22 MCAS El Toro RI/FS sites into three OUs. Operable Unit-1 consists of the regional VOC Groundwater Investigation (Site 18). At this time, VOCs have been identified in the near surface groundwater under MCAS El Toro and in the deep aquifer downgradient of the Station. Suspect VOC source areas on-Station, including four landfills and a petroleum disposal area, have been grouped into OU-2. Operable Unit-3 consists of the remaining 16 sites not addressed in OU-1 and OU-2. These OU-3 sites generally address the VOC groundwater contamination as a secondary issue. Primary concerns at these sites involve soil and sediment contamination. An OU-4 has also been designated for the MCAS El Toro, which will bring sites identified by the RFA into the RI/FS program. The RI/FS Work Plan for OU-4 will be submitted to the agencies by 15 December 1991.

In May 1988, the USMC submitted Air Solid Waste Assessment Test (SWAT) Proposals for all four MCAS El Toro landfills to the South Coast Air Quality Management District (SCAQMD). Following approval by the SCAQMD, Strata Technologies, Inc. conducted the field work and prepared draft reports in October 1990 (Strata, 1990). The field activities consisted of meteorological and geophysical surveys, and sampling of landfill gas, ambient air, and surface gas. The geophysical surveys using ground-penetrating radar (GPR) were somewhat successful at defining the landfill perimeters. The contaminants TCE, PCE, chloroform, and benzene were detected in landfill gas samples in concentrations above the minimum detection limits determined by the California Air Resources Board (CARB). Methylene chloride (MeCl) has also been detected in the

landfill gases at MCAS El Toro; due to inadequate decontamination procedures, however, the field system blanks were also contaminated with MeCl. The ambient air samples collected at the MCAS El Toro landfills contained concentrations of MeCl, trichloroethane (TCA), and PCE near the CARB detection limits that, based on upwind and downwind measurements, were not necessarily attributable to emissions from these landfills. The draft Air SWAT reports were submitted in April 1991 to SCAQMD.

The estimated area of groundwater with detectable TCE concentrations based on the latest OCWD sampling results (Herndon, 1990), and the location of the nearest drinking water wells and the downgradient communities are shown in Figure 3.

The MCAS El Toro is currently an Interim Status Facility. Although a previous Part B Permit application was approved by DHS, the Station was never a fully permitted facility because EPA did not approve the permit. Six satellite hazardous waste collection facilities (HWCFs) located at Building Nos. 769, 770 771, 772, 778, and 779 and one central HWCF at Building 673T3 were identified in the permit application. Current plans are to close the six HWCFs and to submit a new Part B Permit application during the summer of 1991.

Inspections by EPA of hazardous waste management activities at MCAS El Toro in August 1988, July 1989, and June 1990 indicated violations of RCRA and the Hazardous and Solid Waste Amendments (HSWA) of 1984. Based on these violations, EPA issued a Notice of Noncompliance to MCAS El Toro in August 1990 and entered into a Federal Facilities Compliance Agreement (FFCA) with MCAS El Toro on 28 September 1990.

The tasks for compliance with FFCA are being handled by MCAS El Toro and additionally through the Comprehensive Long-term Environmental Action, Navy (CLEAN) Program.

## 2.5 Environmental Setting

This section summarizes the environmental setting at MCAS El Toro, including topography, surface water, climate, geology, hydrogeology, groundwater chemistry, and ecology.

### 2.5.1 Setting and Topography

The MCAS El Toro is situated on the edge of the Tustin Plain, a gently sloping surface comprised of alluvial fan deposits derived mainly from the Santa Ana Mountains. The Tustin Plain is the southernmost extension of the Coastal Plain of Los Angeles, a structural basin located in the Peninsular Ranges Geologic Province (Yerkes et al, 1965). The Tustin Plain is bounded by the Santa Ana Mountains to the north and the San Joaquin Hills to the south.

The MCAS El Toro boundaries extend across the Tustin Plain into the Santa Ana Mountains. Elevations range from about 215 feet above mean sea level (msl) in the southwest corner of the Station on the Tustin Plain to about 800 feet above msl in the northeast corner in the foothills of the Santa Ana Mountains.

### 2.5.2 Surface Water

Surface drainage in the vicinity of MCAS El Toro flows generally to the southwest, following the slope of the land perpendicular to the trend of the Santa Ana Mountains. Off-Station drainage from the hills to the northeast and from upgradient irrigated farmlands combines with on-Station runoff generated from the extensive paved surfaces at MCAS El Toro and flows into four main drainage channels (see Figure 2). Three of these drainage channels (i.e., Borrego Canyon Wash, Agua Chinon Wash, and Bee Canyon Wash) are continuous with natural washes that originate in the Santa Ana Mountains. The southernmost of these washes is Borrego Canyon Wash, which is lined and flows along the southeast boundary of MCAS El Toro. Borrego Canyon Wash crosses the southern corner of the MCAS El Toro and joins Agua Chinon Wash about 1/4 mile from the Station boundary.

Agua Chinon Wash and Bee Canyon Wash transect the central portion of the Station and receive runoff mainly from storm sewers. Their flow is contained within culverts along nearly all their pathway across MCAS El Toro. Agua Chinon Wash flows into San Diego Creek just east of the intersection of the San Diego and Laguna Freeways, about 1 mile downstream of its confluence with Borrego Canyon Wash. Bee Canyon Wash flows into San Diego Creek about 1,500 feet north of Agua Chinon Wash.

Marshburn Channel is a lined drainage channel that runs along the northwestern boundary of MCAS El Toro and receives runoff from the western part of the

Station. The wash flows into San Diego Creek about 3/4 mile northwest of Bee Canyon Wash. San Diego Creek flows into Upper Newport Bay about 7 miles downstream from this intersection with Marshburn Channel.

### 2.5.3 Climate

The climate at MCAS El Toro is typical of what is sometimes referred to as a Mediterranean climate (i.e., cool, moist winters and warm, dry summers). Temperatures in the winter seldom drop below 37°F. Summer temperatures rarely exceed 100°F.

Average annual precipitation is about 12 inches and occurs primarily in the winter. Early morning light fogs and low clouds are common in the late spring and early summer. Dry winds known as *Santa Anas* with velocities up to 70 miles per hour occur for short periods during the late fall and early winter (B&C, 1986).

### 2.5.4 Geology

The MCAS El Toro lies on alluvial fan deposits derived mainly from the Santa Ana Mountains. These Holocene materials consist of isolated coarse-grained stream channel deposits contained within a matrix of fine-grained overbank deposits that range in thickness up to a maximum of 300 feet (Herndon and Reilly, 1989).

The Holocene alluvial materials conformably overlie Pleistocene Age sediments predominantly composed of interlayered fine-grained lagoonal and near-shore

marine deposits. These materials become increasingly mixed with beach sands, terrace, and stream channel deposits in the eastern portion of the Tustin Plain and along the basin margins. Thus, the Quaternary deposits form a heterogeneous mixture of silts and clays with interbedded sands and fine gravels that range in thickness up to 500 feet in the western portion of the Tustin Plain (Singer, 1973).

The deeper Quaternary sediments may be equivalent to the lower Pleistocene San Pedro Formation, which consist of semiconsolidated silts, clays, and sands with interbedded limestone. These lagoonal and shallow marine deposits are considered to be a major water-bearing unit in the region, but probably do not extend beneath MCAS El Toro (B&C, 1986).

The Pleistocene deposits nonconformably overlie older semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene age. These units comprise the Fernando, Capistrano, and Niguel Formations. The lower Pliocene Fernando Formation, considered to be the major aquifer in the Irvine area, is the base of the water-bearing units (Herndon and Reilly, 1989). This formation probably interfingers with clayey and sandy siltstones of the Capistrano and Niguel Formations west of MCAS El Toro and together range up to 1,500 feet in thickness (JMM, 1988).

Beneath the semiconsolidated rocks lies a very thick sequence of interbedded marine and nonmarine sedimentary rocks and volcanic rocks of the Monterey, Puente, Vaqueros, and Sespe Formations. These units, which are deposited on a

basement of crystalline metamorphic and igneous rocks, have been considered to be nonwater bearing in previous studies (JMM, 1990).

### 2.5.5 Hydrogeology

Although the aquifers beneath the Tustin Plain are in hydraulic contact with the main Orange County Groundwater Basin, it is difficult to make correlations among specific aquifer zones. In the Irvine area, aquifers are much thinner and separated by thicker sequences of fine-grained materials (Banks, 1984). Aquifers tend to be composed of lenticular clayey and silty sands and fine gravels contained within a complex assemblage of sandy clays and sandy silts. Thus, rather than identifiable aquifers that may be correlated from place to place, the groundwater may be considered to flow in a single, large-scale heterogeneous system (Herndon and Reilly, 1989).

The groundwater system beneath the Tustin Plain has been divided into a forebay area and a pressure area. The forebay area lies along the margin of the basin where sediments are relatively shallow and coarse-grained above consolidated rock. Groundwater generally occurs under unconfined conditions in this area. Recharge to the regional system takes place in the forebay area primarily along washes that exit the Santa Ana Mountains. The pressure area lies in the central portion of the basin, where sediments are thicker and relatively finer grained. Groundwater in this area occurs mainly in deeper zones that become increasingly

confined with depth. The groundwater has historically been discharged through irrigation wells or has moved westward to the Main Orange County Basin (Banks, 1984).

The MCAS El Toro lies along the margin of the groundwater system beneath the Tustin Plain. Although the boundary between the forebay and pressure areas varies seasonally and yearly according to the amount of groundwater recharge and withdrawal, MCAS El Toro is situated mainly in the forebay area. Thus, geologic materials are relatively coarser than in the central portion of the basin, and groundwater lies under mainly unconfined conditions. This statement regarding geologic materials will be verified during RI Phase I. In addition, recharge to the regional system may occur as infiltration of surface water along washes and swales at MCAS El Toro and as subsurface inflow along permeable zones.

Where it occurs, groundwater within the foothills lies within 50 feet of the ground surface (JMM, 1988). Along the perimeter of MCAS El Toro, the depth to groundwater varies between 82 and 122 feet (JMM, 1990). The direction of flow along the southwest boundary of MCAS El Toro is to the northwest at a gradient of 0.0066, according to 1989 water levels (JMM, 1990). Regional flow has been to the west and northwest since the 1940s and controlled locally by large pumping depressions. Reduced pumping and water imports in the past 20 years have allowed groundwater levels to recover as much as 100 feet. In 1988, the regional gradient was calculated to be 0.008 (Herndon and Reilly, 1989).

Vertical piezometric gradients measured in multiple-completion wells west of the Station revealed a downward gradient of flow in the upper 400 feet, probably in response to pumping in irrigation wells in this area (Herndon and Reilly, 1989). A downward vertical gradient may occur for the same reason at MCAS El Toro. However, limited investigation has failed to detect a vertical gradient in multiple-depth cluster wells installed at the Station (JMM, 1990).

Aquifer tests performed in monitoring wells installed on and near MCAS El Toro generated hydraulic conductivity estimates that range from 2.2 to 36 feet per day (ft/day), with an average of 30 ft/day determined in a 72-hour aquifer test (JMM, 1990). A 72-hour test performed by OCWD in the basin west of the Station found the hydraulic conductivity to be 21 ft/day. The average linear groundwater velocity was estimated to range from 0.7 to 4 ft/day (Herndon and Reilly, 1989).

### 2.5.6 Groundwater Chemistry

In addition to the VOC contamination described earlier, historical degradation of groundwater quality associated with other contaminants has occurred in the Irvine area. Increases in the levels of total dissolved solids (TDS), selenium, and nitrates in the groundwater have been related to past agricultural activities and incursions of lower quality water from the margins of the basin under the influence of pumping wells. The deterioration has been taking place at least since 1971. The largest area of groundwater remaining unaffected by this contamination lies in deeper zones in the central pressure area of the basin (Banks, 1984). Unfortunately, this area is being threatened by VOC contamination.

Investigations by OCWD in this area have revealed the presence of three hydrochemical facies in groundwater related to depth in the aquifer. The first facies, characteristic of shallow groundwater lying within 200 feet of the ground surface, contains relatively high levels of TDS and nitrate and is dominated by calcium and sulfate ions. The second facies, characteristic of groundwater lying between 200 and 450 feet in depth, contains lower levels of TDS and nitrate and is dominated by sodium, calcium, and bicarbonate ions. This is the zone in which VOC contamination has occurred. The third facies, lying at depths greater than 450 feet, contains relatively high levels of TDS, relatively low levels of nitrate, and is dominated by sodium and sulfate ions (Herndon and Reilly, 1989). Preliminary work performed by MCAS El Toro has tended to confirm these findings (JMM, 1990).

### 2.5.7 Ecology

The following information on ecology and land use has been taken from the IAS (B&C, 1986) and from information supplied by the USMC.

About 1,000 acres within MCAS El Toro are leased to local farmers, who grow oranges and other produce. The Station itself has a residential population of about 6,000 and also employs about 10,000 workers. A school and a children's playground are located in the northeast portion of MCAS El Toro near the on-Station residential area. Land adjacent to the Station on the north, south, and east is used for agriculture. Commercial and light industrial land usage is located directly adjacent to the southwest and southeast borders of the Station.

The annual rainfall of 12 inches per year occurs almost entirely in the winter months and supports a semidesert grassland community. Three types of plants have adapted to this region: annuals, succulents, and desert shrubs. Annuals have adapted by growing only in areas with adequate moisture. Succulents avoid drying out by storing water. Desert shrubs have adapted to lengthy dry periods with many branches and with thick small leaves that are shed during droughts (B&C, 1986).

Nearby surface water bodies that may receive runoff from MCAS El Toro include Sand Canyon Reservoir (about 3 miles southwest of the site) and Laguna Reservoir (about 2 miles south of the site). Other surface water bodies exist from 1 to 6 miles from the site; these may or may not receive runoff from the site.

The IAS estimated that 90 percent of the native flora on the Station premises has been cleared for agriculture, construction, or paving. The existing natural habitat consists mainly of grassland and sage-scrub communities. The IAS contains lists of predominant local species for these habitat types, as well as results of data base searches for endangered and threatened species in the vicinity of the Station, including the Upper Newport Bay Ecological Reserve.

No plants or animals were listed on the Natural Diversity Data Base (NDDB) in the vicinity of the Station as of March 1985. There were several species of birds and two plants listed for the Upper Newport Bay Ecological Reserve or for duck pond areas associated with the University of California at Irvine. The Reserve and duck pond areas are about 8 to 9 miles southwest of MCAS El Toro.

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# 3.0 MAPS AND FIGURES

This section contains, in one place, all of the maps and figures referenced in other sections of this report. Included in this section are site maps showing the proposed sampling points for the SWMUs and areas of concern recommended for a sampling visit.

Section 4.0 provides a narrative of the rationale for the sampling schemes and analytical parameters selected for these areas.

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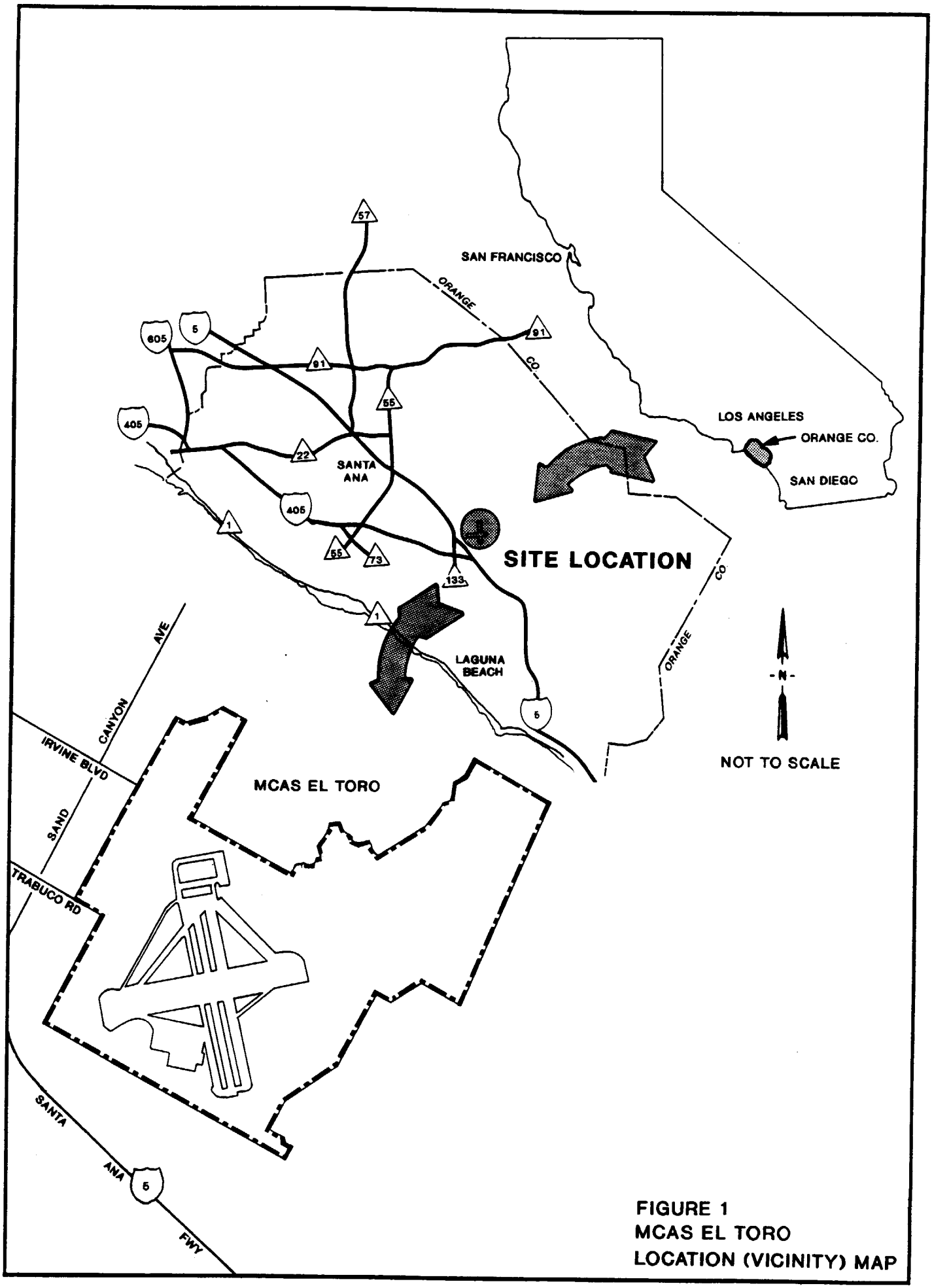
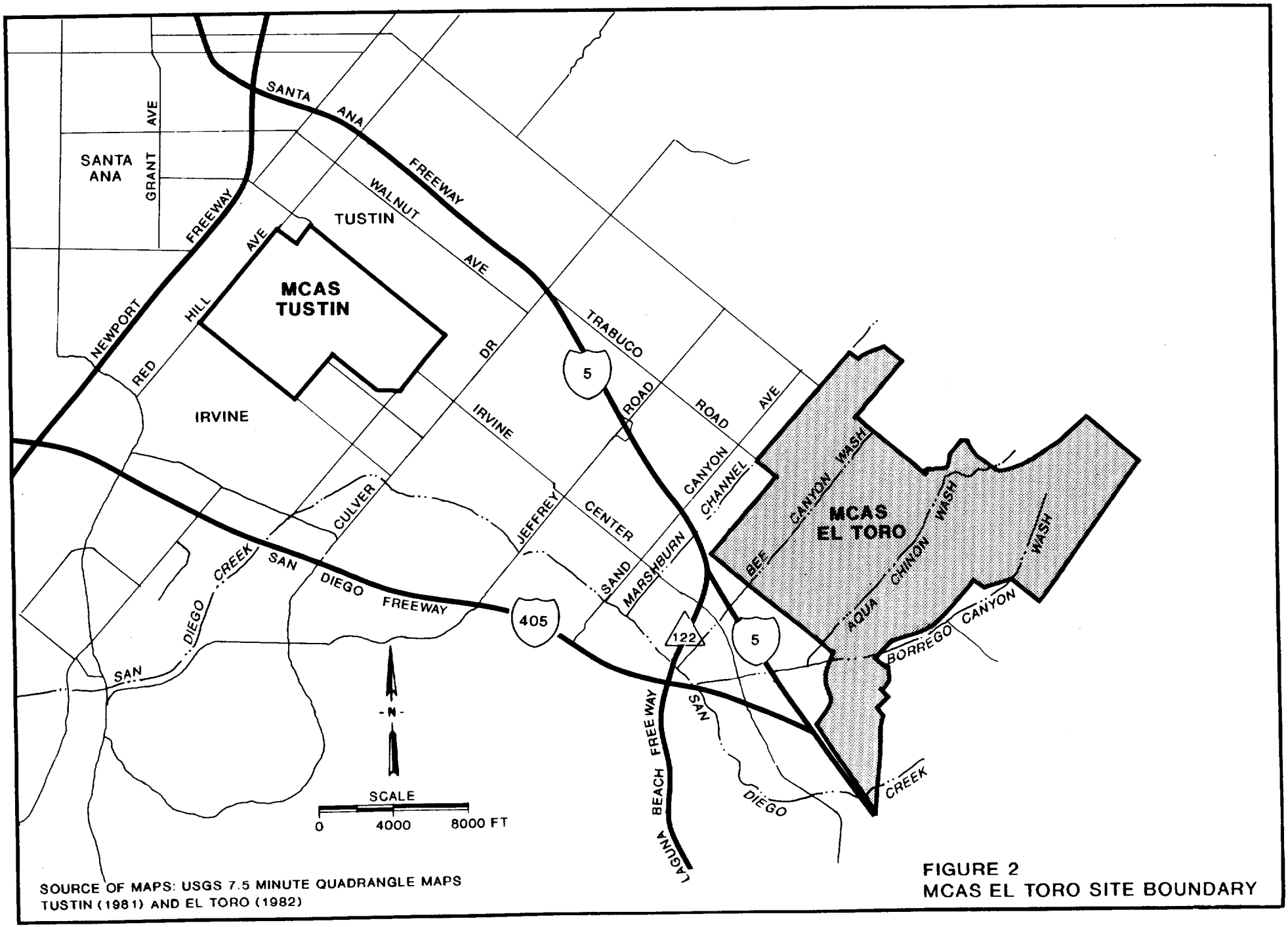



FIGURE 1
MCAS EL TORO
LOCATION (VICINITY) MAP




SOURCE OF MAPS: USGS 7.5 MINUTE QUADRANGLE MAPS
TUSTIN (1981) AND EL TORO (1982)

FIGURE 2
MCAS EL TORO SITE BOUNDARY

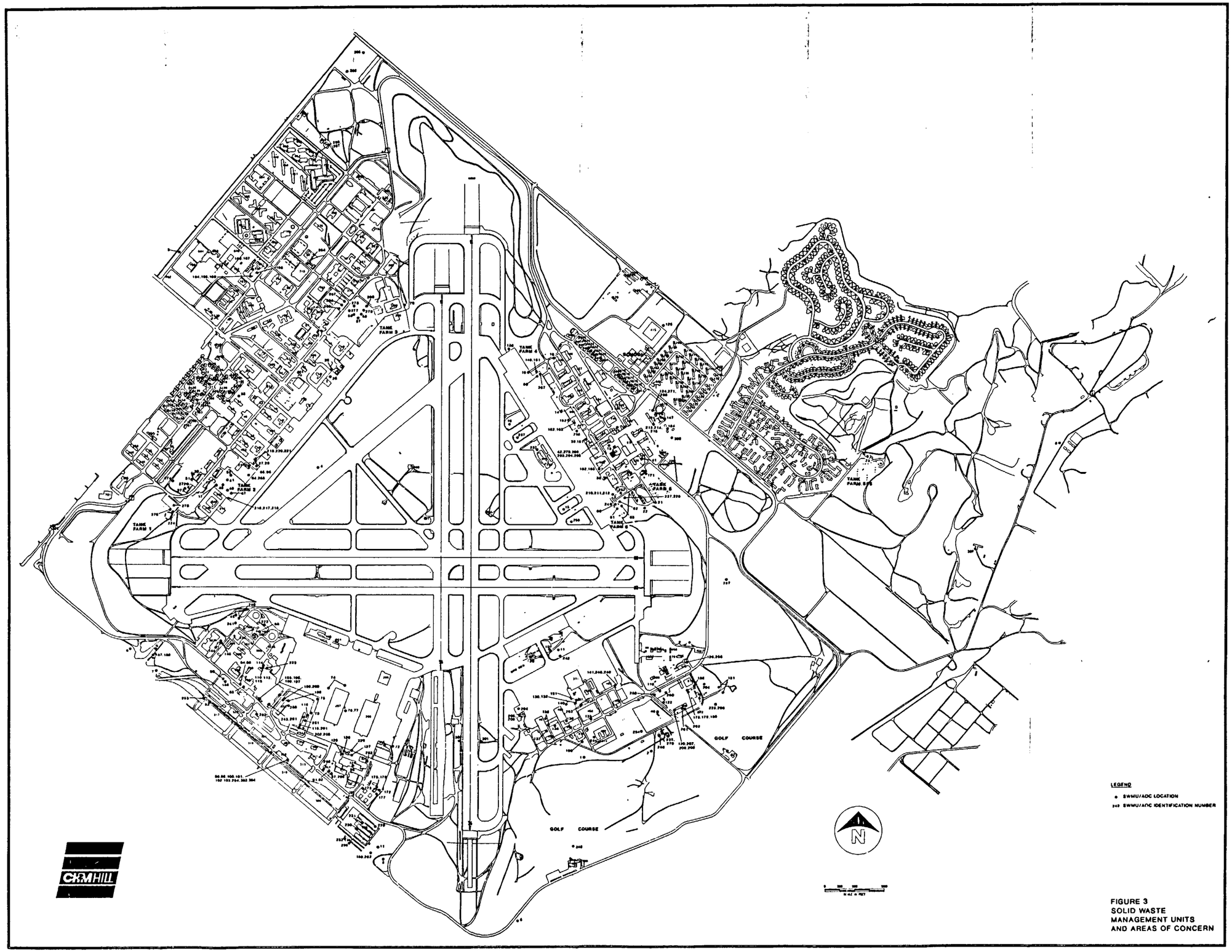
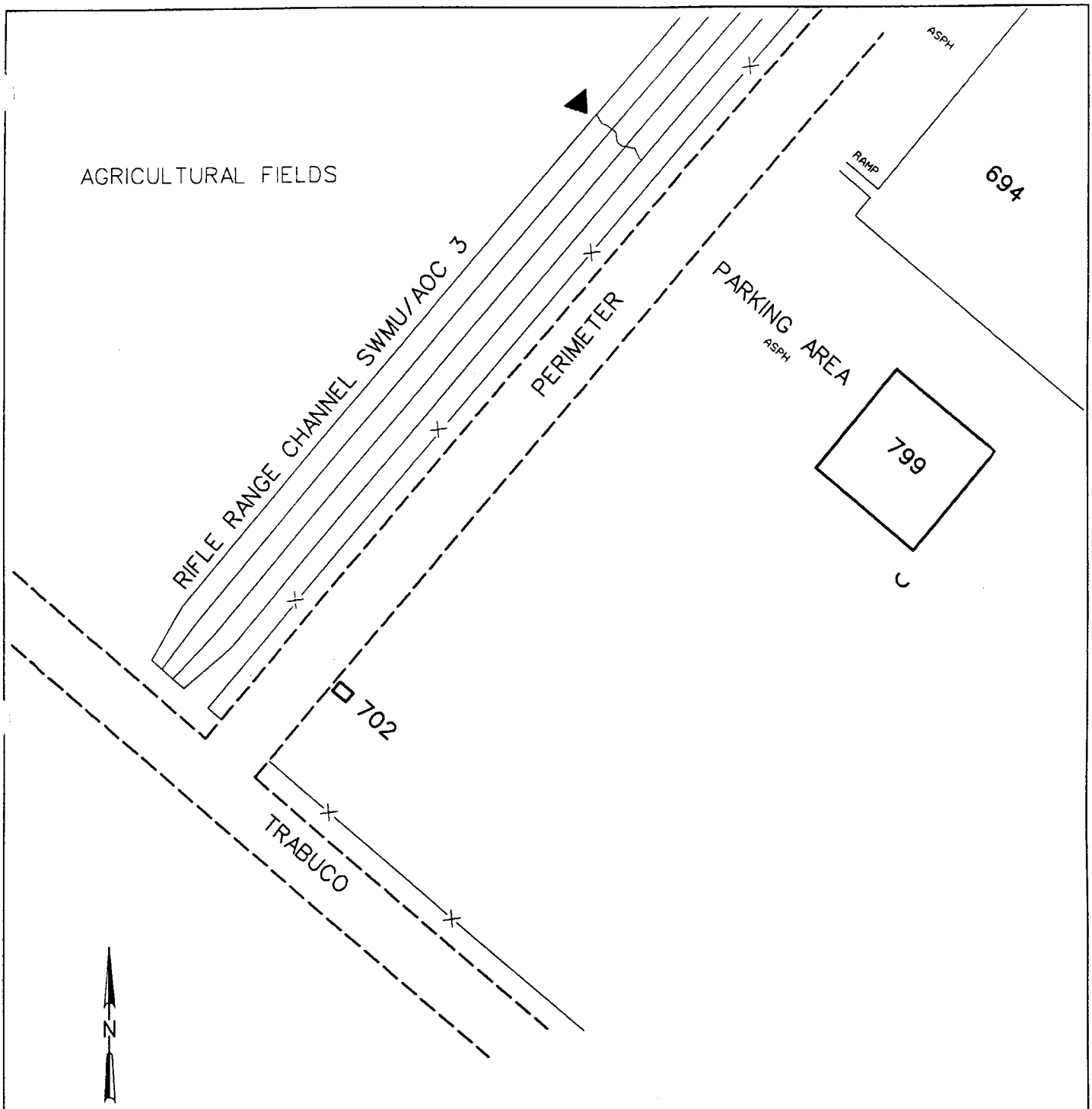



FIGURE 3
SOLID WASTE
MANAGEMENT UNITS
AND AREAS OF CONCERN




PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

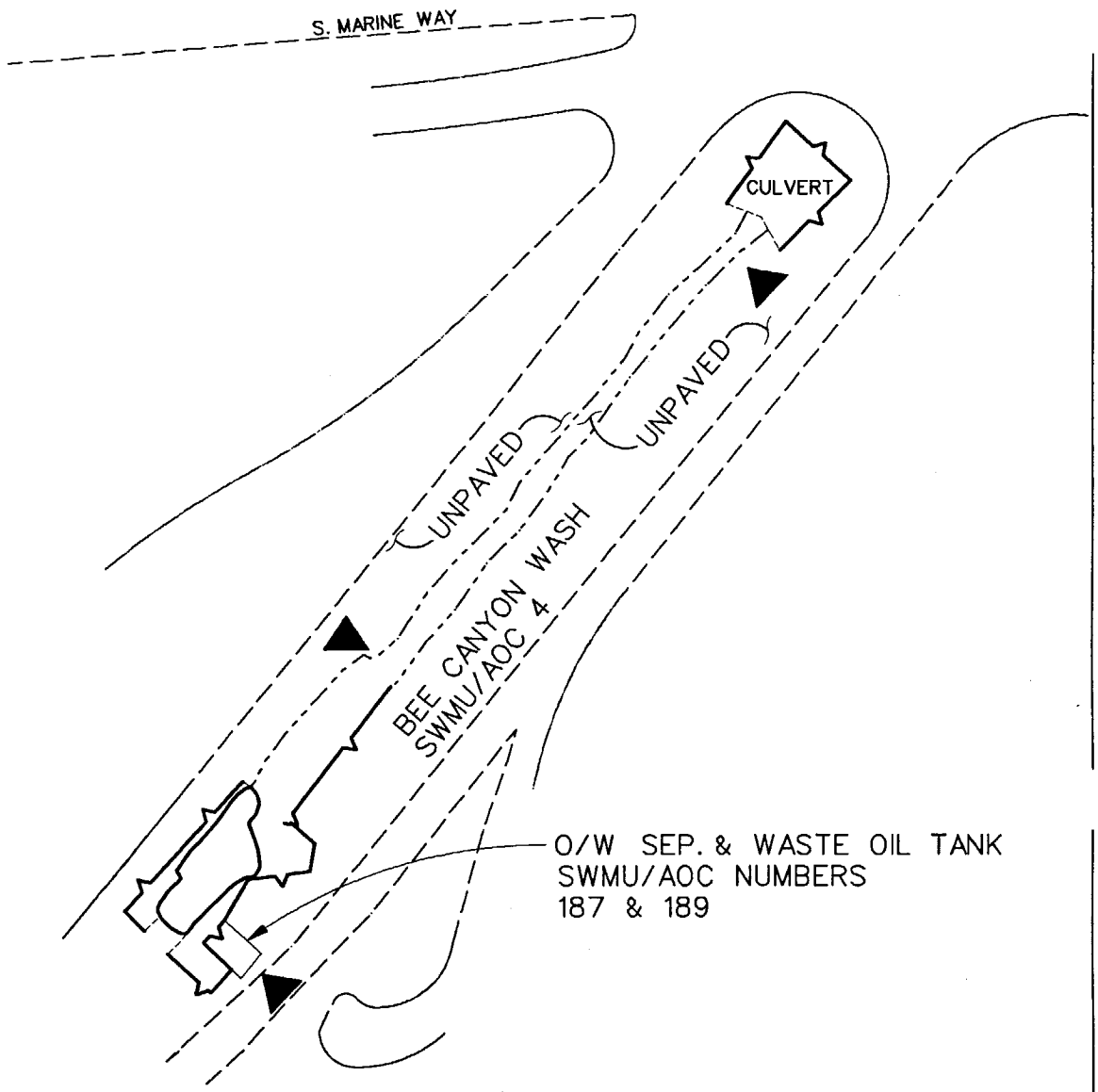
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 4
SAMPLING PLAN FOR
SWMU/AOC NUMBER 3
MCAS EL TORO



SITE79.DGN



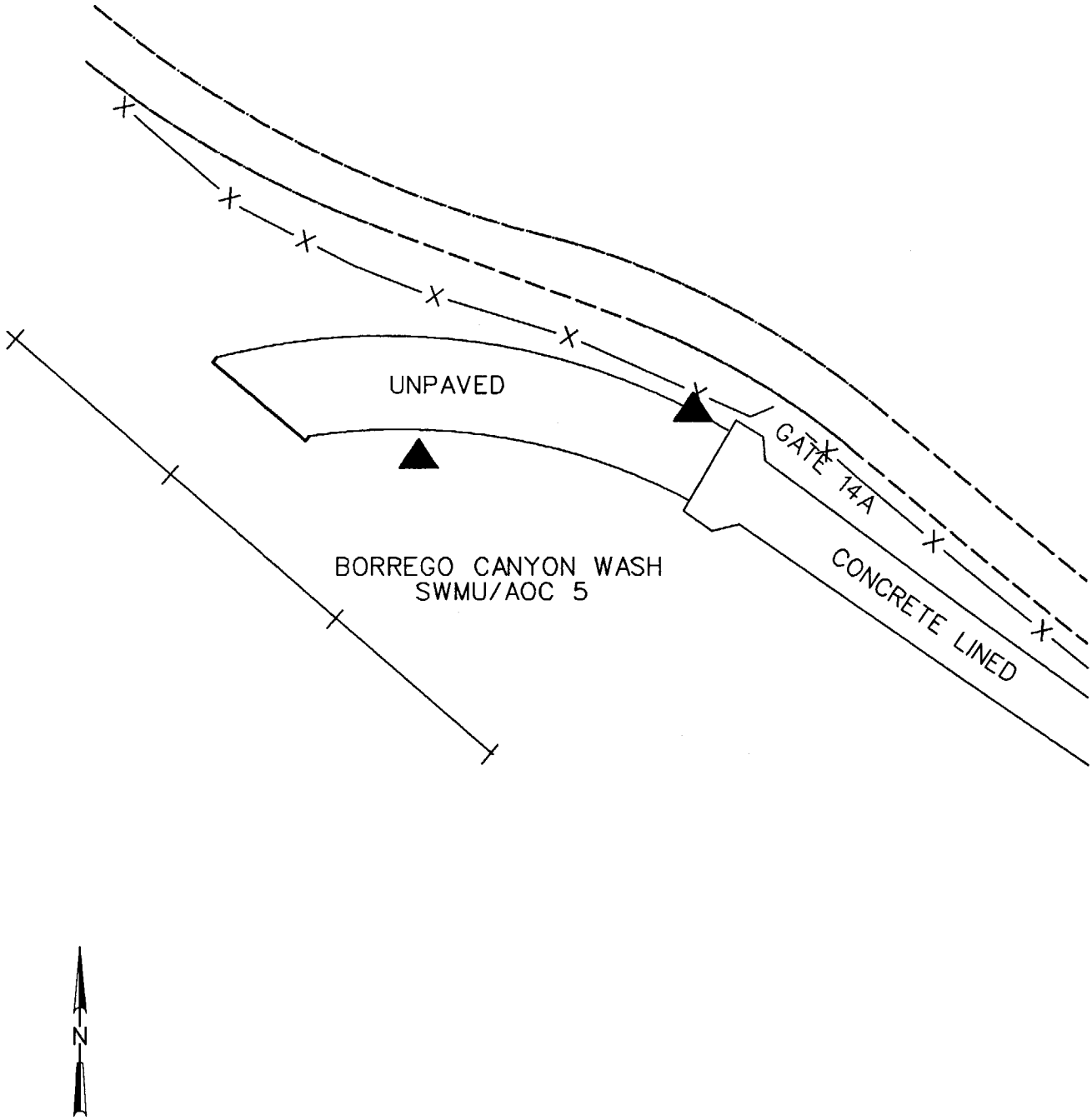
PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 5
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
4,187,189
MCAS EL TORO



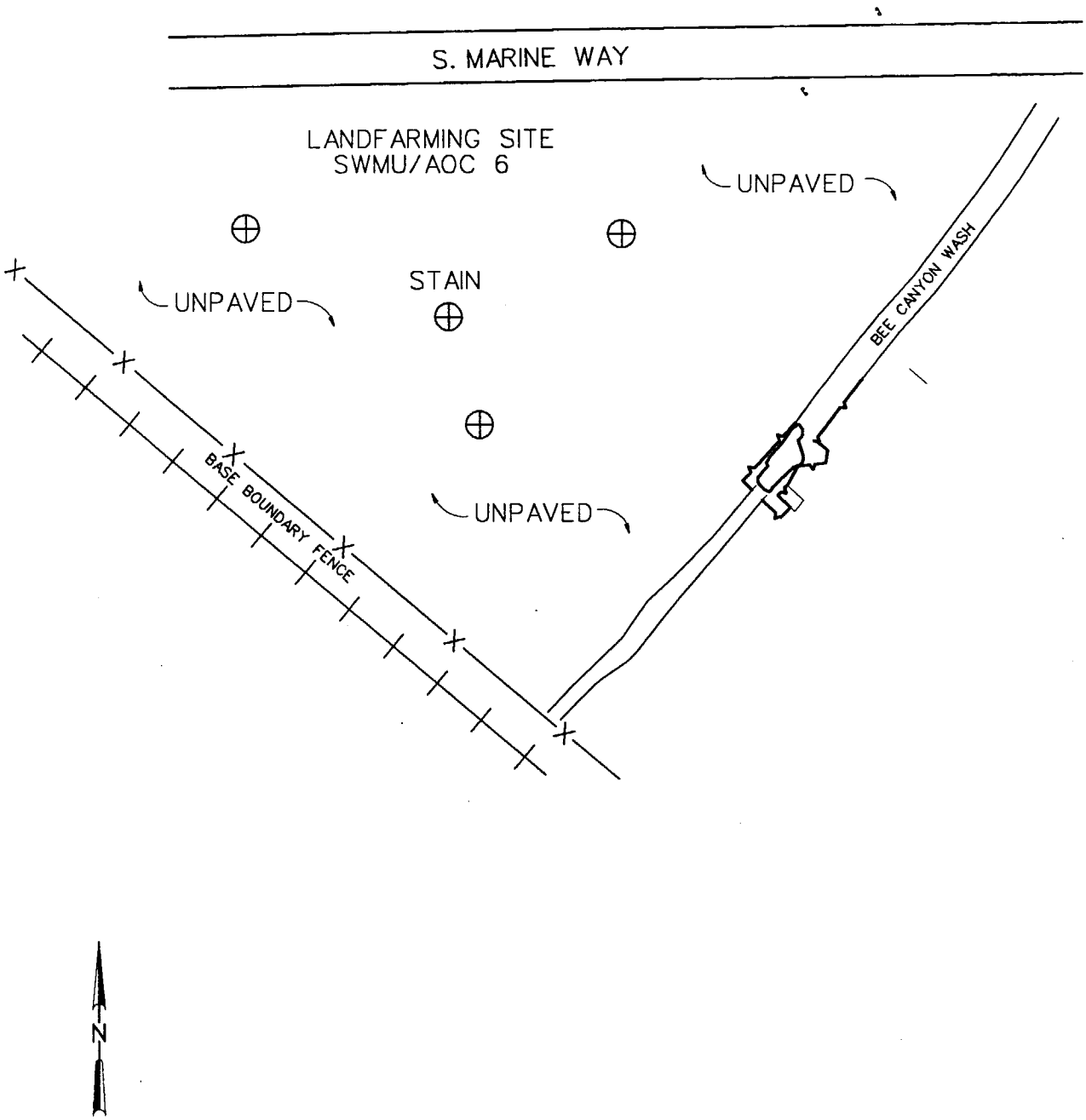

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 6
SAMPLING PLAN FOR
SWMU/AOC NUMBER 5
MCAS EL TORO



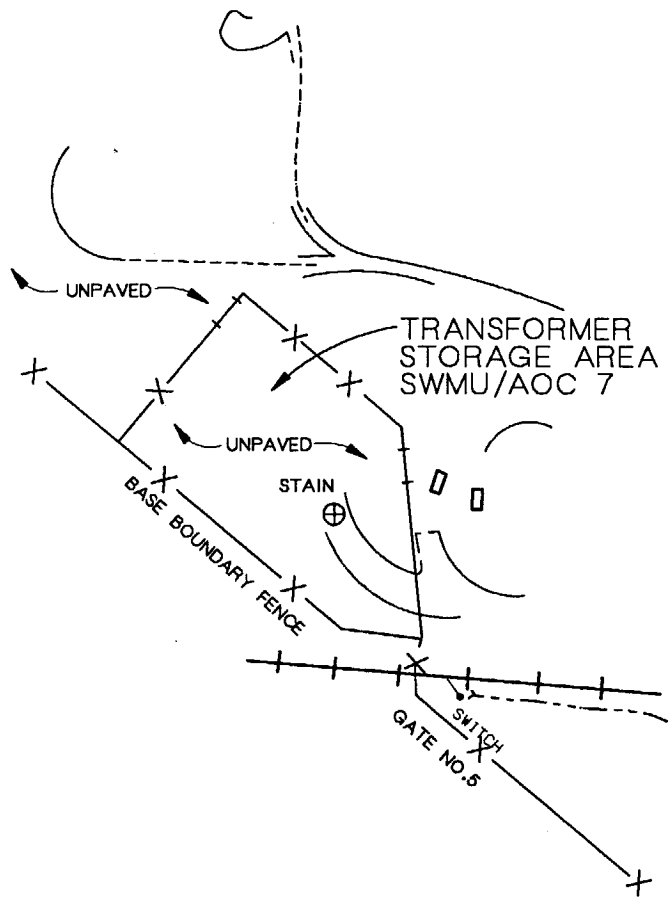

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 7
SAMPLING PLAN FOR
SWMU/AOC NUMBER 6
MCAS EL TORO



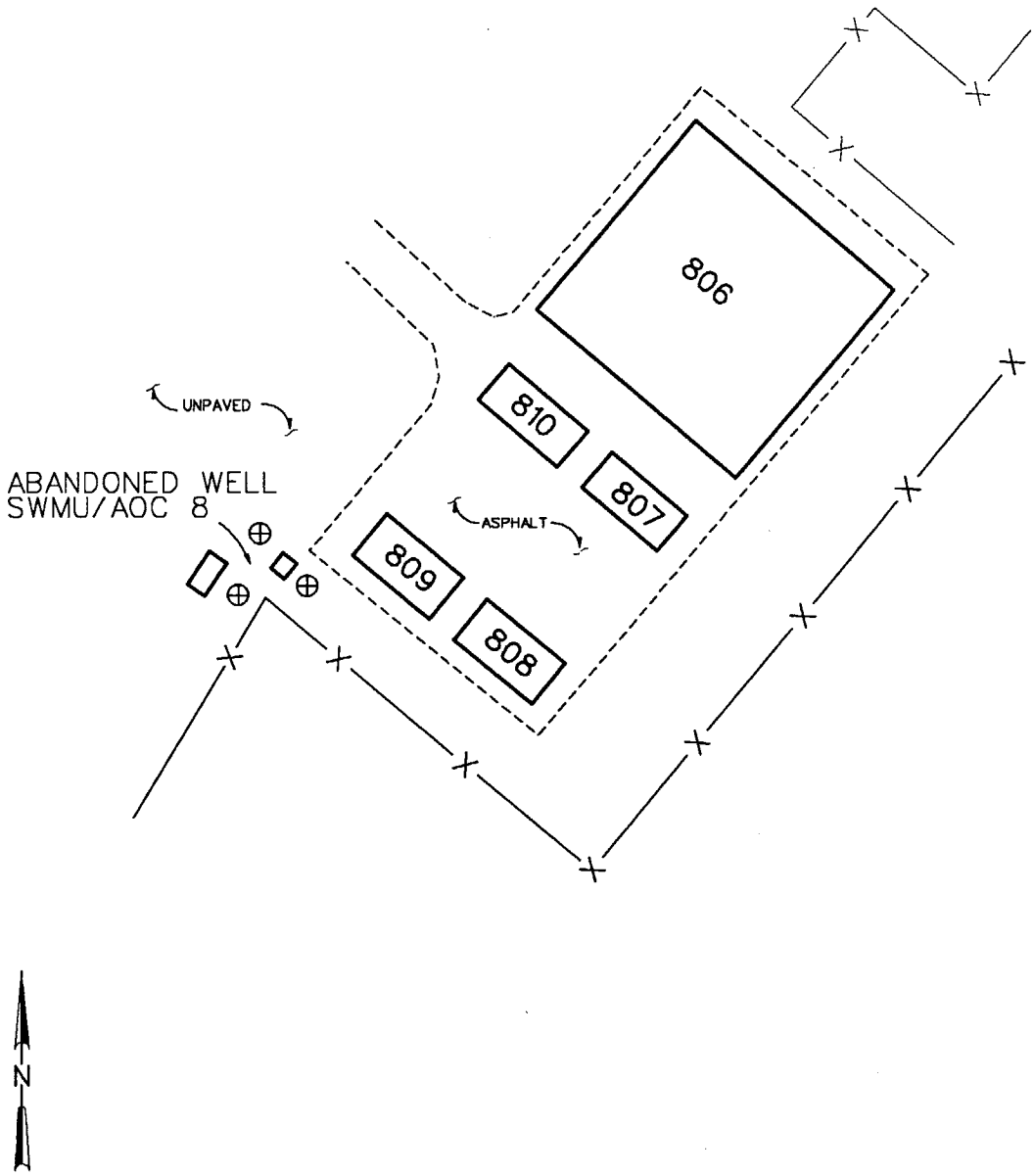
PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 8
SAMPLING PLAN FOR
SWMU/AOC NUMBER 7
MCAS EL TORO



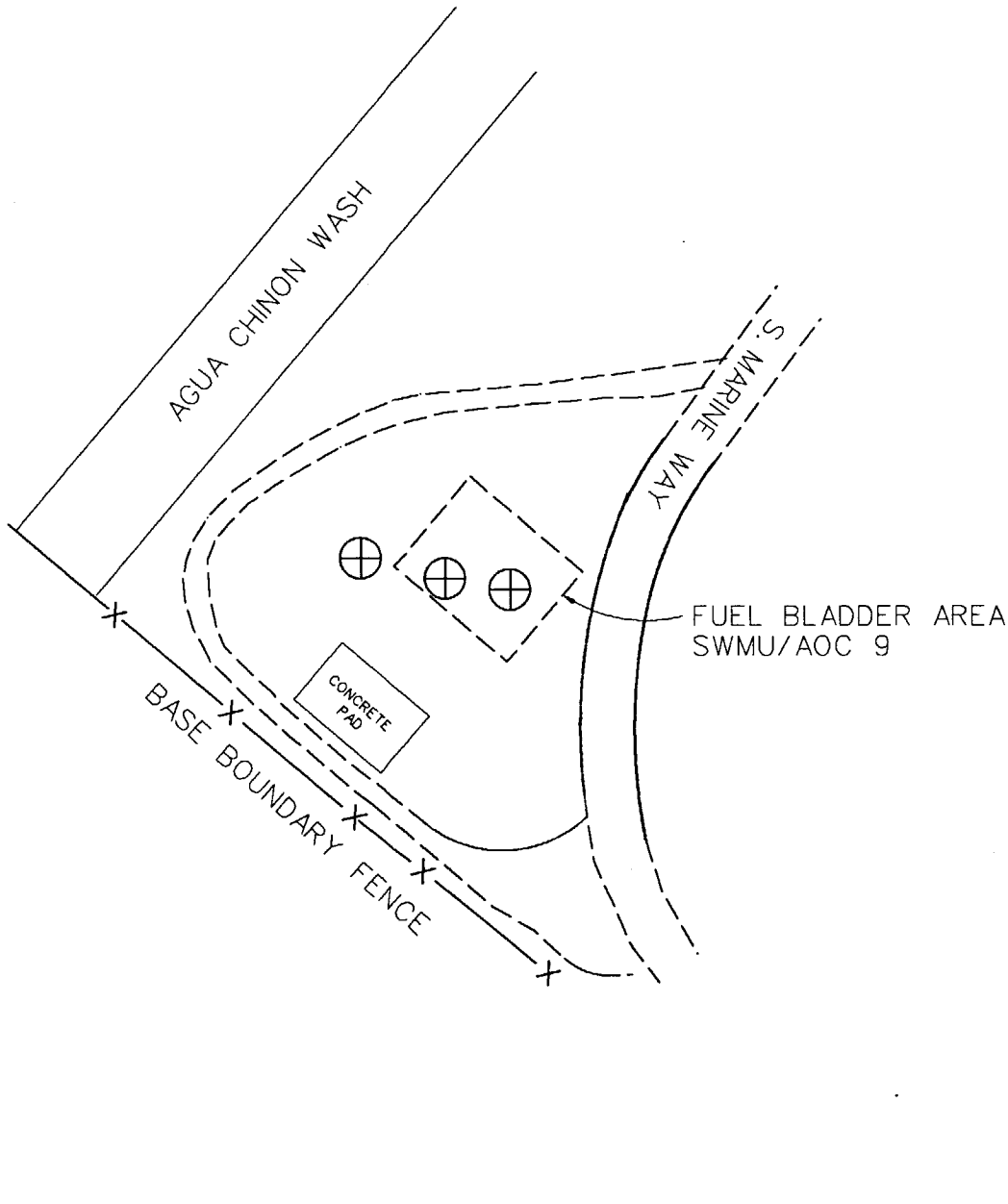

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 9
SAMPLING PLAN FOR
SWMU/AOC NUMBER 8
MCAS EL TORO



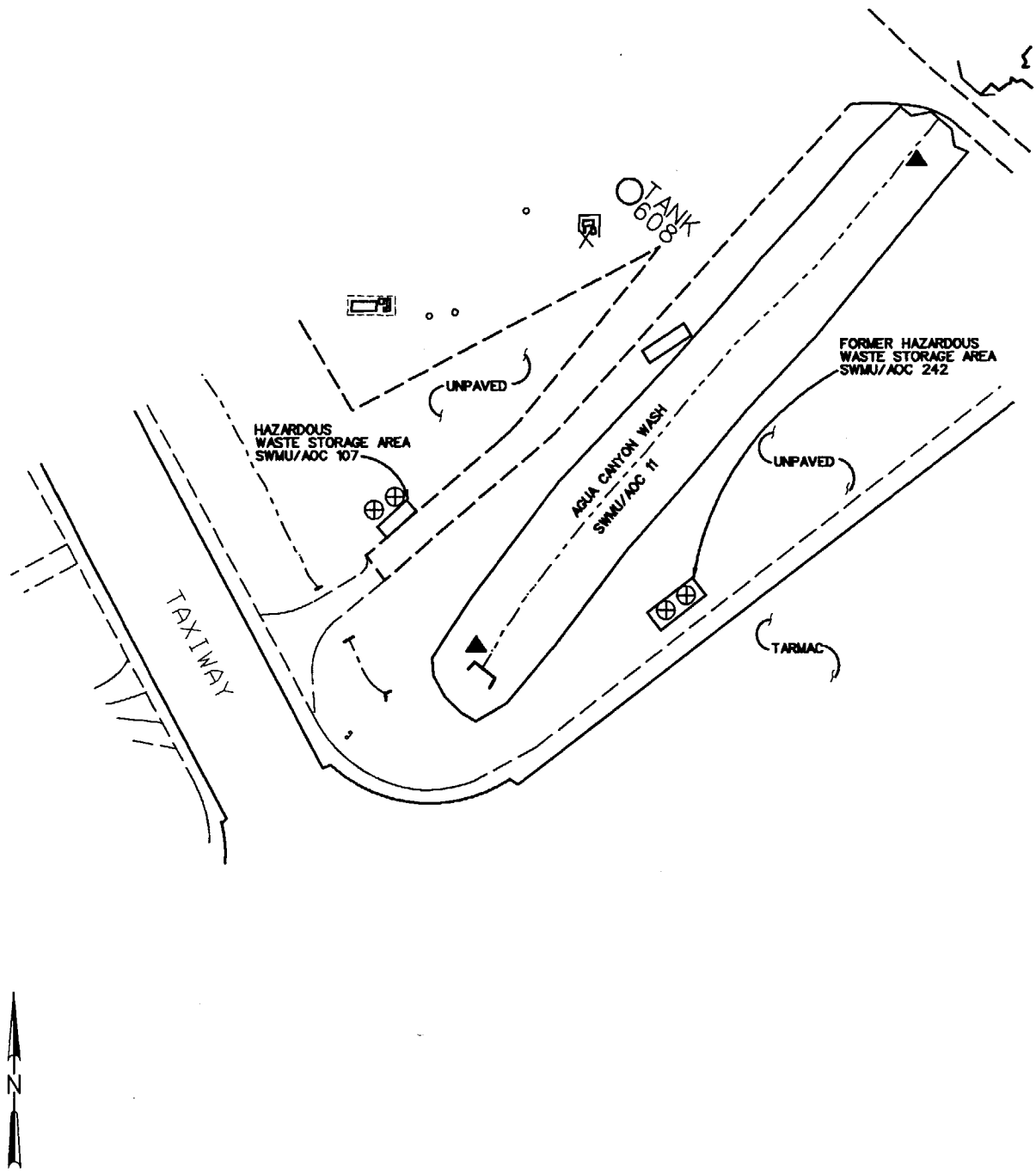

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 10
SAMPLING PLAN FOR
SWMU/AOC NUMBER 9
MCAS EL TORO



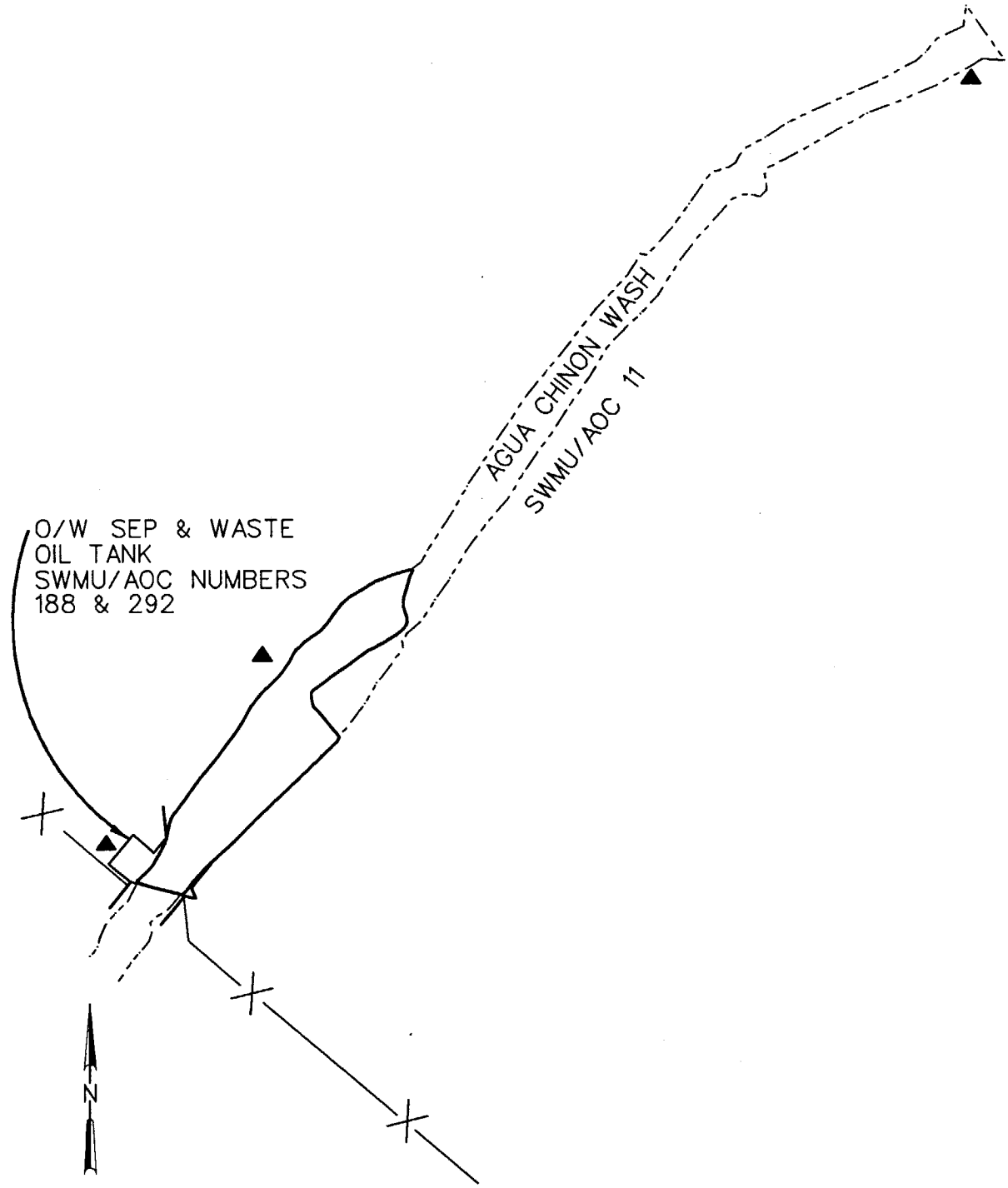

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 11
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
11,107,242
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

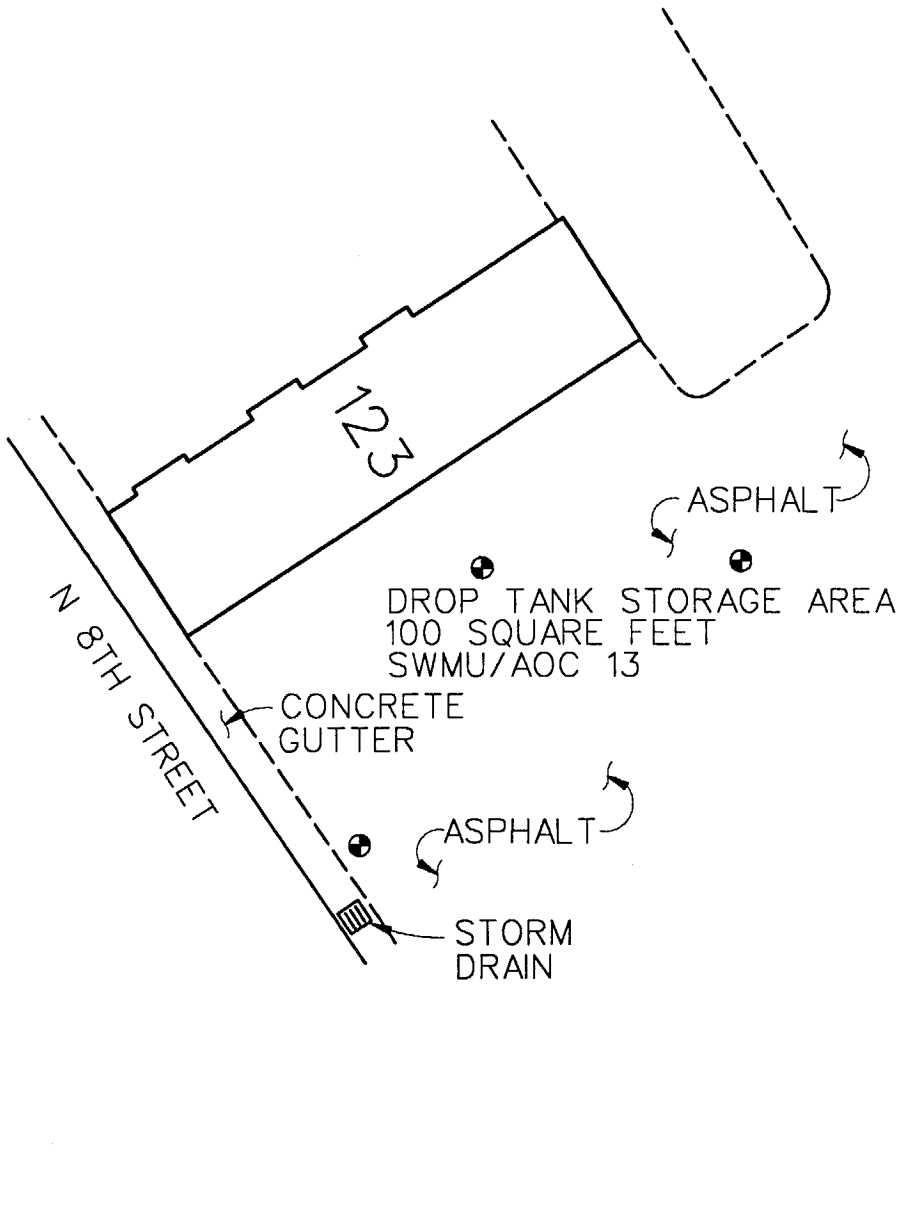
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 12
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
11, 188, 292
MCAS EL TORO

site25.dgn



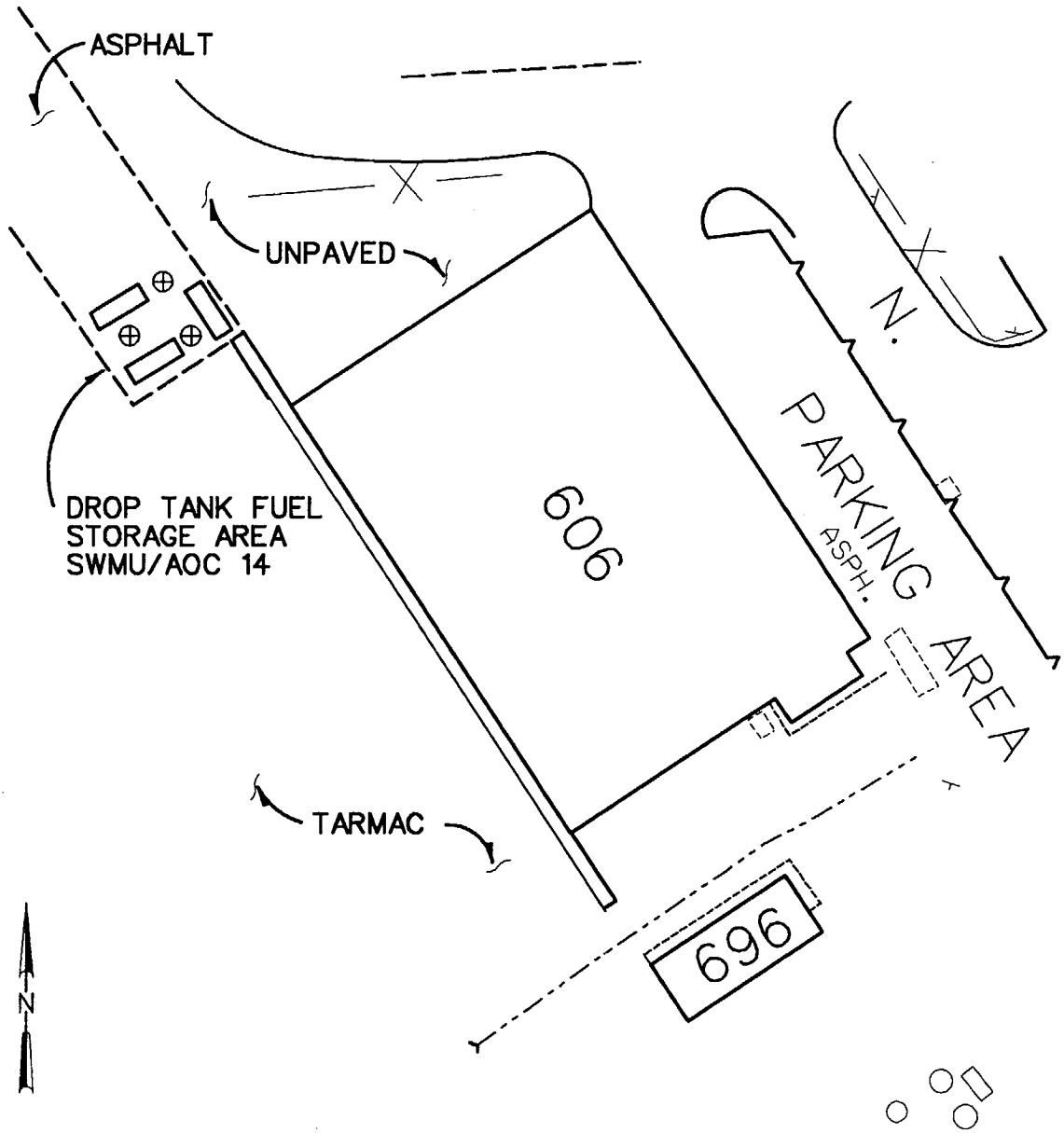

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 13
SAMPLING PLAN FOR
SWMU/AOC NUMBER 13
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

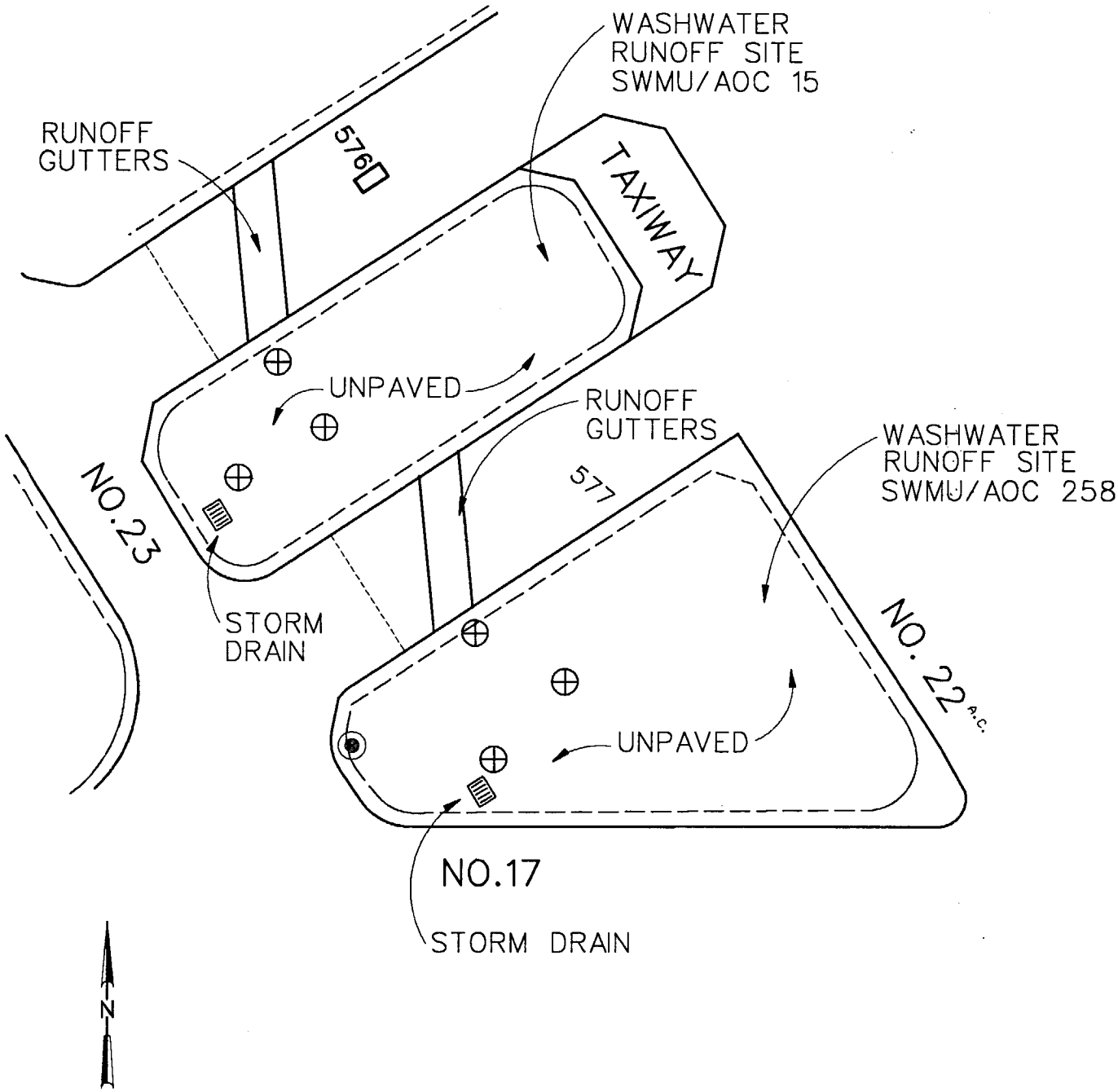
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 14
SAMPLING PLAN FOR
SWMU/AOC NUMBER 14
MCAS EL TORO

SITE51.DGN




PROPOSED SAMPLING LOCATIONS

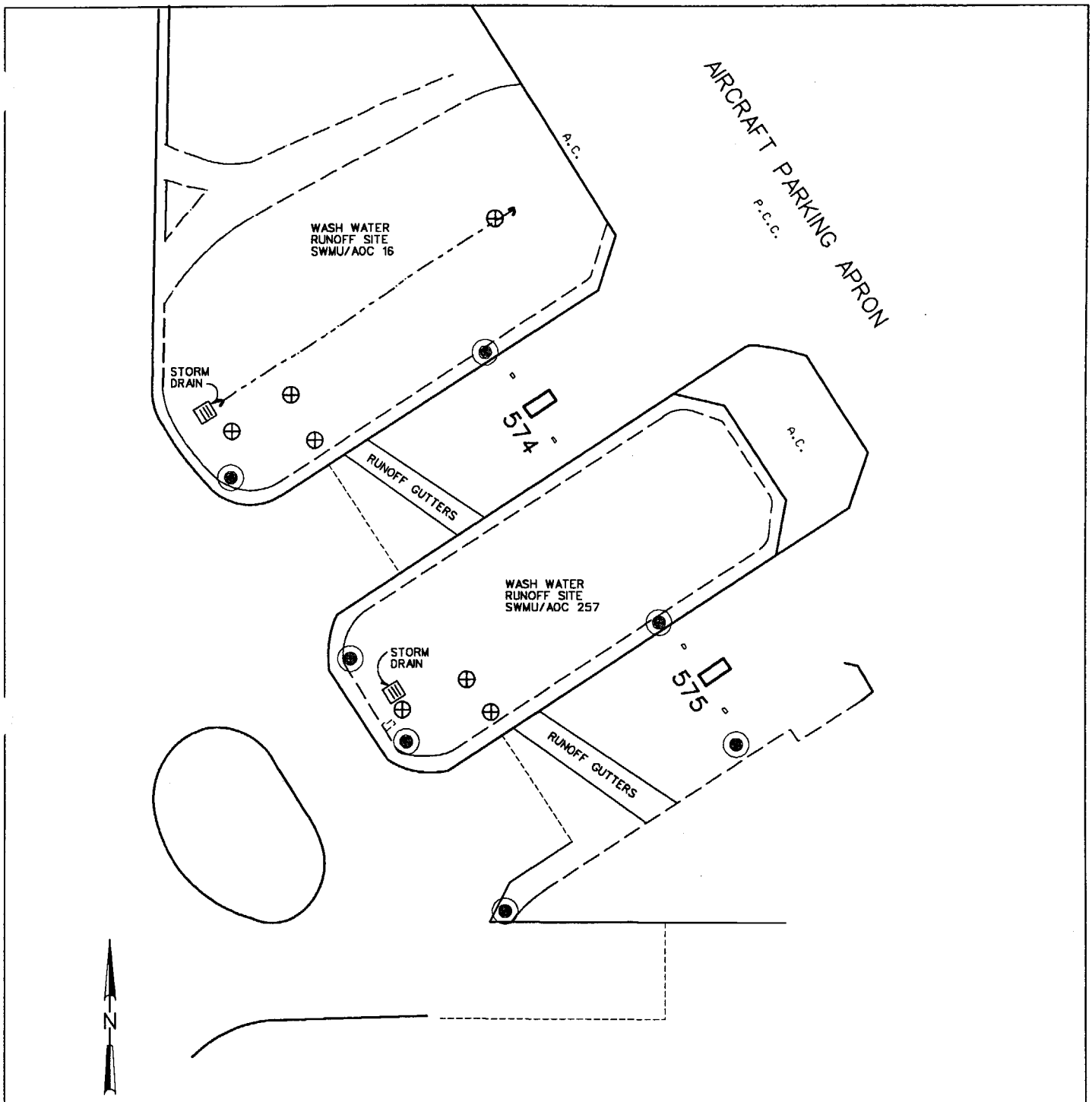
⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 15
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
15 & 258
MCAS EL TORO

site46.dgn




PROPOSED SAMPLING LOCATIONS

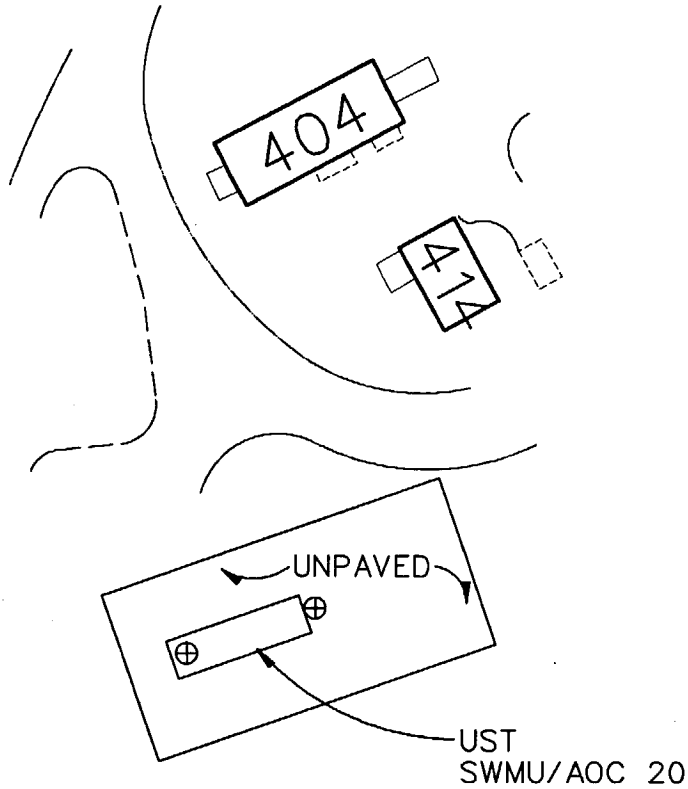
⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 16
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
16 & 257
MCAS EL TORO

SITE48.DGN



PROPOSED SAMPLING LOCATIONS

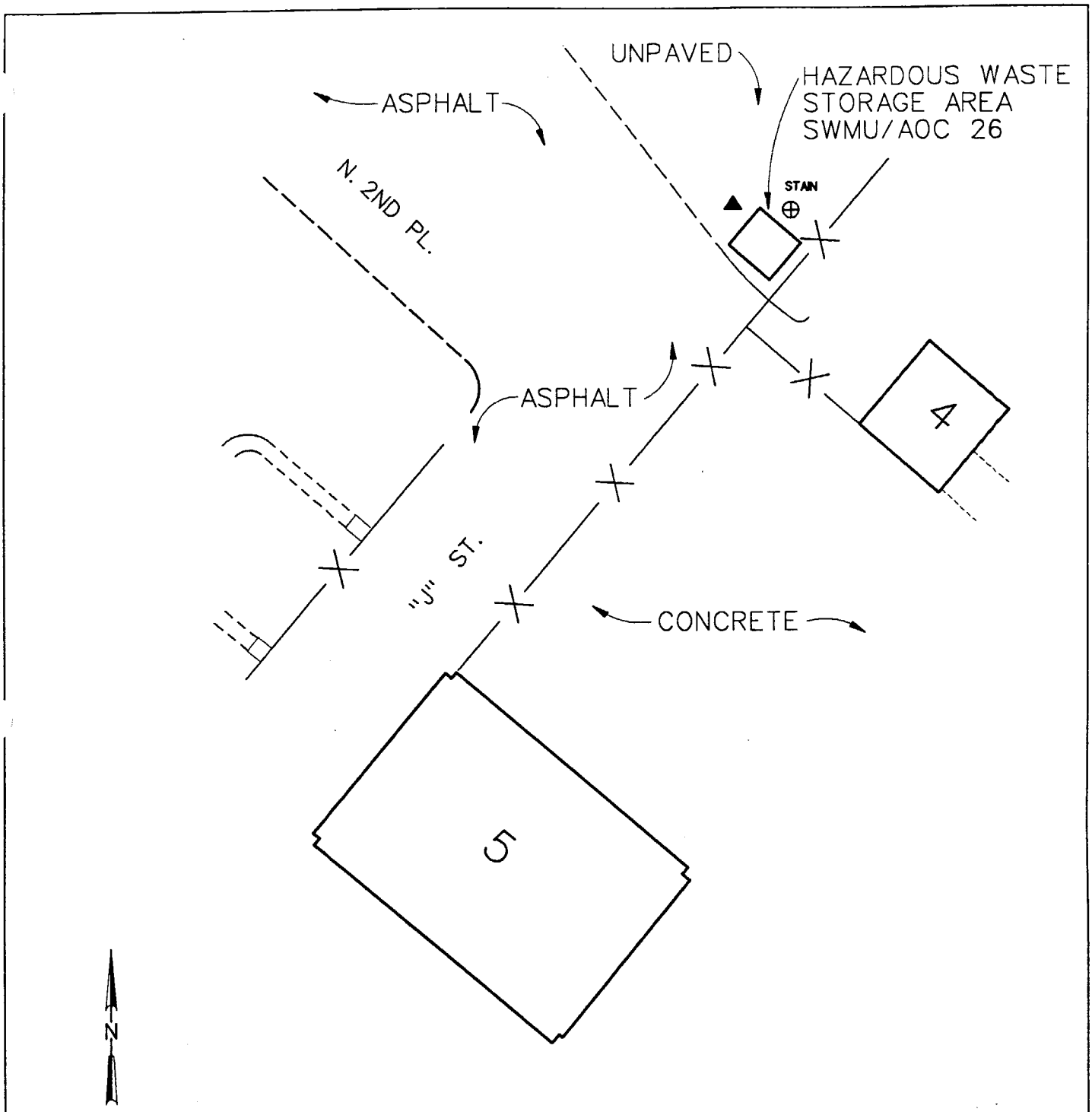
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 17
SAMPLING PLAN FOR
SWMU/AOC NUMBER 20
MCAS EL TORO

site28.dgn




PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

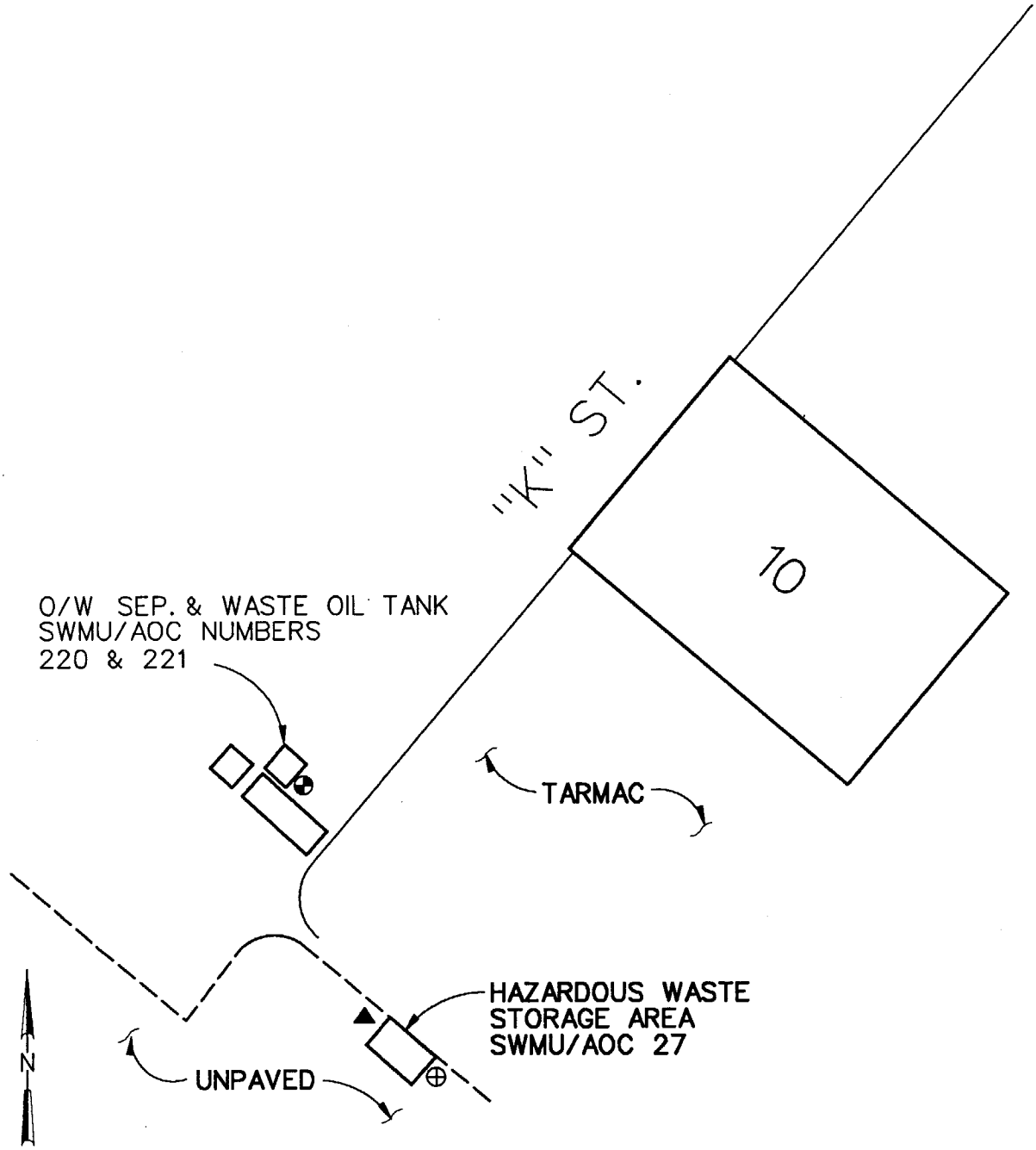
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 18
SAMPLING PLAN FOR
SWMU/AOC NUMBER 26
MCAS EL TORO



site69.dgn




PROPOSED SAMPLING LOCATIONS

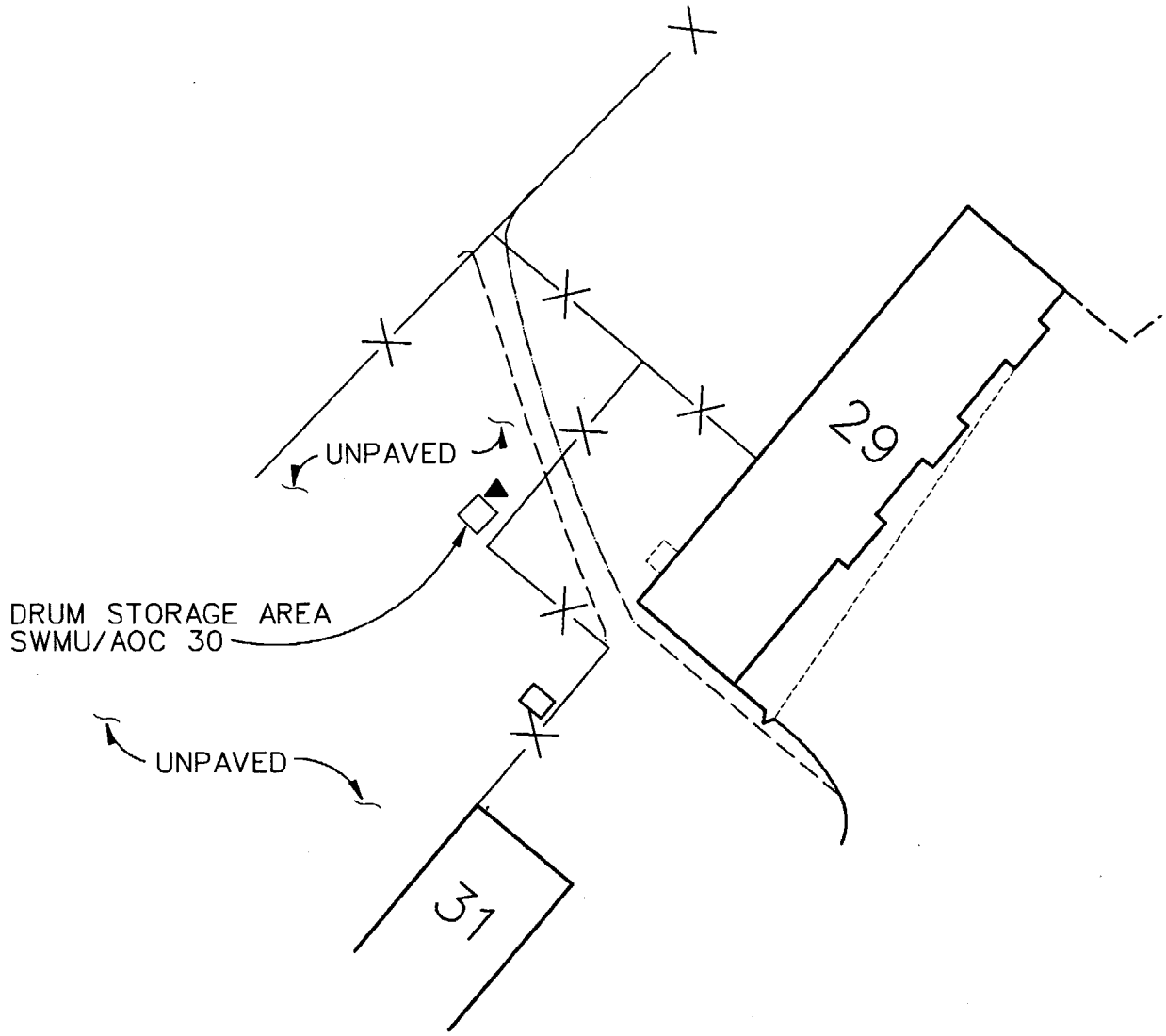
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 19
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
27, 220, 221
MCAS EL TORO

