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ENSAFE/ ALLEN AND HOSHALL

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COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA
CTO-029

FINAL
ZONE E RFI WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA

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Appendix C Analytical Data from Previous Investigations
Appendix D Location Maps and Well Construction Logs from Previous Investigations
Appendix E MSDSs
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Appendix G Health and Safety Plan Acceptance Forms
Appendix H Zone E Historic Structure Survey

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Attachment 2 High Volume Air Sampling Procedures

ABBREVIATIONS AND ACRONYMS

AL	Action Levels
AHERA	Asbestos Hazard and Emergency Response Act
ALARA	As low as reasonably achievable
AOC	Area of Concern
AST	Above-ground storage tank
bgs	below ground surface
BRA	Baseline Risk Assessment
BTEX	Benzene, toluene, ethylbenzene, and xylene
CAMP	Corrective Action Management Plan
CEC	Cation Exchange Capacity
CFR	Code of Federal Regulations
CHASP	Comprehensive Health and Safety Plan
CGI	Combustible Gas Indicator
CIA	Controlled Industrial Area
CIH	Certified Industrial Hygienist
CLEAN	Comprehensive Long-term Environmental Action Navy
CMS	Corrective Measures Study
CNSY	Charleston Naval Shipyard
cpm	counts per minute
COPC	Constituents of Potential Concern
CRZ	Contamination Reduction Zone
CSI	Confirmatory Sampling Investigation
CSP	Certified Safety Professional
DAC	Derived Air Concentration
DD	Drydock
DLA	Defense Logistics Agency
DMDA	Dredged Material Disposal Area
DOD	Department of Defense
DQO	Data Quality Objectives
E/A&H	EnSafe/Allen & Hoshall
EIC	Engineer in Charge
EP	Extraction Procedure
ESD	Environmental Services Division
EZ	Exclusion Zone
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High-efficiency Particulate Air
HVAC	Heating, ventilation, and air conditioning

IDLH	Immediately Dangerous to Life and Health
LEL	Lower Explosive Limit
LLRW	Low-Level Radioactive Waste
MAPP	Methylacetylene and Propadiene Gas
MEK	2-butanone
mg/m^3	milligrams per cubic meter
mg/g	milligrams per gram
μR/hour	microRoentgens per hour
μg/swab	Micrograms per swab
μg/wipe	Micrograms per wipe
MSDS	Material Safety Data Sheets
NAVBASE	Naval Base Charleston
NIOSH	National Institute for Occupational Safety and Health
NORM	Naturally Occurring Radioactive Materials
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Health and Safety Administration
OVA	Organic Vapor Analysis
OWS	Oil/Water Separator
PCB	Polychlorinated biphenyls
PCE	Perchloroethylene
PEL	Permissible Exposure Limit
PFD	Personal Flotation Device
PHSO	Project Health and Safety Officer
PID	Photoionization detector
PM 10	Particulate matter less than 10 microns in diameter
PPE	Personal Protective Equipment
ppm	Parts per million
PRG	Preliminary Remedial Goals
QA/QC	Quality Assurance/Quality Control
RBC	Risk-based Concentrations
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RSP	Radiation Safety Program
SAA	Satellite Accumulation Area
SAR	Supplied-Air Respirator
SCBA	Self-Contained Breathing Apparatus

SCDHEC	South Carolina Department of Health and Environmental Control
SHSO	Site Health and Safety Officer
SOP/QAM	Standard Operating Procedures and Quality Assurance Manual
SOUTHDIV	Southern Division, Naval Facilities Engineering Command
SPF	Sun Protection Factor
SVOA	Semivolatile Vapor Analysis
SVOC	Semivolatile organic compounds
SWMU	Solid Waste Management Unit
SZ	Support Zone
TAL	Target Analyte List
TCE	Trichloroethene
TLV	Threshold Limit Value
TOC	Total Organic Carbon
TIC	Tentatively Identified Compound
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WWTS	Wastewater Treatment System
ZHASP	Zone-Specific Health and Safety Plan

ABBREVIATIONS AND ACRONYMS

AL	Action Levels
AHERA	Asbestos Hazard and Emergency Response Act
ALARA	As low as reasonably achievable
AOC	Area of Concern
AST	Above-ground storage tank
bgs	below ground surface
BRA	Baseline Risk Assessment
BTEX	Benzene, toluene, ethylbenzene, and xylene
CAMP	Corrective Action Management Plan
CEC	Cation Exchange Capacity
CFR	Code of Federal Regulations
CHASP	Comprehensive Health and Safety Plan
CGI	Combustible Gas Indicator
CIA	Controlled Industrial Area
CIH	Certified Industrial Hygienist
CLEAN	Comprehensive Long-term Environmental Action Navy
CMS	Corrective Measures Study
CNSY	Charleston Naval Shipyard
cpm	counts per minute
COPC	Constituents of Potential Concern
CRZ	Contamination Reduction Zone
CSI	Confirmatory Sampling Investigation
CSP	Certified Safety Professional
DAC	Derived Air Concentration
DD	Drydock
DLA	Defense Logistics Agency
DMDA	Dredged Material Disposal Area
DOD	Department of Defense
DQO	Data Quality Objectives
E/A&H	EnSafe/Allen & Hoshall
EIC	Engineer in Charge
EP	Extraction Procedure
ESD	Environmental Services Division
EZ	Exclusion Zone
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High-efficiency Particulate Air
HVAC	Heating, ventilation, and air conditioning

IDLH	Immediately Dangerous to Life and Health
LEL	Lower Explosive Limit
LLRW	Low-Level Radioactive Waste
MAPP	Methylacetylene and Propadiene Gas
MEK	2-butanone
mg/m^3	milligrams per cubic meter
mg/g	milligrams per gram
μR/hour	microRoentgens per hour
μg/swab	Micrograms per swab
μg/wipe	Micrograms per wipe
MSDS	Material Safety Data Sheets
NAVBASE	Naval Base Charleston
NIOSH	National Institute for Occupational Safety and Health
NORM	Naturally Occurring Radioactive Materials
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Health and Safety Administration
OVA	Organic Vapor Analysis
OWS	Oil/Water Separator
PCB	Polychlorinated biphenyls
PCE	Perchloroethylene
PEL	Permissible Exposure Limit
PFD	Personal Flotation Device
PHSO	Project Health and Safety Officer
PID	Photoionization detector
PM 10	Particulate matter less than 10 microns in diameter
PPE	Personal Protective Equipment
ppm	Parts per million
PRG	Preliminary Remedial Goals
QA/QC	Quality Assurance/Quality Control
RBC	Risk-based Concentrations
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RSP	Radiation Safety Program
SAA	Satellite Accumulation Area
SAR	Supplied-Air Respirator
SCBA	Self-Contained Breathing Apparatus

SCDHEC	South Carolina Department of Health and Environmental Control
SHSO	Site Health and Safety Officer
SOP/QAM	Standard Operating Procedures and Quality Assurance Manual
SOUTHDIV	Southern Division, Naval Facilities Engineering Command
SPF	Sun Protection Factor
SVOA	Semivolatile Vapor Analysis
SVOC	Semivolatile organic compounds
SWMU	Solid Waste Management Unit
SZ	Support Zone
TAL	Target Analyte List
TCE	Trichloroethene
TLV	Threshold Limit Value
TOC	Total Organic Carbon
TIC	Tentatively Identified Compound
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WWTS	Wastewater Treatment System
ZHASP	Zone-Specific Health and Safety Plan

1.0 INTRODUCTION

As part of the U.S. Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program, the following Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan has been prepared for Zone E at Naval Base Charleston (NAVBASE). This work plan addresses sampling and analysis requirements specific to sites within Zone E and is intended to be used in conjunction with the *Final Comprehensive RFI Work Plan* prepared for NAVBASE. The Solid Waste Management Units (SWMU) and Areas of Concern (AOC) to be investigated within Zone E are presented in Appendix A and in Figure 1-1, which illustrates the location of each.

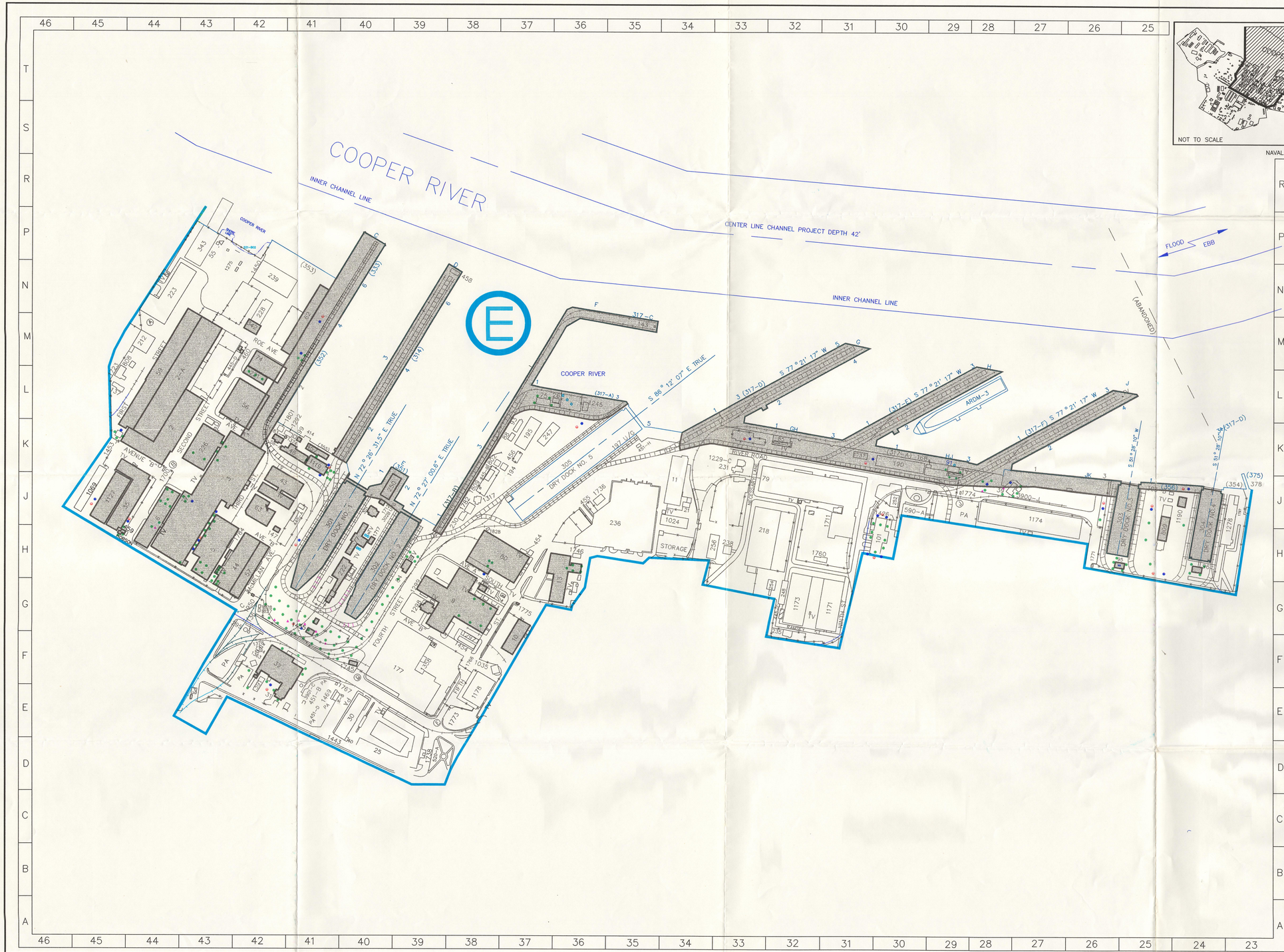
1.1 Environmental Setting

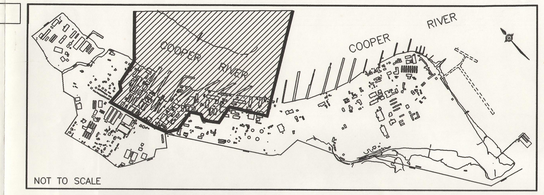
Physiography

Zone E is in the west-central portion of NAVBASE and includes the Controlled Industrial Area (CIA), the base power plant, and the buildings between Hobson and Carolina avenues. Zone E is bound to the north by the Cooper River, to the south by the CIA perimeter and Carolina Avenue, and to the east and west by the CIA fence along Thirteenth Street and Everglades Drive, respectively. Figure 1-2 identifies the Zone E boundary in relation to NAVBASE boundaries and the remaining investigative zones.

Geologic and Hydrogeologic Information

The local and regional geologic/hydrogeologic characteristics are described in Volume II, Sections 1.2 through 1.5 of the *Final Comprehensive RFI Work Plan*. NAVBASE, like most of the Charleston peninsula bordering the Ashley, Cooper and Wando rivers, was low-lying marsh when the base was established in the early 1900s. Portions of the northern end and almost the entire southern end of the base were filled with a wide variety of known and unknown materials to make the property suitable for development. The majority of the filling activity took place during 1930s and 1940s. Figure 1-3 indicates the extent of modern fill activities.





NAVAL BASE CHARLESTON FACILITY LOCATION MAP

LEGEND

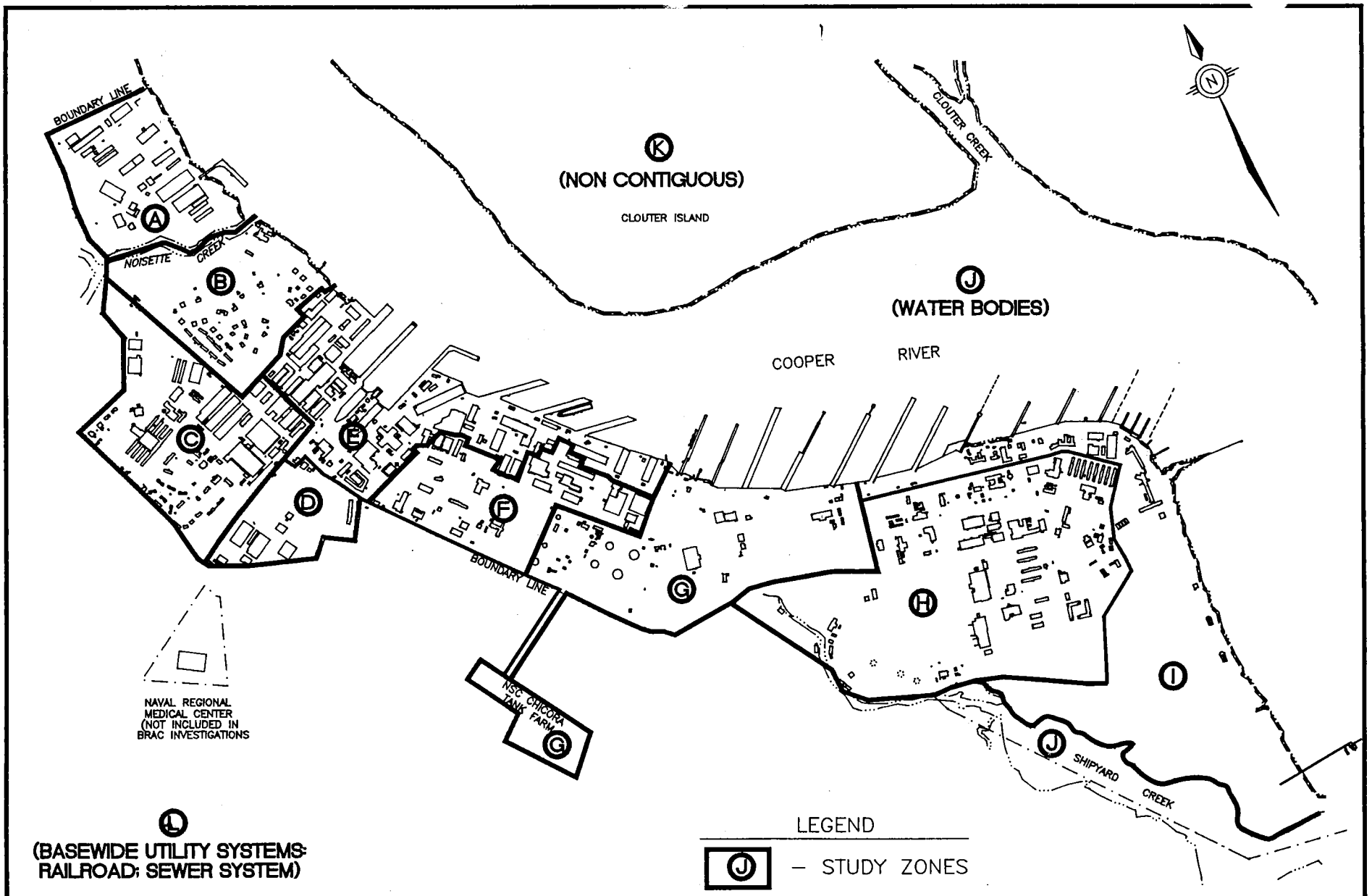
- E – RCRA INVESTIGATION ZONES
- HISTORICAL STRUCTURES
- PROPOSED SOIL BORINGS
- PROPOSED CORE SAMPLES
- PROPOSED DEEP MONITORING WELLS
- PROPOSED SHALLOW MONITORING WELLS
- PROPOSED SEDIMENT SAMPLES

200 0 200 400 600
GRAPHIC SCALE

FINAL RCRA FACILITY INVESTIGATION
ZONE E
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE I-1
ZONE E
HISTORIC STRUCTURE
SAMPLE LOCATION MAP

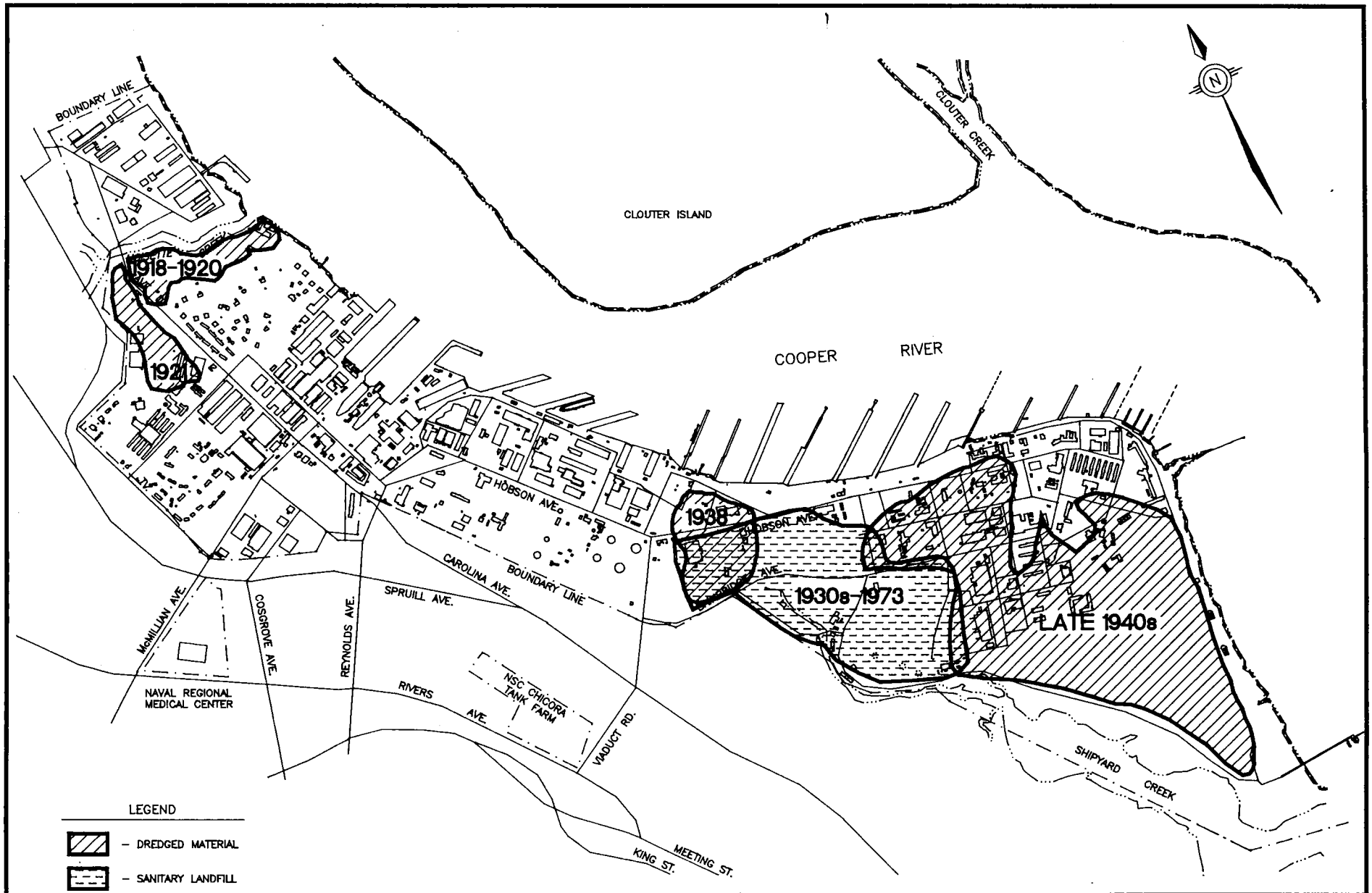
Dr by: J.MAYFIELD	Tr by: J.MAYFIELD	
Ck by: G.TEMPLE	App by: D.BACKUS	Sheet 1
Date: 7/5/95	DWG Name: PRESBASE	Of 1



FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1-2
BASE WIDE
ZONE BOUNDARIES

DWG DATE: 06/01/95 | DWG NAME: 29ZONE1



LEGEND

- DREDGED MATERIAL
- SANITARY LANDFILL

SOURCES: SOUTHDIV, n.d. ESE, 1981.

2000 0 2000

SCALE FEET

FINAL
ZONE E WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1-3
AREAS FILLED AND
APPROXIMATE DATES
OF FILLING OPERATIONS

DWG DATE: 06/01/95 | DWG NAME: 29FILCH2

Groundwater flow and hydrology are dependent upon basewide conditions, but are likely to be artificially influenced within the boundaries of Zone E due to the number of pile supported structures, sheet piling, drydocks, etc. For purposes of this document, groundwater is suspected to flow toward the Cooper River within Zone E. Sampling strategies in Section 2 of the plan were developed assuming a northeastern direction of groundwater flow toward the river. Due to the number of subsurface obstructions, site-specific groundwater flow direction may vary greatly. In fact, static flow conditions may be encountered near the waterfront due to concrete sheet piling associated with the quaywall structures along the border of Zone E and the Cooper River. Information gathered in this investigation will contribute to groundwater characterization of individual sites within Zone E, and will attempt to build a conceptual model of groundwater processes zone-wide.

Climatology

The climatological setting of NAVBASE is described in Volume II, Section 1.6 of the *Final Comprehensive RFI Work Plan*.

1.2 Investigative Strategy

The proposed investigative approach for each site was developed in accordance with the overall investigative strategy presented in Section 2, Volume I, *Final Comprehensive RFI Work Plan*, emphasizing a *Fast-Track Clean up* Program.

Central to this idea is a phased approach to data collection that will ultimately identify constituents of potential concern (COPCs) (if present), define the nature and extent of any contamination, and provide data collection for a corrective measures study (CMS). To meet these objectives, sampling methods and locations discussed in this work plan are designed to be as complete as possible.

If the proposed sampling efforts do not achieve this goal, collection will continue until sufficient data are obtained. In order to determine the need for additional sampling not specified in this work plan, data collected under this plan will be evaluated regarding potential human health impacts expressed as preliminary remedial goals (PRGs), ecological risk, and technical requirements for a CMS. For some chemicals, additional information regarding background concentrations will be required, necessitating onsite and offsite data collection. Background, migration pathways, human and ecological receptors, and PRGs are discussed in Section 1, Volume III of the *Final Comprehensive RFI Work Plan*. Sampling will continue until the extent of any contamination is determined, which is defined herein as the horizontal and vertical area in which concentrations of COPCs in the investigated media are above either PRGs or background concentrations, whichever is appropriate. Methods for calculating background in organics and inorganics will be handled outside of the Zone E Work Plan. Background determination is discussed further in the Baseline Risk Assessment Work Plan.

The zone-specific work plans outline the data collection process for each SWMU and AOC in the particular zones. The *Final Comprehensive RFI Work Plan* discusses how these data will be used to fulfill the investigation goals. An RFI Report and Baseline Risk Assessment (BRA) will be generated when each zone investigation concludes, and a final RFI Report and final BRA will address NAVBASE as a single entity once all zone investigations are completed.

The proposed schedule for conducting the Zone E investigation is included in the *Corrective Action Management Plan* (CAMP) prepared for the NAVBASE RFI. Activity scheduling during the Zone E investigation will be closely coordinated with United States Environmental Protection Agency (USEPA) Region IV and South Carolina Department of Health and Environmental Control (SCDHEC).

1.3 Other Relevant Investigations

Because the Zone E investigation is part of a larger investigative strategy, some pathways included for investigation in Volume III of the *Final Comprehensive RFI Work Plan* that may be relevant to Zone E will be considered in other zone investigations. For example, the Zone J investigation will address potential impacts to surface water bodies and sediment. The Zone L investigation will address the railroad and sewer systems, and other underground conduits.

The CIA of the Charleston Naval Shipyard (CNSY) comprises the majority of Zone E. The CIA is an extensive industrial complex containing virtually all shipyard and dockside operations required to manufacture, repair, overhaul, and refuel naval vessels. As a result, a wide variety of types of hazardous wastes have been generated over the life of the shipyard, which spans approximately 93 years. Because of the extremely dense population of SWMUs and AOCs within Zone E, it is unlikely that any areas within Zone E will be designated as representing background. Due to the high number of potential point sources close to one another and the shallow depth to groundwater, contribution of contaminants may not be site-attributable.

2.0 SITE INVESTIGATION PLANS

2.1 SWMU and AOC-Specific Investigatory Approach

The SWMUs and AOCs in Zone E requiring either Confirmatory Sampling Investigation (CSI) or RFI activities, as determined in the *Draft Final RCRA Facility Assessment (RFA)*, November 22, 1994, are presented in the following sections. Each site or group of sites to be investigated is summarized (including site history and previous investigations), followed by data gaps, and investigation objectives. The last discussion is the specific investigation approach including the specific sample locations and rationale.

Due to the industrial nature of Zone E, most of the RFI sites are traversed by many different types of subsurface utilities. These utilities include but are not limited to; fresh water, salt water, steam, sanitary sewer, storm sewer, electric, natural gas, methylacetylene and propadiene (MAPP) gas, oxygen, and high-pressure air. Additionally, coastal construction techniques for industrial facilities and heavy load-bearing cranes and rail systems require extensive pile support structures. Research has indicated that virtually no area within Zone E is free of subsurface utilities or pile supports. Utility and piling densities increase near the waterfront and drydock areas. Most of the pilings extend 15 to 20 feet into the Cooper Marl formation beneath Zone E. The Public Works Engineering Department has stressed that the utility maps are highly subjective and only approximate the subsurface utility locations. Very few, if any, utility lines were surveyed upon installation, repair, or modification.

Considerable research dedicated to locating subsurface utilities and piling supports has gone into this work plan. The problems associated with subsurface obstructions predominantly relate to the health and safety of field personnel, but may also alter the proposed location of subsurface sampling points. Proposed subsurface sampling locations shown in this work plan have been chosen based on a number of factors including: the suspected direction of groundwater and surface water flow, proximity to the investigated unit, suspected location of subsurface utilities, piling support, and above-ground improvements such as buildings, facilities, railways and portal

crane rails. Additionally, a visual site inspection was performed on all sites to insure that sampling locations would not interfere with ongoing shipyard or future user operations.

Due to the limited accuracy of the available subsurface information, subsurface sample locations shown in this work plan should be considered preliminary. Actual locations must be determined by field conditions. For purposes of this work plan, sample locations will be defined as a 20-foot radius surrounding any point. If a boring or monitoring well is abandoned due to a subsurface obstruction, the field sampling crew will attempt to relocate the sampling point within a 20-foot radius of the original point. If a suitable point cannot be found within a 20 foot radius, the closest point will be determined and the field crew will notify USEPA and SCDHEC to discuss alternate sampling strategy before continuing. Every attempt will be made to keep spatial relationship and distribution of sampling points to investigation sites consistent with those proposed in the work plan. If a sampling point must be moved due to field conditions, the new location will be noted in the field log book and the installed sample locations will be recorded and sent to USEPA and SCDHEC in the status report as required by Permit Condition II.E.3.a.iii.

A subcontractor specializing in utility/location techniques will be employed to assist the field teams in clearing locations for subsurface sampling points. Additionally, a coring subcontractor will be hired to core the asphalt or concrete surface before drilling or hand-augering activities begin. All subsurface borings will be advanced with a posthole digger or hand auger to a depth of 5 feet below ground surface (bgs) to ensure that the drill rig will not encounter a subsurface utility or piling. If a subsurface obstruction is encountered, the boring will be terminated. When a boring is abandoned, the borehole will be pressure-grouted to the soil/asphalt or concrete interface, and the asphalt or concrete plug will be cemented back in place flush with the existing surface grade.

The State Historic Preservation Office (SHPO) has designated 69 facilities as historic structures within the area comprising Zone E. Twenty five of those facilities are associated with sampling locations proposed in this plan. An inventory of the Zone E historic structures is included in Appendix H. Figure I-1 shows the locations of the historic structures within Zone E.

The sites identified in this work plan may not represent all hazardous waste activity that has occurred in Zone E. As a result, a systematic supplemental sampling plan (outlined in Section 3) is designed to identify any sites not found in the RFA process and to provide additional data representative of environmental media conditions within Zone E. The Zone E investigation will be based upon the strategy outlined in the *Final Comprehensive RFI Project Management Plan*.

Table A.1 (Appendix A) is a reference listing the location of each site within Zone E, proximity to existing structures, as well as the selected investigative approach for each site whether it is a CSI or RFI.

2.1.1 Treatment Alternatives

As outlined in the overall sampling strategy in the *Final Comprehensive RFI Work Plan*, treatment alternatives are being identified for each site likely to require remediation. Data collection efforts will support evaluating these alternatives. Table B.1 in Appendix B lists treatment alternatives for groundwater and surface water runoff; Table B.2 lists treatment alternatives for soil; and Table B.3 lists treatment alternatives for soil gas. In the case of sites requiring a CSI, it would be premature to identify treatment alternatives due to the fact that COPCs have not been identified.

2.1.2 Migration Pathways

The migration pathways identified for each site in this work plan are, at a minimum, consistent with the RFA write-ups in the *Draft-Final RCRA Facility Assessment, August 1987* and the

Draft-Final RCRA Facility Assessment, Volumes I — IV, November 22, 1994. Additional pathways have been added to some of the sites based on information more current than the appropriate RFA. Conversely, pathways have been deleted from some sites based on additional information and will be justified in the site-specific sections where applicable. Pathways scheduled for sampling will be shown in bold type in each site-specific description table.

2.1.3 Potential Receptors

Zone E is unique to NAVBASE in that the majority of the zone is a highly secured area surrounded by a perimeter fence. Zone E has a high density of SWMUs and AOCs in a relatively small area, which for the last 50 years has been almost completely covered with asphalt, buildings, and concrete surfaces. Potential receptors that may be exposed to site contaminants include current building users, such as NAVBASE personnel, and any future users this area may support following base closure. Data will be generated during the investigation to determine the level of risk to the spectrum of current and potential future receptors, including any highly sensitive individuals within the population who may be exposed through invasive or non-invasive activities. The risk evaluation will also consider any ecological receptors which may be present. Sampling will include characterizing all potential pathways of exposure at this site, including those in bold type in the site description table of each site-specific plan.

The subsurface utility distribution system (including storm and sanitary sewers) in this area has acted as a conduit for moving any product or waste released within Zone E, and thus could expose those working on any of these subsurface systems, as well as providing a contaminant route to the Cooper River, which borders Zone E along its northeastern side. The subsurface utility system and Cooper River will be addressed in greater detail by the Zone L and Zone J Work Plans, respectively. The Cooper River could receive contaminated sediment, surface water runoff, and groundwater discharges, thus exposing biological receptors other than humans.

2.1.4 Screening Alternatives

No sampling has been conducted yet to determine COPCs except for SWMUs 21 and 25; therefore, selecting screening alternatives would be premature. If the proposed collection of high-quality samples is inadequate to define the nature and extent of contamination (if present), the feasibility of using screening methods will be re-evaluated. Soil gas is a potential migration pathway at many sites; however, quantitative analyses for contaminants in soil gas are not proposed herein. Instead, qualitative screening as part of the routine health and safety monitoring and soil sampling protocols will be conducted. While drilling all soil borings and monitoring wells in Zone E, boreholes and samples will be screened for volatile organic compounds (VOCs) using a flame ionization detector (FID) or photoionization detector (PID). All screening results will be recorded in field logbooks and boring logs.

2.1.5 Radiological Potential

The Charleston Naval Shipyard (CNSY) Radiological Control Office has determined there are a number of sites within Zone E that have a low potential for radioactivity. CNSY will perform detailed radiological surveys at these locations and document that radioactive materials have been removed. This process may be independently verified by the EPA and the State. These surveys are described in separate work plans and reports.

Contractor sampling at any point within Zone E shall not proceed until applicable Navy radiological verification surveys have been completed at the sampling point. As sampling is scheduled, and prior to sampling at any point in Zone E, contact the CNSY General Survey Project Superintendent to determine if the verification surveys have been completed. Once the completion of surveys has been verified, no gamma screening will be required for samples taken in the verified areas.

CNSY will support E/A&H sampling schedule by adjusting survey schedules with reasonable advance notification.

2.2 SWMU 5, Battery Electrolyte Treatment Area, Pad 1278; SWMU 18, PCB Spill Area; and AOC 605, Waste Paint Storage Area

SWMU 5 is a former battery electrolyte treatment area adjacent to Drydock (DD) 4. SWMU 18 is a polychlorinated biphenyl (PCB) spill that occurred at the Public Works Resource Recovery Facility Storage Area. AOC 605 is a waste paint storage area adjacent to DD 4 on Pad 1278. Because of the proximity of these sites, they will be grouped for investigative purposes in the work plan investigation purposes. Table 2.1 describes the site, which has been designated for an RFI.

Table 2.1
SWMU 5 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[3]
SWMU 5 Former Battery Electrolyte Treatment Area	This site is a former battery electrolyte treatment area adjacent to DD 4. This site operated from 1962 until 1985. Associated with battery salvaging, restoring, and recharging operations, this site was used to neutralize submarine battery acid. It consisted of a battery disassembly platform, two neutralization Underground Storage Tanks (USTs) and customized transporting railcars.[1]	Solvents Lead/Acid Batteries (VOCs, Semivolatile organic compounds [SVOCs], Metals, pH)[4]	Air **Soil** Soil Gas **Groundwater**
SWMU 18 PCB Spill Area	This site consists of a 20' x 20' PCB spill area at the Public Works Resource Recovery Facility Storage Area. The spill occurred on June 12, 1987, as a contractor was loading a group of PCB items, of which a transformer broke and discharged Pyranol insulating fluid. The transformer was placed in a drip pan, but the liquid overflowed onto the unprotected ground. Approximately 75 gallons of Pyranol fluid was spilled onto the ground. Three soil excavation episodes were conducted to clean up the site.[1]	Pyranol Insulating Fluid (PCBs)[4]	**Soil** **Groundwater**
AOC 605 Waste Paint Storage Area	This site consists of waste paint storage area adjacent to DD 4 on Pad 1278. The 40' x 250' concrete pad was constructed in 1943 as a welding area. Since 1987, the pad has been used to store materials such as paints, used oils, solvents, and chemicals. The pad is bordered to the south and west by unpaved areas.[2]	Acids Paints Solvents Petroleum Hydrocarbons Metals (Lead) (VOCs, SVOCs, pH)[4]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the RCRA Facility Assessment, August 1987
[2] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[3] Pathways scheduled for sampling are bold.
[4] Analyte groups associated with materials generated or stored.

2.2.1 Previous Investigations

SWMU 5 and AOC 605 have not been investigated previously. However, at SWMU 18 all areas of the 20' x 20' spill site were sampled. A 13-point grid system was used during the cleanup process. Soil samples were taken following three soil excavations. According to facility personnel, based on analytical results no additional excavation was required as reported in the *Final Report RCRA Facility Investigation (RFI) — Charleston Naval Base (Kemron, 1991).*

2.2.2 Data Gaps

Currently, limited environmental media data have been collected to characterize SWMU 5 and AOC 605 or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The nature and extent of impact to the environmental media have not been determined.
- No data exist to support a detailed evaluation of treatment alternatives where necessary.
- Determine whether contamination is still present from spill at SWMU 18.

2.2.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present at SWMU 5 and AOC 605 for the identified migration pathways and to determine whether the contamination at SWMU 18 is still present. In order to fill in data gaps, soil, soil-gas, and groundwater samples will be collected onsite. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.2.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. The sampling strategy is intended to assess the entire area possibly impacted by SWMU 5, SWMU 18, and AOC 605. Figure 2-01 presents soil boring and monitoring well locations for this site and Table 2.2 summarizes the types of samples and analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

Soil boring and monitoring well locations proposed for this site will be shared between AOC 605 and each SWMU due to their proximity. Sample locations along the eastern perimeter of AOC 605 will serve as sample locations for the western perimeters of SWMU 5 and SWMU 18.

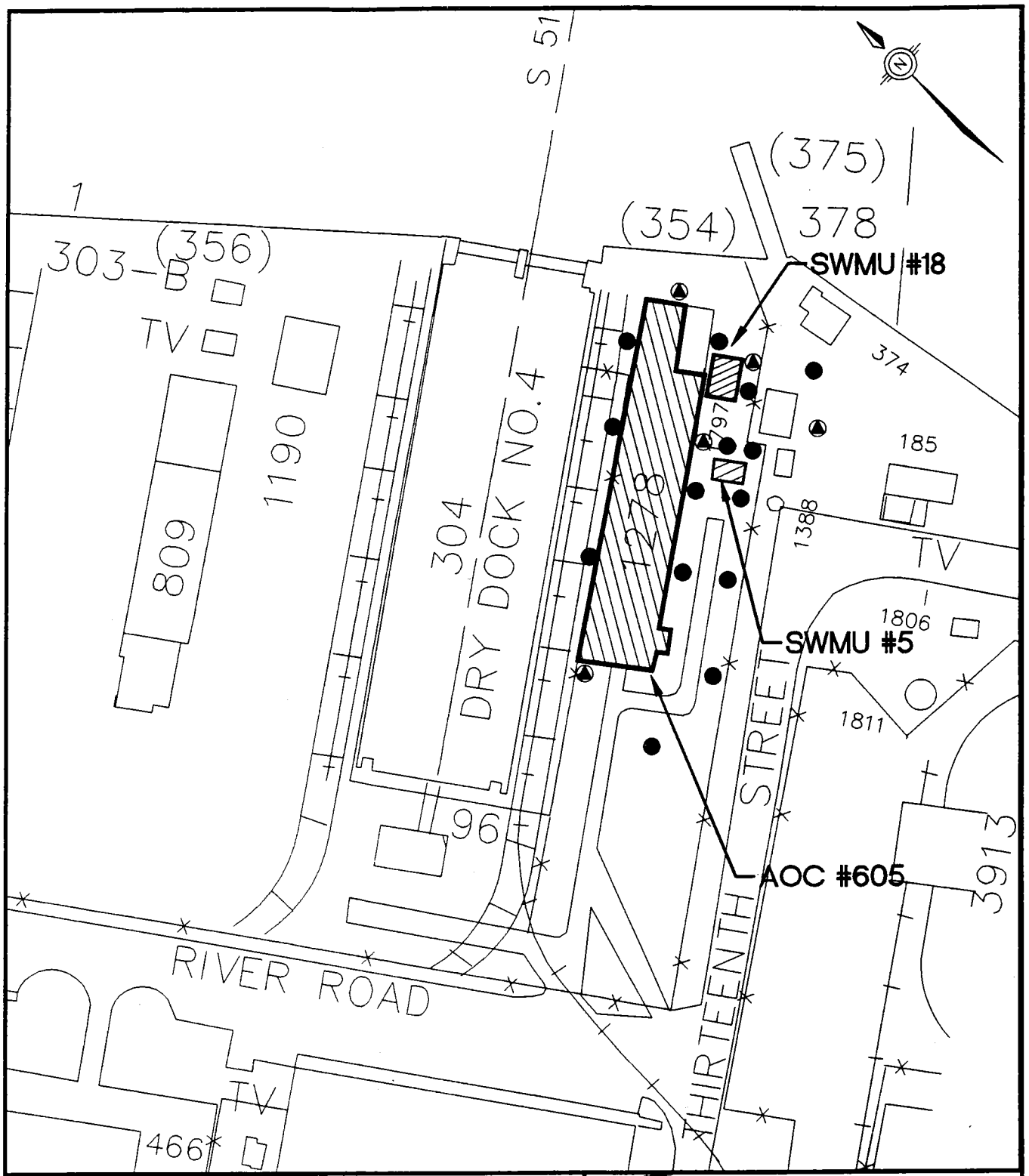
The proposed subsurface sample locations illustrated on Figure 2-01 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Table 2.2
SWMU 5, SWMU 18, and AOC 605
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3-5' bgs) Groundwater (shallow wells)	14 14 5	Volatile Organic Analysis (VOAs) and Semivolatile Organic Analysis (SVOAs) w/Tentatively Identified Compounds (TICs), Metals (including organotins), cyanide, pesticides, and PCBs

Engineering Parameters:
Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, total organic carbon (TOC), and cation exchange capacity (CEC).

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.
All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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FIGURE 2-01
SWMU #5
SWMU 18
AOC #605, PAD 1278
WASTE PAINT STORAGE AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE01

2.3 SWMU 21, Old Paint Storage Area; and SWMU 54, Former Abrasive Blasting Area

SWMUs 21 and 54 are at the northern end of Zone E and are directly adjacent to the Cooper River. These sites have been grouped for investigative purposes because SWMU 21 appears to be completely encompassed within SWMU 54. Table 2.3 describes the sites,which have been designated for an RFI.

Table 2.3
SWMU 21 and SWMU 54
Site Descriptions

Number	Description	Materials Generated or Stored	Potential Pathways[3]
SWMU 21 **Old Paint Storage Area**	This area consists of a 20′ x 180′ concrete pad formerly used for the storage of containerized paint waste generated by ship repair and overhaul operations.[1]	Paint Waste Solvents (VOCs, SVOCs, Metals)[4]	Air **Soil** Soil Gas **Groundwater** **Sediment** Surface Water
SWMU 54 **Former Abrasive Blasting Area**	Area south of Building 223 formerly used for the abrasive blasting of ship components and hull sections. Additionally, ship components and anchor chains were painted in this area. Spent blast grit still remains on the ground.[2]	Paint Waste Solvents Abrasive Blast Media (VOCs, SVOCs, Metals)[4]	Air **Soil** Soil Gas **Groundwater** **Sediment** Surface Water

Notes:
[1] Described in the RCRA Facility Assessment August, 1987
[2] Described in the Draft-Final RCRA Facility Assessment Volume I, November 22, 1994
[3] Pathways scheduled for sampling are bold.
[4] Analyte groups associated with materials generated or stored.

2.3.1 Previous Investigations

SWMU 21 has been the subject of two previous investigative efforts. The first sampling event was a limited-scale effort with the goal of obtaining RCRA closure. During this sampling event, spent blast media and paint chips were analyzed for Extraction Procedure (EP) Toxicity Characteristic. The second sampling event occurred in the fall of 1993 as a prelude to the RFI field activities now being conducted. Samples collected at SWMU 21 also included portions of the area now identified as SWMU 54. The media sampled included soil, groundwater, and

sediment. Samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), and the Target Analyte List (TAL) of inorganics using SW-846 methodologies at Data Quality Objective (DQO) Level III with duplicates collected at a frequency of 10 percent and analyzed at DQO Level IV. The sampling adhered to methods outlined in the USEPA Region IV Environmental Services Division (ESD) *Standard Operating Procedures/Quality Assurance Manual* (SOP/QAM). Table 2.4 summarizes these investigations and the compound groups for which constituents were detected. As outlined in the sampling strategy presented in the *Final Comprehensive RFI Work Plan*, these constituents were compared to the USEPA Region III Risk Based Concentrations (RBCs) to identify the COPCs for the human health assessment. The COPCs identified by the current data set includes benzo(a)pyrene, benzo(b)fluoranthene (both of which are SVOCs), and lead. Sample locations where constituents were detected at concentrations above their respective RBCs include soil borings S21-B01 through S21-B06, and S21-B09. One COPC was detected at sediment sampling location S21-S01 and will be addressed in the Zone J RFI. VOCs were detected in monitoring well CNSY-21-02 at concentrations below the RBC values. Figure 2-02a illustrates previous sampling locations for SWMU 21. It should be noted that monitoring well locations CNSY-21-01 through CNSY-21-03 correspond to soil boring locations S21-B01 through S21-B03 on the figure. Well construction logs for the three monitoring wells installed are included in Appendix D.

Table 2.4
SWMU 21 and SWMU 54
Previous Investigations

Number	Previous Investigations	Contaminants Identified
SWMU 21	Field Investigation for Interim Status Unit RCRA Closure, 1988; Preliminary RFI Field Activities, 1993.[1]	VOCs, SVOCs, and inorganics
SWMU 54	None specifically for SWMU 54. The sampling described above, however, also pertains to this site.	VOCs, SVOCs, and inorganics

Note:
[1] See Tables in Appendix C for analytical results.

2.3.2 Data Gaps

A review of the information available from previous investigations and assessments indicates data are insufficient to fully characterize the site(s) and support a BRA, and a detailed evaluation of remedial alternatives where necessary. The data gaps are as follows:

- Previous sampling events did not analyze for the presence of organotins reported to have been present in the paint waste present at these sites.

- The extent of SVOCs and inorganics identified at concentrations exceeding the RBC values has not been fully determined.

- The data available are insufficient to adequately determine whether the organic constituents identified in monitoring well CNSY-21-02 are present in greater concentrations immediately upgradient or downgradient of the well.

- Groundwater flows toward the Cooper River. A well hydraulically downgradient of the sites is needed to determine if contaminated groundwater is potentially being discharged to the Cooper River.

- The thickness of the spent abrasive blast media over the areal extent of the site has yet to be determined so that the volume of material present can be calculated.

2.3.3 Objectives

The objectives of the proposed field investigation are to delineate the horizontal and vertical extent of the constituents detected during the initial round of sampling that exceeded the USEPA Region III RBCs. The sampling efforts will also determine whether organotins are present, and, if so, are they present at concentrations warranting inclusion on the COPC list. Additional monitoring wells will be installed to determine if the groundwater impacts extend

beyond the immediate vicinity of monitoring well CNSY-21-02 and ascertain whether contaminated groundwater discharges into the Cooper River. The volume of spent abrasive blast media, suspected to be the source of the elevated lead concentrations, will be determined to facilitate evaluating remedial alternatives. Ultimately, all data will be collected with the intent of supporting the BRA and the technical evaluation of treatment alternatives.

2.3.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. The types of samples required will include soil, sediment, and groundwater. Other media that were considered for evaluation were soil gas, ambient air, and surface water. Quantitative analyses for contaminants in soil gas and ambient air will not be performed; however, qualitative screening as part of the routine health and safety monitoring and soil sampling protocols will be conducted. The potential for surface water impacts will be further evaluated if the additional groundwater data to be collected indicate a high probability that contaminated groundwater is being discharged to the Cooper River. The rationale for selecting the type, location, and number of sample points is described below. This determination will be made after review of the groundwater data from points between the SWMU and the Cooper River. If it is determined that surface water or sediments are being impacted as a result of contaminant migration from SWMU 54, further assessment will be conducted in the Zone J investigation.

As discussed in the previous investigations section, COPCs were detected at multiple soil boring locations. To aid in delineating these COPCs, additional soil borings are proposed in the immediate vicinity of the impacted areas. In the area of SWMU 21 and 54, a 10 foot by 10 foot grid will be established across the site to facilitate grid-based sampling. Alternating grid nodes along each grid axis were selected as biased sampling locations. The proposed sampling pattern should adequately delineate COPCs to support the evaluation of remedial alternatives and the BRA. Five additional sampling points were arbitrarily selected in outlying areas (but still

within the boundary of the spent blast material) to help ensure that a representative cross section of the area covered with spent blast media is evaluated.

Twenty-seven soil borings are proposed with the sole purpose of defining the thickness of blast media across the site so that a volume of waste material present can be calculated. Borings will be advanced using a hand auger until the native material beneath the blast media is encountered and then the thickness of the blast media will be measured. The hand auger will not be decontaminated between locations since samples will not be collected for chemical analysis.

Four additional sediment samples will be collected from the Cooper River to help determine if runoff from the site may be contributing to ecological impacts. This information is a necessary part of the point source evaluation to be performed in conjunction with the comprehensive ecological assessment being developed under Zone J. Sediment quality is of particular concern because of the possible presence of organotin compounds, which can be extremely toxic to aquatic organisms.

Two additional monitoring wells are proposed to be installed to fill the data gap identified in Section 2.3.2. The proposed monitoring well locations were based on groundwater elevation data and chemical data obtained from the monitoring wells installed during the preliminary round of RFI field work in the fall of 1993. The focus of the current investigation will be in the vicinity of CNSY-21-02 due to the organic constituents detected there. The well proposed to be installed to the west of CNSY-21-02 is hydraulically upgradient and the well proposed east of CNSY-21-02 is hydraulically downgradient. The upgradient well will help identify the source area for the compounds found in CNSY-21-02 while the downgradient well will help determine if the compounds have migrated from the sites.

Table 2.5 summarizes the types of samples and analytical parameters. Each proposed sample location is illustrated on Figure 2-02. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

Table 2.5
SWMU 21 and SWMU 54
Sampling Plan

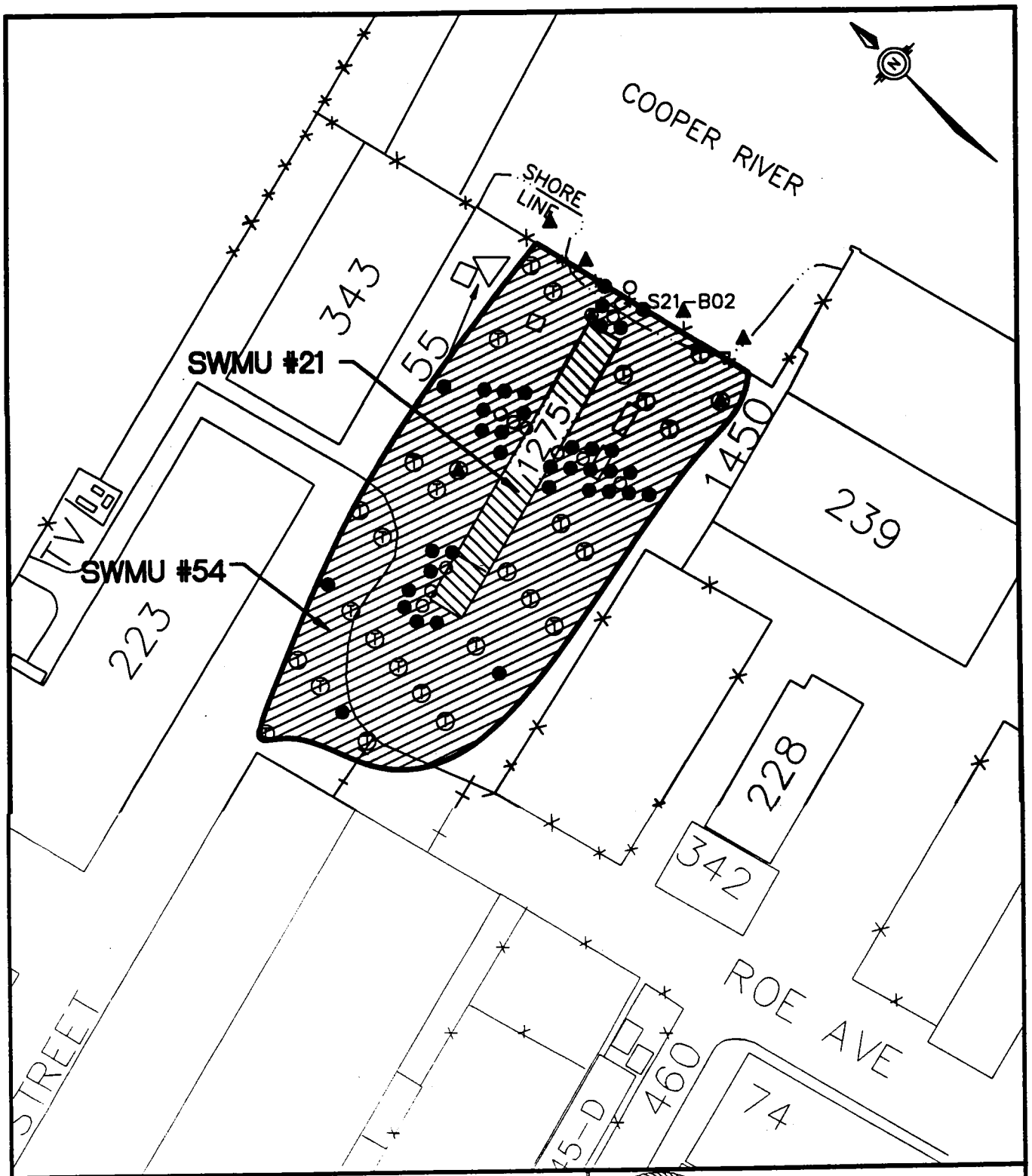
Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3-5' bgs)	37 37	Soil and sediment — SVOAs, and metals including organotins.
Sediment	4	Groundwater — VOAs, SVOAs, and metals including organotins
Soil Profile	25	
Groundwater (shallow well proposed)	3	
Groundwater (shallow well existing)	3	

Engineering Parameters:
Slug tests will be performed on at least one well. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis for any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution (if contamination is present) is developed.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis will be performed per SW-846 except where other methods are specified. DQO Level II analyses will be used as specified in sampling plan. A minimum of 10% duplicates will be analyzed at DQO Level IV for the parameters listed. The sample quantity presented does not include QA/QC samples.



LEGEND

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- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
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- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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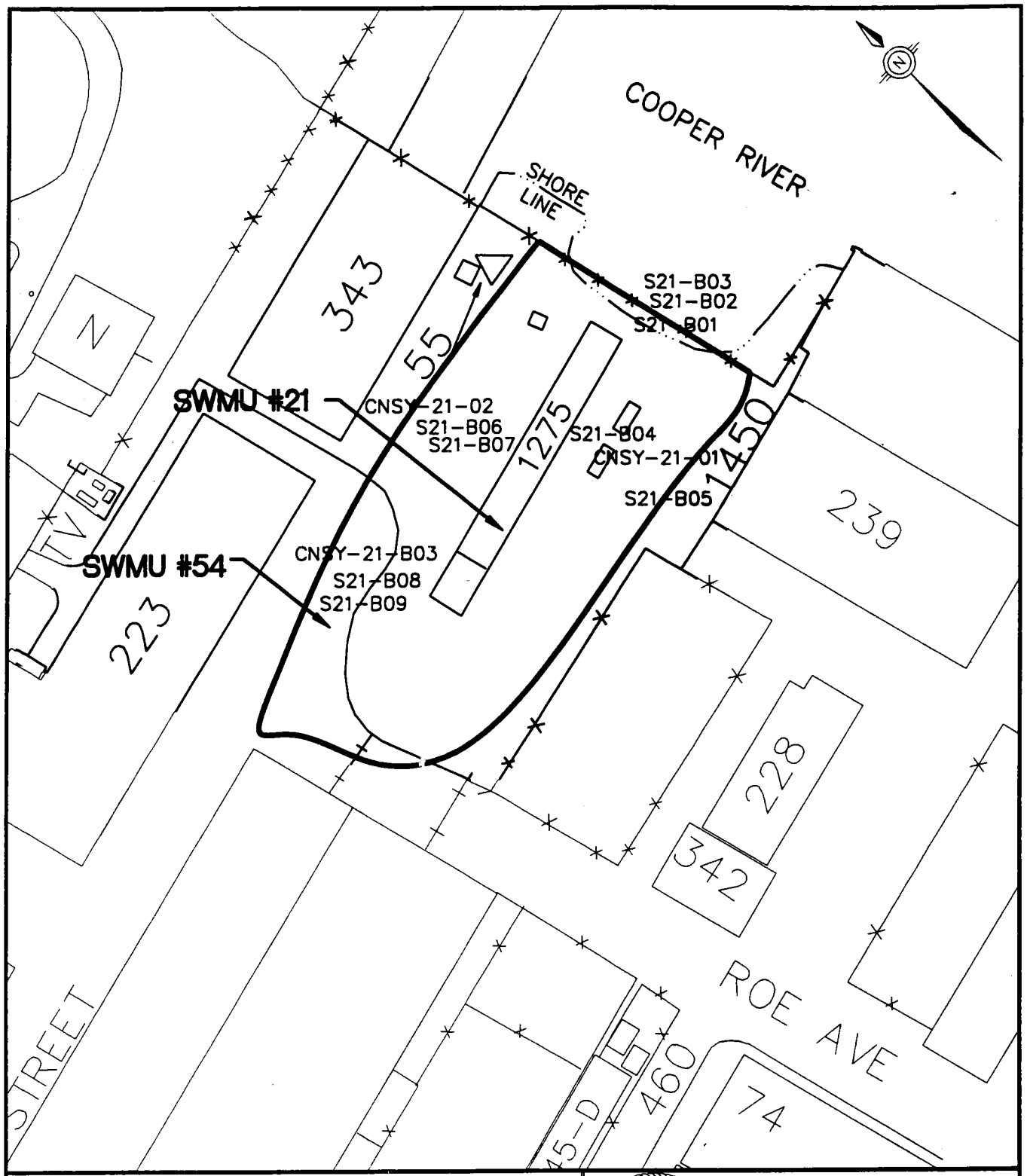
CHARLESTON, S.C.

FIGURE 2-02
SWMU #21
SWMU #54
ABRASIVE BLAST AREA

DWG DATE: 6/2/95 | DWG NAME: FIGUR02



LEGEND

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- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-02A
SWMU #21
SWMU #54
EXISTING MONITOR WELL LOCATIONS

DWG DATE: 6/2/95 | DWG NAME: FIGUR02A

2.4 SWMU 22, Old Plating Shop Wastewater Treatment System (WWTS); SWMU 25, Building 44, Old Plating Operation; and AOC 554, Paint Shop, Former Building 1003

SWMUs 22 and 25 and AOC 554 are northwest of the intersection of McMillan and Hobson Avenues in Zone E. These sites have been grouped for investigative purposes based on their proximity and the similarity in materials likely to be present. SWMUs 22 and 25 have been designated for an RFI and AOC 554 has been designated for a CSI. Table 2.6 describes the sites, which have been designated for an RFI.

Table 2.6
SWMUs 22 and 25 and AOC 554
Site Descriptions

Number	Description	Materials Generated or Stored	Potential Pathways[3]
SWMU 22 **Old Plating Shop WWTS**	The WWTS consisted primarily of a 5'x5'x8' concrete collection sump partioned in half. One side accumulated acidic wastewater while the other side collected cyanide and alkaline wastewater. Treated effluent was discharged to the sanitary sewer. Other components included an elevated 1000-gallon clarifier, four mixing tanks (2-70 gal. and 2-250 gal.), chemical feed equipment, and associated piping.[1]	Chromic Acid Cadmium Copper Chromium Lead Nickel Silver (Metals, pH)[4]	**Groundwater** **Soil** **Air** Soil Gas
SWMU 25 **Building 44, Old Plating Operation**	The southwestern portion of Building 44 housed an electroplating operation that was operational until 1983. The facility contained approximately 40 metal tanks that contained the solutions used in the plating process. The concrete floor shows signs of deterioration. The process tanks were removed in 1992.[2]	Silver Cadmium Chromium Nickel Mercury Lead Cyanide Barium (Metals)[4]	**Soil** **Groundwater** **Air** Soil Gas
AOC 554 **Paint Shop, Former Building 1003**	AOC 554 is the former Building 1003 location. Building 1003 was used as a paint shop from approximately 1909 to 1940. No additional information regarding size, design features, or operating practices is known concerning this unit.[2]	Waste Paint Paint Thinner Solvents Heavy Metals (VOCs, SVOCs, (Metals)[4]	**Soil** **Groundwater** **Air** Soil Gas Surface Runoff

Notes:
[1] Described in the RCRA Facility Assessment, August 1987
[2] Described in the Draft-Final RCRA Facility Assessment Volume II , November 22, 1994
[3] Pathways scheduled for sampling are bold.
[4] Analyte groups associated with materials generated or stored.

2.4.1 Previous Investigations

SWMUs 22 and 25 have been the subject of previous assessments in conjunction with RCRA closure activities and some preliminary RFI field work conducted in the fall of 1993. The media sampled included soil, groundwater, waste material, and equipment.

The initial assessment performed at SWMU 22 in 1988 consisted of sampling soil immediately below the concrete surface at 16 locations. The samples were analyzed for pH, cadmium, and chromium. In comparison to the USEPA Region III RBCs, none of the samples exceeded the RBCs of 39 parts per million (ppm) and 390 ppm, respectively, for either cadmium or chromium (the RBC for hexavalent chromium was used for the most conservative comparison). The pH values ranged from 8.3 to 12.7. Sample results and a sample location diagram from the closure report are enclosed in Appendix C and Appendix D, respectively.

A second study in 1991 addressed only the sampling of waste material and equipment in Building 44. The sampling was completed as part of a study to address demolishing and removing the plating operation. Analysis of samples collected primarily from material left in the process tanks identified the following metals: silver (<1.0 to 145 ppm), cadmium (2.02 to 84,340 ppm), chromium (18 to 11,940 ppm), nickel (0.63 to 2.7 ppm), mercury (6.7 to 446,000 ppm), lead (<0.08 to 6,920 ppm), and cyanide (83 to 129,100 ppm).