SITE 70.DGN



PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

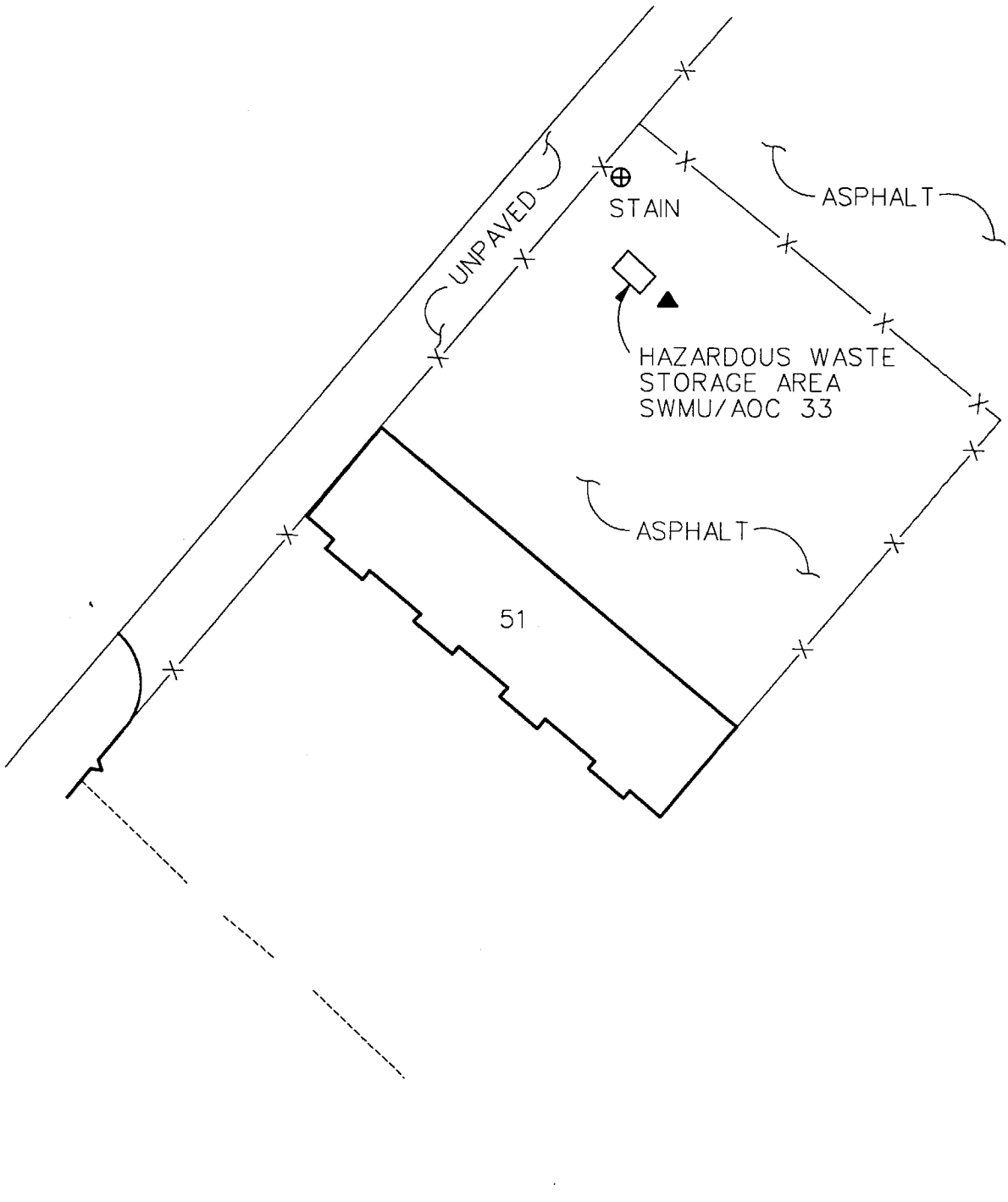
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 20
SAMPLING PLAN FOR
SWMU/AOC NUMBER 30
MCAS EL TORO



site74.dgn



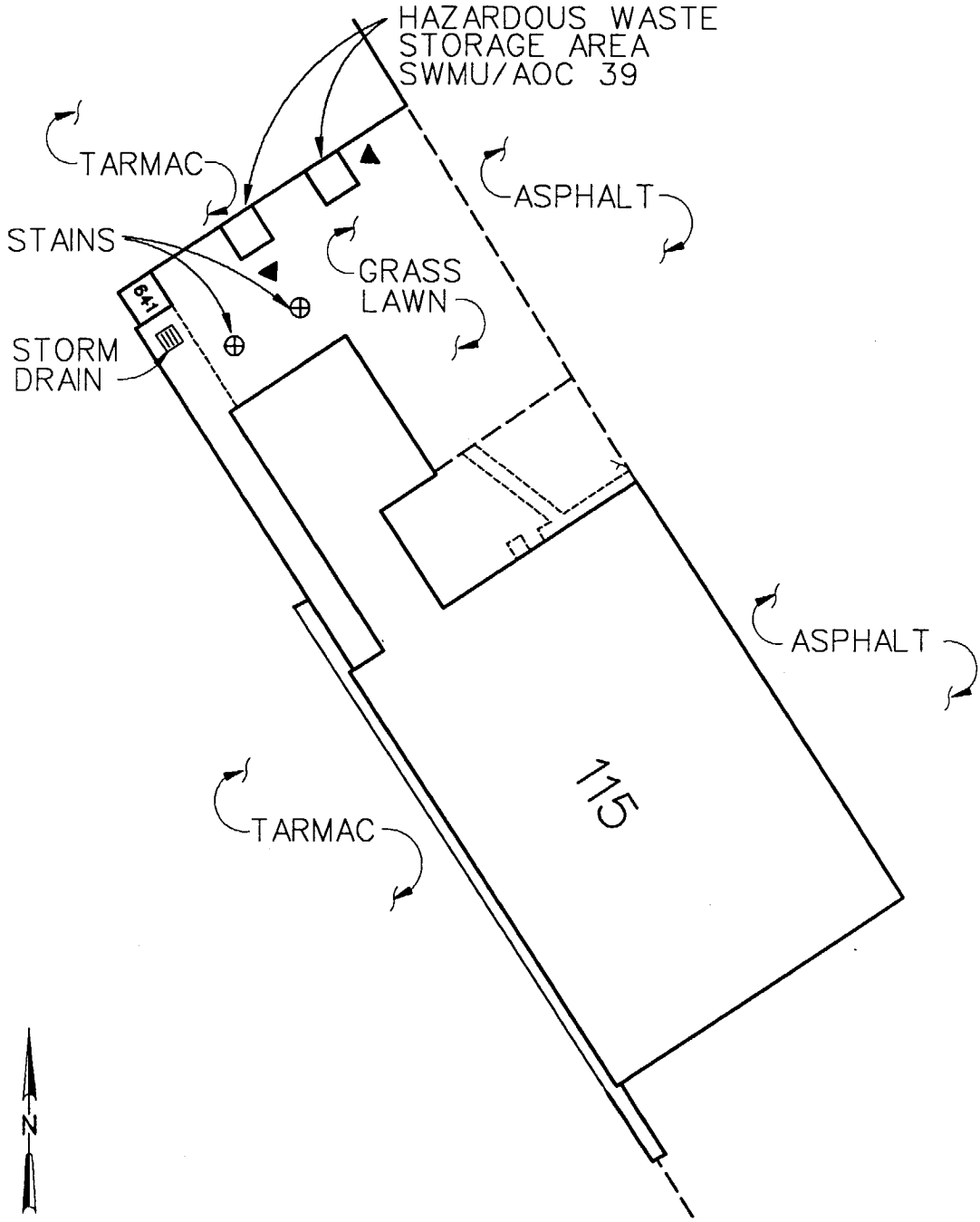

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 21
SAMPLING PLAN FOR
SWMU/AOC NUMBER 33
MCAS EL TORO



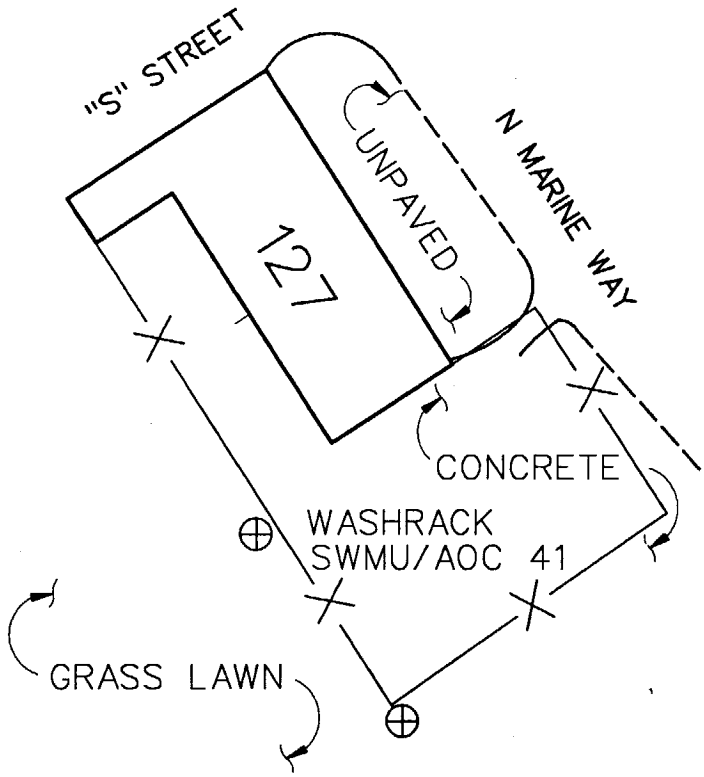

PROPOSED SAMPLING LOCATIONS

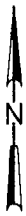
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 22
SAMPLING PLAN FOR
SWMU/AOC NUMBER 39
MCAS EL TORO



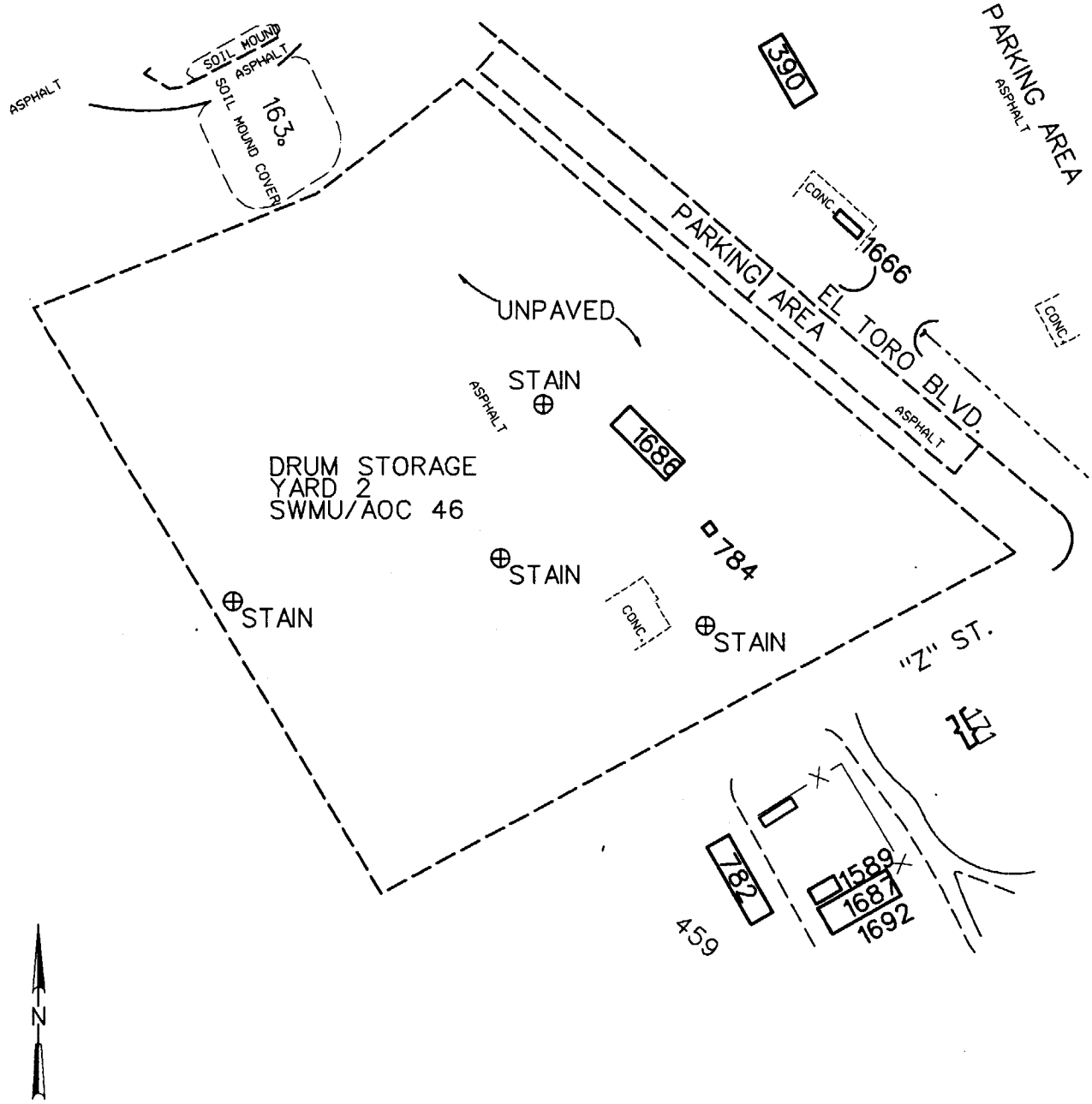

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 23
SAMPLING PLAN FOR
SWMU/AOC NUMBER 41
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

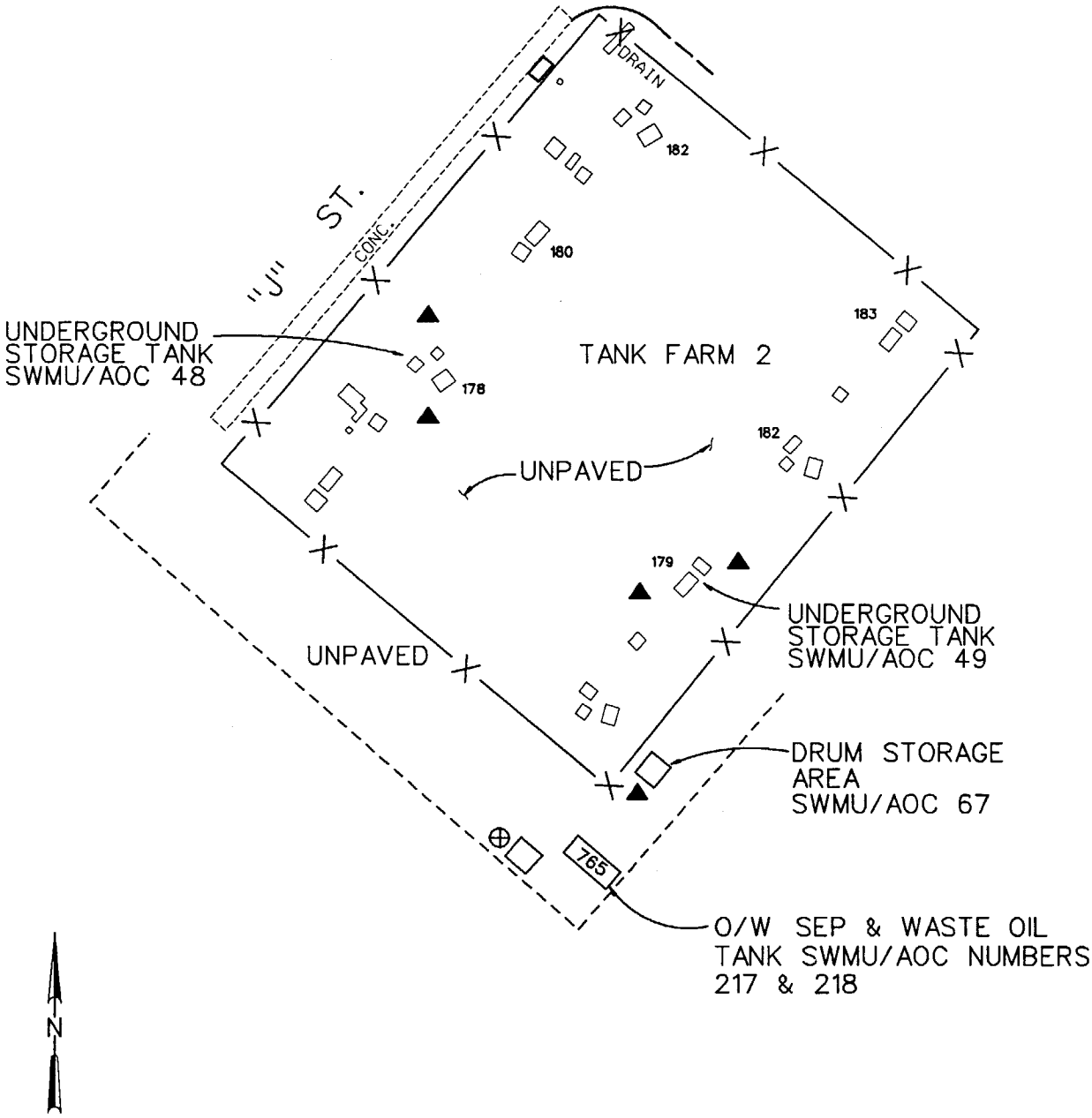
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 24
SAMPLING PLAN FOR
SWMU/AOC NUMBER 46
MCAS EL TORO

SITE37.DGN




PROPOSED SAMPLING LOCATIONS

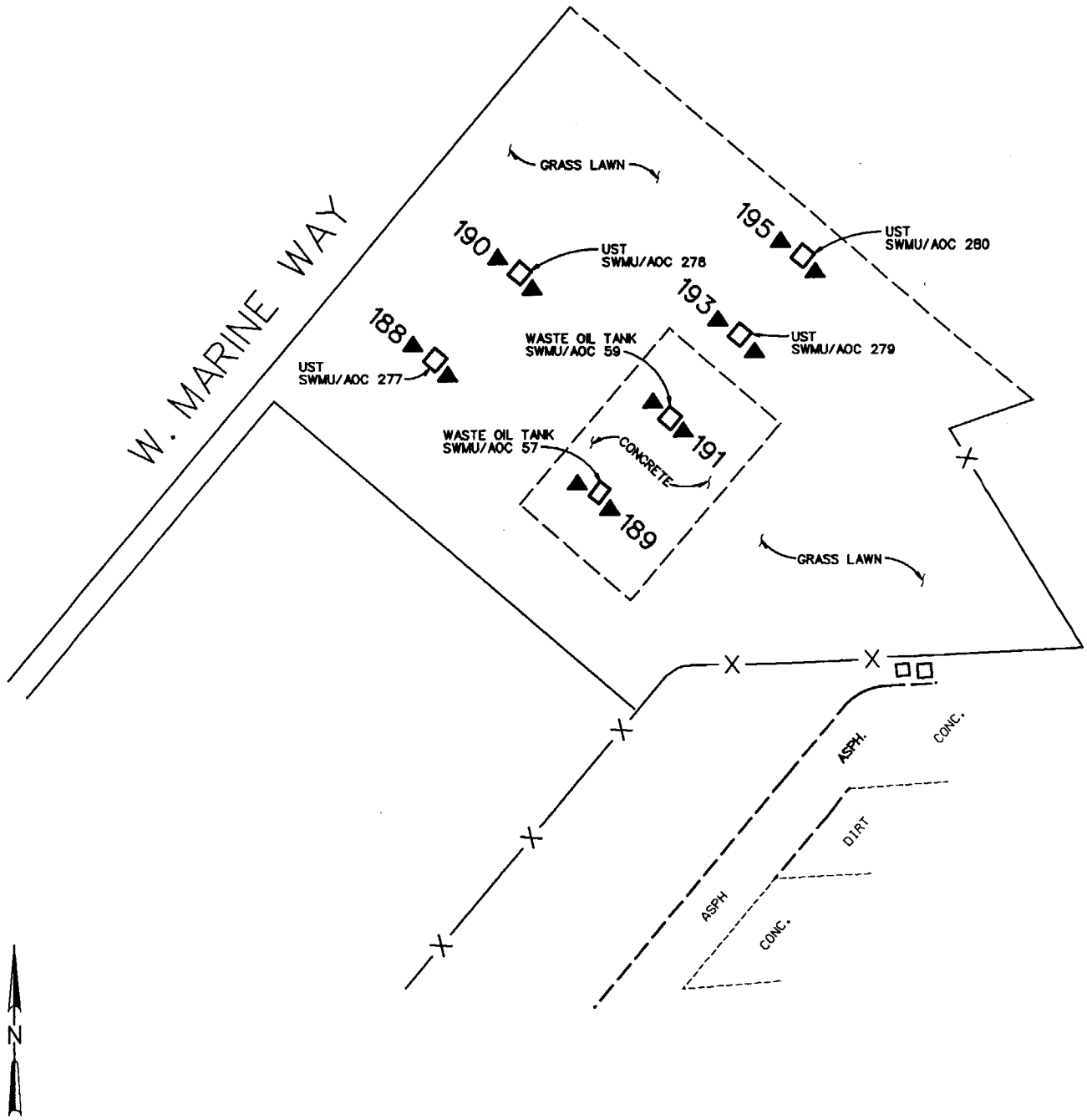
⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 25
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
48,49,67,217,218
MCAS EL TORO

SITE72.DGN



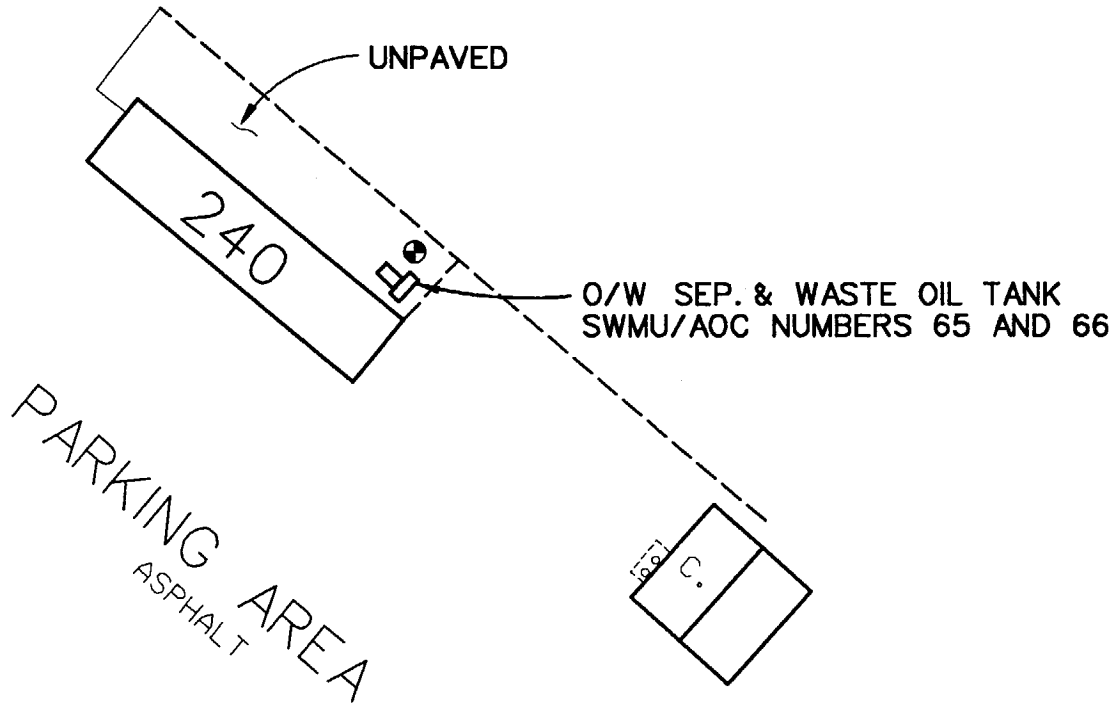

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 26
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
57,59, 277, 278, 279, & 280
MCAS EL TORO



PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

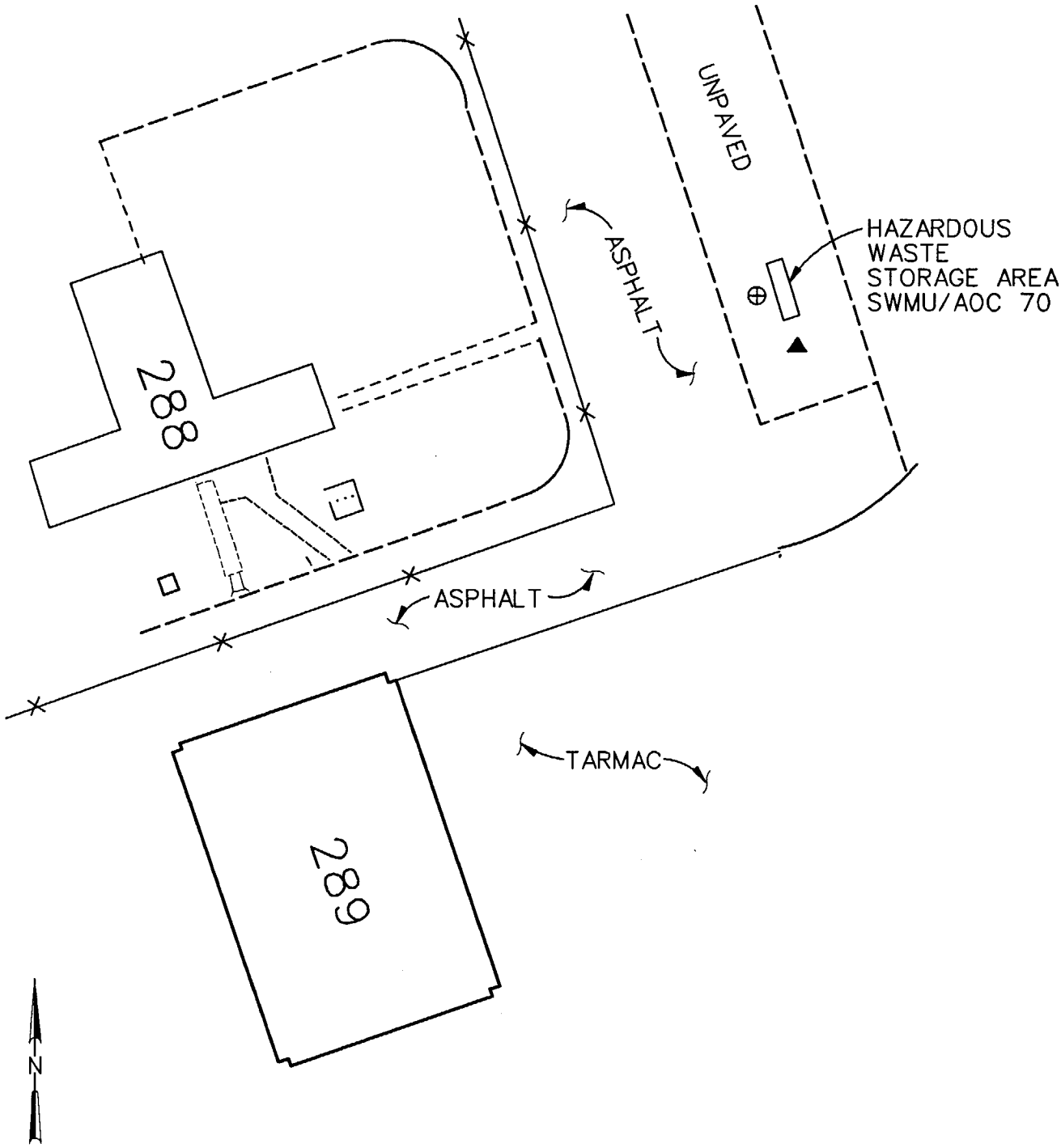
◓ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 27
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
65 AND 66
MCAS EL TORO



site71.dgn



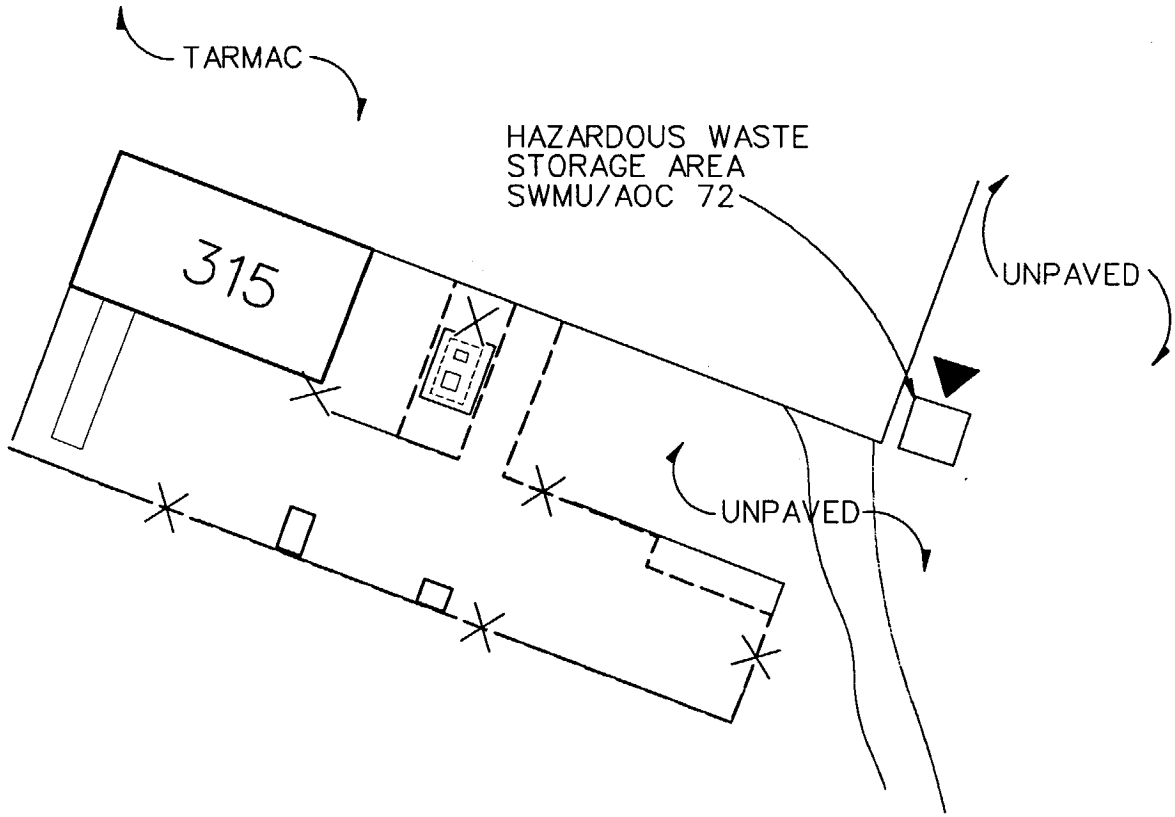

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 28
SAMPLING PLAN FOR
SWMU/AOC NUMBER 70
MCAS EL TORO



PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

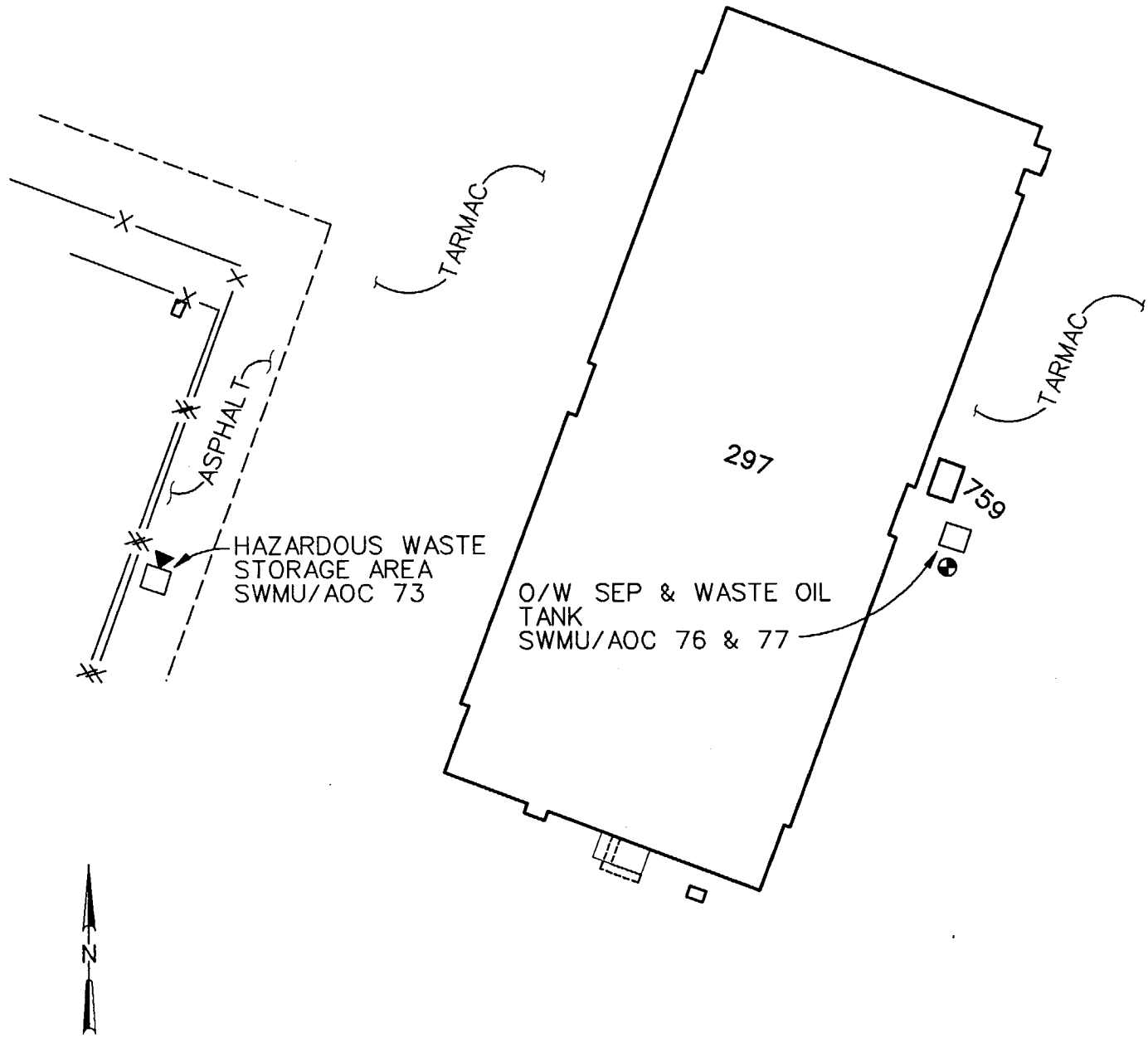
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 29
SAMPLING PLAN FOR
SWMU/AOC NUMBER 72
MCAS EL TORO



SITE23.DGN




PROPOSED SAMPLING LOCATIONS

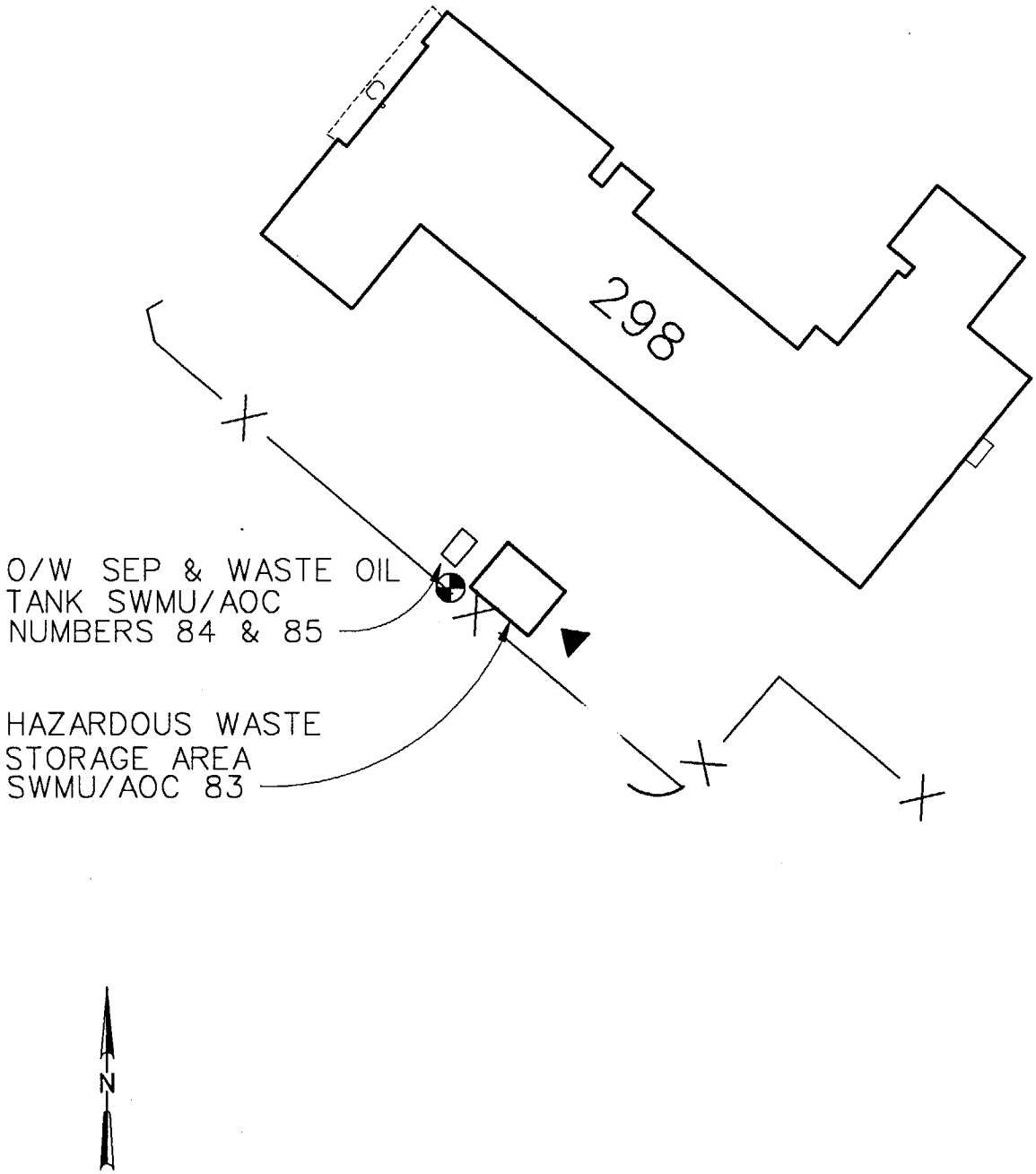
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 30
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
73, 76, 77
MCAS EL TORO

SITE15.DGN




PROPOSED SAMPLING LOCATIONS

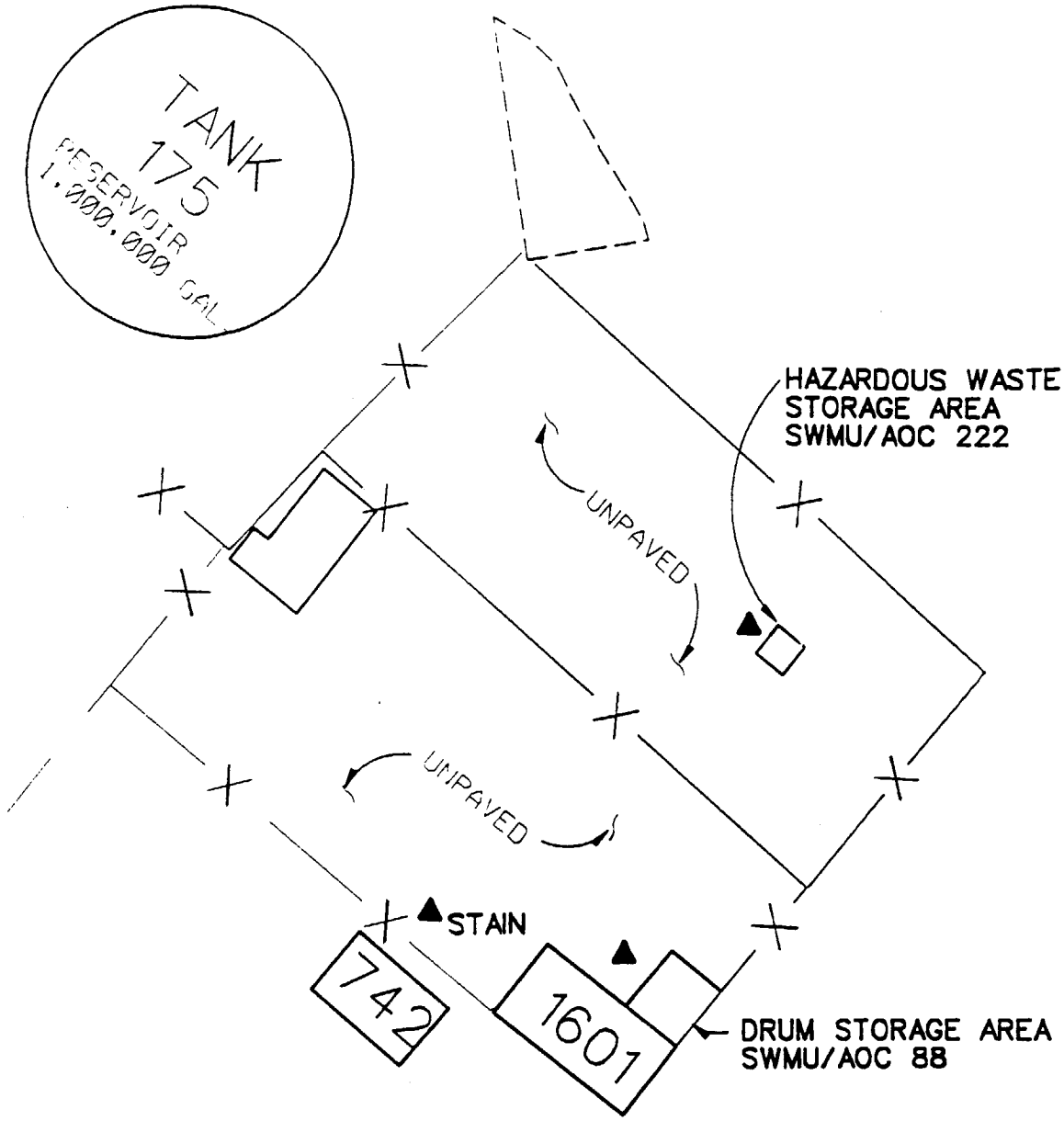
⊕ 5' DEEP BORING

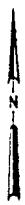
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 31
SAMPLING PLAN FOR
SWMU/AOC NUMBER
83, 84, 85
MCAS EL TORO

site9.dgn



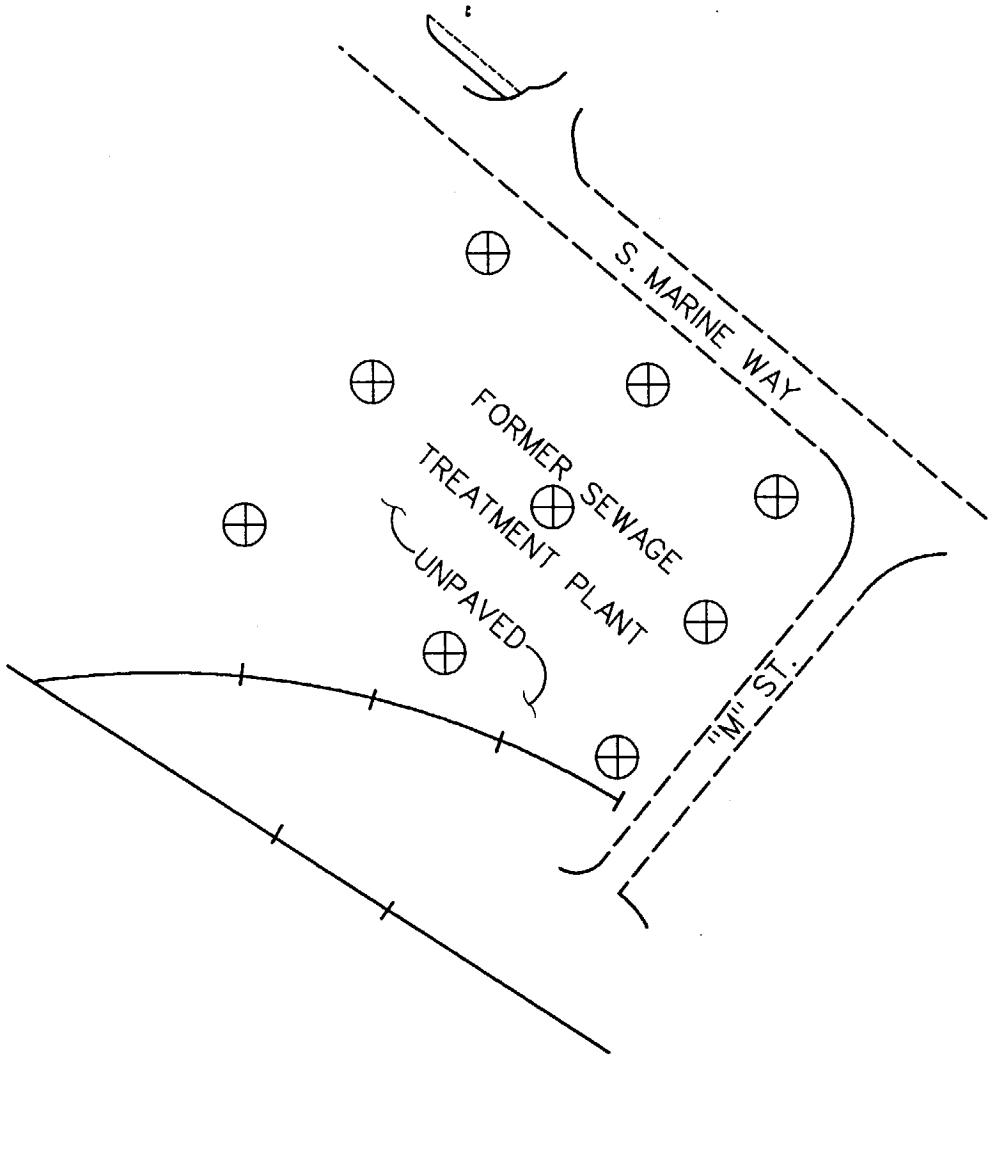

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 32
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
88 & 222
MCAS EL TORO



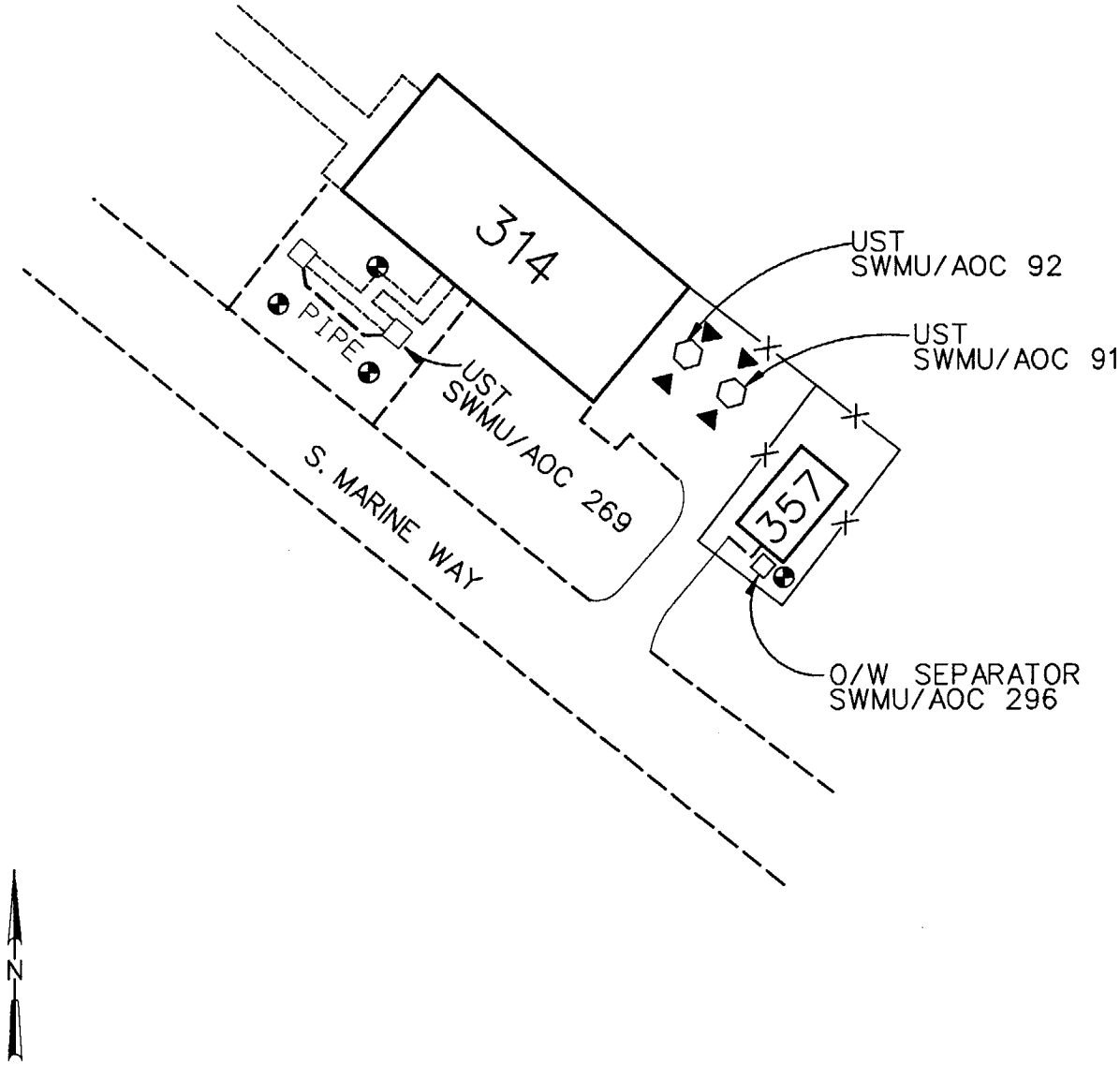

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 33
SAMPLING PLAN FOR
SWMU/AOC NUMBER 90
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

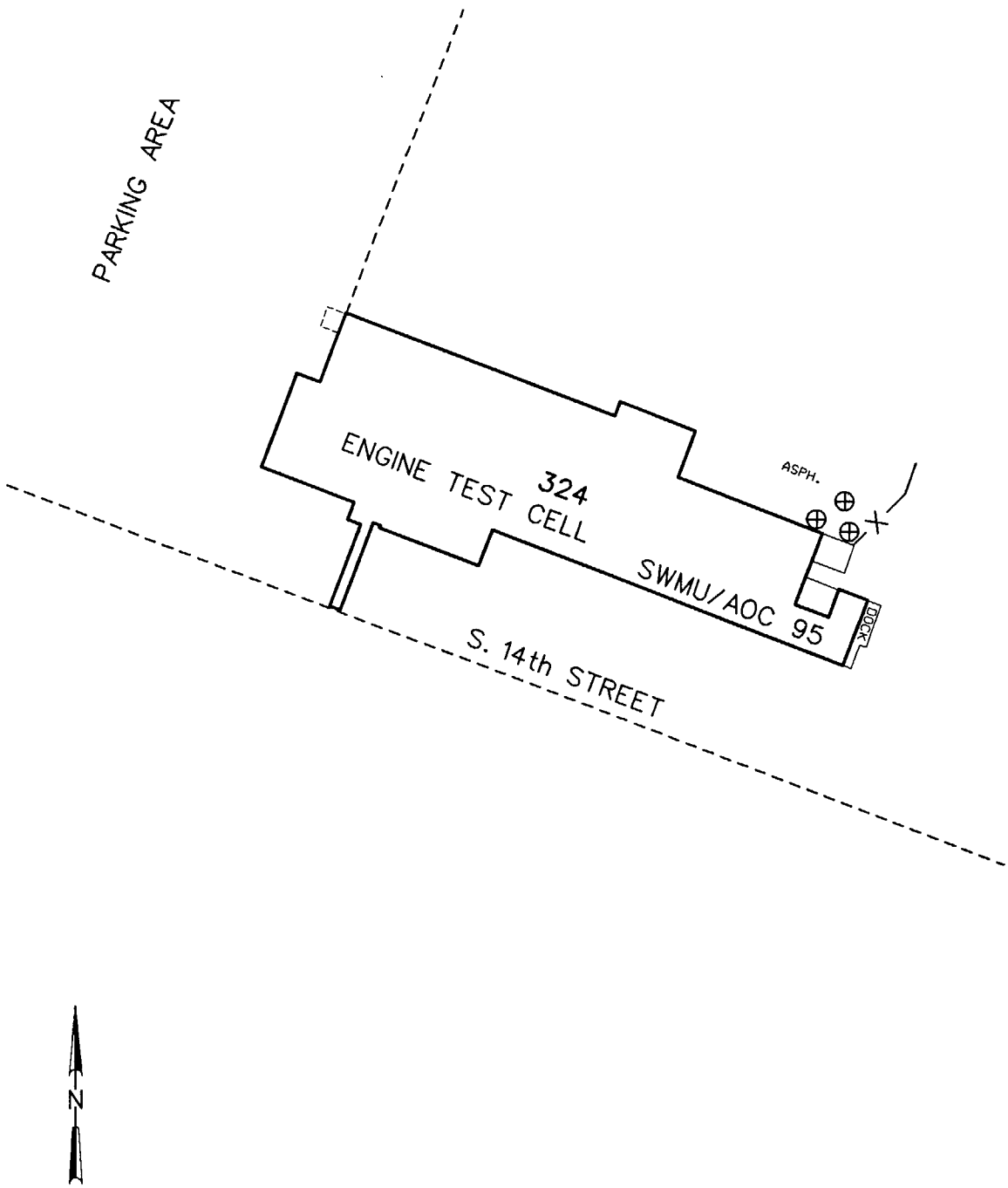
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 34
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
91 & 92, 269, 296
MCAS EL TORO

site20.dgn



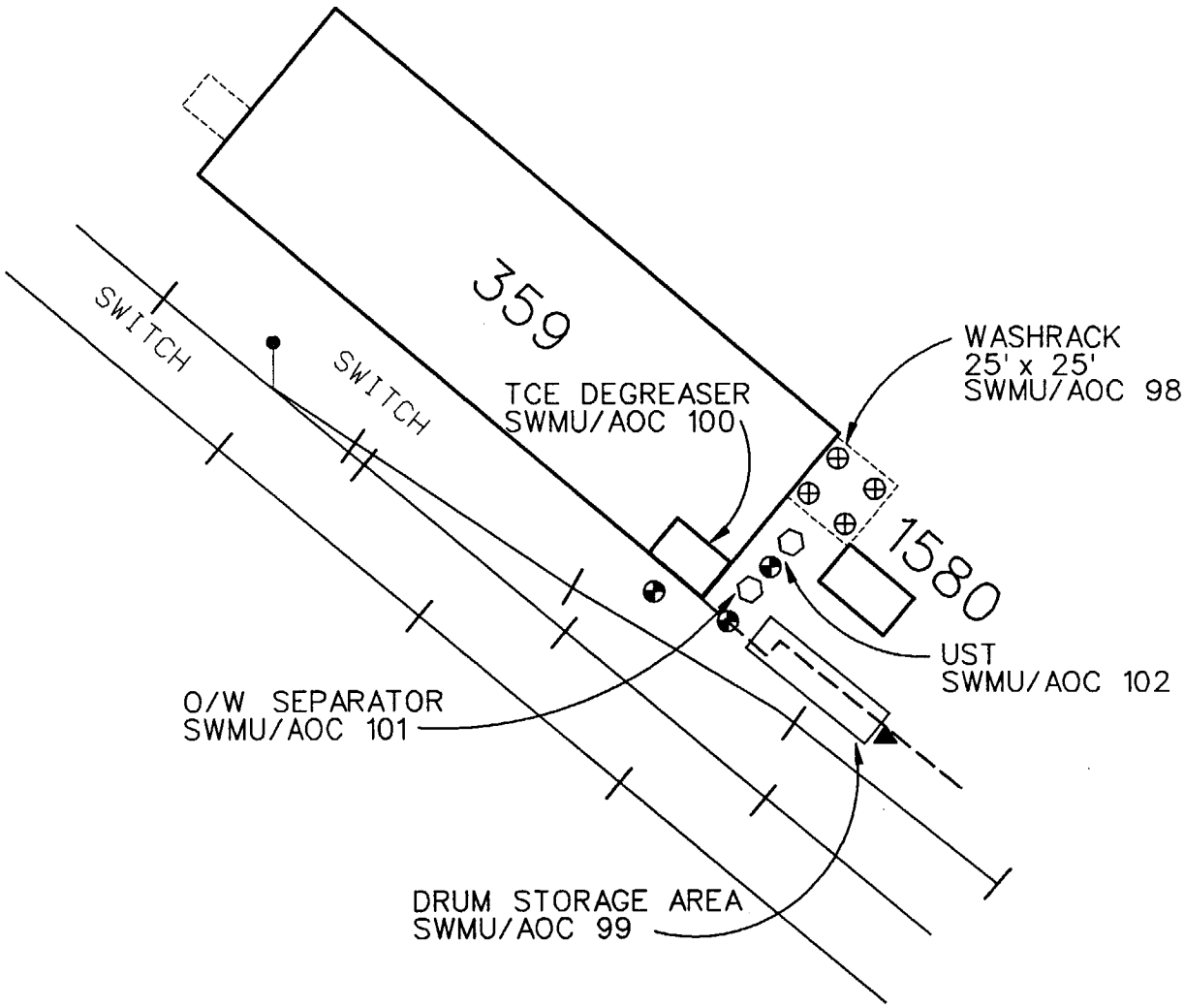

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 35
SAMPLING PLAN FOR
SWMU/AOC NUMBER 95
MCAS EL TORO



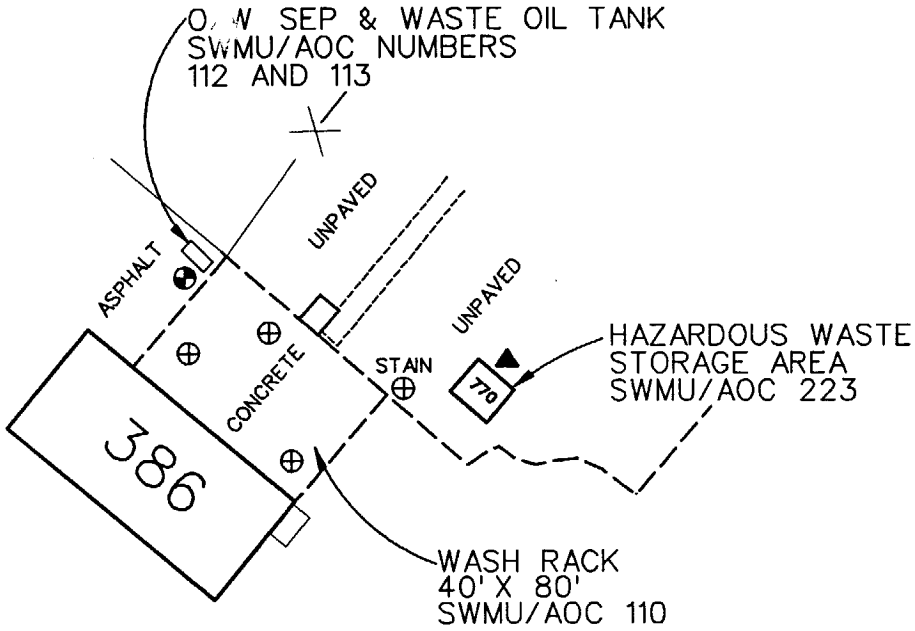
PROPOSED SAMPLING LOCATIONS

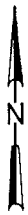
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 36
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
98,99,100,101,102
MCAS EL TORO



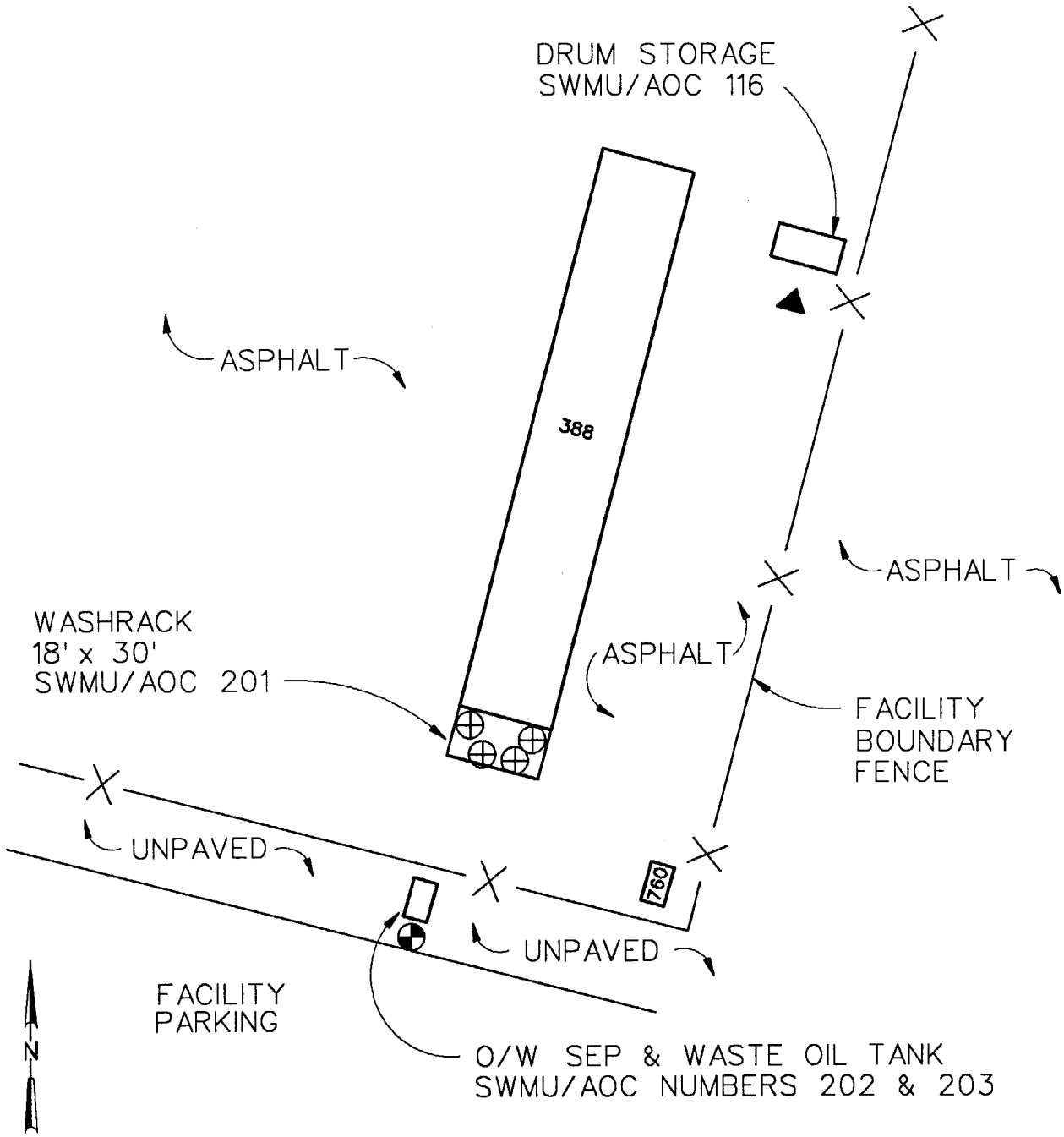

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 37
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
110,112,113,223
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

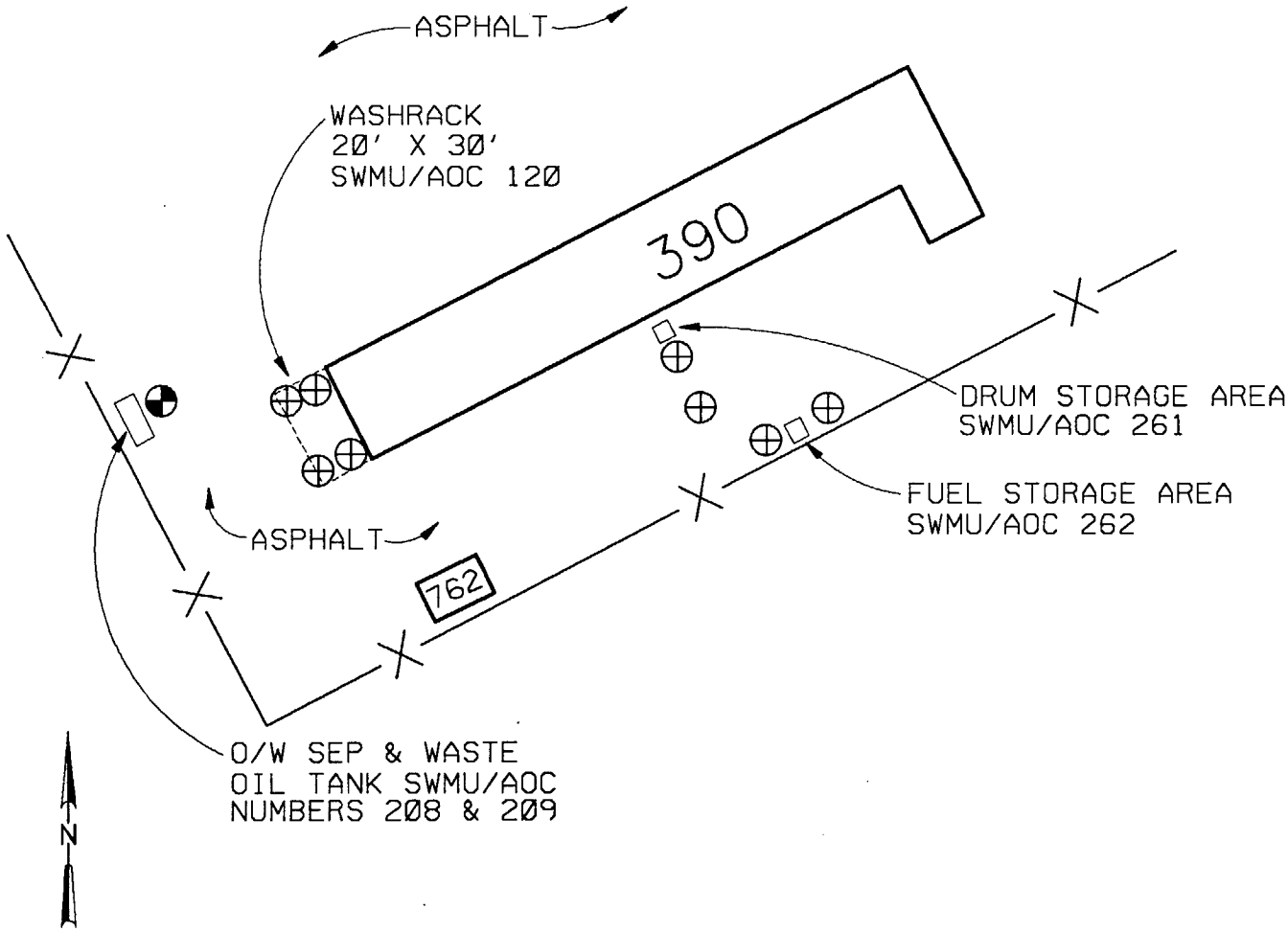
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 38
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
116, 201, 202, 203
MCAS EL TORO

site14.dgn



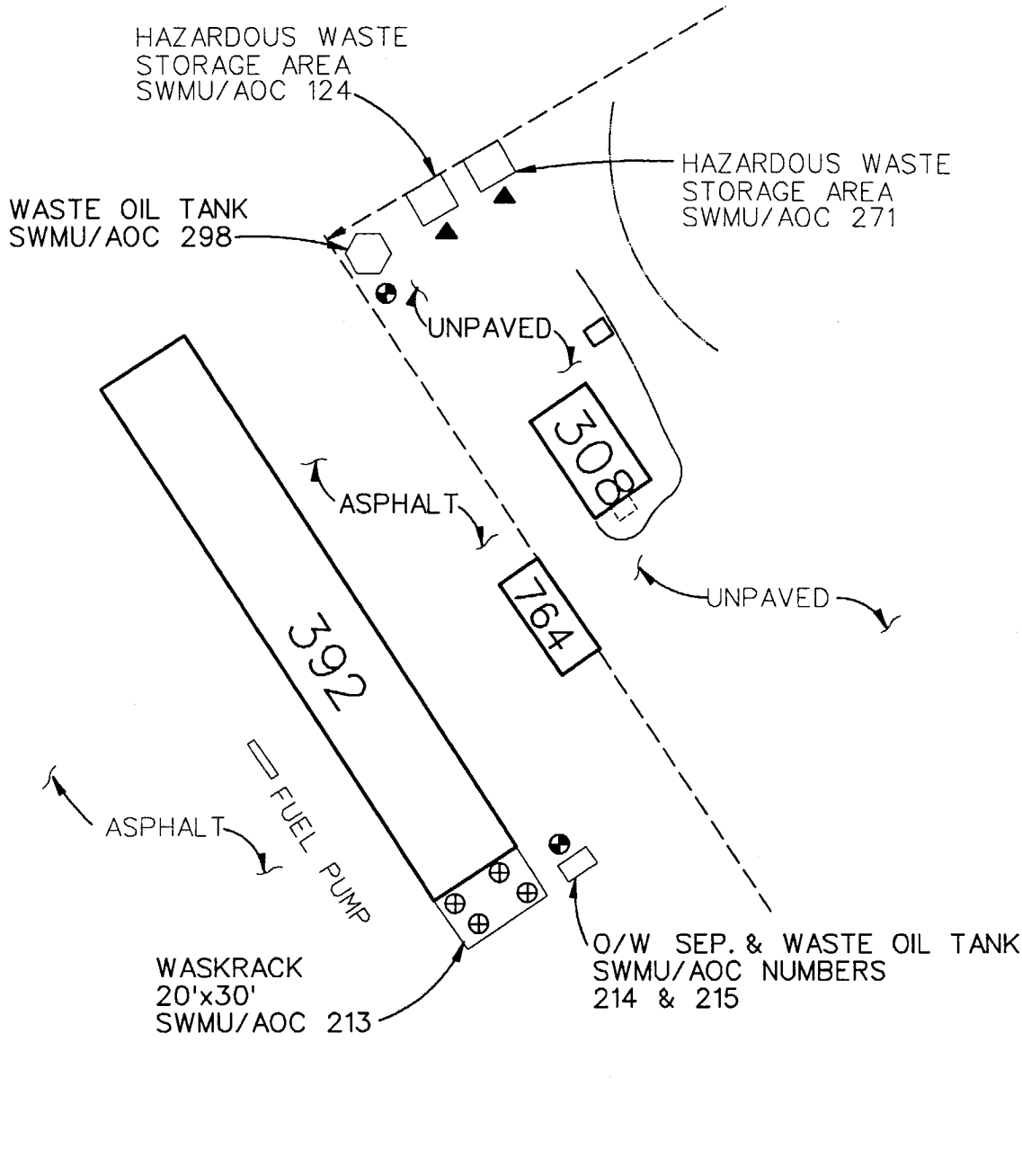

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 39
SAMPLING PLAN FOR
SWMU/AOC NUMBER
120,208,209,261,262
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

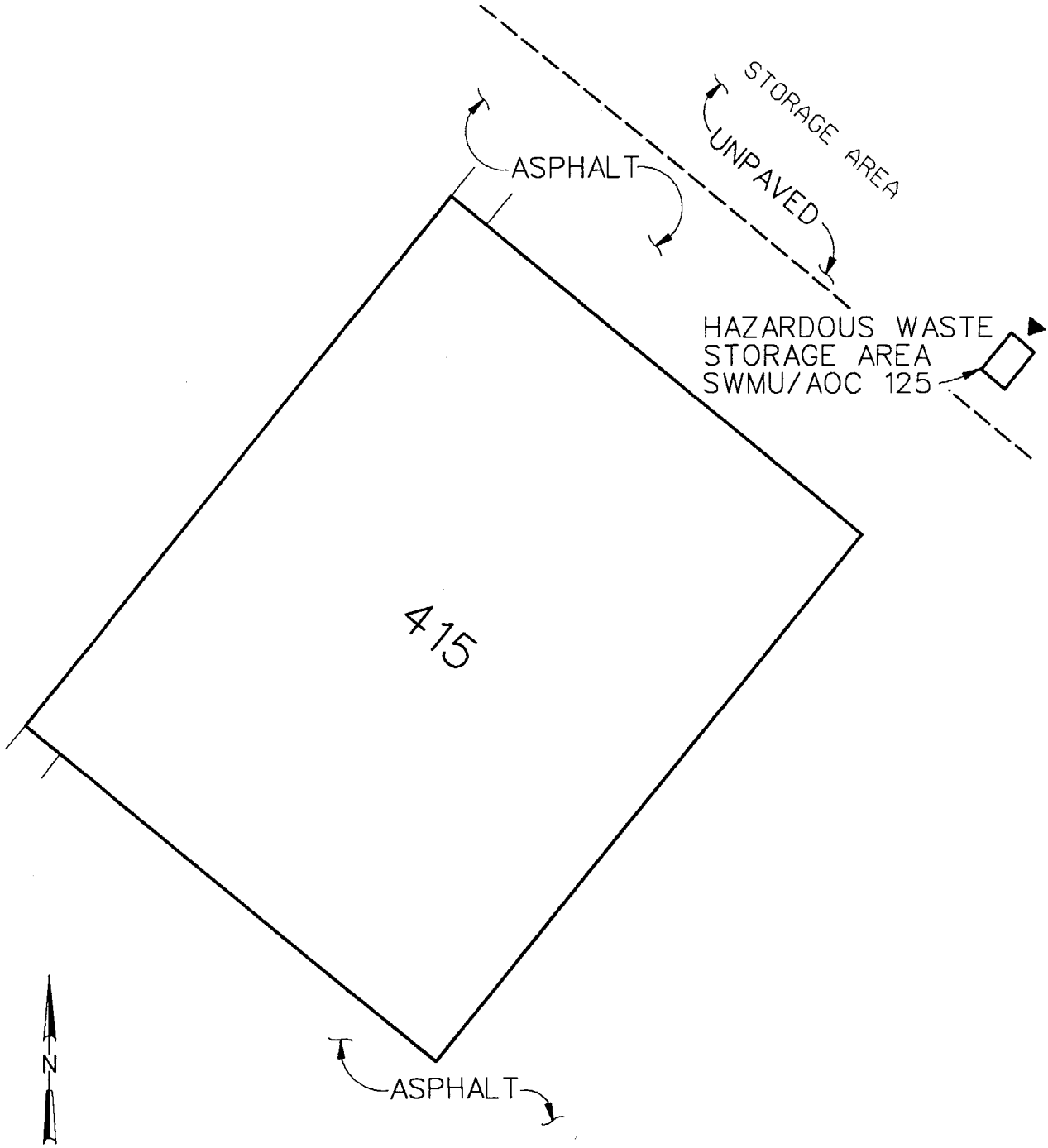
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 40
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
124, 213, 214, 215, 271, 298
MCAS EL TORO

SITE62.DGN




PROPOSED SAMPLING LOCATIONS

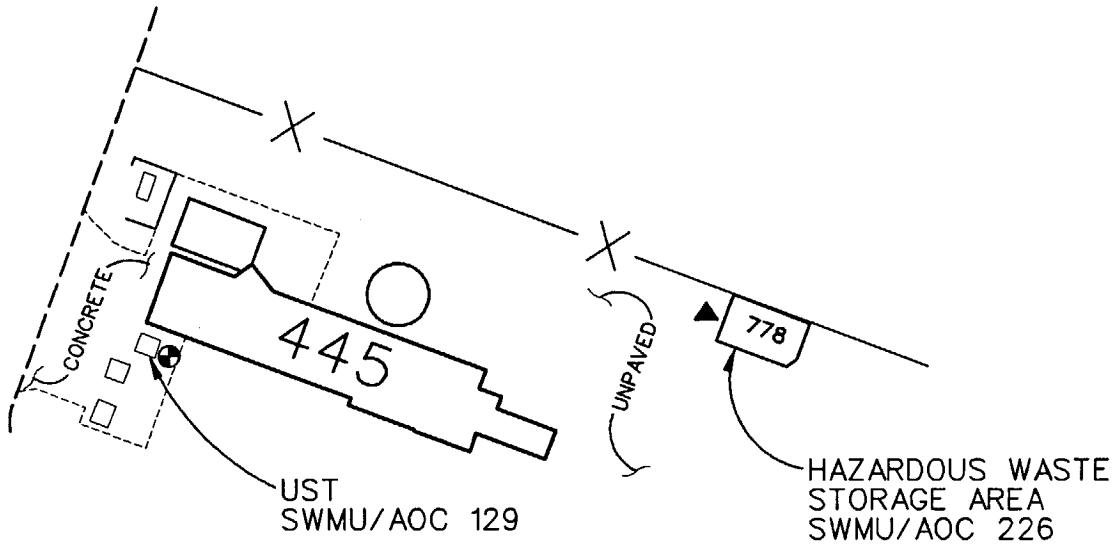
⊕ 5' DEEP BORING

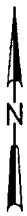
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 41
SAMPLING PLAN FOR
SWMU/AOC NUMBER 125
MCAS EL TORO

site63.dgn




PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

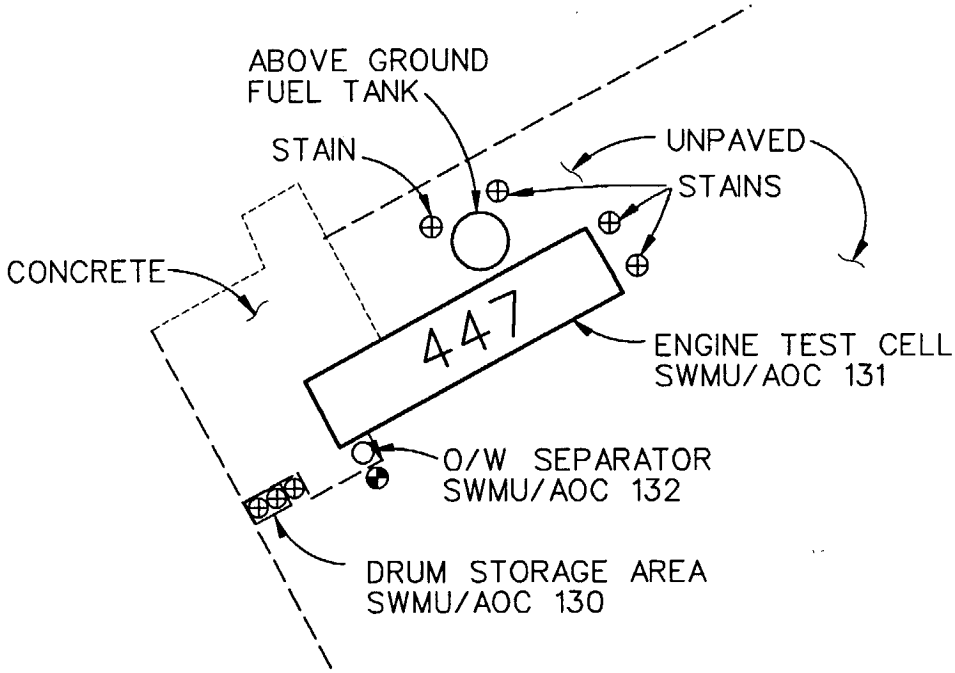
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 42
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
129, 226
MCAS EL TORO



site19.dgn



PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

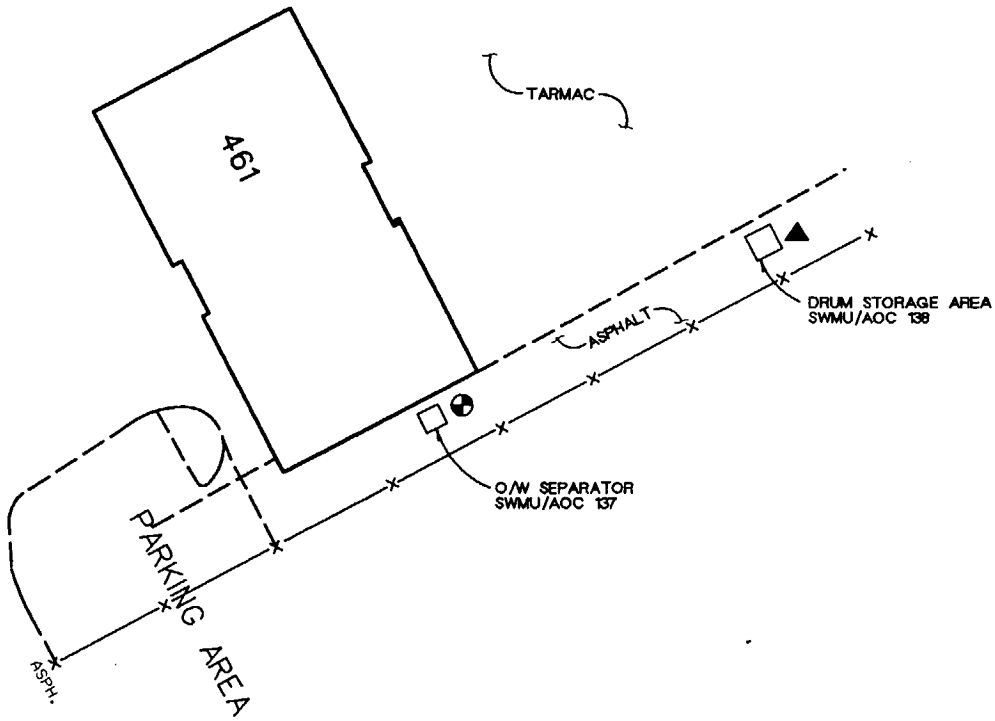
◕ 25' DEEP BORING

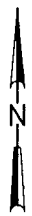
▲ 60' LONG SLANT BORING

FIGURE 43
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
130, 131, 132
MCAS EL TORO