Finally, in the fall of 1993, field work conducted as a preliminary phase of the RFI was conducted near SWMUs 22 and 25. The scope of the preliminary work consisted of installing three monitoring wells. Soil samples were collected from each of these borings as they were drilled. Samples were analyzed for VOCs, SVOCs, and TAL inorganics using SW-846 methodologies at DQO Level III with duplicates collected at a frequency of 10 percent and analyzed at DQO Level IV. The sampling adhered to methods outlined in the USEPA Region IV ESDSOP/QAM. At the locations sampled no inorganics were detected at concentrations exceeding their respective RBCs. Both trichlorethene (TCE) and

perchloroethylene (PCE) were detected in monitoring well CNSY-25-03 at concentrations exceeding their respective RBCs. The analytical data are summarized in Appendix C.

Table 2.7 summarizes these investigations and the compound groups for which constituents were detected. Well construction logs for the three monitoring wells installed are included in Appendix D.

Table 2.7
SWMUs 22 and 25 and AOC 554
Previous Investigations

Number	Previous Investigations	Contaminants Identified
SWMU 22	EnSafe. Report of Field Activities, Closure of Interim Status HW Facilities, Naval Shipyard, Charleston, South Carolina 1988; Preliminary RFI Field Activities, 1993.[1]	VOCs, SVOCs, and inorganics
SWMU 25	Davis and Floyd, Inc. April 1991. Environmental Study of Building No. 44 Demolition of Electro-Plating Facility, Charleston Naval Shipyard, Charleston, South Carolina.	VOCs, SVOCs, and inorganics
AOC 554	None has been specifically conducted for AOC 554. The sampling described above also pertains to this site.	VOCs, SVOCs, and inorganics

Note:
[1] See Tables in Appendix C for analytical results.

2.4.2 Data Gaps

A review of the information available from previous investigations and assessments indicates data are insufficient to fully characterize the site and support a BRA, and a detailed evaluation of remedial alternatives where necessary. The data gaps are as follows:

- The number of soil samples and DQO level of the majority of the samples is inadequate to fully characterize the sites, support the BRA, and design a CMS.

- Mercury is an analyte that is known to have been present at these facilities. Whether mercury is present in ambient air has not been confirmed. This is of particular concern in Building 44, where air circulation may be restricted.

- Preliminary groundwater elevation data indicate groundwater flows eastward toward the Cooper River. Because the existing wells were installed in a linear fashion, the groundwater elevation data are somewhat inconclusive in terms of providing an accurate flow direction.

2.4.3 Objectives

The objective of the proposed field investigation is to fill the data gaps identified in the previous section. Specifically, the proposed sampling activities will confirm whether COPCs are present in the media to be investigated. If present, the data collection efforts will delineate the horizontal and vertical extent of the COPCs as described in the sampling strategy presented in the *Final Comprehensive Project Management Plan RCRA Facility Investigation, Volume I.*

2.4.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. The types of samples required include soil, sediment, groundwater, air, and wipe samples of the structure surfaces. Based on the site history and the data generated during previous assessments, a full scan analysis will be conducted on soil and groundwater samples. Soil gas is a potential migration pathway; however, quantitative analyses for contaminants in soil gas are not proposed herein. **Instead, qualitative air monitoring will be performed using a Jerome Mercury Vapor Analyzer. Air monitoring will be performed prior to intrusive activities and as a component of continuous health and safety monitoring during all sampling activities. The sampling procedure, contained in Attachment 1,** will be used instead of sampling procedures contained in Section 4.13.5 — Sampling and Analysis of Mercury in Ambient Air, of USEPA Region IVs Environmental Compliance Branch Standard

Operating Procedures Quality Assurance Manual, February 1, 1991. The sediment sample will be collected from the area beneath the plating shop's ventilation system where sediments have accumulated on top of the asphalt.

The soil boring locations proposed for SWMU 22 and AOC 554 were selected based on visual confirmation of the former treatment system's location in the case of SWMU 22 and base maps for AOC 554. Soil borings are proposed to be installed immediately adjacent to the treatment system and within the former building footprint at AOC 554. In both instances, soil borings are proposed at locations most likely to have been impacted if a release has occurred. Figure 2-03 presents soil boring and monitoring well locations for this site and Table 2.8 summarizes the types of samples and analytical parameters All sampling will adhere to the NAVBASE *Final Comprehensive Work Plan*.

Table 2.8
SWMUs 22 and 25 and AOC 554
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	13	Soil and Groundwater – VOCs and SVOCs w/TICs, Metals (including organotins) cyanide, pesticides, PCBs, and pH.
Soil (3-5' bgs)	13	
Air	Approximately 17	Air – Mercury
Groundwater		
(existing shallow wells)	3	
(new shallow wells)	1	
Structural Wipe Samples	TBD	
Sediment	1	

Engineering Parameters:
Engineering parameters will be dictated by field data collected.

Slug tests will be performed on at least one of the wells. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis for any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution (if contamination is present) is developed.

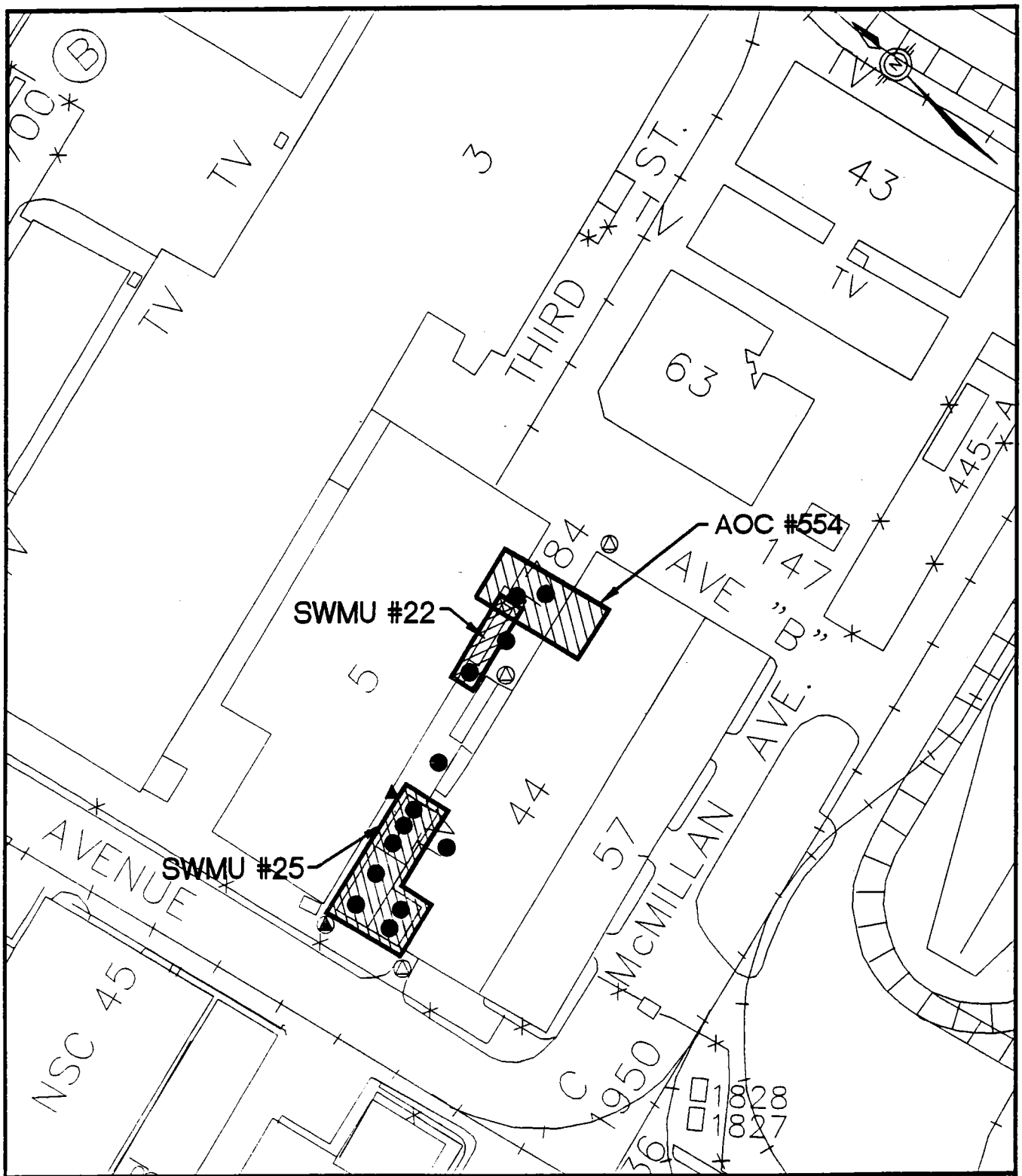
Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis will be performed per SW-846 except where other methods are specified. DQO Level III analyses will be used as specified in sampling plan. A minimum of 10% duplicates will be analyzed at DQO Level IV for the parameters listed. The sample quantity presented does not include QA/QC samples.

The quantity of Structural Wipe Samples will be determined by field conditions such as the number of different structural surfaces, condition of remaining equipment, etc.

The sediment sample will be collected from the area beneath the plating shop's ventilation system where sediments have accumulated on top of the asphalt.



LEGEND

- ○ – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-03
SWMU #22, OLD PLATING SHOP WWTS
SWMU #25, OLD PLATING OPERATION
AOC #554, PAINT SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE03

2.5 SWMU 23, New Plating Waste Water Treatment System — Building 226; SWMU 63, Former Building 73 Battery Charging Station; AOC 540, Building 226 Plating Plant; AOC 541, Oil Storage Shop, Former Building 38; AOC 542, Old Oxy-Acetylene Plant and Paint Shop, Former Building 22; and AOC 543, Former Building 1026, Storage Facility

SWMU 23 is the new wastewater treatment system (WWTS) on the northeast corner of Building 226. SWMU 63, a battery charging station, was former Building 73. AOC 540 is a plating plant in Building 226. AOC 541, an oil storage house, was in former Building 38. AOC 542, a paint shop and oxy-acetylene plant, was at former Building 22. AOC 543, a storage facility, was in former Building 1026.

SWMU 23 has been designated for an RFI. The remaining sites have been designated for a CSI. Because of their proximity and because the units will share borings and monitoring wells, these sites will be investigated as a single unit. Table 2.9 describes the sites.

Table 2.9
SWMU 23 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[3]
SWMU 23 Plating Shop Wastewater Treatment System	The treatment building is a concrete structure built around 1983 to replace an existing system (SWMU 23). The new WWTS currently handles chrome effluent, acid/alkali effluent from metal plating and cadmium effluent. The treatment system consists of rinse water pumps, holding tanks, transfer pumps, a clarifier, a neutralization tank, and a plate and frame filter press.[1]	Sulfuric Acid Sodium Metabisulfite Sodium Hydroxide Potassium Hydroxide Chromium Cadmium (Metals, pH)[4]	Air **Soil** **Groundwater** Surface Water Surface Runoff
SWMU 63 Battery Charging Station	This site is a battery charging area (former Building 73) which operated from 1941 to approximately 1970. No records have been found providing information on its operating practices. Currently the site is covered by Building 226, a plating facility.[2]	Acids Metals (pH)[4]	Air **Soil** Soil Gas **Groundwater** Surface Water

Table 2.9
SWMU 23 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[3]
AOC 540 Plating Plant	Building 226, plating plant, was constructed in 1976. Current operations consist of a pump and valve test area, a plating area, and a hydraulic repair area. A wet scrubber, 120 plating dip tanks, a sludge pit, and waste treatment facility are associated with this facility. An oil/water separator and 300-gallon fuel oil tank are also on the southwest side.[2]	Acids Metals Hydraulic Fluid Petroleum Hydrocarbons (VOCs, SVOCs, pH)[4]	Air **Soil** Soil Gas **Groundwater** Surface Water
AOC 541 Oil Storage Shop	This site was an oil storage area (former Building 38) which operated from 1909 until 1939, but was demolished in 1970. No other information was discovered regarding its operating practices. The site is currently an asphalt parking lot between Building 6 and Building 226.[2]	Petroleum Hydrocarbons (VOCs, SVOCs)[4]	Air **Soil** Soil Gas **Groundwater** Surface Runoff
AOC 542 Paint Shop and Oxy-Acetylene Plant	Former Building 22 is the site of an oxy-acetylene plant and paint shop. From approximately 1922 until 1942, Building 22 was the site of oxy-acetylene manufacturing. In 1943, the building was converted into a paint shop and served that purpose until demolished in 1976. During this period chemical and abrasive paint stripping were also conducted. Currently this site is an open paved area between Buildings 3, 6 and 226.[2]	Acids Metals Paints Solvents Acetylene Gas Abrasive Grit (VOCs, SVOCs, pH)[4]	Air **Soil** Soil Gas **Groundwater** Surface Runoff
AOC 543 Storage Facility	This is the site of former Building 1026, which was constructed in 1922 and used as a storehouse until 1943. From 1943 to 1955, the site was a field electric shop. From 1955 until approximately 1970, this site was used as a storehouse again. Currently this site is covered by Building 226.[2]	Petroleum Hydrocarbons (VOCs, SVOCs)[4]	**Soil** Soil Gas **Groundwater**

Notes:
[1] Described in the RCRA Facility Assessment, August 1987.
[2] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994.
[3] Pathways scheduled for sampling are bold.
[4] Analyte groups associated with materials generated or stored.

2.5.1 Previous Investigations

These sites have not been investigated previously.

2.5.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, where necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.5.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, and groundwater samples will be collected onsite. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.5.4 Sampling and Analysis Plan

To fulfill The RFI and CSI objectives, site-specific sampling and analysis requirements have been proposed. The sampling strategy is intended to assess the entire area possibly impacted by SWMU 23, SWMU 63 and AOCs 540, 541, 542, and 543. Table 2.10 summarizes the sampling plan for the site and Figure 2-04 presents the proposed sampling locations for soil borings and monitoring wells. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

Selected soil boring/monitoring well locations for this site will be shared by AOC 540, SWMU 23, SWMU 63, and the remaining AOCs due to their proximity. The two soil borings and two monitoring wells designated for SWMU 63 and one soil boring and two monitoring wells proposed for SWMU 23 will serve as the sample locations for the northern edge of AOC 540 (Building 226). Two shallow monitoring wells along the southern edge of AOC 540 will serve as sample locations for AOCs 541 and 542. All soil borings and monitoring wells for AOC 543 will be shared with AOC 540 since former Building 1026's location is inside Building 226. Soil boring/monitoring well locations proposed for each AOC and SWMU are expected to define the perimeters of any contamination which may be present. Because the northeastern corner of Building 226 contains a basement, soil borings will be installed along the perimeter of the building instead of inside the building.

The proposed subsurface sample locations illustrated on Figure 2-04 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing borings will require coring through concrete, asphalt, or both. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID.

Table 2.10
SWMU 23 and Associated Sites
Sampling Plan

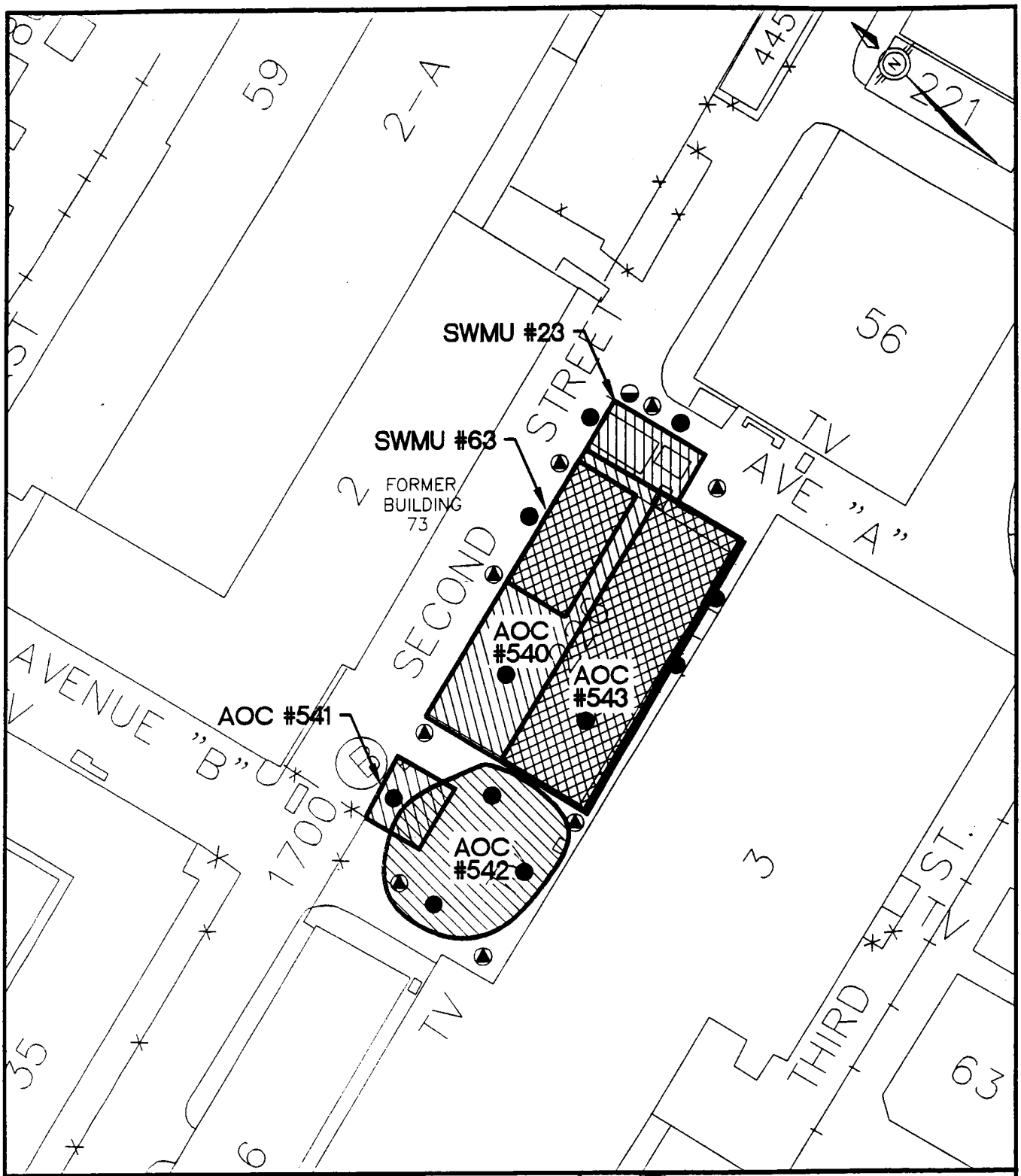
Matrix	Quantity	Analysis
Soil (0-1' bgs)	11	VOAs and SVOAs w/TICs, Metals (including organotins), cyanide, pesticides, PCBs, and pH.
Soil (3-5' bgs)	11	
Groundwater (shallow wells)	8	
Groundwater (deep wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ▲ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-04
SWMU #23, SWMU#63/AOC#540
AOC #541, OIL STORAGE SHOP
AOC #542, ACETYLENE & PAINT SHOP
AOC #543, FORMER BUILDING 1026

DWG DATE: 6/2/95 | DWG NAME: FIGURE04

2.6 SWMU 53, Satellite Accumulation Area, Building 212; and AOC 526, Paint Area, Building 212

SWMU 53, former Satellite Accumulation Area (SAA) 29, and AOC 526, a paint area, once operated in Building 212. These sites have been designated for an RFI. Because of their proximity, they will be investigated as a single unit. Table 2.11 describes the sites.

Table 2.11
SWMU 53 and AOC 526
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 53 SAA 29	This site once contained an SAA unit used as an element of the CNSY hazardous waste management system. Wastes were accumulated in 55-gallon drums on an asphalt surface. The unit had no containment system. Use of the SAA has been discontinued and the unit has been removed from the site. The operation dates of this SAA are not known.[1]	Acids Metals Paints Solvents Petroleum Hydrocarbons (VOCs, SVOCs, pH)[3]	Air **Soil** Soil Gas **Groundwater** Surface Water Surface Runoff
AOC 526 Paint Area	This area was formerly used for spray painting ship components. Two types of metal-based paints were used for this process. Operations started in 1974 and continued until approximately 1993. This unit has been cleaned and all waste sludge has been removed and properly disposed.[1]	Metals Solvents Paints (containing organotin- and tributylin-) (VOCs, SVOCs)[3]	Air **Soil** Soil Gas **Groundwater** Surface Water Sediment

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.6.1 Previous Investigations

These sites have not been investigated previously.

2.6.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection

efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.6.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. To fill data gaps, soil and groundwater samples will be collected onsite. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.6.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. The investigation is intended to define the nature and extent of contamination of the area impacted by SWMU 53 and AOC 526. Soil boring and monitoring well locations proposed for this site will be shared between AOC 526 and SWMU 53 due to their proximity. Figure 2-05 represents proposed soil boring and monitoring well locations for this site and Table 2.12 summarizes the types of samples and analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

The proposed subsurface sample locations illustrated on Figure 2-05 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling

supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID.

Table 2.12
SWMU 53 and AOC 526
Sampling Plan

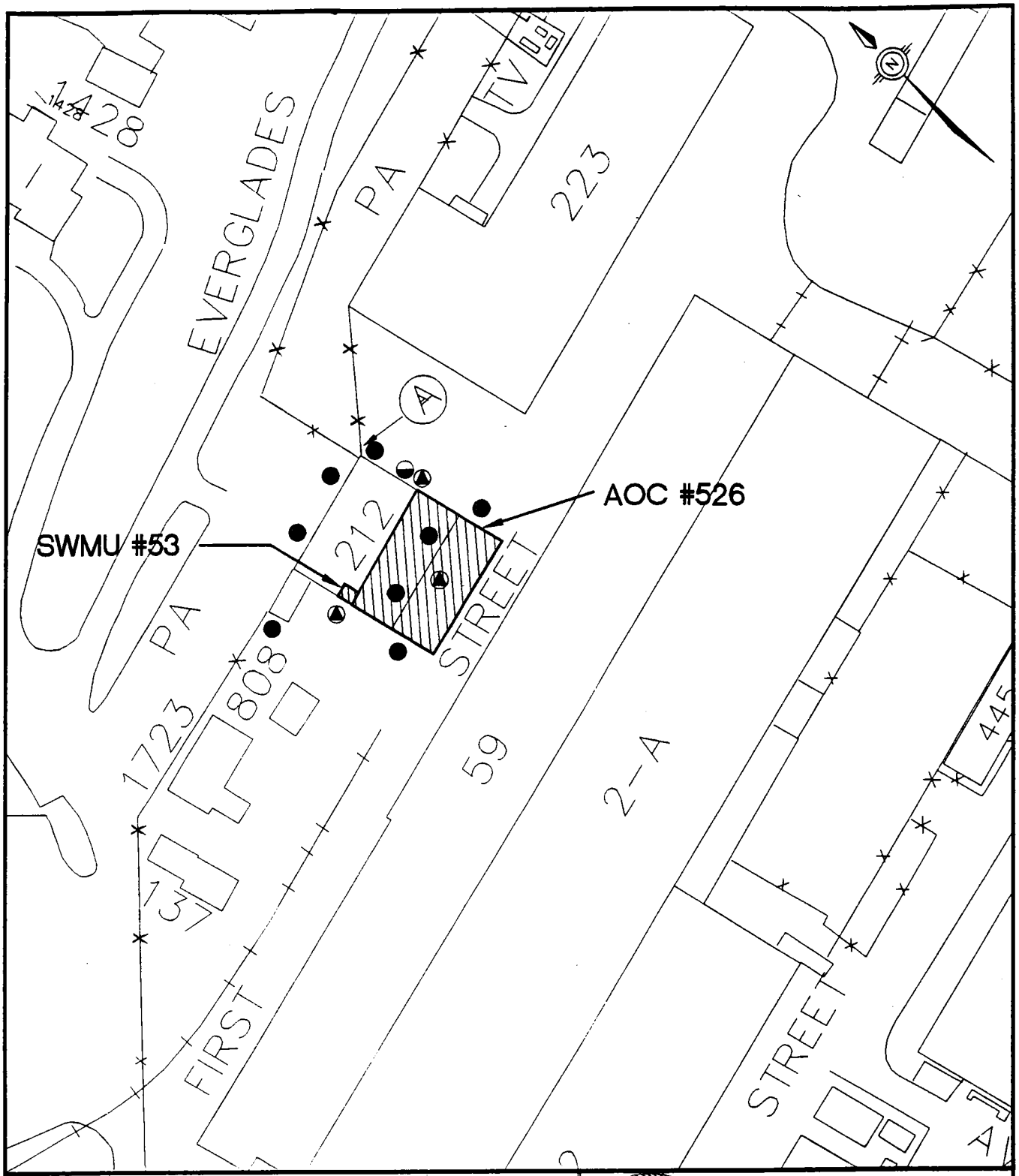
Matrix	Quantity	Analysis
Soil (0-1' bgs)	8	VOAs, SVOAs with TICs, Metals (including organotins), cyanide, pesticides, and PCBs
Soil (3-5' bgs)	8	
Groundwater (shallow wells)	3	
Groundwater (deep wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, total organic carbon (TOC), and cation exchange capacity (CEC).

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. Data Quality Objective (DQO) Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include Quality Assurance/Quality Control (QA/QC) samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-05
SWMU #53 AND AOC #526
BUILDING 212
PAINT AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE05

2.7 SWMU 65, Lead Storage (Includes AOC 544, Former Pickling Plant, and AOC 546, Galvanizing/Pickling Shop)

SWMU 65, lead storage, and AOC 544, pickling plant, operations both occurred in Building 221. AOC 546, galvanizing/pickling shop, was in former Building 1025. The operations associated with Building 221 have been designated for an RFI, while the ones occurring in former Building 1025 have been designated for a CSI. Because of their proximity, sampling locations will be shared by all sites, which will be discussed as a unit. Table 2.13 describes the site.

Table 2.13
SWMU 65 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[3]
SWMU 65 Lead Storage	This site consists of a lead storage area. Lead blankets and shielding materials are stored on pallets and shelves inside and in a paved yard south of Building 221. The majority of the lead is encased in rubber; some exposed lead is stored beneath a tarp inside the building. This site is also a staging area for scrap lead awaiting disposal.[1]	Metals (Lead)[4]	Air **Soil** Soil Gas **Groundwater** Surface Water
AOC 544 Pickling Plant	This site consisted of a former pickling plant at Building 221. From 1940 to 1970, the pickling plant consisted of an open-air facility with only the pickling tanks covered by a roof. In 1970, a single-story structure was built to house the pickling operations. The pickling process used a series of chemical baths and water rinses. Until 1974, spent pickling bath solutions were discharged via the storm drainage system into the Cooper River. After 1974, a private contractor disposed of the wastes. Pickling plant operations were discontinued in 1984 and the process equipment was removed. Currently this site stores lead. [1]	Acids Metals Solvents Petroleum Hydrocarbons (VOCs, SVOCs, pH)[4]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Table 2.13
SWMU 65 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[3]
AOC 546 Galvanizing/ Pickling Shop	This unit consists of a galvanizing/pickling shop that operated within Building 1025 from the early 1920s until 1967. Building 1025 was at the current location of Building 3 until 1942, when it was relocated to southwest of Building 74. No information was found regarding its operational processes. Currently both sites are now covered with pavement or structures.[2]	Acids Solvents (VOCs, SVOCs, pH)[4]	Air **Soil** Soil Gas **Groundwater** Sediment Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[3] Pathways scheduled for sampling are bold.
[4] Analyte groups associated with materials generated or stored.

2.7.1 Previous Investigations

These sites have not been investigated previously.

2.7.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.7.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, groundwater, and surface water samples will be collected at this site.

If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.7.4 Sampling and Analysis Plan

To fulfill the RFI and CSI objectives, site-specific sampling and analysis requirements have been proposed. The sampling strategy is intended to assess the entire area possibly impacted by SWMU 65, AOC 544, and AOC 546. Figure 2-06 presents soil boring and monitoring well locations for this site and Table 2.14 summarizes the types of samples and analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

Soil boring and monitoring well locations proposed for this site will be shared by SWMU 65 and each of the AOC sites due to their proximity. AOC 546 is also included in an area to be investigated with SWMU 67. The data from the investigation of the former mercury storage area (SWMU 67) will be included in the investigation of this portion of AOC 546.

The proposed subsurface sample locations illustrated on Figure 2-06 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Because soil gas is a potential migration pathway, a PID will screen all borings and samples.

Table 2.14
SWMU 65 and Associated Sites
Sampling Plan

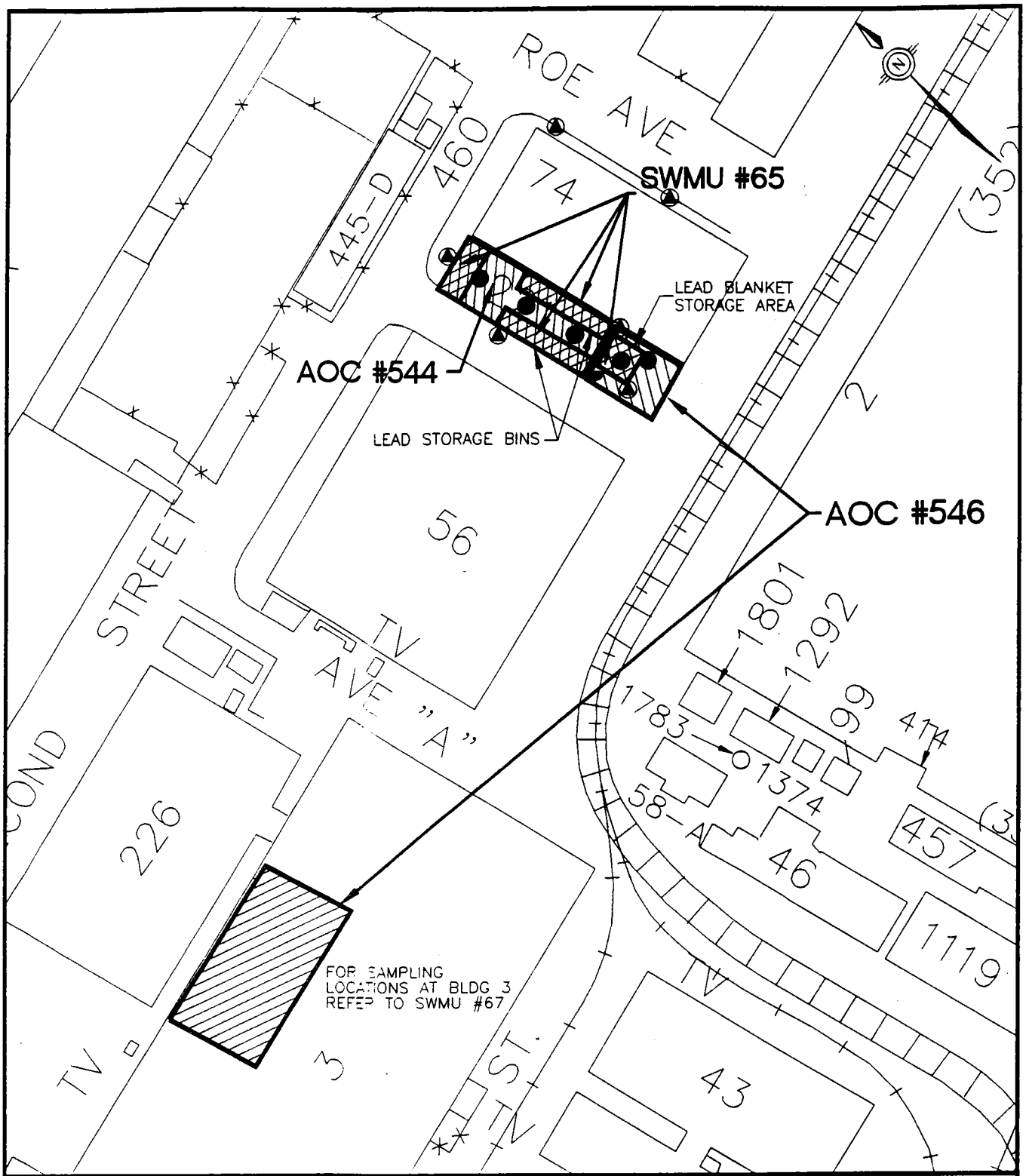
Matrix	Quantity	Analysis
Soil (0-1' bgs)	5	VOAs and SVOAs w/ TICs, Metals (including organotins), Cyanide, Pesticides, PCBs, and pH.
Soil (3-5' bgs)	5	
Groundwater (shallow wells)	6	
Groundwater (deep wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-06
SWMU #65, LEAD STORAGE AREA
AOC #544, PICKLING PLANT
AOC #546, GALVANIZING SHOP
FORMER BUILDING 1025

DWG DATE: 6/2/95 | DWG NAME: FIGURE06

2.8 SWMU 67, Mercury Gauge Room, Building 3

SWMU 67, a (former) mercury gauge room, is in Building 3. This site has been designated for a CSI. Table 2.15 describes the site.

Table 2.15
SWMU 67
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 67 Mercury Gauge Room	SWMU 67 consists of a mercury gauge room, a former mercury gauge room, and a mercury storage area, each in separate locations in Building 3. The building was constructed in 1905, with additions in 1939 and 1943. The mercury gauge room calibrates and leak-tests gauges. The current gauge room is on the mezzanine level. A room near the middle of the northwest wall of the ground floor was originally intended to serve as the gauge room. It is not known whether mercury gauges were ever handled in this room. Mercury gauge operations are known to have been conducted for 25 years in this building.[1]	Mercury[3]	**Soil** **Groundwater** **Air**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.8.1 Previous Investigations

This site has not been investigated previously.

2.8.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.8.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, concrete surface, groundwater, and air samples will be collected onsite. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.8.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. SWMU 67 consists of a mercury gauge room, a former mercury gauge room, and a mercury storage area in three separate locations in Building 3. Figure 2-07 presents proposed soil boring and monitoring well locations. Table 2.16 summarizes the sample types and analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

One soil boring and one shallow monitoring well installed along the southern perimeter of AOCs 541 and 542 will share analytical data with the former mercury gauge room area due to their proximity. The shallow monitoring well on the northern perimeter of the mercury storage area will share analytical data with AOCs 540 and 543 due to their proximity. Wipe samples will be collected from the present gauge room.

The proposed subsurface sample locations illustrated on Figure 2-07 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Both ambient and indoor air-quality samples will be collected for mercury analysis during the investigation. Four wipe samples will be collected from the floor of the present gauge room. The wipe samples will be arranged in a pattern to detect any possible mercury migration pathway.

Qualitative air monitoring will be performed using a Jerome Mercury Vapor Analyzer. Air monitoring will be performed prior to intrusive activities and as a component of continuous health and safety monitoring during all sampling activities. The sample procedure, contained in Attachment 1, will be used instead of sampling procedures contained in Section 4.13.5 — Sampling and Analysis of Mercury In Ambient Air, of USEPA Region IV's Environmental Compliance Branch *Standard Operating Procedures Quality Assurance Manual, February 1, 1991*. The former method will allow E/A&H to 1) determine if mercury vapors are present and 2) if present, field staff will find the source of the vapors. The latter method would only provide information as to the presence of mercury vapors but would not help find the source of the vapors.

For large open areas E/A&H will divide the site into grids with each containing a 20' x 20' area. A reading will be taken at the center of each of these grids. **If mercury is detected, E/A&H will attempt to locate the source using the instrument in a manner similar to a geiger counter, slowly sweeping the floors and other horizontal surfaces.**

The source of the vapor will either be the floor itself or liquid mercury that seeped under the floor. In any case the location of the highest airborne concentration of mercury will be marked with paint, flagging tape, or some other means, as appropriate to the present and potential future use of the building. Once identified then, based on site conditions, decisions can be made on how best to characterize and/or remediate the contamination.

Table 2.16
SWMU 67
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	5	Mercury
Soil (3-5' bgs)	5	
Groundwater (shallow wells)	2	
Air	Random	
Concrete Wipe Samples	7	

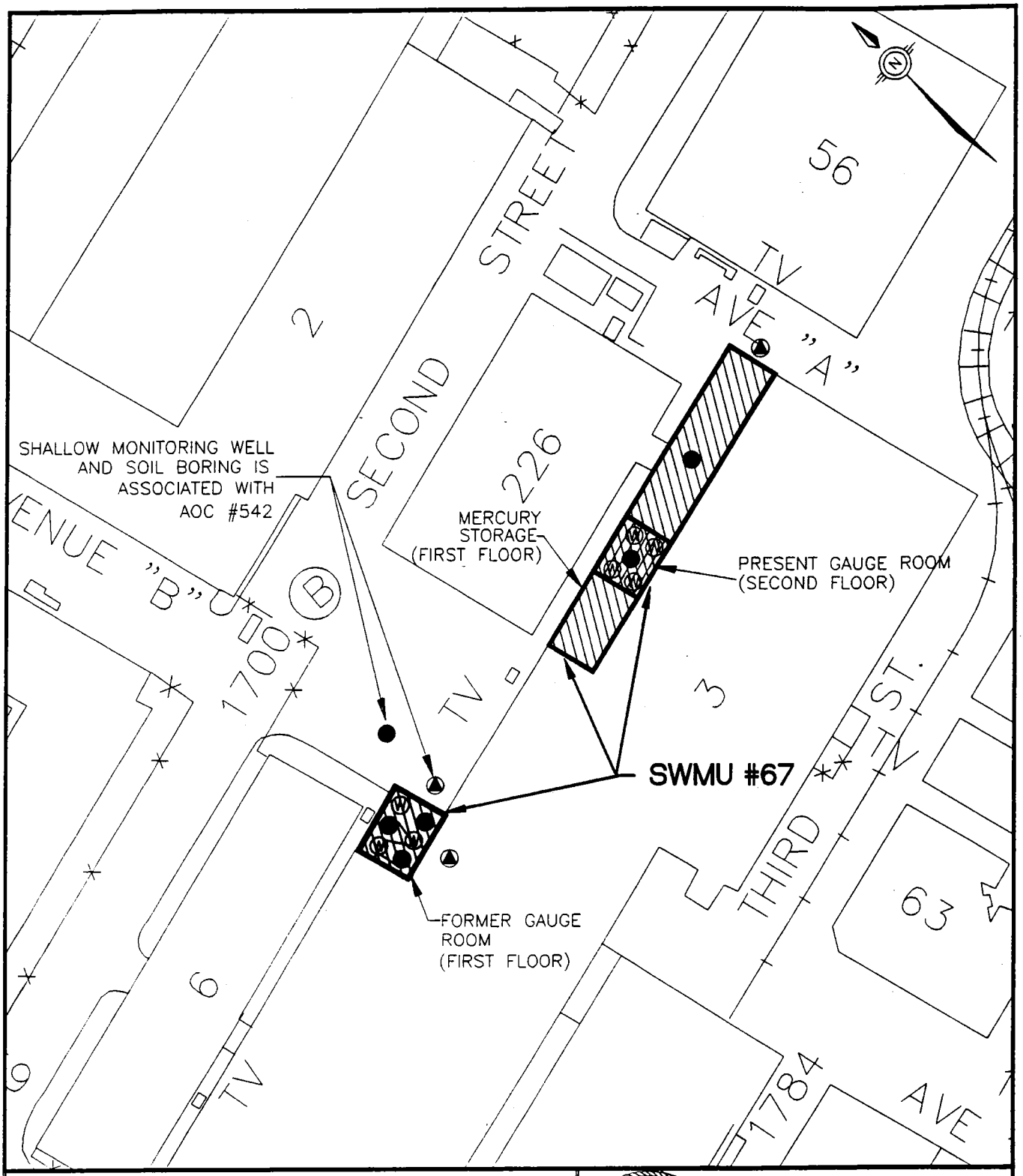
Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

Wipe samples will be analyzed for mercury only.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-07
SWMU #67
GAUGE ROOM
BUILDING 3

DWG DATE: 2/10/95 | DWG NAME: FIGURE07

2.9 SWMU 70, Building 5 Dip Tank; AOC 548, Hydraulic Elevator, Building 5; and AOC 549, Scrap Yard 1054, Building 5

SWMU 70, dip tank area, was at the northwest corner of Building 5 and has been designated for an RFI. AOC 548, a hydraulic elevator, is in the western side of Building 5 and has been designated for a CSI. AOC 549, a former scrap yard, was north of Building 5 and has been designated for an RFI.

Because their proximity, these sites will share sampling locations and they will be discussed as a unit. Table 2.17 describes the site.

Table 2.17
SWMU 70 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 70 Dip Tank Area	This site consists of a former dip tank at the northwest corner of Building 5. The dip tank was used to treat wood with a fire retardant. The tank was removed in 1981 when the shop began receiving pre-treated lumber. No information was found indicating when the operations started.[1]	Acids Metals Solvents (VOCs, SVOCs, Metals, pH)[3]	Air **Soil** Soil Gas **Groundwater**
AOC 548 Hydraulic Elevator	This site consists of an electric hydraulic elevator in Building 5. The elevator is in shaft that is paved on the bottom with approximately 8 inches of concrete. Containment is provided by a container that captures hydraulic fluid leaks and returns it to the main reservoir. However, this containment system has not been in place throughout the life of this unit. [1]	Hydraulic Fluid Petroleum Hydrocarbons (VOCs, SVOCs)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff
AOC 549 Scrap Yard	This site consists of a former scrap yard north of Building 5. The scrap yard was operated in the 1920s and 1930s. No information was found concerning its operating practices. Currently this area is paved with concrete and asphalt.[1]	Metals Petroleum Hydrocarbons (VOCs, SVOCs)[3]	Air **Soil** Soil Gas **Groundwater**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.9.1 Previous Investigations

These sites have not been investigated previously.

2.9.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.9.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater samples will be collected onsite. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.9.4 Sampling and Analysis Plan

To fulfill the RFI and CSI objectives, site-specific sampling and analysis requirements have been proposed. Figure 2-08 presents soil boring and monitoring well locations for this site and Table 2.18 summarizes the types of analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

The proposed subsurface sample locations illustrated on Figure 2-08 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID.

Table 2.18
SWMU 70, AOC 548 and AOC 549
Sampling Plan

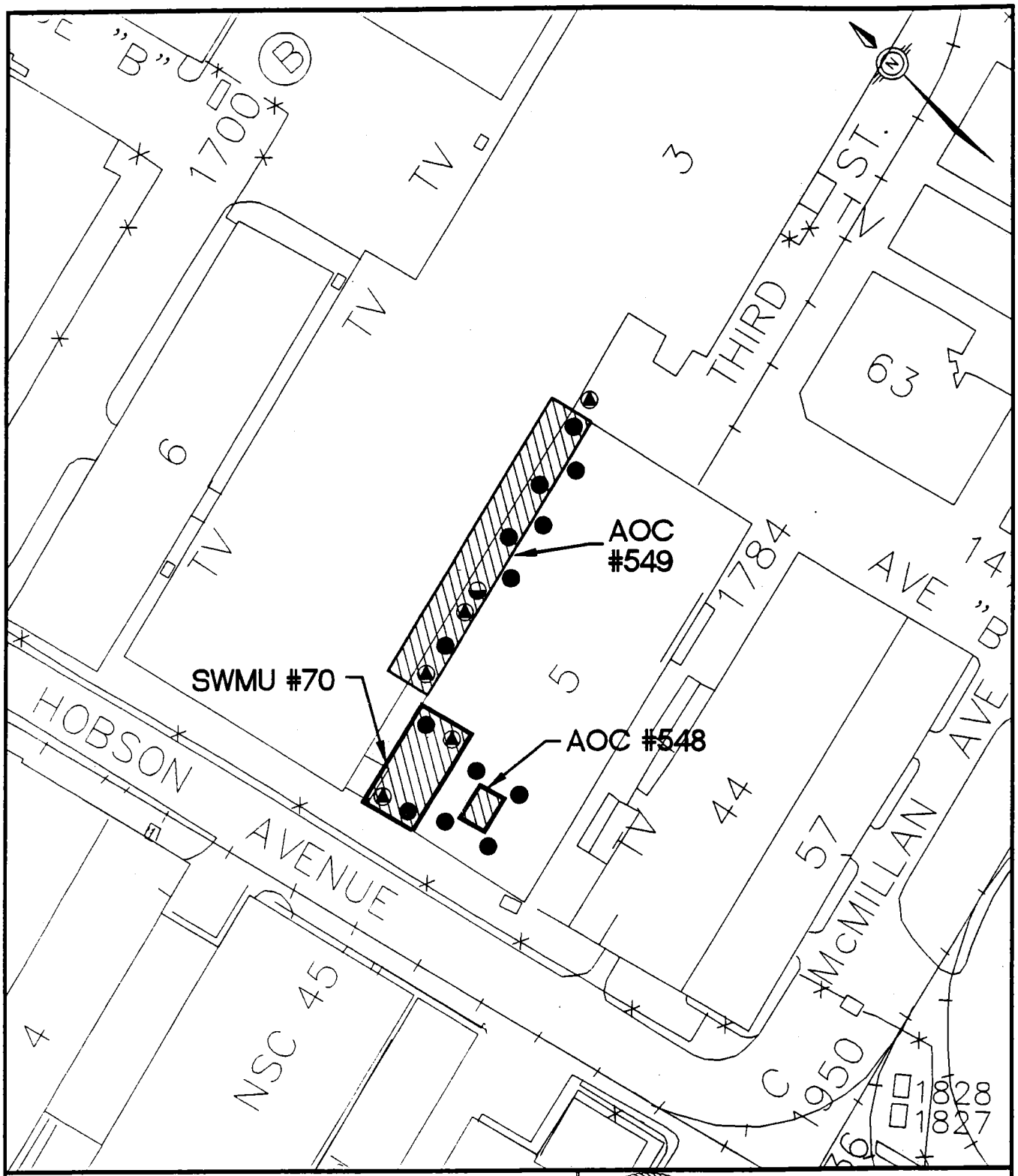
Matrix	Quantity	Analysis
Soil (0-1' bgs)	13	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, PCBs, and pH.
Soil (3-5' bgs)	13	
Groundwater (shallow wells)	5	
Groundwater (deep wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-08
SWMU #70, DIP TANK AREA, BUILD. 5
AOC #548, ELEVATOR, BUILDING 5
AOC #549
SCRAP YARD, FORMER FACILITY 1054

DWG DATE: 6/2/95 DWG NAME: FIGURE08

2.10 SWMU 81, Less-than-90-Day Accumulation Area, Building 1245

SWMU 81, the site of a former less-than-90-day accumulation area, is east of Building 1245 in the northwest corner of the enclosed fence. This site has been designated for a CSI. Table 2.19 describes the site.

Table 2.19
SWMU 81
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 81 Less-than-90-Day Accumulation Area	The accumulation area was used to store hazardous waste for less than 90 days. The origin of the SAA is not known, but it was removed in May 1994. The structure had a wooden floor with no spill containment. Currently the site is a concrete and asphalt area.[1]	Lead Metals Paints Solvents (VOCs, SVOCs)[3]	Air Soil Soil Gas Groundwater **Surface Runoff**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.10.1 Previous Investigations

This site has not been investigated previously.

2.10.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.10.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, concrete core samples will be collected along with sediment samples from the Cooper River. If COPCs are detected, the horizontal and vertical extent and rate of any contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.10.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.20 summarizes the types of samples and analytical parameters. Figure 2-09 presents the proposed sample locations for SWMU 81. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

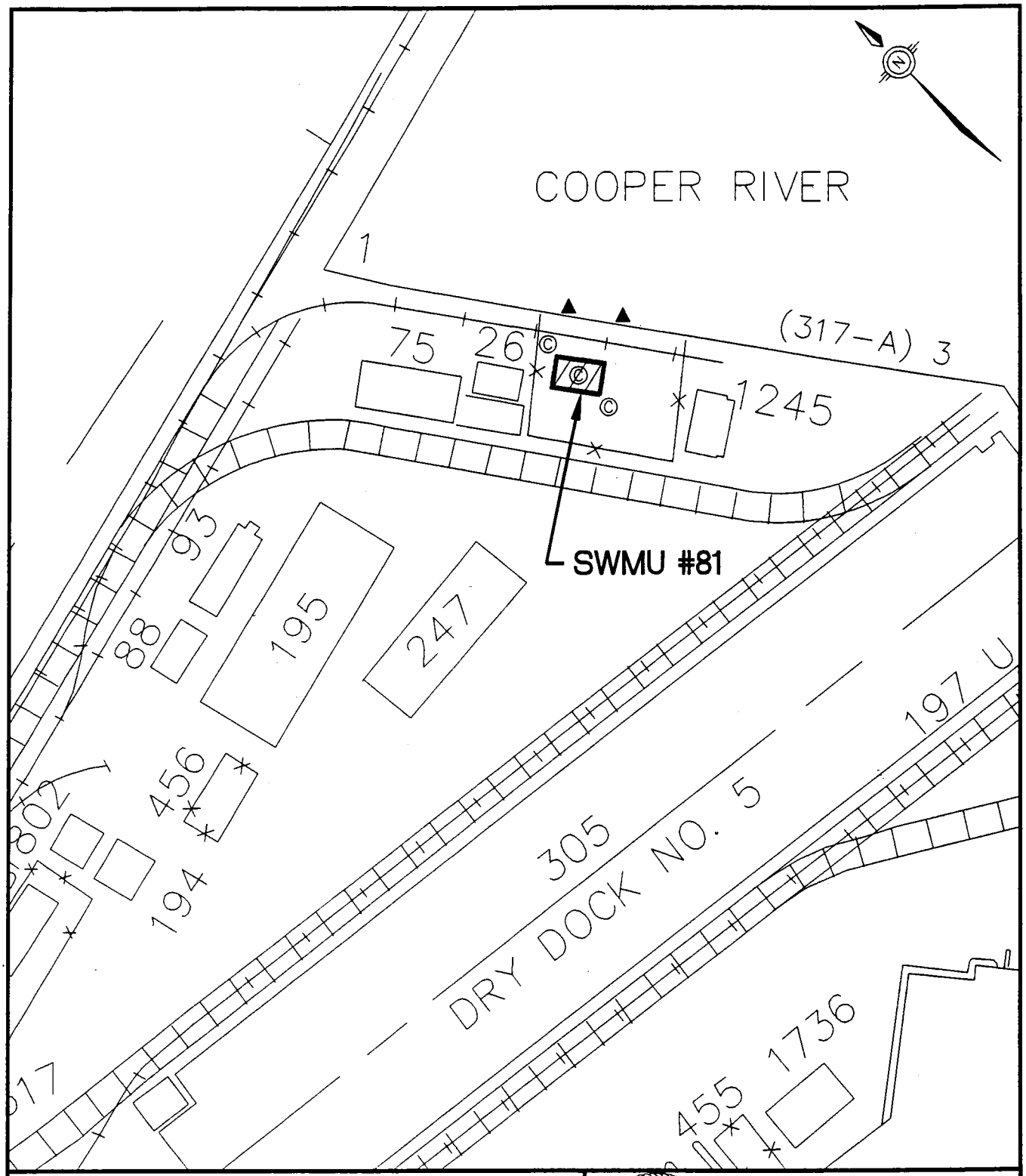
The proposed core and sediment sample locations illustrated on Figure 2-09 have been chosen based on a number of variables including: proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked.

Table 2.20
SWMU 81
Sampling Plan

Matrix	Quantity	Analysis
Concrete Core	3	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs
Sediment	2	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
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- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-09
SWMU #81
BUILDING 1245
LESS THAN 90 DAY AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE09

2.11 SWMU 83, Foundry, Building 9; SWMU 84, Lead Storage, Building 9; and AOC 574, Building 9 Fuel Tank

The foundry is currently used to repair hydraulic equipment and as a power substation (providing electricity for smoldering activities). Several foundry-related air emissions sources remain within the unit. These include:

- The foundry furnace, designated as company point I.D. No. 53 on the Bureau of Air Quality Control Permit No. 0560-0002, has an associated 67-foot stack with no continuous emission monitors.

- The foundry molds' cyclone, designated as company point I.D. No. 54 on the Bureau of Air Quality Control Permit No. 0560-0002, has a 30-foot high, 2-foot inside diameter stack with no continuous emission monitors.

The proximity of these sites enables them to share sampling locations, therefore, they will be discussed as a unit. This site has been designated for an RFI. Table 2.21 describes the site.

Table 2.21
SWMU 83 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 83 **Former Foundry**	SWMU 83 is a former foundry in Building 9. The foundry operations have been discontinued and currently the building contains electrical power supply equipment, capacitors, transformers, rectifiers, furnaces, and ovens. The building is also used to repair hydraulic equipment. The foundry was built in 1906 and was used to cast metal parts in refitting ships. The primary industrial process associated with this facility was melting and casting copper alloy parts. This site has a Bureau of Air Quality Control Permit. Two fuel oil above-ground storage tanks (ASTs) which have not been decommissioned are adjacent to the building. An abandoned oven contains a sign indicating that it contains PCBs. An approximately 10-cubic-foot pit of soot and metal scraps was observed below the electric furnace. The smoldering pots contain friable asbestos. Lead bricks and drums of hazardous materials from previous operations are present in the building.[1]	Lead Paints Solvents Friable Asbestos Dielectric Fluid Petroleum Hydrocarbons (VOCs, SVOCs, Metals, PCBs, Asbestos)[3]	**Air** **Soil** Soil Gas **Groundwater** **Surface Runoff**

Table 2.21
SWMU 83 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 84 Lead Storage	This site consists of an area outside of Building 9 used to store lead blankets and shielding. The majority of the lead is encased in either rubber or fabric; however, uncovered lead materials have been stored here. The lead-containing materials are placed either on pallets or directly on the concrete pavement. No containment structures are associated with this unit. No information could be found regarding the period of operation. [1]	Lead (Metals)[3]	**Soil** **Groundwater** **Surface Runoff**
AOC 574 Fuel Tank	This site consists of a 3,700-gallon AST east of Building 9. The fuel tank, which is no longer in use, formerly contained fuel oil for the furnaces and torches in Building 9. The tank is in an unpaved area and has no secondary containment. No information could be found regarding the period of operation.[1]	Petroleum Hydrocarbons (VOCs, SVOCs)[3]	Air **Soil** Soil Gas **Groundwater** **Surface Runoff**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.11.1 Previous Investigations

SWMU 84 and AOC 574 have not been investigated previously. The following incidents and/or investigations occurred at SWMU 83:

- In a hand-written Department of the Navy memorandum, a transformer oil spill is reported to have occurred on August 22, 1979, in Building 9. The spill occurred while removing transformers. Transformer oil spilled on the ground and concrete pavement southeast of Building 9. More than 100 gallons of oil were reportedly spilled. The oil was sampled and submitted for PCB analysis; no documentation concerning the results has been found. The spill area was covered with absorbent materials, roped off, and posted with signs limiting access due to the presence of PCBs. No other spill cleanup activities are known to have occurred.

- According to Hazardous Material Incident Report No. 84-55, a capacitor in an electrical power supply exploded on September 18, 1984, spraying burned Pyranol oil residue inside an 8' x 6' x 7' containment room. The containment room was subsequently sealed and posted with PCB warning labels. The damaged capacitor was removed on October 3, 1984, and the room was cleaned up on October 19, 1984. The capacitor and cleanup debris were containerized in a 55-gallon drum and submitted for disposal through a Defense Logistics Agency (DLA) contract.

- Environmental Incident Report No. 88-68 states that a half gallon of oil mixed with soot spilled in August 1988. The spill area included an electrical rectifier and concrete foundation. On August 26, 1988, a composite sample from three locations in the spill area was collected and analyzed for PCBs; the results showed 124 ppm of Aroclor 1260. Following cleanup, the debris was placed in a drum and transferred to Building 246, a NAVBASE hazardous waste storage facility, for disposal. Two wipe samples were subsequently taken and analyzed for PCBs. The wipe sample from the rectifier indicated 120 micrograms per swab (μg/swab) of Aroclor 1254; the wipe sample from the concrete pad indicated 347 μg/swab of Aroclor 1254. Based upon these results, a double-rinse cleanup was conducted on September 7, 1988.

- Wipe samples were collected in January 1989 from around the drain plug and the cement foundation for the transformer NS 1A cabinet. The PCB analysis indicated 1,290 μg/swab of Aroclor 1260 (drain plug area) and 19,000 μg/swab of Aroclor 1260 (cement pad). The same two areas were sampled in early February 1989 with PCB results of 125 μg/swab and 5,620 μg/swab Aroclor 1260, respectively. The analytical results necessitated further cleaning to meet the USEPA requirements of 100 micrograms per 100 square centimeters (μg/100 cm^2). The spill area was recleaned and resampled on April 15, 1989, with results of 78 μg/swab in the drain plug area and

132 μg/swab of Aroclor 1260 on the concrete pad. Sampling on May 27, 1989, indicated <10 μg/swab of Aroclor 1260 on the cement pad.

- Environmental Incident Report No. 91-83 states a fire was discovered in the generating station at the foundry on May 23, 1991. The generating station provided the electricity to operate the induction heaters which operated the foundry's ovens. The generating station contained PCB capacitors. It was determined that an air-cooled transformer overheated and caught fire. The PCB capacitors were not damaged. No known PCB investigation or cleanup is known to have been conducted.

- On September 19, 1988, three wipe samples were collected from the interior of the foundry Ajax oven and analyzed for PCBs. One sample was a wipe of a 100 cm^2 area on top of the second capacitor from the left in the bottom bank; analysis indicated 386.32 micrograms per wipe (μg/wipe) of Aroclor 1254. The other two samples are not based on a per unit area due to the large amount of dirt and grease also incidentally collected. One sample from the wooden base under the bottom bank of the capacitor indicated 235.29 milligrams per gram (mg/g) of Aroclor 1254. The second was taken from the floor behind the capacitor banks, and indicated 26.28 mg/g of Aroclor 1254.

- On October 27, 1988, airborne PCB (Aroclors 1254 and 1242) monitoring was conducted inside an Ajax Oven Control Center in the foundry while the oven was operating. Three areas were monitored approximately three hours; only one area had a reported PCB concentration (0.0029 milligrams per cubic meter [mg/m^3] Aroclor 1254) above the laboratory quantitation limit of 0.0020 mg/m^3.

2.11.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection

efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The nature and extent of impact to the environmental media have not been determined.
- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.11.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, air, soil, groundwater, structural wipe, and surface water samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.11.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.22 summarizes the types of samples and analytical parameters. The sampling strategy is intended to assess the entire area possibly impacted by SWMU 83, SWMU 84, and AOC 574. Figure 2-10 presents proposed soil boring and monitoring well locations for this site. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

Soil boring and monitoring well locations proposed for this site will be shared among SWMU 83, SWMU 84, and AOC 574 due to their proximity. Sampling locations on the west perimeter of SWMU 83 will be shared with SWMU 84 and sampling locations along the east perimeter will be shared by SWMU 83 and AOC 574.

The proposed subsurface sample locations illustrated on Figure 2-10 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to

the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID.

Heavy metals have been identified as COPCs and an air exposure pathway identified. In order to evaluate this exposure pathway both air samples and wipe samples will be collected.

Air samples will be collected and analyzed in accordance with SCDHEC R.61-62.5 which states "the analytical methods to be used will be those applicable Federal Reference Methods published in 40 CFR 50, Appendices A-H as revised July 1, 1986." The specific procedures to be followed are contained in 40 CFR, Part 50, Appendix J — *Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere*, with further chemical analysis of the filter for lead and heavy metals as allowed in Appendix J, and as specified in 40 CFR 50, Appendix G — *Reference Method for the Determination of Lead in Suspended Particulate Matter Collected From Ambient Air.* Attachment 2 contains the applicable State and Federal guidelines. Also included in Attachment 2 is the instruction and operations manual for the high volume PM_{10} sampler. Chemical analysis of PM_{10} filters will be for specific heavy metals based on the results of wipe samples collected from the area. This sampling technique collects particulates that have an aerodynamic size of 10 microns and less, i.e., the particulate size range of toxicological interest. Air samples will be collected at three locations within Building 6. Samples will be collected at each location for five consecutive work days. If possible, the building's HVAC system will operate in its "normal" mode during the sample collection period.

Wipe samples will be collected in accordance with the wipe sample procedure contained in the *Final Comprehensive Sampling and Analysis Plan (CSAP)* and EPA Region IV's Environmental Compliance Branch SOP/QAM, February 1, 1991. When collecting wipe samples for metals distilled or deionized water may be used as a solvent (*Air Monitoring for Toxics,* Shirley A. Ness, Van Nostrand Reinhold, New York, 1991). Wipe samples will be collected from the floor, walls, beams, and other surfaces where metal dusts and fumes could settle.

Sample location and frequency is based on information contained in Section 3.6.3.2 Sample Locations and Frequency of the *RFI Guidance Manual.* Eight wipe samples will be collected from the floor. Sample locations will be selected randomly. In addition, eight samples will be collected from surfaces above the floor. These locations will be selected judgmentally, based on observed discoloration, proximity to "emitting processes," and likelihood to collect settled dust and fumes.