SITE32.dgn



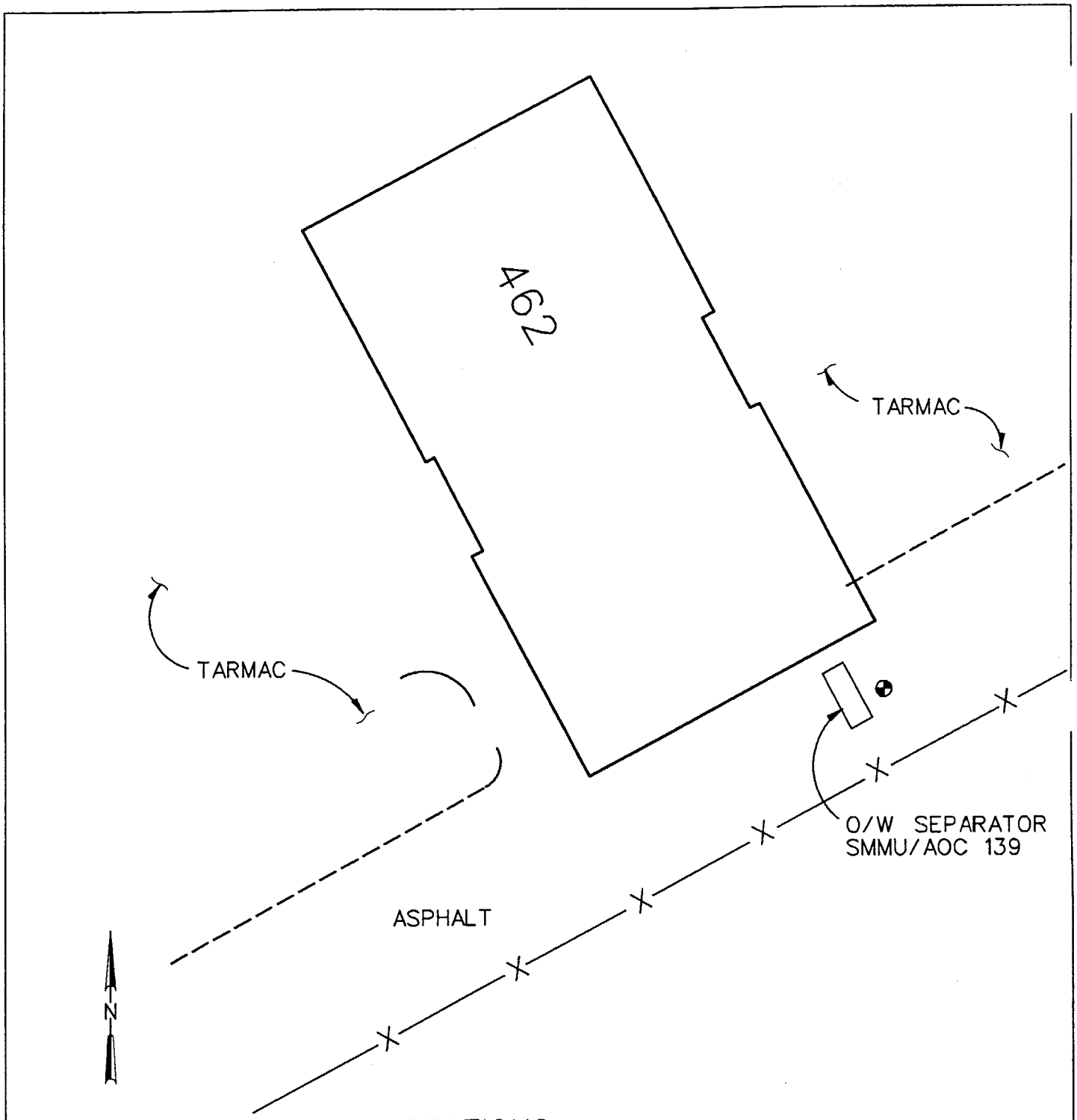

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 44
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
137 & 138
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

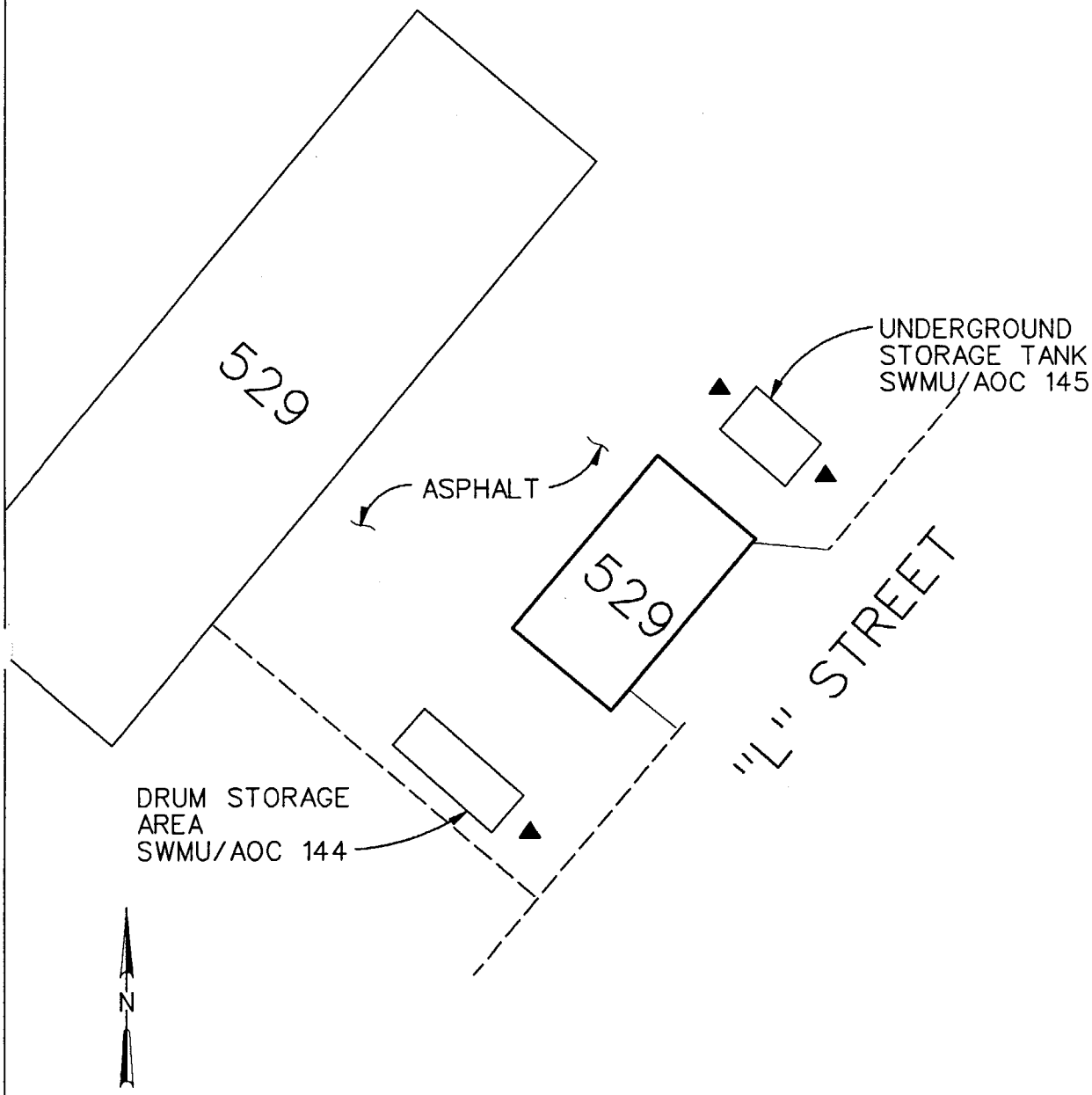
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 45
SAMPLING PLAN FOR
SWMU/AOC NUMBER
139
MCAS EL TORO

SITE31.DGN




PROPOSED SAMPLING LOCATIONS

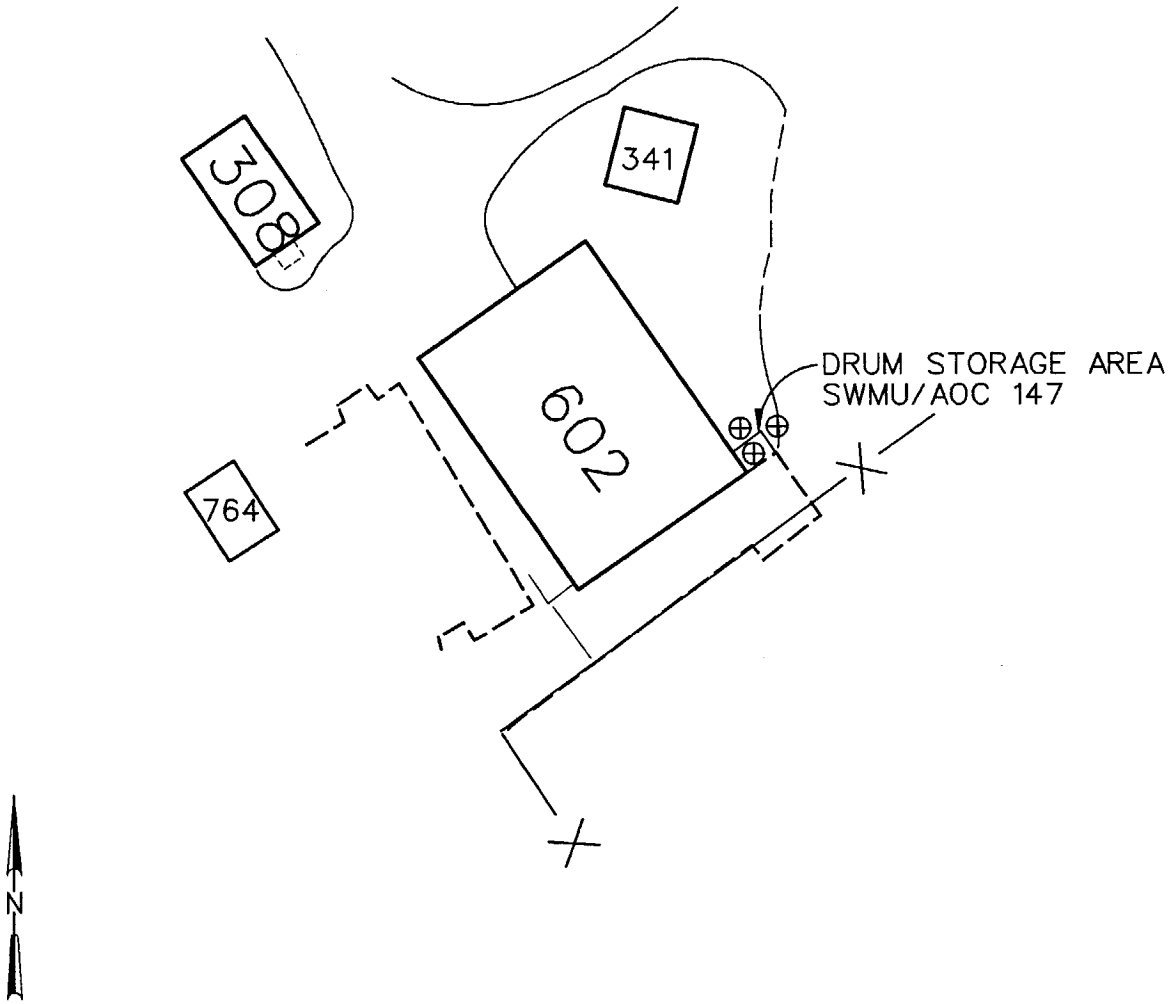
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 46
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
144 & 145
MCAS EL TORO

SITE5.DGN



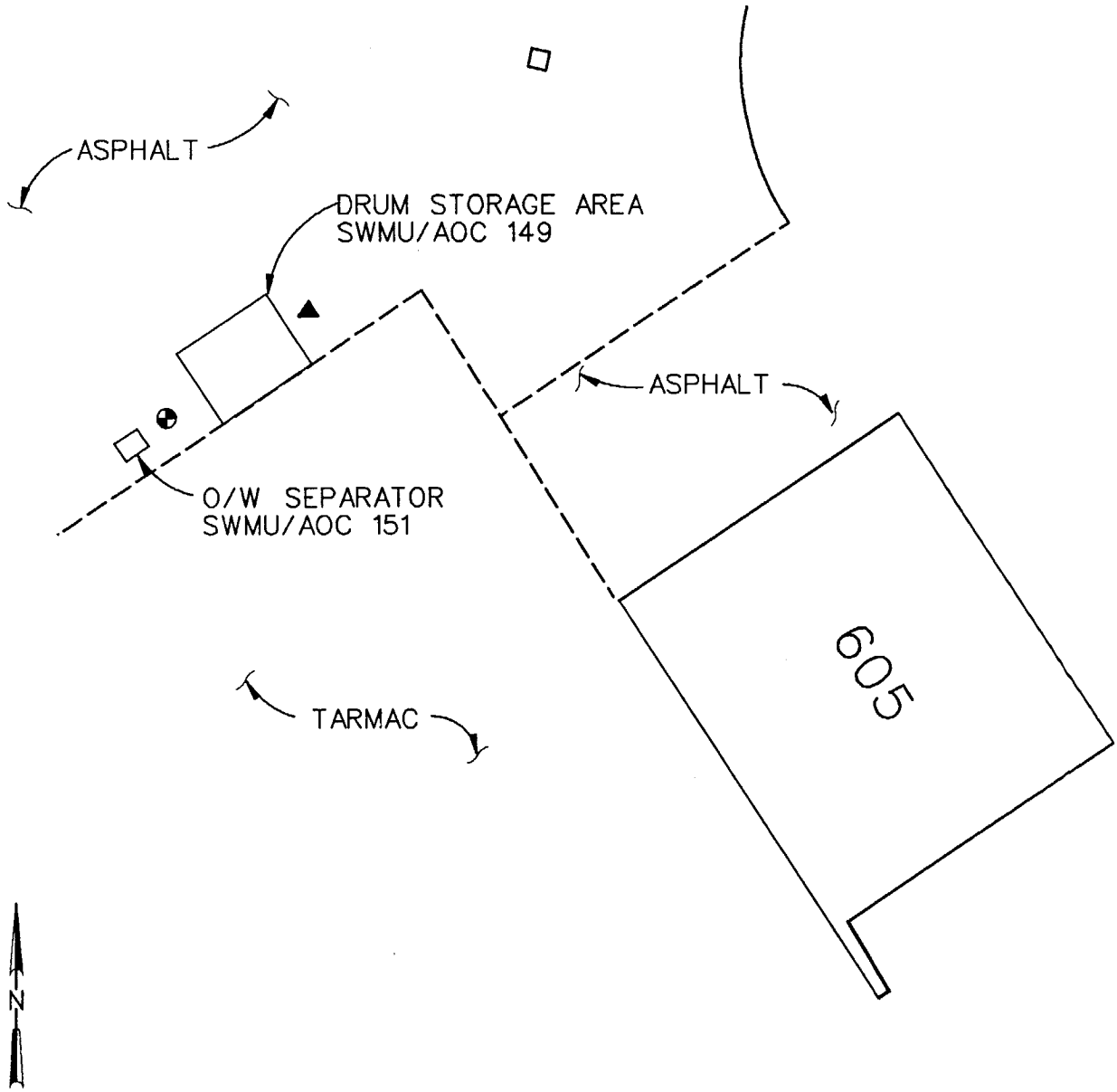

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 47
SAMPLING PLAN FOR
SWMU/AOC NUMBER 147
MCAS EL TORO



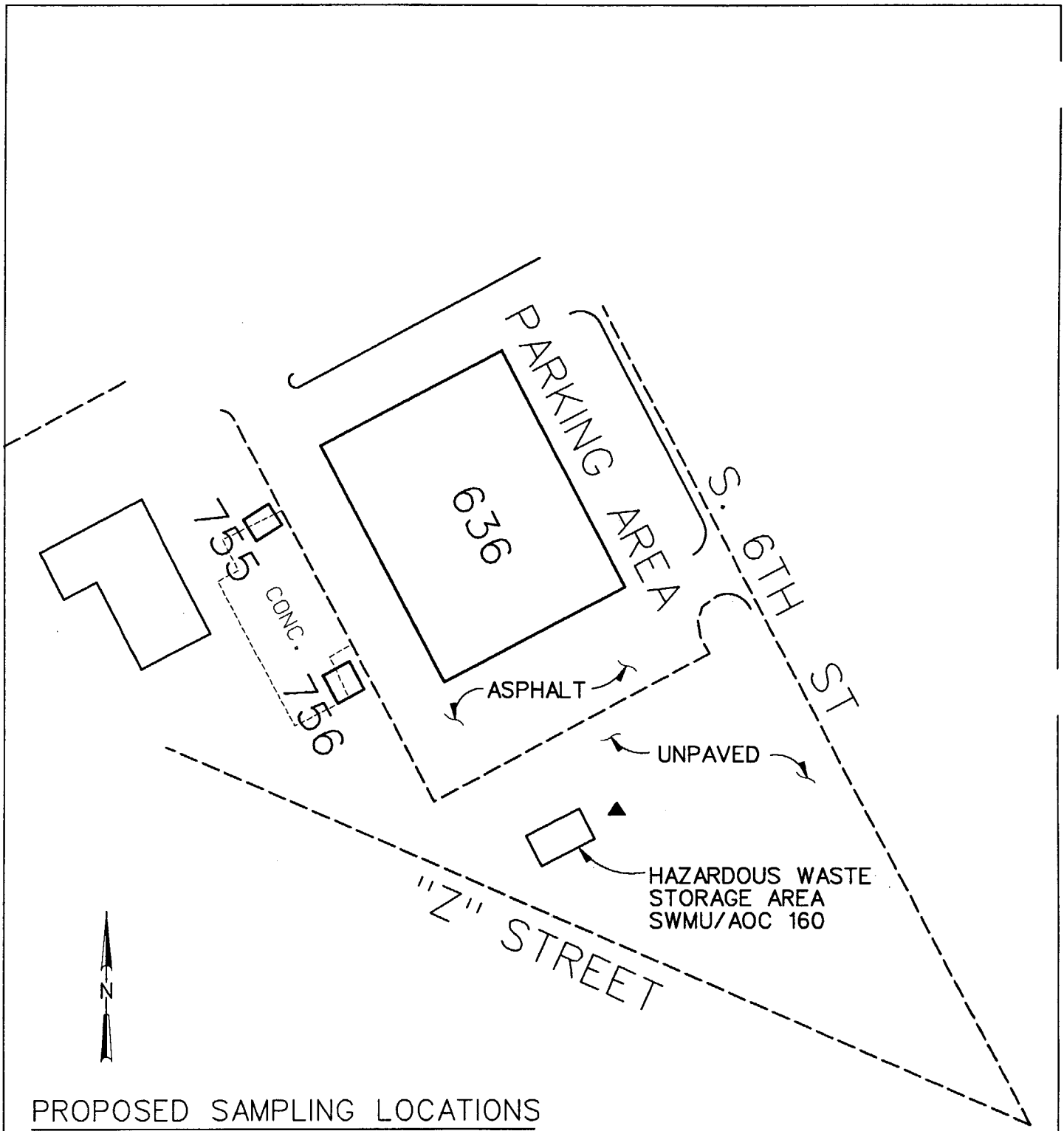

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 48
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
149 & 151
MCAS EL TORO



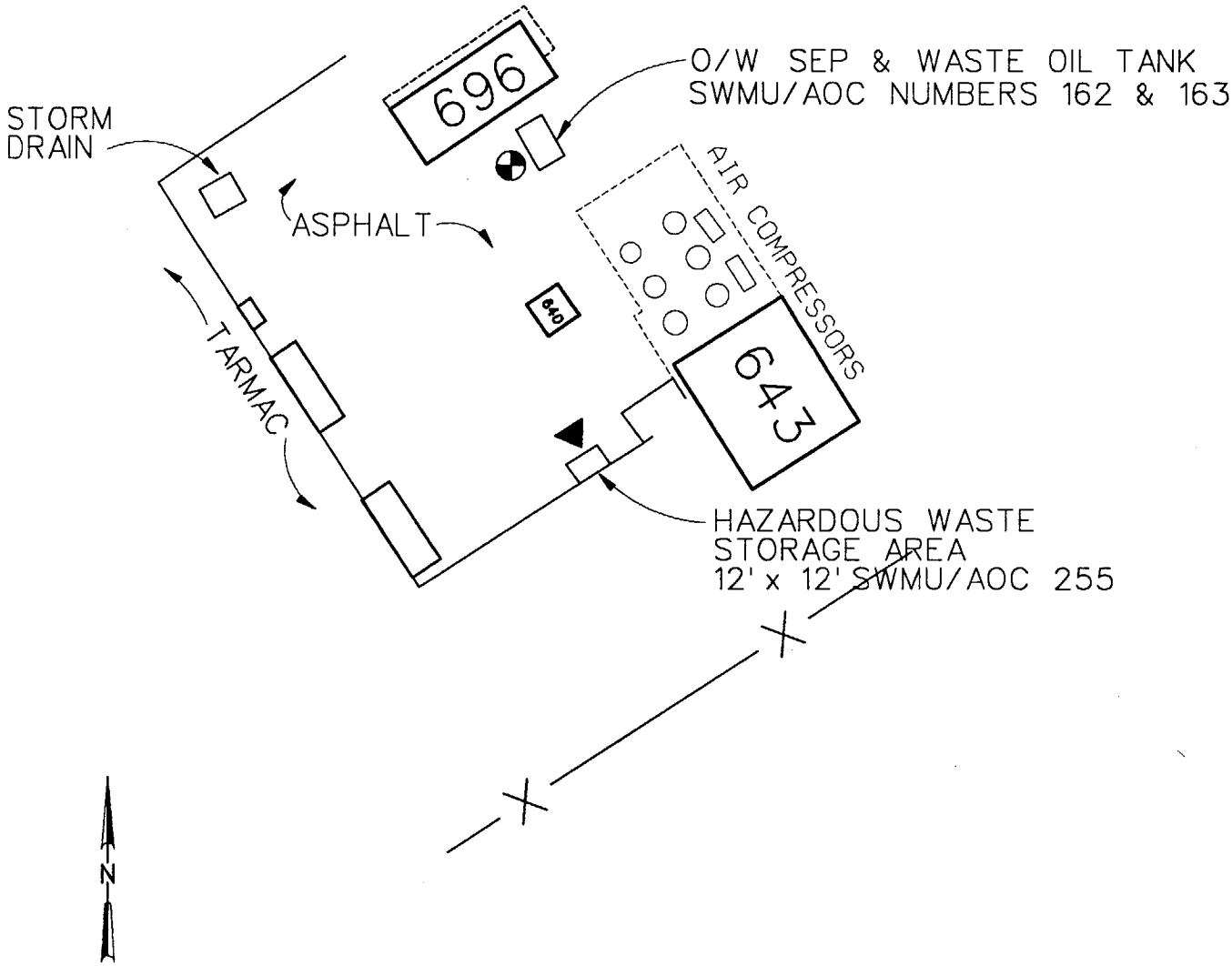

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 49
SAMPLING PLAN FOR
SWMU/AOC NUMBER 160
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

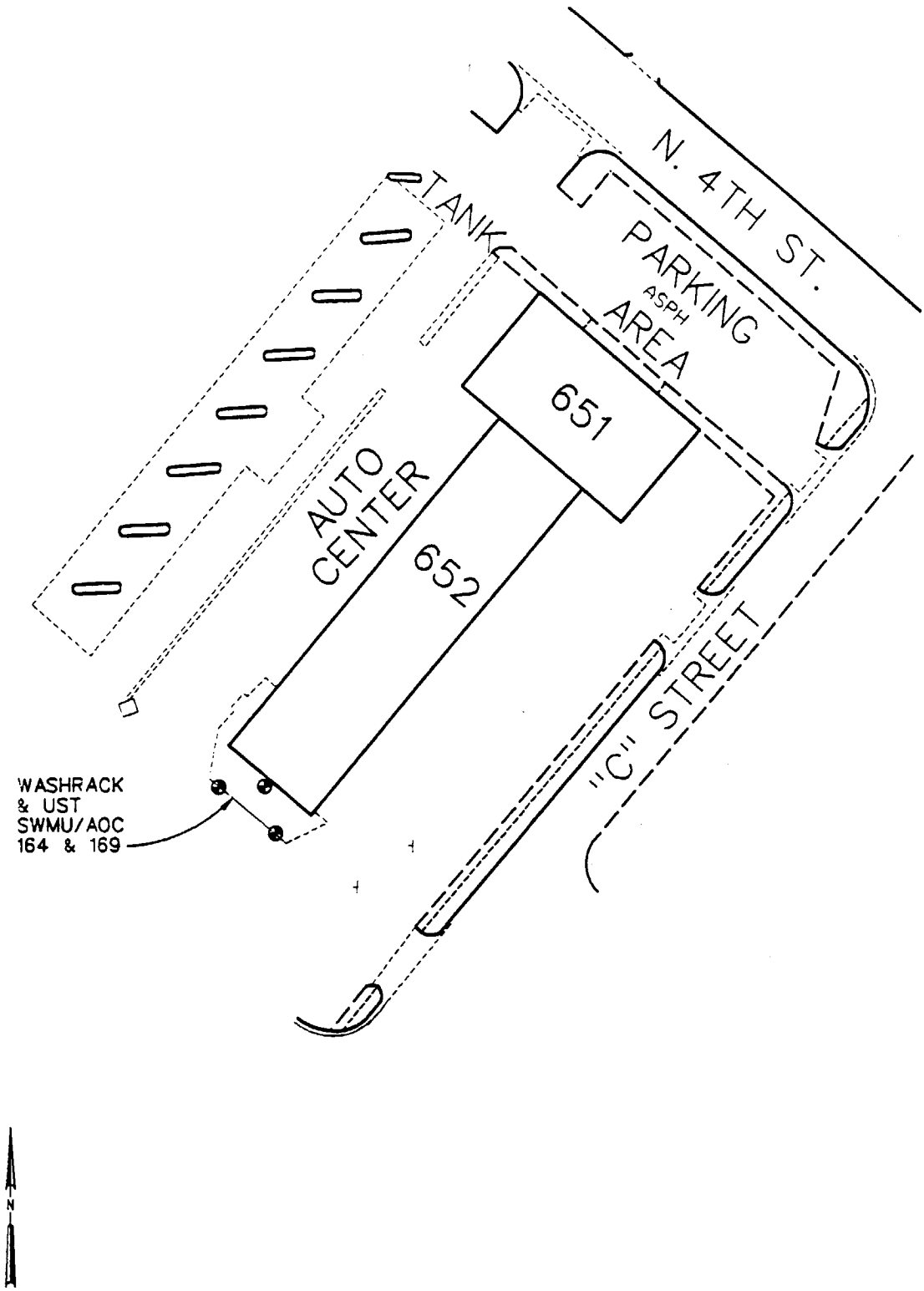
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 50
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
162,163, & 255
MCAS EL TORO



site52.dgn



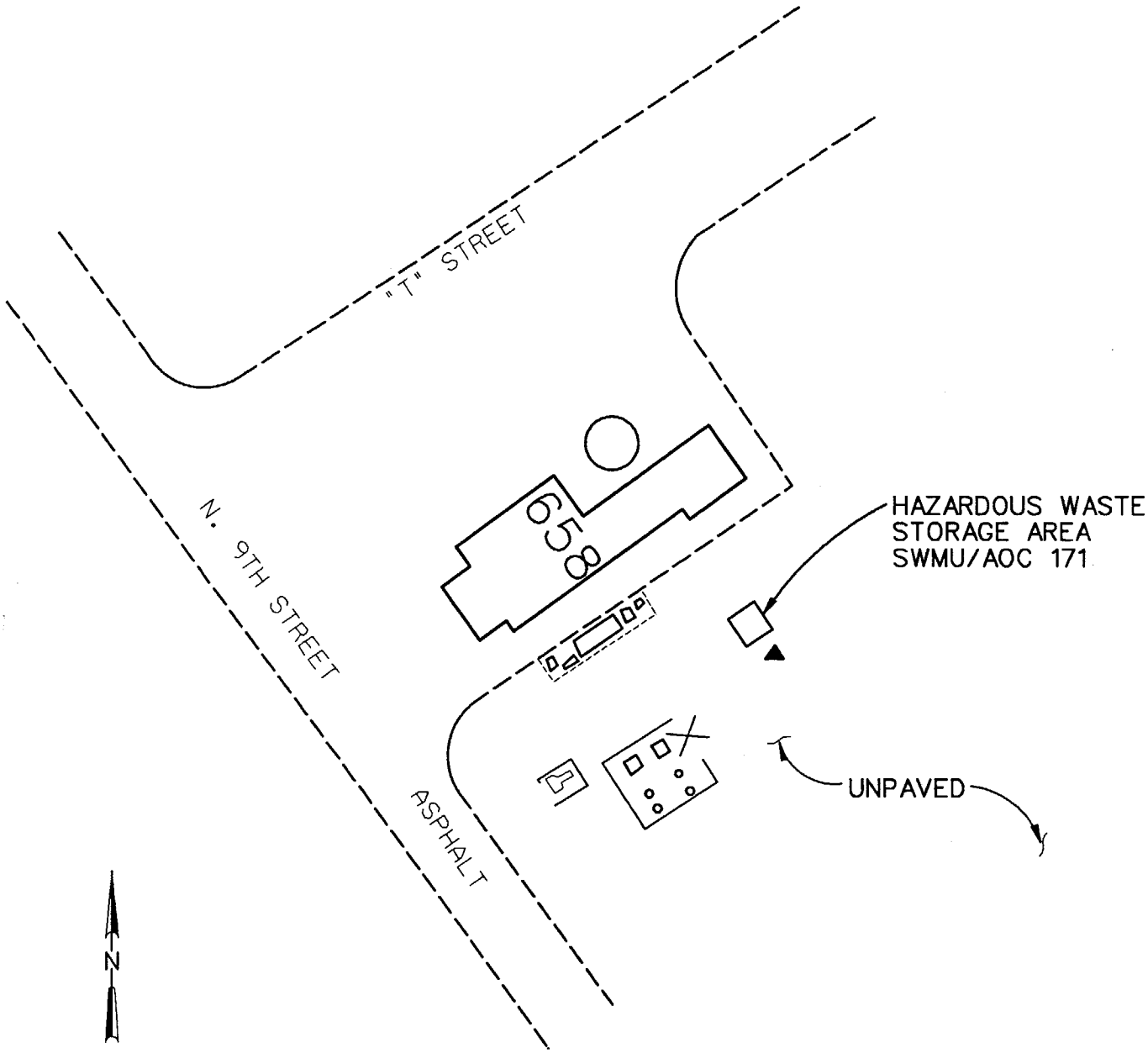

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 51
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
164 & 169
MCAS EL TORO



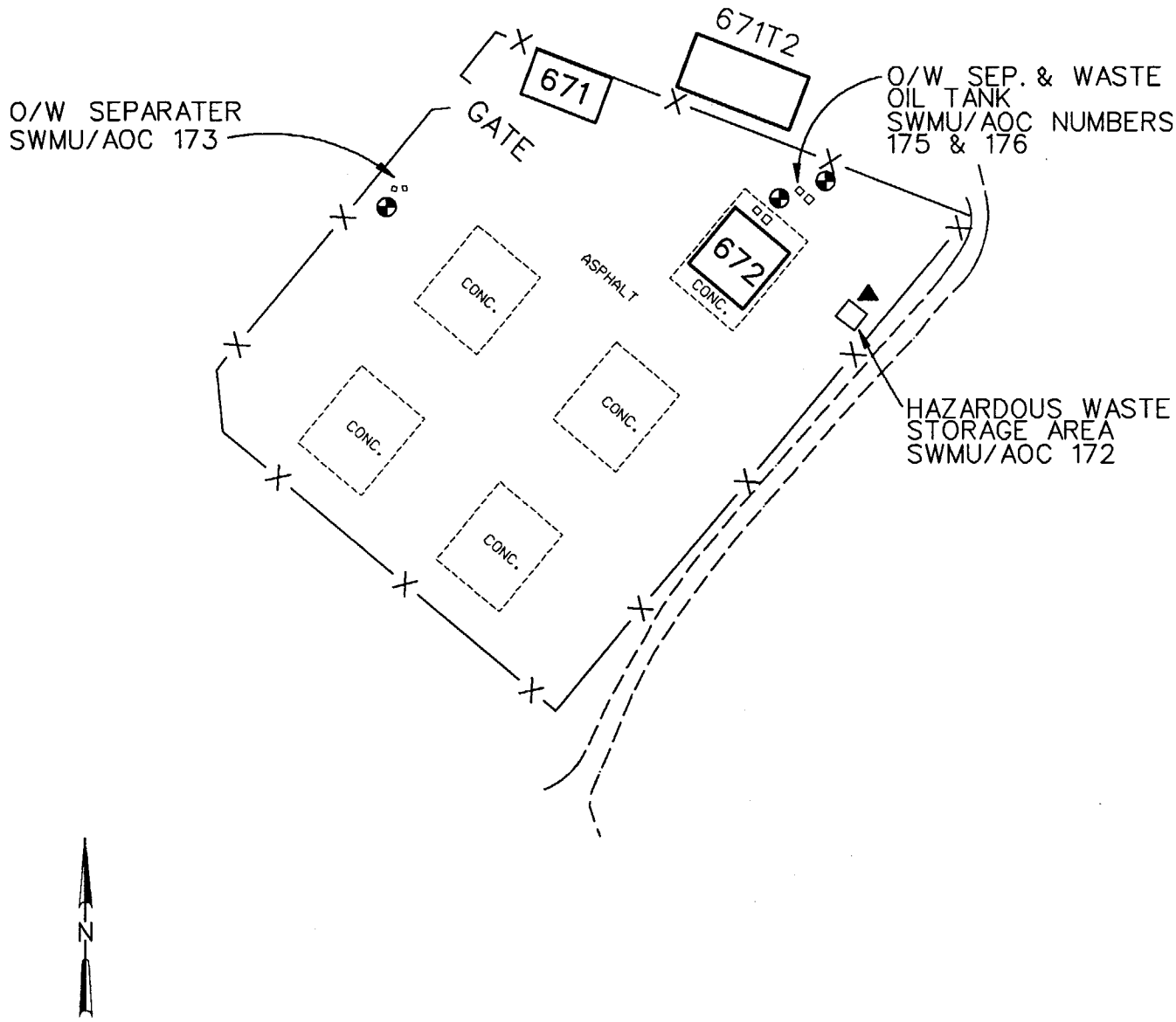

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 52
SAMPLING PLAN FOR
SWMU/AOC NUMBERS 171
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

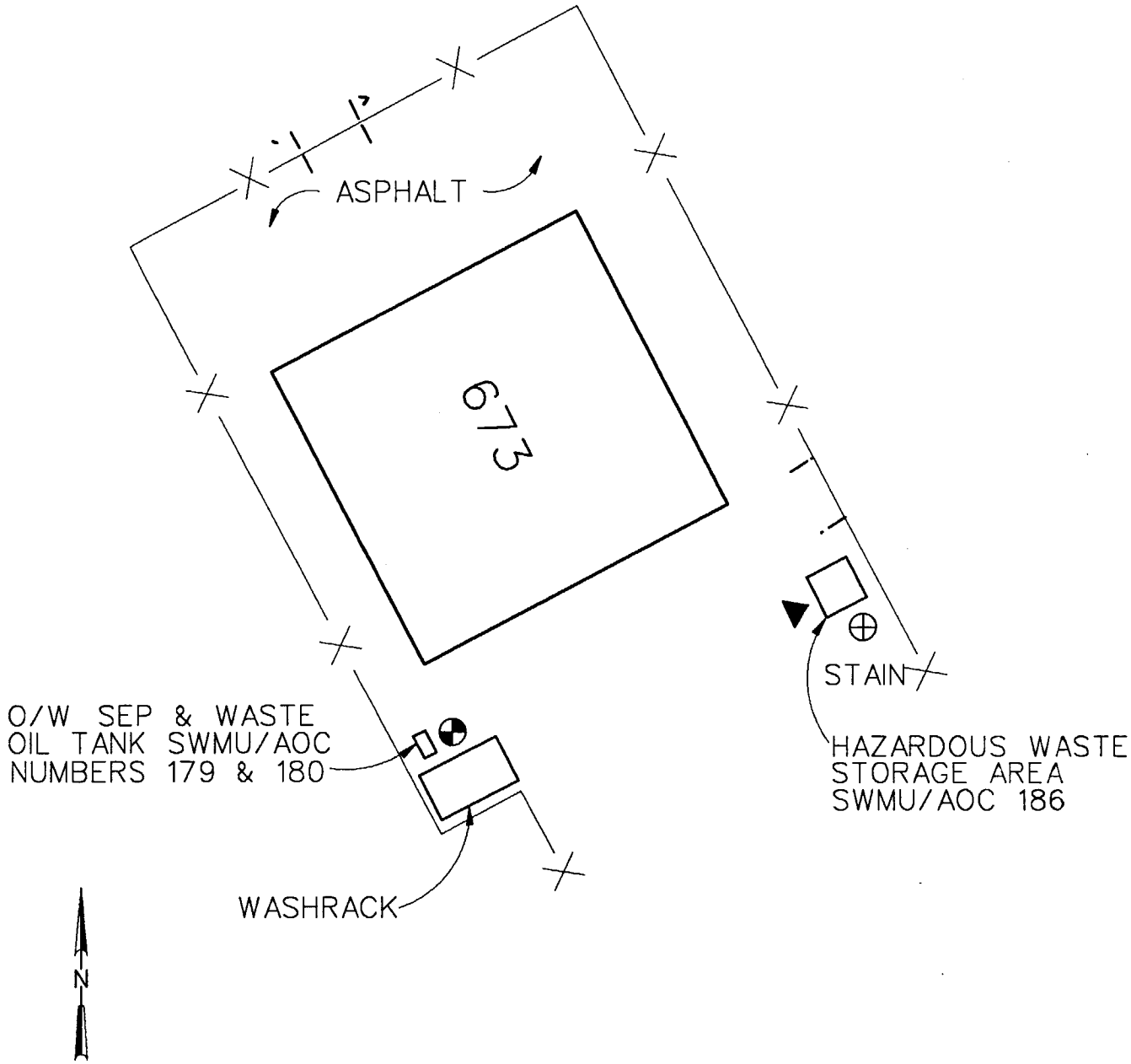
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 53
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
172, 173, 175, 176
MCAS EL TORO

SITE21.DGN



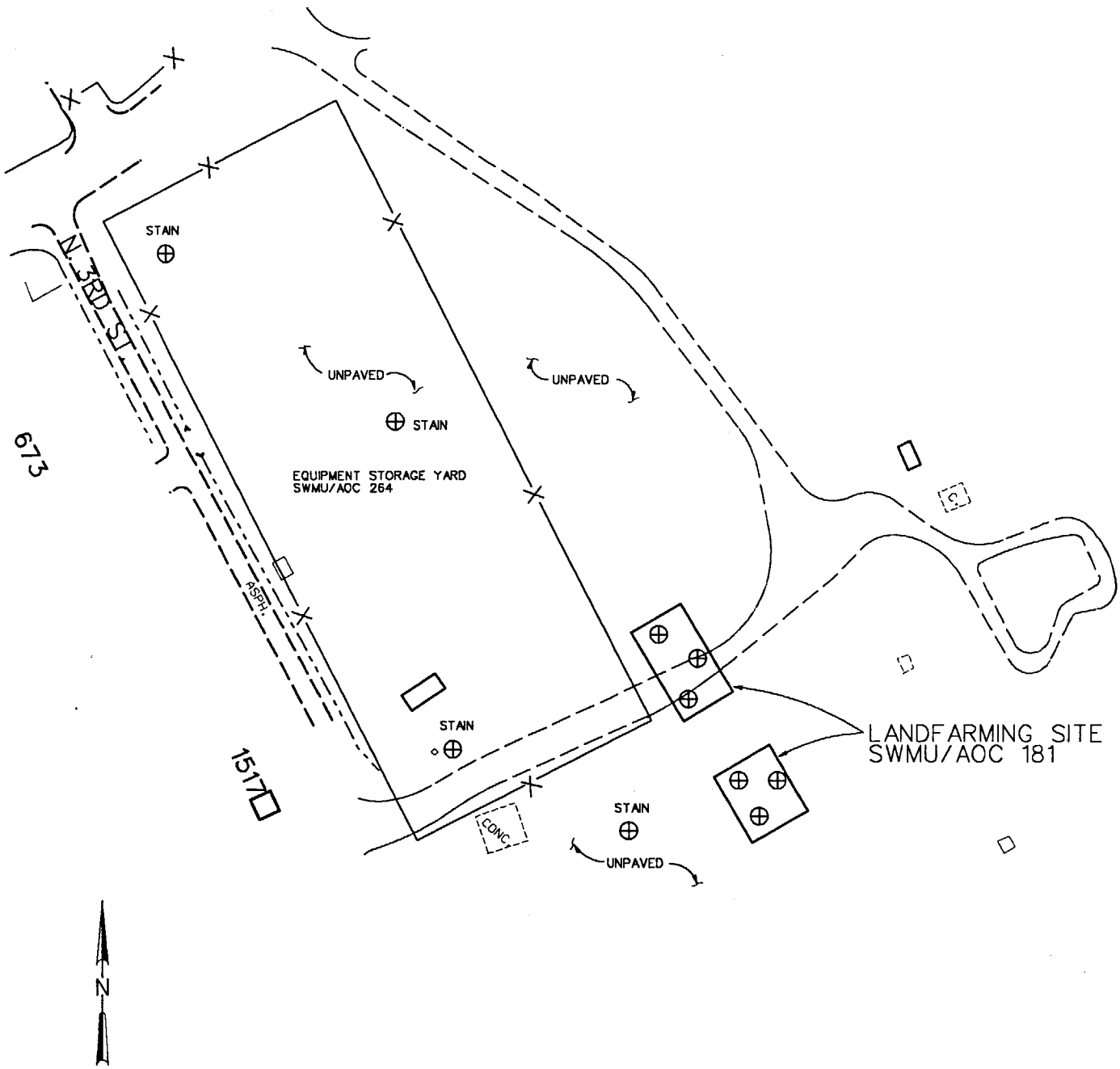

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 54
SAMPLING PLAN FOR
SWMU/AOC NUMBER
179,180, & 186
MCAS EL TORO



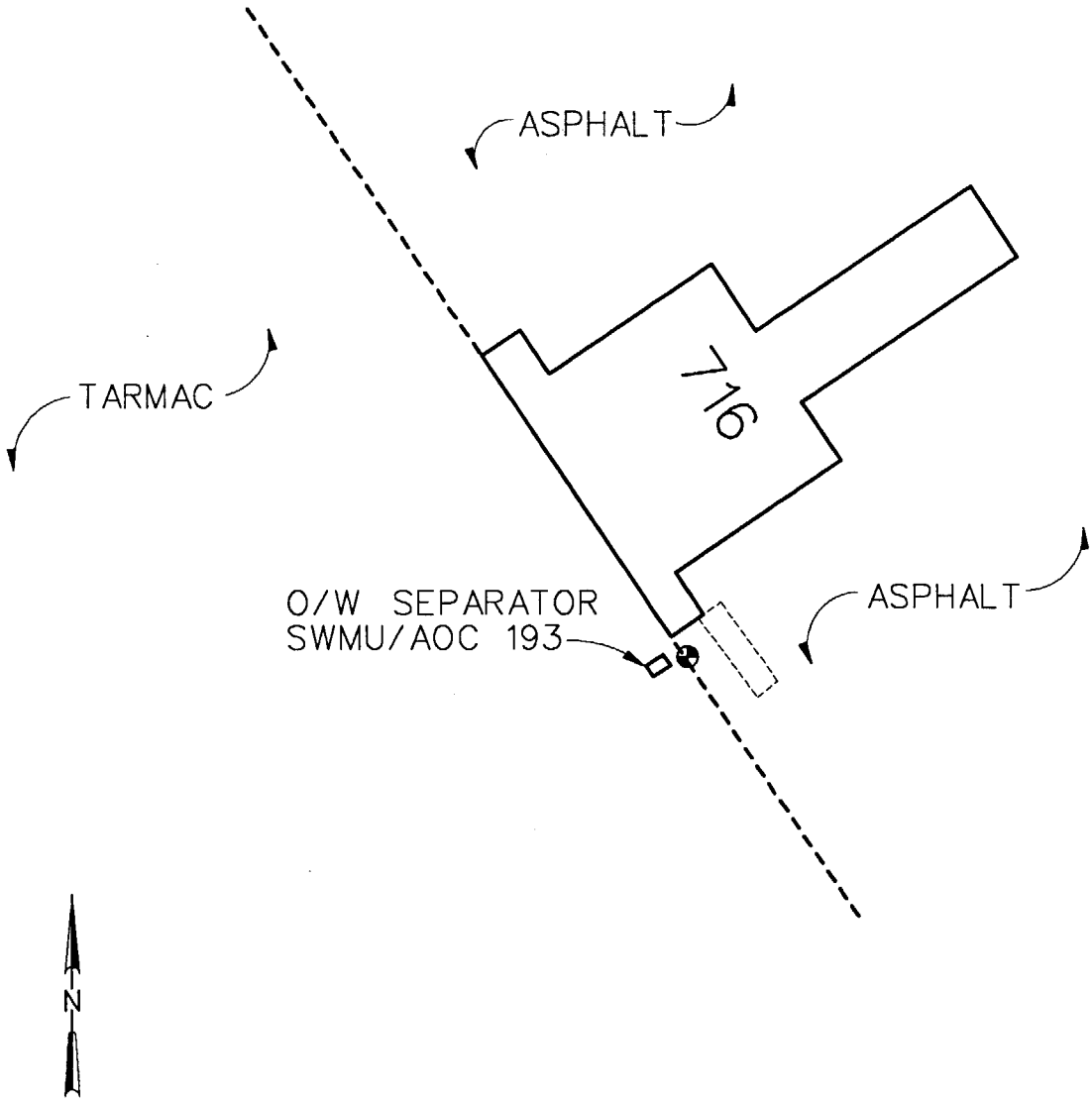

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 55
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
181 & 264
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 56
SAMPLING PLAN FOR
SWMU/AOC NUMBER 193
MCAS EL TORO

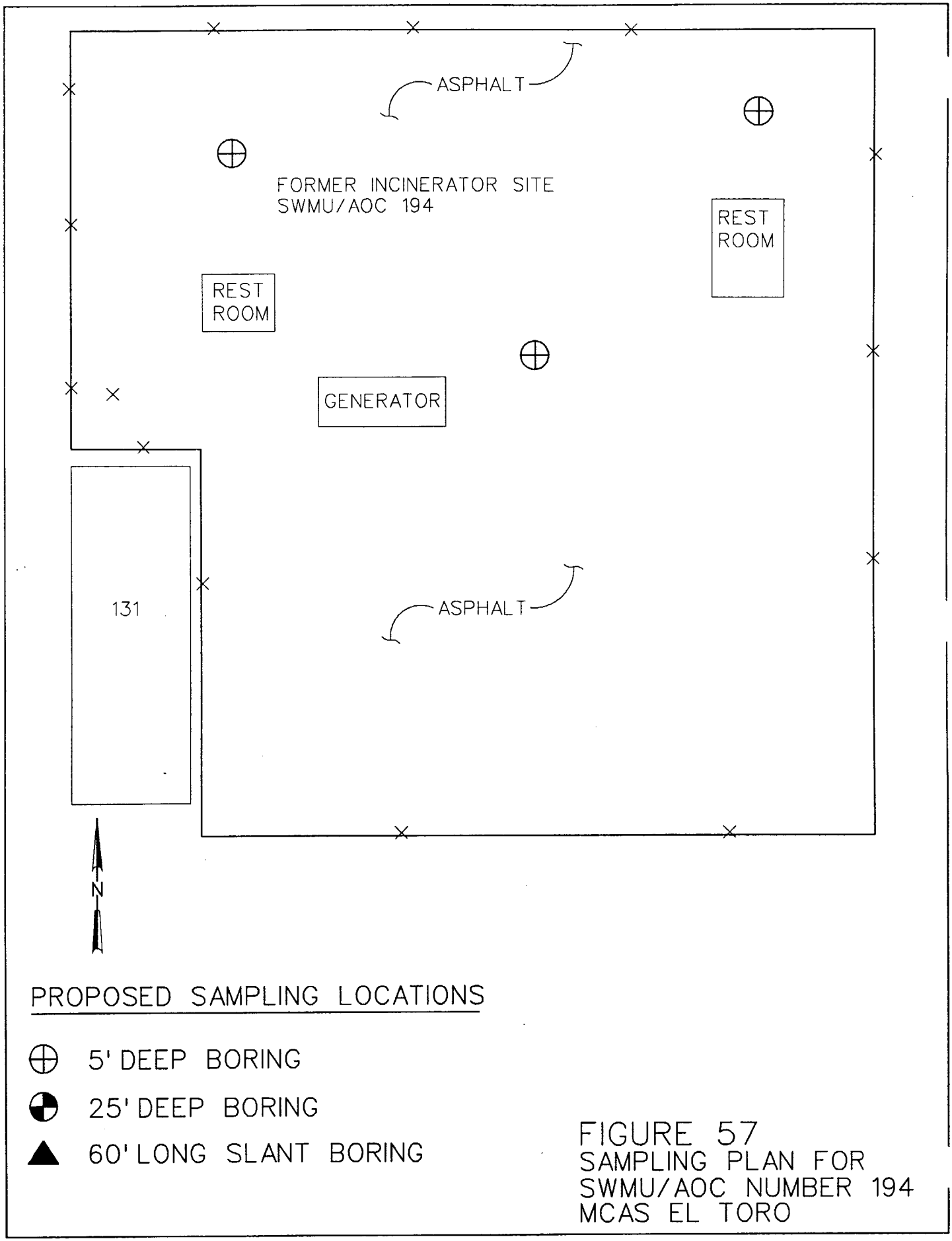
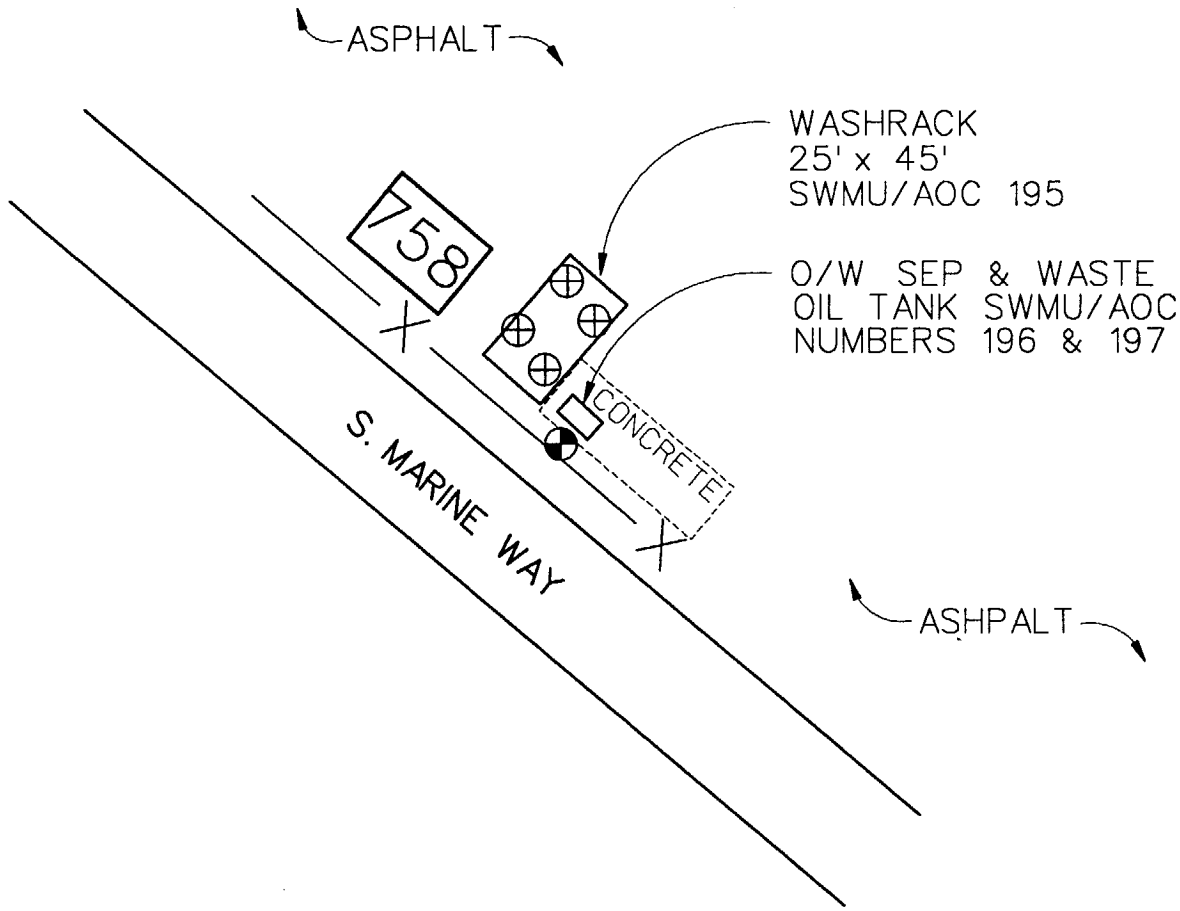



FIGURE 57
SAMPLING PLAN FOR
SWMU/AOC NUMBER 194
MCAS EL TORO

SITE60.DGN



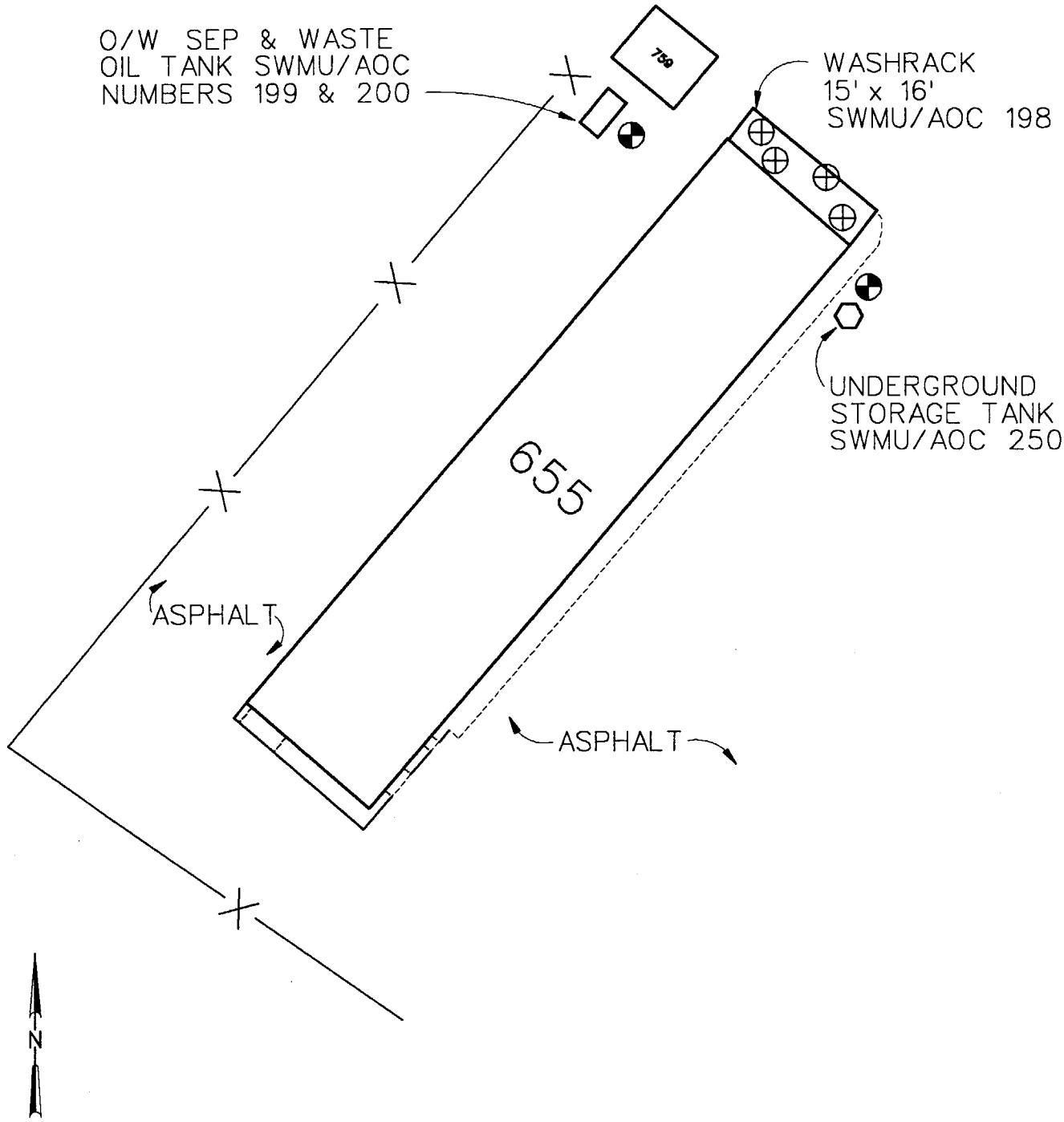
PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 58
SAMPLING PLAN FOR
SWMU/AOC NUMBER
195, 196, 197
MCAS EL TORO



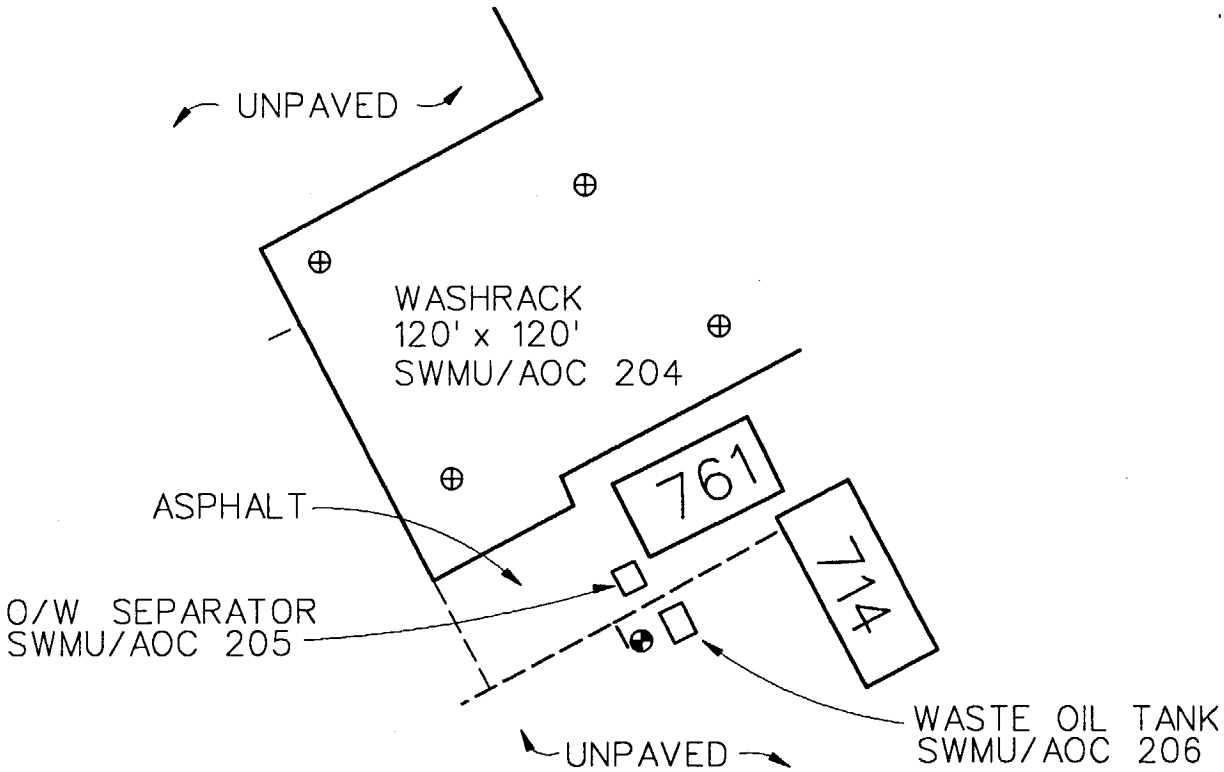

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 59
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
198, 199, 200, 250
MCAS EL TORO



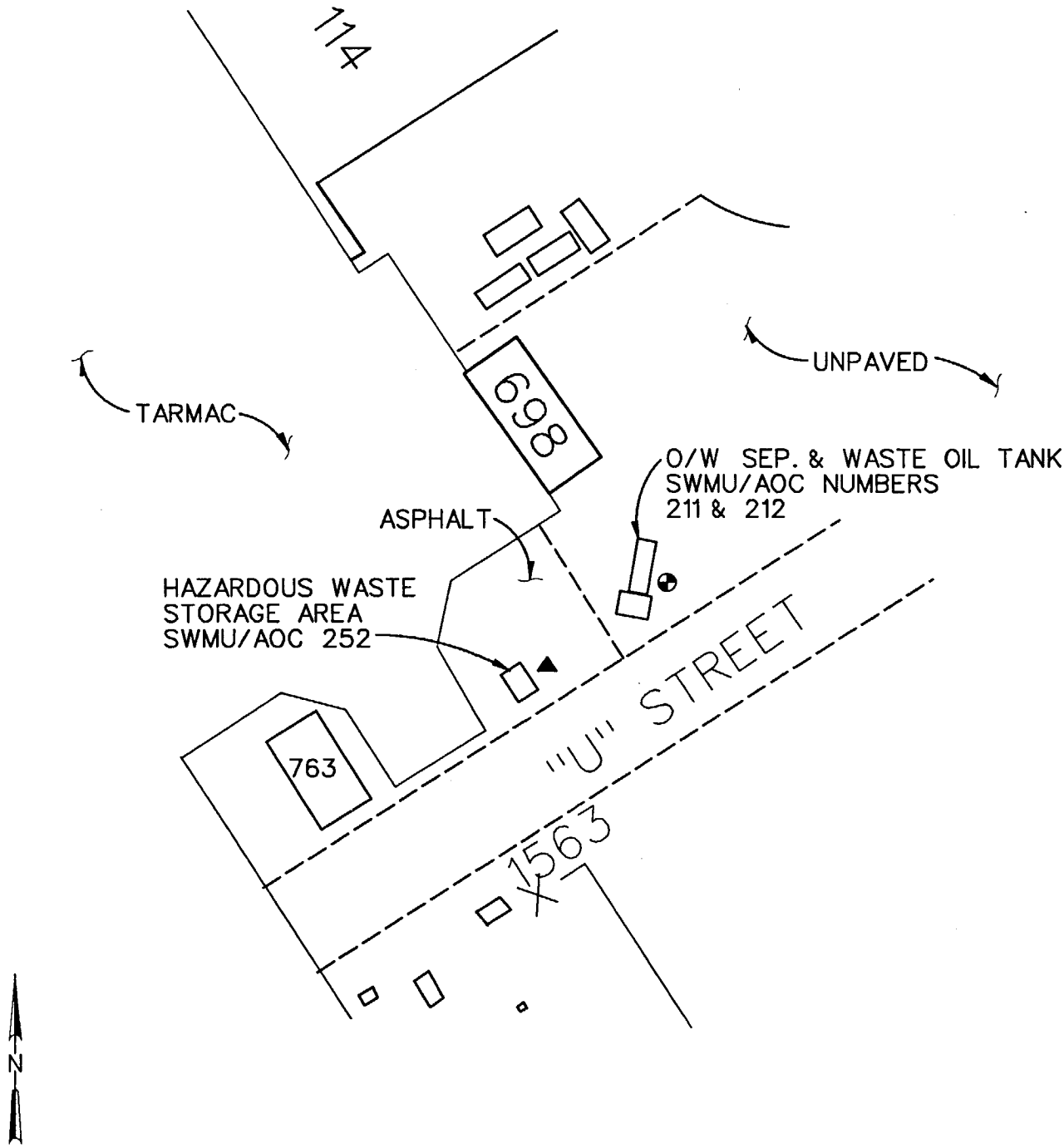
PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 60
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
204,205,206
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

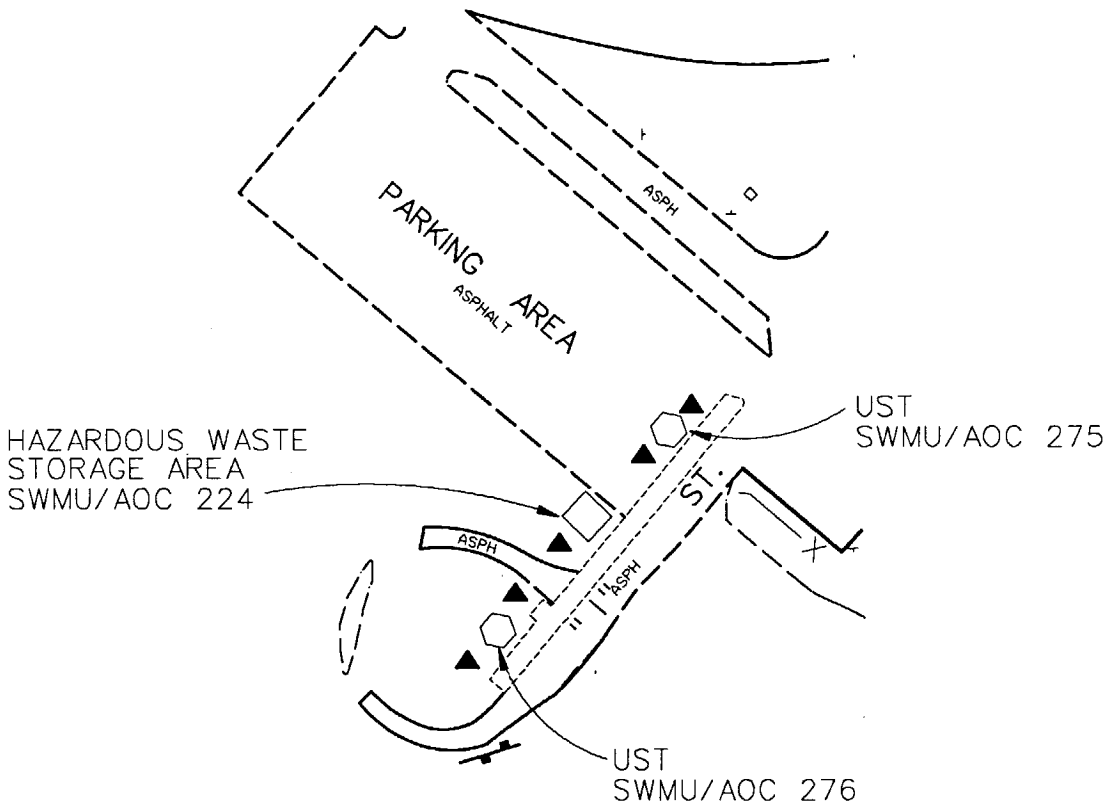
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 61
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
211, 212 & 252
MCAS EL TORO

SITE58.DGN



PROPOSED SAMPLING LOCATIONS

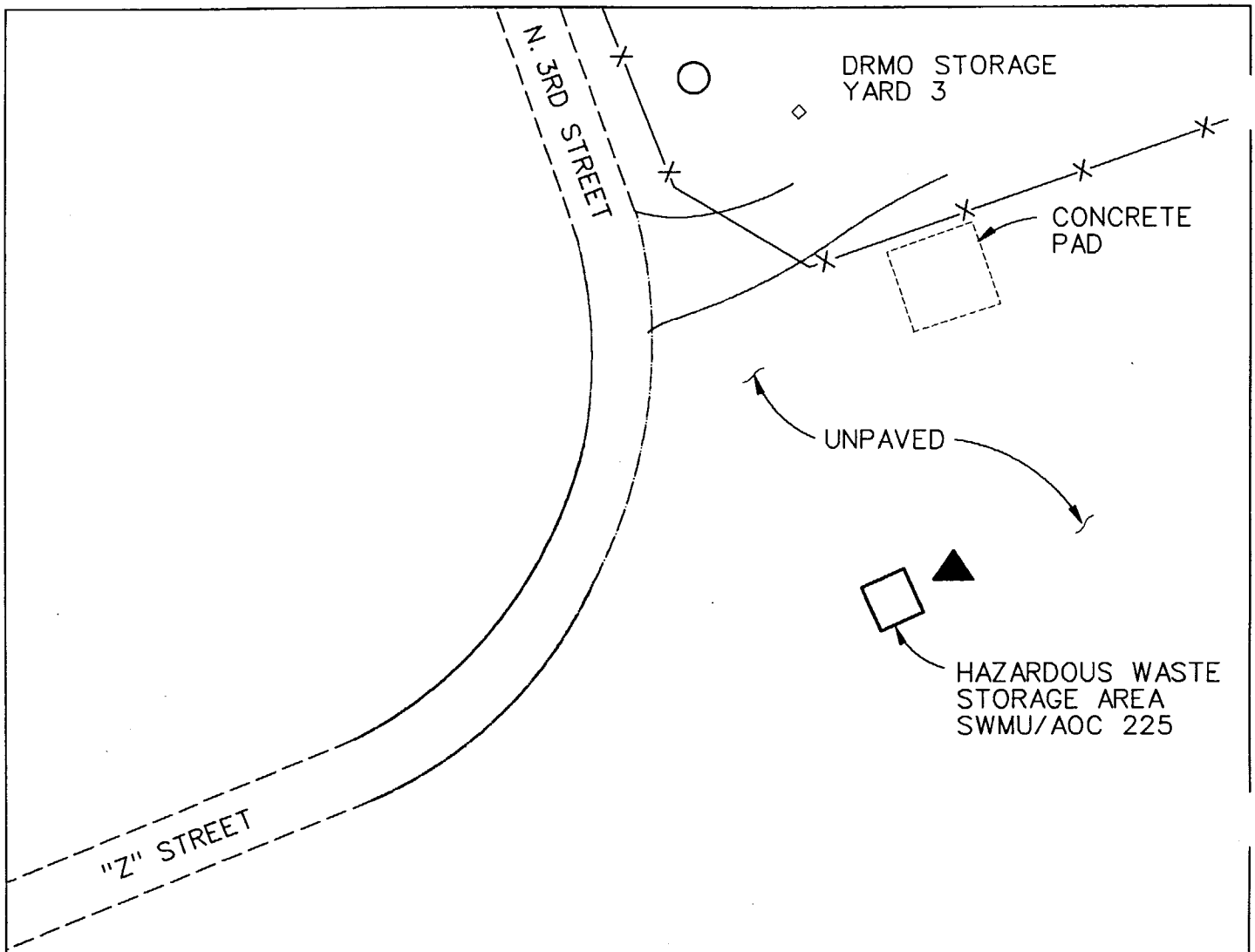
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 62
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
224,275,276
MCAS EL TORO

site76.dgn



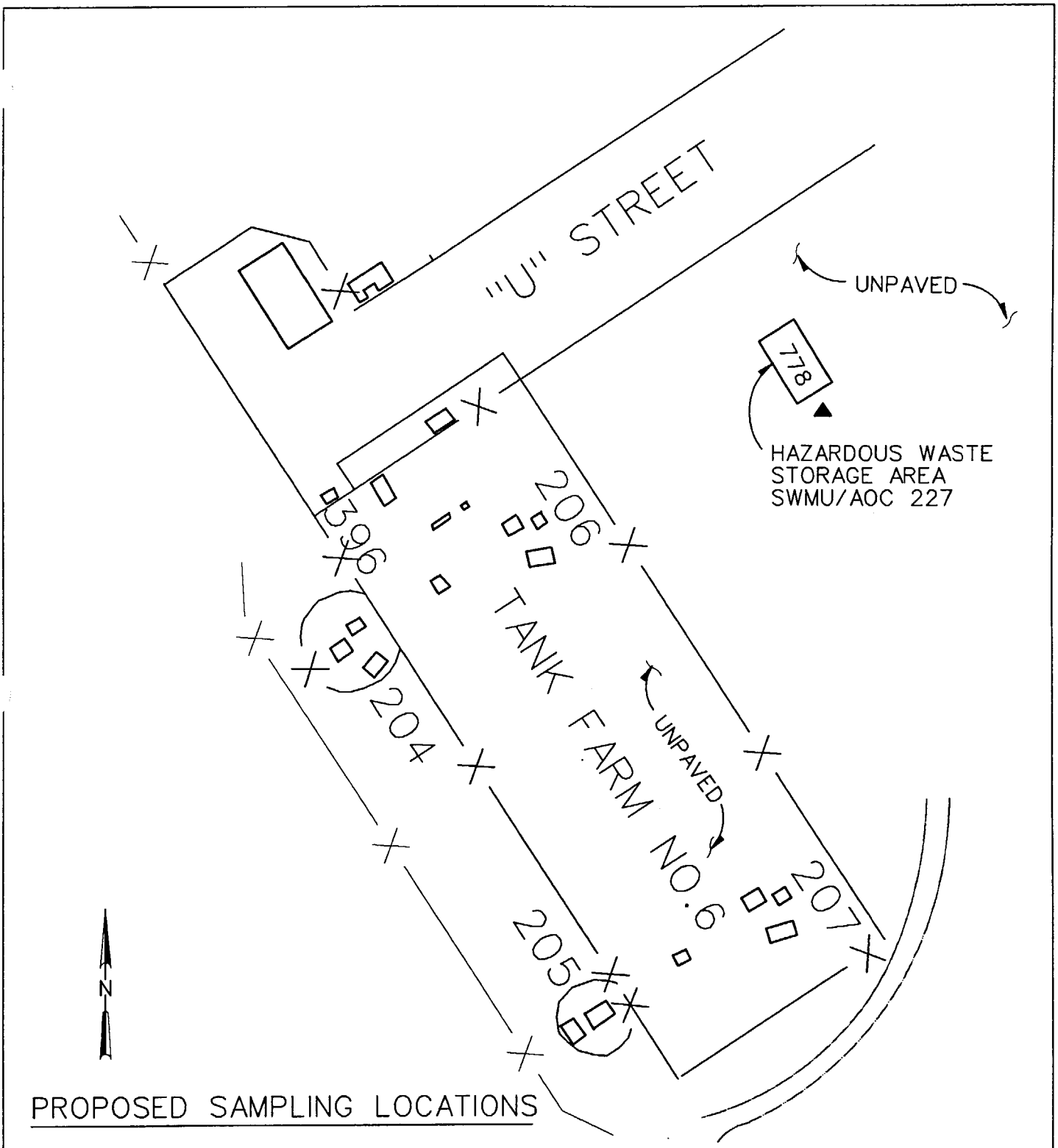

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◓ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 63
SAMPLING PLAN FOR
SWMU/AOC NUMBER 225
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

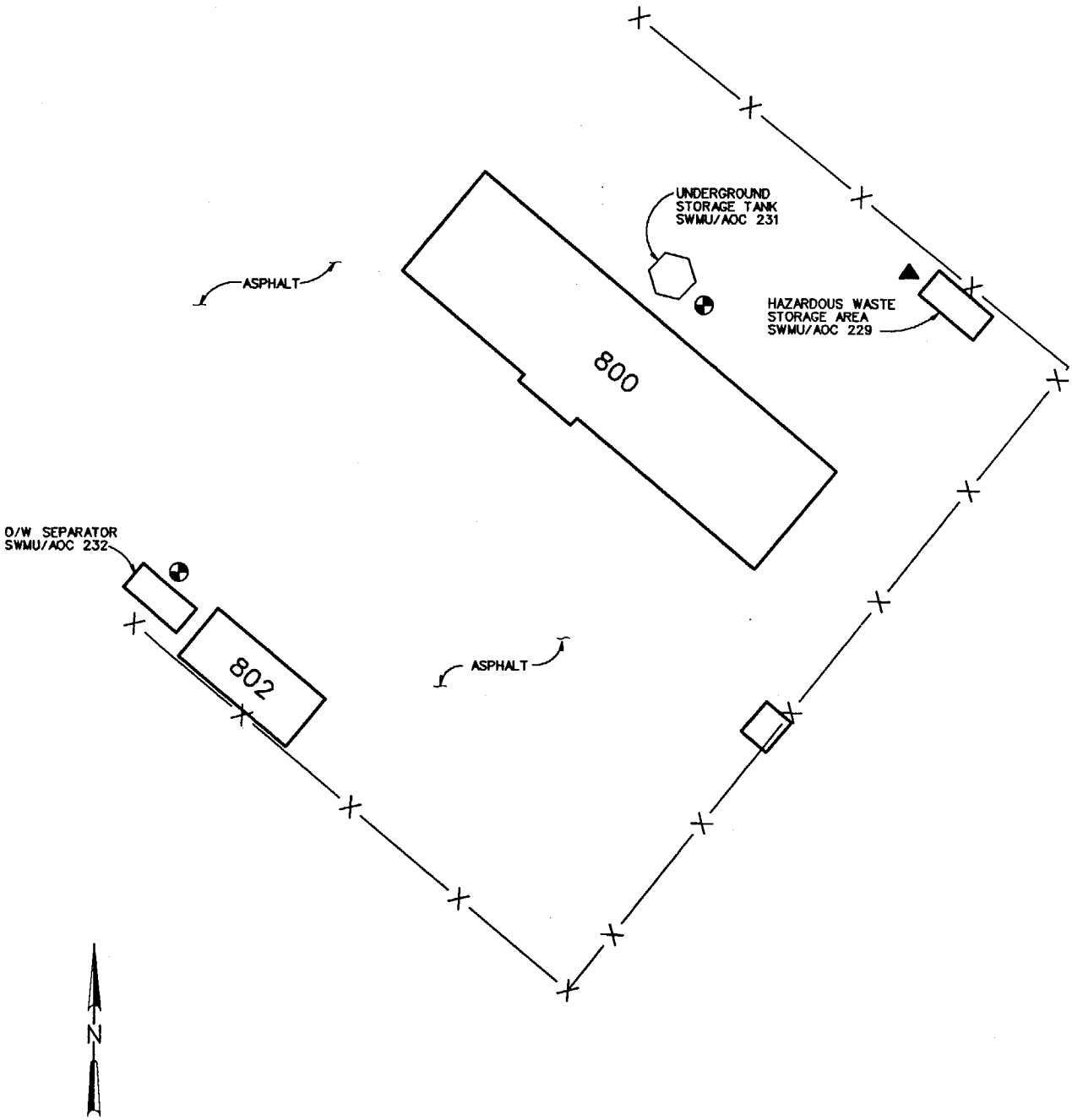
◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 64
SAMPLING PLAN FOR
SWMU/AOC NUMBER 227
MCAS EL TORO