Table 2.22
SWMU 83, SWMU 84 and AOC 574
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	12	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs
Soil (3-5' bgs)	12	
Groundwater (shallow wells)	7	
Groundwater (deep wells)	1	
Air Samples	Random	
Structural Wipe Samples	TBD	

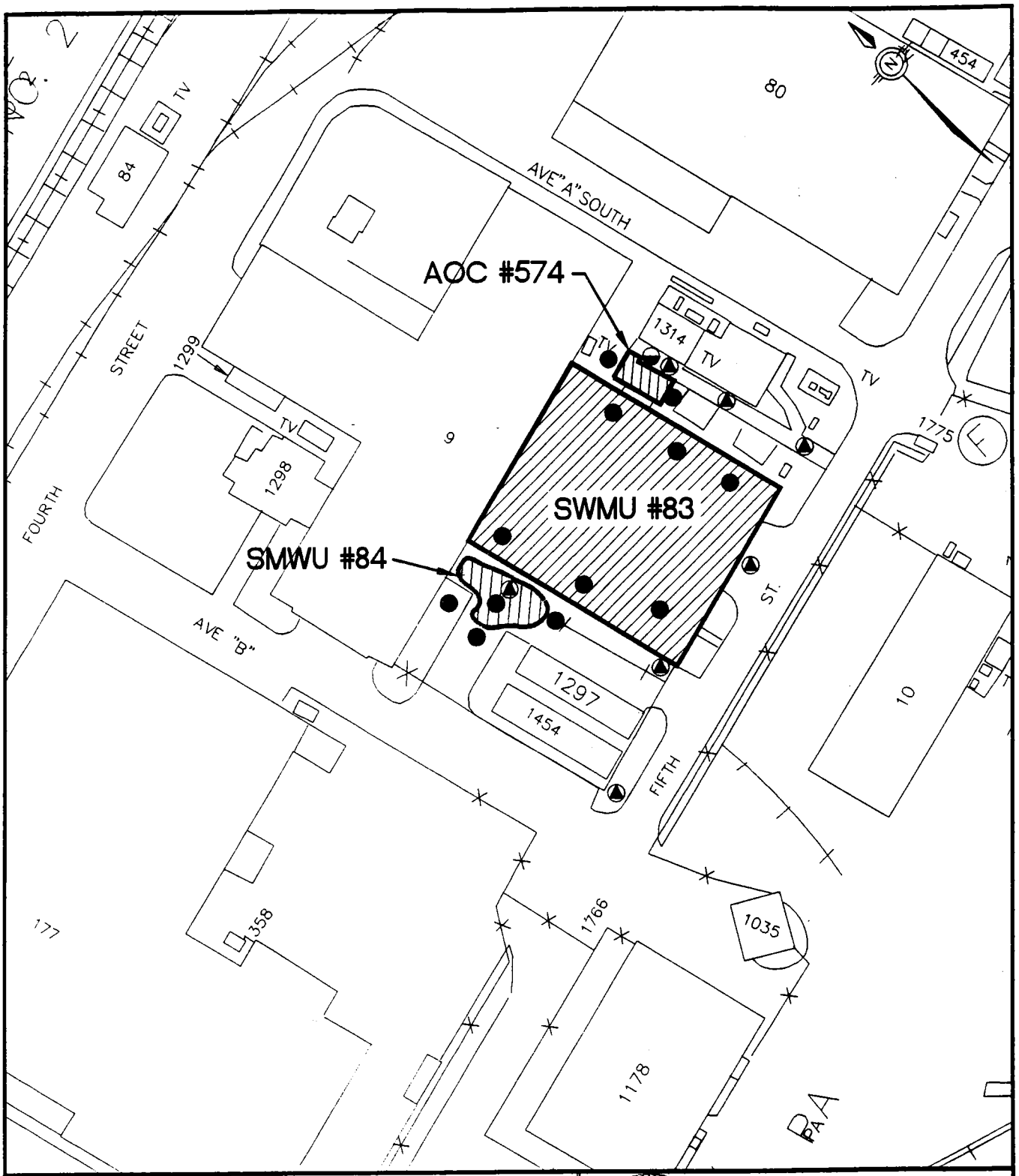
Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While drilling the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

The quantity of Structural Wipe Samples will be determined by field conditions such as the number of different structural surfaces, condition of remaining equipment, etc.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◬ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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CHARLESTON, S.C.

FIGURE 2-10
SWMU #83, BUILDING 9
SWMU #84, LEAD STORAGE, BUILDING 9
AOC #574, BUILDING 9, SAA

DWG DATE: 6/2/95 | DWG NAME: FIGURE10

2.12 SWMU 87, Less-than-90-Day Accumulation Area, Building 80; SWMU 172, Steam Cleaning Operations, Building 80; and AOC 564, Oil/Water Separator, Building 80

SWMU 87, a less-than-90-day accumulation area; SWMU 172, steam cleaning operation; and AOC 564, an oil/water separator (OWS) are all north of Building 80. These sites have been designated for a CSI. Because their proximity enables them to share sampling locations, they will be discussed as a unit. Table 2.23 describes the site.

Table 2.23
SWMU 87 and Associated Sites
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[4]
SWMU 87 Less-Than-90-Day Accumulation Area	This site consists of a former less-than-90-day accumulation area north of Building 80. This unit was an element of the CNSY hazardous waste management system. The unit was a metal building with an asphalt foundation. Within the unit, wastes were accumulated in closed palletized 55-gallon drums and palletized plastic bags. The unit was taken out of service in March 1994.[1]	Paint Mercury Anti-Freeze Petroleum Hydrocarbons (VOCs, SVOCs, Metals)[5]	**Soil** Soil Gas **Groundwater** **Air** **Sediment**
SWMU 172 Steam Cleaning Operations	This site consists of a steam cleaning area north of Building 80. Steam cleaning is performed on various types of equipment, including small engines, generators, and construction equipment. The unit consists of a concrete-paved area designed with curbing and sloping surfaces so all liquids drain into two storm drains. This unit is not enclosed or roofed.[2]	Petroleum Hydrocarbons (VOCs, SVOCs)[5]	Air **Soil** Soil Gas **Groundwater** Surface Runoff **Sediment**
AOC 564 Oil/Water Separator	This site consists of a 300-gallon OWS north of Building 80. Wastewater from machining and parts cleaning in Building 80 drains onto a sloped asphalt ramp which feeds into an exterior drain connected to the OWS. The OWS has been in operation for more than 25 years.[3]	Petroleum Hydrocarbons (VOCs, SVOCs)[5]	Air **Soil** Soil Gas **Groundwater** Surface Runoff **Sediment**

Notes:
1 Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
2 Described in the Draft-Final RCRA Facility Assessment, Volume IV, November 22, 1994
3 Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
4 Pathways scheduled for sampling are bold.
5 Analyte groups associated with materials generated or stored.

2.12.1 Previous Investigations

These sites have not been investigated previously.

2.12.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental media data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.12.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, air, soil, sediment, and groundwater samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.12.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.24 summarizes the types of samples and analytical parameters. The sample strategy is intended to assess the entire area possibly impacted by SWMU 87, SWMU 172, and AOC 564. Figure 2-11 presents proposed soil boring, sediment, and monitoring well locations for this site. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

Soil boring, sediment, and monitoring well locations for this site will be shared among AOC 564 and the SWMU sites due to their proximity.

The proposed subsurface sample locations illustrated on Figure 2-11 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID.

Qualitative air monitoring will be performed using a Jerome Mercury Vapor Analyzer. Air monitoring will be performed prior to intrusive activities and as a component of continuous health and safety monitoring during all sampling activities. The sample procedure, contained in Attachment 1, will be used instead of sampling procedures contained in Section 4.13.5 — Sampling and Analysis of Mercury In Ambient Air, of USEPA Region IV's Environmental Compliance Branch *Standard Operating Procedures Quality Assurance Manual, February 1, 1991*. The former method will allow E/A&H to 1) determine if mercury vapors are present and 2) if present, field staff will find the source of the vapors. The latter method would only provide information as to the presence of mercury vapors but would not help find the source of the vapors.

Table 2.24
SWMU 87, SWMU 172 and AOC 564
Sampling Plan

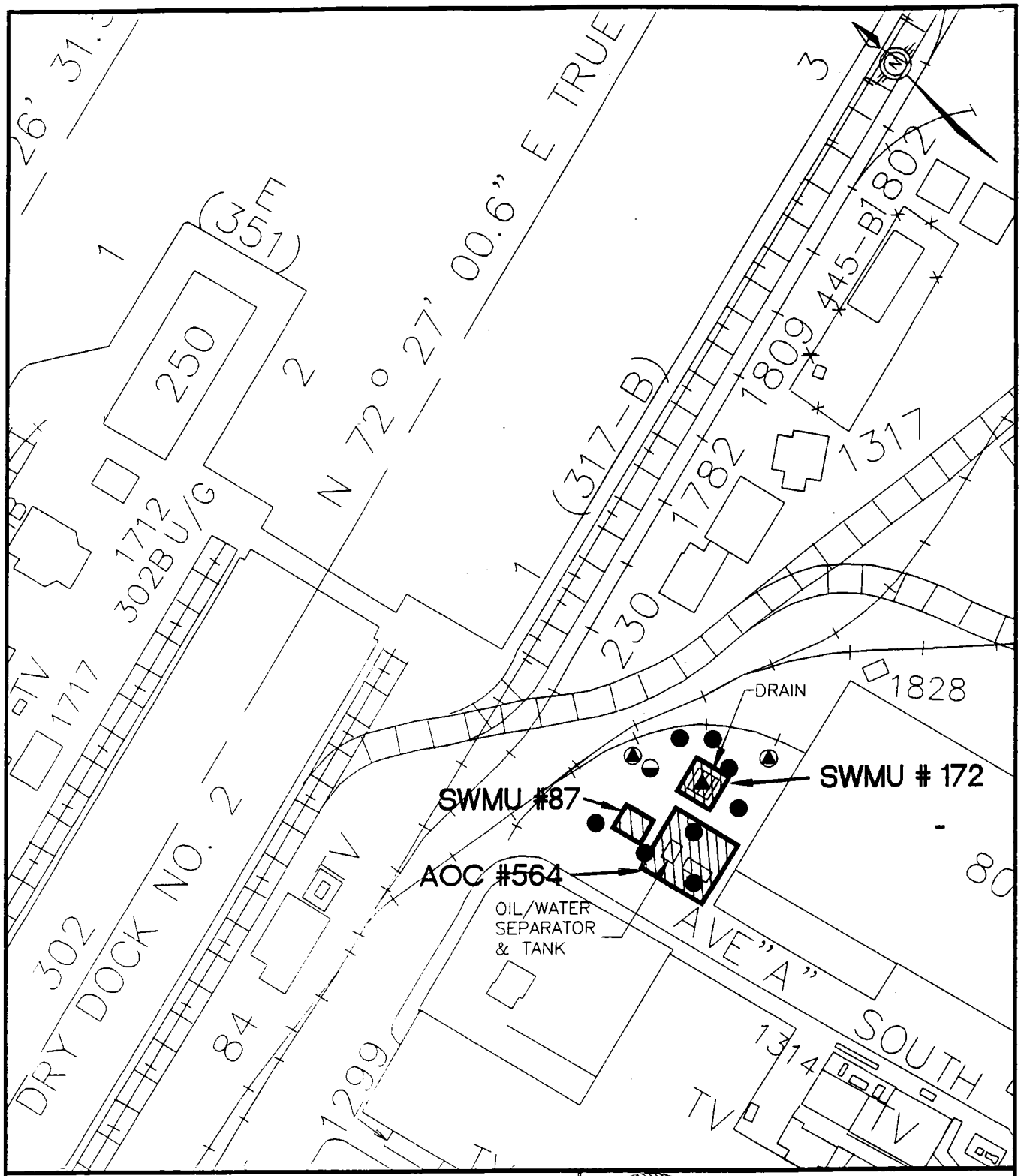
Matrix	Quantity	Analysis
Soil (0-1′ bgs)	8	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs
Soil (3-5′ bgs)	8	
Groundwater (shallow wells)	2	
Groundwater (deep wells)	1	
Air Samples	Random	
Sediment Sample	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
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CHARLESTON, S.C.

FIGURE 2-11
SWMU#87,<90 DAY STORAGE AREA#11
SWMU #172, STEAM CLEANING OPERATIONS
AOC #564, DISPOSAL PIT

DWG DATE: 6/2/95 | DWG NAME: FIGURE11

2.13 SWMU 97, Less-than-90-Day Accumulation Area, Building 236

SWMU 97, the site of a former less-than-90-day storage area, is on the east corner of Building 236. This site has been designated for a CSI. Table 2.25 describes the site.

Table 2.25
SWMU 97
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 97 Less-than-90-Day Storage Area	The storage area, a 20′ x 20′ steel shed on asphalt pavement, was used to store hazardous waste for less than 90 days. Wastes were stored in palletized 55-gallon drums. The operation dates of this storage area are not known. It is currently empty.[1]	Freon Metals Solvents Petroleum Hydrocarbons (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.13.1 Previous Investigations

This site has not been investigated previously.

2.13.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.13.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.13.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.26 summarizes the types of samples to be collected and the analytical parameters. Figure 2-12 presents proposed soil boring and monitoring well locations for this site. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

The proposed subsurface sample locations illustrated on Figure 2-12 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field checked. Installing soil borings and monitoring wells will require coring through concrete, asphalt, or both.

Table 2.26
SWMU 97
Sampling Plan

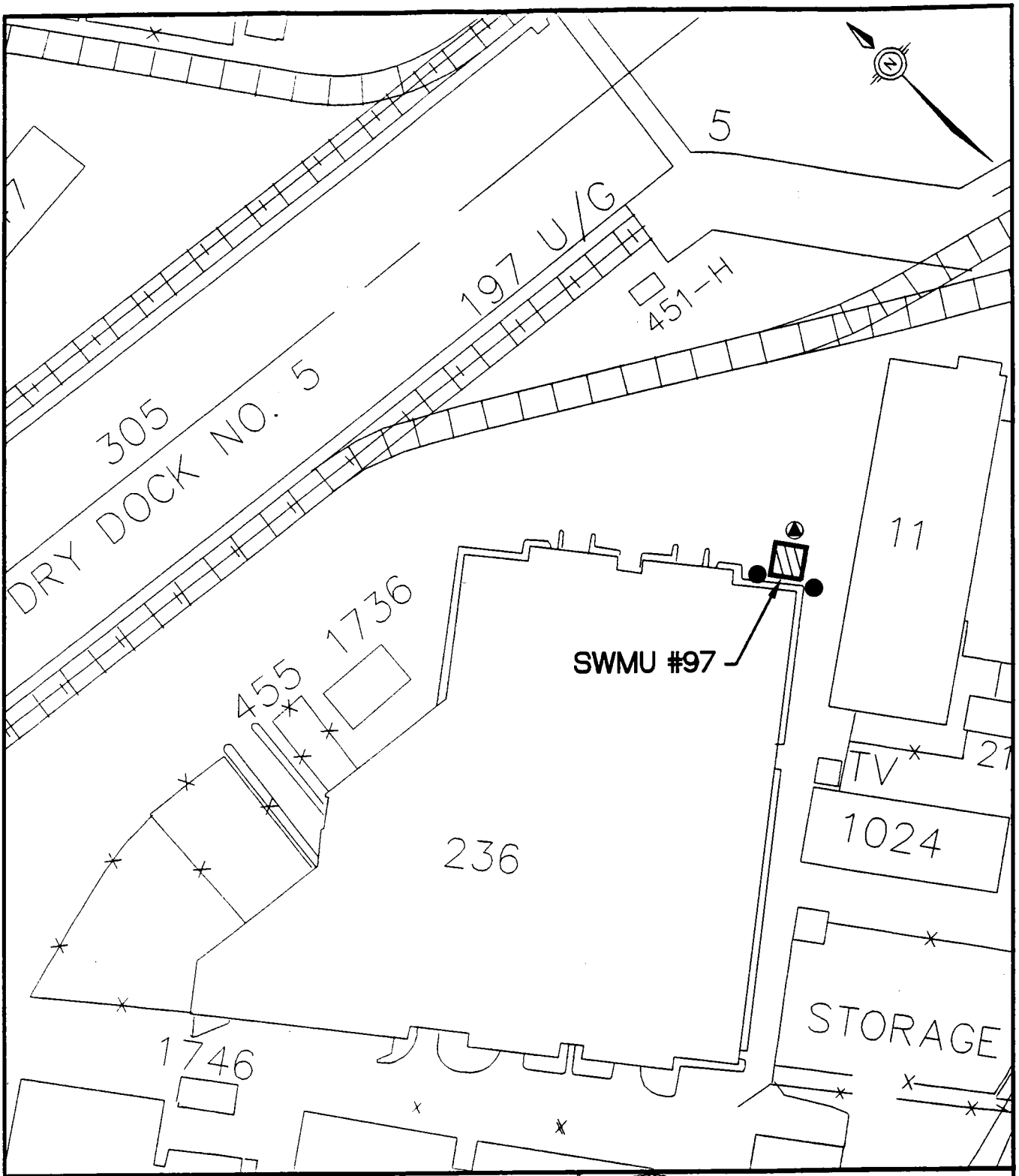
Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3-5' bgs) Groundwater (shallow wells)	2 2 1	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-12
SWMU #97
BUILDING 236
<90 DAY STORAGE AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE12

2.14 SWMU 100, Satellite Accumulation Area, Building 218

SWMU 100, SAA 63, is adjacent to Building 218. This site has been designated for an RFI. Table 2.27 describes the site.

Table 2.27
SWMU 100
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 100 **SAA 63**	SAA 63 stores hazardous waste for less than 90 days. The operation dates of the SAA are not known. The unit consists of closed 55-gallon drums accumulated on an asphalt-paved area. This unit has no containment structures.[1]	Metals Paints Epoxies Solvents Used Blasting Grit Petroleum Hydrocarbons (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.14.1 Previous Investigations

This site has not been investigated previously.

2.14.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.14.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.14.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.28 summarizes the types of samples to be collected and the analytical parameters. Figure 2-13 presents proposed soil boring and monitoring well locations for this site. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

The proposed subsurface sample locations illustrated on Figure 2-13 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID.

Table 2.28
SWMU 100
Sampling Plan

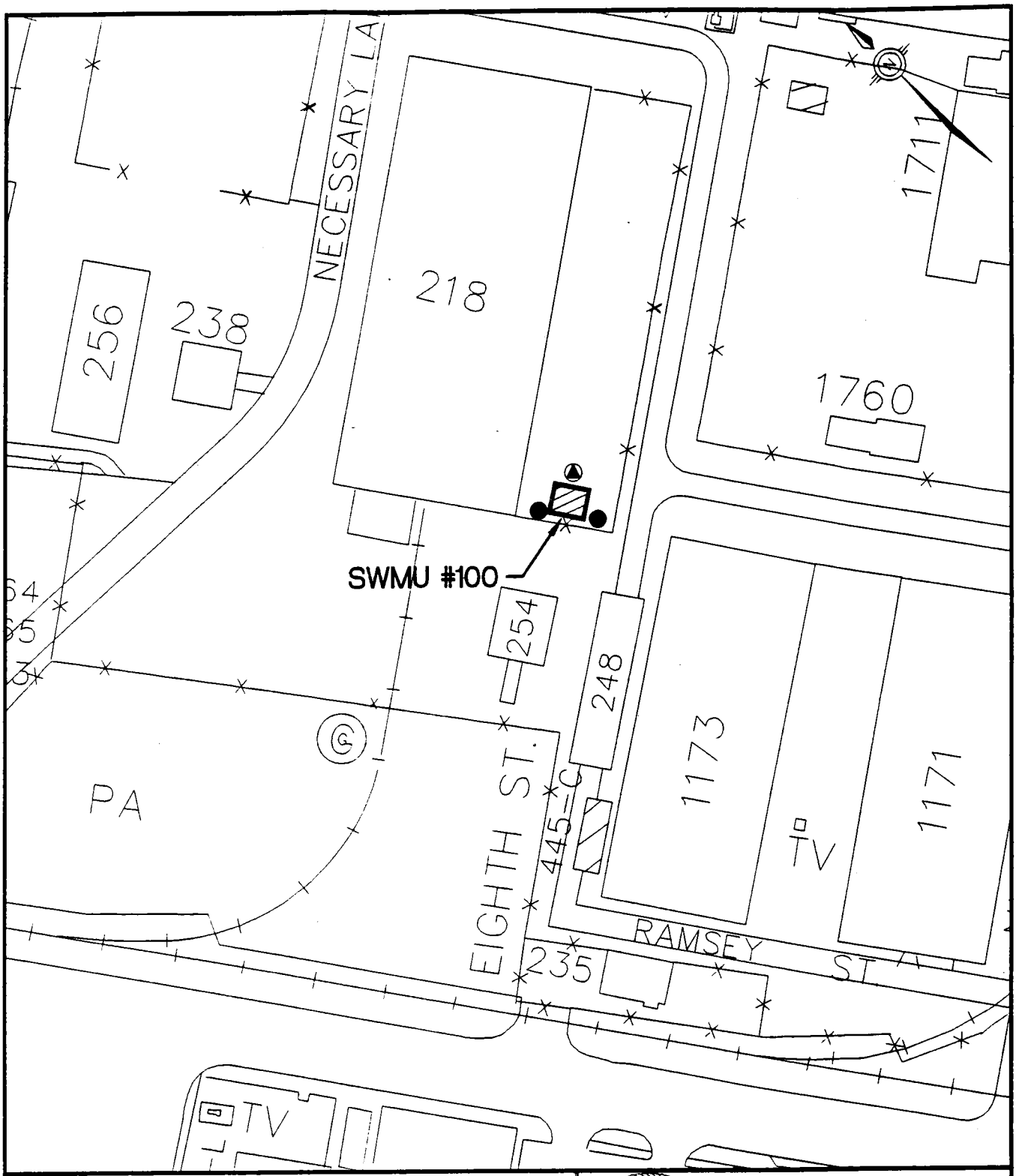
Matrix	Quantity	Analysis
Soil (0-1' bgs)	2	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs
Soil (3-5' bgs)	2	
Groundwater (shallow wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-13
SWMU #100
BUILDING 218
SAA

DWG DATE: 6/2/95 | DWG NAME: FIGURE13

2.15 SWMU 102, Mercury Spill, Building 79

SWMU 102 is a mercury spill under the **central** portion of Building 79. This site has been designated for a CSI. Table 2.29 describes the site.

2.15.1 Previous Investigations

No environmental media data have been found for this site. However, several incidents involving hazardous material spills, as well as cleanup activities, have been documented since 1976. The most noteworthy was the discovery of a mercury pool under the floor inside the **central** portion of the building. Mercury was reported to have been spilled and it seeped under the floor, forming an approximately 10-foot diameter pool. The mercury release reportedly occurred in 1969. The level of cleanup conducted is not known.

Table 2.29
SWMU 102
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 102 Mercury Spill	Building 79 housed an ordnance shop from 1943 to 1966. Currently it houses administrative offices (northeast), a ship storage area (center).[1]	Metals Mercury Petroleum Hydrocarbons (VOCs, SVOCs, Metals)[3]	**Soil** Soil Gas **Groundwater** **Air** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.15.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.15.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, groundwater, and air samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.15.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.30 summarizes the types of samples to be collected and the analytical parameters. Figure 2-14 presents proposed soil boring and monitoring well locations for this site. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

The proposed subsurface sample locations illustrated on Figure 2-14 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through concrete. Because soil gas is a potential migration pathway, all samples and borings will be screened with a PID. Air will be sampled during the investigation to qualitively screen for the presence of mercury.

Qualitative air monitoring will be performed using a Jerome Mercury Vapor Analyzer. Air monitoring will be performed prior to intrusive activities and as a component of continuous health and safety monitoring during all sampling activities. The sample procedure, contained in Attachment 1, will be used instead of sampling procedures contained in Section 4.13.5 — Sampling and Analysis of Mercury In Ambient Air, of EPA Region IV's Environmental Compliance Branch SOP/QAM, February 1, 1991. The former method will allow E/A&H to 1) determine if mercury vapors are present and 2) if present, field staff will find the source of the vapors. The latter method would only provide information as to the presence of mercury vapors but would not help find the source of the vapors.

For large open areas E/A&H will divide the site into grids with each containing a 20' x 20'area. A reading will be taken at the center of each of these grids. **If mercury is detected, E/A&H will attempt to locate the source using the instrument in a manner similar to a geiger counter, slowly sweeping the floors and other horizontal surfaces.** It is likely that a single spill may produce several contaminated areas.

The source of the vapor will either be the floor itself or liquid mercury that seeped under the floor. In any case the location of the highest airborne concentration of mercury will be marked with paint, flagging tape, or some other means, as appropriate to the present and potential future use of the building. Once identified then, based on site conditions, decisions can be made on how best to characterize and/or remediate the contamination.

Table 2.30
SWMU 102
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	8	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs
Soil (3-5' bgs)	8	
Groundwater (shallow wells)	1	
Air	Random	Mercury

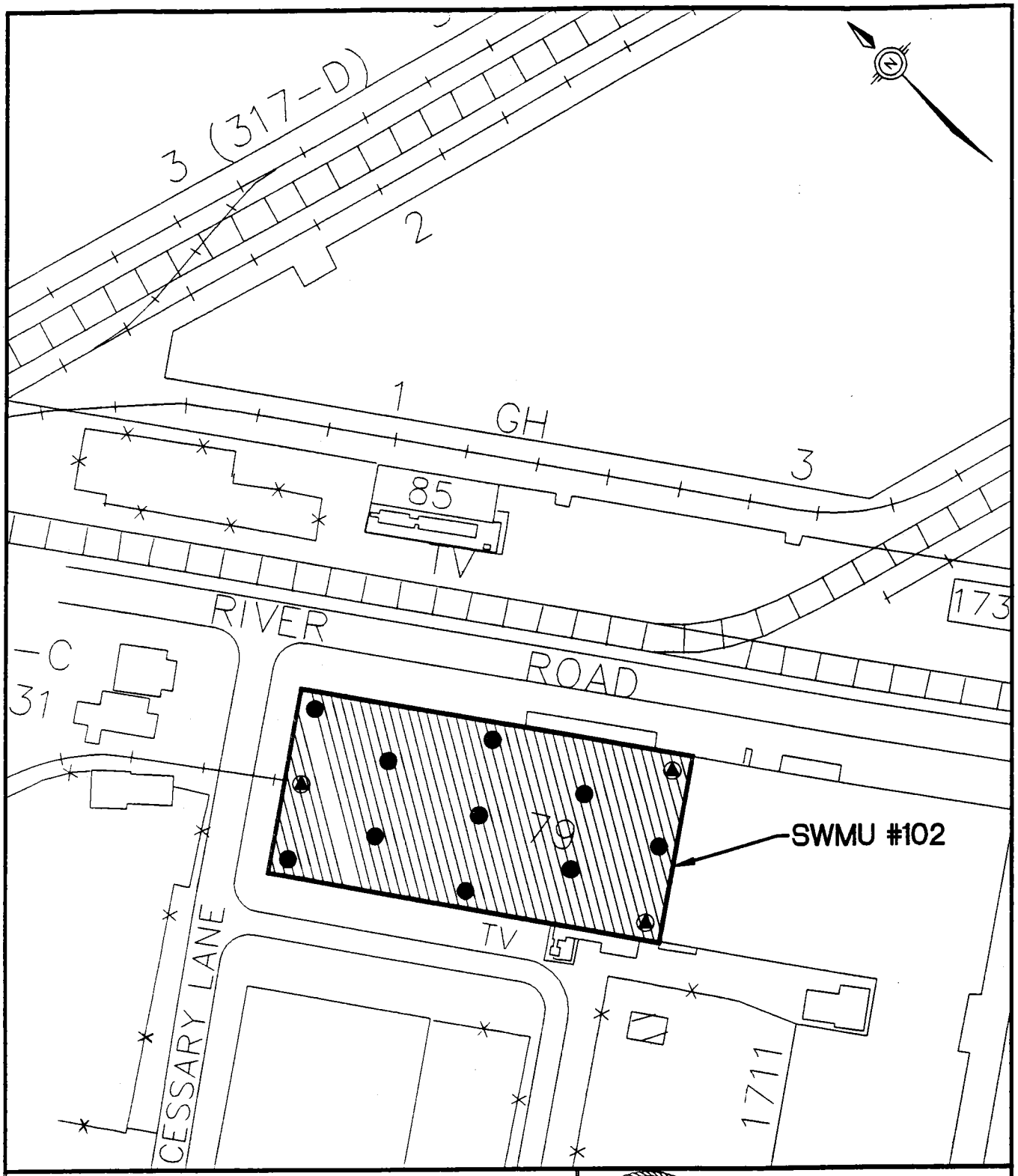
Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Air will be sampled during the investigation to screen for mercury.

Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-14
SWMU #102
MERCURY SPILL
BUILDING 79

DWG DATE: 6/2/95 | DWG NAME: FIGURE14

2.16 SWMU 106, Blast Area, Drydock 3; and AOC 603, Burning Dump, Drydock 3 Area

SWMU 106, a blast area, and AOC 603, a former burning dump, are both near Drydock 3. SWMU 106 has been designated for an RFI and AOC 603 has been designated for a CSI. Because of their proximity, these sites will be discussed as a unit. Table 2.31 describes the sites.

Table 2.31
SWMU 106 and AOC 603
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[3]
SWMU 106 Blast Area	This site consists of an abrasive blasting area near DDs 3 and 4. The blast area is outside on an asphalt/concrete pavement, however this area at one time was merely grade and covered with rock. When blasting occurs, temporary structures are erected using scaffolding and herculite to contain blast material. Abrasive blasting operations are rarely conducted. Steel grit and sodium bicarbonate are the reported materials used for blasting.[1]	Metals Paints Solvents Blasting Material (VOCs, SVOCs, Metals)[4]	Air **Soil** Soil Gas **Groundwater** Sediment Surface Runoff
AOC 603 Burning Dump	This site consists of a former burning dump near the present location of DD 3. The burning dump is believed to have operated from the late 1920s through the late 1930s. No information was found concerning the size or operating practices of the former burning dump.[2]	Petroleum Hydrocarbons Products of Incomplete Combustion (VOCs, SVOCs)[4]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[3] Pathways scheduled for sampling are bold.
[4] Analyte groups associated with materials generated or stored.

2.16.1 Previous Investigations

AOC 603 has not been investigated previously. SWMU 106 was investigated in the area between DDs 3 and 4; analytical results are shown below in Table 2.32.