SITE59.DGN




PROPOSED SAMPLING LOCATIONS

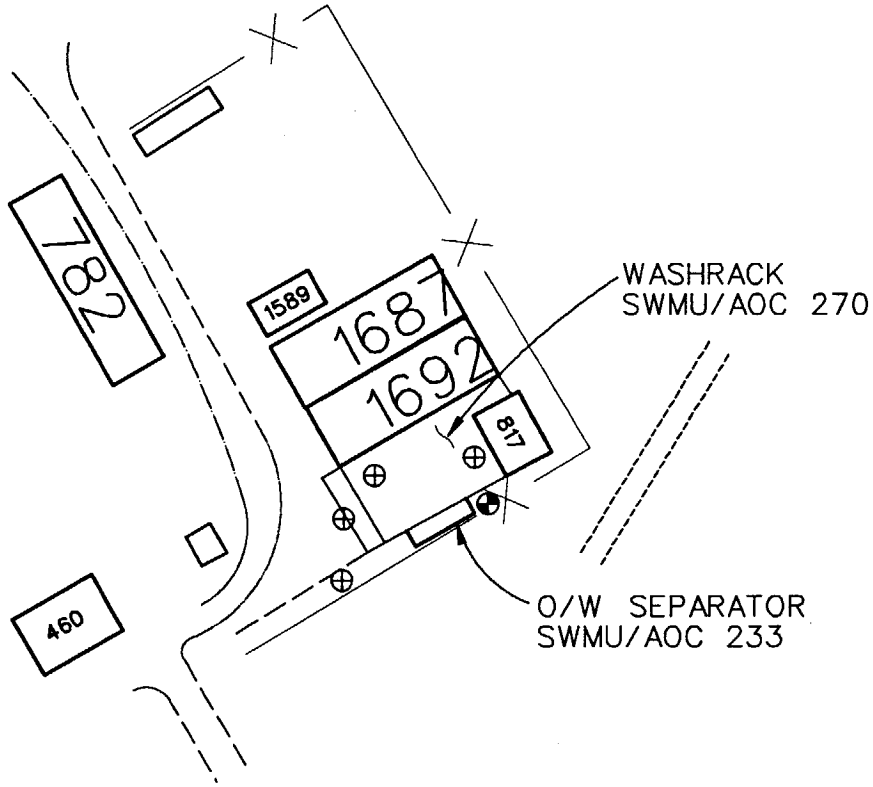
⊕ 5' DEEP BORING

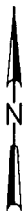
◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 65
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
229, 231, & 232
MCAS EL TORO

site24.dgn




PROPOSED SAMPLING LOCATIONS

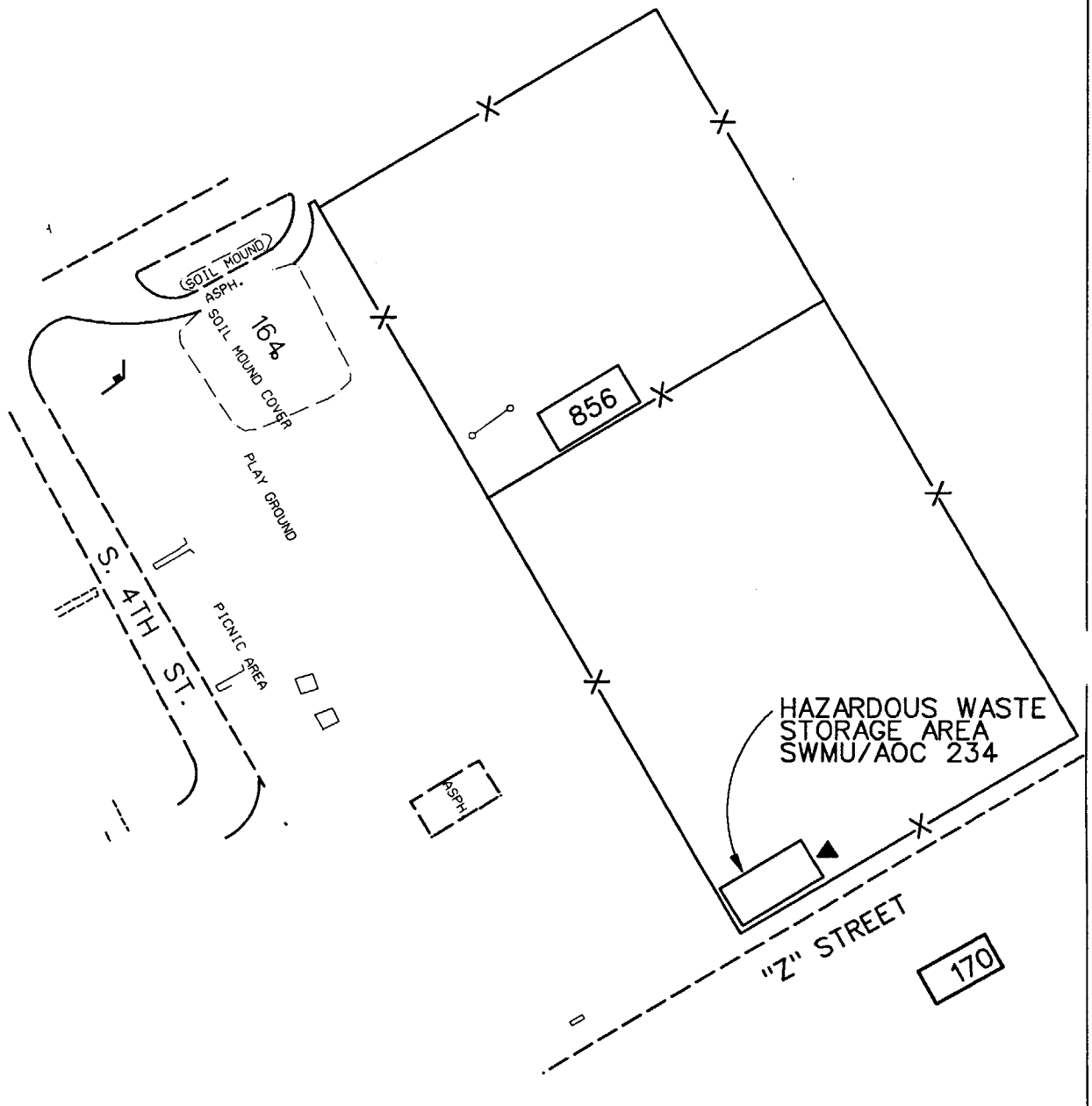
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 66
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
233, 270
MCAS EL TORO

SITE38.dgn



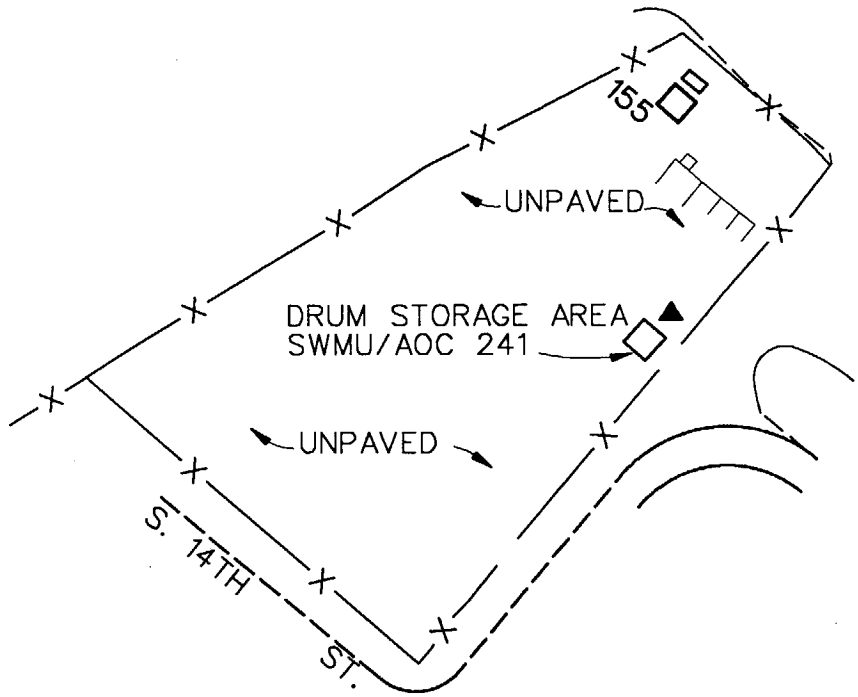

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 67
SAMPLING PLAN FOR
SWMU/AOC NUMBER 234
MCAS EL TORO



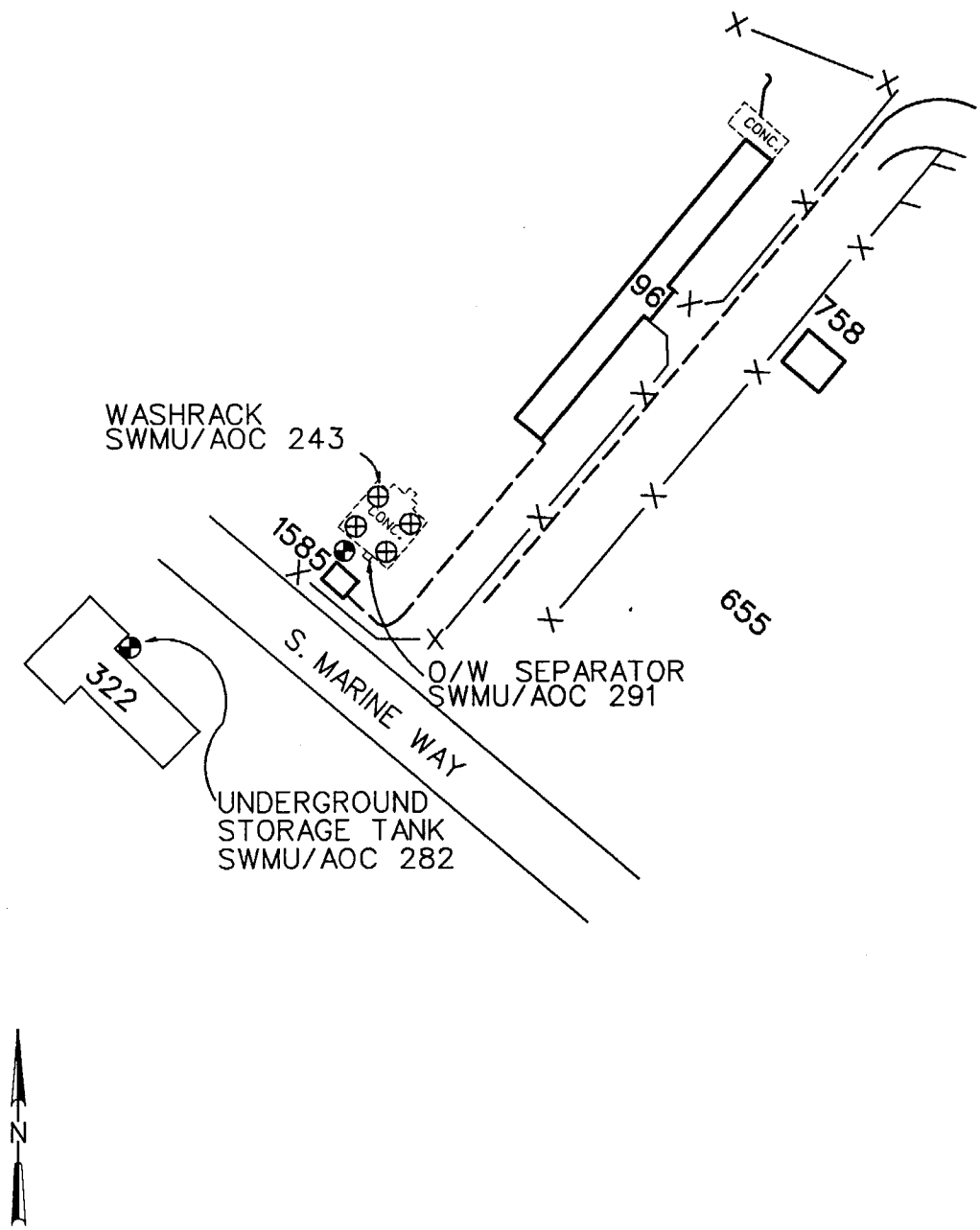
PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 68
SAMPLING PLAN FOR
SWMU/AOC NUMBER 241
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

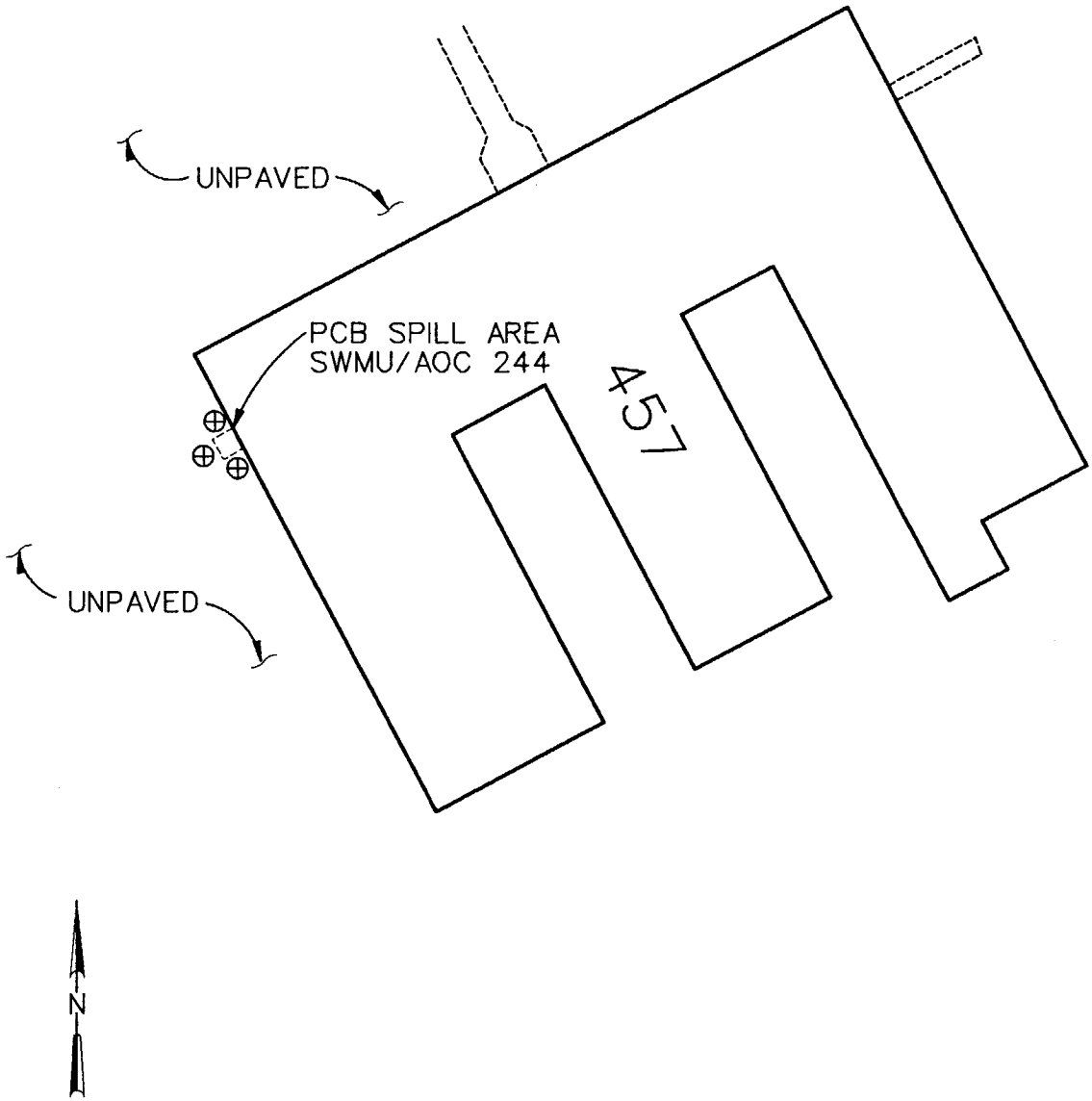
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 69
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
243,282 & 291
MCAS EL TORO

SITE82.DGN




PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◐ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 70
SAMPLING PLAN FOR
SWMU/AOC NUMBER 244
MCAS EL TORO

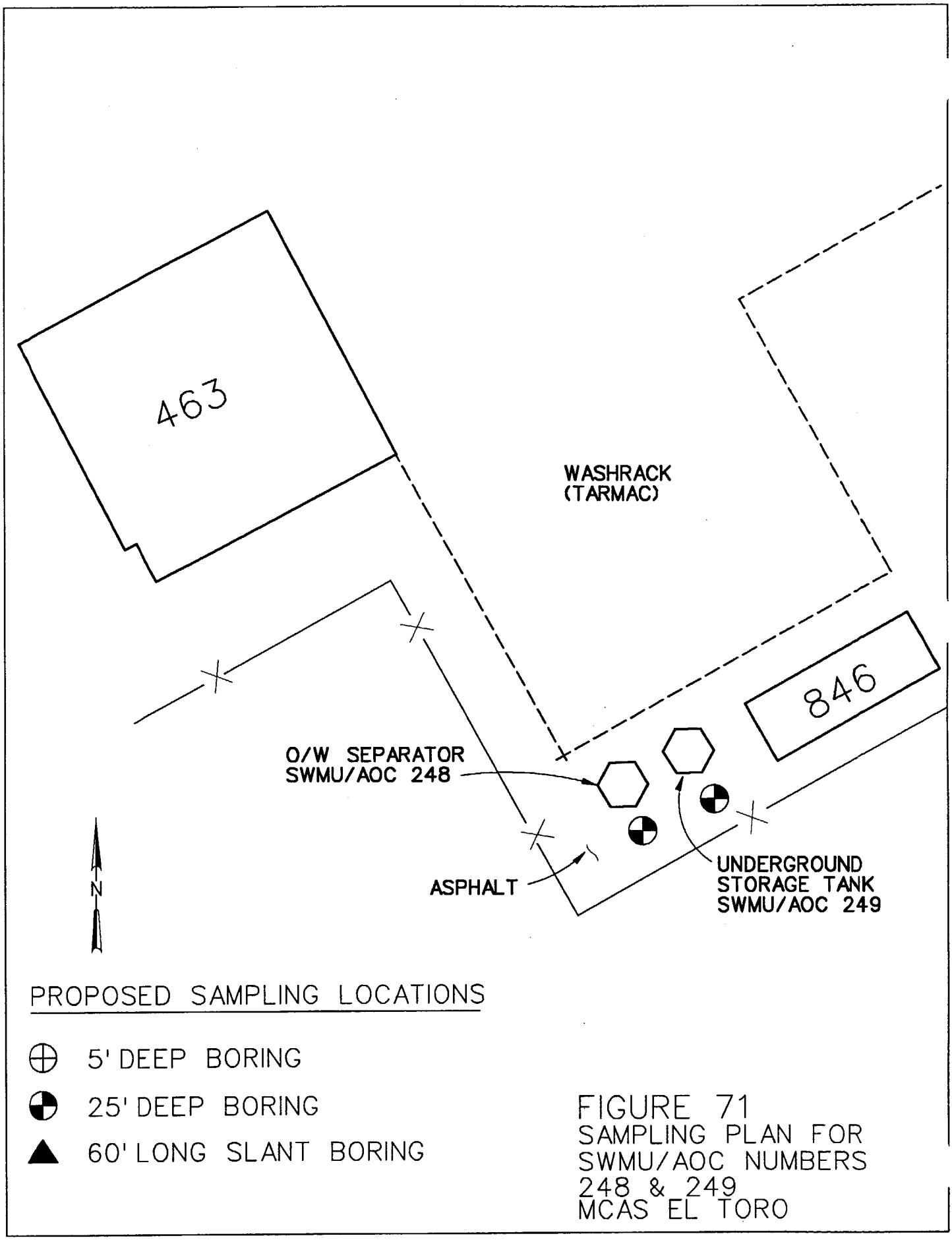
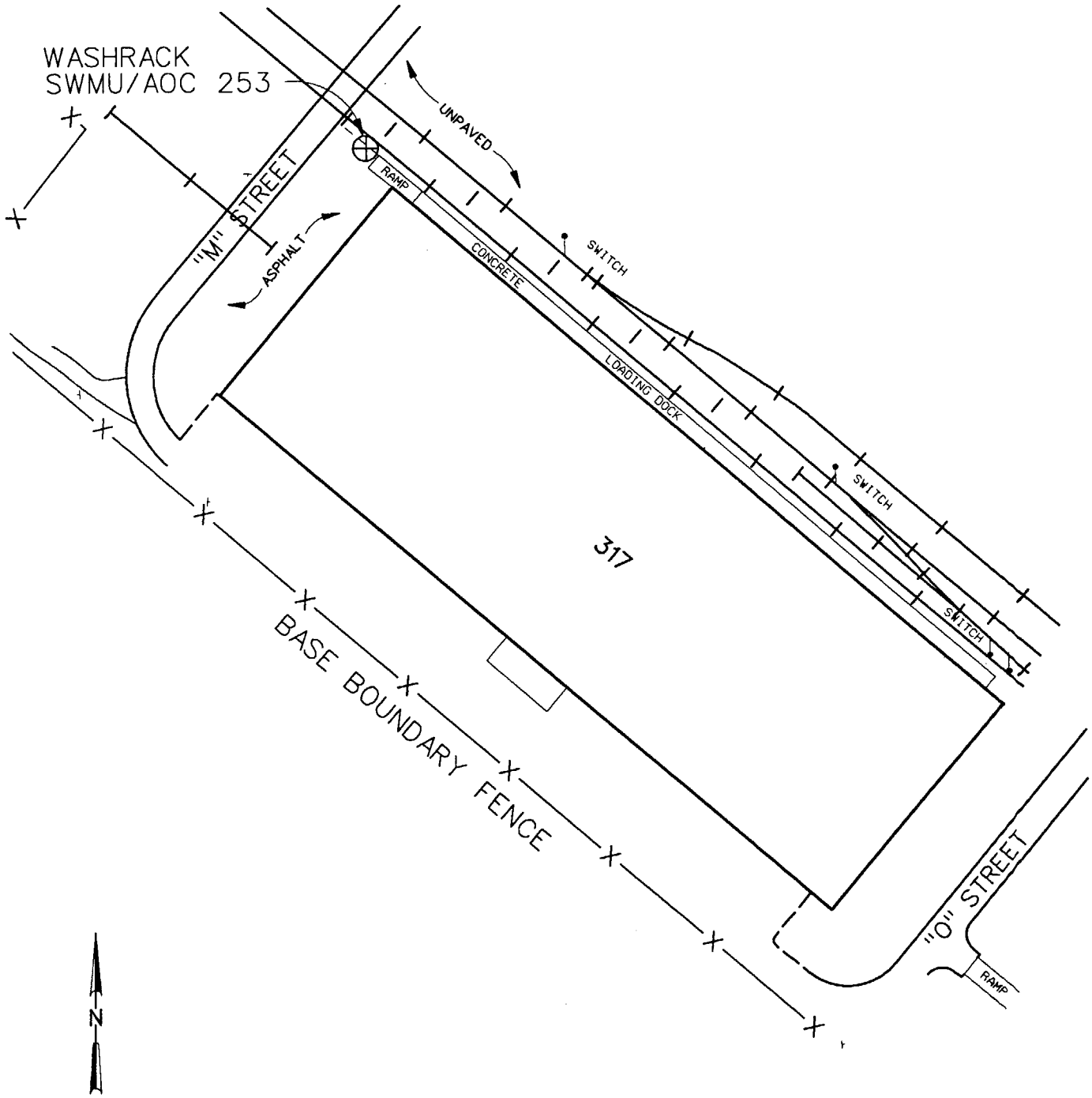



FIGURE 71
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
248 & 249
MCAS EL TORO



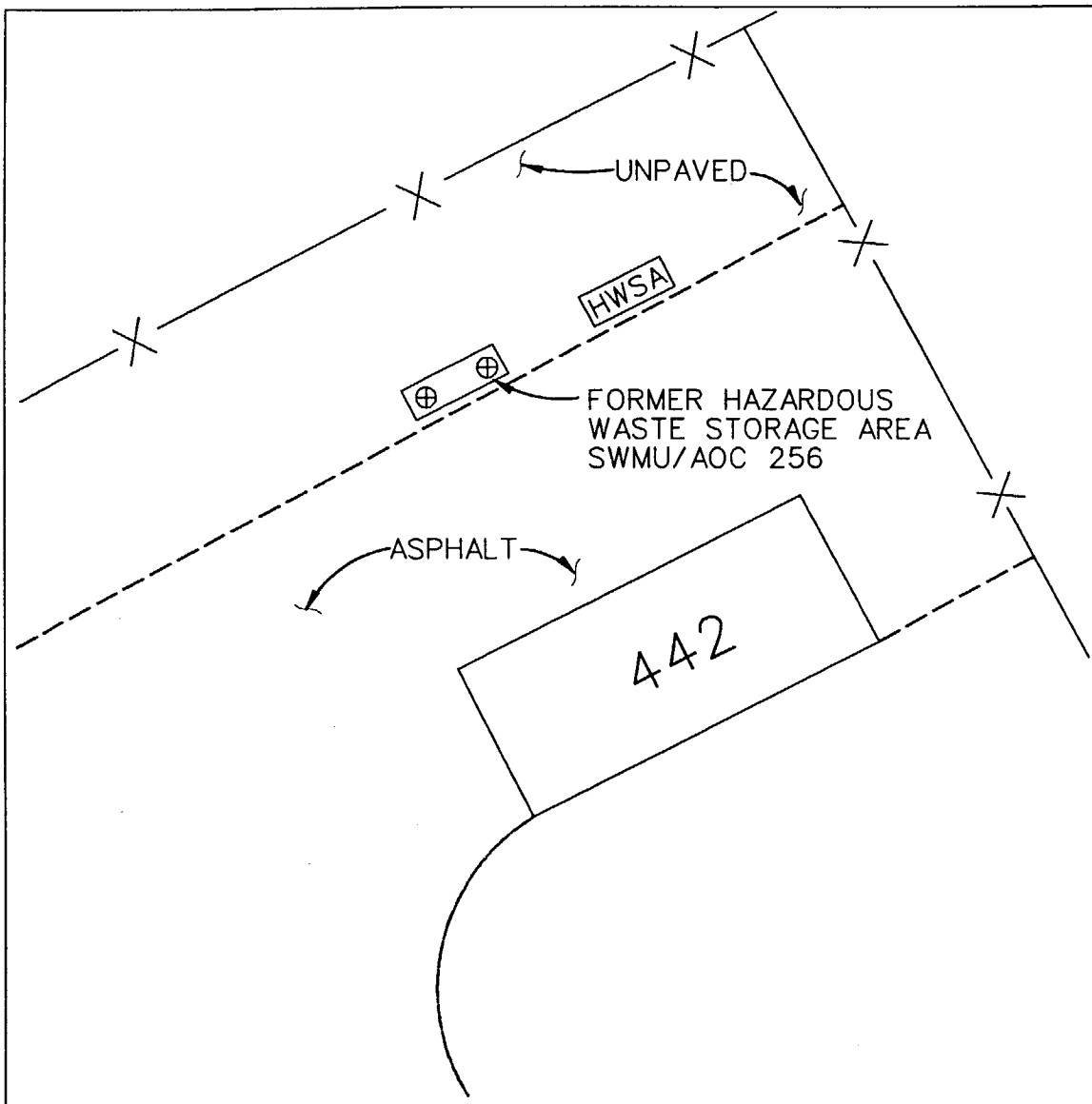

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 72
SAMPLING PLAN FOR
SWMU/AOC NUMBER 253
MCAS EL TORO



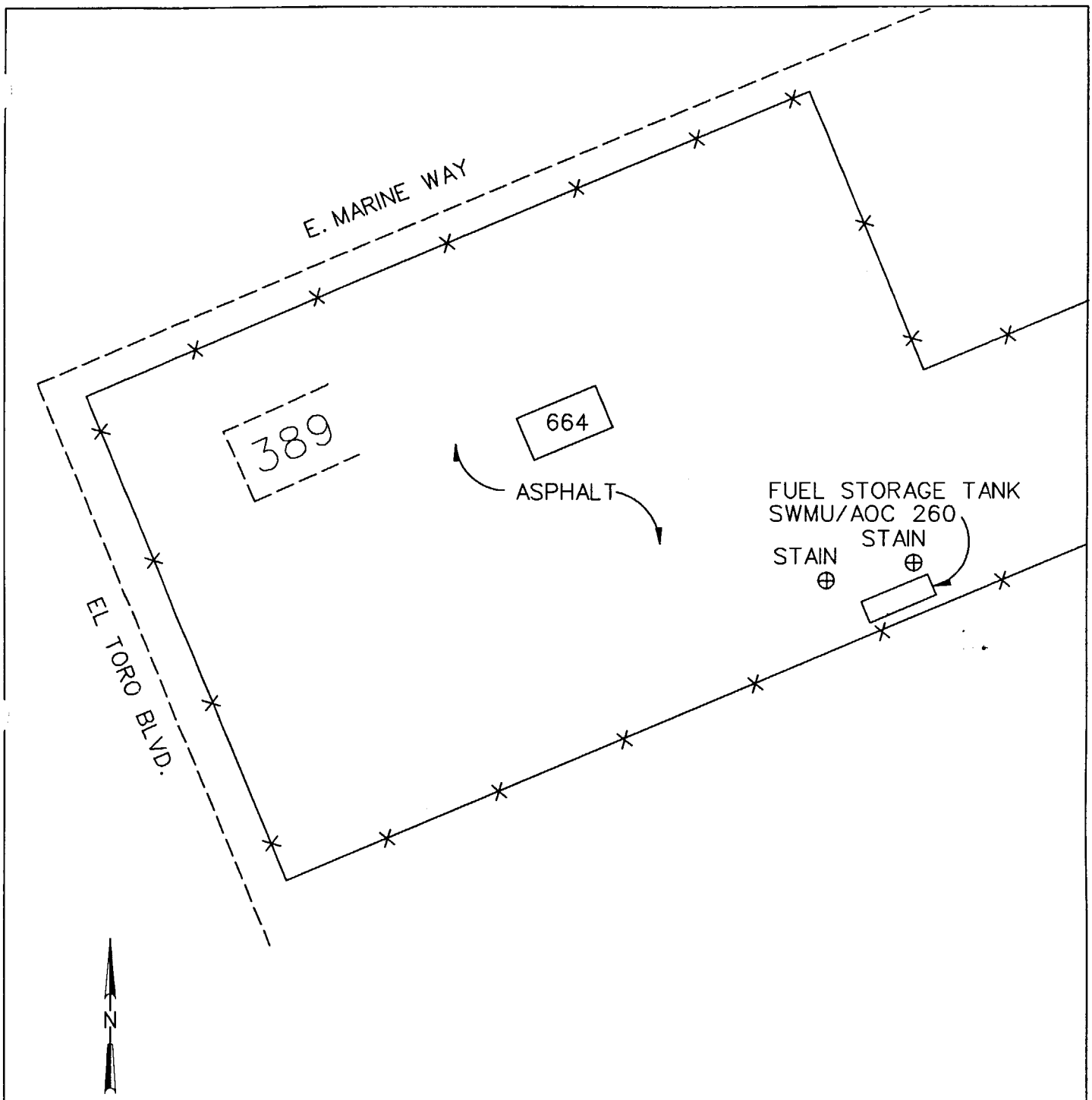
PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 73
SAMPLING PLAN FOR
SWMU/AOC NUMBER 256
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

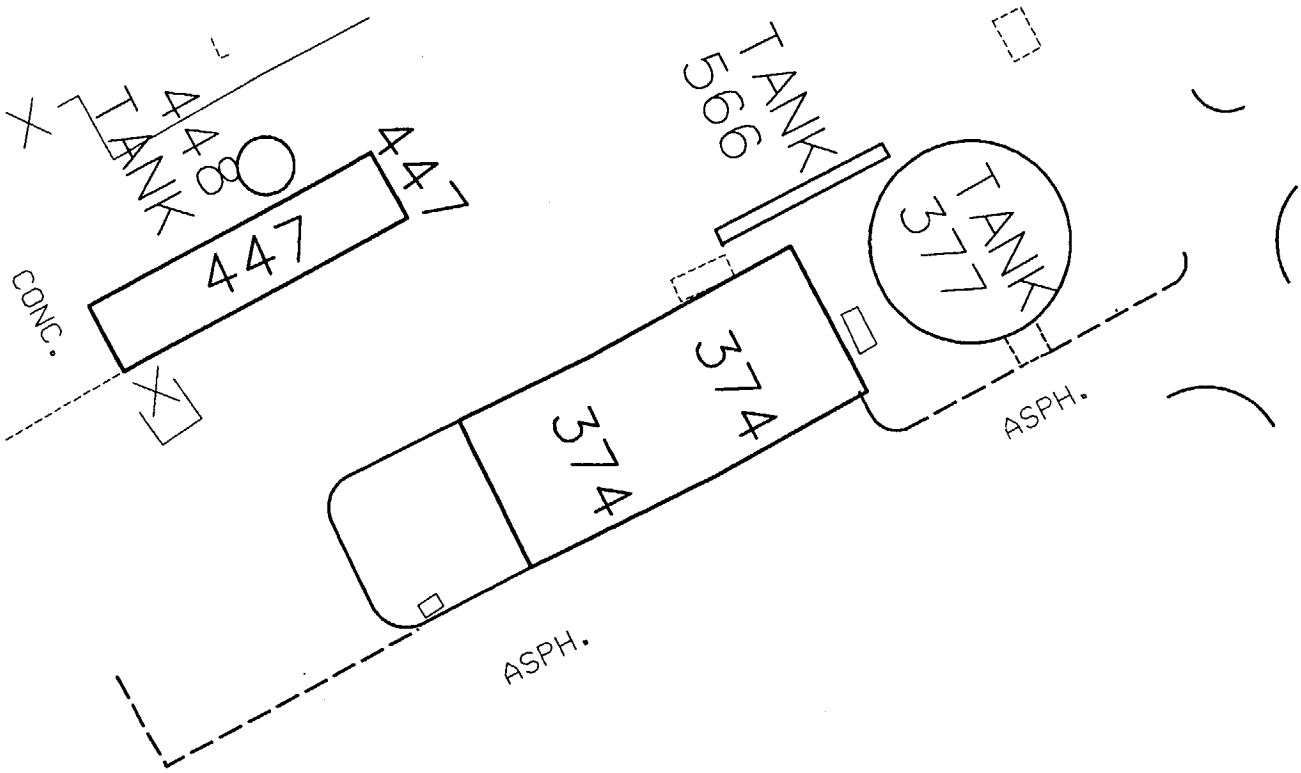
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 74
SAMPLING PLAN FOR
SWMU/AOC NUMBER 260
MCAS EL TORO

SITE45.DGN



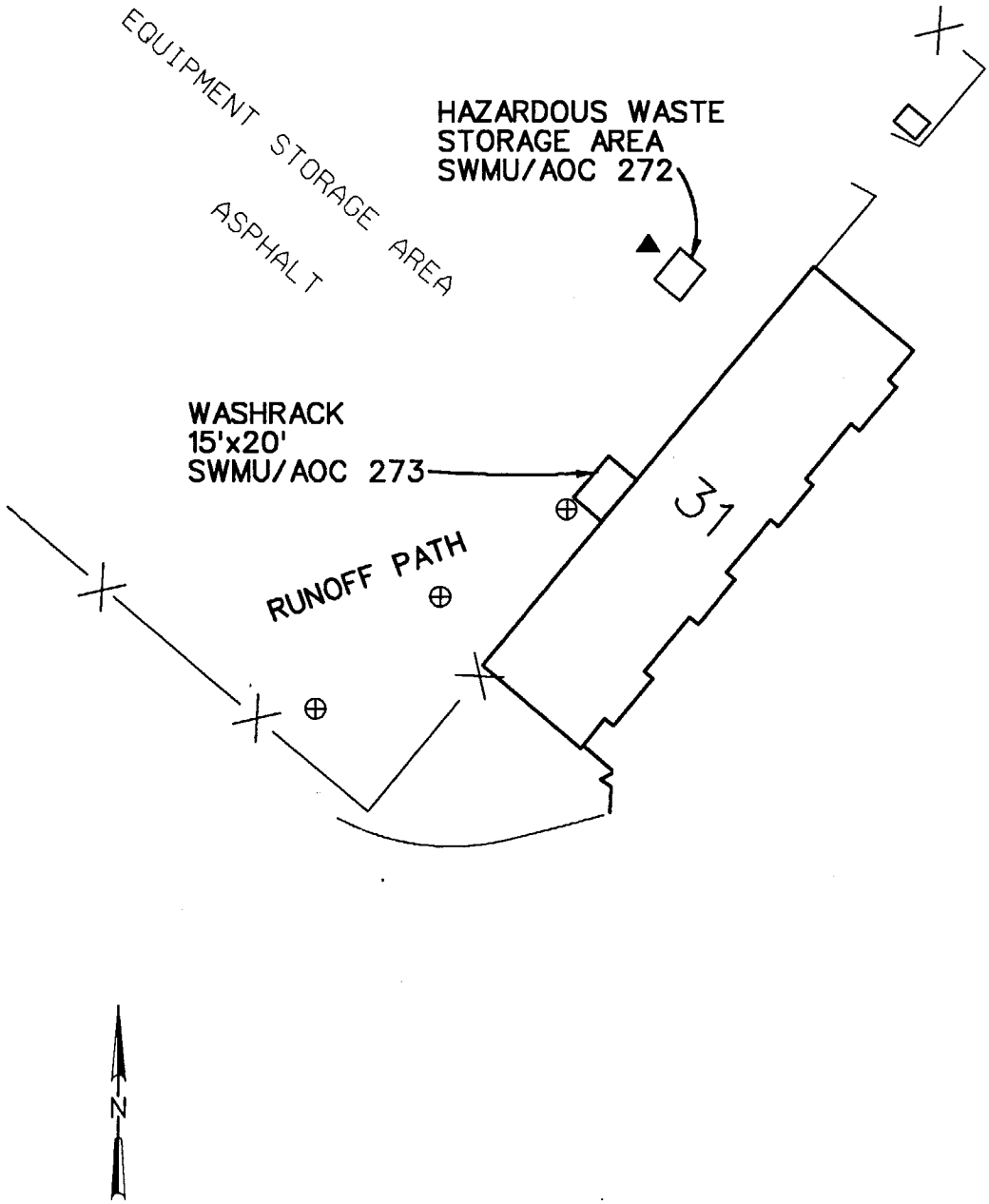
PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 75
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
263
MCAS EL TORO



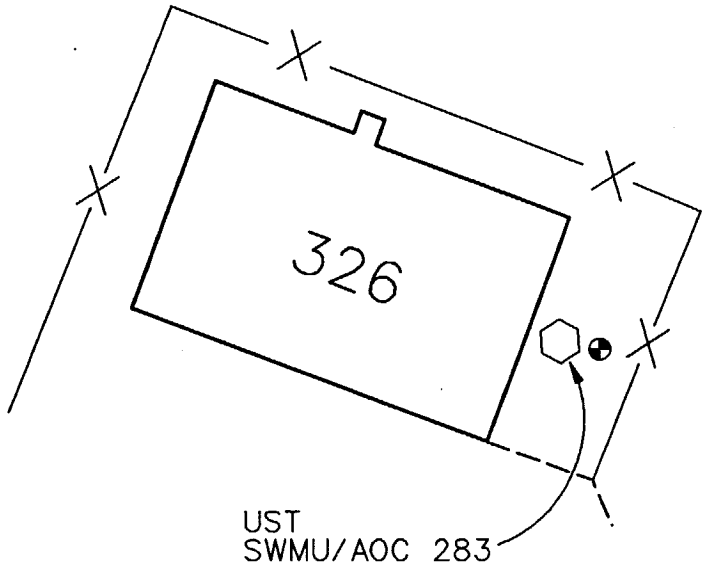

PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 76
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
272 & 273
MCAS EL TORO



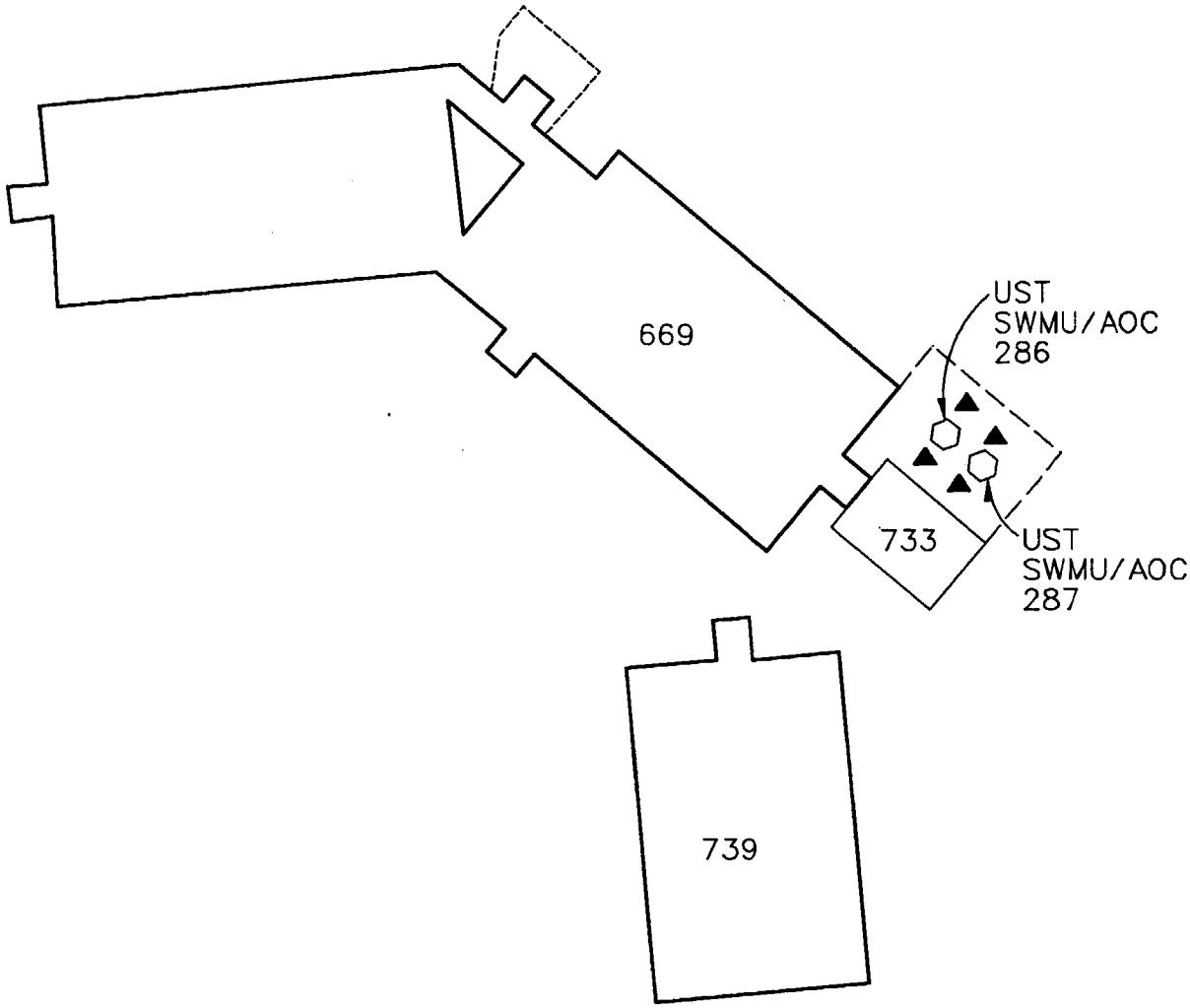
PROPOSED SAMPLING LOCATIONS

⊕ 5' DEEP BORING

◓ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 77
SAMPLING PLAN FOR
SWMU/AOC NUMBER 283
MCAS EL TORO




PROPOSED SAMPLING LOCATIONS

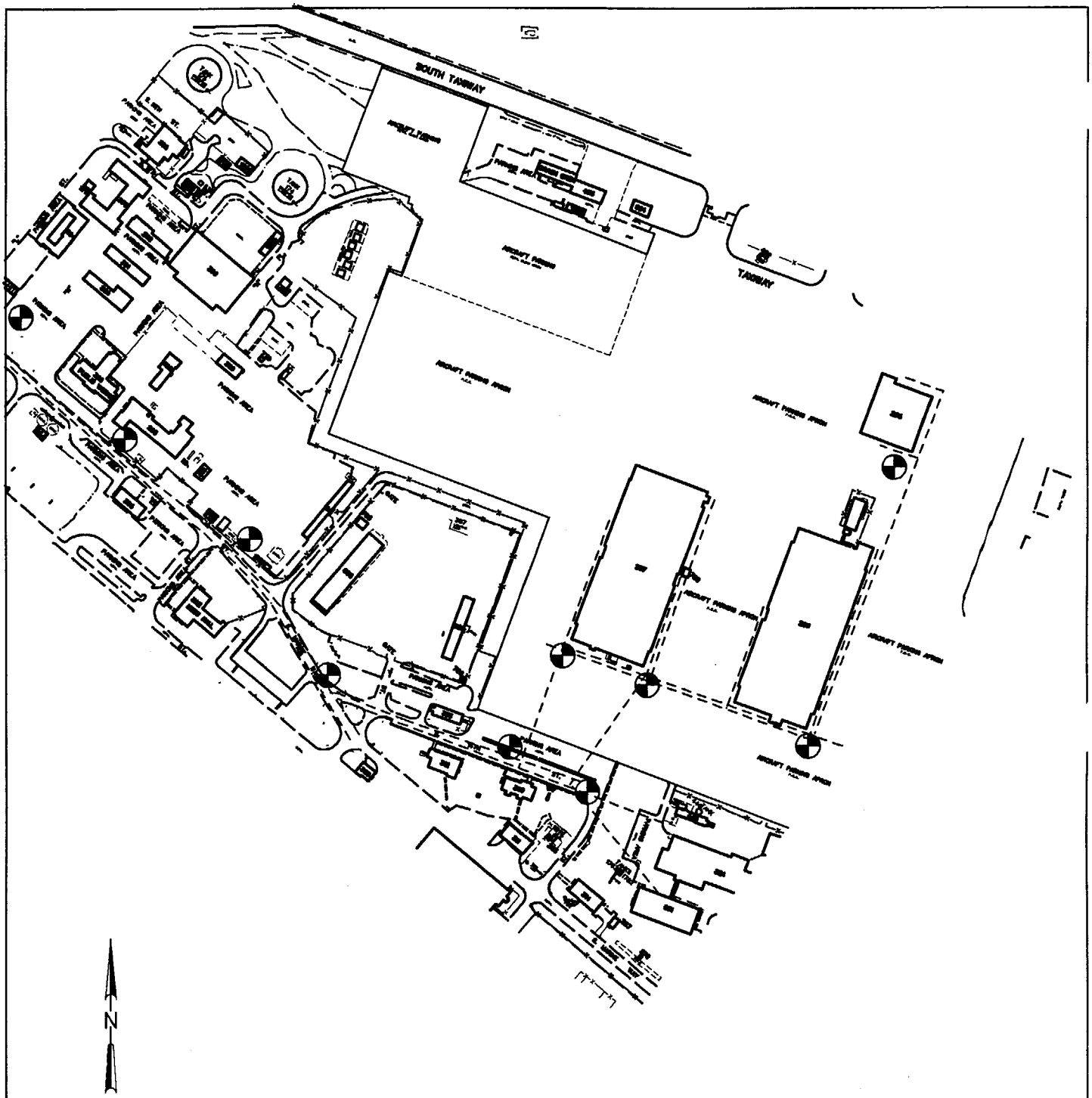
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 78
SAMPLING PLAN FOR
SWMU/AOC NUMBERS
286 & 287
MCAS EL TORO

SITE64.DGN




PROPOSED SAMPLING LOCATIONS

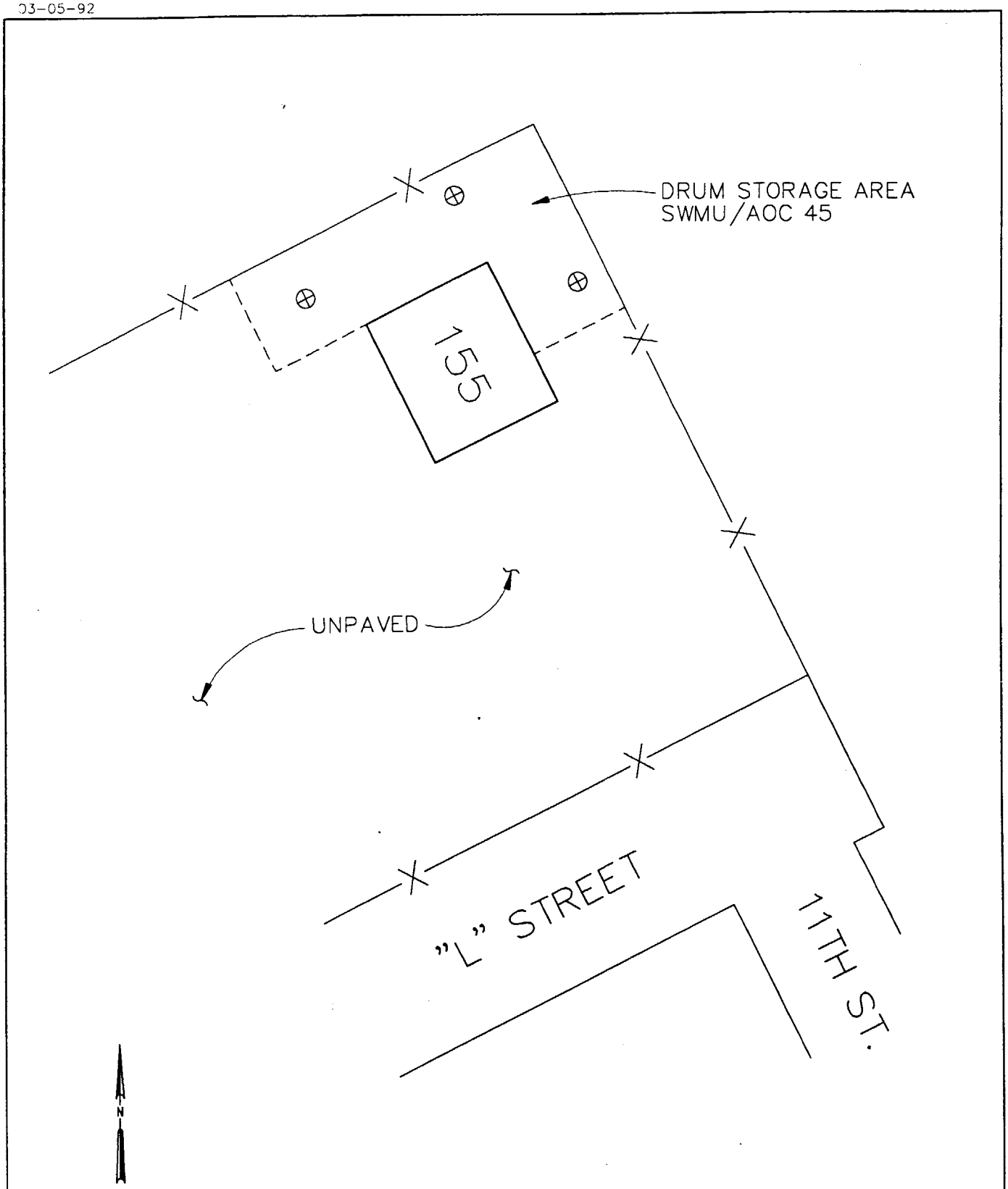
⊕ 5' DEEP BORING

◕ 25' DEEP BORING

▲ 60' LONG SLANT BORING

FIGURE 79
SAMPLING PLAN FOR
SWMU/AOC NUMBER 265
MCAS EL TORO

site90.dgn




PROPOSED SAMPLING LOCATIONS

- ⊕ 5' DEEP BORING
- ◓ 25' DEEP BORING
- ▲ 60' LONG SLANT BORING

FIGURE 80
SAMPLING PLAN FOR
SWMU/AOC NUMBER 45
MCAS EL TORO

FIGURE 81

BORING LOG FORM

| PROJECT NUMBER | BORING NUMBER<br>SHEET OF |
|---|---|

# SOIL BORING LOG

PROJECT _____ LOCATION _____

ELEVATION _____ DRILLING CONTRACTOR _____

DRILLING METHOD AND EQUIPMENT _____

WATER LEVEL AND DATE _____ START _____ FINISH _____ LOGGER _____

| DEPTH BELOW SURFACE (FT) | SAMPLE | | | STANDARD PENETRATION TEST RESULTS | SOIL DESCRIPTION | SYMBOLIC LOG | COMMENTS |
|---|---|---|---|---|---|---|---|
| | INTERVAL | TYPE AND NUMBER | RECOVERY (FT) | 6"-6"-6" (N) | SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL | | DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION |
| | | | | | | | |



REV 7/86 FORM D1586

SAMPLING METHOD: _____

JOB NUMBER: _____
CLIENT: _____
LOCATION: _____
SAMPLED BY: _____
DATE: _____ Page ____ of _____

| BORING NO. | SAMPLE NO./ID | DATE/ TIME | LOCATION | DEPTH | DESCRIPTION/ CLASSIFICATION | CONTAINER TYPE AND STORAGE | pH | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

FIGURE 82
SAMPLE COLLECTION LOG--SOIL

**CH2M HILL** *CHAIN OF CUSTODY RECORD*

| PROJECT NUMBER | PROJECT NAME |
|---|---|
| CLIENT NAME | |
| REPORT TO: | COPY TO: |
| REQUESTED COMPLETION DATE | LABORATORY |

| STA NO | DATE | TIME | COMP | GRAB | SAMPLE DESCRIPTION | NUMBER OF CONTAINERS | ANALYSES REQUESTED | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | |

**FOR LAB USE ONLY**

LAB # _____

PROJ # _____

ACK _____ VERIFIED _____

DATE INVOICED _____

NO. OF SAMPLES _____ pg _____ of _____

DISPOSITION D R _____ DATE

REMARKS

| SAMPLED BY AND TITLE (SIGNATURE) | DATE/TIME | RELINQUISHED BY (SIGNATURE) | DATE/TIME | RECEIVED BY (SIGNATURE) | DATE/TIME |
|---|---|---|---|---|---|
| 1 | | 2 | | 3 | |

| RELINQUISHED BY (SIGNATURE) | DATE/TIME | RECEIVED BY (SIGNATURE) | DATE/TIME | RELINQUISHED BY (SIGNATURE) | DATE/TIME | RECEIVED BY LAB (SIGNATURE) | DATE/TIME |
|---|---|---|---|---|---|---|---|
| 4 | | 5 | | 6 | | 7 | |

REMARKS _____

SAMPLING PROGRAM: SDWA ☐ NPDES ☐ RCRA ☐ OTHER _____ (SPECIFY)

SAMPLE SHIPPED VIA: ☐ UPS ☐ BUS ☐ FED-EX ☐ HAND OTHER _____

AIR BUS BILL NUMBER

DISTRIBUTION: WHITE – ORIGINAL ACCOMPANIES SHIPMENT; PINK – COPY TO COORDINATOR FIELD FILES; YELLOW – CLIENT

REV 6/87 FORM 340

FIGURE 83
CHAIN-OF-CUSTODY RECORD

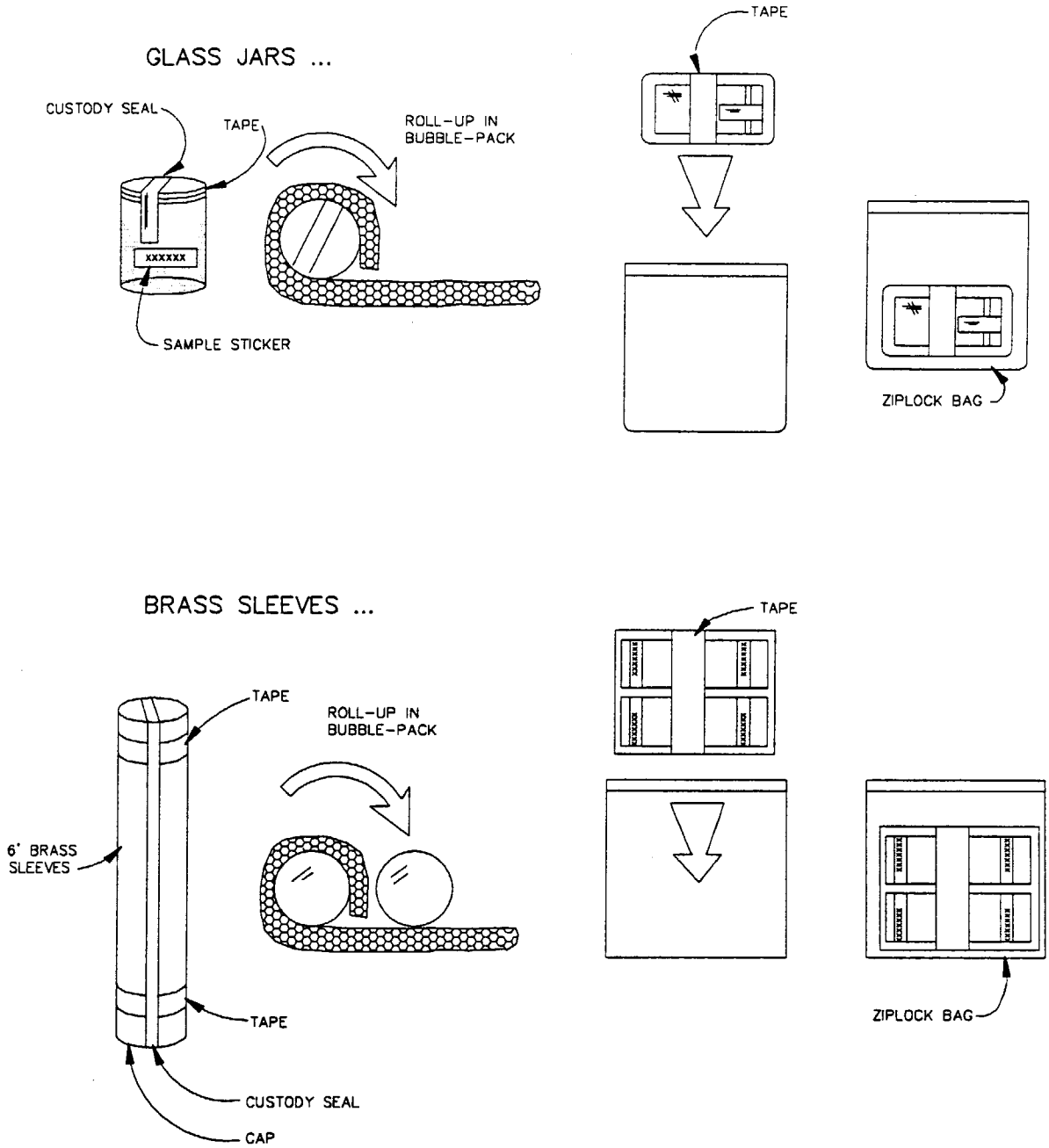



FIGURE 84
SOIL AND SEDIMENT
SAMPLE PACKAGING

FIG38.DWG

JE

Environmental Lab
2218 Railroad Avenue
Redding, CA 96001

Client _____

Sample Description _____

Location _____

Analysis _____

Preservative _____

Date/TIME _____ By _____

**CUSTODY SEAL**

Date _____

Signature _____

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

**CUSTODY SEAL**

Date _____

Signature _____

**FIGURE 85**

**SAMPLE LABEL & CUSTODY SEAL**

# 4.0 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND RECOMMENDED ANALYTICAL PARAMETERS

This section provides a discussion of the sampling scheme and the analytical parameters proposed for the SWMUs and areas of concern recommended for a sampling visit under the RFA at MCAS El Toro. Table 4-1 presents a comprehensive list of the SWMUs and areas of concern identified during the records review and site visit portions of the RFA. Detailed descriptions of each of the 299 SWMUs and areas of concern in this list can be found in the Draft PR/VSI Report for MCAS El Toro. Figure 3, in Section 3.0, presents a map of the Station showing the locations of the SWMUs and areas of concern. In the Draft PR/VSI Report, 157 SWMUs and areas of concern were recommended for a sampling visit.

Of the 157 SWMUs and areas of concern previously recommended for a sampling visit, one (i.e., SWMU/area of concern (AOC) Number 267) is now recommended for no further action after additional review and another (SWMU/AOC Number 45) is being added for a sampling visit. SWMU/AOC Number 267 is a drop tank fuel storage area located on the tarmac in an aircraft wash area with concrete berms. Spilled or dumped fuel from these tanks would be directed to the drain leading to oil/water separator 605-C (SWMU/AOC Number 151) which is recommended for a sampling visit. Since the receptor of any releases from the drop tanks will be sampled, no further action is recommended for SWMU/AOC Number 267. Based on EPA's comments on the Draft Sampling Visit Work Plan, the Navy is including SWMU/AOC Number 45, a drum storage area, for a sampling visit.

The SWMUs and areas of concern recommended for a sampling visit will be evaluated for releases on an individual basis. The only exception to this will be oil/water separators and their adjacent waste oil holding tanks. These SWMUs will be combined and evaluated together in the same sampling visit because of their small size and capacity and their directly adjacent locations.

Plot plans of the various SWMUs and areas of concern with the proposed sampling scheme are presented in Section 3.0 of this report. Some figures contain more than one SWMU or area of concern because of their proximity to each other. It should be noted that a separate, unique sampling plan is proposed for each SWMU and area of concern, except as noted above for oil/water separators and their adjacent waste oil tanks. Table 4-2 presents a summary of the proposed sampling scheme, analytical parameters, and figure numbers (Section 3.0) for the SWMUs and areas of concern recommended for a sampling visit in the RFA.

## 4.1 Preliminary Activities

Prior to initiating field work for the sampling visits, several preliminary activities will be conducted. These activities may require that individual sampling locations or number of samples be changed. Significant changes will be documented in a technical memorandum that will be submitted to the agencies for approval.

### 4.1.1 Establish Exact Boring Locations

Prior to the start of drilling work for the RFA, the boring locations will need to be discussed with and approved by MCAS El Toro staff. A review of aerial photographs, utility maps, and other Station drawings for the Station will be performed

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# TABLE 4-1
## SWMUs AND AREAS OF CONCERN
## MCAS EL TORO

| | NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | Former Scrap Metal Yard | Photograph | Near Golf Course | | | | | |
| | 2 | Vegetation Piles | Photograph | Near Golf Course | | | | | |
| X | 3 | Riffle Range Ditch | 1 | See Figure 2 | | | | | |
| X | 4 | Bee Canyon Wash | 1 | See Figure 2 | | | | | |
| X | 5 | Borrego Canyon Wash | 1 | See Figure 2 | | | | | |
| X | 6 | Landfarming site | e | W. of Perimeter Rd, NW Bee Canyon Wash | For remediating petroleum-contaminated soil | | | | |
| X | 7 | Transformer storage area | e | E of Bee Canyon Wash | | | | | |
| X | 8 | Abandoned Well 50-3285 | i | E of Magazine Road, W. of Bldg. 809 | Drilled in 1950, depth 3285 feet | | | | |
| X | 9 | Fuel bladder | e | East of Aqua Chinon Wash | 2000 gallon fuel bladder | | | | |
| | 10 | Abandoned Well 24-4247 | i | E of bldg 385 | RI/FS Site | | | | |
| X | 11 | Agua Chinon Wash | 1 | See Figure 2 | | | | | |
| | 12 | Active Sanitary Sewer Lines | 1 | Stationwide | | | | | |
| X | 13 | Drop Tank Fuel Storage Area | e | SW of bldgs 114 & 115 | Drop tanks drained onto adjacent soil or the storm drain | | | | |
| X | 14 | Drop Tank Fuel Storage Area | e | SW of bldgs 605 & 606 | Drop tanks drained onto adjacent soil or the storm drain | | | | |
| X | 15 | Wash water runoff site | e | SW of direct fueling stations 576 and 577 | Wash water runoff from fueling pads onto unprotected soil | | | | |
| X | 16 | Wash water runoff site | e | SW of fueling stations 574 and 575 | Wash water runoff from fueling pads onto unprotected soil | | | | |
| | 17 | UST | f | Tank Farm 2 T-05 | Spill Containment Tank | 1988 | 2000 gal | FIBERGLASS COATED STEE | WASTE JP-5 |
| | 18 | UST | f | Tank Farm 4 T-02 | Spill Containment Tank | 1988 | 2000 gal | FIBERGLASS COATED STEE | WASTE JP-5 |
| | 19 | UST | f | Tank Farm 4 T-03 | Spill Containment Tank | 1988 | 2000 gal | FIBERGLASS COATED STEE | WASTE JP-5 |
| X | 20 | UST | f | G-3, Standby Generator 414 T-C | Located near 414; piped to Farm 5, Active | 1988 | 2000 gal | FIBERGLASS COATED STEE | WASTE JP-5 |
| | 21 | UST | f | Tank Farm 5 T-06 | Spill Containment Tank, Active | 1988 | 2000 gal | FIBERGLASS COATED STEE | WASTE JP-5 |
| | 22 | UST | f | Tank Farm 5,6 T-08 | Spill Containment Tank, Active | 1988 | 2000 gal | FIBERGLASS COATED STEE | WASTE JP-5 |
| | 23 | UST | f | Tank Farm 555 T-01 | Spill Containment Tank, Active | 1988 | 2000 gal | FIBERGLASS COATED STEE | WASTE JP-5 |
| | 24 | UST | f | Tank Farm 6 T-07 | Spill Containment Tank, Active | 1988 | 2000 gal | FIBERGLASS COATED STEE | WASTE JP-5 |
| | 25 | Drum Storage Area | b | MWCS-38 SQDN SUPPLY BLDG 5 | | | | | |
| X | 26 | Hazardous Waste Storage Area | CURRENT | MWCS-38 SQDN SUPPLY BLDG 5 Hanger | | | | | |
| X | 27 | Hazardous Waste Storage Area | CURRENT,b | AERO CLUB 10 | | | | | |
| | 28 | Fuel Spill Site | e | AERO CLUB 10 NE | | | | | |
| | 29 | Drum Storage Area | c | AERO CLUB 10 South | | | 240 sq ft | | |
| X | 30 | Drum Storage Area | b,c | NIS Admin (field office) 29 West | No Evidence of Stains | | 360 sq ft | | |
| | 31 | Drum Storage Area | c | NIS Admin (field office) 29 West | RI/FS Site | | 600 sq ft | | |
| | 32 | Drum Storage Area | b | 36 | | | | | |
| X | 33 | Hazardous Waste Storage Area | CURRENT | MAG-46 Academic Instruction 51 | | | | | |
| | 34 | Drum Storage Area | c | 71 F, North, paved | Identified as MCAS Tustin | | 45000 sq ft | | |
| | 35 | Drum Storage Area | b | FMD Transport Office 96 | | | | | |
| | 36 | Drum Storage Area | a | 103 | Duplicate of SWMU/AOC 27 | | | | |
| | 37 | Aircraft Wash Area | a | VMP-3 114 | Duplicate of SWMU/AOC 210 | | | | |

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# TABLE 4-1
## SWMUs AND AREAS OF CONCERN
## MCAS EL TORO

| NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|
| 38 | Drum Storage Area | a | VMP-3 114 | | | | | |
| X 39 | Hazardous Waste Storage Area | CURRENT | VMFA-531 115 | | | | | |
| 40 | Drum Storage Area | a | MALS-11 Tire Storage 127 | | | | | |
| X 41 | Vehicle Wash Rack | a | MALS-11 Tire Storage 127 | | | | | |
| 42 | Drum Storage Area | a,b | MALS-11 Maint. Hanger 130 | | | | | |
| 43 | Drum Storage Area | c | MAG-11 Warehouse 137 West | | | 450 sq ft | | |
| 44 | Drum Storage Area | a | 143 | | | | | |
| X 45 | Drum Storage Area | c | FMD Grnds Equip. Shed 155 East | | | 150 sq ft | | |
| X 46 | Vehicle maintenance and parking | e | Sta Ordn Inert Storehouse 163 East | DRMO Lot 2 | | | | |
| 47 | Drum Storage Area | c | MALS-11 Inert Storehouse 172 | | | | | |
| X 48 | UST | f | Tank Farm #2 178 | Active | 1943 | 50,000 gal | STEEL-LINED CONCRETE | WASTE OIL |
| X 49 | UST | f | Tank Farm #2 179 | Active | 1943 | 25,000 gal | STEEL-LINED CONCRETE | WASTE OIL |
| 50 | Drum Storage Area | c | Tank Farm #2 179 Near | | | 56 sq ft | | |
| 51 | UST | f | Tank Farm #2 180 | Active | 1943 | 25,000 gal | STEEL-LINED CONCRETE | WASTE JP-5 |
| 52 | UST | f | Tank Farm #2 182 | Active | 1943 | 50,000 gal | STEEL-LINED CONCRETE | WASTE OIL |
| 53 | UST | f | 185 A | Identified as MCAS Tustin | UKN. | 750 gal | STEEL | WASTE OIL |
| 54 | UST | f | 185 B | | UKN. | 750 gal | STEEL | WASTE OIL |
| 55 | Drum Storage Area | c | 186 South, paved | | | 20 sq ft | | |
| 56 | Drum Storage Area | c | 187 South, paved | | | 172 sq ft | | |
| X 57 | UST | f | Supply Heating Fuel Storage 189 | Active | 1943 | 50,000 gal | STEEL-LINED CONCRETE | WASTE OIL |
| 58 | UST | f | Supply Heating Fuel Storage 189 T-04 | Active | 1988 | 2,000 gal | FIBERGLASS COATED STEE | WASTE OIL |
| X 59 | UST | f | Supply Heating Fuel Storage 191 | Active | 1943 | 25,000 gal | STEEL-LINED CONCRETE | WASTE OIL |
| 60 | UST | f | Contaminated Fuel Storage 204 | Release Detection 1989, Active | | 50,000 gal | STEEL-LINED CONCRETE | WASTE JP-5 |
| 61 | UST | f | Contaminated Fuel Storage 205 | Release Detection 1989, Active | | 25,000 gal | STEEL-LINED CONCRETE | WASTE JP-5 |
| 62 | UST | f | Tank Farm #6 206 | Release Detection 1989, Active | | 50,000 gal | STEEL-LINED CONCRETE | FUEL, WASTE JP-5 |
| 63 | UST | f | Tank Farm #6 207 | Release Detection 1989, Active | | 50,000 gal | STEEL-LINED CONCRETE | FUEL, WASTE JP-5 |
| 64 | Hazardous Waste Storage Area | CURRENT | Mercury Refuelers 240 | | | | | |
| X 65 | UST | f | Mercury Refuelers 240 B | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| X 66 | Oil/Water Separator | f | Mercury Refuelers 240 C | Active | 1982 | 100 gal | STEEL | |
| X 67 | Drum Storage Area | b | AC/S, G-4 Storage 242 | | | | | |
| 68 | Oil/Water Separator | f | AC/S, G-4 Historical Collection 244 | Active | 1944 | 100 gal | CONCRETE | |
| 69 | Drum Storage Area | a | 262 | | | | | |
| X 70 | Hazardous Waste Storage Area | CURRENT | SOMS Search and Rescue 289 | | | | | |
| 71 | Hazardous Waste Storage Area | CURRENT,b | MAG-46 295 | RI/FS Site | | | | |
| X 72 | Hazardous Waste Storage Area | CURRENT | MAG-46 296 | | | | | |
| X 73 | Hazardous Waste Storage Area | CURRENT,a | VMGR-352 297 | | | | | |
| 74 | Aircraft Wash Area | a | VMGR-352 297 | | | | | |
| 75 | UST | f | VMGR-352 297 T-11 | Active | 1988 | 1,000gal | FIBERGLASS COATED STEE | FUEL SLOP |

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# TABLE 4-1
## SWMUs AND AREAS OF CONCERN
## MCAS EL TORO

| NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|
| X 76 | Oil/Water Separator | f | VMGR-352 297 B | Active | 1982 | 100 gal | STEEL | |
| X 77 | UST | f | VMGR-352 297 C | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| 78 | Drum Storage Area | c | VMGR-352 297 West | | | 720 sq ft | | |
| 79 | Drum Storage Area | c | VMGR-352 297 West | | | 50 sq ft | | |
| 80 | Drum Storage Area | c | VMGR-352 297 West | | | 16 sq ft | | |
| 81 | Drum Storage Area | c | VMGR-352 297 West | | | 352 sq ft | | |
| 82 | Drum Storage Area | c | VMGR-352 297 West | | | 450 sq ft | | |
| X 83 | Hazardous Waste Storage Area | CURRENT,a,b | Light Duty Vehicle Maintenance Shop 298 | | | | | |
| X 84 | Oil/Water Separator | f | Light Duty Vehicle Maintenance Shop 298 C | Active | 1982 | 100 gal | STEEL | |
| X 85 | UST | f | Light Duty Vehicle Maintenance Shop 298 D | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| 86 | Drum Storage Area | c | Light Duty Vehicle Maintenance Shop 298 South, paved | Possible duplicate of SWMU/AOC 83 | | 25 sq ft | | |
| 87 | Drum Storage Area | c | Light Duty Vehicle Maintenance Shop 298 South, paved | Possible duplicate of SWMU/AOC 83 | | 120 sq ft | | |
| X 88 | Drum Storage Area | e | Pipe/Heat Shop 306 East | | | | | |
| 89 | Drum Storage Area | c | Pipe/Heat Shop 306 West | | | 60 sq ft | | |
| X 90 | Former Sewage Treatment Plant | e | 307 SE | | | | | |
| X 91 | Oil/Water Separator | f | Heat Plant 314 A | Active | 1945 | 50,000 gal | CONCRETE | WASTE OIL |
| X 92 | Oil/Water Separator | f | Heat Plant 314 B | Active | 1945 | 50,000 gal | CONCRETE | WASTE OIL |
| 93 | Drum Storage Area | a,b | Commissary 317 | | | | | |
| 94 | Drum Storage Area | a,b | Supply Haz/Flam Storage 320 | | | | | |
| X 95 | Engine Test Cell | a | 324 | | | | | |
| 96 | Drum Storage Area | a | 343 | Possible Duplicate of SWMU/AOC 107 or 242 | | | | |
| 97 | Drum Storage Area | a | FMD Haz/Flam Storage 357 | | | | | |
| X 98 | Vehicle Wash Rack | a | Preservation Facility 359 | | | | | |
| X 99 | Drum Storage Area | a | Preservation Facility 359 | | | | | |
| X 100 | TCE Degreasers | a | Preservation Facility 359 | | | | | |
| X 101 | Oil/Water Separator | f | Preservation Facility 359 B | Active | 1952 | 100 gal | CONCRETE | |
| X 102 | UST | f | Preservation Facility 359 C | Active | 1982 | 500 gal | STEEL | WASTE SOLVENTS |
| 103 | Drum Storage Area | c | Preservation Facility 359 East | | | 120 sq ft | | |
| 104 | Drum Storage Area | b | DRMO 360 | RI/FS Site | | | | |
| 105 | Drum Storage Area | c | DRMO 360 North | RI/FS Site | | | | |
| 106 | Drum Storage Area | c | DRMO 360 North, paved | RI/FS Site | | 5076 sq ft | | |
| X 107 | Hazardous Waste Storage Area | CURRENT | VMFAT-101 371 | | | | | |
| 108 | UST | f | Tank Farm #4 374 T-10 | Spill Containment Tank, Active | 1988 | 1,000 gal | FIBERGLASS COATED STEE | FUEL SLOP |
| 109 | Drum Storage Area | b | Truck Weighing Facility 379 | | | | | |
| X 110 | Vehicle Wash Rack | a | Heavy Duty Vehicle Maintenance Shop 386 | | | | | |
| 111 | Hazardous Waste Storage Area | CURRENT,a | Heavy Duty Vehicle Maintenance Shop 386 | Duplicate of SWMU/AOC 223 | | | | |
| X 112 | Oil/Water Separator | f | Heavy Duty Vehicle Maintenance Shop 386 B | | 1982 | 100 gal | STEEL | |
| X 113 | UST | f | Heavy Duty Vehicle Maintenance Shop 386 C | Active | 1982 | 185 gal | STEEL | WASTE OIL |

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# TABLE 4-1
## SWMUs AND AREAS OF CONCERN
## MCAS EL TORO

| NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|
| 114 | Drum Storage Area | c | Heavy Duty Vehicle Maintenance Shop 386 North | Active | | 50 sq ft | | |
| 115 | Vehicle Wash Rack | a | Field Maintenance Shop 388 | Duplicate of SWMU/AOC 201 | | | | |
| X 116 | Drum Storage Area | a,b | Field Maintenance Shop 388 | | | | | |
| 117 | UST | f | Field Maintenance Shop 388 B | Active, Identified as gasoline tank in VSI | 1955 | 2,000 gal | STEEL | WASTE OIL |
| 118 | Oil/Water Separator | f | Field Maintenance Shop 388 C | Active | 1955 | 100 gal | STEEL | |
| 119 | Drum Storage Area | b | Loading Unloading Ramp 389 | | | | | |
| X 120 | Vehicle Wash Rack | a | Auto Organizational Shop 390 | | | | | |
| 121 | Drum Storage Area | a | Auto Organizational Shop 390 | | | | | |
| 122 | Drum Storage Area | c | Auto Organizational Shop 390 West | | | 480 sq ft | | |
| 123 | Vehicle Wash Rack | a | GSE North 392 | Duplicate of SWMU/AOC 213 | | | | |
| X 124 | Hazardous Waste Storage Area | CURRENT,a | GSE North 392 | | | | | |
| X 125 | Hazardous Waste Storage Area | CURRENT | MC Property 415 | | | | | |
| 126 | Hazardous Waste Storage Area | CURRENT | Ordnance 442 | | | | | |
| 127 | Drum Storage Area | d | FMD Haz/Flam Storage 445 | | | | | |
| 128 | Storage Area | e | FMD Haz/Flam Storage 445 | Waste stored inside the building. Inactive | | | | |
| X 129 | UST | f | FMD Haz/Flam Storage 445 C | | 1959 | 100 gal | STEEL | WASTE OIL/WATER |
| X 130 | Drum Storage Area | a | Engine Test Cell 447 | | | | | |
| X 131 | Engine Test Cell | a | Engine Test Cell 447 | | | | | |
| X 132 | Oil/Water Separator | f | Engine Test Cell 447 C | Active | 1959 | 100 gal | STEEL | |
| 133 | Drum Storage Area | b | VMA-242 453 | | | | | |
| 134 | Drum Storage Area | a | VMA-121 454 | | | | | |
| 135 | Drum Storage Area | a | MALS-11 General Warehouse 456 | | | | | |
| 136 | Aircraft Wash Area | a | VMA-242 461 | | | | | |
| X 137 | Oil/Water Separator | f | VMA-242 461 | Contains sand, and waste #2 fuel oil | 1960 | 1,500 gal | STEEL | SEE COMMENTS |
| X 138 | Drum Storage Area | a | VMA-242 461 | | | | | |
| X 139 | Oil/Water Separator | f | VMA-121 462 | Contains sand, and waste #2 fuel oil | 1960 | 1,500 gal | STEEL | SEE COMMENTS |
| 140 | Hazardous Waste Storage Area | CURRENT | VMA-121 462 | | | | | |
| 141 | Aircraft Wash Area | a | VMFAT-101 463 | | | | | |
| 142 | Drum Storage Area | a | VMFAT-101 463 | | | | | |
| 143 | UST | f | 493 | Inactive | 1944 | UNK. | CONCRETE | WASTE OIL |
| X 144 | Drum Storage Area | b | FMD PW Expend WIP Storage 529 | | | | | |
| X 145 | UST | f | FMD PW Expend WIP Storage 529 | Inactive | 1944 | 25,000 gal | CONCRETE | UNK., WASTE OIL |
| 146 | Drum Storage Area | a,b | Supply Haz/Flam Storage 534 | | | | | |
| X 147 | Drum Storage Area | a,b | MALS-11 Van Maint. Shop 602 | | | | | |
| 148 | Oil/Water Separator | f | MALS-11 Van Maint. Shop 602 | Inactive, Possible Duplicate of SWMU/AOC 215 | 1964 | | CONCRETE | |
| X 149 | Drum Storage Area | a | VMFA-314 605 | | | | | |
| 150 | Aircraft Wash Area | a | VMFA-314 605 | | | | | |
| X 151 | Oil/Water Separator | f | VMFA-314 605 C | Active | 1984 | 100 gal | STEEL | |

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TABLE 4-1
SWMUs AND AREAS OF CONCERN
MCAS EL TORO

| NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|
| 152 | Aircraft Wash Area | a | VMFA-323 606 | | | | | |
| 153 | Drum Storage Area | a | VMFA-323 606 | Possible Duplicate of SWMU/AOC 255 | | | | |
| 154 | Oil/Water Separator | f | VMFA-323 606 C | Possible Duplicate of SWMU/AOC 163 | 1965 | 100 gal | CONCRETE | |
| 155 | Vehicle Wash Rack | a | FMD Admin Office 616 | Possible Duplicate of SWMU/AOC 195 | | | | |
| 156 | UST | f | Auto Hobby Shop 625 | Active, RI/FS Site | 1967 | 500 gal | CATH. PROT. STEEL | WASTE OIL |
| 157 | Vehicle Wash Rack | a | Auto Hobby Shop 626 | RI/FS Site | | | | |
| 158 | Drum Storage Area | a,b | Auto Hobby Shop 626 | RI/FS Site | | | | |
| 159 | Oil/Water Separator | f | Auto Hobby Shop 626 | Active, RI/FS Site | 1967 | | CONCRETE | |
| X 160 | Hazardous Waste Storage Area | CURRENT | MALS-11 Parachute/Surv Shop 636 | | | | | |
| 161 | Hazardous Waste Storage Area | CURRENT | FMD Elect Power Plant 641 | Duplicate of SWMU/AOC 39 | | | | |
| X 162 | UST | f | FMD Fixed ACFT Start System 643 A | Active | 1982 | 185 gal | CATH. PROT. STEEL | WASTE OIL |
| X 163 | Oil/Water Separator | f | FMD Fixed ACFT Start System 643 B | Active | 1982 | 100 gal | CONCRETE | |
| X 164 | Vehicle Wash Rack | a | Exchange Auto Repair 651 | | | | | |
| 165 | Drum Storage Area | a | Exchange Auto Repair 651 | Located within SWMU/AOC 164 | | | | |
| 166 | UST | f | Exchange Auto Repair 651 5 | Active | 1971 | 500 gal | STEEL | WASTE OIL |
| 167 | UST | f | Exchange Auto Repair 651 6 | Active | 1971 | 500 gal | STEEL | WASTE OIL |
| 168 | UST | f | Exchange Auto Repair 651 7 | Active | 1971 | 500 gal | STEEL | WASTE OIL |
| X 169 | Oil/Water Separator | f | Exchange Auto Repair 651 8 | | 1971 | 500 gal | CONCRETE | |
| 170 | Drum Storage Area | a,b | FSSG Field Maint. Shop 655 | | | | | |
| X 171 | Hazardous Waste Storage Area | CURRENT,a | MALS-11 Engine Test Cell 658 | | | | | |
| X 172 | Hazardous Waste Storage Area | CURRENT | MWSS-373 Bulk Refuelers 671 | | | | | |
| X 173 | Oil/Water Separator | f | MWSS-373 Bulk Refuelers 671 | | | | | |
| 174 | UST | f | MWSS-373 Refueler Maint. Shop 672 | Active | UNK. | 500 gal | STEEL | WASTE JP-5 |
| X 175 | Oil/Water Separator | f | MWSS-373 Refueler Maint. Shop 672 A | Active | 1982 | 100 gal | STEEL | |
| X 176 | UST | f | MWSS-373 Refueler Maint. Shop 672 B | Active | 1982 | 1,000 gal | STEEL | WASTE OIL |
| 177 | Drum Storage Area | c | MWSS-373 Refueler Maint. Shop 672 East, paved | | | 360 gal | | |
| 178 | Vehicle Wash Rack | a | MALS-11 GSE South 673 | | | | | |
| X 179 | Oil/Water Separator | f | MALS-11 GSE South 673 A | Active | 1982 | 100 gal | STEEL | |
| X 180 | UST | f | MALS-11 GSE South 673 B | Active | 1982 | 300 gal | STEEL | WASTE OIL |
| X 181 | Landfarming site | e | MALS-11 GSE South 673 East | For remediating petroleum-contaminated soil | | | | |
| 182 | Drum Storage Area | c | MALS-11 GSE South 673 East | | | 500 sq ft | | |
| 183 | Drum Storage Area | c | MALS-11 GSE South 673 East | | | 400 sq ft | | |
| 184 | Drum Storage Area | c | MALS-11 GSE South 673 East | | | 240 sq ft | | |
| 185 | Drum Storage Area | c | MALS-11 GSE South 673 North | | | 600 sq ft | | |
| X 186 | Hazardous Waste Storage Area | CURRENT | MALS-11 GSE South 673 T3 | | | | | |
| X 187 | UST | f | Bee Canyon Wash O/W Separator 674 | Active | 1982 | 500 gal | CONCRETE | WASTE OIL |
| X 188 | UST | f | Agua Chinon Canyon O/W Separator 675 | Active | 1982 | 500 gal | CONCRETE | WASTE OIL |
| X 189 | Oil/Water Separator | f | FMD Comm Storage 676 | | | | | |

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# TABLE 4-1
## SWMUs AND AREAS OF CONCERN
## MCAS EL TORO

| NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|
| 190 | Oil/Water Separator | f | VMFA-323 Line Maint. Hanger 696 | Duplicate of SWMU/AOC 163 | | | | |
| 191 | UST | f | 706 | Demolished 1987 | 1984 | 100 gal | STEEL | UNK., WASTE OIL |
| 192 | UST | f | MALS-11 Hush House 716 A | Active | 1976 | 3,000 gal | FIBERGLASS | WASTE OIL |
| X 193 | Oil/Water Separator | f | MALS-11 Hush House 716 B | Active | 1976 | 100 gal | CONCRETE | |
| X 194 | Former Incinerator Site | l | Flight Simulator 746 N | | | | | |
| X 195 | Vehicle Wash Rack | a | FMD Util Bldg 758 | | | | | |
| X 196 | Oil/Water Separator | f | FMD Util Bldg 758 A | Active | 1982 | 100 gal | STEEL | |
| X 197 | UST | f | FMD Util Bldg 758 B | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| X 198 | Vehicle Wash Rack | a | FSSG Util Bldg 759 | | | | | |
| X 199 | Oil/Water Separator | f | FSSG Util Bldg 759 A | Active | 1982 | 100 gal | STEEL | |
| X 200 | UST | f | FSSG Util Bldg 759 B | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| X 201 | Vehicle Wash Rack | a | FSSG Util Bldg 760 | | | | | |
| X 202 | UST | f | FSSG Util Bldg 760 A | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| X 203 | Oil/Water Separator | f | FSSG Util Bldg 760 B | Active | 1982 | 100 gal | STEEL | |
| X 204 | Vehicle Wash Rack | a | MAG-11 ACFT Washrack Util Bldg 761 | | | | | |
| X 205 | Oil/Water Separator | f | MAG-11 ACFT Washrack Util Bldg 761 A | Active | 1982 | 100 gal | STEEL | |
| X 206 | UST | f | MAG-11 ACFT Washrack Util Bldg 761 B | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| 207 | Vehicle Wash Rack | a | MWSG-37 Util Bldg 762 | Duplicate of SWMU/AOC 120 | | | | |
| X 208 | Oil/Water Separator | f | MWSG-37 Util Bldg 762 A | Active | 1982 | 100 gal | STEEL | |
| X 209 | UST | f | MWSG-37 Util Bldg 762 B | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| 210 | Vehicle Wash Rack | a | MAG-11 ACFT Util Bldg 763 | | | | | |
| X 211 | Oil/Water Separator | f | MAG-11 ACFT Util Bldg 763 A | Active | 1982 | 100 gal | STEEL | |
| X 212 | UST | f | MAG-11 ACFT Util Bldg 763 B | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| X 213 | Vehicle Wash Rack | a | MALS-11 Util Bldg 764 | | | | | |
| X 214 | UST | f | MALS-11 Util Bldg 764 A | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| X 215 | Oil/Water Separator | f | MALS-11 Util Bldg 764 B | Active | 1982 | 100 gal | STEEL | |
| 216 | Vehicle Wash Rack | a | MWSS-371 Util Bldg 765 | | | | | |
| X 217 | UST | f | MWSS-371 Util Bldg 765 A | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| X 218 | Oil/Water Separator | f | MWSS-371 Util Bldg 765 B | Active | 1982 | 100 gal | STEEL | |
| 219 | Vehicle Wash Rack | a | MWCS-38 Util Bldg 766 | | | | | |
| X 220 | Oil/Water Separator | f | MWCS-38 Util Bldg 766 A | Active | 1982 | 100 gal | STEEL | |
| X 221 | UST | f | MWCS-38 Util Bldg 766 B | Active | 1982 | 185 gal | STEEL | WASTE OIL |
| X 222 | Hazardous Waste Storage Area | d | FMD HW Collection Facility 769 | Former permitted HW collection facility | | | | |
| X 223 | Hazardous Waste Storage Area | d | FMD HW Collection Facility 770 | Former permitted HW collection facility | | | | |
| X 224 | Hazardous Waste Storage Area | d | MWSG-37 HW Collection Facility 771 | Former permitted HW collection facility | | | | |
| X 225 | Hazardous Waste Storage Area | d | FMD HW Collection Facility 772 | Former permitted HW collection facility | | | | |
| X 226 | Hazardous Waste Storage Area | d | MAG-46 HW Collection Facility 778 | Former permitted HW collection facility | | | | |
| X 227 | Hazardous Waste Storage Area | d | MAG-11 HW Collection Facility 779 | Former permitted HW collection facility | | | | |

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# TABLE 4-1
## SWMUs AND AREAS OF CONCERN
## MCAS EL TORO

| NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|
| 228 | UST | f | MAG-11 HW Collection Facility 779 T-09 | Active | 1988 | 1,000 gal | FIBERGLASS COATED STEE | FUEL SLOP |
| X 229 | Hazardous Waste Storage Area | CURRENT | MWSS-373 Motor Pool HQ 800 | | | | | |
| 230 | UST | f | MWSS-373 Motor Pool HQ 800 D | Active | 1984 | 1,000 gal | FIBERGLASS | WASTE OIL |
| X 231 | UST | f | MWSS-373 Motor Pool HQ 800 E | Active | 1984 | 1,000 gal | FIBERGLASS | WASTE OIL |
| X 232 | Oil/Water Separator | CURRENT | MWSS-373 Motor Pool HQ 800 F | Active | 1984 | 1,500 gal | CONCRETE | |
| X 233 | Oil/Water Separator | f | MWR-Rec Wash Bldg 817 | | | | | |
| X 234 | Hazardous Waste Storage Area | CURRENT | PMO Sentry Bldg 856 | | | | | |
| 235 | Drum Storage Area | c | 1519 West | Possible Duplicate of SWMU/AOC 27 | | 300 sq ft | | |
| 236 | Drum Storage Area | b | 1663 | RI/FS Site | | | | |
| 237 | Drum Storage Area (2) | b | 1700 | | | | | |
| 238 | Drum Storage Area (2) | b | 1727 | | | | | |
| 239 | Drum Storage Area (2) | a | Riding Stables/Pen Shelter 1798 | | | | | |
| 240 | Drum Storage Area (2) | k | FMD Grnds Equip. Shed 155, South | | | | | |
| X 241 | Drum Storage Area | k | FMD Grnds Equip. Shed 155, Southwest | | | | | |
| X 242 | Hazardous Waste Storage Area | k | VMFAT-101 371 | | | | | |
| X 243 | Washrack | k | FMD Transport Office 96 | | | | | |
| X 244 | PCB Spill Area | l | 457 | | | | | |
| 245 | Golf Course | l | 464 | | | | | |
| 246 | Golf Course Irrigation Tank | l | 459 | | | | | |
| 247 | Pipe line | l | See Figure 1-2 | Form sewage treatment plant to irr. tank | | | | |
| X 248 | Oil/Water Separator | k | VMFAT-101 463 | | | | | |
| X 249 | Underground Storage Tank | k | VMFAT-101 463 | | | | | |
| X 250 | Underground Storage Tank | k | FSSG Field Maint. Shop 655 | | | | | |
| 251 | Drum Storage Area | k | Field Maint. Shop 388 | | | | | |
| X 252 | Hazardous Waste Storage Area | k | 698 | | | | | |
| X 253 | Vehicle Washrack | k | Commissary 317 | | | | | |
| 254 | Drum Storage Area | k | Preservation Facility 359 | | | | | |
| X 255 | Hazardous Waste Storage Area | k | VMFA-232 606 | | | | | |
| X 256 | Hazardous Waste Storage Area | k | 441 | | | | | |
| X 257 | Wash Water Runoff Site | k | 575 | | | | | |
| X 258 | Wash Water Runoff Site | k | 577 | | | | | |
| 259 | Drum Storage Area | k | Loading Unloading Ramp 389 | | | | | |
| X 260 | Aboveground Storage Tank | k | Loading Unloading Ramp 389 | | | | | |
| X 261 | Drum Storage Area | k | Auto Organizational Shop 390 | | | | | |
| X 262 | Fuel Storage Area | k | Auto Organizational Shop 390 | | | | | |
| X 263 | Underground Storage Tank | k | 374 | | | | | |
| X 264 | Equipment Storage Area | k | DRMO LOT #3 | | | | | |
| X 265 | Metal Plating Sewer Lines | l | See Figure 1-1 | | | | | |

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TABLE 4-1
SWMUs AND AREAS OF CONCERN
MCAS EL TORO

| NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|
| 266 | Drum Storage Area | k | MWSS-371 Util Bldg 765 | | | | | |
| 267 | Drop Tank Fuel Storage Area | k | VMFA-314 605 | | | | | |
| 268 | Vehicle Washrack | k | Mercury Refuelers 240 | | | | | |
| X 269 | Flammable Storage Locker | k | Heat Plant 314 | | | | | |
| X 270 | Washrack | k | MWR-Rec Wash Bldg 817 | | | | | |
| X 271 | Hazardous Waste Storage Area | k | GSE North 392 | | | | | |
| X 272 | Hazardous Waste Storage Area | k | 31 | | | | | |
| X 273 | Washrack | k | 31 | | | | | |
| 274 | Stock Pile Soil | k | 31 | | | | | |
| X 275 | Underground Storage Tank | f | Tank Farm #1 186 | Inactive, Decomissioned Tank 1965 | 1943 | 25,000 gal | Concrete | UNKNOWN |
| X 276 | Underground Storage Tank | f | Tank Farm #1 187 | Inactive, Decomissioned Tank 1965 | 1943 | 50,000 gal | Concrete | UNKNOWN |
| X 277 | Underground Storage Tank | f | Tank Farm #3 188 | Removed 1970, Inactive | 1943 | 25,000 gal | Concrete | UNKNOWN |
| X 278 | Underground Storage Tank | f | Tank Farm #3 190 | Removed 1967, 67-C-3184, Inactive | 1943 | 50,000 gal | Concrete | UNKNOWN |
| X 279 | Underground Storage Tank | f | Tank Farm #3 193 | Removed 1970, Inactive | 1943 | 50,000 gal | Concrete | UNKNOWN |
| X 280 | Underground Storage Tank | f | Tank Farm #3 195 | Removed 1970, Inactive | 1943 | 25,000 gal | Concrete | UNKNOWN |
| 281 | Underground Storage Tank (2) | f | 252 | Inactive | | | | UNKNOWN |
| X 282 | Underground Storage Tank | f | 322B | Inactive, Converted to natural gas 73-C-5290 | | | Carbon Steel | UNKNOWN |
| X 283 | Underground Storage Tank | f | 326B | Inactive | 1945 | | Carbon Steel | UNKNOWN |
| 284 | Underground Storage Tank (2) | f | 347D | Inactive, Tank filled with sand | 1948 | | | UNKNOWN |
| 285 | Underground Storage Tank (2) | f | 399 | Inactive | 1955 | 500 gal | Carbon Steel | UNKNOWN |
| X 286 | Underground Storage Tank | f | 733B | Inactive | 1980 | 10,000 gal | Fiberglass | UNKNOWN |
| X 287 | Underground Storage Tank | f | 733C | Inactive | 1980 | 10,000 gal | Fiberglass | UNKNOWN |
| 288 | Underground Storage Tank | f | 850A | Inactive, Temporarily closed for repairs - 1990 RI/FS Site | 1988 | 5,000 gal | Fiberglass | UNKNOWN |
| 289 | Underground Storage Tank | f | 850B | Inactive, Temporarily closed for repairs - 1990 RI/FS Site | 1988 | 5,000 gal | Fiberglass | UNKNOWN |
| 290 | Underground Storage Tank | f | 850C | Inactive, Temporarily closed for repairs - 1990 RI/FS Site | 1988 | 500 gal | Fiberglass | UNKNOWN |
| X 291 | Oil/Water Separator | f | FMD Transport Office 96 | | | | | |
| X 292 | Oil/Water Separator | f | Agua Chinon Canyon O/W Separator 675B | | | | | |
| 293 | Cleaning Tank | k | MALS-11 Maint. Hanger 130 | | | | | |
| 294 | Drum Storage Area | k | MALS-11 Maint. Hanger 130 | | | | | |
| 295 | Drum Storage Area | k | MALS-11 Maint. Hanger 130 | | | | | |
| X 296 | Oil/Water Separator | f | FMD Haz/Flam Storage 357 | | | | | |
| 297 | Former Asphalt Pavement Plant | e | Northeast of Golf Course | | | | | |
| X 298 | Underground Storage Tank | k | GSE North 392 | Active | | | | WASTE OIL |
| 299 | Washrack | k | MWSS-373 Motor Pool HQ 800 | | | | | |

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TABLE 4-1
SWMUs AND AREAS OF CONCERN
MCAS EL TORO

| NO. | TYPE | SOURCE (1) | LOCATION/BUILDING | COMMENTS | DATE | SIZE | MATERIAL | CONTENTS |
|---|---|---|---|---|---|---|---|---|

(1) SOURCE:

Current - Based on site visits Jan-Feb 1991

Past - Based on agency records review and miscellaneous records for MCAS El Toro as identified below:

a - Regional Water Quality Control Board, letter to Lt. Rehor (June 23, 1989)
b - SPCC map (no date)
c - Department of Health Services, 1980 Photographs
d - EPA, Region IX, Compliance Inspection Report, May 1987
e - interview
f - UST list, EG & G Idaho, Inc., (See Appendix A)
g - Drum Storage Areas, see source information in Table 4-2
h - Table 4-1 identifies the RWQCB sites
i - Department of Conservation, California Division of Oil and Gas, Long Beach
j - Per MCAS El Toro List of Oil/Water Separators
k - Observed during VSI
l - Other

(2) SWMU/AOC was not able to be accurately located and/or identified from the records review information and the site visits.

(3) An "X" next to the SWMU/AOC Number idicates that a sampling visit is recommended.

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# TABLE 4-2
## SWMUs AND AREAS OF CONCERN RECOMMENDED FOR A SAMPLING VISIT MCAS EL TORO

| NO. | DESCRIPTION/TYPE | LOCATION/BUILDING | PLOT PLAN | ANALYTICAL PARAMETERS (1) | PROPOSED SAMPLING PLAN |
|---|---|---|---|---|---|
| 3 | Rifle Range Channel | See Figure 1-2 | 4 | 1 | 1-60' long slant boring |
| 4 | Bee Canyon Wash | See Figure 1-2 | 5 | 1 | 2-60' long slant borings |
| 5 | Borrego Canyon Wash | See Figure 1-2 | 6 | 1 | 2-60' long slant borings |
| 6 | Landfarming site | W of Perimeter Rd, NW of Bee Cyn Wash | 7 | 2 | 4-5' deep borings |
| 7 | Transformer storage area | E of Bee Canyon Wash | 8 | 3 | 1-5' deep boring |
| 8 | Abandoned Well 50-3285 | E of Magazine Rd, W of Bldg 809 | 9 | 1 | 3-5' deep borings |
| 9 | Fuel bladder | East of Aqua Chinon Wash | 10 | 2 | 3-5' deep borings |
| 11 | Agua Chinon Wash | See Figure 1-2 | 11,12 | 1 | 4-60' long slant boring |
| 13 | Drop Tank Fuel Storage Area | SW of bldgs 114 & 115 | 13 | 2 | 3-25' deep borings |
| 14 | Drop Tank Fuel Storage Area | NW of Bldg 606 | 14 | 2 | 3-5' deep borings |
| 15 | Wash water runoff site | SW of direct fueling stations 576 | 15 | 2 | 3-5' deep borings |
| 16 | Wash water runoff site | NW of direct fueling stations 574 | 16 | 2 | 4-5' deep borings |
| 20 | Underground Storage Tank | Bldg 414 T-C | 17 | 2 | 2-5' deep borings |
| 26 | Hazardous Waste Storage Area | 5 Hanger | 18 | 1 | 1-60' long slant boring; 1-5' deep boring @ stain |
| 27 | Hazardous Waste Storage Area | 10 | 19 | 1 | 1-60' long slant boring; 1-5' deep boring @ stain |
| 30 | Drum Storage Area | 29 West | 20 | 1 | 1-60' long slant boring |
| 33 | Hazardous Waste Storage Area | 51 | 21 | 1 | 1-60' long slant boring; 1-5' deep boring @ stain |
| 39 | Hazardous Waste Storage Area | 115 | 22 | 1 | 2-60' long slant boring; 2-5' deep boring @ stain |
| 41 | Vehicle Wash Rack | 127 | 23 | 2 | 2-5' deep borings |
| 45 | Drum Storage Area | 155 East | 80 | 1 | 3-5' deep borings |
| 46 | Vehicle maintenance and parking site | 163 East | 24 | 2 | 4-5' deep borings |
| 48 | Underground Storage Tank | 178 | 25 | 2 | 2-60' long slant borings |
| 49 | Underground Storage Tank | 179 | 25 | 2 | 2-60' long slant borings |
| 57 | Underground Storage Tank | 189 | 26 | 2 | 2-60' long slant borings |
| 59 | Underground Storage Tank | 191 | 26 | 2 | 2-60' long slant borings |
| 65 | Underground Storage Tank | 240 B | 27 | 2 | 1-25' deep boring |
| 66 | Oil/Water Separator | 240 C | 27 | 2 | Combine with SWMU/AOC 65 |
| 67 | Drum Storage Area | 242 | 25 | 1 | 1-60' long slant boring |
| 70 | Hazardous Waste Storage Area | 289 | 28 | 1 | 1-60' long slant boring; 1-5' deep boring @ stain |
| 72 | Hazardous Waste Storage Area | 296 | 29 | 1 | 1-60' long slant boring |
| 73 | Hazardous Waste Storage Area | 297 | 30 | 1 | 1-60' long slant boring |
| 76 | Oil/Water Separator | 297 B | 30 | 2 | 1-25' deep boring |
| 77 | Underground Storage Tank | 297 C | 30 | 2 | Combine with SWMU/AOC 65 |
| 83 | Hazardous Waste Storage Area | 298 | 31 | 1 | 1-60' long slant boring |

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# TABLE 4-2
## SWMUs AND AREAS OF CONCERN
## RECOMMENDED FOR A SAMPLING VISIT
## MCAS EL TORO

| NO. | DESCRIPTION/TYPE | LOCATION/BUILDING | PLOT PLAN | ANALYTICAL PARAMETERS (1) | PROPOSED SAMPLING PLAN |
|---|---|---|---|---|---|
| 84 | Oil/Water Separator | 298 C | 31 | 2 | 1-25' deep boring |
| 85 | Underground Storage Tank | 298 D | 31 | 2 | Combine with SWMU/AOC 84 |
| 88 | Drum Storage Area | 306 East | 32 | 1 | 2-60' long slant boring |
| 90 | Former Sewage Treatment Plant Site | 307 SE | 33 | 1 | 9-5' deep borings |
| 91 | Underground Storage Tank | 314 A | 34 | 2 | 2-60' long slant borings |
| 92 | Underground Storage Tank | 314 B | 34 | 2 | 2-60' long slant borings |
| 95 | Hazardous Waste Storage Area | 324 | 35 | 1 | 3-5' deep borings |
| 98 | Vehicle Washrack | 359 | 36 | 2 | 4-5' deep borings |
| 99 | Drum Storage Area | 359 | 36 | 1 | 1-60' long slant boring |
| 100 | TCE Degreasers | 359 | 36 | 2 | 1-25' deep boring |
| 101 | Oil/Water Separator | 359 B | 36 | 2 | 1-25' deep boring |
| 102 | Underground Storage Tank | 359 C | 36 | 2 | 1-25' deep boring |
| 107 | Hazardous Waste Storage Area | 371 | 11 | 1 | 2-25' deep boring |
| 110 | Vehicle Washrack | 386 | 37 | 2 | 4-5' deep borings |
| 112 | Oil/Water Separator | 386 B | 37 | 2 | 1-25' deep boring |
| 113 | Underground Storage Tank | 386 C | 37 | 2 | Combine with SWMU/AOC 112 |
| 116 | Drum Storage Area | 388 | 38 | 1 | 1-60' long slant boring |
| 120 | Vehicle Washrack | 390 | 39 | 2 | 4-5' deep borings |
| 124 | Hazardous Waste Storage Area | 392 | 40 | 1 | 1-60' long slant boring |
| 125 | Hazardous Waste Storage Area | 415 | 41 | 1 | 1-60' long slant boring |
| 129 | Underground Storage Tank | 445 C | 42 | 2 | 1-25' deep boring |
| 130 | Drum Storage Area | 447 | 43 | 1 | 3-5' deep borings |
| 131 | Engine Test Cell | 447 | 43 | 1 | 4-5' deep borings @ stains |
| 132 | Oil/Water Separator | 447 C | 43 | 2 | 1-25' deep boring |
| 137 | Oil/Water Separator | 461 | 44 | 2 | 1-25' deep boring |
| 138 | Drum Storage Area | 461 | 44 | 1 | 1-60' long slant boring |
| 139 | Oil/Water Separator | 462 | 45 | 2 | 1-25' deep boring |
| 144 | Drum Storage Area | 529 | 46 | 1 | 1-60' long slant boring |
| 145 | Underground storage tank | 529 | 46 | 2 | 2-60' long slant borings |
| 147 | Drum Storage Area | 602 | 47 | 1 | 3-5' deep borings |
| 149 | Drum Storage Area | 605 | 48 | 1 | 1-60' long slant boring |
| 151 | Oil/Water Separator | 605 C | 48 | 2 | 1-25' deep boring |
| 160 | Hazardous Waste Storage Area | 636 | 49 | 1 | 1-60' long slant boring |
| 162 | Underground Storage Tank | 643 A | 50 | 2 | 1-25' deep boring |

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# TABLE 4-2
## SWMUs AND AREAS OF CONCERN RECOMMENDED FOR A SAMPLING VISIT MCAS EL TORO

| NO. | DESCRIPTION/TYPE | LOCATION/BUILDING | PLOT PLAN | ANALYTICAL PARAMETERS (1) | PROPOSED SAMPLING PLAN |
|---|---|---|---|---|---|
| 163 | Oil/Water Separator | 643 B | 50 | 2 | Combine with SWMU/AOC 162 |
| 164 | Vehicle Washrack | 651 | 51 | 2 | 2-25' deep borings |
| 169 | Oil/Water Separator | 651 8 | 51 | 2 | 1-25' deep boring |
| 171 | Hazardous Waste Storage Area | 658 | 52 | 1 | 1-60' long slant boring |
| 172 | Hazardous Waste Storage Area | 671 | 53 | 1 | 1-60' long slant boring |
| 173 | Oil/Water Separator | 671 | 53 | 2 | 1-25' deep boring |
| 175 | Oil/Water Separator | 672 A | 53 | 2 | 1-25' deep boring |
| 176 | Underground Storage Tank | 672 B | 53 | 2 | 1-25' deep boring |
| 179 | Oil/Water Separator | 673 A | 54 | 2 | 1-25' deep boring |
| 180 | Underground Storage Tank | 673 B | 54 | 2 | Combine with SWMU/AOC 179 |
| 181 | Landfarming site | 673 East | 55 | 2 | 7-5' deep borings |
| 186 | Hazardous Waste Storage Area | 673 T3 | 54 | 1 | 1-60' long slant boring; 1-5' deep boring @ stain |
| 187 | Underground Storage Tank | 674 | 5 | 2 | 1-60' long slant boring |
| 188 | Underground Storage Tank | 675 | 12 | 2 | 1-60' long slant boring |
| 189 | Oil/Water Separator | 676 | 5 | 2 | Combine with SWMU/AOC 187 |
| 193 | Oil/Water Separator | 716 B | 56 | 2 | 1-25' deep boring |
| 194 | Former Incinerator Site | 746 N | 57 | 1 | 3-5' deep borings |
| 195 | Vehicle Washrack | 758 | 58 | 2 | 3-5' deep borings |
| 196 | Oil/Water Separator | 758 A | 58 | 2 | 1-25' deep boring |
| 197 | Underground Storage Tank | 758 B | 58 | 2 | Combine with SWMU/AOC 196 |
| 198 | Vehicle Washrack | 759 | 59 | 2 | 4-5' deep borings |
| 199 | Oil/Water Separator | 759 A | 59 | 2 | 1-25' deep boring |
| 200 | Underground Storage Tank | 759 B | 59 | 2 | Combine with SWMU/AOC 199 |
| 201 | Vehicle Washrack | 760 | 38 | 2 | 4-5' deep borings |
| 202 | Underground Storage tank | 760 A | 38 | 2 | 1-25' deep boring |
| 203 | Oil/Water Separator | 760 B | 38 | 2 | Combine with SWMU/AOC 202 |
| 204 | Vehicle Washrack | 761 | 60 | 2 | 4-5' deep borings |
| 205 | Oil/Water Separator | 761 A | 60 | 2 | 1-25' deep boring |
| 206 | Underground Storage Tank | 761 B | 60 | 2 | Combine with SWMU/AOC 205 |
| 208 | Oil/Water Separator | 762 A | 39 | 2 | 1-25' deep boring |
| 209 | Underground storage tank | 762 B | 39 | 2 | Combine with SWMU/AOC 208 |
| 211 | Oil/Water Separator | 763 A | 61 | 2 | 1-25' deep boring |
| 212 | Underground Storage Tank | 763 B | 61 | 2 | Combine with SWMU/AOC 211 |
| 213 | Vehicle Washrack | 764 | 40 | 2 | 4-5' deep borings |

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# TABLE 4-2
## SWMUs AND AREAS OF CONCERN RECOMMENDED FOR A SAMPLING VISIT MCAS EL TORO

| NO. | DESCRIPTION/TYPE | LOCATION/BUILDING | PLOT PLAN | ANALYTICAL PARAMETERS (1) | PROPOSED SAMPLING PLAN |
|---|---|---|---|---|---|
| 214 | Underground Storage Tank | 764 A | 40 | 2 | 1-25' deep boring |
| 215 | Oil/Water Separator | 764 B | 40 | 2 | Combine with SWMU/AOC 214 |
| 217 | Underground Storage Tank | 765 A | 25 | 2 | 1-25' deep boring |
| 218 | Oil/Water Separator | 765 B | 25 | 2 | Combine with SWMU/AOC 217 |
| 220 | Oil/Water Separator | 766 A | 19 | 2 | 1-25' deep boring |
| 221 | Underground Storage Tank | 766 B | 19 | 2 | Combine with SWMU/AOC 220 |
| 222 | Hazardous Waste Storage Area | 769 | 32 | 1 | 1-60' long slant boring |
| 223 | Hazardous Waste Storage Area | 770 | 37 | 1 | 1-60' long slant boring |
| 224 | Hazardous Waste Storage Area | 771 | 62 | 1 | 1-60' long slant boring |
| 225 | Hazardous Waste Storage Area | 772 | 63 | 1 | 1-60' long slant boring |
| 226 | Hazardous Waste Storage Area | 778 | 42 | 1 | 1-60' long slant boring |
| 227 | Hazardous Waste Storage Area | 779 | 64 | 1 | 1-60' long slant boring |
| 229 | Hazardous Waste Storage Area | 800 | 65 | 1 | 1-60' long slant boring |
| 231 | Underground Storage Tank | 800 E | 65 | 2 | 1-25' deep boring |
| 232 | Oil/Water Separator | 800 F | 65 | 2 | 1-25' deep boring |
| 233 | Oil/Water Separator | 817 | 66 | 2 | 1-25' deep boring |
| 234 | Hazardous Waste Storage Area | 856 | 67 | 1 | 1-60' long slant boring |
| 241 | Drum Storage Area | 155 Southwest | 68 | 1 | 1-60' long slant boring |
| 242 | Hazardous Waste Storage Area | 371 | 11 | 1 | 2-5' deep borings |
| 243 | Washrack | 96 | 69 | 2 | 4-5' deep borings |
| 244 | PCB Spill Area | 457 | 70 | 3 | 3-5' deep borings |
| 248 | Oil/Water Separator | 463 | 71 | 2 | 1-25' deep boring |
| 249 | Underground Storage Tank | 463 | 71 | 2 | 1-25' deep boring |
| 250 | Underground Storage Tank | 655 | 59 | 2 | 1-25' deep boring |
| 252 | Hazardous Waste Storage Area | 698 | 61 | 1 | 1-60' long slant boring |
| 253 | Vehicle Washrack | 317 | 72 | 2 | 1-5' deep boring |
| 255 | Hazardous Waste Storage Area | 606 | 50 | 1 | 1-60' long slant boring |
| 256 | Hazardous Waste Storage Area | 441 | 73 | 1 | 2-5' deep borings |
| 257 | Wash Water Runoff Site | 575 | 16 | 2 | 3-5' deep borings |
| 258 | Wash Water Runoff Site | 577 | 15 | 2 | 3-5' deep borings |
| 260 | Aboveground Storage Tank | 389 | 74 | 2 | 2-5' deep borings |
| 261 | Drum Storage Area | 390 | 39 | 1 | 2-5' deep borings |
| 262 | Fuel Storage Area | 390 | 39 | 2 | 2-5' deep borings |
| 263 | Underground Storage Area | 374 | 75 | 2 | 3-5' deep borings |

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# TABLE 4-2
## SWMUs AND AREAS OF CONCERN RECOMMENDED FOR A SAMPLING VISIT MCAS EL TORO

| NO. | DESCRIPTION/TYPE | LOCATION/BUILDING | PLOT PLAN | ANALYTICAL PARAMETERS (1) | PROPOSED SAMPLING PLAN |
|---|---|---|---|---|---|
| 264 | Equipment Storage Yard | DRMO LOT # 3 | 55 | 2 | 3-5' deep borings |
| 265 | Metal Plating Sewer Lines | See Figure 1-1 | 79 | 1 | 10-25' deep borings |
| 269 | Fuel Storage Locker | 314 | 34 | 2 | 4-5' deep borings |
| 270 | Washrack | 817 | 69 | 1 | 1-60' long slant boring |
| 271 | Hazardous Waste Storage Area | 392 | 40 | 1 | 1-60' long slant boring |
| 272 | Hazardous Waste Storage Area | 31 | 76 | 2 | 3-5' deep borings |
| 273 | Washrack | 31 | 76 | 2 | 2-60' long slant borings |
| 275 | Underground Storage Tank | Tank Farm # 1 186 | 62 | 2 | 2-60' long slant borings |
| 276 | Underground Storage Tank | Tank farm # 1 187 | 62 | 2 | 2-60' long slant borings |
| 277 | Underground Storage Tank | Tank Farm # 3 188 | 26 | 2 | 2-60' long slant borings |
| 278 | Underground Storage Tank | Tank Farm # 3 190 | 26 | 2 | 2-60' long slant borings |
| 279 | Underground Storage Tank | Tank Farm # 3 193 | 26 | 2 | 2-60' long slant borings |
| 280 | Underground Storage Tank | Tank Farm # 3 195 | 26 | 2 | 1-25' deep boring |
| 282 | Underground Storage Tank | 322B | 69 | 2 | 1-25' deep boring |
| 283 | Underground Storage Tank | 326B | 77 | 2 | 2-60' long slant borings |
| 286 | Underground Storage Tank | 733B | 78 | 2 | 2-60' long slant borings |
| 287 | Underground Storage Tank | 733C | 78 | 2 | 1-25' deep boring |
| 291 | Oil/ Water Separator | 96 | 69 | 2 | Combine with SWMU/AOC 188 |
| 292 | Oil/ Water Separator | 675B | 12 | 2 | 1-25' deep boring |
| 296 | Oil/Water Separator | 357 | 34 | 2 | 1-25' deep boring |
| 298 | Underground Storage Tank | 392 | 40 | 2 | 1-25' deep boring |

(1) The proposed analytical parameters for a SWMU conform to the following code:

1 = Samples are to be analyzed for the entire contract Laboratory Routine Analytical Services (RAS) Target Compound List (TCL) for organics and Target Analyte List (TAL) for metals. In addition, Special Analytical Service analyses for Total Petroleum Hydrocarbons (TPH), Total Fuel Hydrocarbons (TFH), and pH are proposed for each sample.

2 = Samples are to be analyzed for TPH (or TFH) and volatile organics. Tanks with unknown contents are proposed for both TPH and TFH.

3 = Samples are to be analyzed for PCBs, TPH and volatile organics.

4 = Samples are to be analyzed for dioxin.

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to verify that proposed boring locations will bypass known underground obstructions (i.e., underground storage tanks [USTs], pipelines, cables, etc.). For some locations, it may be determined that geophysical surveys should be performed to accurately identify underground utilities and structures.

### 4.1.2 Procure Subcontractors and Field Equipment

Before the field work can begin for the sampling visits, various subcontractors and field equipment will need to be procured. Subcontractor services for the drillers and for the analytical laboratory will need to be procured through a bidding process which will include activities such as preparation of bid packages, conducting necessary meetings and job walks, reviewing bidders' cost proposals, selection of winning subcontractors, and preparation of contract documents.

In addition, necessary field equipment for sampling and health and safety will need to be purchased and be available at the Station prior to implementing the field work.

### 4.1.3 Prepare Waste Management Plan

A Waste Management Plan will be prepared for the RFA sampling visits prior to initiating the field work at the Station. The Waste Management Plan recently developed for the RI/FS Program will be used as a basis for this plan and will be modified as appropriate to cover the waste management requirements for the RFA.

## 4.2 Sampling Strategy

Soil sampling in the vadose zone is recommended for the sampling visits in the RFA for MCAS El Toro. The objective of the sampling visits for the SWMUs and areas of concern recommended for evaluation in the Draft PR/VSI Report is to determine if a release has occurred. It is not the intention of these sampling visits to determine the extent of potential contamination at any of the SWMUs or areas of concern being sampled.

Three basic types of borings described below are recommended for evaluating SWMUs and areas of concern at the Station. These include shallow soil borings 4 to 5 feet in depth, 25-feet deep soil borings, and 60-feet long angle borings. Typically, one of these type of borings is recommended for the sampling visit for a particular SWMU; in some instances, a combination of the three types of borings is recommended. The proposed sampling strategy is based on judgmental sampling in which sample locations are selected based on where a release from a SWMU or area of concern is likely to be detected.

For USTs, soil sampling has been recommended for release detection rather than tank testing for the following reasons:

- Tank testing will only indicate that a release may have occurred from a UST. Soil sampling and analysis will determine whether a release has occurred, and will also identify the released contaminants and their concentrations in the soil. Analysis of soil samples for volatile organics will also assist in deciding whether SWMUs

should be considered for inclusion into OU-4 of the RI/FS Program in the event of a release being detected. Tank testing will not provide a basis for assessing whether a failed UST should be included into the RI/FS Program.

- Releases determined from tank testing would require confirmation sampling because of the possibility of false results (e.g., tanks failing because of leaks in vent lines that are normally liquid-free except during a test).

### 4.2.1 Shallow Soil Borings

Shallow soil borings (4 to 5-foot depth) will be drilled at SWMUs and areas of concern that are unpaved and have a relatively well-defined release area. Shallow borings will also be drilled on certain paved areas (e.g., washracks and parking areas) for detection of releases to soil through cracked or defective concrete and asphalt. The holes will be backfilled with grout and topped with asphalt or concrete.

Two soil samples will be collected from the shallow borings: one at a depth of 24 inches and another at the bottom of the boring at a depth of 4 to 5 feet. Both samples are proposed for laboratory analysis.

### 4.2.2 Twenty-Five-Foot Soil Borings

Soil borings drilled to a depth of 25 feet are recommended for SWMUs and areas of concern where shallow borings may not be adequate for assessing whether a

release has occurred. Underground storage tanks are an example of a SWMU or area of concern where borings deeper than 4 to 5 feet are required to assess a release. Tanks with a capacity of 2,000 gallons or less will be evaluated by a 25-foot depth boring.

Soil will be sampled at depths of 5, 10, 15, 20, and 25 feet in these borings. Soil at each of these sampling depths will be subjected to headspace analysis with an organic vapor analyzer (OVA) or HNu and will be visually observed for indications of contamination. All of the soil samples from the 25-foot boring are proposed for laboratory analysis.

### 4.2.3 Angle Borings

Angle borings will be drilled at SWMUs and areas of concern where it would be difficult (or impossible) to drill directly above the potential release area. Angle borings are recommended for hazardous waste storage areas (HWSAs) where it would not be practical to empty the HWSA, cut the concrete pad, drill a vertical boring, patch up the concrete surface, and then put the drums back inside. Angle borings are also recommended for sampling at the major washes and at USTs greater than 2,000 gallon capacity where vertical borings adjacent to the tank may not adequately detect a release.

Angle borings will be drilled at a 30 degree angle from vertical. Each of the angle borings will be 60 feet in length corresponding to a depth of about 52 feet below ground surface. Soil samples will be collected at intervals of 10 feet along the

length of the borehole, for a total of 6 samples per angle boring. Soil at each of these sampling depths will be subjected to headspace analysis with an OVA or HNu and will be visually observed for indications of contamination. Each of the six samples per angle boring is proposed for laboratory analysis.

## 4.3 Analytical Parameters

Samples collected during the sampling visits are proposed to be analyzed at U.S. Environmental Protection Agency (EPA) Level IV and Level V quality standards. Analyses will be performed in a Contract Laboratory Program (CLP) analytical laboratory. Analytical methods which follow CLP Routine Analytical Services (RAS) procedures and use Contract Required Detection Limits (CRDL) will be analyzed at EPA Level IV quality standards. Level IV is characterized by rigorous quality protocols, documentation, and validation. Analytical methods which follow Special Analytical Services (SAS) procedures will be analyzed at EPA Level V quality standards. These have method-specific protocols, documentation and validation requirements. A complete discussion of data quality objectives (DQOs) and analytical and quality control (QC) procedures is provided in the QAPP (Appendix A).

Table 4-3 presents a summary of the proposed laboratory analyses for each of the SWMUs and areas of concern recommended for a sampling visit.

### 4.3.1 Areas Proposed for Analysis for a Wide Range of Parameters

Soil samples from 51 SWMUs and areas of concern are recommended to be analyzed for a wide range of parameters because of the nature of the wastes that were managed at these areas. Examples of SWMUs in this category are HWSAs, the drainage channels, and the abandoned metal plating sewer lines. Soil samples at these 51 SWMUs will be analyzed for the entire CLP RAS Target Compound List (TCL) for organics and Target Analyte List (TAL) for metals. The compounds included in the TCL and TAL are presented in Table 4-4. This list includes volatile and semivolatile organic compounds, metals, cyanide, pesticides, and polychlorinated biphenyls (PCBs). Additional Special Analytical Services (SAS) analyses for Total Petroleum Hydrocarbons (TPH), Total Fuel Hydrocarbons (TFH), and pH will also be performed on each of the samples for these 51 SWMUs.

In addition to these analyses, analysis for dioxin is proposed for SWMU/AOC Number 194, the former incinerator site. Because burning of waste material occurred at this area, the potential for dioxin formation and release to soil will be evaluated. It should be noted that this is the only SWMU where dioxin analysis is planned.

**Table 4-3**
**Proposed Laboratory Analyses for RFA Sampling Visits**
**MCAS El Toro**



| SWMU/ AOC Number | Volatile Organics | Semi-Volatile Organics | Metals | TPH | TFH | Pesti-cides/ PCBs | pH | Dioxins and Furans |
|---|---|---|---|---|---|---|---|---|
| 3 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 4 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | -- |
| 5 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | -- |
| 6 | 8 | -- | -- | -- | 8 | -- | -- | -- |
| 7 | 2 | -- | -- | 2 | -- | 2 | -- | -- |
| 8 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 9 | 6 | -- | -- | -- | 6 | -- | -- | -- |
| 11 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | -- |
| 13 | 6 | -- | -- | -- | 6 | -- | -- | -- |
| 14 | 6 | -- | -- | -- | 6 | -- | -- | -- |
| 15 | 6 | -- | -- | -- | 6 | -- | -- | -- |
| 16 | 8 | -- | -- | -- | 8 | -- | -- | -- |
| 20 | 4 | -- | -- | -- | 4 | -- | -- | -- |
| 26 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | -- |
| 27 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | -- |
| 30 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 33 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | -- |
| 39 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | -- |
| 41 | 4 | -- | -- | 4 | -- | -- | -- | -- |
| 45 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 46 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 48 | 12 | -- | -- | 12 | -- | -- | -- | -- |
| 49 | 12 | -- | -- | 12 | -- | -- | -- | -- |
| 57 | 12 | -- | -- | 12 | -- | -- | -- | -- |
| 59 | 12 | -- | -- | 12 | -- | -- | -- | -- |
| 65 | 5 | -- | -- | 5 | -- | -- | -- | -- |

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**Table 4-3**
**Proposed Laboratory Analyses for RFA Sampling Visits**
**MCAS El Toro**



| SWMU/ AOC Number | Volatile Organics | Semi-Volatile Organics | Metals | TPH | TFH | Pesti-cides/ PCBs | pH | Dioxins and Furans |
|---|---|---|---|---|---|---|---|---|
| 67 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 70 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | -- |
| 72 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 73 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 76 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 83 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 84 | 5 | -- | -- | 5 | -- | -- | - | -- |
| 88 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | -- |
| 90 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | -- |
| 91 | 12 | -- | -- | 12 | -- | -- | -- | -- |
| 92 | 12 | -- | -- | 12 | -- | -- | -- | -- |
| 95 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 98 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 99 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 100 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 101 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 102 | 5 | -- | -- | -- | 5 | -- | -- | -- |
| 107 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | -- |
| 110 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 112 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 116 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 120 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 124 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 125 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 129 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 130 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |

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**Table 4-3**
**Proposed Laboratory Analyses for RFA Sampling Visits**
**MCAS El Toro**



| SWMU/ AOC Number | Volatile Organics | Semi-Volatile Organics | Metals | TPH | TFH | Pesti-cides/ PCBs | pH | Dioxins and Furans |
|---|---|---|---|---|---|---|---|---|
| 131 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | -- |
| 132 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 137 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 138 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 139 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 144 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 145 | 12 | -- | -- | 12 | -- | -- | -- | -- |
| 147 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 149 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 151 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 160 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 162 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 164 | 10 | -- | -- | 10 | -- | -- | -- | -- |
| 169 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 171 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 172 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 173 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 175 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 176 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 179 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 181 | 14 | -- | -- | -- | 14 | -- | -- | -- |
| 186 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | -- |
| 187 | 6 | -- | -- | 6 | -- | -- | -- | -- |
| 188 | 6 | -- | -- | 6 | -- | -- | -- | -- |
| 193 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 194 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |

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**Table 4-3**
**Proposed Laboratory Analyses for RFA Sampling Visits**
**MCAS El Toro**



| SWMU/ AOC Number | Volatile Organics | Semi-Volatile Organics | Metals | TPH | TFH | Pesti-cides/ PCBs | pH | Dioxins and Furans |
|---|---|---|---|---|---|---|---|---|
| 195 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 196 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 198 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 199 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 201 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 202 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 204 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 205 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 208 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 211 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 213 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 214 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 217 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 220 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 222 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 223 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 224 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 225 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 226 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 227 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 229 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 231 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 232 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 233 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 234 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 241 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |

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**Table 4-3**
**Proposed Laboratory Analyses for RFA Sampling Visits**
**MCAS El Toro**



| SWMU/ AOC Number | Volatile Organics | Semi-Volatile Organics | Metals | TPH | TFH | Pesti-cides/ PCBs | pH | Dioxins and Furans |
|---|---|---|---|---|---|---|---|---|
| 242 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | -- |
| 243 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 244 | 6 | -- | -- | 6 | -- | 6 | -- | -- |
| 248 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 249 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 250 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 252 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 253 | 2 | -- | -- | 2 | - | -- | -- | -- |
| 255 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 256 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | -- |
| 257 | 6 | -- | -- | -- | 6 | -- | -- | -- |
| 258 | 6 | -- | -- | -- | 6 | -- | -- | -- |
| 260 | 4 | -- | -- | -- | 4 | -- | -- | -- |
| 261 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | -- |
| 262 | 4 | -- | -- | -- | 4 | -- | -- | -- |
| 263 | 6 | -- | -- | -- | 6 | -- | -- | -- |
| 264 | 6 | -- | -- | 6 | -- | -- | -- | -- |
| 265 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | -- |
| 269 | 15 | -- | -- | 15 | -- | -- | -- | -- |
| 270 | 8 | -- | -- | 8 | -- | -- | -- | -- |
| 271 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 272 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | -- |
| 273 | 6 | -- | -- | 6 | -- | -- | -- | -- |
| 275 | 12 | -- | -- | 12 | 12 | -- | -- | -- |
| 276 | 12 | -- | -- | 12 | 12 | -- | -- | -- |
| 277 | 12 | -- | -- | 12 | 12 | -- | -- | -- |

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**Table 4-3**
**Proposed Laboratory Analyses for RFA Sampling Visits**
**MCAS El Toro**



| SWMU/ AOC Number | Volatile Organics | Semi-Volatile Organics | Metals | TPH | TFH | Pesti-cides/ PCBs | pH | Dioxins and Furans |
|---|---|---|---|---|---|---|---|---|
| 278 | 12 | -- | -- | 12 | 12 | -- | -- | -- |
| 279 | 12 | -- | -- | 12 | 12 | -- | -- | -- |
| 280 | 12 | -- | -- | 12 | 12 | -- | -- | -- |
| 282 | 5 | -- | -- | 5 | 5 | -- | -- | -- |
| 283 | 5 | -- | -- | 5 | 5 | -- | -- | -- |
| 286 | 12 | -- | -- | 12 | 12 | -- | -- | -- |
| 287 | 12 | -- | -- | 12 | 12 | -- | -- | -- |
| 291 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 296 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| 298 | 5 | -- | -- | 5 | -- | -- | -- | -- |
| **Totals** | **1,028** | **418** | **418** | **939** | **613** | **426** | **418** | **6** |

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**Table 4-4**
**Target Compound List (TCL) and**
**Contract Required Quantitation Limits (CRQL)***

**Sheet 1 of 7**

| | CAS Number | Quantitation Limits** Low Soil/Sediment[a] ug/Kg |
|---|---|---|
| **Volatiles** | | |
| 1. Chloromethane | 74-87-3 | 10 |
| 2. Bromomethane | 74-83-9 | 10 |
| 3. Vinyl Chloride | 75-01-4 | 10 |
| 4. Chloroethane | 75-00-3 | 10 |
| 5. Methylene Chloride | 75-09-2 | 5 |
| 6. Acetone | 67-64-1 | 10 |
| 7. Carbon Disulfide | 75-15-0 | 5 |
| 8. 1,1-Dichloroethene | 75-35-4 | 5 |
| 9. 1,1-Dichloroethane | 75-34-3 | 5 |
| 10. 1,2-Dichloroethene (total) | 540-59-0 | 5 |
| 11. Chloroform | 67-66-3 | 5 |
| 12. 1,2-Dichloroethane | 107-06-2 | 5 |
| 13. 2-Butanone | 78-93-3 | 10 |
| 14. 1,1,1-Trichloroethane | 71-55-6 | 5 |
| 15. Carbon Tetrachloride | 56-23-5 | 5 |
| 16. Vinyl Acetate | 108-05-4 | 10 |
| 17. Bromodichloromethane | 75-27-4 | 5 |
| 18. 1,2-Dichloropropane | 78-87-5 | 5 |
| 19. cis-1, 3-Dichloropropene | 10061-01-5 | 5 |
| 20. Trichloroethene | 79-01-6 | 5 |
| 21. Dibromochloromethane | 124-48-1 | 5 |
| 22. 1,1,2-Trichloroethane | 79-00-5 | 5 |
| 23. Benzene | 71-43-2 | 5 |
| 24. trans-1, 3-Dichloropropene | 10061-02-6 | 5 |
| 25. Bromoform | 75-25-2 | 5 |
| 26. 4-Methyl-2-pentanone | 108-10-1 | 10 |
| 27. 2-Hexanone | 591-78-6 | 10 |

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**Table 4-4**
**Target Compound List (TCL) and**
**Contract Required Quantitation Limits (CRQL)***

**Sheet 2 of 7**

| | CAS Number | Quantitation Limits** Low Soil/Sediment[a] ug/Kg |
|---|---|---|
| **Volatiles (Continued)** | | |
| 28. Tetrachloroethene | 127-18-4 | 5 |
| 29. Toluene | 108-88-3 | 5 |
| 30. 1,1,2,2-Tetrachloroethane | 79-34-5 | 5 |
| 31. Chlorobenzene | 108-90-7 | 5 |
| 32. Ethyl Benzene | 100-41-4 | 5 |
| 33. Styrene | 100-42-5 | 5 |
| 34. Xylenes (Total) | 1330-20-7 | 5 |
| **Semivolatiles** | | |
| 35. Phenol | 108-95-2 | 330 |
| 36. bis(2-Chloroethyl) ether | 111-44-4 | 330 |
| 37. 2-Chlorophenol | 95-57-8 | 330 |
| 38. 1,3-Dichlorobenzene | 541-73-1 | 330 |
| 39. 1,4-Dichlorobenzene | 106-46-7 | 330 |
| 40. Benzyl alcohol | 100-51-6 | 330 |
| 41. 1,2-Dichlorobenzene | 95-50-1 | 330 |
| 42. 2-Methylphenol | 95-48-7 | 330 |
| 43. bis(2-Chloroisopropyl) ether | 108-60-1 | 330 |
| 44. 4-Methylphenol | 106-44-5 | 330 |
| 45. N-Nitroso-di-n-dipropylamine | 621-64-7 | 330 |
| 46. Hexachloroethane | 67-72-1 | 330 |
| 47. Nitrobenzene | 98-95-3 | 330 |
| 48. Isophorone | 78-59-1 | 330 |
| 49. 2-Nitrophenol | 88-75-5 | 330 |
| 50. 2,4-Dimethylphenol | 105-67-9 | 330 |
| 51. Benzoic acid | 65-85-0 | 1600 |
| 52. bis(2-Chloroethoxy) methane | 111-91-1 | 330 |
| 53. 2,4-Dichlorophenol | 120-83-2 | 330 |

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**Table 4-4**
**Target Compound List (TCL) and**
**Contract Required Quantitation Limits (CRQL)***

**Sheet 3 of 7**

| | CAS Number | Quantitation Limits** Low Soil/Sediment[a] ug/Kg |
|---|---|---|
| **Semivolatiles (Continued)** | | |
| 54. 1,2,4-Trichlorobenzene | 120-82-1 | 330 |
| 55. Naphthalene | 91-20-3 | 330 |
| 56. 4-Chloroaniline | 106-47-8 | 330 |
| 57. Hexachlorobutadiene | 87-68-3 | 330 |
| 58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol) | 59-50-7 | 330 |
| 59. 2-Methylnaphthalene | 91-57-6 | 330 |
| 60. Hexachlorocyclopentadiene | 77-47-4 | 330 |
| 61. 2,4,6-Trichlorophenol | 88-06-2 | 330 |
| 62. 2,4,5-Trichlorophenol | 95-95-4 | 1600 |
| 63. 2-Chloronaphthalene | 91-58-7 | 330 |
| 64. 2-Nitroaniline | 88-74-4 | 1600 |
| 65. Dimethylphthalate | 131-11-3 | 330 |
| 66. Acenaphthylene | 208-96-8 | 330 |
| 67. 2,6-Dinitrotoluene | 606-20-2 | 330 |
| 68. 3-Nitroaniline | 99-09-2 | 1600 |
| 69. Acenaphthene | 83-32-9 | 330 |
| 70. 2,4-Dinitrophenol | 51-28-5 | 1600 |
| 71. 4-Nitrophenol | 100-02-7 | 1600 |
| 72. Dibenzofuran | 132-64-9 | 330 |
| 73. 2,4-Dinitrotoluene | 121-14-2 | 330 |
| 74. Diethylphthalate | 84-66-2 | 330 |
| 75. 4-Chlorophenyl-phenyl ether | 7005-72-3 | 330 |
| 76. Fluorene | 86-73-7 | 330 |
| 77. 4-Nitroaniline | 100-01-6 | 1600 |
| 78. 4,6-Dinitro-2-methylphenol | 534-52-1 | 1600 |
| 79. N-nitrosodiphenylamine | 86-30-6 | 330 |
| 80. 4-Bromophenyl-phenylether | 101-55-3 | 330 |

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**Table 4-4**
**Target Compound List (TCL) and**
**Contract Required Quantitation Limits (CRQL)***

**Sheet 4 of 7**

| | CAS Number | Quantitation Limits** Low Soil/Sediment[a] ug/Kg |
|---|---|---|
| **Semivolatiles (Continued)** | | |
| 81. Hexachlorobenzene | 118-74-1 | 330 |
| 82. Pentachlorophenol | 87-86-5 | 1600 |
| 83. Phenanthrene | 85-01-8 | 330 |
| 84. Anthracene | 120-12-7 | 330 |
| 85. Di-n-butylphthalate | 84-74-2 | 330 |
| 86. Fluoranthene | 206-44-0 | 330 |
| 87. Pyrene | 129-00-0 | 330 |
| 88. Butylbenzylphthalate | 85-68-7 | 330 |
| 89. 3,3'-Dichlorobenzidine | 91-94-1 | 660 |
| 90. Benzo(a)anthracene | 56-55-3 | 330 |
| 91. Chrysene | 218-01-9 | 330 |
| 92. bis(2-Ethylhexyl)phthalate | 117-81-7 | 330 |
| 93. Di-n-octylphthalate | 117-84-0 | 330 |
| 94. Benzo(b)fluoranthene | 205-99-2 | 330 |
| 95. Benzo(k)fluoranthene | 207-08-9 | 330 |
| 96. Benzo(a)pyrene | 50-32-8 | 330 |
| 97. Indeno(1,2,3-cd)pyrene | 193-39-5 | 330 |
| 98. Dibenz(a,h)anthracene | 53-70-3 | 330 |
| 99. Benzo(g,h,i)perylene | 191-24-2 | 330 |
| **Pesticides/PCBs** | | |
| 100. alpha-BHC | 319-84-6 | 8.0 |
| 101. beta-BHC | 319-85-7 | 8.0 |
| 102. delta-BHC | 319-86-8 | 8.0 |
| 103. gamma-BHC (Lindane) | 58-89-9 | 8.0 |
| 104. Heptachlor | 76-44-8 | 8.0 |
| 105. Aldrin | 309-00-2 | 8.0 |
| 106. Heptachlor epoxide | 1024-57-3 | 8.0 |

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**Table 4-4**
**Target Compound List (TCL) and**
**Contract Required Quantitation Limits (CRQL)***

**Sheet 5 of 7**

| | CAS Number | Quantitation Limits** Low Soil/Sediment[a] ug/Kg |
|---|---|---|
| **Pesticides/PCBs (Continued)** | | |
| 107. Endosulfan I | 959-98-8 | 8.0 |
| 108. Dieldrin | 60-57-1 | 16.0 |
| 109. 4,4'-DDE | 72-55-9 | 16.0 |
| 110. Endrin | 72-20-8 | 16.0 |
| 111. Endosulfan II | 33213-65-9 | 16.0 |
| 112. 4,4'-DDD | 72-54-8 | 16.0 |
| 113. Endosulfan sulfate | 1031-07-8 | 16.0 |
| 114. 4,4'-DDT | 50-29-3 | 16.0 |
| 115. Methoxychlor | 72-43-5 | 80.0 |
| 116. Endrin ketone | 53494-70-5 | 16.0 |
| 117. alpha-Chlordane | 5103-71-9 | 80.0 |
| 118. gamma-Chlordane | 5103-74-2 | 80.0 |
| 119. Toxaphene | 8001-35-2 | 160.0 |
| 120. Aroclor-1016 | 12674-11-2 | 80.0 |
| 121. Aroclor-1221 | 11104-28-2 | 80.0 |
| 122. Aroclor-1232 | 11141-16-5 | 80.0 |
| 123. Aroclor-1242 | 53469-21-9 | 80.0 |
| 124. Aroclor-124B | 12672-29-6 | 80.0 |
| 125. Aroclor-1254 | 11097-69-1 | 160.0 |
| 126. Aroclor-126D | 11096-82-5 | 160.0 |

[a]Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.
[b]Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semivolatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.
[c]Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL.
*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable. Also CRQL may differ depending on the latest EPA requirements, however the CRQL values are not expected to change greatly in later EPA protocols.
**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

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**Table 4-4**
**Inorganic Target Analyte List (TAL)**

**Sheet 6 of 7**

| Analyte | Contract Required Detection Limit (1,2) (ug/l) |
|---|---|
| Aluminum | 200 |
| Antimony | 60 |
| Arsenic | 10 |
| Barium | 200 |
| Beryllium | 5 |
| Cadmium | 5 |
| Calcium | 5000 |
| Chromium | 10 |
| Cobalt | 50 |
| Copper | 25 |
| Iron | 100 |
| Lead | 5 |
| Magnesium | 5000 |
| Manganese | 15 |
| Mercury | 0.2 |
| Nickel | 40 |
| Potassium | 5000 |
| Selenium | 5 |
| Silver | 10 |
| Sodium | 5000 |
| Thallium | 10 |
| Vanadium | 50 |
| Zinc | 20 |
| Cyanide | 10 |

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**Table 4-4**
**Inorganic Target Analyte List (TAL)**

**Sheet 7 of 7**

**Notes:**

(1) Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:

Method in use - ICP
Instrument Detection Limit (IDL) - 40
Sample concentration - 220
Contract Required Detection Limit (CRDL) - 5

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### 4.3.2 Areas Proposed for Analysis for TPH (or TFH) and Volatile Organics Only

Soil samples from 86 SWMUs and areas of concern are recommended to be analyzed for the following parameters: Volatile organics and TPH (or TFH). These SWMUs have been identified as managing hydrocarbon-type wastes and include USTs storing waste petroleum products, washracks with oily water, and other miscellaneous areas. Samples at these SWMUs are typically recommended for analysis for either TPH or TFH (except for USTs whose tank contents are unknown which are recommended for analysis for both TPH and TFH). Where the waste managed at a SWMU is a fuel (e.g., waste JP-5), analysis for TFH is recommended. For SWMUs with non-fuel hydrocarbons (e.g., waste oil, oily water, etc.), analysis for TPH is recommended. All samples at these SWMUs are also planned for analysis for volatile organics to assess whether they may be potential sources of the regional VOC-contaminated groundwater being investigated under the RI/FS Program.

### 4.3.3 Areas Proposed for Analysis for PCBs, TPH, and Volatile Organics Only

Soil samples from two SWMUs and areas of concern are recommended to be analyzed for the following parameters: PCBs, TPH, and volatile organics. These are SWMU/AOC Numbers 7 and 244 which are both areas where there has been a spill of transformer fluid. Since the nature of the potential contamination is defined at these SWMUs, the analytical parameters have been limited to PCBs

and TPH for characterization of the transformer fluid and volatile organics to assess whether these SWMUs may be potential sources of the regional VOC-contaminated groundwater being investigated under the RI/FS Program.

# 5.0 REQUEST FOR ANALYSIS

The analytical parameters for this study include volatiles, semivolatiles, pesticides/PCBs, metals, cyanide, dioxins and furans, TPH and TFH. Volatiles, semivolatiles, pesticides/ PCBs, metals, and cyanide will be analyzed per EPA Routine Analytical Services (RAS Contract Laboratory Program) compound/analyte lists and procedures. Analytical procedures for dioxins and furans, TPH and TFH are provided below. These procedures are based on standard EPA procedures and include parameter-specific QC procedures.

Table 5-1 presents information on sample preservatives, analytical holding times, contract holding times, and sample bottle requirements for the soil analyses proposed for the RFA sampling program at MCAS El Toro. See Table 4-3 for a list of analytical requirements on a site-by-site basis.

## 5.1 Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans Homologs

### 5.1.1 Analyses

Total tetra through octa chlorinated dibenzofurans (CDFs) and chlorinated dibenzo-p-dioxins (CDDs).

### 5.1.2 Sample Matrices

Water samples, soil samples, and chemical wastes such as still bottoms, fuel oils, sludges, fly ash, and reactor residues.

### 5.1.3 Analytical Procedure and Detection Limits

1. Contract Required Detection Limits (CRDL):

| | Soil, ug/kg |
|---|---|
| Tetra and penta CDFs and CDDs | 0.1 - 0.5 |
| Hexa CDFs and CDDs | 0.5 - 1.0 |
| Hepta and octa CDFs and CDDs | 1.0 - 5.0 |

Calculate and report the detected results or estimated sample detection limits (SDLs) (see Subsection 5.1.5 for calculation) for the dioxin/furan homologous series.

To achieve the specified detection limits, a final volume of 100 ul or less for the extracts is recommended.

**Table 5-1**
**Analyses Requested: Soil**

| CLP Analyses | Special Analytical Services (SAS) | | | Routine Analytical Services (RAS) | | | |
|---|---|---|---|---|---|---|---|
| | **Total Petroleum Hydrocarbons** | **Total Fuel Hydrocarbons** | **Dioxins and Furans** | **TCL VOAs** | **TCL Semi VOAs and Pesticides/PCBs** | **Metals** | **Cyanide Only** |
| Preservatives | Chill to 4°C | Chill to 4°C | Chill to 4°C | Chill to 4 C | Chill to 4 C | Chill to 4°C | Chill to 4°C |
| Analytical Holding Time(s) | Hold <14 days prior to analyses of gasoline or extraction of diesel, hold <40 days after extraction | Hold <14 days | Hold <28 days prior to extraction, 40 days after extraction | Hold <14 days | Hold <14 days prior to extraction, 40 days after extraction | Metals <6 months (28 days for Hg) | Hold <14 days |
| Contract Holding Time(s) | Hold <14 days prior to analyses of gasoline or extraction of diesel, hold <40 days after extraction | Hold <10 days | Hold <10 days prior to extraction, 40 days after extraction | Hold <10 days | Hold <10 days prior to extraction, 40 days after extraction | Metals <6 months (26 days for Hg) | Hold <12 days |
| Sample Bottles | 2 x 500 mi wide mouth glass jar or 4x4 oz | 2 x 500 ml wide mouth glass jar | 1 x 500 ml wide mouth glass jar or 2x4 oz | 2 x 120 ml wide mouth glass vials | 1 x 8 oz wide mouth glass jar or 2x4 oz | 1 x 8 oz wide mouth glass jar or 2x4 oz | 1 x 8 oz wide mouth glass jar |

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2. Analytical Methodology:

Follow the SW-846 Method 8280 or Method 8290 with the following specifications:

a. Analyze samples by a DB-5 fused silica capillary column or the equivalent. If dioxins/furans are detected in the samples, confirmatory analyses using a SP-2331 fused silica capillary column or the equivalent must be performed. Report all dioxins/furans identified and quantified by both columns. To achieve the chromatographic peak resolution criteria of $\leq$25 percent between 2,3,7,8-TCDD and 1,2,3,4-TCDD in the column performance check mixture, 60-meter columns are recommended for both DB-5 and SP-2331.

b. The quantitation ions, confirmation ions, and M - COC1 ions used for selective ion monitoring (SIM) are specified in Table 2 of Method 8280. Ions to be monitored are as follows:

Descriptor 1: 243,304,306,316,318,257,320,322,332,334,376

Descriptor 2: 277,340,342,293,356,358,410

Descriptor 3: 311,374,376,327,390,392,402,404,446

Descriptor 4: 345,408,410,418,420,361,424,426,480

Descriptor 5: 379,442,444,395,458,460,470,472,514

### 5.1.4 Contract Holding Times

Contract required holding times are 28 days from the date of sample receipt for extraction and 40 days from the date of sample receipt for GC/MS analysis.

### 5.1.5 Calibration Procedure and Criteria

Calibrate according to Section 6.0 of Method 8280, with the following specifications:

1. Internal standards and recovery standards required are as follow:

| Recovery Standard (RStd) | Daily Std Amount | Sample Amount |
|---|---|---|
| 13C-1,2,3,4-TCDD | 0.5 ng/ul | 50 ng |
| 13C-1,2,3,7,8,9-HxCDD | 0.5 ng/ul | 50 ng |
| Internal Standard (IStd) | | |
| 13C-2,3,7,8-TCDF | 0.5 ng/ul | 50 ng |
| 13C-2,3,7,8-TCDD | 0.5 ng/ul | 50 ng |
| 13C-1,2,3,6,7,8-HxCDD | 0.5 ng/ul | 50 ng |
| 13C-1,2,3,4,6,7,8-HpCDF | 0.5 ng/ul | 50 ng |
| 13C-OCDD | 1.0 ng/ul | 100 ng |

Compound Quantification

13C-TCDF and 13C-TCDD against 13C-1,2,3,4-TCDD

13C-HxCDD, 13C-HpCDF, and 13C-OCDD against 13C-1,2,3,7,8,9-HxCDD

TCDF and PeCDF against 13C-2,3,7,8-TCDF

TCDD and PeCDD against 13C-2,3,7,8-TCDD

HxCDD and HpCDD against 13C-1,2,3,6,7,8-HxCDD

HxCDF and HpCDF against 13C-1,2,3,4,6,7,8-HpCDF

OCDF and OCDD against 13C-OCDD

Results are to be calculated using the relative response factors (RRF) from the continuing calibration. The percent recoveries of each internal standard are to be calculated and reported. The samples with one or more internal standard recoveries of less than 40 percent or greater than 120 percent must be re-extracted and reanalyzed.

2. A column performance check mixture containing the isomers listed in Method 8280 paragraph 6.3 must be analyzed at the beginning and end of a 12-hour period, as described in paragraph 6.9.1. The QA/QC criteria as described in paragraph 6.3 must be met.

3. Initial calibration using standard solutions at concentrations of 200, 500, 1000, 2,000, and 5,000 ng/ml is required. Percent relative standard deviations (%RSD) of the relative response factors (RRF) for the calibration standards must not exceed 15 percent.

A minimum signal-to-noise (S/N) ratio of 50:1 for the m/z 320 ion of 2,3,7,8-TCDD must be achieved from the 200 ng/ml standard.

4. A calibration standard solution at concentration of 500 ng/ml must be analyzed at the beginning of a 12-hour period. The measured RRFs of all analyses must be within ±30 percent of the mean values established by initial analyses of the calibration standard solutions.

   A minimum S/N ratio of 150:1 for the m/z 320 ion of 2,3,7,8-TCDD must be achieved.

5. Samples and method blanks are not to be analyzed until acceptable calibration criteria as described in paragraphs 6.3, 6.4, 6.6, and 6.7 of Method 8280 are demonstrated and documented.

### 5.1.6 Internal Quality Control Checks, Control Limits, and Corrective Action

1. Alumina/silica column cleanup procedure is required for water and soil samples and chemical wastes. Additional cleanup (such as carbon column) may be needed for highly contaminated samples.

2. Analyze method blanks at a frequency of one per group of 20 or fewer samples. The method blanks must be free of chlorinated dibenzofurans and chlorinated dibenzo-p-dioxins and free of any interfering peaks.

3. Analyze a sample duplicate and native spike (NS) at the frequency of one per group of 20 or fewer samples. The NS solution must contain at least one x,2,3,7,8 isomer from each of the tetra through octa polychlorinated dibenzofuran and dibenzo-p-dioxin homologous series. Concentrations of NS solutions should be such that the final extracts contain amounts at the midrange of the calibration curve. Recoveries of 40 to 140 percent for tetra through octa polychlorinated dibenzofurans and dibenzo-p-dioxins are required. If the recovery limits are not met, the NS must be re-extracted and reanalyzed, unless a reinjection gives acceptable recoveries.

4. For samples in which the concentration of any isomer in a homologous series is above the five-point initial calibration range, the extracts are to be diluted in such a way that the measured concentration of that particular isomer lies within the calibration range. All computed results and raw data for both the undiluted sample analyses are to be submitted.

5. The laboratory will be expected to analyze performance evaluation samples as provided by EPA on a periodic basis.

6. If above control limits are exceeded, take appropriate actions to correct the problems and reanalyze the affected samples.

## 5.2 Analysis of Total Fuel Hydrocarbons by CA LUFT Method

### 5.2.1 Analyses

Gasoline and diesel

### 5.2.2 Sample Matrices

Groundwater, sludges, and soils

### 5.2.3 Analytical Procedure and Detection Limits

Follow the CA LUFT Method. Gasoline may be analyzed for using the headspace method or alternatively using the purge and trap method (EPA Method 5030). Analyze for diesel using the extraction method. The contract required detection limits are listed below:

| Method | Parameter | Matrix | Detection Limit |
|---|---|---|---|
| Headspace | Gasoline | Soil | 5.0 mg/kg |
| Extraction | Diesel | Soil | 10.0 mg/kg |

Samples are to be kept at 4 degrees Centigrade until analysis and validation of results are completed.

### 5.2.4 Contract Holding Times

Samples must be analyzed for gasoline as soon as possible or within 14 days after collection. They must be extracted for diesel within 14 days after collection, and the extract analyzed within 40 days. Samples may be held for a longer period only if the collector or laboratory has data on file to show that the specific types of samples under study are stable for the longer time.

### 5.2.5 Calibration Procedure and Criteria

1. Establish GC operating parameters as specified by the CA LUFT Method.

2. Adjust the sensitivity of the analytical system for the sample analyses by injecting secondary standards, as necessary.

3. Calibrate the chromatographic system using the external standard technique.

4. At least three concentration levels should be used for the preparation of the standard curve. One of the standards should be at a concentration near, but above, the method detection limit. The other standards should correspond to the expected range of concentrations found in real samples, or should define the working range of the detector.

5. Using injections of 2 to 5 ul of each calibration standard, tabulate total peak height or area responses against the mass injected. Use the results to prepare the calibration curve.

6. The working calibration curve must be verified on each working day by the measurement of one or more calibration standards. If the response varies from the predicted response by more than 10 percent, the test must be repeated using a fresh calibration standard. Alternatively, a new calibration curve may be prepared.

### 5.2.6 Internal Quality Control Checks, Control Limits, and Corrective Action

1. Analyze blanks, duplicates, and spikes at a frequency of one per batch or one per 20 samples, whichever is more frequent.

2. Establish appropriate laboratory statistical control limits at 99 percent confidence (average plus or minus three standard deviations) for percent Recovery and percent difference for the spike and duplicate, respectively.

3. If the above control limits are exceeded, take appropriate corrective actions and reanalyze the affected samples.

### 5.2.7 Data Calculations and Reporting Units

Calculate the sample results by external standard technique using peak height or area responses. Report results for soil samples in mg/kg (wet weight basis).

### 5.2.8 Documentation and Deliverables

1. Provide all sample results.

2. Provide all raw data, including copies of chromatograms and data system printouts or manual calculation work sheets. All raw data must be properly identified with the instrument and column identification, sample or standard identification, volume injected, and date and time of analysis.

3. Provide summaries of all blank, spike, and duplicate results, including reference numbers used and control limits.

4. Provide summaries of total peak height or area responses tabulated against mass injected for all initial calibration standards.

5. Provide summaries of daily calibration results showing percent differences from the predicted value, and the date and time of analysis.

6. The data package must be systematically organized with each page sequentially numbered.

## 5.3 Analysis of Total Petroleum Hydrocarbons by EPA Method 418.1

### 5.3.1 Analyses

Fluorocarbon-113 extractable petroleum hydrocarbons

### 5.3.2 Sample Matrices

Surface and saline waters; domestic and industrial wastes

### 5.3.3 Analytical Procedure and Detection Limits

Follow the procedure described in EPA Method 418.1. The contract required detection limit is 1 part per million.

1. The sample must be preserved with hydrochloric acid (HCl) if analysis is not performed within 4 hours of collection. It must be stored under refrigeration.

2. Use the entire sample for the test.

### 5.3.4 Contract Holding Time

Twenty-eight days following sample collection.

### 5.3.5 Calibration Procedure and Criteria

Follow the procedure specified in EPA Method 418.1. It is not necessary to add silica gel to the standards.

### 5.3.6 Internal Quality Control Checks, Control Limits, and Corrective Action

1. Analyze laboratory blanks at a frequency of one per group of 20 samples or fewer. The total petroleum hydrocarbon concentration of the blank must be less than the detection limit.

2. Analyze matrix spikes at a frequency of one per 20 or fewer samples. The spike recovery must be 75 to 125 percent of the spike concentration.

3. Analyze duplicates at a frequency of one per 20 or fewer samples. The relative percent difference between the duplicate values must not exceed 20 percent.

4. If the above control limits are exceeded, take appropriate corrective action and reanalyze the affected samples.

### 5.3.7 Data Calculations and Reporting Units

Report results to two significant figure using the curve and the equation specified in the method.

### 5.3.8 Documentation and Deliverables

Document analysis dates. Report results of all samples and blanks. Also report calibration data and results of matrix spikes and duplicate analyses in summary form. All raw data and sample calculations must be included. The data package must be systematically organized with all pages sequentially numbered.

# 6.0 FIELD METHODS AND PROCEDURES

The RFA field work at MCAS El Toro is limited to the collection of soil samples in the vadose zone. This section describes Standard Operating Procedures to be followed while performing the field investigation. This section also describes QC measures that will be taken with regard to sample collection. A discussion of DQOs, sample and laboratory QC, custody, data quality management, and quality assurance (QA) oversight is also provided in the QAPP (Appendix A). All field activities will be conducted under the direct supervision of a Registered Geologist or a Professional Engineer.

## 6.1 Drilling

### 6.1.1 Soil Boring Drilling

Continuous flight hollow-stem augers will be used to advance deep soil boreholes (greater than 5 feet) and to obtain soil samples. This technique uses continuous flight edges welded to hollow drill pipe with a cutter head at the bottom. As the cutter head rotates and advances the hole, cuttings are lifted to the surface on the flights. At specified intervals, the cutter head and plug may be lifted from the hole and soil sampling devices driven into the ground as described in Sub-section 6.2.1. During drilling the augers provide hole stability. The hollow-stem auger technique was chosen because:

- It is appropriate for the unconsolidated soils and shallow depth of drilling expected at each site.

- Relatively undisturbed samples can be obtained.

- The auger keeps the borehole open during sampling.

- The method introduces no extraneous fluids (liquid or air) into the borehole.

- The technology is well established and proven in use with conventional soil and hazardous waste sampling.

Boreholes drilled with the hollow-stem auger will be used to collect subsurface soil samples for chemical analysis. A maximum drilling depth of approximately 52 feet (60-foot angle boreholes drilled at 30 degrees from vertical) is anticipated at MCAS El Toro with this technique. Following sample collection, boreholes will be abandoned by backfilling with a cement grout containing about 3 to 5 percent bentonite powder.

### 6.1.2 Soil Boring Logging

Soil borings will be logged under the supervision of a registered geologist using the Wentworth scale and the Unified Soil Classification System (USCS) ASTM D 2487-85, and ASTM D 2488-84 on standard logging forms (Figure 81).

For vertical soil borings, drive samples will be taken and inspected for lithology every 5 feet or at change of lithology. Samples will be collected every 10 feet in angle boreholes. Selected samples will be retained for analysis as described in Subsection 6.2.1. The boring log will include lithologic descriptions along with observations of drilling speed, drill bit behavior, drill rig injection rates, cuttings return rates, and pull-down pressures as different materials are encountered. The major components to be recorded in the log by the onsite geologist include the following:

- The depth, color, and texture of cuttings; percentage gravel, sand, silt, and clay; descriptive comments; and moisture content of samples collected

- Sample intervals and blow counts

- Drilling speed and drill rig behavior

- A record of measurements of an organic vapor analyzer used as described in Subsection 6.2.3

- Records of the depths at which suspected contamination occurred based on visual inspection and organic vapor readings, and depths at which the soil cuttings were drummed

## 6.2 Sample Collection

### 6.2.1 Subsurface Soil Samples

Subsurface soil sampling will be done using ASTM Method D-1586 with a 24-inch-long modified California split-spoon drive sampler with eight 3-inch-long stainless steel or brass liners. Samples collected for metals analysis must use stainless steel liners. This method was selected because:

- The sampling method is consistent with the use of the hollow-stem auger drilling method.
- Sample handling is reduced because the soil is already in containers suitable for sealing and shipping.
- Volatile organics are a concern at the site; and the sampling method limits the exposure of the soil to the air, which limits the potential for loss of volatiles during field operations.

If the split-spoon sampler cannot be driven into the soil ahead of the auger (sample refusal), an attempt may be made to collect a sample using a coring device.

Prior to each sampling, the modified California drive sampler with liners will be decontaminated. As each sample is recovered, the exposed ends of each tubular segment will be examined and logged. The sample ends will then be wrapped with a Teflon sheet, capped with plastic caps, and sealed with vinyl tape. The sample will be marked with the appropriate information as described in Subsection 6.6. The outside of the samples will be wiped with deionized water, and the sample will be wrapped in a clear zip-lock plastic bag. Samples will be immediately placed in coolers at 4°C. All samples will be logged on chain-of-custody sampling forms and a sampling log (see Figure 82), and recorded in a field notebook maintained by the onsite supervisor.

The sampling procedures are as follows:

- After the blocking plug, auger flights, and interior have been decontaminated (Subsection 6.4), the auger and blocking plug will be advanced to the depth at which a sample is to be collected using ASTM Method D-1586. During this period between sampling events, the materials encountered during drilling will be recorded on a soil boring log (see Figure 81).

- Organic vapors will be monitored as described in Subsection 6.2.3.

- When a sampling depth is reached, the blocking plug will be removed and replaced with a drive sampler. If the sample is for lithology only, a 1-5/8-inch-diameter standard penetration split-spoon sampler will be used. If the sample will be retained for chemical analysis, a decontaminated California modified

split-spoon sampler equipped with eight 3-inch stainless steel or brass sleeves will be used.

- The sampler will be lowered back into the augers and driven into the undisturbed soil for a depth of 24 inches. The number of blow counts required to drive the sampler for each 6-inch interval will be recorded.

- The sampler will then be removed and drilling to the next sampling depth will be accomplished.

- When maximum depth of borehole has been reached, the auger will be removed; and the borehole will be tremie-grouted to the surface with a bentonite cement slurry.

- All augers and equipment used below the ground surface will be decontaminated (see Subsection 6.4).

### 6.2.2 Shallow Soil Samples

Shallow (i.e., less than 5-feet deep) soil will be sampled with a hand auger. A sufficient volume of soil will be collected using auger buckets and placed in a large container before being transferred to the appropriate sample containers. Only soil samples which will be analyzed for dioxins and furans; semivolatiles; pesticides/PCBs; metals; and cyanide will be collected in this manner. Soil samples which will be analyzed for volatiles; total petroleum hydrocarbons; and

total fuel hydrocarbons will be collected using a soil core sampler. The samples are collected by lowering the core sampler down the borehole and pounding it using a hammer attachment. Aluminum or brass liners are attached to the end of the core sampler assembly. As the samples are recovered, they will be handled in a similar fashion as described in Subsection 6.2.1. All samples will be marked with the sample number, date, time, and other appropriate information, and immediately stored in coolers at approximately 4°C. All sampling information will be recorded in sample log books, chain-of-custody forms, and the field notebook maintained by the onsite supervisor (see Figures 82 and 83).

### 6.2.3 Organic Vapor Monitoring and Soil Vapor Headspace Analysis

During all drilling operations, organic vapor analyzer(s) (OVAs) which are flame ionization detectors, or HNu meters which are photoionization detectors will be used to monitor work place concentrations in the air. During all soil sampling activities, OVAs or HNu meters will also be used to measure head space concentrations of organic vapors from soil samples. These measurements will be recorded in field notebooks.

Work place concentrations will be monitored at various times during drilling/ sampling activities. Monitoring will be conducted especially during activities with highest potential for vapor emissions. Monitoring will be accomplished by holding the analyzer inlet probe at breathing level (4 to 5 feet above ground), in the vicinity of the highest emission source (usually near the borehole opening), and monitoring concentration of organic vapors for a minimum period of 10 seconds.

Results will be compared to background concentrations measured upwind from the work area. (Refer to the Site Health and Safety Plan for additional information.)

Soil vapor headspace concentrations of VOCs will be measured by placing the contents of a 3-inch soil sample ring into a clean 500-ml wide-mouth glass jar and breaking it into a few pieces with a clean spatula. After capping the glass jar with aluminum foil and lid ring, and allowing it to stabilize for a period of 5 minutes, the analyzer probe(s) will be inserted through the foil and a measurement taken.

If saturated water vapor in the sample jar fogs the HNu lamp, resulting in spurious readings, then the OVA will be used for all headspace analyses.

The OVA or HNu meter will be calibrated at the beginning and end of each day using ultra-pure air, and low- and high-level standards (OVA), or supplied calibration gas (HNu meter). The OVA standards used for calibration will reflect the contaminants expected for that particular site.

The analyzer(s) will also be checked for performance at the end of each working day. and any significant drift in the precision or accuracy of the instrument will be recorded.

## 6.3 Disposal of Waste Materials

This section describes the general approach that will be followed when disposing of waste materials generated during the RFA related field activities at MCAS El Toro. A detailed Waste Management Plan has been developed for the RI/FS (JEG, 28 June 1991). Upon agency approval of the plan, waste materials generated during the RFA will be disposed in a similar manner as described in the document. However, the procedures described in the RI/FS will be modified as necessary for RFA derived waste materials.

Three types of waste materials will be generated during field activities: 1) drill cuttings and subsurface soil samples collected for geological information, 2) decontamination rinsate, and 3) discarded personal protective equipment (PPE).

Applicable standards governing waste disposal have been developed in the RI/FS Waste Management Plan. The wastes will be sampled and analyzed to determine the appropriate disposal method. In general, waste classification will follow the standards established by EPA, DHS, and RWQCB. Process knowledge and chemical use information, as well as testing results, are used to classify wastes according to EPA and DHS rules. Wastes can be classified as hazardous by matching ones listed as common waste, or by exceeding regulatory threshold levels. Testing requirements may include ignitability, reactivity, toxicity (using the toxicity characteristic leaching procedure [TCLP]), and bioaccumulative toxicity. Threshold levels are in place for TCLP toxicity, and bioaccumulative toxicity expressed as soluble threshold limit concentration (STLC)

standards as determined by the Waste Extraction Test (WET), or the total threshold limit concentrations (TTLC).

The California Designated Level Methodology may be used to classify waste materials to be land-disposed. This methodology is used to determine whether a waste is classified as designated or nonhazardous according to the RWQCB requirements. It includes a consideration of both the characteristics of the constituent and the site. The designated level equals the product of a water quality goal times an environmental attenuation factor. At MCAS El Toro, the water quality goal may be the Maximum Contaminant Level, or drinking water standard for the constituent; the attenuation factor(s) will be determined at a later date to correspond with those developed for the RI/FS.

The contractor will prepare manifests, and make arrangements for shipping, handling and disposal of wastes at off-Station facilities. The contractor will also track wastes disposed of on-Station. The shipping, handling, and disposal of hazardous materials will be in accordance with all federal, state, and local laws and regulations.

### 6.3.1 Drill Cuttings and Subsurface Soils

Soil generated during drilling and sampling of soil borings will be stored in 55-gallon drums. These will be affixed with a permanent and unique label that identifies the drilling or sampling location, the contents, depth of cuttings or soil samples, and date the container was filled. In addition, the source, volume, and description of materials placed in the containers will be recorded in the field notebook so that an inventory may be maintained.

The drums will be transported to a less-than-90-day storage on-Station designated by MCAS El Toro. This location will be paved and fenced to ensure the security and integrity of the wastes. The drum contents will be sampled and analyzed for waste characterization.

If the soils are classified as hazardous or designated, they will be disposed of according to applicable regulations as described in the RI/FS Waste Management Plan. If they are found to be nonhazardous, they may be disposed of on-Station at a location designated by MCAS El Toro.

### 6.3.2 Decontamination Rinsate

Wastewater generated from equipment decontamination activities will be collected in portable Baker tanks. Water generated during decontamination will flow into a containment sump, and will then be pumped into a Baker tank. Water used in decontamination of sampling devices will also be poured into a Baker tank. Since the decontamination rinsate is expected to have high solids content, it will be transported off-Station for disposal at a treatment plant.

### 6.3.3 Disposable Protective Equipment

Disposable PPE generated during the performance of the work will be contained in 55-gallon drums. The drums will be sealed and labeled to indicate the drilling or sampling location, and cross-referenced to waste generated from the location that is being stored for characterization. If the drill cuttings and subsurface soils

are determined to be hazardous, then the PPE will be disposed of as if it were hazardous also. Otherwise, the PPE will be disposed of to a Class III landfill.

## 6.4 Equipment Decontamination

### 6.4.1 Drilling and Soil Sampling Equipment

All drilling equipment and materials will be decontaminated by steam cleaning prior to any drilling operations and between borings at a location designated by the Station. All tools used for soil sampling and packaging, including split-barrel samplers and sample-cutting knives, will be decontaminated prior to the collection of each sample.

The drilling auger, bits, drill pipe, and other equipment that will go into the bore-hole will arrive clean at the site. Between borings and at the completion of work, the equipment will be decontaminated using a high-pressure steam cleaner.

Soil sampling equipment will be decontaminated at the individual drilling sites. Prior to sampling, the split-spoon sampler will be scrubbed clean with a trisodium phosphate solution using a stiff long-bristle scrub brush. After the detergent scrub, the equipment will be rinsed over a rinsate tub with clean tap water. The sampling equipment will then be spray-rinsed as follows: with distilled water, with hexane, and finally with distilled water twice. The equipment will be allowed to drain and air dry before being placed in a clean area either on plastic or covered with aluminum foil.