Table 2.32 SMWU 106 Previous Investigations			
Previous Investigation		**Analytical Results**	
Date:	June 2, 1989	Flash Point	>140°F
		Total Halogens	0.12 wt%
Type:	Blast Media	pH	7.0 @ 25°C
		Arsenic	<1.0 ppm
Location:	Adjacent to quaywall between DDs 3 and 4	Cadmium	<0.5 ppm
		Chromium	<1.0 ppm
		Lead	<1.0 ppm

2.16.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The nature and extent of impact to the environmental media have not been determined.
- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.16.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.16.4 Sampling and Analysis Plan

To fulfill the RFI and CSI objectives, site-specific sampling and analysis requirements have been proposed. The sampling strategy is intended to assess the entire area possibly impacted by

Table 2.33
SWMU 106 and AOC 603
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	6	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs
Soil (3-5' bgs)	6	
Groundwater (shallow wells)	2	
Groundwater (deep wells)	2	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

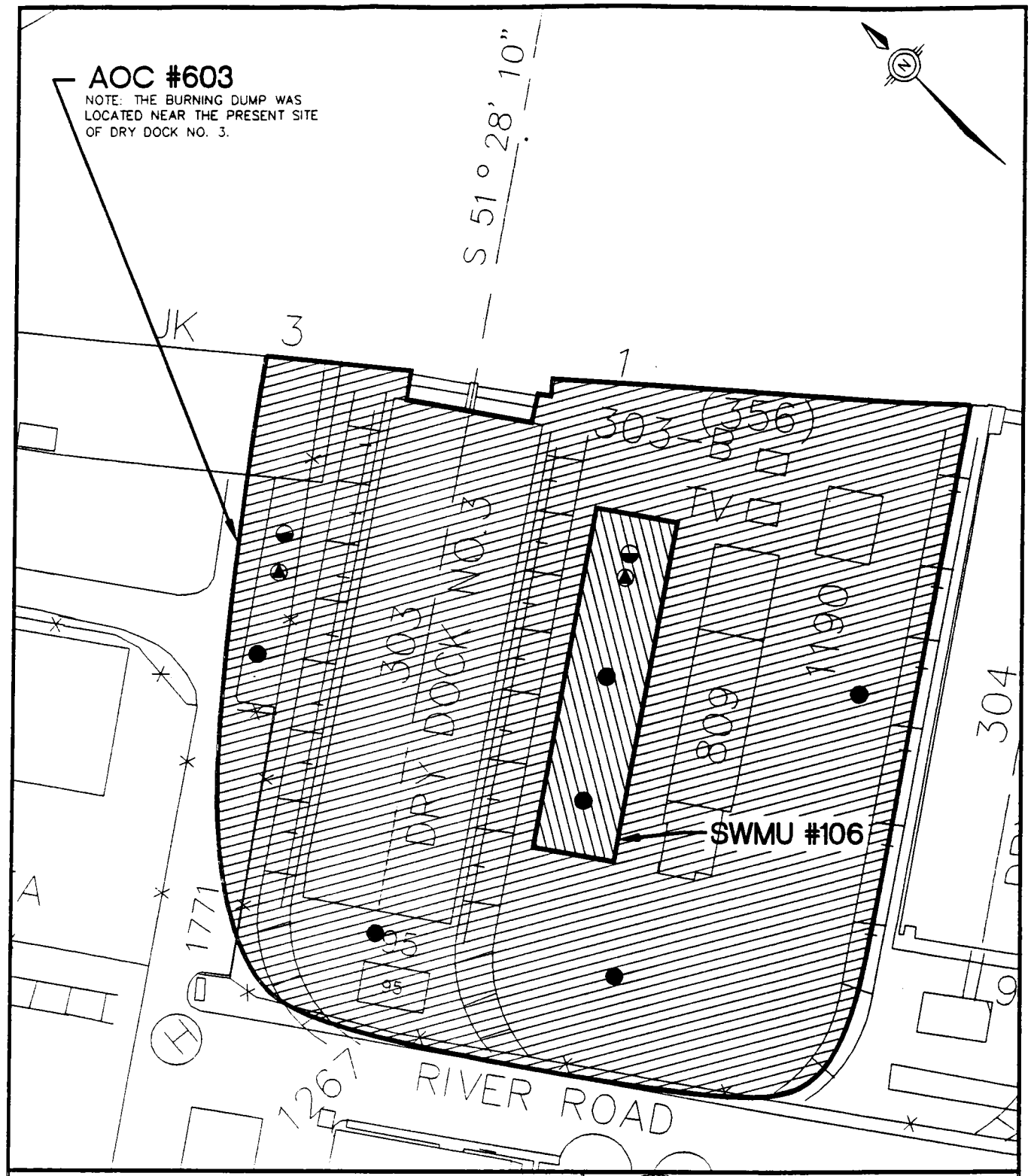
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

SWMU 106 and AOC 603. Table 2.33 summarizes the types of samples to be collected and the analytical parameters. Figure 2-15 presents proposed soil boring and monitoring well locations for this site. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

Soil boring and monitoring well locations for this site will be shared between SWMU 106 and AOC 603 due to their proximity. The soil borings, shallow well, and deep well proposed for SWMU 106 will serve as sample locations for the eastern perimeter of AOC 603.

The proposed subsurface sample locations illustrated on Figure 2-15 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID.



LEGEND

- ○ – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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FIGURE 2-15
SWMU #106
BLAST AREA DRY DOCK #3
AOC #603
BURNING DUMP DRY DOCK #3

DWG DATE: 7/5/95 | DWG NAME: FIGURE15

2.17 SWMU 145, Mercury Spill, Building 13A

SWMU 145 is a mercury spill under a portion of Building 13A. This site has been designated for a CSI. Table 2.34 describes the site.

Table 2.34
SWMU 145
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 145 Mercury Spill	This site consists of a reported mercury spill beneath Building 13A. No additional information could be found regarding the amount or duration of release(s).[1]	Mercury[3]	Soil Gas **Soil** **Groundwater** **Air** Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume III, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.17.1 Previous Investigations

This site has not been investigated previously.

2.17.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.17.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, groundwater, and air samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.17.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.35 summarizes the types of samples to be collected and the analytical parameters. Figure 2-16 presents proposed soil boring and monitoring well locations. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

The proposed subsurface sample locations illustrated on Figure 2-16 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both. Air will be sampled during the investigation to screen for the presence of mercury.

Qualitative air monitoring will be performed using a Jerome Mercury Vapor Analyzer. Air monitoring will be performed prior to intrusive activities and as a component of continuous health and safety monitoring during all sampling activities. The sample procedure, contained in Attachment 1, will be used instead of sampling procedures contained in Section 4.13.5 — Sampling and Analysis of Mercury In Ambient Air, of EPA Region IV's Environmental Compliance Branch *Standard Operating Procedures Quality Assurance Manual,*

February 1, 1991. The former method will allow E/A&H to 1) determine if mercury vapors are present and 2) if present, field staff will find the source of the vapors. The latter method would only provide information as to the presence of mercury vapors but would not help find the source of the vapors.

The mercury vapor detector shall be used to scan the area for mercury vapors. **If mercury is detected, E/A&H will attempt to locate the source using the instrument in a manner similar to a geiger counter, slowly sweeping the floors and other horizontal surfaces.** In this way the source(s) of contamination will be found. It is likely that a single spill may produce several contaminated areas.

The source of the vapor will either be the floor itself or liquid mercury that seeped under the floor. In any case the location of the highest airborne concentration of mercury will be marked with paint, flagging tape or some other means, as appropriate to the present and potential future use of the building. Once identified then based on site conditions, decisions can be made on how best to characterize and\or remediate the contamination.

Table 2.35
SWMU 145
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	9	Mercury
Soil (3-5' bgs)	9	
Groundwater (shallow wells)	3	
Groundwater (deep wells)	1	
Air	Random	

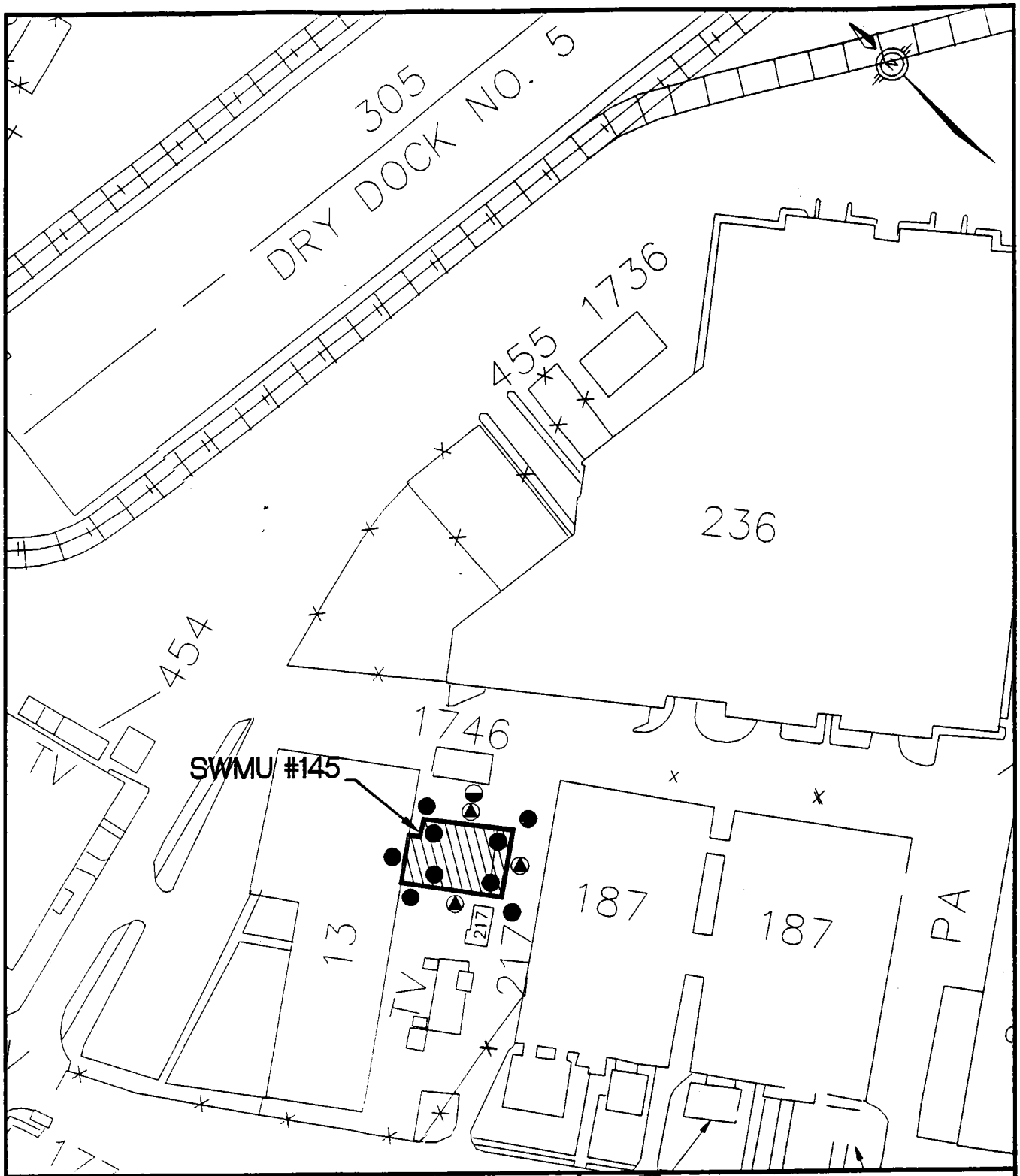
Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Air will be sampled during the investigation to screen for mercury.

Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ▲ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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FIGURE 2-16
SWMU #145
BUILDING 13A, FIRST FLOOR
MERCURY SPILL

DWG DATE: 6/2/95 | DWG NAME: FIGURE16

2.18 SWMU 170, PCB Removal Operations, Drydock 1 Area; and SWMU 171, PCB Removal Operations, Drydock 2 Area

SWMU 170 is a PCB removal operation near DD 1. SWMU 171 is a PCB removal operation near DD 2. These sites have been designated for a CSI. Because of their proximity, these sites will be discussed as a unit. Table 2.36 describes the sites.

Table 2.36
SWMU 170 and SWMU 171
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 170 PCB Removal Operations	This site consists of a storage area immediately west of DD 1. Missile launching tubes removed from decommissioned ballistic missile submarines are stored in this area for removal of PCB-containing components. It is estimated that the missile tube dismantling began around the late 1980s. The missile tube dismantling area has no secondary containment.[1]	PCBs[3]	**Soil** Soil Gas Groundwater **Surface Runoff**
SWMU 171 PCB Removal Area	This site consists of a storage area immediately west of DD 2. Missile launching tubes removed from decommissioned ballistic missile submarines are stored in this area for removal of PCB-containing components. It is estimated that the missile tube dismantling began around the late 1980s. The missile tube dismantling area has no secondary containment.[1]	PCBs[3]	**Soil** Soil Gas Groundwater **Surface Runoff**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume IV, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.18.1 Previous Investigations

These sites have not been investigated previously.

2.18.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.18.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, asphalt and soil samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.18.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling analysis requirements have been proposed. The sampling strategy is intended to assess the entire area possibly impacted by SWMU 170 and SWMU 171. Table 2.37 summarizes the types of samples to be collected and the analytical parameters. Figure 2-17 presents proposed asphalt core and soil boring locations, and sediment sample locations from storm drains in the area. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

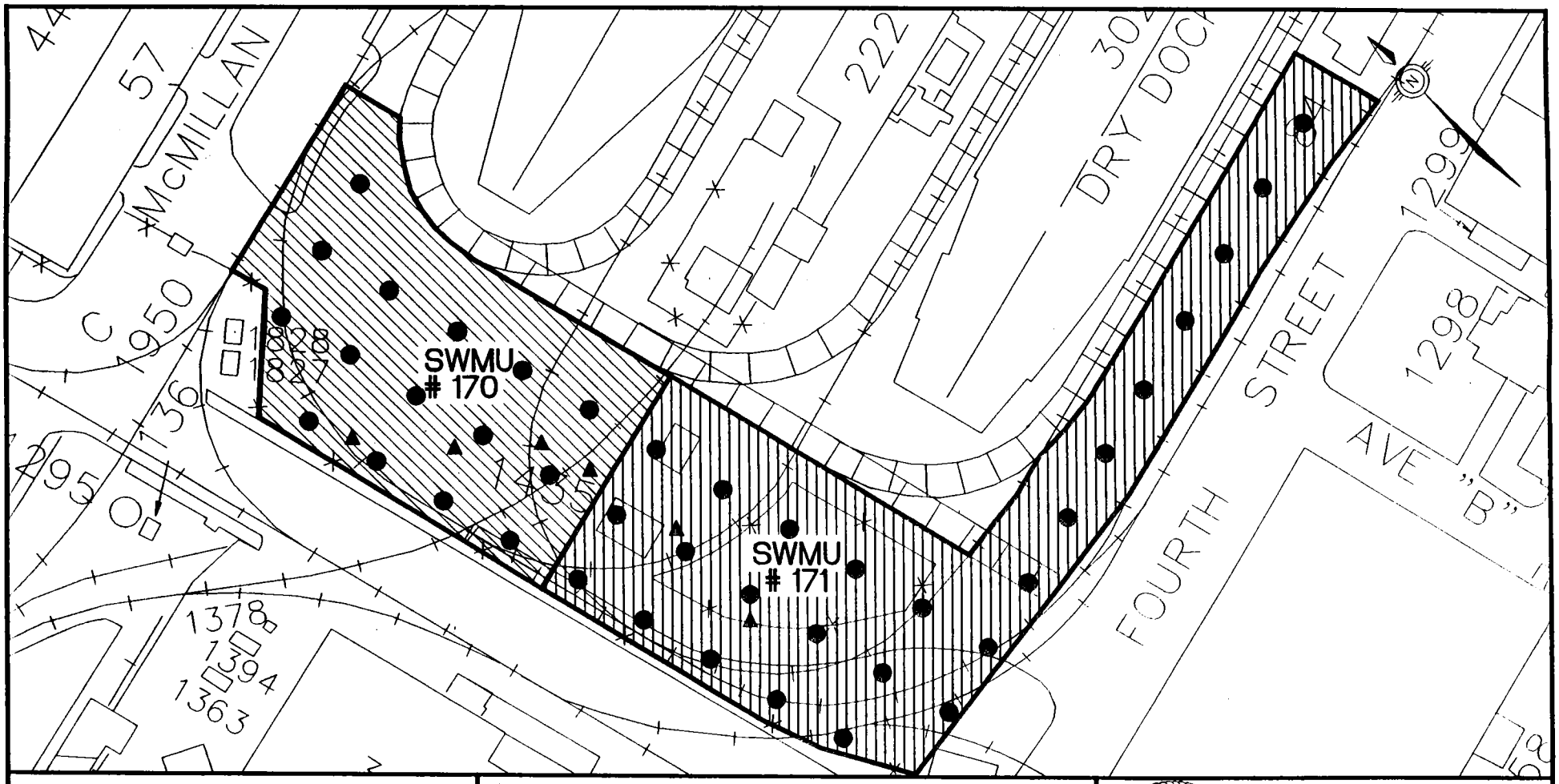
A 50 foot by 50 foot grid will be established at the site to facilitate grid-based sampling. The boundaries of the site approximate the surface area where missile tube dismantling has been performed. Each grid node that falls within the boundary of the site will be sampled. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings will require coring through either concrete, asphalt, or both.

Table 2.37
SWMU 170 and SWMU 171
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	40	PCBs
Soil (3-5' bgs)	40	
Sediment	6	
Asphalt Core Samples	40	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



100 0 100

GRAPHIC SCALE

LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

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FIGURE 2-17
SWMU #170, DRY DOCK #1 AREA
PCB REMOVAL OPERATIONS
SWMU #171, DRY DOCK #2 AREA
PCB REMOVAL OPERATIONS

DWG DATE: 6/2/95 | DWG NAME: FIGURE17

2.19 SWMU 173, Building 1297 Storage Area

SWMU 173 is separate storage areas in Building 1297. This site has been designated for a CSI. Table 2.38 describes the sites.

Table 2.38
SWMU 173
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
SWMU 173 Storage Areas	This site consists of separate storage areas for lead ingots and hazardous materials in Building 1297. The building is divided into 10 storage areas, each accessed through an exterior door. Each area also has an opening in the roof, used to transfer materials. One area is used to store lead ingots. Its roof is protected by a non-watertight wood cover. Another area was previously a hazardous materials storage area. This storage area is currently empty. Three storm drains are close to the building.[1]	Metals (Lead) Hazardous Materials (VOCs, SVOCs, Metals)[3]	Air **Soil** **Surface Runoff** **Sediment** Soil Gas Groundwater

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume IV, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.19.1 Previous Investigations

This site has not been investigated previously.

2.19.2 Data Gaps

Currently limited environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental media data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.19.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and sediment samples will be collected from the storm drains adjacent to the site. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.19.4 Sampling and Analysis Plan

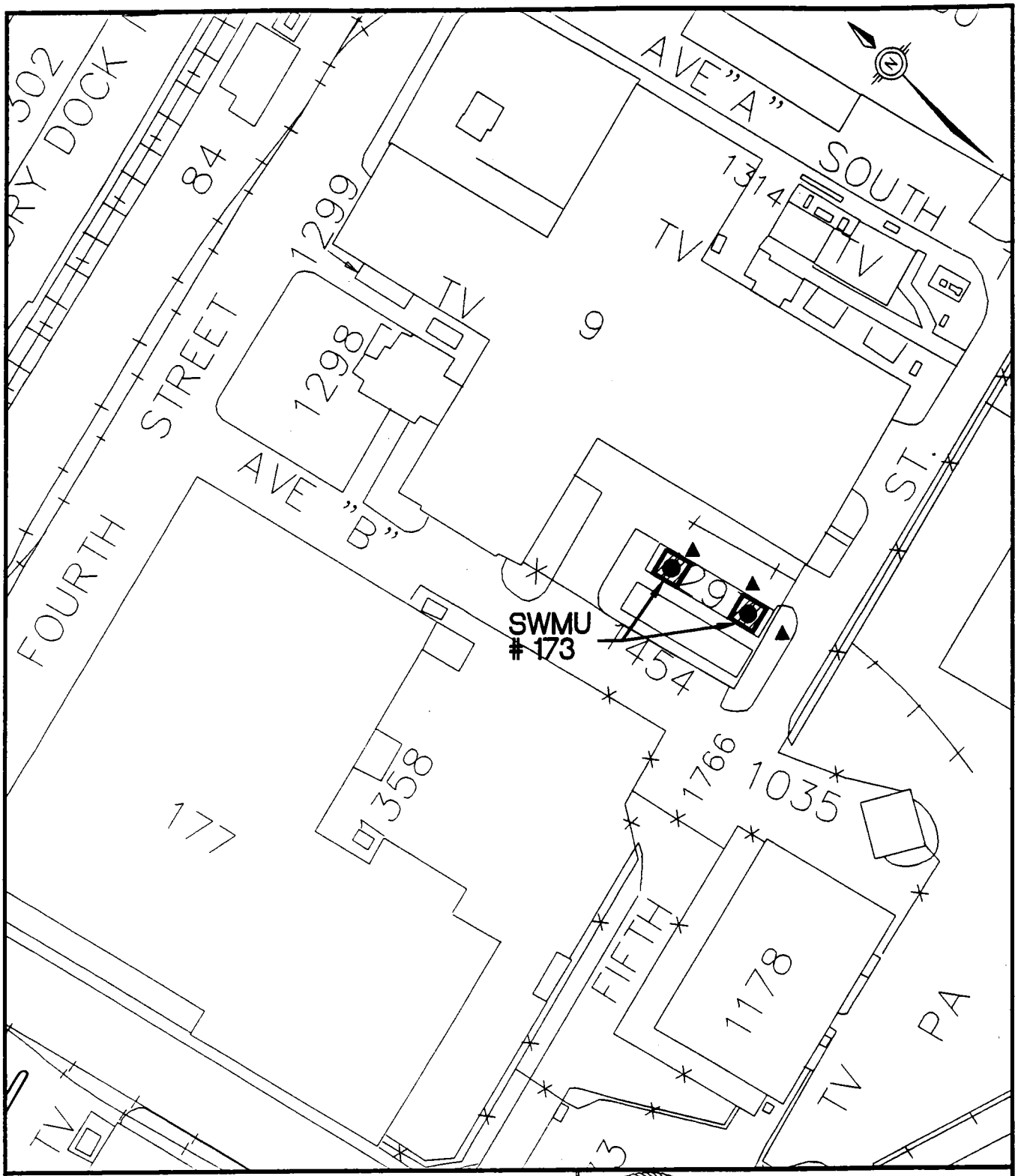
To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.39 summarizes the types of samples to be collected and the analytical parameters. Three sediment samples are proposed from the storm drains adjacent to this site due to the potential release of contaminated surface water runoff. Additionally, a soil boring will be drilled within the floor of the lead and hazardous material storage areas. Figure 2-18 presents the soil and sediment sample locations for this site. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

Table 2.39
SWMU 173
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	2	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs.
Soil (3-5' bgs)	2	
Sediment	3	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

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FIGURE 2-18
SWMU #173
BUILDING 1297
STORAGE AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE18

2.20 AOC 525, Paint Booth No. 35, Building 223

AOC 525 is a paint booth (No. 35) in Building 223. This site has been designated for an RFI. Table 2.40 describes the site.

Table 2.40
AOC 525
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 525 Paint Booth (No. 35)	This site consists of a paint booth (No. 35) in Building 223. Booth 35 is the oldest of the paint booths and is used to paint miscellaneous parts. The booth is 20' x 20' x 15' with a 3' diam. 15' high stack. This booth operates under a South Carolina Bureau of Air Quality Control Permit. Before 1972, water used to capture paint dust from the booths was discharged directly into the storm sewer system. [1]	Paints Solvents (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.20.1 Previous Investigations

This site has not been previously investigated.

2.20.2 Data Gaps

Currently limited environmental media data have been collected to characterize the site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental media data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.20.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater samples will be collected. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will support the technical evaluation of treatment alternatives.

2.20.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.41 summarizes the types of samples to be collected and the analytical parameters. Figure 2-19 presents the proposed soil boring and monitoring well locations. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

The proposed subsurface sample locations illustrated on Figure 2-19 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings will require coring through concrete. Because soil gas is a potential migration pathway, all borings and wells will be screened with a PID.

Table 2.41
AOC 525
Sampling Plan

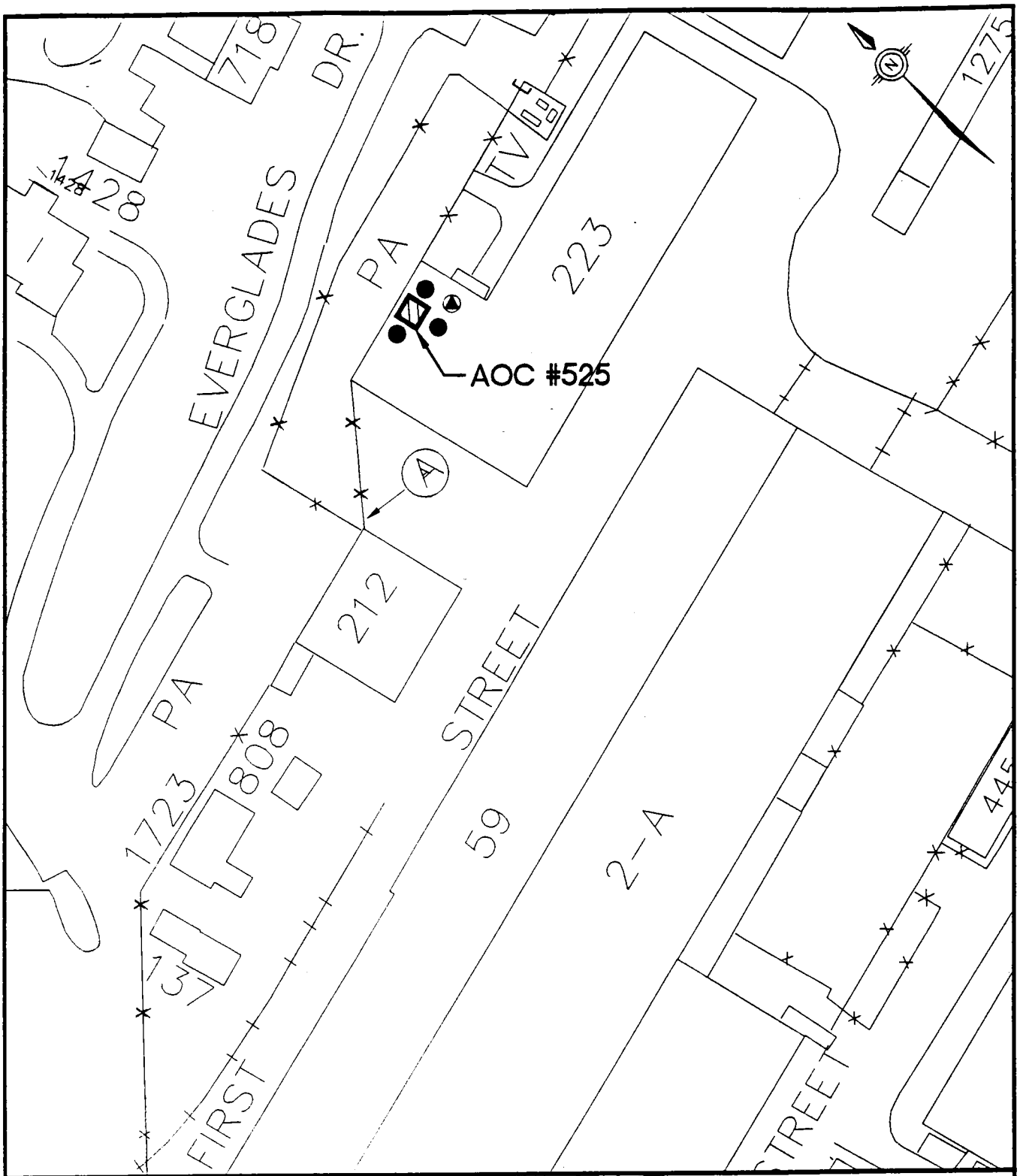
Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3-5' bgs) Groundwater (shallow wells)	3 3 1	VOAs and SVOAs w/ TICs, Metals (including organotins), cyanide, pesticides, and PCBs

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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FIGURE 2-19
AOC #525
PAINT SHOP
BUILDING 223

DWG DATE: 6/2/95 | DWG NAME: FIGURE19

2.21 AOC 528, Steam Cleaning Shop

AOC 528, a former steam cleaning shop, once operated along the western side of Building 59. The boiler shop has been in Building 59 since 1975. This site has been designated for a CSI. Table 2.42 describes the site.

Table 2.42
AOC 528
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 528 Steam Cleaning Shop	The steam cleaning shop was used to clean boiler parts. Boiler tubes preserved with Cosmoline® grease to prevent rust, were received at the boiler shop. The Cosmoline® was removed in Building 59 by a bath of kerosene, and all remaining grease was removed in another bath of hot water, trisodiumphosphate, caustic, and detergents. After the second bath, the tubes were steam rinsed at the steam cleaning shop. Although this operation did not generate hazardous waste, it did produce approximately 800 gallons of contaminated kerosene semiannually. The contents of the second bath and the steam cleaning operation were discharged to the sanitary sewer. Before installation of the sanitary sewer, waste was discharged to the Cooper River via the combined sewer system. [1]	Caustic Petroleum Hydrocarbons Kerosene (VOCs, SVOCs, pH)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.21.1 Previous Investigations

This site has not been investigated previously.

2.21.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are

sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.21.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing the whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.21.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.43 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 528 are illustrated in Figure 2-20. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the steam cleaning operation or the sanitary sewer drainage system within the shop boundaries. One sediment sample will be collected, if it is available, from the floor drain basin.

The proposed subsurface sample locations on Figure 2-20 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated

unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both.

Table 2.43
AOC 528
Sampling Plan

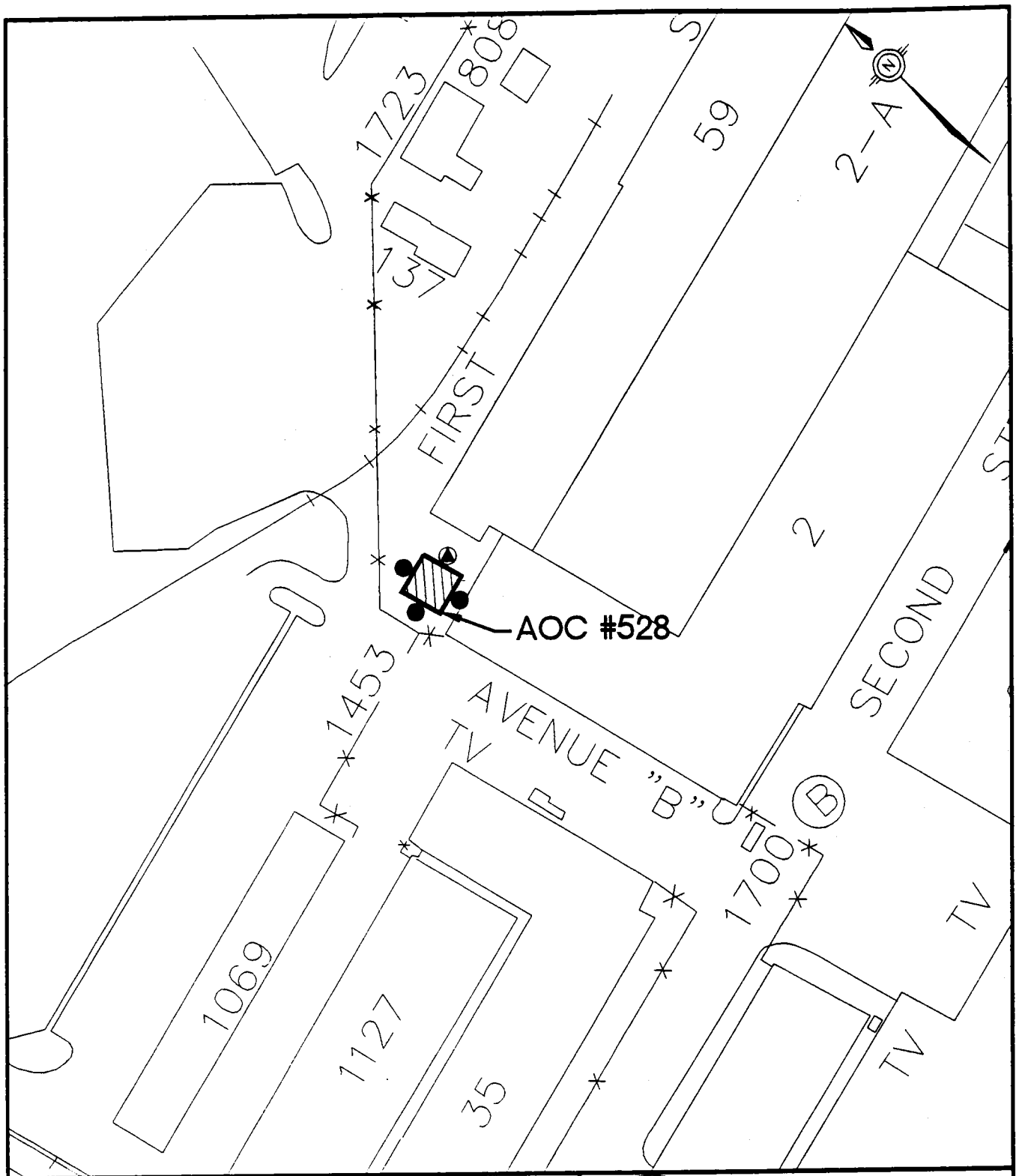
Matrix	Quantity	Analysis
Soil (0-1' bgs)	3	VOA & SVOA w/TICs, pH.
Soil (3'-5' bgs)	3	
Sediment From Floor Drain	1	
Groundwater (shallow wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-20
AOC #528
STEAM CLEANING SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE20

2.22 AOC 530, Paint and Oil Storage, Building 35

AOC 530, paint and oil storage areas, were in Building 35. This site has been designated for a CSI. Table 2.44 describes the site.

Table 2.44
AOC 530
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 530 Paint and Oil Storage	From 1913 to 1939, Building 35 was used to store paint and oil. Additions were made to the building in the 1930s. The Publication and Printing Service was in Building 35 from 1949 to 1979. This service supplied the printing needs of much of the 6th Naval District. Before 1979, wastes generated at Building 35 included an unknown quantity of ferric chloride acid etching bath, lithographic developing solution, and photographic developing solution. The building was used to store paints and oils from 1913 to 1939. Currently, Building 35 is a training facility for welding students. [1]	Alcohols Paints Solvents Petroleum Hydrocarbons Heavy Metals (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with material generated or stored.

2.22.1 Previous Investigations

This site has not been investigated previously.

2.22.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.22.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.22.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.45 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 530 are illustrated in Figure 2-21. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the paint and oil storage areas. Three surface soil samples are proposed for the western portion of AOC 530 due to the fact that the foundation of Building 35 is elevated 18 inches above the ground surface. Surface soil samples will be collected with stainless steel spoons to an approximate depth of 6 inches. The surface soil samples will be taken from the crawl space between the foundation and the ground surface in proximity to the western storage area. The eastern portion of the Building 35 floor is covered with a thick steel plate that will prevent the installation of soil borings in that area. Soil borings will be installed along the eastern edge of the building.

The proposed subsurface sample locations illustrated on Figure 2-21 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID. Installing soil borings will require coring through asphalt, concrete, or both.

Table 2.45
AOC 530
Sampling Plan

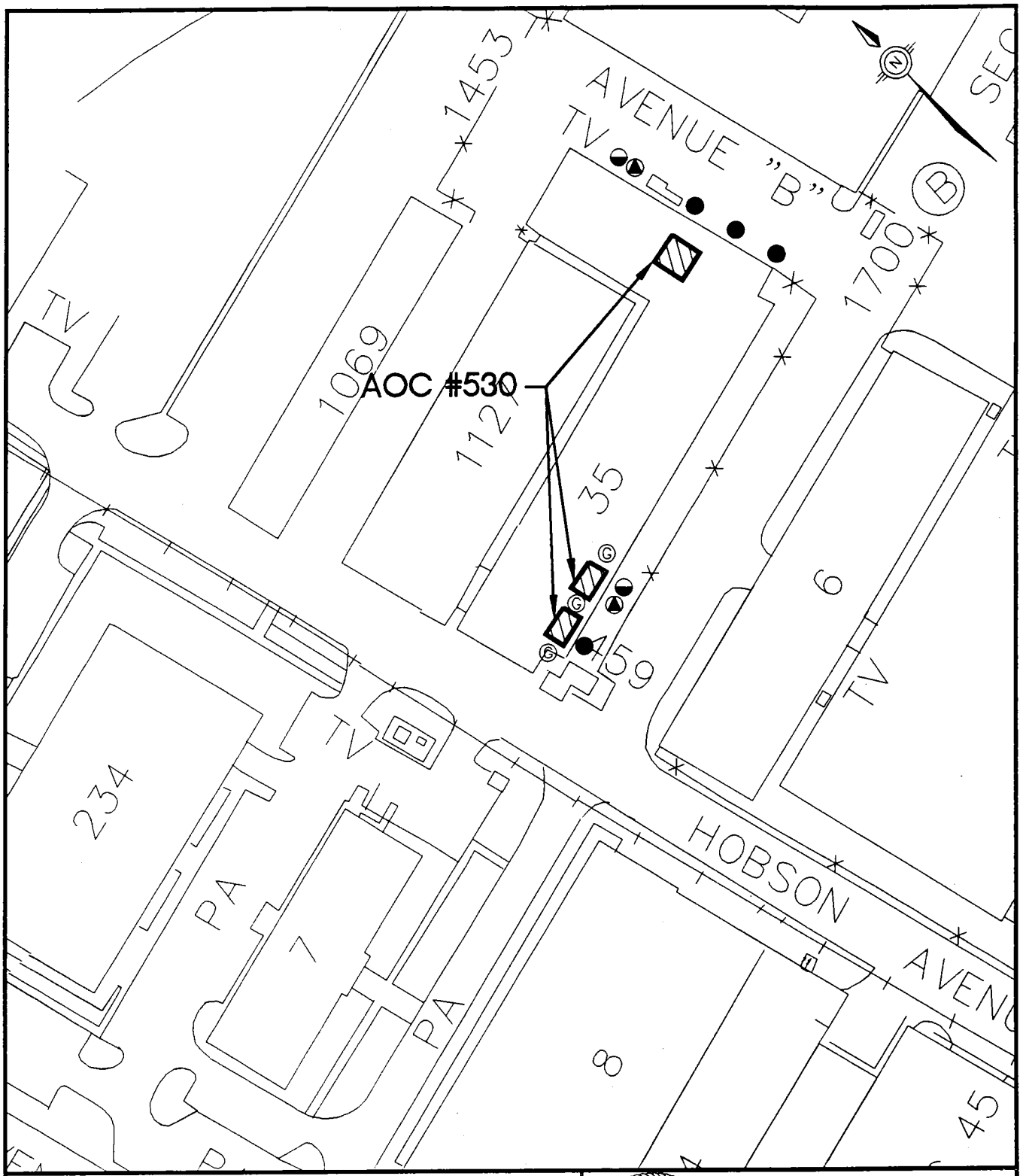
Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	VOA & SVOA w/ TICs, Metals.
Soil (3'-5' bgs)	4	
Surface Soil (0-6" bgs)	3	
Groundwater (shallow wells)	2	
Groundwater (deep wells)	2	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
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CHARLESTON, S.C.

FIGURE 2-21
AOC #530
PAINT AND OIL STORAGE
BUILDING 35

DWG DATE: 6/2/95

DWG NAME: FIGURE21

2.23 AOC 531, Substation and Storage, Building 459

AOC 531 is a substation and storage area in Building 459, which was constructed in 1974. This site has been designated for a CSI. Table 2.46 describes the site.

Table 2.46
AOC 531
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 531 Substation and Storage	Building 459, used for storage and an enclosure for a substation was constructed in 1974. The building has two sections: a metal enclosure containing high-voltage switches and a transformer; and a concrete building containing a battery bank and supplies to maintain it. A 1986 UST Registration document reports the presence of a 20,000-gallon fuel oil tank.[1]	Batteries Dielectric Fluid Petroleum Hydrocarbons (VOCs, SVOCs, Metals, pH)[3]	Air **Soil** Soil Gas Groundwater **Surface Runoff**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with material generated or stored.

2.23.1 Previous Investigations

This site has not been investigated previously, but a 1986 Phase I UST Registration document reports a 20,000-gallon fuel oil underground storage tank (UST) is present at this facility.

2.23.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The UST presence will be verified.

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.23.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether the UST exists and COPCs are present for the identified migration pathways. In order to fill these gaps, soil and concrete wipes will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.23.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.47 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 531 are illustrated in Figure 2-22. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the battery and switch gear areas. The westernmost soil boring and surface soil sample installed at AOC 530 will share data with AOC 531.

The proposed subsurface sample locations illustrated on Figure 2-22 have been chosen based on a number of variables including: proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be

considered preliminary until field-checked. In addition to the soil borings, four wipe samples will be collected from the transformer vault floor. The wipe samples will be arranged in a pattern surrounding the transformer to detect any possible migration pathway of released dielectric fluid. The utilities subcontractor will be responsible for verifying the presence of the UST. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both. Because soil gas is a migration pathway, all borings and sampled will be screened with a PID.

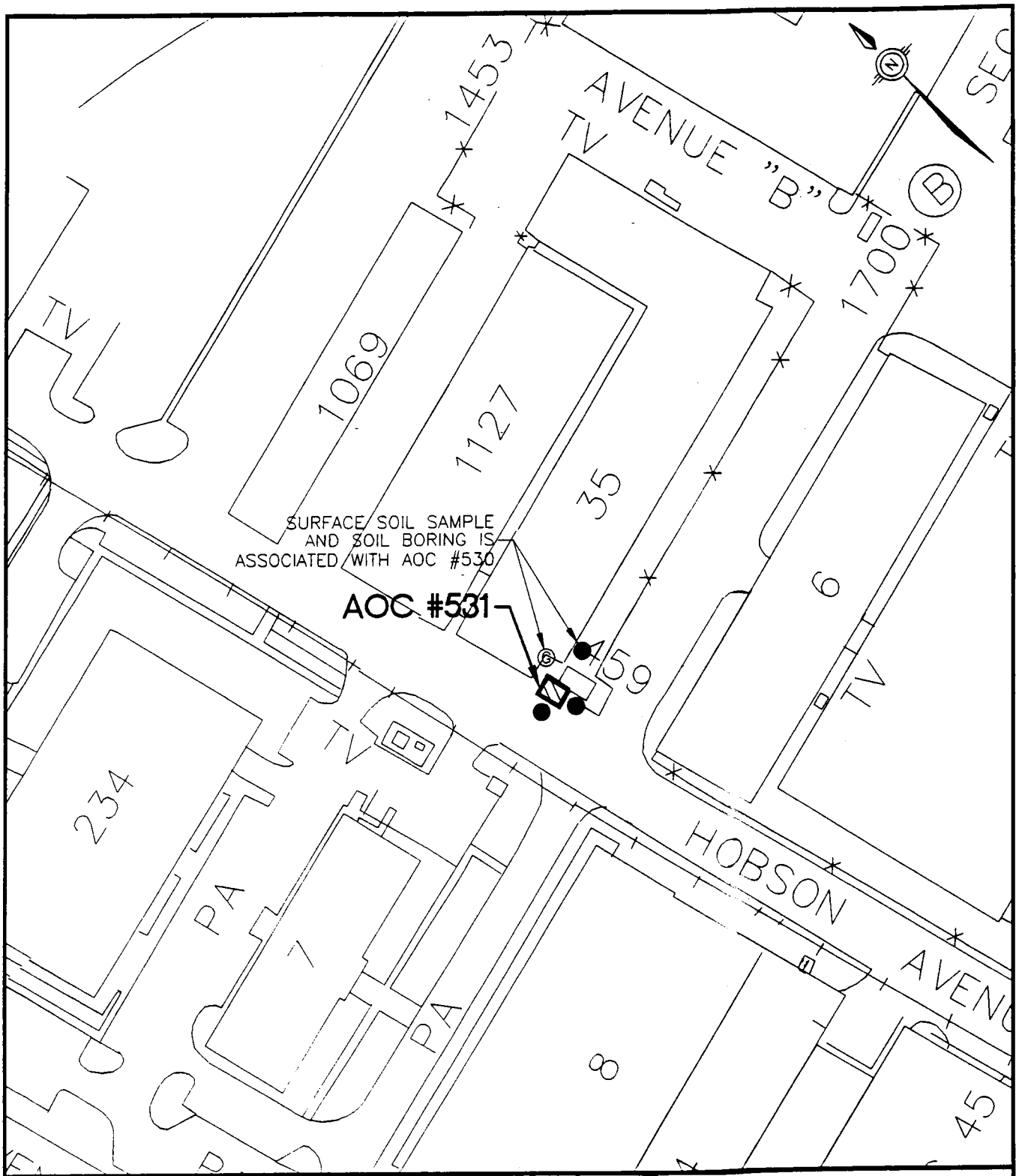
Table 2.47
AOC 531
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3'-5' bgs) Concrete Wipe Samples	2 2 4	VOA & SVOA w/ TICs, Metals, PCBs, pH.

Notes:
Wipe samples will be analyzed for PCBs only.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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CHARLESTON, S.C.

FIGURE 2-22
AOC #531
SWITCHING SUBSTATION
BUILDING 459

DWG DATE: 6/2/95 | DWG NAME: FIGURE22

2.24 AOC 538, Forge Shop, Building 6; and AOC 539, Propeller Shop, Building 6

AOC 538, a forge shop, and AOC 539, a propeller shop, are both in Building 6. These sites have been designated for an RFI. Because their proximity enables sharing sampling locations, they will be grouped for work plan and investigation purposes. Table 2.48 describes the sites.

Table 2.48
AOC 538 and AOC 539
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 538 **Forge Shop**	The forge shop is in the eastern portion of Building 6. Various metal-working processes are conducted in the shop. The forge furnaces are currently oil-fired. Numerous quench oil tanks are also present.	Waste Oils and Paints Heavy Metals Ceramic Refractory Materials Galvanizing Flux Coal and Charcoal Coke (VOCs, SVOCs, Metals)[3]	**Air** **Soil** Soil Gas **Groundwater**
AOC 539 **Propeller Shop**	The propeller shop is in the western extension of Building 6, added in 1967. The Zyglo process was used here until it was replaced by the existing red dye process in 1979. Zyglo reportedly was rinsed from the propellers onto the floor and then outside into the storm sewer. Current operations use a red dye magnaflux process, which is collected in a portable tank.[1]	Zyglo Penetrant (99% 1,1,1-trichloroethane) (VOCs)[3]	**Air** **Soil** Soil Gas **Groundwater** **Sediment** Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volumes I and II , November 22, 1994.
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.24.1 Previous Investigations

Although these sites have never been officially investigated, Code 462.11 (Public Works Department) filled out an Environmental Incident Report on January 25, 1989, responding to a wastewater spill from the magnaflux inspection of propellers into the storm drainage system. The report states that 200 gallons of rinse water with trace amounts of benzene, ethanol, and ethyl acetate were washed to a storm drain in the street because the sanitary sewer drain was blocked (source: Environmental Incident Report #89-01).

2.24.2 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.24.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing COPCs for the identified migration pathways. In order to fill these gaps, air, soil, sediment, and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any air, soil, sediment, and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.24.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Proposed sample locations for AOC 538 and AOC 539 are illustrated in Figure 2-23. Table 2.49 summarizes the types of samples and analytical parameters. The soil boring and shallow groundwater monitoring well shown in Figure 2-23 along the east side of Building 6 will be shared with the investigation for AOCs 541 and 542. One sediment sample will be collected, if it is available, from the floor drain basin nearest the Zyglo penetrant operation.

All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the forge and propeller shops. The proposed subsurface sample locations illustrated on Figure 2-23 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both.

Heavy metals have been identified as COPCs and an air exposure pathway identified. In order to evaluate this exposure pathway both air samples and wipe samples will be collected.

Air samples will be collected and analyzed in accordance with SCDHEC R.61-62.5 which states "the analytical methods to be used will be those applicable Federal Reference Methods published in 40 CFR 50, Appendices A-H as revised July 1, 1986." The specific procedures to be followed are contained in 40 CFR, Part 50, Appendix J — *Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere*, with further chemical analysis of the filter for lead and heavy metals as allowed in Appendix J, and as specified in 40 CFR 50, Appendix G — *Reference Method for the Determination of Lead in Suspended Particulate Matter Collected From Ambient Air.* Attachment 2 contains the applicable State and Federal guidelines. Also included in Attachment 2 is the instruction and operations manual for the high volume PM_{10} sampler. Chemical analysis of PM_{10} filters will be for specific heavy metals based on the results of wipe samples collected from the area. This sampling technique collects particulates that have an aerodynamic size of 10 microns and less, i.e., the particulate size range of toxicological interest. Air samples

will be collected at three locations within Building 6. Samples will be collected at each location for five consecutive work days. If possible, the building's HVAC system will operate in its "normal" mode during the sample collection period.

Wipe samples will be collected in accordance with the wipe sample procedure contained in the *Final Comprehensive Sampling and Analysis Plan (CSAP)* and EPA Region IV's Environmental Compliance Branch *Standard Operating Procedures Quality Assurance Manual, February 1, 1991*. When collecting wipe samples for metals, distilled or deionized water may be used as a solvent (*Air Monitoring for Toxics,* Shirley A. Ness, Van Nostrand Reinhold, New York, 1991). Wipe samples will be collected from the floor, walls, beams and other surfaces where metal dusts and fumes could settle.

Sample location and frequency is based on information contained in Section 3.6.3.2 Sample Locations and Frequency of the *RFI Guidance Manual.* Eight wipe samples will be collected from the floor. Sample locations will be selected randomly. In addition, eight samples will be collected from surfaces above the floor. These locations will be selected judgmentally, based on observed discoloration, proximity to "emitting processes" and likelihood to collect settled dust and fumes.

Table 2.49
AOC 538 and AOC 539
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	9	VOA & SVOA w/ TICs, Metals.
Soil (3'-5' bgs)	9	
Groundwater (shallow wells)	3	
Groundwater (deep wells)	1	
Sediment from Floor Drain (AOC 539)	1	
Air Samples	Random	
Structural Wipe Samples	16	

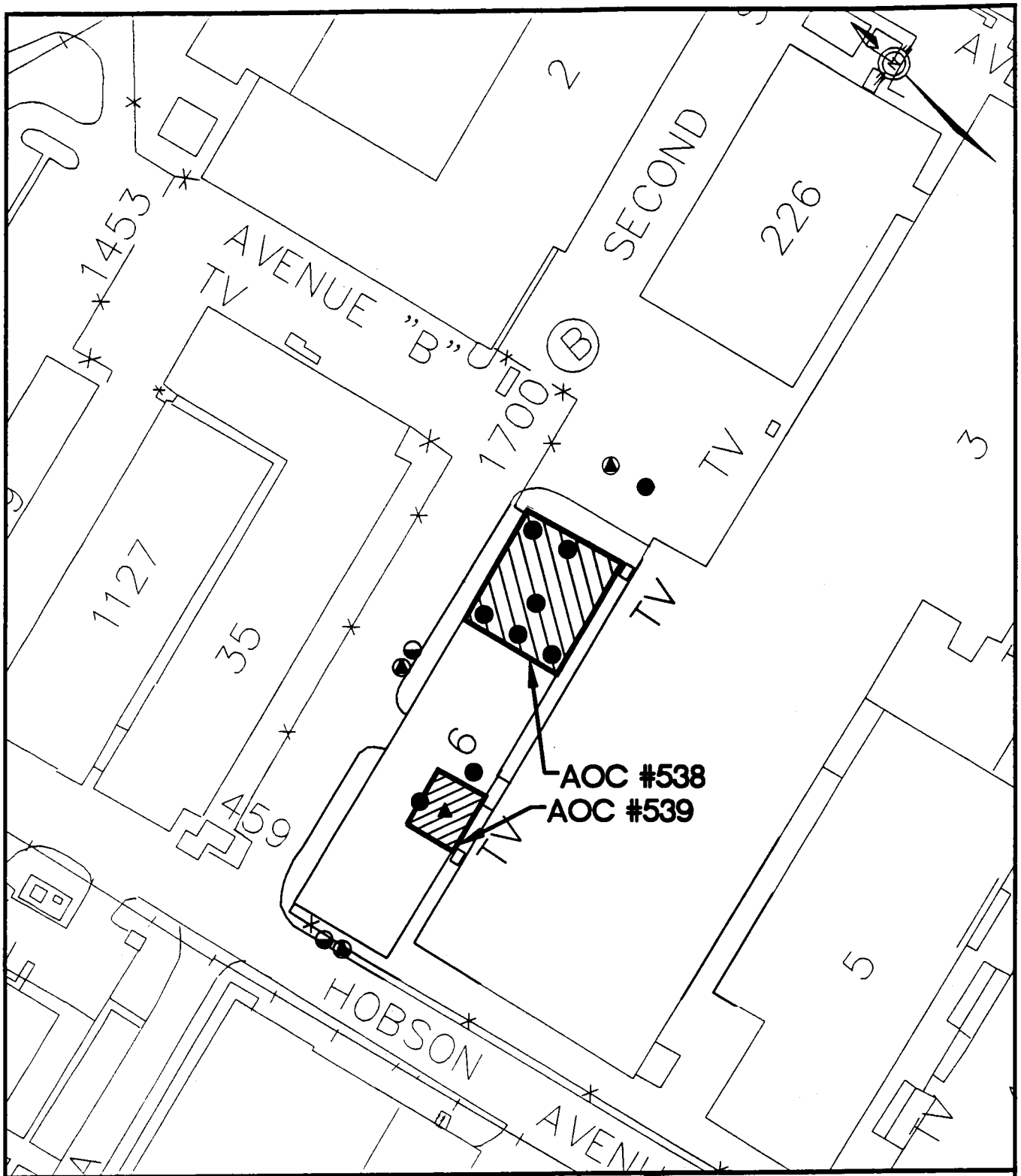
Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

Wipe Samples will be analyzed for metals only.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◬ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-23
AOC #538
BUILDING 6, FORGE SHOP
AOC #539
BUILDING 6, PROPELLER SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE23

2.25 AOC 550, Boiler House, Former Building 1111

AOC 550 is former Building 1111, a transportable boiler house for the U.S. Marine Corps from 1927 to 1941. This site has been designated for a CSI. Table 2.50 describes the site.

Table 2.50
AOC 550
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 550 Boiler House	The dimensions of this facility are unknown, but it is known that former Building 1111 is shown at two locations on historic base maps. Personnel interviews indicate that this facility was transportable. No other information was found during the RFA regarding its design features or operating practices.[1]	Petroleum Hydrocarbons Heavy Metals (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** Sediment Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II , November 22, 1994.
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.25.1 Previous Investigations

This site has not been investigated previously.

2.25.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

- Former Building 1111 is shown at two different sites on historic base maps. There are no engineering drawings to support locating this former facility.

2.25.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing COPCs for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.25.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.51 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 550 are illustrated in Figure 2-24. AOC 550 is shown in two different locations on historic maps. An equivalent investigative level of effort is proposed for each location as Figure 2-24 shows. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from either former boiler house area.

The proposed subsurface sample locations illustrated on Figure 2-24 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Coordination with the Public Works Department will be needed for the soil borings and monitoring well due

south of Building 62 because of their proximity to the portal crane rails along Pier C. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both.

Table 2.51
AOC 550
Sampling Plan

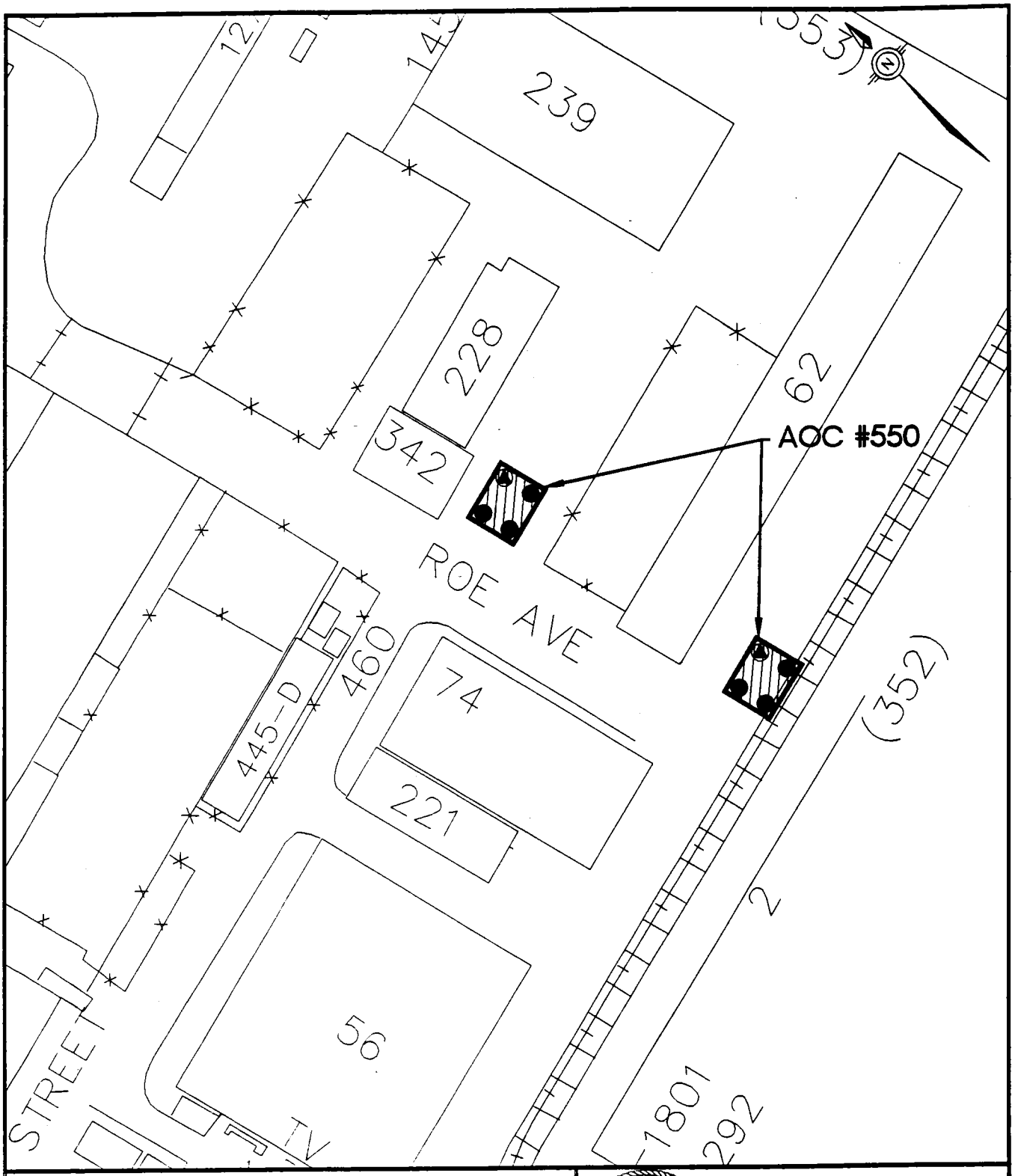
Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3'-5' bgs) Groundwater (shallow wells)	6 6 2	VOA & SVOA w/ TICs, Metals.

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- ◬ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◬ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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NAVAL BASE CHARLESTON
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FIGURE 2-24
AOC #550
BOILER HOUSE
FORMER BUILDING 1111

DWG DATE: 6/2/95 | DWG NAME: FIGURE24

2.26 AOC 551, Boiler House, Building 1119; and AOC 552, Former Galvanizing Shop, Building 1030

AOC 551 is Building 1119, a boiler house that operated before 1942. Presently, Building 1119 is used as production offices. AOC 552 is a former galvanizing shop, Building 1030, which operated from 1922 to 1926. These sites have been designated for CSIs. Table 2.52 describes the sites.

Table 2.52
AOC 551 and AOC 552
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 551 Boiler House	The building appears to have undergone drastic renovations, or may have been demolished and rebuilt close to the original site. No records were found regarding the fuel used in the boiler.[1]	Petroleum Hydrocarbons Heavy Metals (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** Sediment Surface Runoff Surface Water
AOC 552 Former Galvanizing Shop	Building 1030 was constructed in 1922 and used as a galvanizing shop until 1926. From 1926 to 1929, the building was a tooling shop. In 1929, the building was converted to a storage shop and was demolished sometime after. Currently, the site is asphalt traversed by a pair of nuclear- grade railroad tracks.[1]	Inorganic Acids Heavy Metals Zinc (VOCs, Metals, pH)[3]	Air **Soil** Soil Gas **Groundwater**

Notes:
1 Described in the Draft-Final RCRA Facility Assessment, Volume II , November 22, 1994.
2 Pathways scheduled for sampling are bold.
3 Analyte groups associated with materials generated or stored.

2.26.1 Previous Investigations

These sites have not been investigated previously.

2.26.2 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection

efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.26.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.26.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.53 summarizes the types of samples and analytical parameters. Proposed sample locations for AOCs 551 and 552 are illustrated in Figure 2-25. The soil borings and groundwater monitoring wells, shown in Figure 2-25 along the south side of Building 1119, are proposed to be installed within the 30-foot prohibition zone surrounding the nuclear-grade rails serving Pier D. Navy approval will have to be obtained before these borings can be installed.

All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the boiler house and galvanizing shop areas.

The proposed subsurface sample locations illustrated on Figure 2-25 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked and, in this case, approved by the Navy. Because soil gas is a potential migration pathway, all borings and samples will be screened with a PID. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both.

Table 2.53
AOC 551 and AOC 552
Sampling Plan

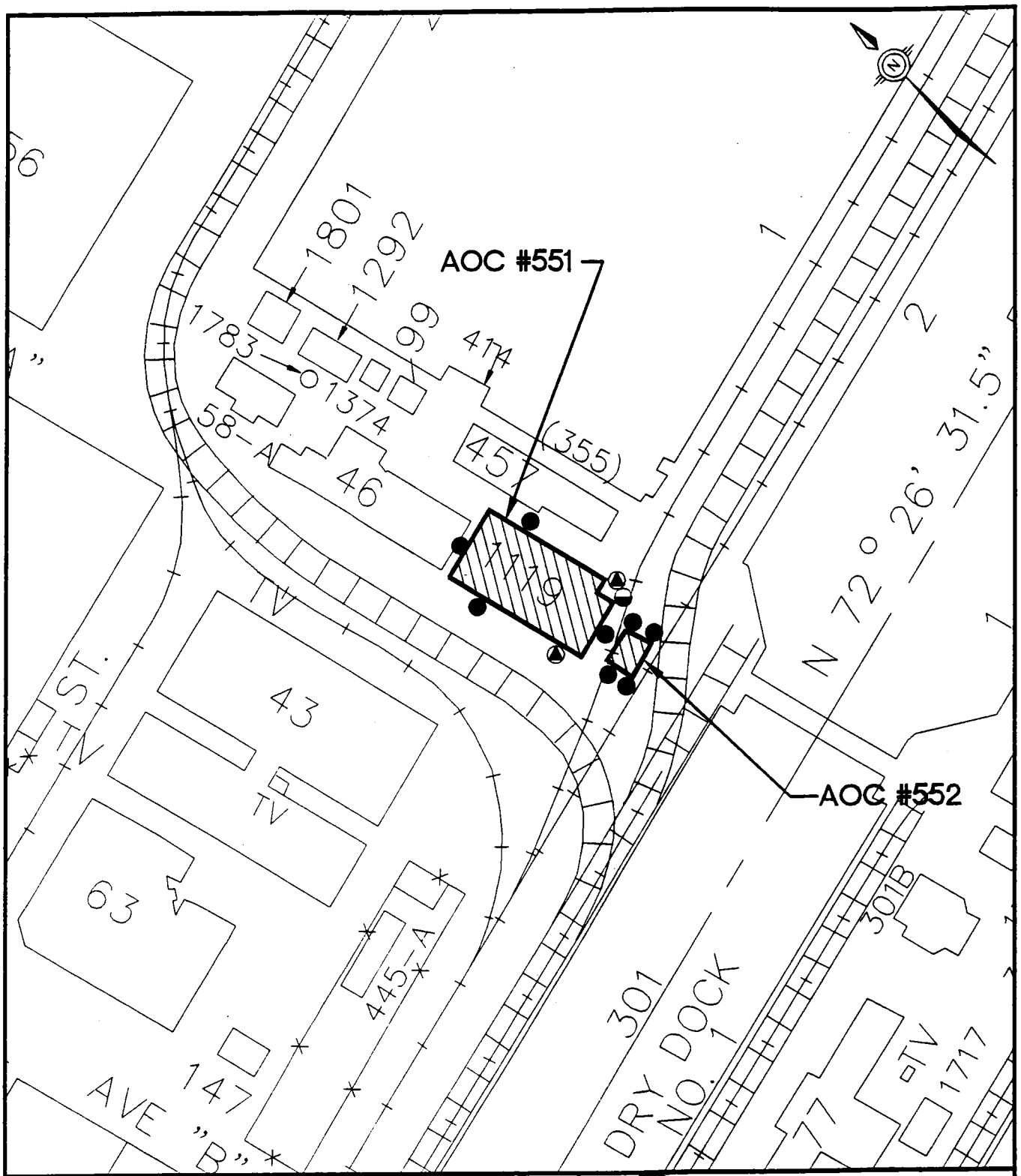
Matrix	Quantity	Analysis
Soil (0-1' bgs)	8	VOA & SVOA w/ TICs, Metals, pH.
Soil (3'-5' bgs)	8	
Groundwater (shallow wells)	2	
Groundwater (deep wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-25
AOC #551
BOILER HOUSE, BUILDING 1119
AOC #552/GALVANIZING SHOP
FORMER BUILDING 1030

DWG DATE: 6/2/95 | DWG NAME: FIGURE25

2.27 AOC 555, Latrine and Substation, Former Building 29

AOC 555 is former Building 29, a latrine and substation constructed in 1922 and used until 1967. This site has been designated for a CSI. Table 2.54 describes the site.