## 6.5 Sample Containers, Preservation, Packaging, and Shipping

### 6.5.1 Sample Preservation

Table 6-1 presents the appropriate methods of sample preservation for analyses planned. The table also shows the methods of sample packaging and shipping criteria.

Table 6-2 provides the allowable holding times for samples to be collected during the sampling at MCAS El Toro.

The project team will pack all samples obtained during the field investigations in the following manner:

1. Each container will be packaged and sealed in a separate sealable plastic bag. Figure 84 shows the process for packaging soil samples.

2. Both the inside and outside of cooler drains will be taped.

3. Coolers will be lined with plastic bags, and approximately 3 inches of vermiculite will be placed in the bottom of bags.

4. The sample containers and frozen Blue-Ice packages in sealable plastic bags will be placed on end in the cooler and arranged so they do not touch, and the voids will be filled with vermiculite.

5. The large plastic bags will be taped closed and custody sealed.

6. A custody seal will be placed on each sample container.

7. A mailing label with the laboratory address will be placed on top of each cooler.

8. "THIS SIDE UP" labels will be attached on all four sides of each cooler. "FRAGILE" labels will be attached on at least two sides of each cooler.

9. Shipper's address will be written on the outside of the cooler. If address is stenciled on, "SHIPPER" will be written above it.

10. Each cooler must weigh less than 70 pounds.

### 6.5.2 Shipping

All samples will be shipped to a Contract Laboratory Program (CLP) laboratory via overnight carrier. All samples will be shipped in the following manner:

1. A completed chain-of-custody record indicating the time and date shipment was relinquished to the shipping agent will be reviewed.

**Table 6-1**
**Sample Quantities, Bottles, Preservatives, and Packing for Samples from MCAS El Toro**

| Analysis | Containers | Sample Volume | Preservation | Shipping | Packaging |
|---|---|---|---|---|---|
| Subsurface Soil<br><br>Pollutant Analysis (all analytes) | Modified California split-spoon with stainless steel or brass sleeve capped with Teflon film, plastic cap, vinyl tape | 6 sleeves,<br>2-inch diameter<br>3 inches long | Iced to 4°C | Priority 1 (if medium or high hard, include certificate for restricted articles) | In cans packed in bubble wrap |
| Shallow Soil<br><br>Volatiles; Total Petroleum Hydrocarbons; Total Fuel Hydrocarbons | Core sampler with aluminum or brass sleeve, capped with Teflon film, plastic cap, vinyl tape | 3 sleeves,<br>2-inch diameter<br>2 inches long | Iced to 4°C, | Priority 1 (if medium or high hazard, include certificate for restricted articles) | In cans packed in bubble wrap |
| Dioxin and Furans | (1) 500-ml wide-mouth glass jar | Fill full | Iced to 4°C, away from sunlight | Priority 1 (if medium or high hazard, include certificate for restricted articles) | Foam Liner No. 3 |
| Semivolatiles and Pesticides/PCBs | (1) 8 oz wide-mouth glass jar | Fill full | Iced to 4°C, away from sunlight | Priority 1 (if medium or high hazard, include certificate for restricted articles) | Foam Liner No. 3 |
| Metals | (1) 8 oz wide-mouth glass jar | Fill full | Iced to 4°C, away from sunlight | Priority 1 (if medium or high hazard, include certificate for restricted articles) | Foam Liner No. 3 |
| Cyanide | (1) 8 oz wide-mouth glass jar | Fill full | Iced to 4°C, away from sunlight | Priority 1 (if medium or high hazard, include certificate for restricted articles) | Foam Liner No. 3 |

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**Table 6-2**
**Holding Times for Soil Samples, By Analysis**

| Analysis | Analytical Holding Time (Days) |
|---|---|
| Volatiles | 14 |
| Semivolatiles | |
| Extraction | 14 |
| Analysis after extraction | 40 |
| Dioxins/Furans | |
| Extraction | 28 |
| Analysis after extraction | 40 |
| Pesticides/PCBs | |
| Extraction | 14 |
| Analysis after extraction | 40 |
| Total Petroleum Hydrocarbons | |
| Extraction | 14 |
| Analysis after extraction | 40 |
| Total Fuel Hydrocarbons | 14 |
| Metals | 6 mo |
| Cyanide | 14 |

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2. The chain-of-custody record going to the laboratory will be placed in a sealable plastic bag. The bag will be custody sealed and taped to the inside of the cooler lid.

3. The lid will be closed and the cooler taped shut with strapping tape.

4. A shipping bill will be completed and attached to the cooler.

5. At least two signed custody seals will be affixed over lid openings (front right and back left of cooler).

### 6.5.3 Sample and Shipping Containers

Table 6-1 presents the types of sample containers and sample quantities to be collected during the sampling at MCAS El Toro.

Shipping containers will be plastic or metal-clad ice chests, in good condition, capable of retaining fluids should a sample loss occur.

## 6.6 Sample Custody and Sample Labeling

A sample is physical evidence collected from a hazardous waste site, from the immediate environment, or from another source. Because of the potential evidentiary nature of samples, the possession of samples must be traceable from the time the

samples are collected until they are introduced as evidence in enforcement proceedings.

Chain-of-custody procedures are used to maintain and document sample possession for enforcement purposes. The principal documents used to identify samples and to document possessions are:

- Chain-of-custody records
- Air bills or shipping records (e.g., Federal Express, Purolator, etc.)
- Field notebooks

These documents may be introduced as evidence should a site investigation result in legal action.

The site sample manager (SSM) will maintain a supply of field documents including sample custody seals and chain-of-custody records. The SSM is responsible for inventory of serialized documents and assignment of these documents to specific tasks. All unused field documents are returned to the SSM at the end of the field sampling work. The SSM notes the return of these documents in the serialized document logbook.

A sample numbering system will be used to identify each sample and associated duplicates for chemical analysis. A sample numbering system will be used to identify each collected sample. This system will provide a tracking number to allow retrieval and cross-referencing of sample information, and provide anonymity for the samples at the

laboratory. A list of the sample identification numbers will be maintained in the field notebook. The anticipated numbering system for the MCAS El Toro project is described in Subsection 6.7.

### 6.6.1 Chain-of-Custody

Because samples collected during any investigation could be used as evidence, their possession must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. To document sample possession, chain-of-custody procedures are followed.

A sample is under custody if one or more of the following criteria is met:

- It is in your possession
- It is in your view, after being in your possession
- It was in your possession and then you locked it up to prevent tampering
- It is in a designated secure area

### 6.6.2 Sample Labels

All samples will be labeled with information identifying the sample location, date and time of sample collection, sampler, and other relevant data, as appropriate. All samples will be assigned a unique identifying number that will be written on the sample label, and affixed as a separate printed label.

All labels will be filled out using indelible ink and affixed to the sample containers via the adhesive backing. Wide, clear plastic tape will then be placed over the label to protect it and to further secure the label to the sample container. An example of the sample label to be used is given in Figure 85.

### 6.6.3 Chain-of-Custody Record

A chain-of-custody record will be filled out for each sample shipment container. All samples within a container must be accounted for on the chain-of-custody record. An example of the chain-of-custody record is given in Figure 83.

### 6.6.4 Transfer of Custody and Shipment

Samples are accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst at the laboratory.

Samples are packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate chain-of-custody record accompanying each shipping container. Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, courier name(s), and other pertinent information are entered in the Remarks section of the chain-of-custody record. An example of the custody record is given in Figure 83.

## 6.7 Sample Documentation

### 6.7.1 Sample Identification

Samples will be assigned unique alpha-numeric numbers consisting of three fields as follows: 1) The first field identifies the SWMU/AOC Number; 2) The second field identifies the boring number; and 3) The last field identifies the sample depth (order sequentially from land surface) and whether the sample is a duplicate or blank sample. For example, the sample identifier, **49-B2-3**, is assigned to SWMU/AOC Number 49, second boring, third sample depth collected during drilling.

A field master sample log will consist of a bound notebook maintained at the field headquarters. All samples collected at the Station will be logged in the master sample log on a regular basis.

If for any reason a sample number is not used (accidentally skipped), all three labels should be placed in the master sample log to indicate that number was not used.

The master sample log will be reviewed and copied weekly (minimum) by the Site Sample Manager.

### 6.7.2 Field Record Keeping

In addition to completion of chain-of-custody record, master sample log, soil boring logs, and other preprinted data forms, all team members will be assigned bound field notebooks, in which significant events, observations, and measurements will be recorded on a daily basis. Members of the field team will use this notebook to record the measurements taken during sampling, including the following: person sampling; sample designation with adhesive label; date; time; location; field parameters such as volatile measurements with organic gas analyzers; volumes of water purged; sample containers used and analyses to be performed; decontamination procedures; and sampling procedures.

These notebooks are to be kept in ink as permanent records. It will be the responsibility of each field member to copy notebook pages weekly, to serve as a backup in case the original notebook is lost or destroyed. Notebook copies will be maintained in CH2M HILL office files.

### 6.7.3 Corrections to Documentation

Unless prohibited by weather conditions, all original data recorded in field notebooks, the master sample log, sample identification tags, and chain-of-custody records are written in waterproof ink. None of these accountable serialized documents is to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on an accountable document assigned to one individual, that individual may make corrections simply by crossing a line through the error and entering the correct information. The erroneous information should not be obliterated. Any subsequent error discovered on an accountable document should be corrected by the person who made the entry. All subsequent corrections must be initialed and dated.

## 6.8 Quality Control Samples

Additional samples will be analyzed as part of a QC program for the RFA at MCAS El Toro. Table 6-3 provides a summary of QC procedures.

### 6.8.1 Field Quality Control Sampling

#### 6.8.1.1 Field Duplicate Samples

Field duplicate samples will be collected at a rate of 10 percent or one per week, whichever is greater. For shallow soils collected by auger buckets, duplicate samples will be collected by splitting samples, provided that sufficient sample volume can be collected. For soil samples collected in drive samples or core samples, the deepest and next-to-deepest sample sleeve will serve as duplicates. If insufficient sample volume exists, a duplicate will be collected in a successive driven or cored sample.

#### 6.8.1.2 Rinsate Samples

Rinsate samples will be collected at a rate of 5 percent of project samples (no daily requirements). Rinsate samples will be collected by retaining the final rinse water following decontamination of soil sampling equipment, including split-spoon samplers and hand augering equipment.

#### 6.8.1.3 Trip Blanks

Trip blank samples will accompany each cooler that contains samples being submitted for VOC analysis. Trip blanks are prepared with Type II Reagent Grade water. Trip blanks will be prepared at the laboratory and are not exposed to field conditions. Samples collected for VOC analysis will be shipped separately together in a cooler each day to minimize the number of trip blanks required for analysis. Analysis will consist of RAS volatiles.

### 6.8.2 Laboratory Quality Control Sampling

Approximately one field sample per week or one QC sample for each 20 samples (include duplicates and blanks) will be designated as a Laboratory QC Sample. This sample will be utilized by the laboratory for duplicate and matrix spike analysis. Samples suspected of moderate contamination will be chosen for the laboratory QC sample, if possible. The sample will be identified and denoted as "Lab QC Sample" on the sample bottle, and the chain-of-custody record.

**Table 6-3**
**Summary of Quality Control Procedures**

| Field QC | | | |
|---|---|---|---|
| **Sample Type** | **Target Frequency** | **Daily Minimum[a]** | **Comment** |
| Replicate (soil) | 10% | None | If sufficient volume |
| Trip blank | 10% | None | EPA 8240 only |
| Rinsate Samples | 5% | None | - |
| **Laboratory QC** | | | |
| **Sample Type** | **Target Frequency** | **Daily Minimum[b]** | |
| Duplicate | 5% | 1/analysis method | |
| Blank | 5% | 1/analysis method | |
| Matrix spike | 5% | 1/analysis method | |
| Surrogate spike | (method specific) | (method specific) | |
| Control | 5% | 1/analysis method | |

[a]During sampling activities for soil
[b]During analysis activities for specific methods

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# Appendix A

# QUALITY ASSURANCE PROGRAM PLAN

## TABLE OF CONTENTS


Page

1.0 PROJECT DESCRIPTION . . . . . A-1

2.0 DATA QUALITY OBJECTIVES . . . . . A-3

3.0 PROJECT ORGANIZATION . . . . . A-11

4.0 SAMPLE COLLECTION AND QUALITY CONTROL . . . . . A-13

5.0 SAMPLE CUSTODY . . . . . A-15

5.1 Chain-of-Custody . . . . . A-16

5.1.1 Definition of Custody . . . . . A-16

5.1.2 Field Custody . . . . . A-17

5.1.3 Transfer of Custody and Shipment . . . . . A-17

5.1.4 Laboratory Custody Procedures . . . . . A-19

5.2 Custody Seals . . . . . A-20

5.3 Sample Labels . . . . . A-20

5.4 Field Notebooks . . . . . A-21

5.5 Corrections to Documentation . . . . . A-21

6.0 ANALYTICAL AND QUALITY CONTROL PROCEDURES . . . . . A-23

6.1 Analytical Procedures . . . . . A-23

6.2 Calibration Procedures . . . . . A-24

6.2.1 Field Calibration Procedures . . . . . A-24

6.2.2 Laboratory Calibration Procedures . . . . . A-25

6.3 Quality Control Procedures . . . . . A-25

6.3.1 Field Quality Control Procedures . . . . . A-25

6.3.2 Laboratory Quality Control Procedures . . . . . A-26

6.3.3 Chain-of-Custody Procedures . . . . . A-26

## TABLE OF CONTENTS (Continued)

Page


6.4 Preventive Maintenance . . . . . A-27

7.0 DATA QUALITY MANAGEMENT . . . . . A-29

7.1 Data Reduction, Validation, and Reporting . . . . . A-29

7.2 Data Assessment Procedures . . . . . A-30

7.2.1 Accuracy . . . . . A-31

7.2.2 Precision . . . . . A-31

7.2.3 Completeness . . . . . A-32

8.0 QUALITY ASSURANCE OVERSIGHT . . . . . A-33

8.1 Performance and System Audits . . . . . A-33

8.2 Corrective Action . . . . . A-34

8.3 Quality Assurance Reports . . . . . A-34

Attachment 1

CLP Accuracy and Precision Limits . . . . . A-35

Attachment 2

Non-CLP Parameters Analytical and Quality Control Procedures . . . . . A-50

Attachment 3

Field Audit Procedures . . . . . A-64


List of Tables


2-1 EPA Descriptions of Analytical Levels . . . . . A-5

2-2 Quality Assurance Objectives for Soil Analyses . . . . . A-7

# 1.0 PROJECT DESCRIPTION

Project objectives and background information are presented in Section 1.0 and Section 2.0 of the Sampling Plan.

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## 2.0 DATA QUALITY OBJECTIVES

The quality assurance objectives of this project are to develop and implement procedures to provide data of known and appropriate quality. Data quality is assessed by representativeness, comparability, accuracy, precision, and completeness. Definitions of these parameters, the applicable procedures and level of effort, are described below.

The applicable quality control (QC) procedures, quantitative target limits, and levels of effort for assessing data quality are dictated by intended data usage and the nature of analytical methods. For this project, the parameter analyses are designed toward the remedial investigation of nature, extent, and source of contaminants at the site as described in greater detail in Section 2.0 of the Sampling Plan. Routine Analytical Services (RAS) analyses for volatiles, semivolatiles, pesticides/PCBs, metals, and cyanide will satisfy data quality Level IV. The Special Analytical Services (SAS) analyses for dioxins/furans, total petroleum hydrocarbons (TPH), and total fuel hydrocarbons will satisfy data quality Level V. Designated data quality Level IV and Level V are based on U.S. Environmental Protection Agency (EPA) guidelines (Data Quality Objectives for Remedial Response Activities. 2 Parts. Vol. 1: Development Process [EPA-540/G-87/003], Vol. 2: Example Scenario [EPA-540/G-87/004]. EPA, 1987). The descriptions of the two data quality levels from EPA guidelines are summarized in Table 2-1. The applicable detection limits for the RAS analyses are Contract Laboratory Program (CLP) contract required detection limits (CRDL). Those for SAS analyses are specific to the methods. Specific data quality objectives in terms of representativeness, comparability,

detection limits, accuracy, precision, and completeness are defined below. Quantitative goals for these data quality parameters, where applicable, are given in Table 2-2.

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the soil sampled. Sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) have been developed and are discussed in subsequent sections of this document. Proposed documentation will establish that protocols have been followed and sample identification and integrity assured. Field blanks and field duplicates obtained at a minimum 10 percent or one-per-day frequency will be used to assess field and transport contamination and method variation. Laboratory sample retrieval, storage, and handling procedures have also been developed and are discussed in subsequent sections of this document. Laboratory method blanks will be run at the minimum frequency of 5 percent or one-per-set to assess laboratory contamination.

Comparability of the data will be maintained by using EPA-defined procedures where available; if EPA procedures are not available, the procedures have been defined or referenced in this document. Data comparability will be maintained by use of consistent methods and consistent units. Table 2-2 lists specific analyses parameters and applicable methods. Section 6.0 of this document and Section 5.0 of the Sampling Plan further describe the analytical procedures and the QC procedures.

**Table 2-1**
**EPA Descriptions of Analytical Levels[a]**

| Data Uses | Analytical Level | Type of Analysis | Limitations | Data Quality |
|---|---|---|---|---|
| Risk assessment PRP determination evaluation of alternatives engineering design | Level IV | HSL organics/inorganics by GC/MS; AA; ICP<br><br>Low ppb detection limit | Tentative identification of nonHSL parameters<br><br>Some time may be required for validation of packages | Goal is data of known quality<br><br>Rigorous QA/QC |
| Risk assessment PRP determination | Level V | Nonconventional parameters<br><br>Method-specific detection limits<br><br>Modification of existing methods<br><br>Appendix 8 parameters | May require method development/modification<br><br>Mechanism to obtain services requires special lead time | Method-specific |

[a]EPA Guidelines (EPA 1987. Data Quality Objectives for Remedial Response Activities. Two Parts. Development Process [EPA-540/G-87/003]. Example Scenario [EPA-540/G-87/004]).

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**Table 2-2**
**Quality Assurance Objectives**
**for Soil Analyses**

| Parameter | Method | Target Detection Limit[a] | Accuracy % Recovery | Precision (Relative Percent Deviation) | Completeness % |
|---|---|---|---|---|---|
| Volatiles | CLP[b] | CLP[b] | CLP[b] | CLP[b] | 90 |
| Semivolatiles | CLP[b] | CLP[b] | CLP[b] | CLP[b] | 90 |
| Pesticides/PCBs | CLP[b] | CLP[b] | CLP[b] | CLP[b] | 90 |
| Metals, Cyanide | CLP[b] | CLP[b] | CLP[b] | CLP[b] | 90 |
| Dioxins and dibenzofurans [total tetra through octa isomers] | 8280[c] | 0.1-5.0μg/kg | 40-140 | ±60 | 90 |
| Fuel hydrocarbons | California method[d] | Gasoline 5mg/kg Diesel 10mg/kg | d | d | 90 |
| Petroleum hydrocarbons | 418.1 | 1mg/kg | N/A | N/A | 90 |

[a]These are target values; actual limits depend on nature of specific matrix and will be reported.
[b]Contract Laboratory Program (CLP) procedures and quality control limits are defined in EPA contracts IFBS WA-85-J664/J680 and WP-85-J838/J839 or the latest contracts. Accuracy and precision values are given in Attachment 1 (QAPP).
[c]Procedure given in Section 5 (SAP) and Attachment 2.
[d]California Regional Water Quality Control Board, Leaking Underground Fuel tank Field Manual: Guidelines for Site Assessment, Cleanup and Underground Storage Tank Closure. December 1987. Accuracy and precision limits to be developed by laboratory per procedure; 50-170 percent and ±50 percent can be estimated for accuracy and precision respectively.

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Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. In general, for organics, two types of recoveries are measured: matrix spike recoveries and surrogate spike recoveries. For a matrix spike, known amounts of standard compounds identical to the compounds present in the sample of interest are added to the sample. For a surrogate spike, the standards are chemically similar but not identical to the compounds in the fraction being analyzed. The purpose of the surrogate spike is to provide QC on every sample by constantly monitoring for unusual matrix effects and gross sample processing errors. For inorganics, only matrix spikes are measured in general. A quantitative definition of average recovery is given in Section 7.0. Accuracy measurements will be carried out at a minimum frequency of 1 in 20 or 1 per set. Target quantitative accuracy objectives are listed as applicable in Table 2-2. Specific procedures are described in CLP Statement of Work or Attachment 2 for parameters not covered under CLP.

Precision of the data is a measure of the data spread when more than one measurement is taken on the same sample. For duplicate measurements, precision can be expressed as the relative percent difference. A quantitative definition of the relative percent difference is given in Section 7.0. The level of effort for precision measurements will be at a minimum of 1 in 20 or 1 per set. Target quantitative precision objectives are listed as applicable in Table 2-2. Specific procedures are described under Statement of Work or Attachment 2 for parameters not covered under CLP.

Completeness is a measure of the amount of valid data obtained from the analytical measurement system. The quantitative definition of completeness is given in

Section 7.0. The target completeness objective will be 90 percent; the actual completeness may vary depending on the intrinsic nature of the samples. The completeness of the data will be assessed during QC reviews.

Audits, internal QC checks, preventive maintenance, and corrective action, as described in other sections of the document, will be implemented toward maintaining the above quality assurance objectives.

## 3.0 PROJECT ORGANIZATION

Primary responsibility for the project quality review rests with the Project Manager (PjM) and the Resource Center Manager (RCM). Independent quality assurance review is provided by the Quality Assurance Manager (QAM) and the quality assurance (QA) auditors.

The PjM will frequently review the financial, schedule, and technical status of the work assignment. The key people involved in interfacing with the PjM are the Remedial Project Manager (RPM), the RCM, and the Technical Reviewer (TR).

The TR and the QA Review Team review all project deliverables. The TR and the PjM monitors the quality and delivery of the reviews and works with the RCM to mediate any differences between the PjM and the QA Reviewers.

Where quality assurance problems or deficiencies requiring special action are uncovered, the PjM, RCM, and QAM will identify the appropriate corrective action to be initiated by the PjM.

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# 4.0 SAMPLE COLLECTION AND QUALITY CONTROL

The sample collection and QC procedures are described in Section 6.0 of the Sampling Plan.

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## 5.0 SAMPLE CUSTODY

A sample is physical evidence collected from a hazardous waste site, immediate environment, or another source. Because of the potential evidentiary nature of samples, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in enforcement proceedings.

Chain-of-Custody procedures are used to maintain and document sample possession for enforcement purposes. The principal documents used to identify samples and to document possessions are:

- Chain-of-Custody records
- Air bills or shipping records (e.g., Federal Express, Purolator,)
- Field notebooks
- Photographs of the investigation

These documents may be introduced as evidence should a site investigation result in legal action.

The Field Team Leader (FTL) will maintain a supply of field documents including sample custody seals and Chain-of-Custody records. The FTL is responsible for inventory of serialized documents and assignment of these documents to specific tasks. All unused field documents are returned to the FTL at the end of the field sampling work. The FTL notes the return of these documents in the serialized document logbook.

A sample numbering system will be used to identify each collected sample and associated duplicates for chemical analysis. This system will provide a tracking number to allow retrieval and cross-referencing of sample information, and provide anonymity for the field QC samples at the laboratory. A listing of the sample identification numbers will be maintained in the field notebook. The anticipated numbering system for the project will identify the solid waste management unit (SWMU) and area of concern, sample location, sample depth, and contain information on whether the sample is a duplicate or blank. Refer to Subsection 6.7.1 for examples of sample identification.

## 5.1 Chain-of-Custody

Because samples collected during any investigation could be used as evidence, their possession must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. To document sample possession, Chain-of-Custody procedures are followed.

### 5.1.1 Definition of Custody

A sample is under of custody if one or more of the following criteria is met:

- It is in your possession.
- It is in your view, after being in your possession.
- It was in your possession and then you locked it up to prevent tampering.
- It is in a designated secure area.

### 5.1.2 Field Custody

- In collecting samples for evidence, only a sufficient number of samples is collected to provide a good representation of the media being sampled. To the extent possible, the quantity and types of samples and sample locations are determined before the actual field work. As few people as possible should handle samples.

- The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly.

- The site manager determines whether proper custody procedures were followed during the field work and decides if additional samples are required.

### 5.1.3 Transfer of Custody and Shipment

- Samples are accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst at the laboratory.

- Samples are packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate chain-of-custody record ac-

companying each shipping container. Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, courier name(s), and other pertinent information are entered in the Remarks section of the chain-of-custody record.

- Whenever samples are split with a source or government agency, it is noted in the Remarks section of the chain-of-custody record. The note indicates with whom the samples are being split and is signed by both the sampler and recipient. If the split is refused, this will be noted and signed by both parties. If a representative is unavailable or refuses to sign, this is noted in the Remarks section of the chain-of-custody record. When appropriate, as in the case where the representative is unavailable, the chain-of-custody record should contain a statement that the samples were delivered to the designated location at the designated time.

- All shipments are accompanied by the chain-of-custody record identifying its contents.

- If sent by mail, the package is registered with return receipt requested. If sent by common carrier, a bill of lading is used. Air freight shipments are sent collect. Freight bills, postal service receipts, and bills of lading are retained as part of the permanent documentation. Documents will be distributed as follows:

  - Ship with samples:

-- Chain-of-Custody Form (original)

- Send to site manager:
  - -- Field logbooks (at completion of project)

- Return to project files:
  - -- Chain-of-Custody Form (pink copy)
  - -- Shipping records

- Send to Navy Project Management:
  - -- Chain-of-Custody Form (yellow copy)

### 5.1.4 Laboratory Custody Procedures

o A designated sample custodian accepts custody of the shipped samples and verifies that the samples received match those on the chain-of-custody records. Pertinent information as to shipment, pickup, and courier is entered in the Remarks section. The custodian then enters the sample numbers into a logbook.

The laboratory custodian uses the sample identification label number or assigns a special laboratory number to each sample, and is responsible for seeing that all samples are transferred to the proper analyst or stored in the appropriate secure area.

- The custodian distributes samples to the appropriate analysts. Laboratory personnel are responsible for the care and custody of samples from the time they are received until the sample is exhausted or returned to the custodian. The data of sample analysis are recorded on the laboratory report form.

- When sample analyses and necessary QA checks have been completed in the laboratory, the unused portion of the sample must be disposed properly. All identifying stickers, data sheets, and laboratory records are retained as part of the permanent documentation. Sample containers and remaining sample material are disposed appropriately.

## 5.2 Custody Seals

When samples are shipped to the laboratory, they must be placed in padlocked containers or containers sealed with custody seals. Two seals must be placed on each shipping container (cooler), one at the front and one at the back.

## 5.3 Sample Labels

Sample labels will be filled out in indelible ink and will provide the following information:

- Sample identification number
- Date and time of sample collection
- Sampler's initials

## 5.4 Field Notebooks

In addition to chain-of-custody records, a bound field notebook must be maintained by the sampling team leader to provide a daily record of significant events, observations, and measurements during field investigations. All entries should be signed and dated. All members of the field investigation should use this notebook. It should be kept as a permanent record.

These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence.

## 5.5 Corrections to Documentation

Unless prohibited by weather conditions, all original data recorded in field notebooks, sample identification tags, and chain-of-custody records are written in waterproof ink. None of these accountable serialized documents is to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on an accountable document assigned to one individual, that individual may make corrections simply by crossing a line through the error and entering the correct information. The erroneous information should not be obliterated. Any

subsequent error discovered on an accountable document should be corrected by the person who made the entry. All subsequent corrections must be initialed and dated.

# 6.0 ANALYTICAL AND QUALITY CONTROL PROCEDURES

## 6.1 Analytical Procedures

Parameters of analyses, analytical methods and detection limits are listed in Table 2-2. The EPA CLP and standard EPA methods have been selected where applicable. For non-CLP analyses the following analytical information has been given for each specific parameter in the Sampling Plan (Section 5.0) and Attachment 2:

- Analytical procedure and detection or quantitation limits
- Calibration procedure and criteria
- Internal QC checks and corrective action
- Data calculations and reporting units
- Documentation and deliverables

The analytical and QC methodology for non-CLP parameters follows EPA Region IX guidance. Preventive maintenance of analytical equipment has been discussed in Subsections 6.2.1 and 6.4; in addition, laboratories will have standard operating procedures for preventive maintenance.

## 6.2 Calibration Procedures

### 6.2.1 Field Calibration Procedures

Field equipment requiring calibration are organic vapor analyzers (OVA) and HNu meters. Calibrated equipment will be specially identified by using either the manufacturer's serial number or other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in a logbook.

Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility of employing properly functioning equipment. If an individual suspects an equipment malfunction, the device shall be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel notified so that a recalibration can be performed or a substitute piece of equipment can be obtained.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use, or tagged to indicate it is out of calibration. Such equipment will be repaired and satisfactorily recalibrated. Equipment that cannot be repaired will be replaced.

Results of activities performed using equipment that has failed recalibration will be evaluated. If the activity results are adversely affected, the results of the evaluation will be documented and the appropriate personnel notified.

### 6.2.2 Laboratory Calibration Procedures

Laboratory calibration procedures are specified in the specific methods for each parameter (Sampling Plan, Section 5.0). Where there are no specifications, the calibration procedures will be as follows:

- Initial and final calibration for all methods will include a three-point calibration before and after a run.

- Continuing calibration for all methods will include midrange calibration standard after every tenth sample.

## 6.3 Quality Control Procedures

### 6.3.1 Field Quality Control Procedures

Field sampling QC procedures will include field duplicates, as discussed in Section 4.0. These QC samples will be submitted blind to the laboratory.

Field measurement QC procedures will include calibration requirements described in Subsection 6.2.

### 6.3.2 Laboratory Quality Control Procedures

Laboratory QC procedures will include the following:

- Instrument calibrations and standards as defined in the Sampling Plan (Section 5.0) and EPA CLP Statement of Work

- Analytical methodology per methods listed in Table 2-2 and the Sampling Plan (Section 5.0)

- Laboratory blank measurements at a minimum 10 percent or one-per-batch frequency

- Accuracy and precision measurements as defined in Section 2.0, at a minimum of one in 20 or one per set

- Data reduction and reporting per specific methods listed in Table 2-2 and the Sampling Plan (Section 5.0)

### 6.3.3 Chain-of-Custody Procedures

- Chain-of-custody procedures is defined in Section 5.0

## 6.4 Preventive Maintenance

Instrument maintenance logbooks are maintained in laboratories at all times. The logbooks in general contain a schedule of maintenance, as well as a complete history of past maintenance, both routine and nonroutine.

Preventive maintenance is performed according to the procedures delineated in the manufacturer's instrument manuals, including lubrication, source cleaning, detector cleaning, and the frequency of such maintenance. Chromatographic carrier gas purification traps, injector liners, and injector septa are cleaned or replaced on a regular basis. Precision and accuracy data are examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance will be performed when an instrument begins to degrade as evidenced by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet one or another of the QC criteria.

Instrument downtime is minimized by keeping adequate supplies of all expendable items, expendable meaning an expected lifetime of less than 1 year. These items include gas tanks, gasoline filters, syringes, septa, GC columns and packing, ferrules, printer paper and ribbons, pump oil, jet separators, open-split interfaces, and MS filaments.

For field equipment (OVA/HNu meter) preventive maintenance will be carried out in accordance with procedures and schedules outlined in the particular model's handbook. To minimize down time, extra meters will accompany the field equipment.

# 7.0 DATA QUALITY MANAGEMENT

## 7.1 Data Reduction, Validation, and Reporting

Data for all parameters will undergo two levels of review and validation: at the laboratory and outside the laboratory.

Initial data reduction, validation, and reporting at the laboratory will be carried out as described in specific methods listed in Table 2-2 and the Sampling Plan (Section 5.0) and Attachment 2. Quality control data per procedures described in this document will also be reported by the laboratory at the defined level of effort; documentation has also been described in Attachment 2 for parameters not covered under CLP.

Data will also be reviewed outside the laboratory by staff chemists not assigned to the laboratory. Data will be reviewed per EPA data validation functional guidelines. Ten percent of data will undergo full validation per EPA functional guidelines outside the laboratory.

The review process includes flagging data with qualifiers. Commonly used qualifiers include:

J = Estimated; usable for limited purposes. The data are qualitatively, but not quantitatively acceptable.

R = Rejected; unusable. The data are qualitatively and quantitatively unacceptable.

U = Undetected. The result is undetected at the instrument detection level (IDL). The data are acceptable.

B = The result is between the IDL and the CRDL (contract-required detection level) and is subject to inaccuracies common to the lower end of the instruments' linearity.

No qualifier--data are acceptable.

Field data validation will be based on field logbooks and field audits with regard to proper calibration and procedures.

### 7.2 Data Assessment Procedures

Data assessment will follow the data review and validation described in the preceding section. An assessment report will summarize the findings of the data review/validation as relevant to project usage. Data accuracy, precision, and completeness values will be summarized in the assessment report. Following is the quantitative definition of accuracy, precision, and completeness.

### 7.2.1 Accuracy

For spiked samples, the recovery (R) can be defined as a measure of accuracy:

Let

$c_o$ = measured concentration analyzed in the sample without the addition of a spike, mg/l

$c_s$ = concentration of standard added to the sample, mg/l

$c_l$ = measured concentration analyzed in the sample after adding the spike, mg/l

$$R = (c_l - c_o)/c_s$$

or on a percentage basis

$$\%R = (c_l - c_o)100/c_s$$

### 7.2.2 Precision

This section provides the basis for the quantitative limits used to control data precision. The primary measurement of data precision will be the relative percent difference (RPD) between a duplicate pair of data points:

where:

$X_1$ = first duplicate point value

$$RPD = \frac{X_2 - X_1}{(X_1 + X_2)/2} \times 100$$

$X_2$ = second duplicate point value

### 7.2.3 Completeness

Measurement completeness (C) can be described as the ratio of acceptable measurements obtained to the total number of planned measurements for an activity. Percent completeness can be defined as:

$$C = \frac{\text{(Number of acceptable data per target quality control limits)}}{\text{(Total number of data points)}} \times 100$$

# 8.0 QUALITY ASSURANCE OVERSIGHT

## 8.1 Performance and System Audits

The QAM will monitor and audit the performance of the QA procedures. When necessary, the QAM will conduct field audits as described in Attachment 3. Audits may be scheduled to evaluate the execution of sample identification, sample control, Chain-of-Custody procedures, field notebooks, sampling procedures, and field measurements.

The laboratories will be audited as necessary by a staff chemist not assigned to the laboratory who also will coordinate data validation activities. The external onsite laboratory audits will be carried out to cover analytical methodology QC procedures and level of effort specific to this project.

Verification of computer models and software will be conducted periodically by entry of known data sets or programs by a computer expert not assigned to the project. Electronic and paper-based data sets will be verified by double entry, cross checking, and range checking against the known programs and models to check for correctness, reasonableness, and user competence. Verification of model and software performance will be documented in the QA/QC portion of the specific reports.

## 8.2 Corrective Action

If QC audits result in detection of unacceptable conditions or data, the PjM will be responsible for developing and initiating corrective action. The Navy and QAM will be notified if nonconformance is of program significance or requires special expertise not normally available to the project team. Corrective action may include:

- Reanalyzing samples if holding time criteria permit
- Resampling and analyzing
- Evaluating and amending sampling and analytical procedures
- Accepting data acknowledging level of uncertainty

## 8.3 Quality Assurance Reports

The PjM may request that a report be submitted to the QAM on the performance of sample collection and data quality. The report may include:

- Assessment of measurement data accuracy, precision, and completeness
- Results of performance audits
- Results of systems audits
- Significant QA problems and recommended solutions

Alternatively, in lieu of a separate Quality Assurance Report, sampling and field measurement data quality information may be summarized and included in the Final Report.

# Attachment 1

## CLP

## Accuracy and Precision Limits

3A

# WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name:_____ Contract:_____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____

| COMPOUND | SPIKE ADDED (ug/L) | SAMPLE CONCENTRATION (ug/L) | MS CONCENTRATION (ug/L) | MS % REC # | QC. LIMITS REC. |
|---|---|---|---|---|---|
| 1,1-Dichloroethene | | | | | 61-145 |
| Trichloroethene | | | | | 71-120 |
| Benzene | | | | | 76-127 |
| Toluene | | | | | 76-125 |
| Chlorobenzene | | | | | 75-130 |

| COMPOUND | SPIKE ADDED (ug/L) | MSD CONCENTRATION (ug/L) | MSD % REC # | % RPD # | QC LIMITS RPD | QC LIMITS REC. |
|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | | | | | 14 | 61-145 |
| Trichloroethene | | | | | 14 | 71-120 |
| Benzene | | | | | 11 | 76-127 |
| Toluene | | | | | 13 | 76-125 |
| Chlorobenzene | | | | | 13 | 75-130 |

# Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD:_____ out of _____ outside limits
Spike Recovery:_____ out of _____ outside limits

COMMENTS: _____

FORM III VOA-1 3/90

2B

# SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name:_____ Contract:_____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____ Level:(low/med) _____

| COMPOUND | SPIKE ADDED (ug/Kg) | SAMPLE CONCENTRATION (ug/Kg) | MS CONCENTRATION (ug/Kg) | MS % REC # | QC. LIMITS REC. |
|---|---|---|---|---|---|
| 1,1-Dichloroethene | | | | | 59-172 |
| Trichloroethene | | | | | 62-137 |
| Benzene | | | | | 66-142 |
| Toluene | | | | | 59-139 |
| Chlorobenzene | | | | | 60-133 |

| COMPOUND | SPIKE ADDED (ug/Kg) | MSD CONCENTRATION (ug/Kg) | MSD % REC # | % RPD # | QC LIMITS RPD | QC LIMITS REC. |
|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | | | | | 22 | 59-172 |
| Trichloroethene | | | | | 24 | 62-137 |
| Benzene | | | | | 21 | 66-142 |
| Toluene | | | | | 21 | 59-139 |
| Chlorobenzene | | | | | 21 | 60-133 |

# Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD:_____ out of _____ outside limits
Spike Recovery:_____ out of _____ outside limits

COMMENTS: _____

FORM III VOA-2 3/90

3C

# WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name:_____ Contract:_____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____

| COMPOUND | SPIKE ADDED (ug/L) | SAMPLE CONCENTRATION (ug/L) | MS CONCENTRATION (ug/L) | MS % REC # | QC. LIMITS REC. |
|---|---|---|---|---|---|
| Phenol | | | | | 12-110 |
| 2-Chlorophenol | | | | | 27-123 |
| 1,4-Dichlorobenzene | | | | | 36- 97 |
| N-Nitroso-di-n-prop.(1) | | | | | 41-116 |
| 1,2,4-Trichlorobenzene | | | | | 39- 98 |
| 4-Chloro-3-methylphenol | | | | | 23- 97 |
| Acenaphthene | | | | | 46-118 |
| 4-Nitrophenol | | | | | 10- 80 |
| 2,4-Dinitrotoluene | | | | | 24- 96 |
| Pentachlorophenol | | | | | 9-103 |
| Pyrene | | | | | 26-127 |

| COMPOUND | SPIKE ADDED (ug/L) | MSD CONCENTRATION (ug/L) | MSD % REC # | % RPD # | QC LIMITS RPD | QC LIMITS REC. |
|---|---|---|---|---|---|---|
| Phenol | | | | | 42 | 12-110 |
| 2-Chlorophenol | | | | | 40 | 27-123 |
| 1,4-Dichlorobenzene | | | | | 28 | 36- 97 |
| N-Nitroso-di-n-prop.(1) | | | | | 38 | 41-116 |
| 1,2,4-Trichlorobenzene | | | | | 28 | 39- 98 |
| 4-Chloro-3-methylphenol | | | | | 42 | 23- 97 |
| Acenaphthene | | | | | 31 | 46-118 |
| 4-Nitrophenol | | | | | 50 | 10- 80 |
| 2,4-Dinitrotoluene | | | | | 38 | 24- 96 |
| Pentachlorophenol | | | | | 50 | 9-103 |
| Pyrene | | | | | 31 | 26-127 |

(1) N-Nitroso-di-n-propylamine

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD:_____ out of _____ outside limits
Spike Recovery:_____ out of _____ outside limits

COMMENTS: _____

FORM III SV-1 3/90

3D

# SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: _____ Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____ Level:(low/med) _____

| COMPOUND | SPIKE ADDED (ug/Kg) | SAMPLE CONCENTRATION (ug/Kg) | MS CONCENTRATION (ug/Kg) | MS % REC # | QC. LIMITS REC. |
|---|---|---|---|---|---|
| Phenol | | | | | 26- 90 |
| 2-Chlorophenol | | | | | 25-102 |
| 1,4-Dichlorobenzene | | | | | 28-104 |
| N-Nitroso-di-n-prop.(1) | | | | | 41-126 |
| 1,2,4-Trichlorobenzene | | | | | 38-107 |
| 4-Chloro-3-methylphenol | | | | | 26-103 |
| Acenaphthene | | | | | 31-137 |
| 4-Nitrophenol | | | | | 11-114 |
| 2,4-Dinitrotoluene | | | | | 28- 89 |
| Pentachlorophenol | | | | | 17-109 |
| Pyrene | | | | | 35-142 |

| COMPOUND | SPIKE ADDED (ug/Kg) | MSD CONCENTRATION (ug/Kg) | MSD % REC # | % RPD # | QC LIMITS RPD | QC LIMITS REC. |
|---|---|---|---|---|---|---|
| Phenol | | | | | 35 | 26- 90 |
| 2-Chlorophenol | | | | | 50 | 25-102 |
| 1,4-Dichlorobenzene | | | | | 27 | 28-104 |
| N-Nitroso-di-n-prop.(1) | | | | | 38 | 41-126 |
| 1,2,4-Trichlorobenzene | | | | | 23 | 38-107 |
| 4-Chloro-3-methylphenol | | | | | 33 | 26-103 |
| Acenaphthene | | | | | 19 | 31-137 |
| 4-Nitrophenol | | | | | 50 | 11-114 |
| 2,4-Dinitrotoluene | | | | | 47 | 28- 89 |
| Pentachlorophenol | | | | | 47 | 17-109 |
| Pyrene | | | | | 36 | 35-142 |

(1) N-Nitroso-di-n-propylamine

# Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: _____ out of _____ outside limits
Spike Recovery: _____ out of _____ outside limits

COMMENTS: _____

FORM III SV-2 3/90

3E

# WATER PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: _____ Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____

| COMPOUND | SPIKE ADDED (ug/L) | SAMPLE CONCENTRATION (ug/L) | MS CONCENTRATION (ug/L) | MS % REC # | QC. LIMITS REC. |
|---|---|---|---|---|---|
| gamma-BHC (Lindane) | | | | | 56-123 |
| Heptachlor | | | | | 40-131 |
| Aldrin | | | | | 40-120 |
| Dieldrin | | | | | 52-126 |
| Endrin | | | | | 56-121 |
| 4,4'-DDT | | | | | 38-127 |
| | | | | | |

| COMPOUND | SPIKE ADDED (ug/L) | MSD CONCENTRATION (ug/L) | MSD % REC # | % RPD # | QC LIMITS RPD | QC LIMITS REC. |
|---|---|---|---|---|---|---|
| gamma-BHC (Lindane) | | | | | 15 | 56-123 |
| Heptachlor | | | | | 20 | 40-131 |
| Aldrin | | | | | 22 | 40-120 |
| Dieldrin | | | | | 18 | 52-126 |
| Endrin | | | | | 21 | 56-121 |
| 4,4'-DDT | | | | | 27 | 38-127 |
| | | | | | | |

# Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: _____ out of _____ outside limits
Spike Recovery: _____ out of _____ outside limits

COMMENTS: _____

FORM III PEST-1 3/90

3F

# SOIL PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name:_____ Contract:_____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____

| COMPOUND | SPIKE ADDED (ug/Kg) | SAMPLE CONCENTRATION (ug/Kg) | MS CONCENTRATION (ug/Kg) | MS % REC # | QC. LIMITS REC. |
|---|---|---|---|---|---|
| gamma-BHC (Lindane) | | | | | 46-127 |
| Heptachlor | | | | | 35-130 |
| Aldrin | | | | | 34-132 |
| Dieldrin | | | | | 31-134 |
| Endrin | | | | | 42-139 |
| 4,4'-DDT | | | | | 23-134 |
| | | | | | |

| COMPOUND | SPIKE ADDED (ug/Kg) | MSD CONCENTRATION (ug/Kg) | MSD % REC # | % RPD # | QC LIMITS RPD | QC LIMITS REC. |
|---|---|---|---|---|---|---|
| gamma-BHC (Lindane) | | | | | 50 | 46-127 |
| Heptachlor | | | | | 31 | 35-130 |
| Aldrin | | | | | 43 | 34-132 |
| Dieldrin | | | | | 38 | 31-134 |
| Endrin | | | | | 45 | 42-139 |
| 4,4'-DDT | | | | | 50 | 23-134 |
| | | | | | | |

# Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD:_____ out of _____ outside limits
Spike Recovery:_____ out of _____ outside limits

COMMENTS: _____

FORM III PEST-2 3/90

Results for the ICP analyses of Solution AB during the analytical runs must fall within the control limit of ±20% of the true value for the analytes included in the Interference Check Samples. If not, terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze the analytical samples analyzed since the last good ICS. If true values for analytes contained in the ICS and analyzed by ICP are not supplied with the ICS, the mean must be determined by initially analyzing the ICS at least five times repetitively for the particular analytes. This mean determination must be made during an analytical run where the results for the previously supplied EPA ICS met all contract specifications. Additionally, the result of this initial mean determination is to be used as the true value for the lifetime of that solution (i.e., until the solution is exhausted).

If the ICP Interference Check Sample is not available from EPA, independent ICP Check Samples must be prepared with interferent and analyte concentrations at the levels specified in Table 2-Interferent and Analyte Elemental Concentrations Used for ICP-Interference Check Sample. The mean value and standard deviation must be established by initially analyzing the Check Samples at least five times repetitively for each parameter on FORM IV-IN. Results must fall within the control limit of ±20% of the established mean value. The mean and standard deviation must be reported in the raw data. Results from the Interference Check Sample analyses must be recorded on FORM IV-IN for all ICP parameters.

TABLE 2. INTERFERENT AND ANALYTE ELEMENTAL CONCENTRATIONS USED FOR ICP INTERFERENCE CHECK SAMPLE

| Analytes | (mg/L) | Interferents | (mg/L) |
|---|---|---|---|
| Ag | 1.0 | Al | 500 |
| Ba | 0.5 | Ca | 500 |
| Be | 0.5 | Fe | 200 |
| Cd | 1.0 | Mg | 500 |
| Co | 0.5 | | |
| Cr | 0.5 | | |
| Cu | 0.5 | | |
| Mn | 0.5 | | |
| Ni | 1.0 | | |
| Pb | 1.0 | | |
| V | 0.5 | | |
| Zn | 1.0 | | |

6. Spike Sample Analysis (S)

The spike sample analysis is designed to provide information about the effect of the sample matrix on the digestion and measurement methodology. The spike is added before the digestion (i.e., prior to the addition of other reagents) and prior to any distillation steps (i.e., CN-). At least one spike sample analysis must be performed on

each group of samples of a similar matrix type (i.e., water, soil) and concentration (i.e., low, medium) or for each Sample Delivery Group.[2]

If the spike analysis is performed on the same sample that is chosen for the duplicate sample analysis, spike calculations must be performed using the results of the sample designated as the "original sample" (see section 7, Duplicate Sample Analysis). The average of the duplicate results cannot be used for the purpose of determining percent recovery. Samples identified as field blanks cannot be used for spiked sample analysis. EPA may require that a specific sample be used for the spike sample analysis.

The analyte spike must be added in the amount given in Table 3-Spiking Levels for Spike Sample Analysis, for each element analyzed. If two analytical methods are used to obtain the reported values for the same element within a Sample Delivery Group (i.e. ICP, GFAA), spike samples must be run by each method used.

If the spike recovery is not at or within the limits of 75-125%, the data of all samples received associated with that spike sample and determined by the same analytical method must be flagged with the letter "N" on FORMs I-IN and V-IN. An exception to this rule is granted in situations where the sample concentration exceeds the spike concentration by a factor of four or more. In such an event, the data shall be reported unflagged even if the percent recovery does not meet the 75-125% recovery criteria.

For flame AA, ICP, and CN analyses, when the pre-digestion/pre-distillation spike recovery falls outside the control limits and the sample result does not exceed 4x the spike added, a post-digestion/post-distillation spike must be performed for those elements that do not meet the specified criteria (exception: Ag). Spike the unspiked aliquot of the sample at 2x the indigenous level or 2x CRDL, whichever is greater. Results of the post-digestion/post-distillation spike must be reported on FORM V(PART 2)-IN. Note: No post digest spike is required for Hg.

In the instance where there is more than one spike sample per matrix and concentration per method per SDG, if one spike sample recovery is not within contract criteria, flag all the samples of the same matrix, level, and method in the SDG. Individual component percent recoveries (%R) are calculated as follows:

$$\%\text{Recovery} = \frac{(SSR-SR)}{SA} \times 100$$

Where, SSR - Spiked Sample Result
SR - Sample Result
SA - Spike Added

When sample concentration is less than the instrument detection limit, use SR = 0 only for purposes of calculating % Recovery. The spike

---

[2]EPA may require additional spike sample analysis, upon Administrative Project Officer request, for which the Contractor will be paid.

sample results, sample results and % Recovery (positive or negative) must be reported on FORM V-IN for ICP, AA and cyanide analyses, as indicated.

The units for reporting spike sample results will be identical to those used for reporting sample results in FORM I-IN (i.e., ug/L for aqueous and mg/Kg dry weight basis for solid).

TABLE 3. SPIKING LEVELS FOR SPIKE SAMPLE ANALYSIS

| | For ICP/AA | | For Furnace AA | | Other[1] |
|---|---|---|---|---|---|
| Element | Water (ug/L) | Soil[2] (mg/kg) | Water (ug/L) | Soil[2] (mg/kg) | |
| Aluminum | 2,000 | * | | | |
| Antimony | 500 | 100 | 100 | 20 | |
| Arsenic | 2,000 | 400 | 40 | 8 | |
| Barium | 2,000 | 400 | | | |
| Beryllium | 50 | 10 | | | |
| Cadmium | 50 | 10 | 5 | 1 | |
| Calcium | * | * | | | |
| Chromium | 200 | 40 | | | |
| Cobalt | 500 | 100 | | | |
| Copper | 250 | 50 | | | |
| Iron | 1,000 | * | | | |
| Lead | 500 | 100 | 20 | 4 | |
| Magnesium | * | * | | | |
| Manganese | 500 | 100 | | | |
| Mercury | | | | | 1 |
| Nickel | 500 | 100 | | | |
| Potassium | * | * | | | |
| Selenium | 2,000 | 400 | 10 | 2 | |
| Silver | 50 | 10 | | | |
| Sodium | * | * | | | |
| Thallium | 2,000 | 400 | 50 | 10 | |
| Vanadium | 500 | 100 | | | |
| Zinc | 500 | 100 | | | |
| Cyanide | | | | | 100[3] |

*No spike required. NOTE: Elements without spike levels and not designated with an asterisk, must be spiked at appropriate levels.

[1]Spiking level reported is for both water and soil/sediment matrices.

[2]The levels shown indicate concentrations in the final digestate of the spiked sample (100 mL for mercury and 200 mL for all other metals) when the wet weight of 1 gram (for ICP, Furnace, and Flame AA), or 0.2 grams (for mercury) of sample is taken for analysis. Adjustment must be made to maintain these spiking levels when the weight of sample taken deviates by more than 10% of these values. Appropriate adjustment must be made for microwave digestion procedure where 0.5 grams of sample or 50.0 mL (45.0 mL of sample plus 5.0 mL of acid) of aqueous sample are required for analysis.

[3]The level shown indicates the amount of cyanide that must be added to the original (undistilled) sample. For instance, 100 ug must be added per each Liter of aqueous sample. If the sample volume is 500 mL, then 50 ug of cyanide must be added. If the volume is 50 mL, then 5 ug of cyanide must be added.
For soil samples, 25 ug of cyanide must be added per each gram of solid sample taken for analysis. The spiking level is dependent on the weight of the sample taken and the final distillate volume. If one gram of sample is taken for analysis, and the final distillate volume is 250 mL, then the distillate must contain cyanide at a concentration

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of 100 ug/L. If five grams of sample are taken, then the distillate must contain cyanide at a concentration of 500 ug/L. Assuming a sample of one gram, the manual and semi-automated colorimetric methods call for a cyanide concentration of 25 ug per the 500 mL mixture of the sample, reagents, and water before distillation. The final distillate, in this case, contains cyanide at a concentration of 100 ug/L. For the midi-distillation method, a cyanide concentration of 25 ug must be added into the 50 mL mixture of sample, reagents, and water before distillation. This yields a cyanide concentration of 500 ug/L in the final distillate of 50 mL.

7. Duplicate Sample Analysis (D)

One duplicate sample must be analyzed from each group of samples of a similar matrix type (i.e., water, soil) and concentration (i.e., low, medium) or for each Sample Delivery Group.[3] Duplicates cannot be averaged for reporting on FORM I-IN.

Duplicate sample analyses are required for percent solids. Samples identified as field blanks cannot be used for duplicate sample analysis. EPA may require that a specific sample be used for duplicate sample analysis. If two analytical methods are used to obtain the reported values for the same element for a Sample Delivery Group (i.e., ICP, GFAA), duplicate samples must be run by each method used.

The relative percent differences (RPD) for each component are calculated as follows:

$$RPD = \frac{|S - D|}{(S+D)/2} \times 100$$

Where, RPD = Relative Percent Difference
S = First Sample Value (original)
D = Second Sample Value (duplicate)

The results of the duplicate sample analyses must be reported on FORM VI-IN in ug/L for aqueous samples and mg/Kg dry weight basis for solid original and duplicate samples. A control limit of 20% for RPD shall be used for original and duplicate sample values greater than or equal to 5x CRDL (Exhibit C). A control limit of (±) the CRDL must be used for sample values less than 5x CRDL, and the absolute value of the control limit (CRDL) must be entered in the "Control Limit" column on FORM VI-IN.

If one result is above the 5x CRDL level and the other is below, use the ± CRDL criteria. If both sample values are less than the IDL, the RPD is not calculated on FORM VI-IN. For solid sample or duplicate results < 5x CRDL, enter the absolute value of the CRDL, corrected for sample weight and percent solids, in the "Control Limit" column.

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[3] EPA may require additional duplicate sample analyses, upon Administrative Project Officer request, for which the Contractor will be paid.

3F

# SOIL PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: _____ Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____

| COMPOUND | SPIKE ADDED (ug/Kg) | SAMPLE CONCENTRATION (ug/Kg) | MS CONCENTRATION (ug/Kg) | MS % REC # | QC. LIMITS REC. |
|---|---|---|---|---|---|
| gamma-BHC (Lindane) | | | | | 46-127 |
| Heptachlor | | | | | 35-130 |
| Aldrin | | | | | 34-132 |
| Dieldrin | | | | | 31-134 |
| Endrin | | | | | 42-139 |
| 4,4'-DDT | | | | | 23-134 |
| | | | | | |

| COMPOUND | SPIKE ADDED (ug/Kg) | MSD CONCENTRATION (ug/Kg) | MSD % REC # | % RPD # | QC LIMITS RPD | QC LIMITS REC. |
|---|---|---|---|---|---|---|
| gamma-BHC (Lindane) | | | | | 50 | 46-127 |
| Heptachlor | | | | | 31 | 35-130 |
| Aldrin | | | | | 43 | 34-132 |
| Dieldrin | | | | | 38 | 31-134 |
| Endrin | | | | | 45 | 42-139 |
| 4,4'-DDT | | | | | 50 | 23-134 |
| | | | | | | |

# Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: _____ out of _____ outside limits
Spike Recovery: _____ out of _____ outside limits

COMMENTS: _____

FORM III PEST-2 3/90

Results for the ICP analyses of Solution AB during the analytical runs must fall within the control limit of ±20% of the true value for the analytes included in the Interference Check Samples. If not, terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze the analytical samples analyzed since the last good ICS. If true values for analytes contained in the ICS and analyzed by ICP are not supplied with the ICS, the mean must be determined by initially analyzing the ICS at least five times repetitively for the particular analytes. This mean determination must be made during an analytical run where the results for the previously supplied EPA ICS met all contract specifications. Additionally, the result of this initial mean determination is to be used as the true value for the lifetime of that solution (i.e., until the solution is exhausted).

If the ICP Interference Check Sample is not available from EPA, independent ICP Check Samples must be prepared with interferent and analyte concentrations at the levels specified in Table 2-Interferent and Analyte Elemental Concentrations Used for ICP-Interference Check Sample. The mean value and standard deviation must be established by initially analyzing the Check Samples at least five times repetitively for each parameter on FORM IV-IN. Results must fall within the control limit of ±20% of the established mean value. The mean and standard deviation must be reported in the raw data. Results from the Interference Check Sample analyses must be recorded on FORM IV-IN for all ICP parameters.

TABLE 2. INTERFERENT AND ANALYTE ELEMENTAL CONCENTRATIONS USED FOR ICP INTERFERENCE CHECK SAMPLE

| Analytes | (mg/L) | Interferents | (mg/L) |
|---|---|---|---|
| Ag | 1.0 | Al | 500 |
| Ba | 0.5 | Ca | 500 |
| Be | 0.5 | Fe | 200 |
| Cd | 1.0 | Mg | 500 |
| Co | 0.5 | | |
| Cr | 0.5 | | |
| Cu | 0.5 | | |
| Mn | 0.5 | | |
| Ni | 1.0 | | |
| Pb | 1.0 | | |
| V | 0.5 | | |
| Zn | 1.0 | | |

6. Spike Sample Analysis (S)

The spike sample analysis is designed to provide information about the effect of the sample matrix on the digestion and measurement methodology. The spike is added before the digestion (i.e., prior to the addition of other reagents) and prior to any distillation steps (i.e., CN-). At least one spike sample analysis must be performed on

# Attachment 2

## Non-CLP Parameters

## Analytical and Quality Control Procedures

**Analytical Procedure and Detection or Quantitation Limits**

**Calibration Procedure and Criteria**

**Internal Quality Control Checks and Corrective Action**

**Data Calculations and Reporting Units**

**Documentation and Deliverables**

# 1.0 REQUEST FOR ANALYSIS

The following procedures are based on standard EPA procedures and include parameter-specific QC procedures. Following the procedure sheets are analyses request sheets to facilitate and track proper sample handling from field to laboratory.

## 1.1 Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans Homologs

### 1.1.1 Analyses

Total tetra through octa chlorinated dibenzofurans (CDFs) and chlorinated dibenzo-p-dioxins (CDDs).

### 1.1.2 Sample Matrices

Water samples, soil samples, and chemical wastes such as still bottoms, fuel oils, sludges, fly ash, and reactor residues.

### 1.1.3 Analytical Procedure and Detection Limits

1. Contract Required Detection Limits (CRDL):

| | Soil, ug/kg |
|---|---|
| Tetra and penta CDFs and CDDs | 0.1 - 0.5 |
| Hexa CDFs and CDDs | 0.5 - 1.0 |
| Hepta and octa CDFs and CDDs | 1.0 - 5.0 |

Calculate and report the detected results or estimated sample detection limits (SDLs) (see Subsection 5.1.5 for calculation) for the dioxin/furan homologous series.

To achieve the specified detection limits, a final volume of 100 ul or less for the extracts is recommended.

2. Analytical Methodology:

Follow the SW-846 Method 8280 or Method 8290 with the following specifications:

a. Analyze samples by a DB-5 fused silica capillary column or the equivalent. If dioxins/furans are detected in the samples, confirmatory analyses using a SP-2331 fused silica capillary column or the equivalent must be performed. Report all dioxins/furans identified and

quantified by both columns. To achieve the chromatographic peak resolution criteria of $\leq$25 percent between 2,3,7,8-TCDD and 1,2,3,4-TCDD in the column performance check mixture, 60-meter columns are recommended for both DB-5 and SP-2331.

b. The quantitation ions, confirmation ions, and M - COC1 ions used for selective ion monitoring (SIM) are specified in Table 2 of Method 8280. Ions to be monitored are as follows:

Descriptor 1: 243,304,306,316,318,257,320,322,332,334,376

Descriptor 2: 277,340,342,293,356,358,410

Descriptor 3: 311,374,376,327,390,392,402,404,446

Descriptor 4: 345,408,410,418,420,361,424,426,480

Descriptor 5: 379,442,444,395,458,460,470,472,514

### 1.1.4 Contract Holding Times

Contract required holding times are 28 days from the date of sample receipt for extraction and 40 days from the date of sample receipt for GC/MS analysis.

### 1.1.5 Calibration Procedure and Criteria

Calibrate according to Section 6.0 of Method 8280, with the following specifications:

1. Internal standards and recovery standards required are as follow:

| Recovery Standard (RStd) | Daily Std Amount | Sample Amount |
|---|---|---|
| 13C-1,2,3,4-TCDD | 0.5 ng/ul | 50 ng |
| 13C-1,2,3,7,8,9-HxCDD | 0.5 ng/ul | 50 ng |

| Internal Standard (IStd) | | |
|---|---|---|
| 13C-2,3,7,8-TCDF | 0.5 ng/ul | 50 ng |
| 13C-2,3,7,8-TCDD | 0.5 ng/ul | 50 ng |
| 13C-1,2,3,6,7,8-HxCDD | 0.5 ng/ul | 50 ng |
| 13C-1,2,3,4,6,7,8-HpCDF | 0.5 ng/ul | 50 ng |
| 13C-OCDD | 1.0 ng/ul | 100 ng |

Compound Quantification

13C-TCDF and 13C-TCDD against 13C-1,2,3,4-TCDD

13C-HxCDD, 13C-HpCDF, and 13C-OCDD against 13C-1,2,3,7,8,9-HxCDD

TCDF and PeCDF against 13C-2,3,7,8-TCDF

TCDD and PeCDD against 13C-2,3,7,8-TCDD

HxCDD and HpCDD against 13C-1,2,3,6,7,8-HxCDD

HxCDF and HpCDF against 13C-1,2,3,4,6,7,8-HpCDF

OCDF and OCDD against 13C-OCDD

Results are to be calculated using the relative response factors (RRF) from the continuing calibration. The percent recoveries of each internal standard are to be calculated and reported. The samples with one or more internal standard

recoveries of less than 40 percent or greater than 120 percent must be re-extracted and reanalyzed.

2. A column performance check mixture containing the isomers listed in Method 8280 paragraph 6.3 must be analyzed at the beginning and end of a 12-hour period, as described in paragraph 6.9.1. The QA/QC criteria as described in paragraph 6.3 must be met.

3. Initial calibration using standard solutions at concentrations of 200, 500, 1000, 2,000, and 5,000 ng/ml is required. Percent relative standard deviations (%RSD) of the relative response factors (RRF) for the calibration standards must not exceed 15 percent.

   A minimum signal-to-noise (S/N) ratio of 50:1 for the m/z 320 ion of 2,3,7,8-TCDD must be achieved from the 200 ng/ml standard.

4. A calibration standard solution at concentration of 500 ng/ml must be analyzed at the beginning of a 12-hour period. The measured RRFs of all analyses must be within $\pm$30 percent of the mean values established by initial analyses of the calibration standard solutions.

   A minimum S/N ratio of 150:1 for the m/z 320 ion of 2,3,7,8-TCDD must be achieved.

5. Samples and method blanks are not to be analyzed until acceptable calibration criteria as described in paragraphs 6.3, 6.4, 6.6, and 6.7 of Method 8280 are demonstrated and documented.

### 1.1.6 Internal Quality Control Checks, Control Limits, and Corrective Action

1. Alumina/silica column cleanup procedure is required for water and soil samples and chemical wastes. Additional cleanup (such as carbon column) may be needed for highly contaminated samples.

2. Analyze method blanks at a frequency of one per group of 20 or fewer samples. The method blanks must be free of chlorinated dibenzofurans and chlorinated dibenzo-p-dioxins and free of any interfering peaks.

3. Analyze a sample duplicate and native spike (NS) at the frequency of one per group of 20 or fewer samples. The NS solution must contain at least one x,2,3,7,8 isomer from each of the tetra through octa polychlorinated dibenzofuran and dibenzo-p-dioxin homologous series. Concentrations of NS solutions should be such that the final extracts contain amounts at the midrange of the calibration curve. Recoveries of 40 to 140 percent for tetra through octa polychlorinated dibenzofurans and dibenzo-p-dioxins are required. If the recovery limits are not met, the NS must be re-extracted and reanalyzed, unless a reinjection gives acceptable recoveries.

4. For samples in which the concentration of any isomer in a homologous series is above the five-point initial calibration range, the extracts are to be diluted in such a way that the measured concentration of that particular isomer lies within the calibration range. All computed results and raw data for both the undiluted sample analyses are to be submitted.

5. The laboratory will be expected to analyze performance evaluation samples as provided by EPA on a periodic basis.

6. If above control limits are exceeded, take appropriate actions to correct the problems and reanalyze the affected samples.

## 1.2 Analysis of Total Fuel Hydrocarbons by CA LUFT Method

### 1.2.1 Analyses

Gasoline and diesel

### 1.2.2 Sample Matrices

Groundwater, sludges, and soils

### 1.2.3 Analytical Procedure and Detection Limits

Follow the CA LUFT Method. Gasoline may be analyzed for using the headspace method or alternatively using the purge and trap method (EPA Method 5030). Analyze for diesel using the extraction method. The contract required detection limits are listed below:

| Method | Parameter | Matrix | Detection Limit |
|---|---|---|---|
| Headspace | Gasoline | Soil | 5.0 mg/kg |
| Extraction | Diesel | Soil | 10.0 mg/kg |

Samples are to be kept at 4 degrees Centigrade until analysis and validation of results are completed.

### 1.2.4 Contract Holding Times

Samples must be analyzed for gasoline as soon as possible or within 14 days after collection. They must be extracted for diesel within 14 days after collection, and the extract analyzed within 40 days. Samples may be held for a longer period only if the collector or laboratory has data on file to show that the specific types of samples under study are stable for the longer time.

### 1.2.5 Calibration Procedure and Criteria

1. Establish GC operating parameters as specified by the CA LUFT Method.

2. Adjust the sensitivity of the analytical system for the sample analyses by injecting secondary standards, as necessary.

3. Calibrate the chromatographic system using the external standard technique.

4. At least three concentration levels should be used for the preparation of the standard curve. One of the standards should be at a concentration near, but above, the method detection limit. The other standards should correspond to the expected range of concentrations found in real samples, or should define the working range of the detector.

5. Using injections of 2 to 5 ul of each calibration standard, tabulate total peak height or area responses against the mass injected. Use the results to prepare the calibration curve.

6. The working calibration curve must be verified on each working day by the measurement of one or more calibration standards. If the response varies from the predicted response by more than 10 percent, the test must be repeated using a fresh calibration standard. Alternatively, a new calibration curve may be prepared.

### 1.2.6 Internal Quality Control Checks, Control Limits, and Corrective Action

1. Analyze blanks, duplicates, and spikes at a frequency of one per batch or one per 20 samples, whichever is more frequent.

2. Establish appropriate laboratory statistical control limits at 99 percent confidence (average plus or minus three standard deviations) for percent Recovery and percent difference for the spike and duplicate, respectively.

3. If the above control limits are exceeded, take appropriate corrective actions and reanalyze the affected samples.

### 1.2.7 Data Calculations and Reporting Units

Calculate the sample results by external standard technique using peak height or area responses. Report results for soil samples in mg/kg (wet weight basis).

### 1.2.8 Documentation and Deliverables

1. Provide all sample results.

2. Provide all raw data, including copies of chromatograms and data system printouts or manual calculation work sheets. All raw data must be properly

identified with the instrument and column identification, sample or standard identification, volume injected, and date and time of analysis.

3. Provide summaries of all blank, spike, and duplicate results, including reference numbers used and control limits.

4. Provide summaries of total peak height or area responses tabulated against mass injected for all initial calibration standards.

5. Provide summaries of daily calibration results showing percent differences from the predicted value, and the date and time of analysis.

6. The data package must be systematically organized with each page sequentially numbered.

## 1.3 Analysis of Total Petroleum Hydrocarbons by EPA Method 418.1

### 1.3.1 Analyses

Fluorocarbon-113 extractable petroleum hydrocarbons

### 1.3.2 Sample Matrices

Surface and saline waters; domestic and industrial wastes

### 1.3.3 Analytical Procedure and Detection Limits

Follow the procedure described in EPA Method 418.1. The contract required detection limit is 1 part per million.

1. The sample must be preserved with hydrochloric acid (HCl) if analysis is not performed within 4 hours of collection. It must be stored under refrigeration.

2. Use the entire sample for the test.

### 1.3.4 Contract Holding Time

Twenty-eight days following sample collection.

### 1.3.5 Calibration Procedure and Criteria

Follow the procedure specified in EPA Method 418.1. It is not necessary to add silica gel to the standards.

### 1.3.6 Internal Quality Control Checks, Control Limits, and Corrective Action

1. Analyze laboratory blanks at a frequency of one per group of 20 samples or fewer. The total petroleum hydrocarbon concentration of the blank must be less than the detection limit.

2. Analyze matrix spikes at a frequency of one per 20 or fewer samples. The spike recovery must be 75 to 125 percent of the spike concentration.

3. Analyze duplicates at a frequency of one per 20 or fewer samples. The relative percent difference between the duplicate values must not exceed 20 percent.

4. If the above control limits are exceeded, take appropriate corrective action and reanalyze the affected samples.

### 1.3.7 Data Calculations and Reporting Units

Report results to two significant figure using the curve and the equation specified in the method.

### 1.3.8 Documentation and Deliverables

Document analysis dates. Report results of all samples and blanks. Also report calibration data and results of matrix spikes and duplicate analyses in summary form. All raw data and sample calculations must be included. The data package must be systematically organized with all pages sequentially numbered.

# Attachment 3

# Field Audit Procedures

## SCOPE AND PURPOSE

The purpose of this section is to provide guidance to persons conducting project audits.

All information produced or obtained in the course of enforcement inspections, investigations, and evaluations is potential evidence. As such, the information must be reliable, gathered with constitutional safeguards, and maintained with integrity. The potential evidence may take any of several forms including such items as a Field Notebook, film, computer tape, a Traffic Report, or a degradable sample. Typically, a case preparation investigation may generate large volumes of file material, samples, data tabulations, and reports. Security and accountability (chain-of-custody) must be maintained even while the evidence is in shipment.

Uniform sample control, chain-of-custody, and document control procedures, using EPA's procedures as a model have been adopted for this project.

These procedures ensure the integrity of the data and related information and its security while awaiting, during, and after any litigation takes place.

## AUDIT PROCEDURES

The QAM may schedule audits of field activities at various times to evaluate the execution of sample identification, sample control, chain-ofcCustody procedures, field documentation, and sampling operations. The evaluation is based on the extent to which the applicable standard operating procedures (SOPs) are being followed.

The person conducting the audit is normally a senior technical reviewer who is familiar with the technical and procedural requirements of field sampling and with the applicable SOPs. The auditor keeps a record of his evaluation using field notes and checklists. Following the audit, he reviews its preliminary results with the person in charge of the sampling. The auditor also prepares an audit report containing the results of his evaluation and recommendations for any necessary corrective actions.

Audits are scheduled with the SM and the person in charge of the field sampling.

## DOCUMENT CONTROL

Once a project has been completed, the individual files must be assembled, organized, and securely stored. The QAM may schedule audits of project files.

The document control audit consists of checking each document submitted for accountability. All documents used for field investigations are checked against the list of field documents issued to the SPM or his designated person. Written explanations must be

present for any documents unaccounted for. Documents other than those issued are reviewed to ensure that they all appear on an inventory and that all documents listed on the inventory are accounted for. The auditor checks the documents for an appropriate numbering system.

The documents are examined to determine that all necessary items such as signatures, dates, and project codes are included.

The auditor examines any classified documents and determines if they are handled and stored in the proper manner.

# FIELD AUDIT CHECKLIST
## Briefing With SM

PROJECT NO. DATE OF AUDIT

PROJECT MANAGER SIGNATURE OF AUDITOR

OFFICE LOCATION

Yes __ No __ N/A __ 1. Was a QA Project Plan and a Site Health and Safety Plan plan prepared? If yes, what items are addressed in the plan?
Comments:

Yes __ No __ N/A __ 2. Was a briefing held with project participants?
Comments:

Yes __ No __ N/A __ 3. Were additional instructions given to project participants (i.e., changes in project plan)?
Comments:

Yes __ No __ N/A __ 4. Is there a written list of sampling locations and descriptions?
Comments:

Yes __ No __ N/A __ 5. Is there a map of sampling locations?
Comments:

Yes __ No __ N/A __ 6. Does the sampling team follow a system of accountable documents? If yes, what documents are accountable?
Comments:

Yes __ No __ N/A __ 7. Is there a list of accountable field documents checked out to the SM or designated person? If yes, who checked them out?
Comments:

Yes __ No __ N/A __ 8. Is the transfer of field documents (Traffic Reports, chain-of-custody records, logbooks, etc.) from the SM to the field participants documented in a logbook?
Comments:

# FIELD AUDIT CHECKLIST
## Field Observations

PROJECT NO. DATE OF AUDIT

PROJECT MANAGER SIGNATURE OF AUDITOR

OFFICE LOCATION

Yes __ No __ N/A __ 1. Was permission granted to enter and inspect the facility?
Comments:

Yes __ No __ N/A __ 2. Is permission to enter the facility documented?
Comments:

Yes __ No __ N/A __ 3. Were split samples offered to the facility? If yes, was the offer accepted or declined?
Comments:

Yes __ No __ N/A __ 4. If the offer to split samples was accepted, were the split samples collected?
Comments:

Yes __ No __ N/A __ 5. Is the offering of split samples recorded?
Comments:

Yes __ No __ N/A __ 6. If split samples were collected, are they documented? If yes, where are they documented?
Comments:

Yes __ No __ N/A __ 7. Are the number, frequency, and types of field measurements and observations taken as specified in the project plan or as directed by the SM?
Comments:

Yes __ No __ N/A __ 8. Are field measurements recorded (pH, temperature, conductivity, etc.)? Where?
Comments:

Yes __ No __ N/A __ 9. Are samples collected in the types of containers specified in the project plan or as directed by the SM?
Comments:

Yes __ No __ N/A __ 10. Are samples preserved as specified in the Project Plan or as directed by the SM?
Comments:

Yes __ No __ N/A __ 11. Are the number, frequency, and types of samples collected as specified in the Project Plan or as directed by the SM?
Comments:

Yes __ No __ N/A __ 12. Are samples packed for preservation as specified in the Project Plan (i.e., packed in ice, etc.)?
Comments:

Yes __ No __ N/A __ 13. Is sample custody maintained at all times?
Comments:

# FIELD AUDIT CHECKLIST
## Document Control

PROJECT NO. DATE OF AUDIT

PROJECT MANAGER SIGNATURE OF AUDITOR

OFFICE LOCATION

Yes __ No __ N/A __ 1. Have all unused and voided accountable documents been returned to the SM by the team members?
Comments:

Yes __ No __ N/A __ 2. Have document numbers of all lost or destroyed accountable documents been recorded in the SM's logbook?
Comments:

Yes __ No __ N/A __ 3. Are all samples collected listed on a chain-of-custody record? If yes, describe the type of chain-of-custody Record used.
Comments:

Yes __ No __ N/A __ 4. Do the chain-of-custody records indicate the method of sample shipment?
Comments:

Yes __ No __ N/A __ 5. Is a chain-of-custody record included with the samples in the shipping container?
Comments:

Yes __ No __ N/A __ 6. If used, are blank samples identified?
Comments:

Yes __ No __ N/A __ 7. If collected, are duplicate samples identified on chain-of-custody records?
Comments:

Yes __ No __ N/A __ 8. If used, are spiked samples identified?
Comments:

Yes __ No __ N/A __ 9. Are Field Notebooks signed by the individual who checked out the notebook from the SM?
Comments:

Yes __ No __ N/A __ 10. Are Field Notebooks dated upon receipt from the SM?
Comments:

Yes __ No __ N/A __ 11. Are Field Notebooks project-specific (by notebook or by page)?
Comments:

Yes __ No __ N/A __ 12. Are Field Notebook entries dated and identified by author?
Comments:

Yes __ No __ N/A __ 13. Is the facility's approval or disapproval to take photographs noted in a Field Notebook?
Comments:

Yes __ No __ N/A __ 14. Are photographs documented in Field Notebooks (e.g., time, date, description of subject, photographer, etc.)?
Comments:

Yes __ No __ N/A __ 15. If a Polaroid camera is used, are photos matched with Field Notebook documentation?
Comments:

Yes __ No __ N/A __ 16. Are Traffic Report numbers recorded in the SM logbook?
Comments:

Yes __ No __ N/A __ 17. Are Quality Control checks documented (i.e., calibration of pH meters, conductivity meters, etc.)?
Comments:

Yes __ No __ N/A __ 18. Are amendments to the Project Plan documented (on the Project Plan itself, in a project logbook, elsewhere)?
Comments:

## FIELD AUDIT CHECKLIST
## Debriefing with SM or Field Sampling Team Leader

PROJECT NO. DATE OF AUDIT

PROJECT MANAGER SIGNATURE OF AUDITOR

OFFICE LOCATION

Yes __ No __ N/A __ 1. Was a debriefing held with project participants after the audit was completed?
Comments:

Yes __ No __ N/A __ 2. Were any recommendations made to project participants during the debriefing?
If yes, briefly describe what recommendations were made.
Comments:

# DOCUMENT AUDIT CHECKLIST
## Closed Files

PROJECT NO. DATE OF AUDIT

PROJECT MANAGER SIGNATURE OF AUDITOR

OFFICE LOCATION

Yes __ No __ N/A __ 1. Have individual files been assembled (field investigation, laboratory, other)?
Comments:

Yes __ No __ N/A __ 2. Is each file inventoried?
Comments:

Yes __ No __ N/A __ 3. Is a document numbering system used?
Comments:

Yes __ No __ N/A __ 4. Has each document been assigned a document control number?
Comments:

Yes __ No __ N/A __ 5. Are all documents listed on the inventory accounted for?
Comments:

Yes __ No __ N/A __ 6. Are there any documents in the file that are not on the inventory?
Comments:

Yes __ No __ N/A __ 7. Is the file stored in a secure area?
Comments:

Yes __ No __ N/A __ 8. Are there any project documents that have been declared enforcement sensitive?
Comments:

## DOCUMENT AUDIT CHECKLIST
## Enforcement Sensitive Documents

PROJECT NO. DATE OF AUDIT

PROJECT MANAGER SIGNATURE OF AUDITOR

OFFICE LOCATION

Yes __ No __ N/A __ 1. Are Enforcement Sensitive documents stored in a secure area separate from other project documents?
Comments:

Yes __ No __ N/A __ 2. Are Enforcement Sensitive documents listed in the project file?
Comments:

Yes __ No __ N/A __ 3. Is access to Enforcement Sensitive files restricted?
Comments:

Yes __ No __ N/A __ 4. Have classified documents been marked or stamped "Enforcement Sensitive?"
Comments:

Yes __ No __ N/A __ 5. Is classified information inventoried?
Comments:

Yes __ No __ N/A __ 6. Is classified information numbered for document control?
Comments:

# DOCUMENT AUDIT CHECKLIST
## Active Project Files

PROJECT NO. DATE OF AUDIT

PROJECT MANAGER SIGNATURE OF AUDITOR

OFFICE LOCATION

Yes __ No __ N/A __ 1. Are project notebooks being maintained in accordance with policies?
Comments:

Yes __ No __ N/A __ 2. Are project activities logbooks being kept up to date?
Comments:

Yes __ No __ N/A __ 3. Is each entry in the project activities logbook identified by date and author, if made by persons not originally assigned to the book?
Comments:

Yes __ No __ N/A __ 4. Are entries legible, factual, and made in ink?
Comments:

Yes __ No __ N/A __ 5. Are modifications to the project work plan noted in the project activities logbook or elsewhere?
Comments:

Yes __ No __ N/A __ 6. Is an inventory of serialized field documents (chain-of-custody records, etc.) in the RDCO's inventory logbook?
Comments:

Yes __ No __ N/A __ 7. Does the Field Notebook contain adequate information about each sample including the Traffic Report number, date, location, and information necessary to reconstruct the sample?
Comments:

Yes __ No __ N/A __ 8. Are entries to the Field Notebook made in ink?
Comments:

Yes __ No __ N/A __ 9. Are corrections properly executed with one line through the error in all project logbooks and Field Notebooks?
Comments:

Yes __ No __ N/A __ 10. Are all project notebooks and logbooks properly labeled with the project number, EPA site number and title?
Comments:

## DOCUMENT AUDIT CHECKLIST
## Regional Document Control Officer

OFFICE LOCATION
DATE OF AUDIT
SIGNATURE OF AUDITOR

Yes __ No __ N/A __ 1. Is an inventory of serialized field documents (chain-of-custody records, etc.) in the RDCO's inventory logbook?
Comments:

Yes __ No __ N/A __ 2. Are project materials secured during other than working hours unless they are in use?
Comments:

Yes __ No __ N/A __ 3. Is Enforcement Sensitive material maintained in a secured area with a check-out log at all times?
Comments:

# Appendix B

# SITE HEALTH AND SAFETY PLAN

## TABLE OF CONTENTS


Page

1.0 GENERAL INFORMATION . . . . . B-1

2.0 SITE CHARACTERISTICS . . . . . B-3

2.1 Station Description . . . . . B-3

3.0 PHYSICAL AND CHEMICAL HAZARDS . . . . . B-5

3.1 Physical Hazards . . . . . B-5

3.2 Chemical Hazards . . . . . B-9

3.3 Toxicity Profiles . . . . . B-15

3.4 References . . . . . B-43

4.0 PROCEDURES . . . . . B-49

4.1 Site Organization . . . . . B-49

4.2 Site Personnel . . . . . B-49

4.3 Site Entry Procedures . . . . . B-58

4.4 Work Limitations . . . . . B-59

4.5 Decontamination Procedures . . . . . B-60

4.6 Disposal of Materials Generated On-Station . . . . . B-67

5.0 EMERGENCY INFORMATION . . . . . B-69

5.1 Local Emergency Phone Numbers . . . . . B-70

5.2 Emergency Routes . . . . . B-70

5.3 Emergency Contacts . . . . . B-70

6.0 CATEGORY-SPECIFIC INFORMATION AND PROCEDURES . . . . . B-77

6.1 Category 1 - Drainage Channels . . . . . B-79

6.2 Category 2 - Landfarming Sites . . . . . B-81

6.3 Category 3 - PCB Spill Area/Transformer Storage Area . . . . . B-83

TABLE OF CONTENTS (Continued)

Page

6.4 Category 4 - Abandoned Well . . . . . B-85

6.5 Category 5 - Above-Ground Fuel Storage Areas . . . . . B-87

6.6 Category 6 - Underground Storage Tanks and Oil/Water Separators . . B-91

6.7 Category 7 - Hazardous Waste Storage Areas/Drum Storage Areas . . . B-93

6.8 Category 8 - Washracks/Wash Water Runoff Areas . . . . . B-95

6.9 Category 9 - TCE Degreaser . . . . . B-97

6.10 Category 10 - Former Sewage Treatment Plant . . . . . B-99

6.11 Category 11 - Former Incinerator Site . . . . . B-101

6.12 Category 12 - Equipment/Vehicle Storage Yards . . . . . B-105

6.13 Category 13 - Metal Plating Sewer Lines . . . . . B-107

7.0 PLAN APPROVAL . . . . . B-109

Attachment 1

Material Safety Data Sheets . . . . . B-111

Attachment 2

Health and Safety Forms . . . . . B-137

Attachment 3

Cal/OSHA Work Site Poster . . . . . B-145

List of Tables

B-1 Guidelines for Working in Temperature Extremes While Wearing Personal Protective Equipment . . . . . B-7

B-2 Symptoms and Treatment of Heat and Cold Stress . . . . . B-7

## TABLE OF CONTENTS (Continued)

Page

List of Figures

1 Minimum Decontamination Layout for PPE Level B . . . . . B-63

2 Emergency Route to Irvine Medical Center (Map) . . . . . B-71

blank page

# ACRONYMS

| | |
|---|---|
| APR | Air Purifying Respirators |
| B&C | Brown and Caldwell |
| Cal/OSHA | California Occupational Safety and Health Administration |
| CDHS | California Department of Health Services |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Commonly known as Superfund) |
| CLEAN | Comprehensive Long-Term Environmental Action, Navy |
| CLP | Contact Laboratory Program |
| CNS | Central Nervous System |
| COMCABWEST | Commander Marine Corps Bases, Western Area |
| CPR | Cardiopulmonary Resuscitation |
| CRDL | Contract Required Detection Limits |
| CRP | Community Relations Plan |
| DCA | Dichloroethane |
| DCE | Dichloroethylene |
| DI | Deionized Water |
| DPBA | Dual Purpose Breathing Apparatus |
| DQO | Data Quality Objectives |
| DRMO | Defense Reutilization and Marketing Office |
| EC | Electrical Conductivity |
| ELSA | Emergency Life Support Apparatus |

| | |
|---|---|
| EOD | Explosive Ordnance Disposal |
| EPA | U.S. Environmental Protection Agency |
| FFA | Federal Facilities Agreement |
| FS smoke | Sulfur Trioxide Chlorosulforic Acid |
| FS | Feasibility Study |
| GAC | Granular Activated Carbon |
| GIS | Geographical Information System |
| GPR | Ground-penetrating Radar |
| HLA | Harding Lawson Associates |
| HRS | Hazardous Ranking System |
| HSP | Health and Safety Plan |
| IAS | Initial Assessment Study |
| IRIS | Integrated Risk Information System |
| IRP | Installation Restoration Program |
| IRWD | Irvine Ranch Water District |
| Jacobs | Jacobs Engineering Group, Inc. |
| JMM | James M. Montgomery Engineers, Inc. |
| LEL | Lower Explosion Limit |
| MAGs | Marine Air Groups |
| MCAS | Marine Corps Air Station |
| msl | Mean Sea Level |
| NACIP | Navy Assessment and Control of Installation Pollutants |
| NAVFACENGCOM | Naval Facilities Engineering Command |
| NCP | National Contingency Plan |

| | |
|---|---|
| NIOSH | National Institute of Occupational and Health |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| OCEMA | Orange County Environmental Management Agency |
| OCHCA | Orange County Health Care Agency |
| OCWD | Orange County Water District |
| OU | Operable Unit |
| OVA | Organic Vapor Analyzer |
| PA/SI | Preliminary Assessment Site Investigation |
| PAHs | Polynuclear Aromatic Hydrocarbons |
| PAO | Public Affairs Office |
| PCB | Polychlorinated biphenyl |
| PCE | Perchloroethylene or Tetrachloroethylene |
| PEL | Permissible Exposure Limit |
| ppb | Parts Per Billion |
| PPE | Personnel Protective Equipment |
| ppm | Parts Per Million |
| PRP | Potentially Responsible Part |
| QAPP | Quality Assurance Program |
| RA | Remedial Action |
| RAP | Remedial Action Plan |
| RAS | Routine Analytical Services |
| RCRA | Resource Conservation and Recovery Act of 1978 |
| RD | Remedial Design |
| REL | Recommended Exposure Limit |

| | |
|---|---|
| RFA | RCRA Facility Assessment |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| ROD | Record of Decision |
| RWQCB | California Regional Water Quality Control Board, Santa Ana Region |
| SAP | Sampling and Analysis Plan |
| SARA | Superfund Amendments and Reauthorization Act |
| SI | Site Investigation |
| SIPOA | Site Inspection Plan of Action |
| SPCC | Spill Prevention Control and Countermeasure |
| SSC | Site Safety Coordinator |
| STEL | Short-Term Exposure Limit |
| SWAT | Solid Waste Assessment Test |
| SWMU/AOC | Solid Waste Management Unit/Area of Concern |
| TAFDS | Tactical Air Fuel Dispensing System |
| TAG | Technical Assistance Grant |
| TCA | Trichloroethane |
| TCE | Trichloroethylene |
| TDS | Total Dissolved Solids |
| TIC | The Irvine Company |
| TLV | Threshold Limit Value |
| TNT | 2,4,6-Dinitrotoluene |
| TPH | Total Petroleum Hydrocarbons |
| TRC | Technical Review Committee |

| | |
|---|---|
| TSA | Transformer Storage Area |
| USMC | United States Marine Corps |
| UST | Underground Storage Tank |
| VOC | Volatile Organic Compound |

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## Checklist for Field Use of MCAS El Toro
## Site Health and Safety Plan

All of the following items must be completed before this Site Health and Safety Plan (HSP) can be duplicated and distributed to field personnel and posted at the work site.

| | |
|---|---|
| ____ Medical/Training | Obtain evidence that all site personnel listed in this HSP are in current medical and training status (each within the last calendar year). If not, they must become current or must be removed from the site team. |
| ____ New Field Personnel | Add the names and responsibilities of all new site personnel to the plan by completing the Site Personnel Additions form in Attachment 2. Require evidence of medical and training status for all new personnel. |
| ____ Subcontractor Personnel | Have each field subcontractor complete the Subcontractor Medical and Training Certification Letter found in Attachment 2. Copies of all completed forms must be included with this HSP along with evidence of medical and training status. |
| ____ Work Site Poster | Post a copy of the Cal/OSHA work site poster in an easily visible location in the support zone of each site. The copy must be legible and not less than 11 x 17 inches. A copy of the poster is provided in Attachment 3. |

_____ Site Safety Coordinator

_____ Date

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# 1.0 GENERAL INFORMATION

CLIENT: U.S. Navy Comprehensive Long-Term Environmental Action, Navy (CLEAN)

JOB NO: LAO30976.99.FP

PROJECT MANAGER: Mike Arends/CH2M HILL, Santa Ana, California

SITE NAME: MCAS El Toro

SITE LOCATION: El Toro, Orange County, California

PURPOSE OF FIELD VISIT: Field sampling program RCRA Facility Assessment (RFA). Work will include drilling soil borings to collect soil samples from 156 sites.

DATE OF VISIT: Approximately October to December 1991

BACKGROUND INFORMATION: Complete _____ Preliminary X

INFORMATION AVAILABLE FROM: CH2M HILL, Santa Ana, California

OVERALL HAZARD SUMMARY: Serious _____ Moderate _____

Low X Unknown _____

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# 2.0 SITE CHARACTERISTICS

## 2.1 Station Description

The Marine Corps Air Station (MCAS) El Toro (or Station) is a U.S. military reservation that contains a large, active air base operated by the U.S. Marine Corps. The Station includes support areas such as aircraft and maintenance shops, office spaces, housing facilities, and large areas of undeveloped land that act as a buffer zone with surrounding property.

The Site Health and Safety Plan (HSP) addresses 156 Solid Waste Management Units and areas of concern at MCAS El Toro. These 156 sites have been divided into 13 categorical sites. Information applicable to all the categorical sites, such as site personnel, details of personnel protective equipment (PPE) levels, details of monitoring equipment and procedures, site entry procedures, decontamination, and emergency information will be provided in Sections 1.0 through 5.0. The following 13 categorical sites are the subject of field investigation for MCAS El Toro.

1. Drainage channels
2. Landfarm sites
3. PCB spill site/Transformer storage area
4. Abandoned well
5. Above-ground fuel storage areas
6. Underground storage tanks and oil/water separators

7. Hazardous waste/drum storage areas

8. Washracks

9. TCE degreasers

10. Former sewage treatment facility

11. Former incinerator site

12. Equipment/vehicle storage yard

13. Metal plating sewer lines

# 3.0 PHYSICAL AND CHEMICAL HAZARDS

## 3.1 Physical Hazards

On-Station activities involve potential hazards of heat stress: vehicular traffic on roadways and in parking areas, aircraft in taxi or low flight operations, and active industrial operations in shop spaces.

Drilling poses safety hazards to personnel in the immediate vicinity of the drill rig. Where there is a hazard due to high pressure hose rupture, precautions will be taken to check to see that fitting and pressurized lines are in good condition before use. To protect personnel from overhead falling objects (i.e., bolts, wrenches, pieces of pipe), hard hats must be worn in the immediate vicinity of the drill rig. Safety glasses are also required to protect against flying projectiles possibly caused by hammering fittings or connections and driving casing. Drilling activities near overhead electrical lines will be avoided. The drill rig mast shall remain a minimum distance of 15 feet from all overhead utility lines. Work under suspended loads will not be permitted. Continuous monitoring with an explosion meter and organic vapor analyzer (OVA) will be performed to identify potential fire/explosion and inhalation hazards. Recording of readings will be documented every 1/2 hour from the onset of the work shift in the Site Safety Coordinator (SSC) logbook. Noise from drilling operations will require appropriate hearing conservation measures such as earplugs and earmuffs. Where there is a potential hazard from flying debris/objects, shields and/or personal protective equipment will be used.

Potential hazards exist with subsurface utilities at the site, such as electrical conduits, water lines, and pressurized gas lines. All drilling locations will be cleared by an appropriate knowledgeable Marine Corps representative prior to commencement of drilling at every location. The location of buried utilities will be marked prior to drilling or digging.

Noise. The main direct source of noise for this project is produced by the drill rig, vehicles, and electric generators. However, since the site is located near a landing strip, various aircraft may cause extremely loud intermittent noise exposure to site personnel. Hearing protection must be worn while within 30 feet of the drill rig. A good rule of thumb for knowing when hearing protection is required is when, at 3 feet apart in normal conversation, voices must be raised to be heard. The PEL for noise is 90 dBA (90 decibels on the A-weighted scale).

Industrial Operations pose a vehicular traffic hazard to onsite personnel. Various trucks and employee transportation vehicles travel across the site. Work sites must be posted with legible traffic signs at points of hazard. Personnel must be aware of this hazard, be cautious when working near these right-of-ways, and wear brightly colored vests.

Heat and Cold Stress poses a physical hazard which site workers must learn to recognize and treat. Table B-1 and B-2 provide guidelines for working in temperature extremes while wearing PPE and symptoms and treatment of heat and cold stress.

**Table B-1**
**Guidelines for Working in Temperature Extremes**

| Temperature | Work Cycle | Rest Cycle | Control Measures |
|---|---|---|---|
| <32° F or <55° F & raining | 2 hrs | 15 min | Review cold stress in safety meeting. Rest in a warm area. Drink at least 8 ounces of warm non-caffeinated, non-alcoholic beverage at each rest break. Schedule a mid-day lunch break of at least 30 minutes in a warm area to begin not later than 5 hours after startup. |
| 72° to 77° F | 2 hrs | 5 min | Review heat stress in safety meeting. Take resting pulse rate before beginning work. Drink 8 ounces of cool water before beginning work, and 4 ounces at rest break. Have ice available. |
| 77° to 82° F | 2 hrs | 5 min | As above, but seated rest break. Monitor pulse rate. (See below.) |
| 82° to 87° F | 60 min | 15 min | As above, but rest area to be shaded. |
| 87° to 90° F | 30 min | 15 min | As above, but provide a shaded work area. |
| >90° F | 15 min | 15 min | As above. Provide a shaded area with seats in the work area for team members to use as needed. Reschedule work to avoid mid-day heat. |

**PULSE CRITERIA.** Take resting radial (wrist) pulse at start of work day; record it. Measure radial pulse for 30 seconds as rest period begins. Pulse not to exceed 110 beats per minute (bpm). If pulse exceeds this criteria, reduce work load and/or shorten the work cycle by one third, and observe for signs of heat stress. No team member is to return to work until his/her pulse has returned to <110 bpm.

**Table B-2**
**Symptoms and Treatment of Heat and Cold Stress**

| Heat Stroke | Heat Exhaustion | Frostbite | Hypothermia |
|---|---|---|---|
| Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high body temperature. | Pale, clammy, moist skin; profuse sweating; weakness; normal temperature; headache; dizzy; vomiting. | Blanched, white, waxy skin, but tissue resilient; tissue cold and pale. | Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration. |
| Cool victim rapidly by soaking in cool (not cold) water. Get medical attention immediately!! | Remove victim to a cool, air conditioned place. Loosen clothing, place in head low position. Have victim drink cool (not cold) water. | Remove victim to a warm place. Rewarm area quickly in warm (not hot) water. Have victim drink warm fluids--not coffee or alcohol. Do not break any blisters. Elevate the injured area and get medical attention. | Remove victim to a warm place. Have victim drink warm fluids--not coffee or alcohol. Get medical attention. |

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## 3.2 Chemical Hazards

A summary of hazards from chemical constituents found at one or more of the 13 categorical sites is presented below. This information is referenced in the appropriate site-specific sections. Chemicals that present strong potential hazards will be highlighted in the site-specific sections of Section 6 of this HSP.

Gasoline. This is a variable mixture of paraffins, aromatics, and olefins. Acute toxicity includes anesthetic effects and mucous membrane irritation. Symptoms of exposure to low concentrations include headache, blurred vision, slurred speech, dizziness, and nausea. The major toxicity concern is benzene, which is a known human carcinogen through inhalation. Leaded gasoline contains tetraethyl lead as antiknock additives. Both compounds are volatile and both may be absorbed through skin. The concern for exposure to these additives is lead because lead overexposure is associated with central nervous system (CNS) effects. Precautions to avoid dermal contact with leaded gasoline is important to prevent lead exposure. The California Occupational Safety and Health Administration (Cal/OSHA) permissible exposure limit (PEL) for gasoline is 300 parts per million (ppm).

Skin contact with gasoline can produce immediate or delayed symptoms of dryness or irritation. If skin comes in contact with gasoline, remove clothing from affected area and wash promptly with soap and water. Dry carefully with a clean towel. If skin is inflamed, painful, or blistered, seek medical attention. If ingestion occurs, DO NOT INDUCE VOMITING. Get medical help. Be prepared to administer artificial respiration.

Diesel Fuel. Diesel fuel is a complex petroleum mixture of paraffinic, olefinic, naphthionic, and aromatic hydrocarbons. Diesel fuel typically has a much lower aromatic content than gasoline. The benzene content is typically less than 100 ppm in the source product. Excessive inhalation exposure may cause respiratory irritation, headache, dizziness, nausea, vomiting, and loss of coordination. Prolonged skin contact may lead to irritation of hair follicles and blockage of the sebaceous glands. Good personal hygiene will prevent this. There is no Cal/OSHA permissible exposure limit (PEL), National Institute of Occupational Safety and Health (NIOSH) recommended exposure limit (REL), or American Conference of Governmental Industrial Hygienists, Inc. (ACGIH) threshold limit value (TLV) for diesel fuel.

Kerosene (Includes Jet Engine Fuels). Kerosene is a refined petroleum distillate composed of aliphatic hydrocarbons with 10 to 16 carbons per molecule and benzene and naphthalene derivatives. Typical gas turbine (jet) engine fuels are derivatives of kerosene with various additives to improve performance or reduce smoke. Over-exposure may cause headaches, dizziness, nausea, stupor, and respiratory tract and eye irritation. The primary health hazard is skin irritation and dermatitis from prolonged or repeated skin contact. Ingestion can be irritating to the mouth, throat, and digestive tract, with the hazard of aspiration into the lungs. The National Institute of Occupational Safety and Health (NIOSH) recommended limit is 100 milligrams per cubic meter ($mg/m^3$).

If ingestion occurs, DO NOT INDUCE VOMITING. Seek immediate medical attention. If inhalation occurs, move to a clean area to breathe fresh air. If skin contact occurs,

wash immediately with soap and water. If eye contact occurs, immediately flush the eye for 15 minutes with clean water and then seek medical attention.

Motor Oils, Insulating and Transformer Oils. These oils are relatively harmless products, but they may contain polynuclear aromatic hydrocarbons (PAHs), lead, and other carcinogenic or mutagenic substances at relatively low concentrations. These constituents may be absorbed through the skin and, therefore, dermal protection and decontamination are important to protect exposure. There are no Cal/OSHA PELs, NIOSH RELs, or ACGIH TLVs for these oils.

Chlorinated Solvents. Possible low levels of chlorinated compounds may be encountered in water samples. The primary avenue of exposure is inhalation and dermal contact. Some of these compounds act as central nervous system depressants that produce visual disturbances, mental confusion, fatigue, and nausea. The Cal/OSHA PELs for chlorinated solvents can be as low as 1 ppm, depending on the solvent.

Metals. Heavy metals typically have a high affinity for soil particles, creating potential for both inhalation and dermal contact from dust created during drilling operations. Metals are absorbed in the bloodstream and produce fever, dizziness, mental confusion, and nausea. The Cal/OSHA PELs for several heavy metals are: arsenic 0.01 $mg/m^3$, cadmium 0.2 $mg/m^3$, lead 50 $mg/m^3$, antimony 0.5 $mg/m^3$, and barium 0.5 $mg/m^3$. The NIOSH RELs for several heavy metals are: arsenic 0.01 $mg/m^3$, cadmium 0.1 $mg/m^3$, and lead 0.1 $mg/m^3$, respectively.

PCBs. Polychlorinated biphenyls (PCBs) are suspected human carcinogens. At locations where PCBs could reasonably be expected, field measurable levels of petroleum products (using OVA) will be managed as if PCBs were present. The Cal/OSHA PEL for chlorodiphenyl (54 percent chlorine) is 0.5 $mg/m^3$. The NIOSH REL and ACGIH TLV for PCBs are 0.001 $mg/m^3$ and 0.5 mg/m3, respectively.

Battery Acid poses a dermal contact hazard as well as an inhalation hazard if airborne concentrations of acid-contaminated dust are generated in the personnel breathing zone. Sulfuric acid is a common battery acid and causes skin irritation on contact. Symptoms of inhalation exposure include irritation of the eyes, nose, throat, and lungs. The Cal/OSHA PEL, NIOSH REL, and ACGIH TLV for sulfuric acid is 1 $mg/m^3$.

Landfill Gas. Landfill gas may include the following constituents:

- Methane
- Carbon dioxide
- Hydrogen cyanide
- Vinyl chloride
- Solvents and paints
- Dioxin

Methane is not highly toxic, but is a hazard because of its flammability. The lower explosion limit (LEL) is 5.3 percent (53,000 ppm) and the flash point is -183 degrees fahrenheit. Methane is a simple asphyxiant that displaces oxygen in the air. At high

methane concentrations it is important to continuously monitor oxygen concentrations. In landfill gas, methane concentrations generally run 60 to 80 percent.

Carbon Dioxide is another major landfill gas constituent. The Cal/OSHA PEL is 5,000 ppm, with a short-term exposure limit (STEL) of 30,000 ppm. At high levels, such as 50,000 ppm, respiration is increased and blood pressure is increased, as is the pulse. Air purifying respirators (APRs) provide no protection from carbon dioxide concentrations and, therefore, Level B would be required if short-term exposures (15 minutes) exceed 30,000 ppm.

Hydrogen Cyanide (HCN) could be released if cyanide wastes were brought into contact with acids. HCN has the odor of bitter almonds, is highly flammable and has a ACGIH TLV ceiling of 10 ppm. HCN is also absorbed through the skin. Overexposure is associated with headache, weakness, changes in taste and smell, throat irritation, nausea, vomiting, and difficulty in breathing. The immediately dangerous to life and health (IDLH) level is 50 ppm. Inhalation, ingestion, or skin absorption of HCN may be rapidly fatal. The Cal/OSHA PEL for HCN is 10 ppm and the NIOSH REL is 4.7 ppm.

Hydrogen Sulfide ($H_2S$) is another common landfill constituent formed by decomposition. Drilling could liberate pockets of this flammable gas. APRs provide no protection. The Cal/OSHA PEL and the ACGIH TLV is 10 ppm, with an STEL (15-minute time weighted average) of 15 ppm.

Its rotten egg odor is detectable at levels as low as 0.0005 ppm, but odor perception is extremely unreliable because $H_2S$ quickly deadens odor perception, making it

impossible to smell its presence, and some persons are congenitally unable to smell $H_2S$. In fact, the absence of the $H_2S$ odor after smelling $H_2S$ may mean that the olfactory senses are temporarily deadened.

At high levels (500 to 1,000 ppm), $H_2S$ causes death by respiratory paralysis. Lower concentrations (50 to 500 ppm) produce respiratory irritation. Eye irritation has been reported for levels as low as 5 to 30 ppm. Other low-level exposure effects of $H_2S$ include headache, sleep disturbance, and nausea. The IDLH level is 300 ppm.

Vinyl Chloride is a flammable gas at room temperature and is a common constituent of landfill gas that may constitute up to 4 percent by volume of the landfill gas. It is apparently formed during the degradation of chlorinated solvents. Three problems are associated with vinyl chloride in hazardous waste investigations. These problems are: 1) it is difficult to specifically monitor because of the interferences by chemically similar compounds, 2) it is highly toxic, having a Cal/OSHA PEL of 0.5 ppm and the ACGIH TLV is 5 ppm, and 3) APRs provide little protection. The major toxicity concern over vinyl chloride is its association with liver cancer and cancers of the skin, lungs, and bones. Other overexposure effects may include liver and kidney damage, narcotic effects, inebriation, stomach pain, and allergic dermatitis.

Solvents and Paints. Organic chemicals in general act as anesthetics and irritants to the eyes, respiratory system, and skin. Eye contact may cause irritation, dermatitis, cell damage, and necrosis. Chronic toxicities include kidney, liver, heart, and lung damage. The Cal/OSHA PEL, the ACGIH TLV, and the NIOSH REL for toluene and xylene are 100 ppm. The Cal/OSHA PEL, and the ACGIH TLV for acetone is 750 ppm and the

NIOSH REL is 250 ppm. The Cal/OSHA PEL and the ACGIH TLV for benzene is 10 ppm and the NIOSH REL is 0.1 ppm.

Dioxin has been implicated as a human carcinogen. Dermal exposure may cause chloracne, liver dysfunction, or muscle weakness. Exposure should be kept as low as practical by wearing gloves, Tyveks, and controlling dusts during sampling activities.

Hazards Posed by Chemical Substances Used at Sites. In accordance with California regulations for hazard communication, Material Safety Data Sheets are provided in Attachment 1 for the following chemicals:

- Methanol
- Isopropyl alcohol
- Acetone
- Hexane
- Hydrochloric acid
- Sulfuric acid
- Nitric acid
- Sodium Hydroxide

### 3.3 Toxicity Profiles

In addition to the general hazard information presented above, toxicity profiles have been prepared for many of the suspected chemicals of concern. The toxicity profiles give a short description of the acute and chronic effects associated with exposure to the

chemical. These summaries are given below. It is important to note that health effects may be based on animal studies and do not imply that human exposure will have the same results. Sources for the summaries are listed following the text. Prepared profiles have not been available for all the listed chemicals, but additional information on these will be included as it is acquired. Some descriptions have been included following the prepared toxicity profiles. Since the exact composition of general commodities such as JP-5 and crankcase oil is uncertain, no attempt was made to assess the toxicity of these general waste groups beyond the above hazard information.

o ACETONE

**Acute Toxicity Summary.** Exposure to acetone can cause irritation of the eyes, skin, and respiratory tract. Depression of the central nervous system and narcosis can occur following inhalation of high concentrations of acetone. Dryness of the mouth and throat, dizziness, nausea, incoordination, loss of speech, and even coma have been described in some cases of workers exposed to acetone. The Cal/OSHA PEL and the ACGIH TLV is 750 ppm and the NIOSH REL is 250 ppm.

**Chronic Toxicity Summary.** In a study reported by EPA (IRIS, 3/1/88), kidney damage was observed in albino rats administered acetone by oral gavage. Kidney damage and metabolic changes have been noted in humans who ingested acetone. (Sax, 1989).

**Cancer Potential.** Not indicated.

**Other.** Acetone can potentiate the toxicity of other chemicals, particularly solvents. The hepatotoxicity of carbon tetrachloride can be increased greatly in the presence of acetone.

o ANTIMONY

**Acute Toxicity Summary.** Many antimony compounds irritate the gastrointestinal tract. Antimony tartar has been used as an emetic; intoxication results in severe vomiting and diarrhea. With occupational inhalation exposures, rhinitis and acute pulmonary edema may occur. The Cal/OSHA PEL, the ACGIH TLV, and NIOSH REL is 0.5 $mg/m^3$.

**Chronic Toxicity Summary.** Inhalation of some antimony compounds can produce rhinitis, pharyngitis, tracheitis, bronchitis, and pneumoconiosis with obstructive lung disease and emphysema. Transient spots on the skin have been reported in workers. Antimony may form stibine gas, which causes hemolysis.

**Cancer Potential.** Not indicated.

**Other.** Trivalent or equivalent compounds. In mutation tests, some antimony compounds were positive in human lymphocytes and Syrian hamster embryo cells. Trivalent antimony compounds were used for treatment of parasites.

o ARSENIC

**Acute Toxicity Summary.** Acute oral exposure can cause muscular cramps, facial swelling, cardiovascular reactions, severe gastrointestinal damage, and vascular collapse leading to death. Sensory loss and hematopoietic symptoms delayed after exposure to high concentrations are usually reversible. Inhalation exposures can cause severe irritation of nasal lining, larynx, and bronchi. The Cal/OSHA PEL and the ACGIH TLV is 0.2 $mg/m^3$ and the NIOSH REL is 0.1 $mg/m^3$.

**Chronic Toxicity Summary.** Chronic oral or inhalation exposure can produce changes in skin, including hyperpigmentation and hyperkeratosis, peripheral neuropathy, liver injury, cardiovascular disorders, oral exposures associated with peripheral vascular disease, and blackfoot disease.

**Cancer Potential.** Known human carcinogen. Oral exposures associated with skin cancer, inhalation exposures with lung cancer.

**Other.** Toxicity varies for different compounds, inorganic trivalent arsenic compounds usually more toxic than pentavalent compounds. High doses of some inorganic arsenic compounds to pregnant laboratory animals produced malformations in offspring.

- BENZENE

**Acute Toxicity Summary.** Acute exposures (inhalation) to high levels of benzene may lead to depression of the central nervous system (unconsciousness and death) or may cause fatal cardiac arrhythmias. The Cal/OSHA PEL and the ACGIH TLV is 10 ppm and the NIOSH REL is 0.1 ppm.

**Chronic Toxicity Summary.** Major toxic effect is hematopoietic toxicity (affects formation of blood); chronic exposure of workers to low levels has been associated with blood disorders, such as leukemia and aplastic anemia (depression of all three cell types of the blood in the absence of functioning marrow).

**Cancer Potential.** Sufficient evidence that benzene is a human and animal carcinogen. Classified by EPA as a human carcinogen. Strong correlation between exposure to benzene by inhalation and leukemia.

**Other.** Chromosomal aberrations in bone marrow and blood have been reported in experimental animals and some workers.

- BERYLLIUM

**Acute Toxicity Summary.** Acute lung disease (chemical pneumonitis) has been observed immediately after inhalation of aerosols of soluble beryllium compounds, such as beryllium fluoride and compounds (probably zinc beryllium silicate) in

broken fluorescent light tubes. Several months after exposure, the entire respiratory tract may become inflamed with fulminating pneumonitis in severe reactions. Recoveries usually occur within weeks, but fatalities have occurred. In studies with monkeys, high concentrations of aerosols of beryllium fluoride or beryllium phosphate produced severe lung reactions in all animals and damaged the liver and kidney as well as affecting adrenals, pancreas, thyroid, and spleen; many lesions were similar to those in patients who died of pneumonitis. Conjunctivitis and contact dermatitis may follow exposure to beryllium, with skin lesions or ulcerations. Beryllium compounds may produce hypersensitivity with delayed allergic reactions. The Cal/OSHA PEL and the ACGIH TLV is 0.002 $mg/m^3$ and the ceiling limit is 0.025 $mg/m^3$. The NIOSH REL is 0.0005 $mg/m^3$.

**Chronic Toxicity Summary.** The lung is a major target organ for toxic effects of beryllium. Berylliosis, a chronic granulomatous lung disease, which is frequently fatal, has been described for over 40 years among workers exposed to insoluble beryllium compounds. Symptoms may include shortness of breath, cyanosis, clubbed fingers, lesions that progress to fibrotic tissue, and nodules with respiratory dysfunction.

**Cancer Potential.** Beryllium compounds or alloys have produced cancer in rats, rabbits, and monkeys. Lung tumors have been reported in rats and monkeys exposed by inhalation, intratracheally, or intrabronchial implantation, and bone tumors have been produced in rabbits after intravenous or intraosseus administration. Excess lung cancer has been observed in some studies of

workers occupationally exposed to beryllium, but data on exposure and confounding factors are lacking. Beryllium and its compounds have been classified by International Agency for Research on Cancer (IARC) as having sufficient evidence of being carcinogenic in animals and limited evidence in humans (Group 2B) and classified by EPA as B1, probable human carcinogen.

**Other.** Wide variations in individual sensitivity have been reported, perhaps because of an immune reaction; individuals exposed to low doses may exhibit severe effects. Beryllium is stored in the body for many years with detectable amounts in the lungs reported as long as 23 years after exposure. Some beryllium compounds are mutagenic in vitro tests.

o CADMIUM

**Acute Toxicity Summary.** For acute exposures by ingestion, symptoms of cadmium toxicity include nausea, vomiting, diarrhea, muscular cramps, salivation, spasms, drop in blood pressure, vertigo, loss of consciousness, and collapse. Acute renal failure, liver damage, and death may occur. Exposure by inhalation can cause irritation, coughing, labored respiration, vomiting, acute chemical pneumonitis, and pulmonary edema. The Cal/OSHA PEL and the ACGIH TLV is 0.05 $mg/m^3$. The NIOSH REL is 0.1 $mg/m^3$.

**Chronic Toxicity Summary.** Respiratory and renal toxicity are major effects in workers. Chronic oral exposures can produce kidney damage. Cadmium accumulates in kidney, and nephropathy results after critical concentration in the

kidneys is reached, probably about 200 µg/g. Inhalation can cause chronic obstructive pulmonary disease, including bronchitis, progressive fibrosis, and emphysema. Chronic exposure affects calcium metabolism and can cause loss of calcium from bone, bone pain, osteomalacia, and osteoporosis. Chronic exposure may be associated with hypertension. Cadmium can produce testicular atrophy, sterility, and teratogenic effects in experimental animals.

**Cancer Potential.** Increased risk of prostate cancer and perhaps respiratory tract cancer in workers exposed by inhalation. No evidence of carcinogenicity from chronic oral exposure.

**Other.** A nonessential element.

o CARBON TETRACHLORIDE

**Acute Toxicity Summary.** Fatalities have occurred in humans, with death after ingestion of as little as 1.5 ml and average lethal doses of 70 to 140 mg/kg body weight. Exposure to high dosages of carbon tetrachloride can cause CNS depression. Changes in the liver of animals have been reported after a single oral dose and may include rapid lipid accumulation, single cell necrosis, membrane effects, and liver necrosis within 24 hours, but some changes may be reversed. The Cal/OSHA PEL and the ACGIH TLV is 5 ppm and the NIOSH REL is 2 ppm.

**Chronic Toxicity Summary.** Exposure can produce liver and kidney damage in humans. Classic hepatotoxic, liver necrosis, and fat accumulation have been

reported in humans, monkeys, rats, mice, rabbits, guinea pigs, hamsters, cats, dogs, sheep, and cattle. After inhalation CNS depression, pulmonary edema, and fatal cardiac arrhythmias have been described. Encephalopathy and neuropathological alterations have also been observed in rats exposed for several weeks.

**Cancer Potential.** Carcinogen (liver tumors) in mice and rats. Suggestive case reports of humans exposed to carbon tetrachloride who develop liver tumors several years later (IARC).

**Other.** Phytotoxic in mice. Retarded development in rats. Synergistic with alcohol, producing liver injury.

- CHLOROBENZENE

**Acute Toxicity Summary.** Central nervous system depression and irritation of the eye and respiratory tract have been reported in humans exposed to chlorobenzene. Workers exposed to chlorobenzene and perhaps to contaminants exhibited blood dyscrasias. Cardiac effects and toxemia of pregnancy were noted in workers exposed to chlorobenzene and other chemicals. Liver necrosis and interference with porphyrin metabolism occurred in rats dosed orally with chlorobenzene. Kidneys of rabbits were swollen after injection with chlorobenzene. The Cal/OSHA PEL, the ACGIH TLV, and the NIOSH REL is 75 ppm.

**Chronic Toxicity Summary.** In dogs inhaling chlorobenzene, increased adrenal weights, increased liver-to-body weight ratios, and emesis were seen. In rats administered chlorobenzene orally, increased liver and kidney weights and histopathological changes in the liver were observed. Histopathological changes in lymphoid, liver, and kidney and depressed body weight gain were also found in another study with mice and rats receiving chlorobenzene by gavage. In the NTP chronic study of rats and mice receiving chlorobenzene by gavage, liver necrosis occurred in rats and decreased survival was found in low-dose male mice but not high-dose male mice.

**Cancer Potential.** Increased incidence of neoplastic nodules were observed in the livers of male rats receiving chlorobenzene in corn oil by gavage, but judged to be of borderline significance because of carcinomas in vehicle controls.

**Other.** Lipophilic. No teratogenic effects in 2-phase inhalation study of rats and rabbits. Mutagenicity tests mixed.

o CHLOROFORM

**Acute Toxicity Summary.** Anesthetic depresses CNS. Fatalities in humans may be rapid, resulting from cardiac arrest (apparently sensitization to epinephrine) or delayed with kidney and liver damage. Respiratory depression, coma, and liver and kidney damage are among the symptoms of exposure to chloroform. In laboratory animals, acute toxicity depends on species, strain, sex, and age. Liver

damage may be cause of death in rats and mice after acute exposure. The Cal/OSHA PEL and the ACGIH TLV is 10 ppm and the NIOSH REL is 2 ppm.

**Chronic Toxicity Summary.** Kidney damage (renal tubular necrosis) can occur in mice, and kidney and liver damage in rats, rabbits, dogs, and guinea pigs exposed by inhalation.

**Cancer Potential.** Carcinogenic in mice (hepatomas, hepatocellular carcinomas), male rats (malignant kidney tumors), and female rats (thyroid tumors).

**Other.** Phytotoxic in rats and rabbits.

o CHROMIUM

**Acute Toxicity Summary.** Major acute effect from oral exposure is renal tubular necrosis. Inhalation of cremate salts results in irritation and inflammation of nasal mucosa, ulceration, and perforation of nasal septum. The Cal/OSHA PEL, ACGIH TLV, and NIOSH REL is 0.5 $mg/m^3$.

**Chronic Toxicity Summary.** Chronic exposure to hexavalent chromium has resulted in kidney damage in animals and humans. Inhalation exposures to chromates in industrial settings have resulted in nasal membrane inflammation, chronic rhinitis, laryngitis, and pharyngitis. Exposures to skin can result in allergic skin reactions in sensitive individuals. Overall, hexavalent forms are usually more toxic than trivalent forms.

**Cancer Potential.** Excess lung cancer has been associated with cremate-producing industry workers. Chromatic salts are carcinogenic in rats exposed by inhalation.

**Other.** Essential element. Toxicity is related to valence state.

o COPPER

**Acute Toxicity Summary.** Inhalation of copper dusts result in symptoms similar to metal fume fever. Exposure to metal fumes results in upper respiratory tract irritation, metallic or sweet taste, metal fume fever, and skin and hair discoloration. Exposure to dusts and mists of copper salt results in congestion of nasal mucous membranes, sometimes of pharynx, and occasional ulceration with perforation of nasal septum. Acute copper sulfate poisoning in humans (oral) is sometimes fatal and includes vomiting, diarrhea, hypotension, coma, and jaundice. The Cal/OSHA PEL and the ACGIH TLV is 0.2 $mg/m^3$ and the NIOSH REL is 0.1 $mg/m^3$.

**Chronic Toxicity Summary.** Hemolytic anemia after chronic exposure in some dialysis patients. Sensitive individuals with disorders of metabolism--Wilson's disease and Menke's disease.

**Cancer Potential.** Not indicated.

**Other.** Essential nutrient. Organoleptic threshold in water between 1 to 5 mg/l.

o 1,1-DICHLOROETHANE

**Acute Toxicity Summary.** CNS depression may occur when 1,1-dichloroethane is inhaled at high concentrations. Irritating to skin. The Cal/OSHA PEL and the ACGIH TLV is 200 ppm and the NIOSH REL is 100 ppm.

**Chronic Toxicity Summary.** Data limited.

**Cancer Potential.** Not indicated.

o 1,1-DICHLOROETHYLENE (Vinylidene chloride)

**Acute Toxicity Summary.** Liver appears to be principal target. Biochemical changes and necrosis in liver in fasted rats have been reported to develop rapidly after inhalation. Liver damage in fasted rats can occur after one oral dose. At high concentrations, inhalation of 1,1-DCE can cause CNS depression in humans and unconsciousness. The Cal/OSHA PEL and the ACGIH TLV is 5 ppm. The NIOSH REL is not provided.

**Chronic Toxicity Summary.** Described as "exquisite hepatotoxin" because it is more potent and faster acting than classic hepatotoxin, carbon tetrachloride. Kidney injury can also occur at relatively low doses. Reports of health effects on workers exposed to 1,1-DCE include liver function abnormalities, headaches, vision problems, weakness, fatigue, and neurological sensory disturbances.

**Cancer Potential.** One group of investigators reported an increased incidence of kidney tumors in mice exposed by inhalation and possibly mammary tumors in rats. Tumor initiator activity in mouse skin following several treatments with phorbol as promoter has been described.

**Other.** Structure similar to vinyl chloride, a known human carcinogen. Mutagenic in bacterial tests. May be phytotoxic in laboratory animals.

o cis-1,2-DICHLOROETHENE

**Acute Toxicity Summary.** Anesthetic at high concentrations. Appears half as potent as transisomer in depressing CNS. Elevated liver enzymes in rats reported after one exposure. The Cal/OSHA PEL and the ACGIH TLV is 10 ppm and the NIOSH REL is 1 ppm.

**Chronic Toxicity Summary.** Minimal fatty accumulation in liver of rats chronically exposed to high doses of cis-1,2-DCE in drinking water.

**Cancer Potential.** Not indicated.

o trans-1,2-DICHLOROETHENE

**Acute Toxicity Summary.** Inhalation exposure to high levels can cause narcosis and death in rats.

**Chronic Toxicity Summary.** Rats exposed by inhalation exhibited fatty accumulation in liver and infiltration of lungs.

**Cancer Potential.** Not indicated.

o DICHLOROMETHANE (Methylene chloride)

**Acute Toxicity Summary.** Dichloromethane acts as a mild narcotic irritating to eyes and upper respiratory passages. Fatalities have been associated with acute or prolonged exposure. The Cal/OSHA PEL is 100 ppm. The ACGIH TLV is 50 ppm and the NIOSH REL is 500 ppm.

**Chronic Toxicity Summary.** In animals, chronic exposure can affect the liver and kidney. May substantially increase carboxyhemoglobin levels, preventing the transfer of oxygen to tissues. Damage to liver and CNS following long-term occupational exposure has been reported.

**Cancer Potential.** Carcinogen in female rats and male and female mice. Classified as B2 by EPA.

**Other.** Mutagenic in some bacterial tests.

o ETHYLBENZENE

**Acute Toxicity Summary.** Ethylbenzene is irritating to eyes, mucous membranes, and skin. It can cause headaches and narcosis. The Cal/OSHA PEL, ACGIH TLV, and the NIOSH REL is 100 ppm.

**Chronic Toxicity Summary.** Data limited.

**Cancer Potential.** Not indicated.

o LEAD

**Acute Toxicity Summary.** Acute systemic inorganic lead intoxication in humans is characterized by encephalopathy, abdominal pain, hemolysis, liver damage, renal tubular necrosis, seizures, coma, and respiratory arrest. The Cal/OSHA PEL is 0.05 $mg/m^3$ and the ACGIH TLV is 0.15 $mg/m^3$. The NIOSH REL is 0.1 $mg/m^3$.

**Chronic Toxicity Summary.** Chronic low levels of exposure to lead can affect the hematopoietic system, the nervous system, and the cardiovascular system. Lead inhibits several key enzymes involved in heme biosyntheses. One characteristic effect of chronic lead intoxication is anemia, by reduced hemoglobin production and shortened erythrocyte survival. In humans, lead exposure has resulted in nervous system injury including reduced hand-eye coordination, reaction time, visual motor performance, and nerve conduction velocity. The developing child appears especially sensitive to lead-induced nervous system injury. Lead can also

affect the immune system and produce gingival lead lines. Epidemiological studies have indicated that chronic lead exposure may be associated with increased blood pressure in humans. Exposure to lead is associated with sterility, abortion, neonatal mortality, and morbidity. Organolead compounds are neurotoxic.

**Cancer Potential.** Lead salts have some evidence of carcinogenicity in animals.

**Other.** Children are especially sensitive to low level effects.

o MERCURY

**Acute Toxicity Summary.** Inhalation of mercury vapor can cause bronchitis and nervous system effects. Oral exposure can result in abdominal cramps, gastrointestinal effects, ulceration, shock, circulatory collapse, and renal failure. The Cal/OSHA PEL, ACGIH TLV, and the NIOSH REL is 0.05 $mg/m^3$.

**Chronic Toxicity Summary.** Occupational exposure to inorganic mercury can produce effects on nervous system, including tremors, erethism, muscular weakness, personality changes, gingivitis, and colored eye reflex. In children, pink disease has been reported after ingestion of mercurous compounds. Exposure to organic mercury can cause sensory and visual disturbances, tingling, paresthesia, numbness, tunnel vision leading to blindness, visual, peripheral neuropathy, weakness in extremities and progressive ataxia, tremor, cerebral atrophy, degeneration of nerves, and death.

**Cancer Potential.** Not indicated.

**Other.** Mercury is transferred transplacentally. Toxicity depends on chemical form. Metallic, organic, and inorganic compounds can be biotransformed.

o METHYL ETHYL KETONE (2-Butanone)

**Acute Toxicity Summary.** The compound is of relatively low toxicity, but at high doses affects the nervous system and causes irritation of the eyes, nose, and skin. Exposures to high concentrations may retard fetal development and cause some teratogenic effects. The Cal/OSHA PEL and, the ACGIH TLV is 200 ppm. The NIOSH REL is not indicated.

**Chronic Toxicity Summary.** Not indicated.

**Cancer Potential.** Has not been adequately tested for carcinogenicity.

**Other.** Although 2-Butanone is not strongly neurotoxic on its own, it apparently strongly potentiates the neurotoxicity of n-hexane and n-hexanone.

o NICKEL

**Acute Toxicity Summary.** Signs of acute nickel toxicity may include headaches, nausea, vomiting, chest pain, cough, hyperpnea, cyanosis, gastrointestinal and CNS effects, weakness, fever, pneumonia, respiratory failure, cerebral edema, and

death. Acute exposures to nickel containing dust may result in chemical pneumonitis. The Cal/OSHA PEL and the ACGIH TLV is 0.1 $mg/m^3$. The NIOSH REL is 0.015 $mg/m^3$.

**Chronic Toxicity Summary.** Rhinitis, nasal sinusitis, and nasal mucosal injury are among the effects reported among workers chronically exposed to various nickel compounds. Allergic contact dermatitis and other dermatological effects are the most frequent effects of dermal exposure to nickel and nickel-containing compounds.

**Cancer Potential.** There is extensive epidemiological evidence indicating excess cancer of the lung and nasal cavity for workers exposed to certain nickel compounds. Nickel compounds implicated as having carcinogenic potential include insoluble dusts of nickel subsulfide and nickel oxides, vapor of nickel carbonyl and soluble sulfate, nickel carbonyl.

**Other.** May or may not be an essential element.

- PHENOL

**Acute Toxicity Summary.** Corrosive to tissue. Severe eye damage and blindness may result from direct eye contact. Skin contact may produce whitening of skin, burn, or systemic poisoning. Paleness, weakness, sweating, headaches, cyanosis, kidney damage, and death may occur. The Cal/OSHA PEL, ACGIH TLV, and the NIOSH REL is 5 ppm.

**Chronic Toxicity Summary.** Chronic phenol poisoning is rare. It induces vomiting, difficulty swallowing, diarrhea, lack of appetite, headaches, fainting, dizziness, and neural disturbances. Liver and kidney damage may occur.

**Cancer Potential.** Phenol may promote the effects of certain carcinogens.

o POLYCHLORINATED BIPHENYLS (PCBs)

**Acute Toxicity Summary.** Acute exposure of rats to technical mixtures at high doses causes diarrhea, loss of appetite, and liver necrosis. The Cal/OSHA PEL and the ACGIH TLV is 0.5 $mg/m^3$ and the NIOSH REL is 0.001 $mg/m^3$.

**Chronic Toxicity Summary.** Cumulative toxic effects may follow continuous exposure to low levels. In animals the most notable effects are alterations to the liver, including liver enlargement, fatty infiltration, centrilobular neurosis, induction of metabolizing enzymes, and changes in porphyrin metabolism. Effects on liver enzymes may alter the toxicity of other chemicals. Adverse reproductive effects and phytotoxicity have been observed in animals. Immunosuppressive effects have also been reported.

**Cancer Potential.** Rats fed Aroclor 1260 exhibit an increased incidence of neoplastic nodules and hepatocellular carcinomas (liver tumors), as well as proliferative lesions in the liver.

o SELENIUM

**Acute Toxicity Summary.** Acute exposures can produce CNS effects, including nervousness, drowsiness, and convulsions, and eye and nasal irritation. These symptoms clear when the worker is removed from the exposed area. The Cal/OSHA PEL, ACGIH TLV, and the NIOSH REL is 0.2 $mg/m^3$.

**Chronic Toxicity Summary.** Chronic exposure to selenium-containing compounds by inhalation can result in pallor, coated tongue, gastrointestinal disorders, nervousness, garlic breath, liver and spleen damage, anemia, and mucosal irritation. Discoloration, decayed teeth, skin eruptions, gastrointestinal distress, and loss of hair and nails have been reported in humans exposed orally. In livestock, excess intake can cause blind staggers--impaired vision, weak limbs, respiratory failure--and alkali disease--hair loss, sterility, atrophy of hooves, lameness, and anemia. Embryotoxic and teratogenic in animals.

**Cancer Potential.** Carcinogenic in laboratory animals. May be anticarcinogenic and protective in humans.

**Other.** Essential. Toxicity related to chemical form.

o SILVER

**Acute Toxicity Summary.** Argyria (local or generalized impregnation of tissue causing discoloration of skin and eye) may affect eyes and respiratory tract.

Gastrointestinal irritation may occur with oral exposure. The Cal/OSHA PEL, ACGIH TLV, and the NIOSH REL is 0.01 $mg/m^3$.

**Chronic Toxicity Summary.** Kidney and lung damage and possibly arteriosclerosis have been reported for industrial or medial exposures.

**Cancer Potential.** Not indicated.

o 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCDD)

**Acute Toxicity Summary.** Toxic effects include liver damage (histopathologic change, jaundice, increased liver weights), thymic atrophy, gastric hemorrhage, testicular degeneration, weight loss, pericardial edema (chickens), and kidney and hematological effects. Humans exposed to TCDD by industrial accidents reported nausea, vomiting, headaches, fatigue, muscular aches and joint pains, peripheral neuropathy, loss of libido, and irritation of eyes, respiratory tract, and skin. Skin reactions resemble a chemical burn, followed by chloracne (and often persistent, disfiguring skin disease with blackheads, cysts, and pustules, usually on face and shoulders). Some symptoms persist for years after exposure. The Cal/OSHA PEL, ACGIH TLV, and NIOSH REL are not indicated for TCDD.

**Chronic Toxicity Summary.** Toxic effects from chronic exposure are similar to those from acute exposure. In laboratory animals, exposure to TCDD can produce extreme weight loss, thymic atrophy, liver damage, impaired kidney function, hematological effects, hormonal alterations, immune suppression, altered

lipid metabolism, nervousness and irritability. The liver is a particularly sensitive target organ, with degeneration, necrosis, and inflammatory changes demonstrated. Some studies of mice attributed mortality to amyloidosis--extensive disposition of proteinaceous material in kidney. TCDD is phytotoxic and teratogenic in laboratory animals and adversely affects reproduction. Humans exposed to TCDD generally have been exposed to multiple chemicals; skin diseases, including chloracne and porphyria cutanaea tarda (photosensitive skin disease), liver impairment, and peripheral nerve damage have been reported. Veterans exposed to Agent Orange containing TCDD reported numbness of extremities, skin rash and irritation, liver dysfunction, weakness, decreased sex drive, and psychological effects.

**Cancer Potential.** In animals, oral exposure to TCDD produced malignant tumors in multiple organs, including liver, thyroid, adrenal, lung, kidney, testes, nasal structures, ear duct, and skin. Leukemia was demonstrated in some studies. Mouse skin studies have indicated that TCDD is a complete carcinogen, while other studies suggest that TCDD is a promoter, particularly in liver. Soft tissue sarcomas have been found in workers occupationally exposed to TCDD and other chemicals, usually trichlorophenol or phenoxy acids.

**Other.** Bacterial tests and a study of chromosomal breaks in rats are among those indicating that TCDD is mutagenic; many other tests have been negative. TCDD can accumulate in fat and milk. It alters enzyme activity and may affect metabolism of other chemicals. TCDD is a contaminant that can be produced in the manufacture of chlorophenols.

o TETRACHLOROETHENE (Perchloroethylene)

**Acute Toxicity Summary.** Tetrachloroethene can depress the CNS and cause narcosis. It is irritating to mucous membranes and skin and can cause lung edema. Neurological effects on dry-cleaners have been reported. The Cal/OSHA PEL and the ACGIH TLV is 50 ppm. The NIOSH REL is 25 ppm.

**Chronic Toxicity Summary.** Chronic exposure may result in pathological changes in liver of laboratory animals. It may also affect the kidney. In humans, inhalation exposure may produce irritation of respiratory tract, nausea, headache, sleeplessness, and abdominal pains. Fatalities have been reported.

**Cancer Potential.** Carcinogenic in laboratory animals. An increased incidence of cancers among dry-cleaning workers exposed to several solvents has been described.

o TOLUENE

**Acute Toxicity Summary.** Humans exposed by inhalation experimentally, occupationally, or by intentional abuse may exhibit excitation, then CNS depression and necrosis. Neurotoxic effects include nausea, fatigue, and coordination at low levels and confusion, ataxia, and weakness at higher levels. In rats, irritation of mucous membranes and incoordination have been observed, as well as pulmonary irritation with subchronic exposure. The Cal/OSHA PEL, ACGIH TLV, and the NIOSH REL is 100 ppm.

**Chronic Toxicity Summary.** CNS effects have been reported in workers, such as disturbances in memory and thinking, psychomotor skills, visual accuracy, sensorimotor speed, and performance tests. Indications of cerebral and cerebellar dysfunction include tremors, ataxia, and equilibrium disorders, bizarre behavior, and emotional lobility may occur. In cases of abuse, changes in liver and kidney function have been observed. In rats, a decrease in hematocrit has been reported.

**Cancer Potential.** Embryotoxicity and possible teratogenicity in mice have been reported in an abstract. In rats, skeletal retardation of offspring has been described.

**Other.** Not determined.

- 1,1,1-TRICHLOROETHANE

**Acute Toxicity Summary.** Trichloroethane is a CNS depressant and may impair psychophysiological functions. Human fatalities have been reported following deliberate inhalation or occupational exposures; lung congestion was found. Acute, high-level exposures can also adversely effect the cardiovascular system. It is irritating to the skin and liquid can be absorbed through the skin. The Cal/OSHA PEL, ACGIH TLV, and the NIOSH REL is 350 ppm.

**Chronic Toxicity Summary.** Exposure by inhalation can produce liver damage in mice and affects drug metabolism in liver of rats.

**Cancer Potential.** National Toxicology program study not finalized.

**Other.** Mutagenic in some in vitro tests.

o TRICHLOROETHENE (TCE)

**Acute Toxicity Summary.** Exposure to TCE can cause depression of the CNS, including dizziness, headaches, incoordination similar to that induced by alcohol, nausea, vomiting, and unconsciousness. The Cal/OSHA PEL and the NIOSH REL is 25 ppm. The ACGIH TLV is 50 ppm.

**Chronic Toxicity Summary.** Long-term inhalation exposure can affect liver and kidneys in animals. In humans, changes in liver enzymes have been associated with TCE exposure.

**Cancer Potential.** Exposure of mice (orally and by inhalation) and rats have produced increases in liver or lung or kidney tumors.

**Other.** "Degreasers flush" has been described in TCE-exposed workers who consume alcohol.

o VINYL CHLORIDE

**Acute Toxicity Summary.** Acute occupational exposure to high concentrations of vinyl chloride can produce symptoms of narcosis in humans. Respiratory tract

irritation, bronchitis, headache, irritability, memory disturbances, and tingling sensations may also occur. Deaths have been reported. In animals, ataxia, narcosis, blood clotting difficulties, congestion and edema in lungs, and kidney and liver effects have been demonstrated. At high doses excitement, contractions, convulsions, and an increase in respiration followed by respiratory failure precede death. The Cal/OSHA PEL and the ACGIH TLV is 1 ppm, with a STEL of 5 ppm. The NIOSH REL is 5 ppm.

**Chronic Toxicity Summary.** Human health effects associated with chronic occupational exposure to vinyl chloride include hepatitis-like liver changes, decreased blood platelets, enlarged spleens, decreased pulmonary function, acroosteolyis (sometimes with Raynaud-like syndrome), sclerotic syndrome, thrombocytopenia, cardiovascular and gastrointestinal toxicity, and disturbances in vision and in the CNS. In laboratory animals, liver and kidney toxicity may be severe and histopathological changes in lung and spleen may also occur with vinyl chloride exposure.

**Cancer Potential.** Vinyl chloride is a known human carcinogen causing liver angiosarcomas (a very rare tumor in humans) and possibly increasing incidence of tumors of the brain, lung, and hemolymphopoietic system in humans. Vinyl chloride is carcinogenic in mice, rats, and hamsters.

**Other.** Vinyl chloride is mutagenic in several test systems. Chromosome aberrations have been reported in exposed workers. In humans, possible relationships between exposure and birth defects and fetal death have been

reported. Possible increased fetal mortality among wives of occupationally exposed workers has been debated. Increased skeletal variants were found in offspring of mice exposed during gestation.

o XYLENE

**Acute Toxicity Summary.** Acute exposures to inhaled xylene can depress the CNS and irritate mucous membranes. The Cal/OSHA PEL, ACGIH TLV and the NIOSH REL is 100 ppm.

**Chronic Toxicity Summary.** Changes in behavioral tests, manual coordination, balance, and EEG patterns have been reported in humans exposed to xylenes. Development of tolerance against some of these effects has been described. Effects on liver of rats have been reported.

**Cancer Potential.** Not indicated.

o ZINC

**Acute Toxicity Summary.** Acute adverse effects of zinc include metal fume fever by the inhalation of fumes. Fever, nausea, vomiting, stomach cramps, diarrhea may result from acute ingestions. The Cal/OSHA PEL and the ACGIH TLV is 5 $mg/m^3$. The NIOSH REL is not indicated.

**Chronic Toxicity Summary.** Prolonged ingestion of zinc can result in irritability, muscular stiffness and pain, loss of appetite, and nausea. High levels of zinc in diet may retard growth and produce defective mineralization of bone.

**Cancer Potential.** Not indicated.

**Other.** Essential nutrient. Taste threshold 15 ppm; 40 ppm soluble zinc salts impart a metallic taste.

### 3.4 References

The preceding toxicity profiles have been summarized from the following sources:

1. Casarett and Doull's *Toxicology*, 3rd edition. Ed. C. D. Klaassen, M. O. Amdur, and J. Doull. New York: Macmillan. 1986.

2. IARC Monographs, Vol. 3, 20, 23. International Agency for Research on Cancer, Lyon, France. 1973, 1979, 1980.

3. *Drinking Water and Health*, Vol. 1. National Academy of Sciences. 1977.

4. M. Sittig, *Handbook of Toxic and Hazardous Chemicals*. Park Ridge, N.J.: Noyes Publications. 1981.

5. EPA Health Advisories for Inorganics, Organics, and Pesticides. March 1987.

6. *Experimental and Clinical Neurotoxicology*. Ed. P. S. Spencer and H. H. Schaumburg. Baltimore: Williams and Wilkins. 1980.

7. W. J. Hayes. *Pesticides Studied in Man*. Baltimore: Williams and Wilkins. 1982.

8. 29 CFR 1910:50412-99. Cal/OSHA, Occupational Exposure to Formaldehyde. December 10, 1985.

9. 40 CFR 141:25720-34. EPA, Drinking Water. July 8, 1987.

10. ACGIH, American Conference of Governmental Industrial Hygienists, Inc., Documentation of the Threshold Limit Values. 1980, 1984.

11. Sax, 7th edition, August. 1989.

12. Ambient Water Quality Criteria for Halomethanes, EPA 44015-80-051. October 1980.

Prepared toxicity profiles were not available for the following chemicals:

o 1,1,2-TRICHLOROETHANE

1,1,1-TCA is sometimes used as a specialty solvent and chemical intermediate; the principal physiologic responses to exposure are central nervous system

depression and liver injury (Clayton, 1981). EPA classifies 1,1,1-TCA as a possible human carcinogen (IRIS, 1991).

- THALLIUM

Several forms of thallium are listed on EPA's Integrated Risk Information System (IRIS) data base. In general, these are not classifiable as to human carcinogenicity (Thallium[I] sulfate, carbonate, chloride). Thallium salts are described as poisonous if swallowed; inhalation of dust is also poisonous (IRIS, 1991).

- FERROCENE

The Merck Index (1983) describes ferrocene as an antiknock additive for gasoline. The chemical name for this organometallic compound is dicyclopentadienyl iron. It is insoluble in water, but soluble in alcohol, ether, benzene, and certain acids. According to Kirk-Othmer (1985), ferrocene and similar cyclopentadienyl complexes are aromatic in nature, and undergo several typical ionic aromatic substitution reactions.

- WHITE PHOSPHORUS

According to information in IRIS (accessed January, 1991), white phosphorus toxicity in humans is associated with its use in fireworks and rodent poisons. Acute ingestion affects the liver, kidney, hematopoietic system, brain, intestines, circulatory system, and myocardium. A minimum lethal dose of 1 mg/kg has been

reported; death occurred in a child after the consumption of as little as 3 mg. Chronic exposure has been associated with a progressive necrotic disease of the jaw bones. White phosphorus is currently not classifiable as to human carcinogenicity.

o NAPALM

Napalm is a mixture of 33 percent gasoline, 21 percent benzene, and 40 percent polystyrene with a syrupy consistency. When exposed to the air, it forms a "skin" and becomes progressively more viscous until it hardens into a solid material.

o FS SMOKE

This was described in the Initial Assessment Study (IAS) as sulfur trioxide chlorosulfonic acid. Information on this exact compound description was not found. According to Kirk-Othmer (1985), chlorosulfuric acid, a mixture that also contains hydrogen chloride, sulfur trioxide, and related compounds, reacts violently with water to produce heat and dense white fumes of hydrochloric and sulfuric acids. It reacts with almost all organic materials, even to the point of charring, and may cause ignition by contact with combustible material. The liquid acid will severely burn the skin, while the vapor is hazardous and irritating to the skin, eyes, nose, and throat. The hydrochloric and sulfuric acid resulting from exposure to moisture are irritating and corrosive. Other types of military smoke

generators described in the reference are FS smoke (titanium tetrachloride) and HC smoke (formed by combustion of aluminum, hexachloroethane, and zinc oxide).

- MAGNESIUM PHOSPHATE

According to Kirk-Othmer (1985), typical military ignition mixtures contain boron or magnesium and barium nitrate. Delay primer fuses typically contain mixtures of manganese and lead and barium cremate. Other magnesium compounds have been found to have toxic effects under various exposure scenarios.

- NITRATED TOLUENES

2,4,6-Dinitrotoluene (TNT) is listed on IRIS. It is currently classified as a possible human carcinogen, with inadequate evidence of human carcinogenicity. The NIOSH Pocket Guide to Chemical Hazards (1985) lists target organs for exposure as blood, liver, eyes, cardiovascular and central nervous systems, kidneys, and skin. Di- and trinitrotoluenes are fire and explosion hazards when exposed to heat or flame.

- ALPHA AND BETA RADIATION

Toxicity information on alpha and beta radiation will be added if these are determined to be compounds of concern for the risk assessment.

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# 4.0 PROCEDURES

## 4.1 Site Organization

Map/Sketches Attached Yes Sites Secured No

Perimeter Identified Yes

Zone(s) of Contamination Identified No

## 4.2 Site Personnel

Team Organization

| Team Member/Office | Responsibility | First Aid and CPR Expir. Date |
|---|---|---|
| Ed Rogan/LAO | Principal Engineer | NA/NA |
| Mike Arends/LAO | Project Manger | NA/NA |
| Daryl Hernandez/LAO | Engineer/Field Team Leader | 8-93 / 8-92 |
| Tim Smith/LAO | Scientist/SSC | 1-94 / 1-92 |
| Aldo Lucitra/LAO | Field Technician | 8-94 / 8-92 |

All participating personnel must submit a certification of medical fitness for this work. All personnel must also submit documentation of training by their employers in hazardous waste operations in accordance with the provisions of 29 CFR 1910.120. This documentation must be provided before site work begins and copies of the certification must be attached to this HSP.

All participating personnel must attend a site safety briefing with the site safety coordinator (SSC) prior to beginning onsite work.

Each of the team members named above shall meet the training and medical surveillance requirements of 29 CFR 1910.120. In addition, each is currently certified by the American Red Cross, or equivalent, in both first aid and cardiopulmonary resuscitation (CPR), unless otherwise noted.

The SSC must complete Form 533 (sample in Attachment 2) for CH2M HILL employees and return it to Anne West, CH2M HILL/Reston, Virginia, at the end of each week. Complete a separate Form 533 for IT Corporation and Jacobs Engineering Group, Inc. (JEG) employees and forward them to the Health and Safety contacts listed in Section 5.0.

If additional team members, beyond those previously listed, are added to the project, they must be identified on the Site Personnel Additions form found in Attachment 2. Each new team member must certify that the requirements for current medical and training status have been met. No persons shall be allowed beyond the support zone of any site unless they are listed in the HSP, are in current medical and training status, and receive a site safety briefing from the SSC.

All field subcontractors must complete the Subcontractor Medical and Training Certification Letter found in Attachment 2 prior to the start of any field work involving these subcontractors. Each letter must include the names and responsibilities of all subcontractor personnel expected to participate in site work. Each letter must also

certify the medical and training status of all listed personnel. A copy of all completed letters must be attached to the onsite HSP. No subcontractor personnel shall be allowed beyond the support zone of any site unless they are listed on the subcontractor letter, are in current medical and training status, and receive a site safety briefing from the SSC.

There must be one SSC present during any task performed in exclusion or decontamination zones with the potential for exposure to safety and health hazards. The "buddy system" requirements of 29 CFR 1910.120 are to be met at all times.

Level of Protection

Site-specific initial PPE levels for each of the 13 categorical sites is provided in Section 6.0. All equipment is to be inspected prior to each days use to assure it is without defects and capable of use. Defective equipment is to be removed from use immediately. Record inspections in the SSC logbook.

Level B. To be used when the greatest level of respiratory protection is desired. Dermal protection may be varied to fit site conditions. Level B is minimum acceptable for initial entry or confined space. Increased logistical support is required.

- SCBA, MSA 401, or Dual Purpose Breathing Apparatus (DPBA). Only Grade D or Grade E breathing air shall be used

- Coveralls, chemically resistant (ChemKlos®, Tyvek®, Saranex®, Sigel suit, etc.)

- Coveralls, cotton
- Vinyl or latex inner gloves
- Neoprene outer gloves (Viton®, or nitrile if PCB contamination is anticipated)
- Boots, steel toe and shank, neoprene, 16-inch tops
- Booties, latex, or butyl
- Hard hat with splash shield and earplugs or earmuffs
- Radio
- Work gloves, disposable, cotton

Level C. To be used when airborne contaminants can be sufficiently characterized to permit use of air-purifying respirator. Requires additional monitoring if site conditions are subject to change. Dermal protection may be varied to fit site conditions.

- MSA Ultra Twin or Full-face air-purifying respirator with cartridges appropriate to the airborne contaminants
- Coveralls, chemically resistant (Chem-Klos®, Tyvek®, Saranex®, Sigel suit, etc.)

- Chemically resistant apron, sleeves, chaps, etc.
- Coveralls, cotton
- Vinyl inner gloves
- Neoprene outer gloves (Vitron® or nitrile, if PCB contamination is anticipated)
- Boots, steel toe and shank, neoprene, 16-inch tops
- Booties, latex or butyl
- Hard hat with splash shield and earmuffs
- Radio
- Work gloves, disposable, cotton
- Emergency life support apparatus (ELSA) emergency escape device, carried or immediately available, or equivalent 5- to 15-minute supplied air escape device

Level D. To be used when the atmosphere contains no known hazard. Work functions preclude overexposure to chemical or radioactive hazards.

- Coveralls or khakis, cotton (polycoated Tyvek if splash hazard - no street clothing)
- Workboots, leather, steel toe and shank (Latex booties if splash hazard)
- Disposable workgloves, leather or cotton (Vinyl or latex gloves if splash hazard)
- Hard hat
- Chemical resistent goggles

Cotton coveralls will be worn in Level D protection only when there is no contract anticipated with contaminated soils or leachate. Well sampling activities that are performed in Level D will use protective clothing (polycoated Tyvek) to protect personnel against the splash/dermal contact hazard.

Safety Equipment and Materials Needed for Each Crew

First aid kit, eye wash, (capable of 0.4 gpm flow for 20 minutes) stretcher or blanket, clean water, paper cups, 20-pound ABC fire extinguisher, outdoor thermometer, and wind flag.

Monitoring Equipment and Procedures

Carefully inspect each piece of monitoring equipment prior to work startup. Failure of any of the equipment listed below to work properly must be reported to the Project Manager immediately.

Explosimeter/oxygen ($O_2$) meter: Calibrate prior to and after each day's activities, according to the manufacturer's instructions. Recharge at the end of each day. Monitor

during drilling activities and record measured levels in the logbook at 5-foot boring intervals.

Action levels (borehole collar):

- Zero to 5 percent: monitor borehole collar at 5-foot intervals
- Five to 20 percent: monitor continuously and be prepared to shut down operations at readings approaching 20 percent
- Greater than 20 percent: shut down operations and allow vapors to dissipate to below 10 percent before continuing. Should readings at the borehole collar fail to dissipate, apply mechanical ventilation to keep concentrations less than 20 percent

Ludlum Geiger Mueller: Check background using 2x2 sampling matrix and check response with the attached standard. Monitor during drilling and sampling activities and record measured readings in the logbook every hour.

To check background, divide the site into four roughly equal portions (2x2 matrix) and monitor at a point near the center of each section. If all measurements are within a factor of three of the lowest, average the four and record the average as the background value. If any measurement exceeds a factor of three, contact the health physics professional listed below.

Action levels (work area):

- Background to three times background: Continue work

- Greater than three times background: Stop work, evacuate immediate work area and notify SSC and appropriate health physics professionals (at CH2M HILL - George Stevens/Oak Ridge, Tennessee; 615/483-9032

Organic Vapor Analyzer (OVA): Calibrate prior to and after each day's activities, according to the manufacturer's instructions. Record calibration in the SSC logbook. For use at landfill sites, the activated carbon filter must be installed.

The correct method of calibrating the OVA is to fill a tedlar bag with calibration gas and let the unit draw a sample. The OVA is sensitive to flow (much more so than an HNu). It needs a flow rate of about 1200 cc/min; therefore, calibration by direct connection to the regulator is not recommended. A suitable alternative to the tedlar bag approach is use of the 1.5 liter/min regulator and a "T" tubing arrangement, with one leg open to the atmosphere. However, since the OVA draws nearly 1.5 liter/min, verify that excess calibration gas is leaving the open leg of the "T."

Monitor personnel breathing zone periodically (as practical) during drilling activities and record readings at 5-foot boring intervals. During groundwater sampling, open well cap and allow well to vent for 5 minutes, monitor well headspace from an upwind position, then monitor personnel breathing zone as continuously as practical. Record initial readings and readings above background every 15 minutes at each well location.

Action levels (breathing zone):

- Background to 10 ppm above background: Level D

- Sustained readings greater than 5 ppm above background in the breathing zone: stop work, evacuate immediate work area, and allow vapors to dissipate for 15 minutes to below 1 ppm or upgrade to Level C

- Readings above 10 ppm: immediately evacuate the team. Allow the area to ventilate for 15 minutes until levels are below 10 ppm before resuming work or upgrade to Level B

Hydrogen Sulfide/HCN Monitor (i.e., Monitox): Calibrate prior to and after each day's activities according to the manufacturer's instructions. Record calibration in SSC logbook. Monitor at the borehole and in the breathing zone.

Action levels (the breathing zone):

- Zero to 5 ppm: Level D protection, unless odors produce symptoms of headache or nausea. If symptoms occur, move to an upwind location until symptoms subside

- Five to 10 ppm: Level B with hooded Saranex

- Above 10 ppm: evacuate team upwind and ventilate work area until levels drop below 10 ppm

Mini-RAM Dust Monitor: Calibrate and zero prior to and after each day's activities according to the manufacturer's instructions. Record calibration data and site background readings in SSC logbook each day. Monitor at the borehole and at surface sampling locations. Do not block detector opening on Mini-RAM.

Action levels (work area)

- Background to three times background: Continue work

- Greater than three times background: Stop work, suppress dust with enough water to just stop visible dust, or upgrade to Level C with particulate cartridges

### 4.3 Site Entry Procedures

Confirm emergency telephone numbers and route to hospital prior to starting any work. Designate a vehicle for emergency use whenever team members are in the exclusion zone. The SSC should identify safe evacuation routes and reassembly points for emergencies. Notify the onsite client representative of your presence and your field plans. Position equipment and subcontractor upwind of the area to be drilled and upgradient of the wells. Post Cal/OSHA work site poster (Attachment 3) in an easily visible location in the support zone.

The SSC will define the exclusion zone. For drilling, the radius must be at least 25 feet. The exclusion zone is to be defined with traffic cones, barriers, tape, or other means to warn and exclude the public. The SSC may reduce the exclusion zone radius for well sampling or other noninvasive tasks. If traffic is a potential hazard, all site workers shall wear orange safety vests.

Set up decontamination area upwind of the exclusion area. The decontamination area should be established at a sufficient distance from the boring to be reasonably sure no one is in an area that can become contaminated by splashing water or flying dirt. Inspect exclusion zone for spark sources, paying careful attention to electrical equipment.

The support zone will be located upwind of the decontamination area, and outside any known area of contamination. No person shall pass beyond the support zone without the authorization of the SSC.

### 4.4 Work Limitations

- No eating, drinking, or smoking will be permitted except in areas designated by the SSC.

- Contact lenses will not be worn onsite.

- Facial hair that could interfere with respirator fit will not be permitted.

- The buddy system will be used at all times in the exclusion zone.

- Work will be done during daylight hours only.

- Work will not begin until coordination with site operating personnel has taken place.

- Wear hearing protection in the vicinity of drill rigs

## 4.5 Decontamination Procedures

Measures for Level B Decontamination

| | | |
|---|---|---|
| Section 1: Equipment Drop | 1. | Deposit equipment used onsite (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down station may be set up within this area. |
| Section 2: Outer Garment, Boots | 2. | Scrub outer boots, outer gloves and Gloves, Wash and chemical-resistant splash suit with decon Rinse solution or detergent water. |

| | |
|---|---|
| | Rinse off using copious amounts of water. Remove tape. |
| Section 3: Outer Boot and Glove Removal | 3. Remove outer boots and gloves. Deposit in container with plastic liner. |
| Section 4: Tank Change | 4. If worker leaves exclusive zone to change the air tank this is the last step in the decontamination procedure. Worker's tank is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty. |
| Section 5: Boot, Gloves and | 5. Boots, chemical-resistant splash suit, inner Outer Garment gloves removed and deposited in separate Removal containers lined with plastic. |
| Section 6: SCBA Removal | 6. SCBA backpack and facepiece is removed. Avoid touching face with fingers. SCBA deposited on plastic sheets. |
| Section 7: Field Wash | 7. Hands and face are thoroughly washed. Shower as soon as possible. |

A sample minimum decontamination layout for Level B is shown in Figure 1.

Measures for Level C Decontamination

| | |
|---|---|
| Section 1: Equipment Drop | 1. Deposit equipment used onsite (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down station may be set up within this area. |
| Section 2: Outer Garment | 2. Scrub outer boots, outer gloves and splash suit with decon solution or detergent water. Rinse off using copious amounts of water. Remove tape. |
| Section 3: Outer Boot and Glove Removal | 3. Remove outer boots and gloves. Deposit in container with plastic liner. |
| Section 4: Canister Change | 4. If worker leaves exclusive zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty. |

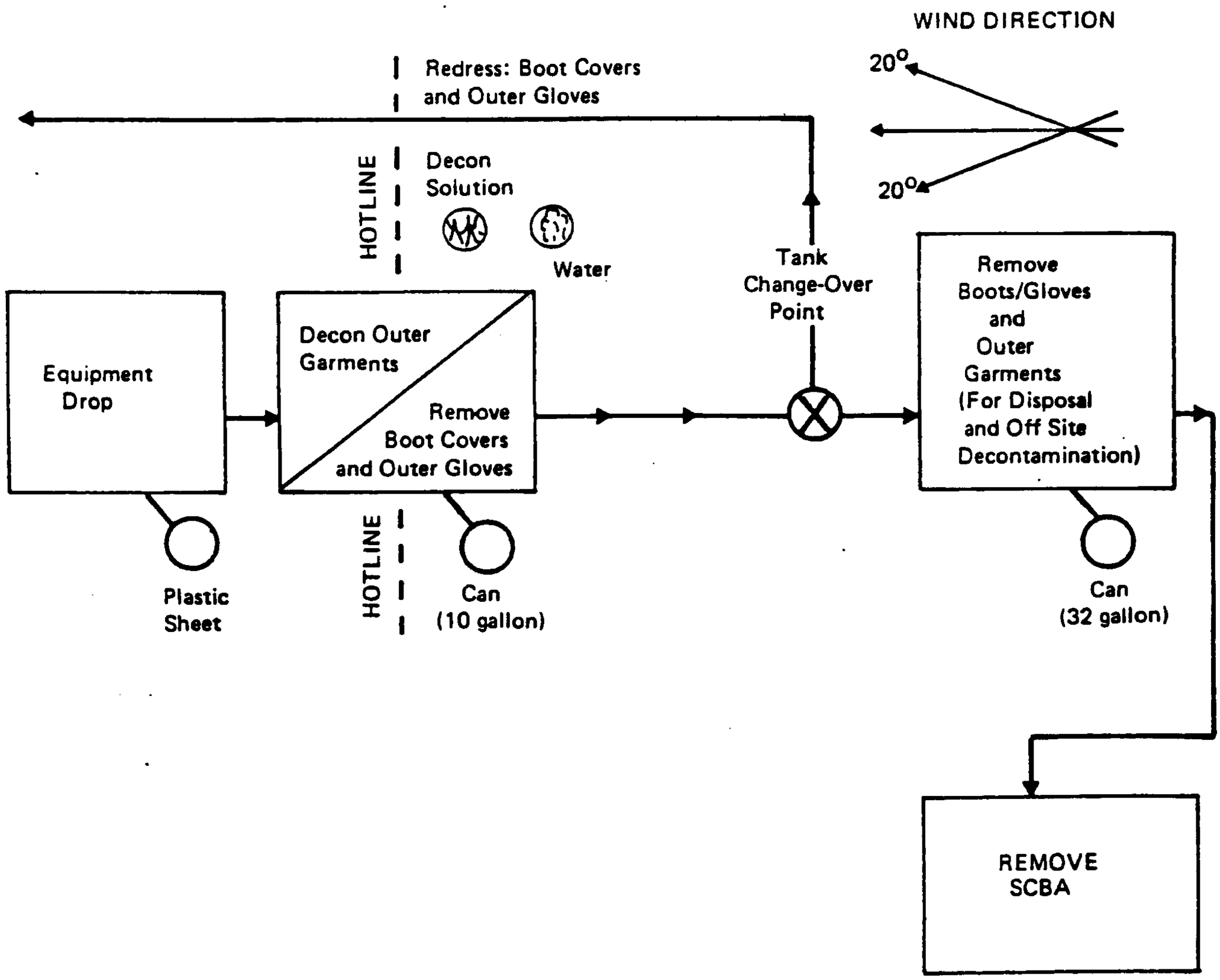


FIGURE 1
MINIMUM DECONTAMINATION
LAYOUT FOR PPE LEVEL B

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| | | |
|---|---|---|
| Section 5: | Boot, Gloves and Outer Garment Removal | 5. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic. |
| Section 6: | Face Piece Removal | 6. Facepiece is removed. Avoid touching face with fingers. Facepiece deposited on plastic sheet. |
| Section 7: | Field Wash | 7. Hands and face thoroughly washed. Shower as soon as possible. |

Equipment Needed for Decontamination Measures for Levels B and C

Section 1: a. Various Size Containers

b. Plastic Liners

c. Plastic Drop Cloths

Section 2: a. Containers (20-30 gallons)

b. Decon Solution

c. Rinse Water

d. 2-3 Long-handled, Soft-bristled scrub brushes

Section 3: a. Containers (20-30 gallons)

b. Plastic Liners

c. Bench or stools

Section 4: a. Air tanks or masks and cartridges, depending upon Level

b. Tape

c. Boot Covers

d. Gloves

Section 5: a. Containers (20-30 gallons)

b. Plastic liners

c. Bench or stools

Section 6: a. Plastic Sheets

b. Basin or bucket

c. Soap and towels

d. Bench or stools

Section 7: a. Water

b. Soap

c. Tables

d. Wash basin or bucket

Decontamination Measures for Level D

Wash and rinse outer gloves and boots with soap and water. Remove and dispose of outer gloves. Remove Tyvek or cotton coveralls; dispose of Tyvek. Wash sampling clothes on a daily basis, prior to rewearing. Remove inner gloves. Wash hands and face with soap and water.

Sampling Equipment. Thoroughly wash with nonphosphate detergent. Rinse with water, then rinse with hexane followed by water.

Samples. Wash with a nonphosphate detergent, rinse twice with tap water and once with deionized water (DI) water.

Heavy Equipment. Scrape off dirt. Steam clean. Rinse with methanol followed by DI water.

It is the responsibility of the SSC to assure that all pieces of equipment coming off-Station are properly decontaminated according to the procedures outlined above. Documentation of decontamination must be made in the field log notebook that is a part of the permanent project file.

### 4.6 Disposal of Materials Generated On-Station

Collected Groundwater. Contain collected groundwater in 55-gallon drums and move the drums to the staging area specified by the SSC. Bag all health and safety related disposable items.

Drill Cuttings. Contain drill cuttings in 55-gallon drums and move the drums to the staging area specified by the SSC.

Disposal of materials generated on-Station will be done according to the Waste Management Plan prepared for the RFA fieldwork.

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## 5.0 EMERGENCY INFORMATION

If an injury occurs, take the following steps:

- Prevent further injury and notify the SSC.

- Initiate first aid and call for medical attention for the injured person immediately. Perform decontamination, as appropriate.

- Once medical attention has been provided, and depending upon the type and severity of the injury, call the occupational physician and/or medical consultant.

- Notify the injured person's personnel office. Notify JEG Health and Safety Program Manager.

- Prepare an Accident Report (Form 308, in Attachment 2). The SSC is responsible for preparing and submitting the Accident Report to the CH2M HILL Health and Safety Director and CH2M HILL Corporate Personnel Office within 48 hours. If the incident involves an IT Corporation or JEG employee, submit the report to that firm's Health and Safety contact listed below.

## 5.1 Local Emergency Phone Numbers

| | |
|---|---|
| Ambulance: | 911 |
| Hospital (Irvine Medical Center) | 714/753-2000 |
| Poison Control Center: | 213/484-5151 |
| MCAS El Toro Police: | 9911 |
| Fire: | 911 |
| Electric Company: | 714/635-9051 |
| Gas Company: | 714/630-2966 |
| Water Company: | 714/635-9051 |
| EPA Hotline | 800/424-9346 |
| Chemtrec | 800/424-9300 |

## 5.2 Emergency Routes (see Figure 2 for map)

## 5.3 Emergency Contacts

- CH2M HILL Medical Consultant

Name: Dr. Kenneth Chase/Washington Occupational Health Associates

Phone: 202/463-6698 (8:00 a.m. to 5:00 p.m. EST)
202/463-6440 (after-hours answering service;
physician will return call within 30 minutes)

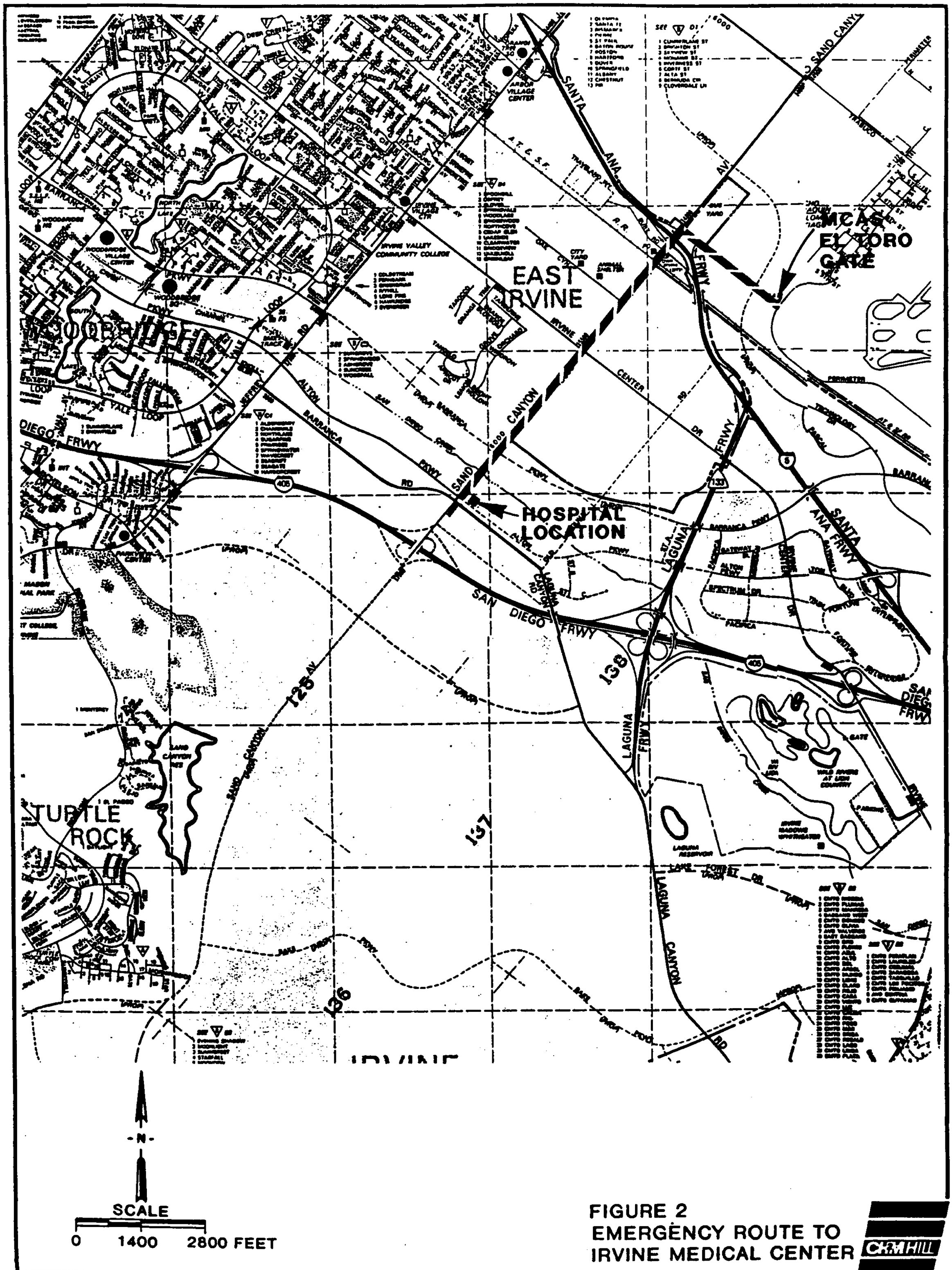


FIGURE 2
EMERGENCY ROUTE TO
IRVINE MEDICAL CENTER

CH2M HILL

blank page

- JEG Health and Safety Program Manager

Name: Carl Wilson

Phone: 818/449-2171

818/453-9605 (beeper) After hours

Fax: 818/578-6880

- IT Corporation Health and Safety Coordinator

Name: Larry R. Froebe

Phone: 714/261-6441

Fax: 714/474-8309

- CH2M HILL Health and Safety Director

Name: Marty Mathamel, CH2M HILL/Reston, Virginia

Phone: 703/471-6405

Fax: 703/481-0980

- CH2M HILL Health and Safety Coordinators

Name: Allen Macenski/Santa Ana, California

Phone: 714/250-5500

Fax: 714/250-5508

- Subcontractor Contacts

See Subcontractor Medical and Training Letter (Attachment 2)

- Occupational Physician (CH2M HILL, Santa Ana)

Name: Sky Park Walk-in Medical Group

Phone: 714/546-4233

Address: 3100 West Warner Avenue

Santa Ana, California 92704

- Occupational Physician (IT Corporation)

Name: Pacific Walk-In Clinic

Phone: 714/863-9103

Address: 2362 Morse Avenue

Irvine, California

- Occupational Physician (JEG)

Name: Dr. Mitchell Zavon/Agatha Corporation

Phone: 716/754-2176

Address: P.O. Box 881

Lewiston, New York 14092

- Project Manager/CH2M HILL

  Name: Mike Arends/Santa Ana, California

  Phone: 714/250-5500

- Client Contacts

  Name: Andy Piszkin/SOUTHWESTDIV

  Phone: 619/532-2635

  Name: ENS John Kliem/MCAS El Toro

  Phone: 714/726-6614

- Regional Manager/CH2M HILL

  Name: Jerry Boyle/Santa Ana, California

  Phone: 714/250-5500

o CH2M HILL Corporate Personnel Office

Name: Beth Brown/Denver, Colorado

Phone: 303/771-0952

Address: 6060 S. Willow Drive

Greenwood Village, CO

Mailing

Address: P.O. Box 22508

Denver, CO 80222

If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured. Notification must be made within 24 hours of the injury. For JEG and IT Corporation employees, notify that firm's Health and Safety contact listed above.

# 6.0 CATEGORY-SPECIFIC INFORMATION AND PROCEDURES

This section presents specific information for each of the 13 site categories addressed in the Sampling Visit Work Plan. Specific descriptions for each of the 156 sites are provided in the Visual Site Inspection (VSI) Report. The categorical site-specific hazards addressed in this section are for both physical and chemical hazards at each site. Unless changes to the general procedures are provided, such as PPE level, monitoring equipment, and decontamination, the general procedures identified above will be followed.

Reason to Upgrade or Downgrade Level of Protection

o Upgrade in level of protection will be directed by the SSC when:

- Request of individual performing task
- Change in work task that will increase contact or potential contact with hazardous materials
- Occurrence or likely occurrence of gas or vapor emission
- Known or suspected presence of dermal hazard
- Instrument action levels exceeded

- Down grade in level of protection will be directed by the SSC when:

  - New information that the situation is less hazardous than originally thought
  - Change in sit conditions that decreases the hazard
  - Change in work task that will reduce contact with hazardous materials

## 6.1 Category 1 - Drainage Channels

The drainage channels are concrete-lined trapezoidal channels or unlined earthen channels. The channels are approximately 10 feet deep and 30 feet wide. The channels receive storm water runoff and/or drainage from the Station as well as off-Station sources.

WASTE CHARACTERISTICS

Waste Type(s)

Liquid _____ Solid X Sludge _____ Gas _____

Characteristic(s)

Corrosive X Ignitable X Radioactive _____

Volatile X Toxic X Reactive _____ Unknown X

Other (Name) _____

SUSPECTED SITE CONTAMINANTS

- Petroleum fuels
- Waste oil and grease
- Solvents
- Paint waste
- Kerosene

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is low. Potentially volatile materials may be released during drilling operations and sample collection. Drilling near the drainage channels is a potential physical hazard.

Physical Hazards. Typical slip, trip, and fall safety hazards are present and of special concern near the drainage channels. Side-slope stability should be considered when positioning the drilling operations near the edge of the drainage channels. The proximity of Bee Canyon Wash and Agua Chinon Wash to active aircraft is a potential hazard due to ground level and low altitude operations. Hearing protection will be available to site personnel if low altitude aircraft are anticipated.

Chemical Hazards. The hazards associated with petroleum products, solvents, and paint products are discussed in Section 3.0 of the HSP.

Level of Protection

A____ B____ C__X__ D____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0. of this document.

## 6.2 Category 2 - Landfarming Sites

The landfarming sites have been used for remediating petroleum-contaminated soil. The remediation process consisted of spreading or piling soils onto unpaved ground and allowing exposure to open air. The landfarming sites measure 2 and 3 acres.

### WASTE CHARACTERISTICS

**Waste Type(s)**

Liquid_____ Solid __X__ Sludge_____ Gas_____

**Characteristic(s)**

Corrosive_____ Ignitable __X__ Radioactive_____

Volatile __X__ Toxic __X__ Reactive_____ Unknown_____

Other (Name)_____

### SUSPECTED SITE CONTAMINANTS

- Petroleum wastes

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is assumed to be low. Contamination is anticipated to be present above and below ground surface. Potentially volatile materials may be released during drilling operations.

Physical Hazards. Typical slip, trip, and fall safety hazards are present.

Chemical Hazards. The hazards associated with petroleum products are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C__X__ D____

Site work will proceed at Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of the explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

## 6.3 Category 3 - PCB Spill Area/Transformer Storage Area

The sites involving PCBs include a 2-acre temporary storage area for transformers and a reported PCB leak site adjacent to an office building. Soil staining was observed at the storage area.

WASTE CHARACTERISTICS

Waste Type(s)

Liquid_____ Solid __X__ Sludge_____ Gas_____

Characteristic(s)

Corrosive __X__ Ignitable_____ Radioactive_____

Volatile __X__ Toxic __X__ Reactive_____ Unknown_____

Other (Name)_____

SUSPECTED SITE CONTAMINANTS

- Transformer oil
- PCBs

HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is low. All contamination is anticipated to be at or below ground surface.

Physical Hazards. Typical slip, trip, and fall safety hazards are present, especially where materials are piled together. Overhead utility lines may be a potential hazard for drillers.

Chemical Hazards. The hazards associated with transformer oils and PCBs are discussed in Section 3.0 of this document.

Level of Protection

| A | B | C | X | D |
|---|---|---|---|---|

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC. Viton or nitrile outer gloves, to be replaced every four hours, shall be worn when sampling in areas where PCB contamination is anticipated.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

## 6.4 Category 4 - Abandoned Well

An abandoned oil well is located in an unpaved area near Platform 809. The well was drilled in 1950 to a depth of approximately 3,285 feet. The location of the well, as identified during the VSI, consists of an unpaved area with two square concrete surfaces with metal covers.

WASTE CHARACTERISTICS

Waste Type(s)

Liquid____ Solid X Sludge____ Gas____

Characteristic(s)

Corrosive____ Ignitable X Radioactive____

Volatile X Toxic X Reactive____ Unknown X

Other (Name)____

SUSPECTED SITE CONTAMINANTS

- Oil

HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is low. A potential physical hazard is present from activities involving and storage of ordnance near the site.

Physical Hazards. Typical slip, trip, and fall safety hazards are present even on relatively flat terrain. There is a possible hazard from ordnance located near the site. The ground surface should be cleared by responsible facility personnel prior to entry by the site team.

Chemical Hazards. The hazards associated with petroleum products are described in Section 3.0 of this document.

Level of Protection

A____ B____ C_X__ D_____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. A Mini-RAM dust monitor is recommended to monitor dust levels during sampling activity. Follow the procedures documented in Section 4.0 of this document.

## 6.5 Category 5 - Above-Ground Fuel Storage Areas

These sites involve locations where fuel has been stored above ground. This category includes the following types of sites:

- Fuel bladder
- Above ground storage tank
- Drop-tank storage area

The storage site characteristics range from earthen bermed areas to asphalt and concrete-paved areas.

WASTE CHARACTERISTICS

Waste Type(s)

Liquid_____ Solid___X___ Sludge_____ Gas_____

Characteristic(s)

Corrosive_____ Ignitable___X___ Radioactive_____

Volatile___X___ Toxic___X___ Reactive_____ Unknown_____

Other (Name)_____

## SUSPECTED SITE CONTAMINANTS

- Aviation fuel (JP-5)
- Diesel fuel
- Lubricating fluid

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is anticipated to be low. Potentially volatile materials may be released during drilling operations. A potential hazard would be ground level and low altitude aircraft operations in the vicinity of the site.

Physical Hazards. Typical slip, trip, and fall safety hazards are present even on relatively flat terrain. There are possible hazards from ground level and low altitude aircraft operations. Hearing protection will be available to site personnel if low altitude aircraft are anticipated.

Chemical Hazards. JP-5 fuel is similar to kerosene in composition. This fuel has lower volatility than JP-4 in order to reduce fire hazard in shipboard operations. Hazards associated with petroleum products are described in Section 3.0 of this document.

Level of Protection

A____ B____ C__X__ D____

Site activities will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

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## 6.6 Category 6 - Underground Storage Tanks and Oil/Water Separators

The underground storage tanks are constructed of metal, concrete, or fiberglass and range in size from 100 to 50,000 gallons. The oil/water separators are typically of concrete construction and have a capacity on the order of 100 gallons

### WASTE CHARACTERISTICS

Waste Type(s)

Liquid _____ Solid ___X___ Sludge ___X___ Gas _____

Characteristic(s)

Corrosive _____ Ignitable ___X___ Radioactive _____

Volatile ___X___ Toxic ___X___ Reactive _____ Unknown _____

Other (Name) _____

### SUSPECTED SITE CONTAMINANTS

- Aviation fuel (JP-5)
- Diesel fuel
- Waste oil
- Antifreeze

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is assumed to be low. Potentially volatile materials may be released during drilling operations and sample collection. A potential physical hazard would be ground level and low altitude aircraft operations near the sites.

Physical Hazards. Typical slip, trip, and fall safety hazards are present even on relatively flat terrain. Sites may be adjacent to runways and taxiways where active aircraft operations take place. There are possible hazards from ground level and low altitude operations. Hearing protection will be available to site personnel if low altitude aircraft are anticipated.

Chemical Hazards. The hazards are associated with petroleum products and antifreeze are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C__X__ D_____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

## 6.7 Category 7 - Hazardous Waste Storage Areas/Drum Storage Areas

The typical storage areas are 12 by 12 feet bermed, concrete pads. Some of these storage areas have a roof and/or sump. Other storage areas are asphalt paved or are unpaved with storage atop bare soil, marzdon matting, or a plastic or canvas liner.

### WASTE CHARACTERISTICS

Waste Type(s)

Liquid_____ Solid X Sludge_____ Gas_____

Characteristic(s)

Corrosive X Ignitable X Radioactive_____

Volatile X Toxic X Reactive_____ Unknown X

Other (Name)_____

### SUSPECTED SITE CONTAMINANTS

- Petroleum fuels
- Waste oil and grease
- Solvents
- Paint waste
- Kerosene

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is anticipated to be low. Potentially volatile materials may be released during drilling operations and sample collection.

Physical Hazards. Materials and handling equipment are potential hazards if they are involved in an accident with the site team. Typical slip, trip, and fall safety hazards are present, especially where materials are stored together. Overhead utility lines and existing materials may be a potential hazard for drillers. The proximity of some sites to active aircraft is a potential hazard due to ground level and low altitude operations. Hearing protection will be available to site personnel if low altitude aircraft are anticipated.

Chemical Hazards. The hazards associated with petroleum products, solvents, and paint products are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C_X__ D____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

## 6.8 Category 8 - Washracks/Wash Water Runoff Areas

These sites typically consist of a concrete washpad with a drain leading to a sump or oil/water separator, or a drainageway leading off the washpad. The washpads range in size from approximately 100 to 3,200 square feet.

### WASTE CHARACTERISTICS

#### Waste Type(s)

Liquid_____ Solid X Sludge_____ Gas_____

#### Characteristic(s)

Corrosive_____ Ignitable X Radioactive_____

Volatile X Toxic X Reactive_____ Unknown X

Other (Name)_____

### SUSPECTED SITE CONTAMINANTS

- Aviation fuel (JP-5)
- Waste oil
- Hydraulic fluid
- Antifreeze

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is anticipated to be low. Potentially volatile materials may be released during drilling operations. A potential hazard would be ground level and low altitude aircraft operation in the vicinity of the site.

Physical Hazards. Typical slip, trip, and fall safety hazards are present even on relatively flat terrain. There are possible hazards for ground level and low altitude aircraft operations. Hearing protection will be available to site personnel if low altitude aircraft are anticipated. Overhead utility lines may be a potential hazard to drillers.

Chemical Hazards. The hazards are associated with petroleum fuels and products and antifreeze are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C__X__ D_____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

## 6.9 Category 9 - TCE Degreaser

A TCE Degreaser Tank is located inside Building 359 in the southwestern corner. The tank occupies approximately 120 square feet. Currently inactive, the degreaser has a cat-walk type platform around two sides of the unit. Leakage is evident on the sides of the tank. No entry into degreaser. Confined space entry requires an additional health and safety plan and a permit.

WASTE CHARACTERISTICS

Waste Type(s)

Liquid____ Solid X Sludge____ Gas____

Characteristic(s)

Corrosive X Ignitable X Radioactive____

Volatile X Toxic X Reactive____ Unknown____

Other (Name)____

SUSPECTED SITE CONTAMINANTS

- TCE
- Waste oil and grease

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is anticipated to be low. Potentially volatile materials may be released during drilling and sampling operations.

Physical Hazards. Typical slip, trip, and fall safety hazards are present even on relatively flat terrain. Overhead utility lines may be a potential hazard for drillers.

Chemical Hazards. Hazards associated with solvents and petroleum products are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C__X__ D_____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

## 6.10 Category 10 - Former Sewage Treatment Plant

The former sewage treatment facility was located west of Building 307, on the west side of South Marine Way. The treatment facility was demolished in the late 1970s. The site is currently occupied by a 2- to 3-acre grass lawn picnic area. No evidence of the treatment facility was observed during the VSI. The location of the former treatment facility overlies abandoned sewer lines associated with the past tie-in to the current sanitary sewer lines.

### WASTE CHARACTERISTICS

**Waste Type(s)**

Liquid_____ Solid __X__ Sludge_____ Gas_____

**Characteristic(s)**

Corrosive __X__ Ignitable __X__ Radioactive_____

Volatile __X__ Toxic __X__ Reactive_____ Unknown __X__

Other (Name)_____

### SUSPECTED SITE CONTAMINANTS

- Petroleum fuels
- Waste oil and grease
- Solvents
- Paint waste

- Kerosene
- Metal plating waste

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is anticipated to be low. Potentially volatile materials may be released during drilling and sampling operations.

Physical Hazards. Typical slip, trip, and fall safety hazards are present even on relatively flat terrain. Overhead utility lines may be a potential hazard for drillers.

Chemical Hazards. Hazards associated with petroleum products, solvents, paint products, and metals are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C__X__ D_____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

## 6.11 Category 11 - Former Incinerator Site

The former incinerator site was used to burn trash and municipal-type waste generated by the Station. There was no evidence of the former facility observed in the VSI. The site is currently occupied by an asphalt-paved parking lot. The Original Landfill (RI/FS Site 3) is located to the northwest of the former incinerator site.

WASTE CHARACTERISTICS

Waste Type(s)

Liquid____ Solid X Sludge____ Gas____

Characteristic(s)

Corrosive X Ignitable X Radioactive____

Volatile X Toxic X Reactive____ Unknown X

Other (Name)____

SUSPECTED SITE CONTAMINANTS

- Petroleum fuels
- Waste oil and grease
- Solvents

- Paint waste
- Kerosene
- Combustion residue
- Dioxins

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is anticipated to be low. Potentially volatile materials may be released during drilling and sampling operations.

Physical Hazards. Typical slip, trip, and fall safety hazards are present even on relatively flat terrain. Overhead utility lines may be a potential hazard for drillers.

Chemical Hazards. Hazards associated with petroleum products, solvents, paint products, combustion residue, dioxins, and metals are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C__X__ D_____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

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## 6.12 Category 12 - Equipment/Vehicle Storage Yards

These sites are approximately 3-acre unpaved soil storage lots. There is little or no vegetation within the lots. The sites have numerous soil stains and several more significant stained areas.

### WASTE CHARACTERISTICS

Waste Type(s)

Liquid_____ Solid __X__ Sludge_____ Gas_____

Characteristic(s)

Corrosive_____ Ignitable __X__ Radioactive_____

Volatile __X__ Toxic __X__ Reactive_____ Unknown __X__

Other (Name)_____

### SUSPECTED SITE CONTAMINANTS

- Petroleum fluids

### HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is low. Potentially volatile materials may be released during drilling operations.

Physical Hazards. Scrap metals and salvage materials are potential hazards if they are involved in an accident. Typical slip, trip, and fall safety hazards are present, especially where materials are piled together. Overhead utility lines and narrow aisles in the yard may be a potential hazard for drillers.

Chemical Hazards. Hazards associated with petroleum products are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C_X__ D____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

## 6.13 Category 13 - Metal Plating Sewer Lines

Abandoned metal plating sewer lines are located underground between Buildings 295, 296, 297, and the former sewage treatment plant. The lines are approximately 3,000 feet in length. The physical condition of these lines is unknown. No entry into sewer lines. Confined space entry requires an additional health and safety plan and a permit.

WASTE CHARACTERISTICS

Waste Type(s)

Liquid_____ Solid __X__ Sludge_____ Gas_____

Characteristic(s)

Corrosive __X__ Ignitable __X__ Radioactive_____

Volatile __X__ Toxic __X__ Reactive_____ Unknown_____

Other (Name)_____

SUSPECTED SITE CONTAMINANTS

- Metal Plating Wastes
- Solvents

## HAZARD EVALUATION

Overall Hazard Level. The overall hazard level is anticipated to be low. Potentially volatile materials may be released during drilling and sampling operations.

Physical Hazards. Typical slip, trip, and fall safety hazards are present even on relatively flat terrain. Overhead utility lines may be a potential hazard for drillers.

Chemical Hazards. Hazards associated with solvents and metals are discussed in Section 3.0 of this document.

Level of Protection

A____ B____ C__X__ D_____

Site work will proceed in Level C unless upgrade or downgrade is indicated by monitoring or by direction of the SSC.

Monitoring Equipment and Procedures. Monitoring at this site will require the use of an explosimeter and OVA. Follow the procedures documented in Section 4.0 of this document.

# 7.0 PLAN APPROVAL

This HSP has been written for the use of CH2M HILL, its employees, and CLEAN associate firm personnel working on this Contract Task Order. CH2M HILL claims no responsibility for use of this HSP by others. The HSP is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change (see amendments attached).

PREPARED BY: _____ Date: _____
Daryl Hernandez/CH2M HILL

APPROVED BY: _____ Date: _____
Allen Macenski/CH2M HILL

APPROVED BY: _____ Date: _____
Carl Wilson/JEG

Distribution of approved plan:

- Project Manager (responsible for distribution to team members and client)
- CH2M HILL Health and Safety Manager
- JEG Health and Safety Program Manager

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# Attachment 1

## MATERIAL SAFETY DATA SHEETS

chemists helping chemists in research & industry
**aldrich chemical co.**
P.O. Box 355, Milwaukee, Wisconsin 53201 USA

Telephone: (414) 273-3850
TWX: (910) 262-3052 Aldrichem MI
Telex: 26 843 Aldrich MI
FAX: (414) 273-4979

ATTN: SAFETY DIRECTOR
CH2M HILL INC
PO BOX 4400
RESTON VA 22090
KIRK THOMSPON

DATE: 11/06/87
CUST # 924476 P.O. # W6530

# MATERIAL SAFETY DATA SHEET

PAGE

## IDENTIFICATION

PRODUCT # 15490-3 NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETRIC GRADE

CAS # 67-56-1

## TOXICITY HAZARDS

RTECS # PC1400000
METHANOL
IRRITATION DATA
SKN-RBT 500 MG/24H MOD 28ZPAK -,33,72
EYE-RBT 40 MG MOD UCDS## 3/24/70
TOXICITY DATA
ORL-HMN LDLO:428 MG/KG NPIRI# 1,74,74
ORL-HMN LDLO:143 MG/KG 34ZIAG -,382,69
UNR-MAN LDLO:868 MG/KG 85DCAI 2,73,70
ORL-RAT LD50:5628 MG/KG GTPZA9 19(11),27,75
INL-RAT LC50:64000 PPM/4H NPIRI# 1,74,74
IPR-RAT LD50:7529 MG/KG EVHPAZ 61,321,85
IVN-RAT LD50:2131 MG/KG EVHPAZ 61,321,85
OSL-MUS LD50:7300 MG/KG TXCYAC 25,271,82
IPR-MUS LD50:10765 MG/KG EVHPAZ 61,321,85
SCU-MUS LD50:9800 MG/KG TXAPA9 18,165,71
IVN-MUS LD50:4710 MG/KG EVHPAZ 61,321,85
SKN-RBT LD50:15800 MG/KG NPIRI# 1,74,74
IPR-RBT LD50:1326 MG/KG EVHPAZ 61,321,85
IVN-RBT LD50:8907 MG/KG EVHPAZ 61,321,85
IPR-GPG LD50:3556 MG/KG EVHPAZ 61,321,85
IPR-HAM LD50:3555 MG/KG EVHPAZ 61,321,85
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 200 PPM; STEL 250 PPM (SKIN) 85INAB 5,372,86
MSHA STANDARD-AIR:TWA 200 PPM (260 MG/M3) (SKIN) DTLVS# 3,155,71
OSHA STANDARD-AIR:TWA 200 PPM FEREAC 39,23540,74
NIOSH REL TO METHYL ALCOHOL-AIR:TWA 200 PPM;CL 800 PPM/15M MMWR## 34(1S),21S,85
EPA GENETOX PROGRAM 1986, NEGATIVE: SHE-CLONAL ASSAY; CELL TRANSFORM.-SAT/SHE
EPA GENETOX PROGRAM 1986, NEGATIVE: N CRASSA-ANEUPLOIDY; IN VITRO SCE-NONHUMAN
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT SEHQ-0378-0109
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, DECEMBER 1986
NIOSH ANALYTICAL METHODS: SEE METHANOL, 2000
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420-22

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORM.

chemists helping chemists in research & industry
**aldrich chemical co.**
P.O. Box 355, Milwaukee, Wisconsin 53201 USA

Telephone: (414) 273-3850
TWX: (910) 262-3052 Aldrichem MI
Telex: 26 843 Aldrich MI
FAX: (414) 273-4979

# MATERIAL SAFETY DATA SHEET

PAGE:

CATALOG # 15490-3 NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETR GRADE

## HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF SWALLOWED.
HARMFUL IF INHALED OR ABSORBED THROUGH SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
EXPOSURE CAN CAUSE:
DAMAGE TO THE EYES
DAMAGE TO THE LIVER
DAMAGE TO THE HEART
DAMAGE TO THE KIDNEYS
GASTROINTESTINAL DISTURBANCES
MAY CAUSE CONVULSIONS.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
DISCARD CONTAMINATED CLOTHING AND SHOES.

ADDITIONAL INFORMATION
METHYL ALCOHOL MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. CANNOT BE MADE NON-POISONOUS.

## PHYSICAL DATA

MELTING POINT: -98 C
BOILING POINT: 64.6 C
SPECIFIC GRAVITY: 0.791
VAPOR DENSITY: 1.1
VAPOR PRESSURE: 97.66 MM @ 20 C

## FIRE AND EXPLOSION HAZARD DATA

AUTO IGNITION TEMP.: 725 F
LOWER EXPLOSION LEVEL: 6.0%
UPPER EXPLOSION LEVEL: 36.0%
FLASH POINT: 52 F

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSION HAZARDS
EXTREMELY FLAMMABLE.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.

## REACTIVITY DATA

INCOMPATIBILITIES
ACIDS
ACID CHLORIDES
ACID ANHYDRIDES
OXIDIZING AGENTS
REDUCING AGENTS
ALKALI METALS

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# MATERIAL SAFETY DATA SHEET



CATALOG # 15490-3 NAME: METHYL ALCOHOL, 99.9%, SPECTROPHOTOMETI GRADE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

## SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

## PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
MECHANICAL EXHAUST REQUIRED.
SAFETY SHOWER AND EYE BATH.
DO NOT BREATHE VAPOR.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
DO NOT USE IF SKIN IS CUT OR SCRATCHED. WASH THOROUGHLY AFTER HANDLING.
POISON.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
HYGROSCOPIC.
STORE IN A COOL DRY PLACE.

## ADDITIONAL PRECAUTIONS AND COMMENTS

NOT APPLICABLE

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ATTN: SAFETY DIRECTOR
CH2M HILL INC
PO BOX 4400
RESTON VA 22090
DEAN CHARPENTIER

DATE: 04/22/88
CUST # 924476 P.O. # W9026

# MATERIAL SAFETY DATA SHEET



## IDENTIFICATION

PRODUCT # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT
CAS # 7647-01-0

## TOXICITY HAZARDS

RTECS # MW4025000
HYDROCHLORIC ACID
IRRITATION DATA
EYE-RBT 5 MG/30S RINSE MLD TXCYAC 23,281,82
TOXICITY DATA
IHL-HMN LCLO:1300 PPM/30M 29ZWAE -,207,68
IHL-HMN LCLO:3000 PPM/5M TABIA2 3,231,33
UNR-MAN LDLO:81 MG/KG 85DCAI 2,73,70
IHL-RAT LC50:3124 PPM/1H AMRL** TR-74-78,74
IHL-MUS LC50:1108 PPM/1H JCTODH 3,61,76
IPR-MUS LD50:1449 MG/KG COREAF 256,1043,63
ORL-RBT LD50:900 MG/KG BIZEA2 134,437,23
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 5 PPM 85INA8 5,313,86
OSHA STANDARD-AIR:CL 5 PPM FEREAC 39,23540,74
EPA GENETOX PROGRAM 1986, NEGATIVE: CELL TRANSFORM.-SA7/SHE
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0578-0146
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1987
NIOSH ANALYTICAL METHODS: SEE ACIDS, INORGANIC, 7903
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMAT

## HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF EXPOSURE, OBTAIN MEDICAL ATTENTION IMMEDIATELY.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

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# MATERIAL SAFETY DATA SHEET

PAGE:

CATALOG # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT

DISCARD CONTAMINATED SHOES.

## PHYSICAL DATA

SPECIFIC GRAVITY: 1.200
VAPOR DENSITY: 1.3
VAPOR PRESSURE: 230.0 MM @ 21 C

## FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE
EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.
UNUSUAL FIRE AND EXPLOSION HAZARDS
NOT APPLICABLE

## REACTIVITY DATA

INCOMPATIBILITIES
BASES
AMINES
ALKALI METALS
COPPER, COPPER ALLOYS
ALUMINUM
CORRODES STEEL
DO NOT ALLOW WATER TO ENTER CONTAINER BECAUSE OF VIOLENT REACTION.
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
HYDROGEN CHLORIDE GAS

## SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

## PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
NIOSH/MSHA-APPROVED RESPIRATOR IN NONVENTILLATED AREAS AND/OR FOR EXPOSURE ABOVE THE ACGIH TLV.
MECHANICAL EXHAUST REQUIRED.
RUBBER GLOVES.

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## MATERIAL SAFETY DATA SHEET

PAGE:

CATALOG # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT

DO NOT PIPET BY MOUTH.
AVOID BREATHING VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
POISON.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ----------

NOT APPLICABLE

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# MALLINCKRODT

## Material Safety Data Sheet

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Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

Emergency Telephone Number: 314-982-5000

# ISOPROPYL ALCOHOL

## PRODUCT IDENTIFICATION:

Synonyms: 2-propanol; sec-propyl alcohol; isopropanol

Formula CAS No.: 67-63-0

Molecular Weight: 60.10

Chemical Formula: $(CH_3)_2$ CHOH

Hazardous Ingredients: Isopropyl alcohol

## PRECAUTIONARY MEASURES

WARNING! FLAMMABLE LIQUID. HARMFUL IF SWALLOWED OR INHALED. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION.

Keep away from heat, sparks and flame.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.

## EMERGENCY/FIRST AID

If swallowed, give water to drink. Induce vomiting if medical help is not immediately available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Flammable Liquid

## SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Rubbing alcohol.

Solubility: Infinite in water.

Boiling Point: 82°C (180°F).

Melting Point: -89°C (-128°F).

Specific gravity: 0.79

Vapor Density (Air = 1): 2.1

Vapor Pressure (mm Hg): 33 @ 20°C (68°F)

Evaporation Rate: (n-BUAC = 1) 2.83

## SECTION 2 Fire and Explosion Information

**Fire:**
Flammable Liquid
Flashpoint: 12°C (53°F). (closed cup).
Autoignition temperature: 399°C (750°F).
Flammable limits in air, % by volume:
lel: 2.0; uel: 12.0.

**Explosion:**
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion.

**Fire Extinguishing Media:**
Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

**Special Information:**
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures. Vapors can flow along surfaces to distant ignition source and flash back.

## SECTION 3 Reactivity Data

**Stability:**
Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.

**Hazardous Decomposition Products:**
Toxic gases and vapors such as carbon monoxide may be released in a fire involving isopropyl alcohol.

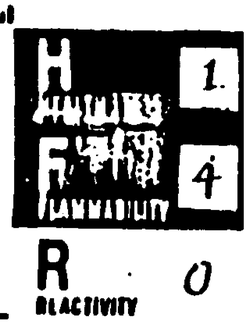
**Hazardous Polymerization:**
Will not occur.

**Incompatibilities:**
Heat, flame, strong oxidizers, acetadehyde, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, oleum and perchloric acid.

## SECTION 4 Leak/Spill Disposal Information

Remove all sources of ignition. Ventilate area of leak or spill. Clean-up personnel require protective clothing and respiratory protection from vapors. Small spills may be absorbed on paper towels and evaporated in a fume hood. Allow enough time for fumes to clear hood, then ignite paper in a suitable location away from combustible materials. Contain and recover liquid for reclamation when possible. Larger spills and lot sizes can be collected as hazardous waste and atomized in a suitable RCRA approved combustion chamber, or absorbed with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved fac

Ensure compliance with local, state and federal regul




NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

## SECTION 5 Health Hazard Information

### A. EXPOSURE / HEALTH EFFECTS

**Inhalation:**
May cause irritation of the nose and throat. Exposure to high concentrations has a narcotic effect, producing symptoms of drowsiness, headache, staggering, unconsciousness and possibly death.

**Ingestion:**
May cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls (SAX Sixth Edition).

**Skin Contact:**
Has a defatting action of the skin that can cause irritation. May cause irritation with a stinging effect and burning sensation.

**Eye Contact:**
Vapors may irritate the eyes. Splashes may cause severe irritation, possible corneal burns and eye damage.

**Chronic Exposure:**
Prolonged contact with skin may cause mild irritation, drying, cracking, or contact dermatitis may develop.

**Aggrevation of Pre-existing Conditions:**
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

### B. FIRST AID

**Inhalation:**
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**Ingestion:**
Give water to drink. Induce vomiting if medical help not is immediately available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

**Skin Exposure:**
Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

**Eye Exposure:**
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

### C. TOXICITY DATA (RTECS, 1986)

Oral rat LD50: 5840 mg/kg. Skin rabbit LD50: 13 gm/kg. Inhalation rat LC50: 16000 ppm/8H. Mutation references cited Aquatic Toxicity rating TLm96: 1000-10 ppm.

## SECTION 6 Occupational Control Measures

**Airborne Exposure Limits:**

-OSHA Permissible Exposure Limit (PEL):
400 ppm (TWA), 500 ppm (STEL)

-ACGIH Threshold Limit Value (TLV):
400 ppm (TWA), 500 ppm (STEL)

**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommende Practices", most recent edition, for details.

**Personal Respirators: (NIOSH Approved)**
If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to the maximum use concentration specified by the respirator supplier. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

**Eye Protection:**
Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

## SECTION 7 Storage and Special Information

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment.

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ISALC

# MALLINCKRODT

Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

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Emergency Telephone Number: 314-982-5000

## Addendum to Material Safety Data Sheet

## REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS must include a copy of this addendum

(Chem.Key: ISALC)

**Hazard Categories for SARA Section 311/312 Reporting**

| Acute | Chronic | Fire | Pressure | Reactive |
|---|---|---|---|---|
| X | X | X | | |

| Product or Components of Product: | SARA EHS Sect. 302 RQ (lbs.) | SARA EHS Sect. 302 TPQ (lbs.) | SARA Section 313 Chemicals Name List | SARA Section 313 Chemicals Chemical Category | CERCLA Sec.103 RQ (lbs.) | RCRA Sec. 261.33 |
|---|---|---|---|---|---|---|
| ISOPROPYL ALCOHOL (67-63-0) | No | No | Yes | No | No | No |

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.
SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.
SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec. 103: Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4
RCRA: Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

# SULFURIC ACID

SFA

| Common Synonyms | Oily liquid | Colorless | Odorless |
|---|---|---|---|
| Oil of vitriol<br>Battery acid<br>Fertilizer acid<br>Chamber acid | Strike and mixes violently with water. Irritating mist is produced. | | |

AVOID CONTACT WITH LIQUID. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

Not flammable.
May cause fire on contact with combustibles.
Flammable gas may be produced on contact with metals.
POISONOUS GAS MAY BE PRODUCED IN FIRE.
Wear goggles, self-contained breathing apparatus, and rubber overclothing.
DO NOT USE WATER ON ADJACENT FIRES.
Extinguish with dry chemical or carbon dioxide.

**Exposure**

CALL FOR MEDICAL AID.

MIST
Irritating to eyes, nose and throat.
If inhaled, will cause coughing, difficult breathing, or loss of consciousness.
Move to fresh air.
IF IN EYES, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.
LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

**Water Pollution**

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-corrosive
Restrict access
Disperse and flush with care

## 2. LABEL

2.1 Category: Corrosive
2.2 Class: 8

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Sulfuric acid
3.2 Formula: $H_2SO_4$
3.3 IMO/UN Designation: 8.0/1830
3.4 DOT ID No.: 1830
3.5 CAS Registry No.: 7664-93-9

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (at shipping): Liquid
4.2 Odor: Colorless (pure) to dark brown
4.3 Odor: Odorless unless hot, then choking

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Safety shower; eyewash fountain; safety goggles; face shield; approved respirator (self-contained or air-line); rubber safety shoes; rubber apron.
5.2 Symptoms Following Exposure: Inhalation of vapor from hot, concentrated acid may injure lungs. Swallowing may cause severe injury or death. Contact with skin or eyes causes severe burns.
5.3 Treatment of Exposure: Call a doctor. INHALATION: observe victim for delayed pulmonary reaction. INGESTION: have victim drink water if possible; do NOT induce vomiting. EYES AND SKIN: wash with large amounts of water for at least 15 min.; do not use oils or ointments in eyes; treat skin burns.
5.4 Threshold Limit Value: 1 mg/m³
5.5 Short Term Inhalation Limits: 10 mg/m³ for 5 min.; 5 mg/m³ for 15 min.; 2 mg/m³ for 30 min.; 1 mg/m³ for 60 min.
5.6 Toxicity by Ingestion: No effects except those secondary to tissue damage.
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors from hot acid (77-99%) cause moderate irritation of eyes and respiratory system. Effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: 77-99% acid causes severe second- and third-degree burns of skin on short contact and is very injurious to the eyes.
5.10 Odor Threshold: Greater than 1 mg/m³
5.11 IDLH Value: 60 mg/m³

## 6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to Be Used: Water used on adjacent fires should be carefully handled.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not flammable
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: None
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Reacts violently with evolution of heat. Spattering occurs when water is added to the compound.
7.2 Reactivity with Common Materials: Extremely hazardous in contact with many materials, particularly metals and combustibles. Dilute acid reacts with most metals, releasing hydrogen which can form explosive mixtures with air in confined spaces.
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Dilute with water, then neutralize with lime, limestone, or soda ash.
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent

(Continued)

## 8. WATER POLLUTION

8.1 Aquatic Toxicity:
24.5 ppm/24 hr/bluegill/fathead/fresh water
42.5 ppm/48 hr/prawn/$LC_{50}$/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: CP, USP, Technical, at 30% to 99% (60° Be to 66° Be).
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-O

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Corrosive material
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 0 |
| Health | |
| Vapor Irritant | 2 |
| Liquid or Solid Irritant | 4 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 2 |
| Aquatic Toxicity | 3 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 4 |
| Water | 3 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 3 |
| Flammability (Red) | 0 |
| Reactivity (Yellow) | 2 |
| | W |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 98.08
12.3 Boiling Point at 1 atm: 644°F = 340°C = 613°K
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.84 at 20°C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: —119.0 Btu/lb = —[illegible] cal/g = —0.715 X 10⁶ J/kg
12.16 Heat of Polymerization: Not pertinent
12.17 Heat of Fusion: Data not available
12.18 Limiting Value: Data not available
12.19 Reid Vapor Pressure: Low

*Physical properties apply to concentrated (99%) acid unless otherwise stated. More dilute acid is more water-like.

## 7. CHEMICAL REACTIVITY (Continued)

7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 2

| SFA | SULFURIC ACID |
|---|---|

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 115.400 | 35 | .330 | | NOT PERTINENT | | NOT PERTINENT |
| 40 | 115.200 | 40 | .331 | | | | |
| 45 | 115.000 | 45 | .331 | | | | |
| 50 | 114.900 | 50 | .332 | | | | |
| 55 | 114.700 | 55 | .333 | | | | |
| 60 | 114.500 | 60 | .333 | | | | |
| 65 | 114.299 | 65 | .334 | | | | |
| 70 | 114.200 | 70 | .334 | | | | |
| 75 | 114.000 | 75 | .335 | | | | |
| 80 | 113.799 | 80 | .335 | | | | |
| 85 | 113.599 | 85 | .336 | | | | |
| 90 | 113.500 | 90 | .336 | | | | |
| 95 | 113.299 | 95 | .337 | | | | |
| 100 | 113.099 | 100 | .338 | | | | |
| 105 | 112.900 | 105 | .338 | | | | |
| 110 | 112.799 | 110 | .339 | | | | |
| 115 | 112.599 | 115 | .339 | | | | |
| 120 | 112.400 | 120 | .340 | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| | MISCIBLE | | NOT PERTINENT | | NOT PERTINENT | | NOT PERTINENT |

# MALLINCKRODT

## Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

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Emergency Telephone Number: 314-982-5000

# ACETONE

## PRODUCT IDENTIFICATION:

Synonyms: Dimethylketone; 2-propanone

Formula CAS No.: 67-64-1

Molecular Weight: 58.08

Chemical Formula: $CH_3COCH_3$

Hazardous Ingredients: Acetone

## PRECAUTIONARY MEASURES

DANGER! EXTREMELY FLAMMABLE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION.

Keep away from heat, sparks and flame.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.

## EMERGENCY/FIRST AID

If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Flammable Liquid

## SECTION 1 Physical Data

Appearance: Clear, colorless, volatile liquid.

Odor: Fragrant, mint-like

Solubility: Miscible in all proportions in water.

Boiling Point: 56.5°C (133.7°F)

Melting Point: -95°C (-139°F)

Specific Gravity: 0.8

Vapor Density (Air=1): 2.0

Vapor Pressure (mm Hg): 400 @ 39.5°C (103°F)

Evaporation Rate: (Butyl Acetate=1) ca. 7.7

## SECTION 2 Fire and Explosion Information

Fire:
Flammable liquid!
Flash point:-18°C (0°F) closed cup
Autoignition temperature: 465°C (869°F)
Flammable limits in air, % by volume:
lel: 2.6 uel:12.8

Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above.

Fire Extinguishing Media:
Water, dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.

## SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Oxidizing materials, chloroform, alkalies, acids, potassium t-butoxide.

## SECTION 4 Leak/Spill Disposal Information

Isolate or enclose the area of the leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Contain and recover liquid for reclamation when possible. Larger spills and lot sizes can be collected as hazardous waste and atomized in a suitable RCRA approved combustion chamber, or absorbed with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!

Reportable Quantity (RQ)(CWA/CERCLA) : 5000 lbs.

Ensure compliance with local, state and federal regulations

H HEALTH 1
F FLAMMABILITY 4
R REACTIVITY 0

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

## SECTION 5 Health Hazard Information

### A. EXPOSURE / HEALTH EFFECTS

**Inhalation:**
Irritating to the nose, throat, and mucous membranes. May cause dizziness, dullness, and headache. Narcotic in high concentrations.

**Ingestion:**
May produce narcotic effects with other symptoms paralleling those from inhalation exposure.

**Skin Contact:**
Irritating due to defatting action on skin. May cause redness, pain, drying and cracking of the skin.

**Eye Contact:**
Vapors are irritating to the eyes. Splashes may cause severe irritation, with redness and pain.

**Chronic Exposure:**
Prolonged or repeated skin contact may produce severe irritation or dermatitis.

**Aggravation of Pre-existing Conditions:**
Use of alcoholic beverages enhances toxic effects.

### B. FIRST AID

**Inhalation:**
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**Ingestion:**
If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately.

**Skin Exposure:**
Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

**Eye Exposure:**
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

### C. TOXICITY DATA (RTECS, 1986)

Oral rat LD50: 9750 mg/kg Skin rabbit LD50: 20 gm/kg Mutation references cited. Irritation eye rabbit 3.95 mg Severe Aquatic toxicity rating: TLm96: over 1000 ppm

## SECTION 6 Occupational Control Measures

**Airborne Exposure Limits:**
-OSHA Permissible Exposure Limit (PEL):
750 ppm (TWA), 1000 ppm (STEL)

-ACGIH Threshold Limit Value (TLV):
750 ppm (TWA), 1000 ppm (STEL)

**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

**Personal Respirators:** (NIOSH Approved)
If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to the maximum use concentration specified by the respirator supplier. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

**Eye Protection:**
Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

## SECTION 7 Storage and Special Information

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment.

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ACCET

# MALLINCKRODT

Material Safety Data Sheet

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Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

Emergency Telephone Number: 314-982-5000

## Addendum to Material Safety Data Sheet

## REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS must include a copy of this addendum

(Chem.Key: ACCET)

Hazard Categories for SARA Section 311/312 Reporting

| Acute | Chronic | Fire | Pressure | Reactive |
|---|---|---|---|---|
| X | | X | | |

| Product or Components of Product: | SARA EHS Sect. 302 RQ (lbs.) | SARA EHS Sect. 302 TPQ (lbs.) | SARA Section 313 Chemicals Name List | SARA Section 313 Chemicals Chemical Category | CERCLA Sec.103 RQ (lbs.) | RCRA Sec. 261.33 |
|---|---|---|---|---|---|---|
| ACETONE (67-64-1) | No | No | Yes | No | 5000 | U002 |

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.
SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.
SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec. 103: Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4
RCRA: Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

**NNITRIC ACIDNN
**NNITRIC ACIDNN
**NNITRIC ACIDNN

# MATERIAL SAFETY DATA SHEET

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## SUBSTANCE IDENTIFICATION

CAS-NUMBER 7697-37-2

SUBSTANCE: NNITRIC ACIDNN

TRADE NAMES/SYNONYMS: AQUA FORTIS; HYDROGEN NITRATE; AZOTIC ACID; NITRYL HYDROXIDE; A-200; A-200C; A-200S; A-198; A-202; A-206-C

CHEMICAL FAMILY:
INORGANIC ACID

MOLECULAR FORMULA: H-N-O3 MOL WT 63.02

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=0

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## COMPONENTS AND CONTAMINANTS

PERCENT: 70 COMPONENT: HYDROGEN NITRATE

PERCENT: 30 COMPONENT: WATER

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
2 PPM (5 MG/M3) OSHA TWA; 2 PPM NIOSH RECOMMENDED TWA;
2 PPM ACGIH TWA; 4 PPM ACGIH STEL

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## PHYSICAL DATA

DESCRIPTION: COLORLESS FUMING LIQUID WITH AN ACRID ODOR; SUFFOCATING FUMES. THE ODOR IS NOT CONSIDERED AN ADEQUATE WARNING PROPERTY.

BOILING POINT: 181 F (83 C) MELTING POINT: -44 F (-42 C)

SPECIFIC GRAVITY: 1.5 VAPOR PRESSURE: 62 MMHG @ 25 C

EVAPORATION RATE: NOT AVAILABLE SOLUBILITY IN WATER: MISCIBLE

SOLVENT SOLUBILITY: ETHER ODOR THRESHOLD: <5.0 PPM VAPOR DENSITY: 2.2

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## FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
INCREASES THE FLAMMABILITY OF COMBUSTIBLES, ORGANIC MATERIAL, AND READILY OXIDIZABLE MATERIALS, CAUSING IGNITION OF SOME. SEVERE EXPLOSION HAZARD BY REACTION WITH MANY INCOMPATIBLES, INCLUDING METALLIC POWDERS, CARBIDES, HYDROGEN SULFIDE, AND TURPENTINE. IN OR NEAR FIRE, MATERIAL EMITS TOXIC AND REACTIVE NITROGEN OXIDES AS GASES.

FLASH POINT: NONCOMBUSTIBLE

FIREFIGHTING MEDIA:
WATER SPRAY

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

EXTINGUISH USING AGENTS INDICATED. IF LARGE AMOUNTS OF COMBUSTIBLE MATERIALS ARE INVOLVED, USE WATER SPRAY OR FOG IN FLOODING AMOUNTS. USE WATER SPRAY TO ABSORB CORROSIVE VAPORS. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS; KEEP UPWIND

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## TOXICITY

430 MG/KG ORAL-HUMAN LDLO; 110 MG/KG UNKNOWN-MAN LDLO;
CARCINOGEN STATUS: NONE.
NITRIC ACID IS A SEVERE EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT.

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## HEALTH EFFECTS AND FIRST AID

INHALATION:
CORROSIVE. 100 PPM IS IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.
ACUTE EXPOSURE- MAY CAUSE COUGHING, HEADACHE, DIZZINESS, AND WEAKNESS. DELAYED SYMPTOMS MAY INCLUDE DRYNESS OF THE THROAT AND NOSE, CHEST PAIN OR TIGHTNESS, DYSPNEA, FROTHY SPUTUM, HYPOTENSTION AND CYANOSIS FOLLOWED BY PNEUMONITIS AND PULMONARY EDEMA, WHICH MAY BE FATAL. IF PATIENT RECOVERS, SCAR TISSUE MAY CAUSE STRICTURE OF THE PYLORUS OR ESOPHAGUS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE CAUSES DENTAL EROSION FOLLOWED BY JAW NECROSIS, CHRONIC COUGH AND BRONCHITIS OR CHEMICAL PNEUMONITIS AND GASTROINTESTINAL DISTURBANCES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST.

SKIN CONTACT:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID OR CONCENTRATED VAPOR CAUSES IMMEDIATE SEVERE AND PENETRATING BURNS, STAINING THE SKIN YELLOW OR YELLOWISH-BROWN.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION.

EYE CONTACT:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT WITH THE LIQUID MAY CAUSE PAIN, PHOTOPHOBIA, TEARING, EDEMA, CORNEAL ULCERATION, SEVERE BURNS, AND NECROSIS OF THE DEEPER TISSUES WITH PERMANENT DAMAGE AND BLINDNESS IS POSSIBLE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IN PRESENCE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION.

INGESTION:
CORROSIVE.
ACUTE EXPOSURE- IMMEDIATE PAIN IN THE MOUTH, THROAT, AND STOMACH MAY BE FOLLOWED BY VOMITING, AND DIARRHEA OF DARK PRECIPATED BLOOD. HYPOTENSION, OLIGURIA, ANURIA, SEVERE, POSSIBLY FATAL, CIRCULATORY COLLAPSE, AND ASPHYXIA FROM EDEMA OF THE GLOTTIS ARE POSSIBLE. BURNS OF THE GASTROINTESTINAL TRACT MAY BE SEVERE ENOUGH TO CAUSE PERFORATION OF THE ESOPHAGUS AND STOMACH WHICH MAY BE FOLLOWED BY MEDIASTINITUS OR PERITONITIS, INDICATED BY FEVER.

FIRST AID- IF VICTIM IS CONSCIOUS, GIVE HIM LARGE QUANTITIES OF WATER IMMEDIATELY TO DILUTE THE ACID. DO NOT INDUCE VOMITING. GIVE PATIENT 1 OUNCE (30 ML) OF MILK OF MAGNESIA. GET MEDICAL ATTENTION IMMEDIATELY.

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## REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES. HOWEVER NITRIC VAPOR AND/OR NITRIC OXIDES ARE QUIETLY EVOLVED. ALSO SUNLIGHT CATLAYSES THE FORMATION OF THE OXIDES AND THIS GIVES A YELLOW COLOR TO THE CONCENTRATED ACID.

INCOMPATIBILITIES:
EASILY OXIDIZED SUBSTANCES, EXAMPLES FOLLOW:

EXPLOSION: ACETONITRILE, CESIUM CARBIDE, CUPRIC NITRIDE, CYANIDES, 1,2-DIAMINOETHANE BISTRIMETHYL GOLD, DINITROTOLUENE, EPICHLOROHYDRIN, 5-ETHYL-2-METHYL PYRIDINE, CYCLOPENTADIENE, BENZENE, TOLUENE, METALS, METAL CARBIDES, 4-METHYLCYCLOHEXANONE, NITROBENZENE AND WATER, NITROMETHANE, POLYDIBROMOSILANES, PHOSPHORUS TRICHLORIDE, POTASSIUM HYPOPHOSPHITE (ON EVAPORATION), RUBIDIUM CARBIDE, SELENIUM IODOPHOSPHIDE, SULFUR DIOXIDES, THIOCYANATES,

THIOBENZOIC ACID METAL SALTS, THIOPHENES, TETRABORANE, TRICADMIUM DIPHOSPHIDE, TRITHIOACETONE.
PROBABLE EXPLOSION: ACETONE AND ACETIC ACID, SULFURIC ACID AND GLYCERIDES, TRIAZINE AND TRIFLUOROACETIC ANHYDRIDE @ 36 C.
POSSIBLE EXPLOSION: ACETIC ACID, T-AMINOTHIAZOLE AND SULFURIC ACID, CYANATES, 1,3-CYCLOPENTADIENE, FLURORINE, LACTIC ACID AND HYDROGEN FLUORIDE, MESITYLENE, ORGANIC SUBSTANCES AND SULFURIC ACID, ORGANIC SUBSTANCES AND PERCHLORATES, PHTHALIC ACID OR PHTHALIC ANHYDRIDE AND SULFURIC ACID, REDUCING AGENTS, SULFURIC ACID, TITANIUM ALLOY.
EXPLOSION BY FRICTION OR IMPACT: ACETIC ANHYDRIDE.
EXPLOSIVE OXIDATION: NON-METAL OXIDES- ARSINE, PHOSPHINE, OR TETRABORANE, DIPHENYLDISTIBENE.
POSSIBLE EXPLOSION BY IMPACT : TITANIUM-MAGNESIUM ALLOY.
VIOLENT REACTION: ACRYLONITRILE, ALCOHOLS, ARSINE, CARBON (PULVERIZED), CHLORINE TRIFLUORIDE, CUPROUS NITRIDE, CYCLIC KETONES, CYCLOHEXANOL, ETHANOL, GERMANIUM, HYDRAZINE, SULFUR HALIDES, SULFURIC ACID AND TEREPHTHALIC ACID, THIOALDEHYDES OR THIOKETONES, URANIUM, URANIUN ALLOYS.
VIOLENT OXIDATION: ACETONE AND SULFURIC ACID, SULFAMIC ACID.
VIOLENT DECOMPOSITION: BUTANETHIOL, PHOSPHINE.
VIOLENT DECOMPOSITION RESULTING IN IGNITION: CROTONALDEHYDE, TETRAPHOSPHORUS TRIIODIDE.
POSSIBLE VIOLENT REACTION: ANTIMONY.
POSSIBLE VIOLENT EXOTHERMIC REACTION: ANION EXCHANGE RESIN.
INTENSE EXOTHERMIC REACTION: ACROLEIN, ALLYL ALCOHOL, ALLYL CHLORIDE, 2-AMINOETHANOL, AMMONIUM HYDROXIDE, BISMUTH, N-BUTYRALDEHYDE, CHLOROSULFONIC ACID, CRESOL, CUMENE, DIISOPROPYL ETHER, ETHYLENEDIAMINE, POLYALKENES, GLYOXAL, ISOPRENE, MESITYL OXIDE, 2-METHYL-5-ETHYLPYRIDINE, OLEUM, PROPYLENE OXIDE, PROPIOLACTONE (BETA-), PYRIDENE, SODIUM HYDROXIDE, VINYL ACETATE, VINYLDENE CHLORIDE,.
INTENSE REACTION: DIETHYLETHER, HYDRAZOIC ACID, P-XYLENE IN THE PRESENCE OF SULFURIC ACID, SELENIUM, SODIUM AZIDE, TOLUENE, TRIMETHYLTRIOXANE.
IGNITION WITH POSSIBLE EXPLOSION: HYDROGEN TELLURIDE.
IGNITION: ANILINE, BORON PHOSPHIDE, BROMINE PENTAFLUORIDE, N-BUTYLMERCAPTAN, CALCIUM HYPOPHOSPHITE, DIBORANE, DIPHENYL TIN, M-ETHYL ANILINE, ETHYL PHOSPHINE, FURFURYL ALCOHOL, HALOGEN PHOSPHIDES, HYDROGEN IODIDES, LITHIUM, METALS, PHOSPHONIUM IODIDE, PHOPHORUS, SELENIUM HYDRIDE, SODIUM, TERPENES, TOLUIDINE, TRIETHYLGALLIUM MONOETHYL ETHER COMPLEX, UNS-DIMETHYLHYDRAZINE.
POSSIBLE IGNITION: AMMONIA, ANION EXCHANGE RESIN AND CHROMITES OR DICHROMATE, AROMATIC AMINES, DIVINYL ETHER, DIENE OR ACETYLENE DERIVATIVES, LITHIUM, REDUCING AGENTS.
INCANDESCENT REACTION: BORON, FERROUS OXIDE (POWDER), HYDROGEN SULFIDE, LITHIUM SILICIDE, SELENIUM HYDRIDE, MAGNESIUM PHOSPHIDE, MANGANESE, ZINC.
FORMATION OF HIGHLY EXPLOSIVE PRODUCTS: NITROAROMATIC HYDROCARBONS.
FORMATION OF EXPLOSIVE PRODUCTS: ACETYLENE, 4-CHLORO-2-NITROANILINE, CYCLOHEXANE, CYCLOHEXYLAMINE, 2,6-DI-T-BUTYL PHENOL, DICHLOROMETHANE, ETHANOL AND SILVER, 5-ETHYL-2-PICOLINE, HYDROGEN PEROXIDE AND KETONES, HYDROGEN PEROXIDE AND MERCURIC OXIDE, HYDROGEN PEROXIDE AND THIOUREA, INDANE AND SULFURIC ACID, METAL SALICYLATES, PHENYLORTHOPHOSPHORIC ACID DISODIUM SALT, TITANIUM.
FORMATION OF POSSIBLY EXPLOSIVE PRODUCTS: BENZOTHIOPHENE DERIVATIVES.
FORMATION OF EASILY COMBUSTIBLE ESTER: CELLULOSE.
DETONATABLE MIXTURE (DEPENDING ON AMOUNT OF WATER PRESENT): NITROBENZENE.

DECOMPOSITION:
DECOMPOSES ON EXPOSURE TO AIR OR ORGANIC MATTER, OR WITH HEAT, TO RELEASE HIGHLY TOXIC FUMES OR OXIDES OF NITROGEN, INCLUDING NITRIC OXIDE AND NITROGEN DIOXIDE, AND HYDROGEN NITRATE. REACTS WITH THE FOLLOWING TO RELEASE TOXIC GASES: SULFIDES, CARBONATES, CYANIDES. VIOLENT REACTION WITH ALL CARBIDES, GAS MIXTURE EVOLVED (N2O4) REACTS STRONGLY WITH HYDROCARBONS, FLUORINE, OR

FORMALDEHYDE.

POLYMERIZATION:
WILL NOT OCCUR.

**********************************************************************

## CONDITIONS TO AVOID

MAY IGNITE COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTS VIOLENTLY WITH WATER AND FUELS. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD. AVOID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS, INCLUDING THOSE MATERIALS AND CLASSES OF MATERIALS LISTED IN THE REACTIVITY SECTION. HEATING MAY INCREASE THE EVOLUTION OF NITRIC ACID VAPOR AND/OR NITROGEN OXIDES (GASES) BEYOND AN ACCEPTABLE LEVEL.

**********************************************************************

## SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL AND OTHER EASILY OXIDIZABLE MATERIALS) AWAY FROM SPILLED MATERIAL. WEAR PERSONAL PROTECTIVE EQUIPMENT. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. DILUTE SPILLS OR LEAKS WITH PLENTY OF WATER. NEUTRALIZE RESIDUE WITH (A) ALKALI, SUCH AS SOLDA ASH, LIME, LIMESTONE; OR (B) OTHER SUITABLE NEUTRALIZATION MATERIALS. ADEQUATE VENTILATION IS REQUIRED TO ELIMINATE ANY NITROGEN OXIDES RELEASED AND, IF SODA ASH OR LIMESTONE IS USED, $CO_2$. ABSORB WITH EXCESS SODA ASH, SCOOP UP AND PLACE IN A SUITABLE E.G. GLASS OR PLASTIC CONTAINER AND CLOSE. LABEL 'OXIDIZER'. KEEP OUT OF SEWERS AND WATER SOURCES. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

----------------------------------------------------------------------

## PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION, PROCESS ENCLOSURE OR GENERAL DILUTION VENTILATION TO MEET PERMISSABLE EXPOSURE LIMITS REQUIREMENTS. EQUIPMENT MUST BE CORROSION-RESISTANT.

RESPIRATOR:
EXPOSURE LIMIT TO 100 MG/M3-
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.
TYPE 'C' SUPPLIED-AIR RESPIRATOR OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE OR CONTINUOUS FLOW MODE.

—> 100 MG/M3, INCLUDING THE IDLH LEVEL, 250 MG/M3-
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE, OR USE EQUIVALENT RESPIRATOR.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR IMPERVIOUS CLOTHING AS NECESSARY TO AVOID ANY POSSIBILITY

OF CONTACT WITH CHEMICAL.

GLOVES:
WEAR IMPERVIOUS GLOVES AS NECESSARY TO AVOID ANY POSSIBLILITY OF CONTACT WITH SUBSTANCE. PREFERRED MATERIALS: VITON OR SARANEX.

EYE PROTECTION:
WEAR FACESHIELD (8 INCH MINIMUM) AND VENTED SAFETY GOGGLES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 02/10/85 REVISION DATE: 10/21/85

-ADDITIONAL INFORMATION-

THE INFORMATION BELOW IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. HOWEVER, WE MAKE NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT TO SUCH INFORMATION, AND WE ASSUME NO LIABILITY RESULTING FROM ITS USE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION FOR THEIR PARTICULAR PURPOSES.

# American Burdick & Jackson
# Material Safety Data Sheet

MATERIAL SAFETY DATA SHEET

HEXANE

emergency telephone no. 312/973-3600 (American Scientific Products)
chemtrec telephone no. 800/424-9300
information telephone no. 616/726-3171 (American Burdick & Jackson)

## I. Identification

chemical name: Hexane — molecular weight: 86.18
chemical family: Aliphatic Hydrocarbon — formula: $C_6H_{14}$
synonyms: n-Hexane
DOT proper shipping name: Hexane
DOT hazard class: Flammable Liquid
DOT identification no.: UN1208 — CAS no: 110-54-3

## II. Physical and Chemical Data

boiling point, 760mm Hg: 68.7°C — freezing point: -95.3°C — evaporation rate: (BuAc=1) ca 10
vapor pressure at 20°C: 124 mm Hg — vapor density (air = 1): 3.0 — solubility in water: @ 20°C-0.014%
% volatiles by volume: ca 100 — specific gravity ($H_2O$ = 1): @ 20°C 0.659 — stability: Stable
hazardous polymerization: Not expected to occur.
appearance and odor: Clear, colorless liquid with a mild hydrocarbon odor.
conditions to avoid: Heat, sparks, open flame, open containers, and poor ventilation.

materials to avoid: Strong oxidizing agents.

hazardous decomposition products: Incomplete combustion can generate carbon monoxide and other to vapors.

## III. Fire and Explosion Hazard Data

flash point, (test method): -26°C (Tag closed cup) — auto ignition temperature: 225°C
flammable limits in air % by volume: lower limit: 1.2 — upper limit: 7.7
unusual fire and explosion hazards: Very volatile and extremely flammable.

extinguishing media: Carbon dioxide, dry chemical or foam.

special fire fighting procedures: Water will not be effective in extinguishing a fire and may spread but a water spray can be used to cool exposed containers. Wear fu protective clothing and self-contained breathing apparatus. Heat will build pressure and may rupture closed storage containers.

## IV. Hazardous Components

| | % | TLV | CAS no. |
|---|---|---|---|
| Hexane and isomers | ca 100 | 50 ppm | 110-54- |

**American Burdick & Jackson's Disclaimer:** "The information and recommendations presented herein are based on sources believed reliable as of the date hereof. American Burdick & Jackson makes no representation as to the completeness or accuracy thereof. It is the user's responsi to determine the product's suitability for its intended use, the product's safe use, and the product's proper disposal. No representations or warranties expressly set forth herein are made hereunder, whether express or implied by operation of law or otherwise, including, but not limited to any implied warra MERCHANTABILITY OR FITNESS. American Burdick & Jackson neither assumes nor authorizes any other person to assume for it, any other or ADDITI LIABILITY OR RESPONSIBILITY resulting from the use of, or reliance upon, this information."

## V. Health Hazards

### Occupational Exposure Limits

| | | | |
|---|---|---|---|
| OSHA | 8-hour PEL | - | 500 ppm |
| | Ceiling | - | not listed |
| | Peak | - | not listed |
| ACGIH | TLV-TWA | - | 50 ppm |
| | TLV-STEL (15-min) | - | not listed |
| NIOSH | TLV-TWA | - | 100 ppm |
| | TLV-C | - | 510 ppm |

### Concentration Immediately Dangerous to Health

| | |
|---|---|
| OSHA/NIOSH | 5,000 ppm |

### Odor Threshold

| | |
|---|---|
| NSC & OHS | not listed |
| NIOSH | not listed |

### Carcinogenic, Mutagenic, Teratogenic Data

Experimental carcinogen (NTP)
Animal teratogen (RTEC)

### Primary Routes of Entry

Hexane may exert its effects through inhalation, skin absorption, and ingestion.

### Industrial Exposure: Route of Exposure/Signs and Symptoms

| | |
|---|---|
| Inhalation: | Exposure can cause dizziness, numbness of extremities, and intoxication. |
| Eye Contact: | Liquid and high vapor concentration can be irritating. |
| Skin Contact: | Prolonged or repeated skin contact can cause irritation and dermatitis through defatting of skin. |
| Ingestion: | Can cause gastrointestinal tract discomfort. |

### Effects of Overexposure

Hexane is a mild eye and mucous membrane irritant, primary skin irritant, central nervous system depressant and neurotoxin. Acute exposure causes irritation, narcosis, and gastrointestinal tract irritation. Chronic inhalation causes peripheral neuropathy. No systemic toxicity has been reported.

### Medical Condition Aggravated by Exposure

Preclude from exposure those individuals susceptible to dermatitis.

Emergency First Aid

| | |
|---|---|
| Inhalation: | Immediately remove to fresh air. If not breathing, administer mouth-to-mouth rescue breathing. If there is no pulse administer cardiopulmonary resuscitation (CPR). Contact physician immediately. |
| Eye Contact: | Rinse with copious amounts of water for at least 15 minutes. Get emergency medical assistance. |
| Skin Contact: | Flush thoroughly for at least 15 minutes. Wash affected skin with soap and water. Remove contaminated clothing and shoes. Wash clothing before re-use, and discard contaminated shoes. Get emergency medical assistance. |
| Ingestion: | Call local Poison Control Center for assistance. Contact physician immediately. Aspiration Hazard - Do not induce vomiting. |

## VI. Safety Measures and Equipment

| | |
|---|---|
| Ventilation: | Adequate ventilation is required to protect personnel from exposure to chemical vapors exceeding the PEL and to minimize fire hazards. The choice of ventilation equipment, either local or general, will depend on the conditions of use, quantity of material, and other operating parameters. |
| Respiratory: | Use approved respirator equipment. Follow NIOSH and equipment manufacturer's recommendations to determine appropriate equipment (air-purifying, air-supplied, or self-contained breathing apparatus). |
| Eyes: | Safety glasses are considered minimum protection. Goggles or face shield may be necessary depending on quantity of material and conditions of use. |
| Skin: | Protective gloves and clothing are recommended. The choice of material must be based on chemical resistance and other user requirements. Generally, Buna-N offers acceptable chemical resistance. Individuals who are acutely and specifically sensitive to hexane may require additional protective equipment. |

# SODIUM HYDROXIDE

**SHD**

**Common Synonyms**
Caustic soda
Lye

Solid flakes or pellets. White. Odorless.

Stop and rinse with water.

Avoid contact with solid and dust. Keep people away.
Wear rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

Not flammable.
May cause fire on contact with combustibles.
Flammable gas may be produced on contact with metals.
Wear rubber overclothing (including gloves).
Flood discharge area with water.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

DUST
Irritating to eyes, nose and throat.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.
IF IN EYES, hold eyelids open and flush with plenty of water.

SOLID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

**Water Pollution**

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-corrosive
Restrict access
Disperse and flush

## 2. LABEL

2.1 Category: Corrosive
2.2 Class: 8

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: NaOH
3.3 IMO/UN Designation: 8.0/1823
3.4 DOT ID No.: 1823
3.5 CAS Registry No.: 1310-73-2

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid
4.2 Odor: White
4.3 Odor: Odorless

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Chemical safety goggles; face shield; filter or dust-type respirator; rubber boots; rubber gloves.
5.2 Symptoms Following Exposure: Strong corrosive action on contacted tissues. INHALATION: dust may cause damage to upper respiratory tract and lung itself, producing from mild nose irritation to pneumonitis. INGESTION: severe damage to mucous membranes; severe scar formation or perforation may occur. EYE CONTACT: produces severe damage.
5.3 Treatment of Exposure: INHALATION: remove from exposure; support respiration; call physician. INGESTION: give water or milk followed by dilute vinegar or fruit juice; do NOT induce vomiting. SKIN: wash immediately with large quantities of water under emergency safety shower while removing clothing; continue washing until medical help arrives; call physician. EYES: irrigate immediately with copious amounts of water for at least 15 min.; call physician.
5.4 Threshold Limit Value: 2 mg/m³
5.5 Short Term Inhalation Limits: Not pertinent
5.6 Toxicity by Ingestion: (10% solution) oral rabbit $LD_{50}$ = 500 mg/kg
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Non-volatile
5.9 Liquid or Solid Irritant Characteristics: Severe skin irritant. Causes second-and third-degree burns on short contact and is very injurious to the eyes.
5.10 Odor Threshold: Not pertinent
5.11 IDLH Value: 200 mg/m³

## 6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Dissolves with liberation of much heat; may steam and splatter
7.2 Reactivity with Common Materials: When wet, attacks metals such as aluminum, tin, lead, and zinc to produce flammable hydrogen gas.
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Flush with water, rinse with dilute acetic acid
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Groups: Data not available

## 8. WATER POLLUTION

8.1 Aquatic Toxicity:
155 ppm/96 hr/mosquito fish/$TL_m$/fresh
189 ppm/96 hr/oysters/lethal/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical flakes; USP pellets
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Vented: Open

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
SB

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Corrosive material
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 3 |
| Flammability (Red) | 0 |
| Reactivity (Yellow) | 1 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 40.00
12.3 Boiling Point at 1 atm: Very high
12.4 Freezing Point: 604°F = 318°C = 591°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 2.13 at 20°C (solid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.17 Heat of Fusion: 50.9 cal/g
12.18 Limiting Value: Data not available
12.19 Reid Vapor Pressure: Data not available

## NOTES

JUNE 1985

| SHD | SODIUM HYDROXIDE |
|---|---|

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| | NOT PERTINENT | | NOT PERTINENT | | NOT PERTINENT | | NOT PERTINENT |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 34 | 44.810 | | NOT PERTINENT | | NOT PERTINENT | | NOT PERTINENT |
| 36 | 47.660 | | | | | | |
| 38 | 50.500 | | | | | | |
| 40 | 53.350 | | | | | | |
| 42 | 56.190 | | | | | | |
| 44 | 59.040 | | | | | | |
| 46 | 61.880 | | | | | | |
| 48 | 64.719 | | | | | | |
| 50 | 67.570 | | | | | | |
| 52 | 70.410 | | | | | | |
| 54 | 73.259 | | | | | | |
| 56 | 76.099 | | | | | | |
| 58 | 78.950 | | | | | | |
| 60 | 81.790 | | | | | | |
| 62 | 84.639 | | | | | | |
| 64 | 87.480 | | | | | | |
| 66 | 90.320 | | | | | | |
| 68 | 93.169 | | | | | | |
| 70 | 96.009 | | | | | | |
| 72 | 98.860 | | | | | | |
| 74 | 101.700 | | | | | | |
| 76 | 104.500 | | | | | | |
| 78 | 107.400 | | | | | | |
| 80 | 110.200 | | | | | | |
| 82 | 113.099 | | | | | | |
| 84 | 115.900 | | | | | | |

# Attachment 2

# HEALTH AND SAFETY FORMS

## Site Personnel Additions

The following site personnel are to be added to this Site Health and Safety Plan (HSP) for the purposes of identification and site control. All new site personnel must meet the same requirements for medical surveillance and training as those individuals identified in the original HSP.

**By signing this form, each of the undersigned certifies that the requirements for current medical and training have been met. If you are not certain of your status, check with the Site Safety Coordinator before signing this form.**

| Employee Name (print) | Company | Signature |
|---|---|---|
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# Subcontractor Medical and Training Certification Letter

Subcontractor: _____

Address: _____

_____

Site Name: _____

TO: Site Safety Coordinator

SUBJECT: Authorized Personnel List

This letter certifies that the personnel listed below are Subcontractor employees who are scheduled to perform work on the above site. Each of the employees named below participates in the medical surveillance program according to 29 CFR 1910.120 and 29 CFR 1910.134, has been examined by a physician within the time period required by 29 CFR 1910.120, and has no medical restrictions for respirator use. In addition, each employee named below has been trained according to the provisions of 29 CFR 1910.120(e) established for the protection of hazardous waste workers.

| Name of Employee(s) | Job Function |
|---|---|

The physician to be notified in case of emergency is:

_____

Phone Number: _____

(**Note:** If the above information is not provided, Subcontractor employees will be taken to the emergency room designated on the Site Health and Safety Plan, in event of emergency.)

_____ _____

Signature of Subcontractor Date

_____

Title

# TRAINING ATTENDANCE ROSTER

TRAINING TOPICS: _____ TRAINING METHODS: _____

LOCATION: _____ DATE OF TRAINING: _____

TRAINER(S): _____

I have understood the materials presented and have had my questions answered satisfactorily. In the event of any further questions, I know the individuals to contact.

| EMPLOYEE NAME (PLEASE PRINT) | Employee Number | COMPANY | EMPLOYEE SIGNATURE |
|---|---|---|---|
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FORM 533

# RECORD OF HAZARDOUS WASTE FIELD ACTIVITY

SITE NAME:
SITE SAFETY COORDINATOR:
PROJECT NUMBER:
RECORD OF ACTIVITIES FOR (DATES):

| Employee Number | Employee Name | Total Days Onsite | Days at the Site in Level B | Days at the Site in Level C | Days at the Site in Level D | or | Number of days as SSC Level B | Number of days as SSC Level C | Number of days as SSC Level D | Activities Employees Performed While Onsite |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
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Signature of SSC: _____

WDCM19/102.50

CH2M HILL

# ACCIDENT REPORT

DATE: _____

NOTE: *TO BE COMPLETED ONLY FOR REPRESENTATIVES OF CH2M HILL, INC.*

PROJECT: _____ PROJECT NO. _____

INJURED EMPLOYEE: _____ EMPLOYEE NO. _____

DATE INJURED: _____ TIME _____ A.M. P.M.

DATE REPORTED: _____ LAST DAY WORKED: _____

DID EMPLOYEE RETURN TO WORK: _____ DATE RETURNED: _____

WHERE ACCIDENT OCCURRED: _____

WITNESSES: _____

WORK PERFORMING WHEN INJURED: _____

KIND AND EXTENT OF INJURY: _____

NAME - ADDRESS OF DOCTOR - HOSPITAL: _____

DESCRIPTION OF ACCIDENT: _____

WAS THERE EQUIPMENT MALFUNCTION? ☐ YES ☐ NO

DESCRIBE DAMAGE TO EQUIPMENT OR PROPERTY: _____

UNSAFE CONDITION OR ACT CAUSING ACCIDENT: _____

ACTION TAKEN TO PREVENT SIMILAR ACCIDENT: _____

ADDITIONAL RECOMMENDATIONS OR ACTION: _____

SUPERVISOR: _____

☐ PHOTO(S) TAKEN



FORM 308

## Attachment 3

## CAL/OSHA WORK SITE POSTER

# SAFETY AND HEALTH PROTECTION ON THE JOB

State of California
Department of Industrial Relations

**The California Occupational Safety and Health Act of 1973 provides job safety and health protection for workers. The Department of Industrial Relations has primary responsibility for administering the Cal/OSHA program. Job safety and health standards are promulgated by the Occupational Safety and Health Standards Board. Employers and employees are required to comply with these standards. Enforcement is carried out by the Division of Occupational Safety and Health within the Department of Industrial Relations.**

## EMPLOYERS AND EMPLOYEES

California law requires every employer to provide employment and a place of employment which are safe and healthful for the employees therein. Employers and employees are required to comply with the occupational safety and health standards contained in Title 8 of the California Code of Regulations and all rules, regulations and orders pursuant to Division 5 of the California Labor Code which are applicable to their employment and actions on the job.

## COMPLIANCE WITH JOB SAFETY AND HEALTH REQUIREMENTS

To ensure compliance with State job safety and health requirements, the Division of Occupational Safety and Health conducts periodic jobsite inspections. The inspections are made by trained safety engineers and industrial hygienists.

The law provides that an authorized representative of the employer and a representative of the employees be given an opportunity to accompany the safety engineer/industrial hygienist for the purpose of aiding the inspection. Where there is no authorized employee representative, the safety engineer/industrial hygienist talks with a reasonable number of employees about the safety and health conditions in the workplace.

Every employee has the right to bring unsafe or unhealthful conditions to the attention of the safety engineer/industrial hygienist making the inspection. In addition, any employee who believes unsafe or unhealthful conditions exist at the worksite has the right to notify the Division of Occupational Safety and Health. The Division upon request will withhold the names of employees who submit or make statements during an inspection or investigation.

If the Division of Occupational Safety and Health believes that an employer has violated a safety and health standard or order, it issues a citation to the employer. Each citation specifies a date by which the alleged violation must be corrected. The law provides for mandatory penalties against employers of up to $2,000 for each serious violation and for optional penalties of up to $1,000 for each general violation. Penalties of up to $2,000 per day may be proposed for failure to correct serious violations and up to $1,000 per day may be proposed for failure to correct general violations by the abatement date. Also any employer who willfully or repeatedly violates any occupational safety and health standard or order may be assessed civil penalties of not more than $20,000 for serious violations and $10,000 for general violations.

A willful violation that causes death or permanent impairment of the body of any employee results, upon conviction, in a fine of not more than $10,000 or imprisonment of not more than six months, or both. A second conviction, after a first conviction, doubles these maximum penalties.

While governmental entities may be cited on the same basis as other employers, and abatement dates set, civil penalties will not be assessed.

An employer who receives a citation, Order to Take Special Action or Special Order must post it prominently at or near the place of the violation for three working days, or until the unsafe condition is corrected, whichever is longer, to warn employees of danger that may exist there. Any employee may protest the time allowed for correction of the violation.

## COMPLAINTS

Employees or their representatives who believe unsafe or unhealthful conditions exist in their workplace have the right to file a complaint with any office of the Division of Occupational Safety and Health and thereby to request an inspection. The Division keeps confidential the names of complainants unless they request otherwise.

An employee may not be fired or punished in any way for filing a complaint about unsafe or unhealthful working conditions or using any other right given to employees by the Cal/OSHA law. An employee of a private employer who believes that he/she has been fired or punished for excercising such rights may file a complaint about this discrimination with the nearest office of the Department of Industrial Relations - Division of Labor Standards Enforcement (State Labor Commissioner) or with the San Francisco office of the U.S. Department of Labor, Occupational Safety and Health Administration. Employees of state or local government agencies may file discrimination complaints only with the State Labor Commissioner. Consult your local telephone directory for the office nearest you.

## OTHER EMPLOYEE RIGHTS

Any employee has the right to refuse to perform work which would violate the Cal/OSHA Act or any occupational safety or health standard or order where such violation would create a real and apparent hazard to the employee or other employees.

Employers who use any substance listed as a hazardous substance in Section 339 of Title 8 of the California Code of Regulations or subject to the Federal Hazard Communication Standard (29 CFRS 1910.1200) must provide employees with information on the contents of material safety data sheets (MSDS) or equivalent information about the substance which trains employees to use the substance safely.

Employers shall make available on a timely and reasonable basis a material safety data sheet on each hazardous substance in the workplace upon request of an employee collective bargaining representative, or an employee's physician.

Employees have the right to see and copy their medical records and accurate records of employee exposure to potentially toxic materials or harmful physical agents.

Any employee has the right to observe monitoring or measuring of employee exposure to hazards conducted pursuant to Cal/OSHA standards. Employers must tell their employees when they are being, or have been, exposed to concentrations of harmful substances higher than the exposure limits allowed by Cal/OSHA standards, and the corrective action being taken.

For information and assistance, contact the nearest office of the Division of Occupational Safety and Health. See addresses below.

The law requires each employer in California to post this poster conspicuously in each workplace.

## CONSULTATION SERVICE

In order to encourage voluntary compliance, Cal/OSHA provides free, upon request, a full range of occupational safety and health consulting services. The Cal/OSHA Consultation Service is separate from Cal/OSHA enforcement activities.

## OFFICES OF THE DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

**HEADQUARTERS: 395 Oyster Point Blvd. So. San Francisco 94080**

### Regional Offices

| | | |
|---|---|---|
| Anaheim | 2100 E. Katella Ave., Room 125, 92806 | (714) 939-8611 |
| Los Angeles | 3550 West Sixth Street, Suite 413, 90020 | (213) 736-4911 |
| Sacramento | 2422 Arden Way, Suite B-53, 95825 | (916) 920-6127 |
| San Francisco | 455 Golden Gate Ave., Room 1171, 94102 | (415) 557-8640 |
| Van Nuys | 6150 Van Nuys Blvd., Suite 405, 91401 | (818) 901-5403 |
| Ventura | 1655 Mesa Verde, 93003 | (805) 654-4581 |
| Vernon | 13050 Heritage Pk Dr, Ste 201,Santa Fe Spgs 90670 | (213) 944-7676 |

### District Offices

| | | |
|---|---|---|
| Anaheim | 2100 E. Katella Ave., Room 140, 92806 | (714) 939-0145 |
| Bakersfield | 4800 Stockdale Highway, Suite 212, 93309 | (805) 395-2718 |
| Concord | 1465 Enea Circle, Bldg. E, Suite 900, 94520 | (415) 676-5333 |
| Covina | 1123 So. Parkview, Suite 100, 91724 | (818) 966-1166 |
| Fresno | 2550 Mariposa St., Room 4000, 93721 | (209) 445-5302 |
| Long Beach | 401 E. Ocean Blvd., Room, 400, 90802 | (213) 590-5035 |
| Los Angeles | 3550 West Sixth St., Room 431, 90020 | (213) 736-3041 |
| Modesto | 1209 Woodrow Ave., Suite C-4, 95350 | (209) 576-6260 |
| Oakland | 7700 Edgewater Dr., Suite 658, 94621 | (415) 568-8602 |
| Redding | 381 Hemsted Drive, 96002 | (916) 224-4743 |
| Sacramento | 2422 Arden Way, Suite B-55, 95825 | (916) 920-6123 |
| San Bernardino | 303 West Third St., Room 640, 92401 | (714) 383-4321 |
| San Diego | 7807 Convoy Court, Suite 140, 92111 | (619) 237-7325 |
| San Francisco | 455 Golden Gate Ave., Room 1193, 94102 | (415) 557-1677 |
| San Jose | 100 Paseo De San Antonio, Suite 101, 95113 | (408) 277-1260 |
| San Mateo | 1900 So. Norfolk St., Suite 215, 94403 | (415) 573-3812 |
| Santa Fe Spgs | 13050 Heritage Park Dr. Ste. 201, 90670 | (213) 944-7676 |
| Santa Rosa | 50 "D" St., Suite 430, 95404 | (707) 576-2388 |

### Field Offices

| | | |
|---|---|---|
| Chico | 555 Rio Lindo, Suite A, 95926 | (916) 895-4761 |
| Eureka | 619 Second St., Room 109, 95501 | (707) 445-6611 |
| Salinas | 1164 Monroe St., Suite 1, 93906 | (408) 443-3050 |
| Stockton | 31 E. Channel St., Room 418, 95202 | (209) 948-7762 |
| Ukiah | 620 Kings Court, Suite 5, 95482 | (707) 463-4783 |

### CAL/OSHA CONSULTATION SERVICE

**Headquarters:** 395 Oyster Pt. Blvd., 3rd Fl., So.San Francisco, 94080 (415) 737-2843

**Area Offices**

| | | |
|---|---|---|
| Downey | 8535 E. Florence Ave., Suite 200, 90240 | (213) 861-9993 |
| Fresno | 1901 N. Gateway, Suite 102, 93727 | (209) 454-1295 |
| Sacramento | 2424 Arden Way, Suite D-90, 95825 | (916) 920-6131 |
| San Diego | 7827 Convoy Court, Suite 406, 92111 | (619) 279-3771 |
| San Mateo | 3 Waters Park Drive, Suite 230, 94403 | (415) 573-3862 |

Persons wishing to register a complaint alleging inadequacy in the administration of the California Occupational Safety and Health Plan may do so by contacting the San Francisco Regional Office of the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor (Tel. 415/744-6670). OSHA monitors the operation of State plans to assure that continued approval is merited.

TO ALL EMPLOYERS OF CALIFORNIA EMPLOYEES: Section 6408(a) of the California Labor Code requires that information shall be posted regarding protections and obligations of employees under the occupational safety and health laws. This poster meets that requirement and must be prominently posted in all places of employment in the state of California. Section 6431 of the California Labor Code provides that any employer who violates any of the posting requirements of Section 6408 of the California Labor Code shall be assessed a civil penalty of up to one thousand dollars ($1,000) for each violation.

APRIL 1990