Table 2.54
AOC 555
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 555 Latrine and Substation	Aerial photos show that the facility did not exist after 1967. During operation, it is believed its contents were diverted directly into the Cooper River. No other information was found regarding the size, design features, or operating practices of the site. Presently, the site is asphalt at the corner of Pier D and Quaywall 414.[1]	Organic Wastes Heavy Metals PCBs (Metals, PCBs)[3]	Air Soil Groundwater Soil Gas **Sediment** Surface water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II , November 22, 1994.
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.27.1 Previous Investigations

This site has not been investigated previously.

2.27.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.27.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, sediment will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any sediment contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.27.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.55 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 555 are illustrated in Figure 2-26. AOC 555 is shown in a different location than on the maps in the RFA. It is believed that Figure 2-26 depicts the most accurate location of former Building 29. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the former latrine/substation.

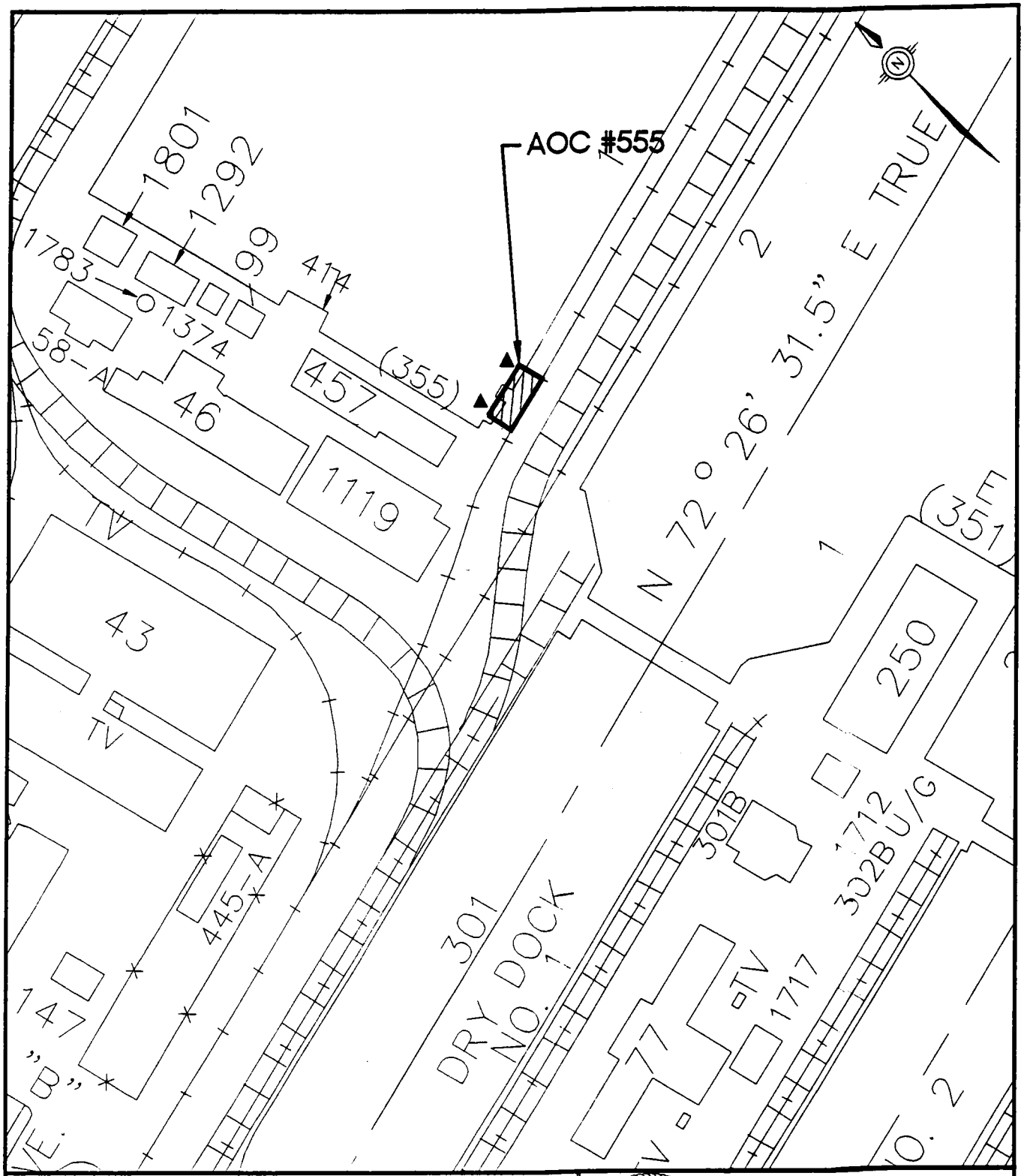
The proposed sediment sample locations illustrated on Figure 2-26 have been chosen based on a number of variables including: the suspected direction of surface water flow, proximity to the investigated unit, suspected location of latrine outfalls, and suspected location of piling supports.

Table 2.55
AOC 555
Sampling Plan

Matrix	Quantity	Analysis
Sediment	2	Metals, PCBs.

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-26
AOC #555
LATRINE
FORMER BUILDING 29

DWG DATE: 6/2/95 | DWG NAME: FIGURE26

2.28 AOC 556, Drydock Discharges

AOC 556 consists of the drydock drains and areas around the mouth of each of the five drydocks. These sites have been designated for an RFI. Table 2.56 describes the sites.

Table 2.56
AOC 556
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 556 Drydock Discharges	The five drydocks were constructed in the following years: DD 1 1907 DD 2 1942 DD 3 1943 DD 4 1943 DD 5 1964 A large, grated drain runs along the middle of the entire length of each drydock. Underground pumps remove the water collected in the drain and direct it to the sanitary sewer system after the drydock is sealed and pumped dry. Outfalls adjacent to the drydock are used to de-water the drydock immediately following the sealing of the caisson. The drydock outfalls were first permitted in May 1995. Operations include ship overhaul, refueling, defueling, welding, painting, mechanical work, and light industrial work. The following outfall designations are based on the National Pollutant Discharge Elimination System (NPDES) permit application (March 1992): DD 1 and DD 2 - Outfall 009; DD 3 and DD 4 - Outfall 010; and DD 5 - Outfall 011.[1]	PCBs Lead Acids Freon Metals Paints Mercury Caustics Solvents Antifreeze Raw Sewage Hydraulic Fluid Cleaning Compounds Petroleum Hydrocarbons Abrasive Blasting Grit (VOCs, SVOCs, Metals, PCBs, pH)[3]	Air Soil Soil Gas **Sediment** Groundwater **Surface Water**

Notes:
[1] Described in the Draft-RCRA Final Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.28.1 Previous Investigations

Numerous releases at the dry docks have been reported. Information from these documents is summarized below.

DD 1: Between February 1979 and November 25, 1992, the following releases were reported: up to 100 gallons of oil, 25 gallons of lube oil, 250 gallons of raw sewage, < 1 gallon of diesel fuel, 200 milliliters of ethylenediamine, 135 gallons of non-PCB mineral oil, 2 gallons of antifreeze, 1 teaspoon of mercury, approximately 3,000 gallons of muriatic acid, and unknown quantities of waste soapy water, paint, discolored discharge water, an unknown white milky liquid, and abrasive blasting grit.

DD 2: Between August 8, 1979, and September 16, 1993, the following releases were reported: up to 100 gallons of oil, 2 ounces of mercury, up to 25 gallons of ammonium hydroxide, 3 pounds of acid, and unknown quantities of cleaning compound, raw sewage, caustic soda, Freon, sodium bicarbonate, paint, grease, sodium hydroxide, PCBs, and abrasive blasting grit.

DD 3: Between April 29, 1981, and January 13, 1993, the following releases were reported: up to 30 gallons of oil, unknown quantities of <50 ppm PCB transformer oil, non-PCB transmission fluid, paint, fuel, hydraulic fluid, PCBs, possible lead, and abrasive blasting grit.

DD 4: A July 30, 1987, environmental incident report states that 7,000 gallons of oil released to the Cooper River from DD 4.

DD 5: Between June 11, 1982, and September 21, 1993, the following releases were reported: up to 100 gallons of oil, up to 100 gallons of raw sewage, and unknown quantities of paint, Gamlen cold wash, mercury, an unknown green liquid, grease, and abrasive blast grit.

2.28.2 Data Gaps

Currently limited environmental media data have been collected to characterize these sites and to support detailed evaluation of treatment alternatives. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The nature and extent of impact to environmental media have not been defined.
- Data are insufficient to support a evaluate treatment alternatives in detail.

2.28.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, sediment and surface water will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any sediment and/or surface water contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.28.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.57 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 556 are illustrated in Figures 2-27 a-c. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the shipyard drydocks.

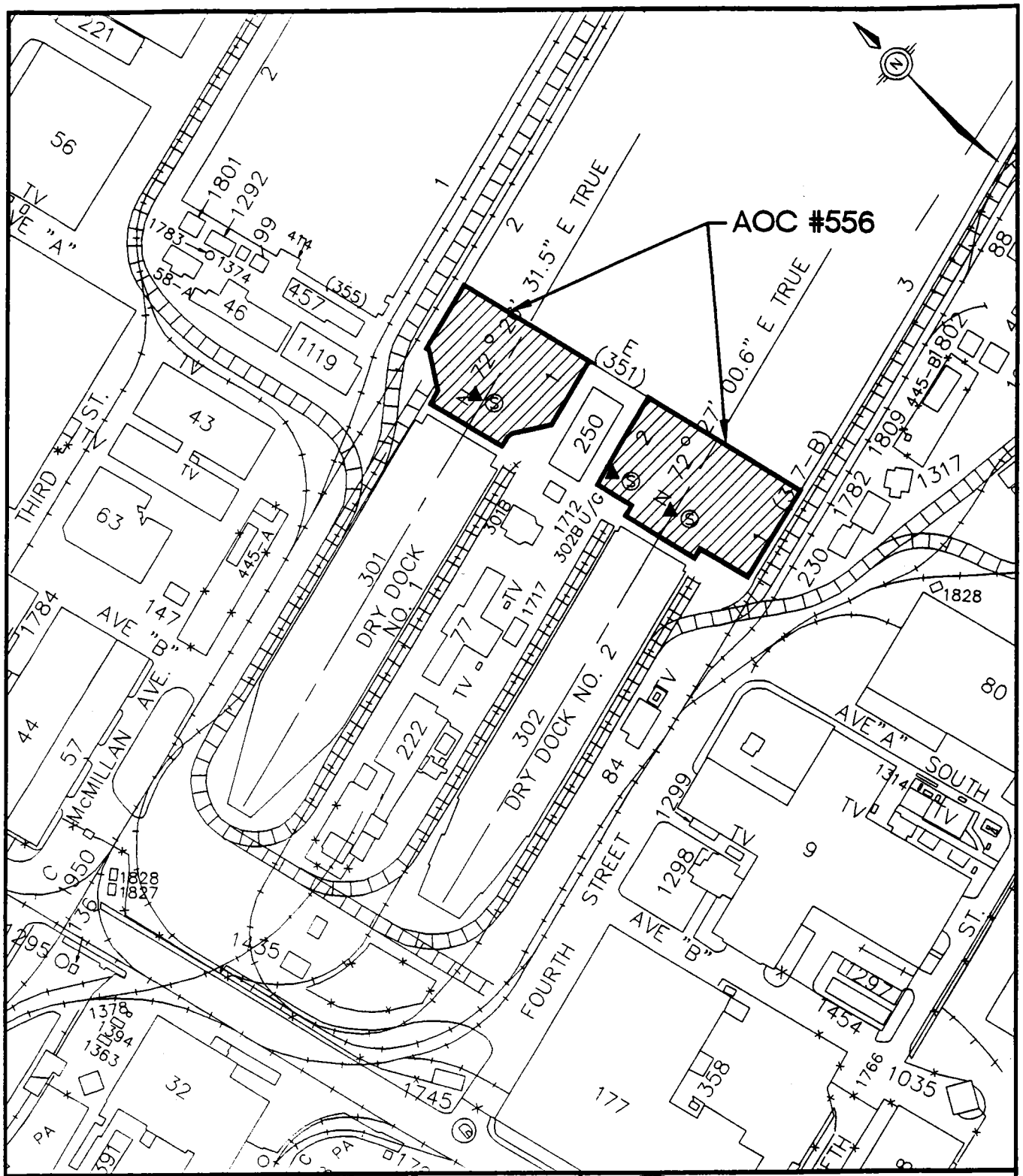
The proposed sediment and surface water sample locations illustrated on Figures 2-27 a-c have been chosen based on proximity to the investigated unit, and the location of drydock outfalls.

Table 2.57
AOC 556
Sampling Plan

Matrix	Quantity	Analysis
Sediment	8	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides and PCBs.
Surface Water	8	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

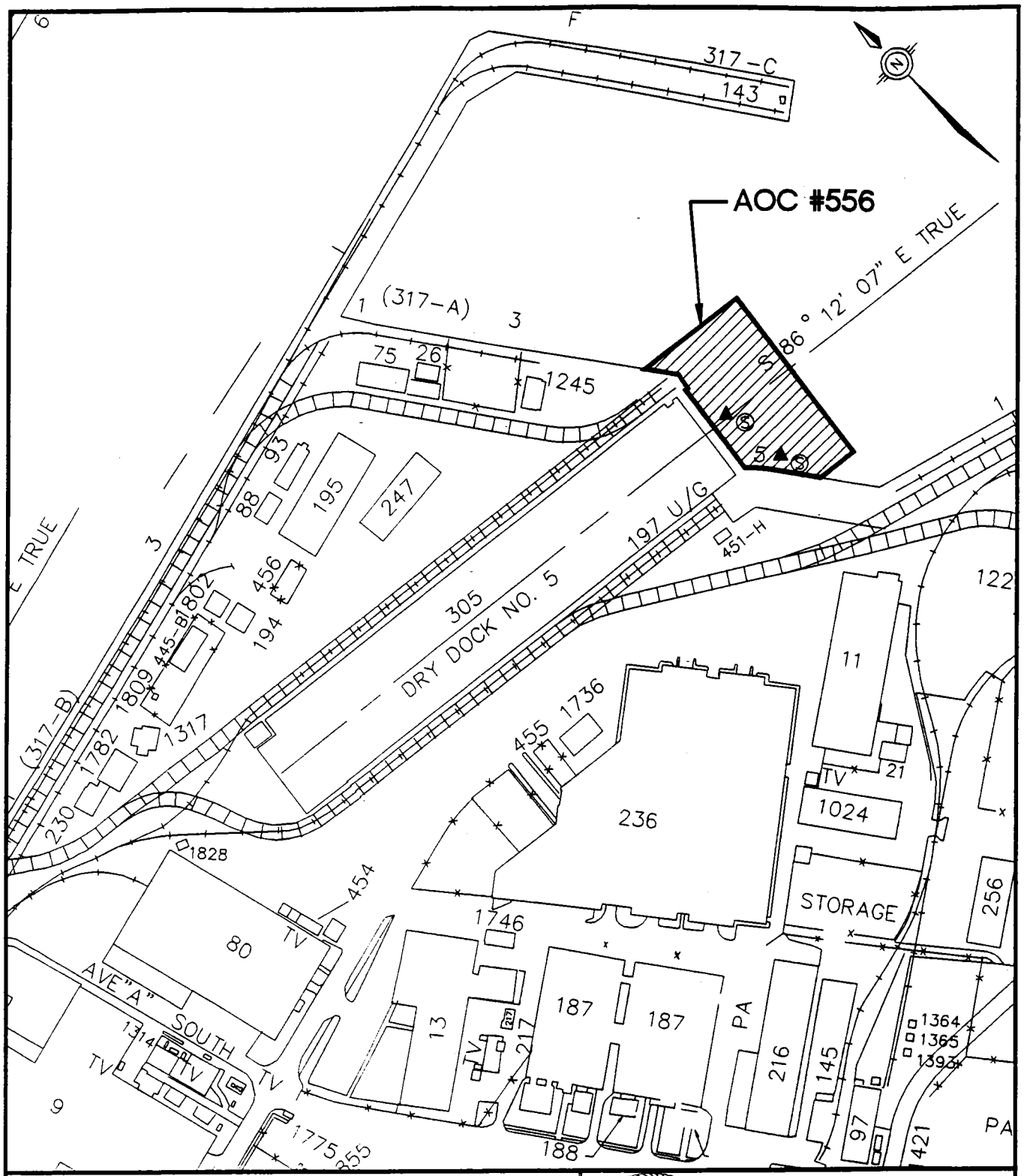
- O – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 250 0 250 500

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-27A
AOC #556
DRY DOCK DISCHARGES
DRY DOCKS #1 AND #2

DWG DATE: 6/2/95 | DWG NAME: FIGUR27A



LEGEND

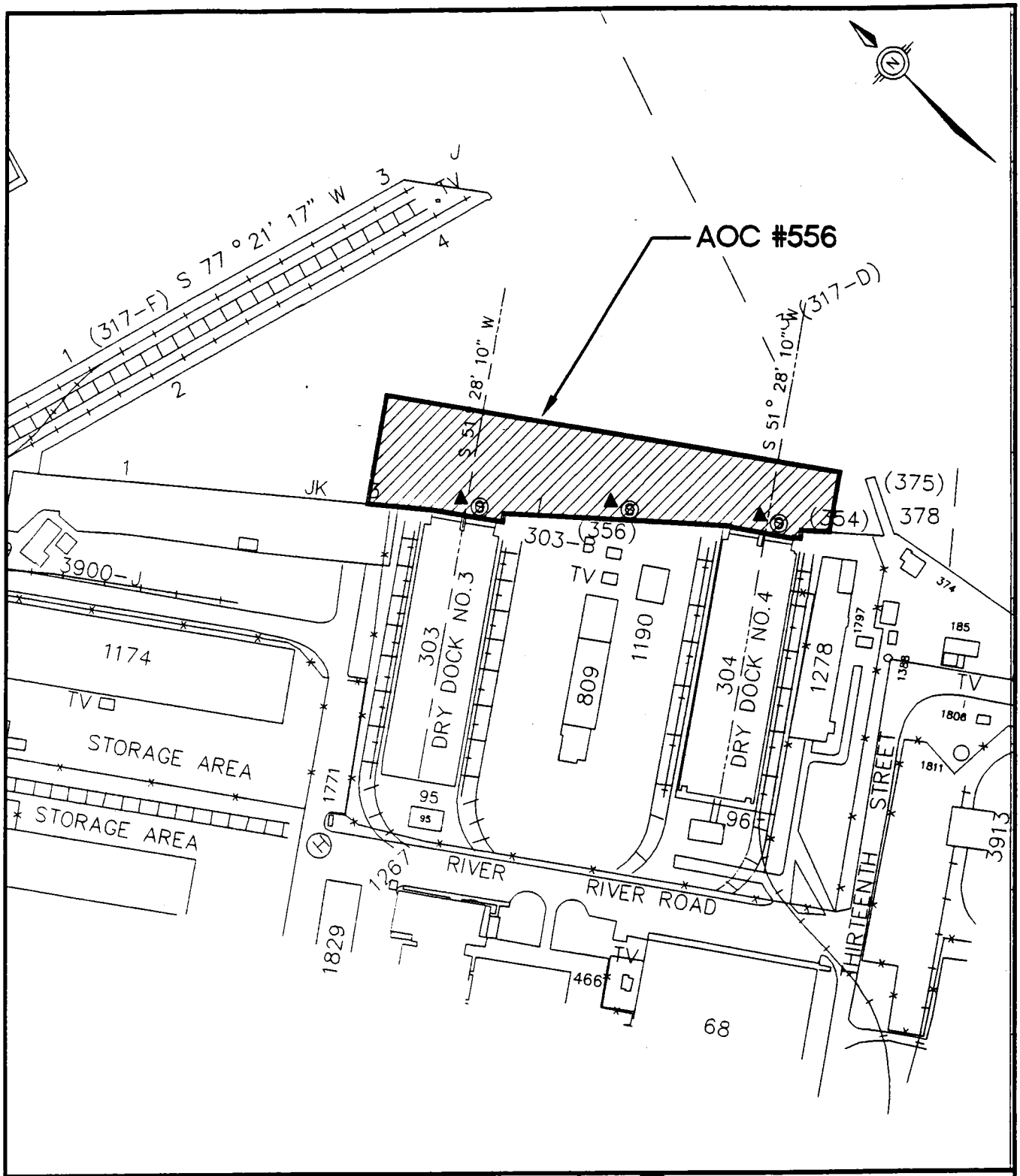
- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 250 0 250 500

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-27B
AOC #556
DRY DOCK DISCHARGES
DRY DOCK #5

DWG DATE: 6/2/95 | DWG NAME: FIGUR27B



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 250 0 250 500

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-27C
AOC #556
DRY DOCK DISCHARGES
DRY DOCK #3 AND #4

DWG DATE: 6/2/95 | DWG NAME: FIGUR27C

2.29 AOC 558, Electrical Substation, Building 77

AOC 558 is an electrical substation, Building 77. This site has been designated for a CSI. Table 2.58 describes the site.

Table 2.58
AOC 558
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 558 Substation	Building 77 is a two-story concrete structure built in 1942. Transformers, switches, and other electrical equipment are housed within the substation. The last PCB-containing equipment was removed in 1991. Reportedly, the cable vaults leading from the substation were cleaned to remove PCBs and asbestos in 1991.[1]	Heavy Metals Ethylene Glycol Monoethanolamine Mercury Perchloroethylene TCE Petroleum Hydrocarbons PCBs (VOCs, SVOCs, Metals, PCBs)[3]	Air Soil Soil Gas **Sediment** Groundwater Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II , November 22, 1994.
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.29.1 Previous Investigations

This site has not been investigated previously.

2.29.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.29.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, concrete cores and surfaces will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or sediment contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.29.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.59 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 558 are illustrated in Figure 2-28. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the electrical substation. Four concrete core samples will be taken from the concrete pads associated with the switchgear located at Building 77 to investigate possible releases of dielectric fluids.

Four wipe samples will be collected from the floor area within the transformer vault. The wipe samples will be arranged in a pattern surrounding the transformer to detect any possible migration pathway of released dielectric fluid.

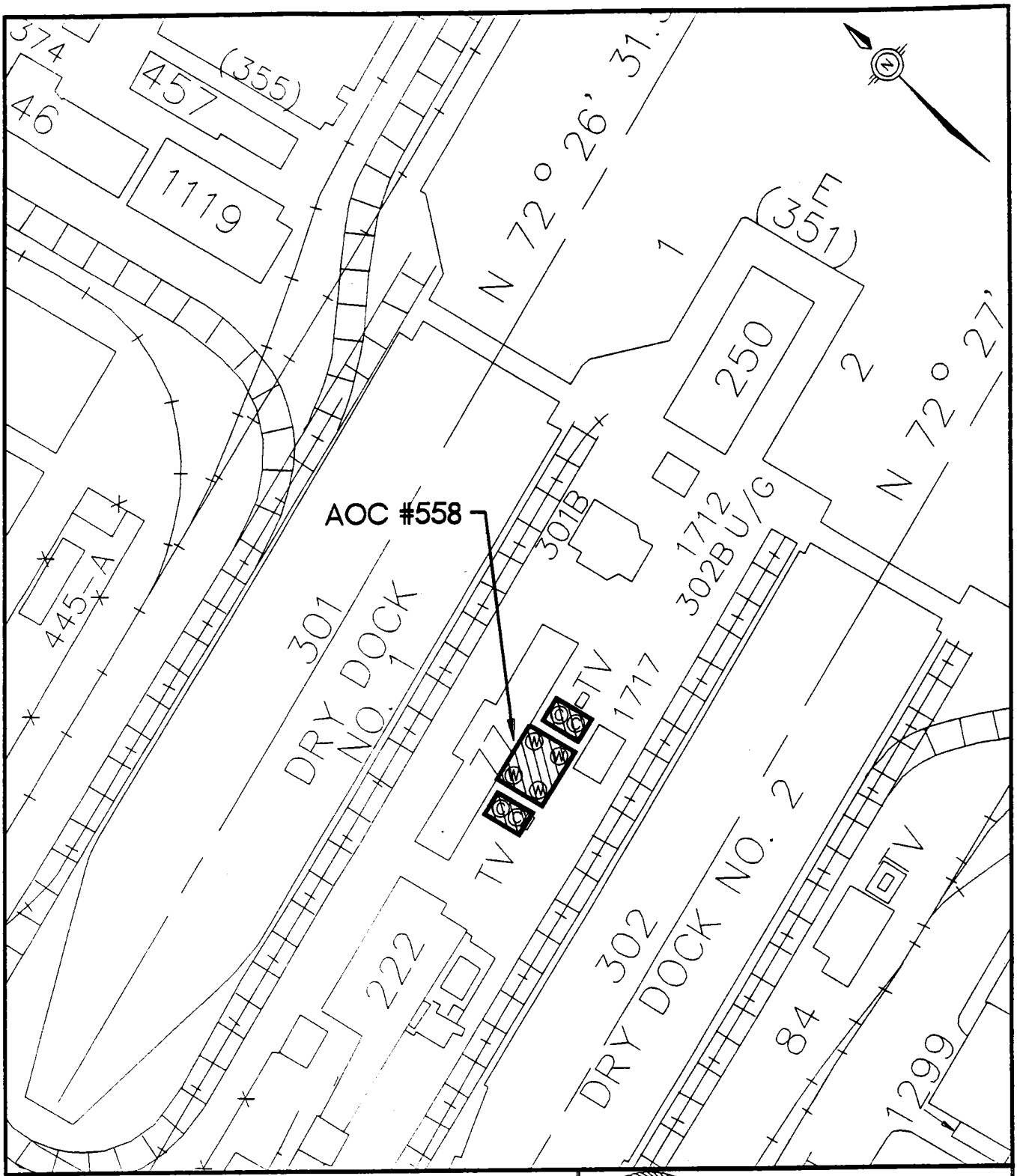
Table 2.59
AOC 558
Sampling Plan

Matrix	Quantity	Analysis
Concrete Core Samples	4	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides and PCBs.
Concrete Wipe	4	

Notes:
Concrete wipe samples will be analyzed for PCBs only.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-28
AOC #558
SUBSTATION
BUILDING 77

DWG DATE: 6/2/95 | DWG NAME: FIGURE28

2.30 AOC 559, Central Power Station, Building 32; AOC 560, Disinfector, Building 34; and AOC 561, Substation, Building 451B

AOC 559 consists of Building 32, the central power station constructed in 1909 and still used today. AOC 560 is former Building 34, a disinfector used during the 1920s and 1930s. AOC 561 is Building 451B, a substation constructed in 1944. Because their proximity enables these sites to share sampling locations, they will be grouped for work plan and investigation purposes. These sites have been designated for an RFI. Table 2.60 describes the sites.

Table 2.60
AOC 559, AOC 560, and AOC 561
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 559 Central Power Station	Building 32 is a three-story brick and concrete structure with concrete floors. The building was constructed in 1909 for steam and electric generation and still serves that purpose. The power plant has historically burned coal, fuel oil, and diesel fuel. Air emissions from this facility are permitted under CNSY Air Permit No. 0560-0002.[1]	Solvents Heavy Metals Lube Oil Morpholene PCBs Acids/Caustics Oils/Oily Wastes Trisodiumphosphate (VOCs, SVOCs, Metals, PCBs, pH)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff
AOC 560 Disinfector	Former Building 34 was labeled as a disinfector on base maps during the 1920s and 1930s. No visible evidence of the disinfector remains. It is believed that the disinfector treated water prior to use in the power plant, or treated steam with a rust inhibitor after it was generated. Chlorine or iron-reducing agents are the most likely disinfection agents that may have been used.[1]	Iron-Reducing Agent Chlorine VOCs (VOCs)[3]	Air **Soil** Soil Gas **Groundwater**
AOC 561 Substation	Building 451B is a substation constructed in 1944. The substation has three parts: a weatherproof metal enclosure containing the switch gear; a pad-mounted, high-voltage transformer with feed towers; and a battery bank housed in a two-room area. The substation is one of the principal feeds for electrical power to the shipyard and the CIA.[1]	Dielectric Fluid (PCBs)[3]	**Soil** **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II , November 22, 1994.
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.30.1 Previous Investigations

Numerous releases have been reported at the central power station. Select information from documents collected in the Environmental Baseline Survey are summarized below.

- Environmental Incident Report No. 86-137: On November 7, 1986, a 55-gallon drum of transformer oil dated March 1984 was punctured by a forklift and found leaking on pavement behind Building 32. A PCB screen test run on the oil was negative. The spilled oil was picked up with absorbent and the drum was taken to the old corral at Building 1515 to be disposed of as waste oil.

- Environmental Incident Report No. 85-06: On January 30, 1985, approximately 2 gallons of residual fuel oil spilled from a transfer hose to the ground and a catch basin under the precipitator on the south side of Building 32. Oil absorbent was spread over the spill and the oil was contained in the basin. The spill was ultimately cleaned up on February 4, 1985.

- Environmental Incident Report No. 89-41: On July 12, 1989, approximately 20 gallons of 4 percent hydrochloric acid flush solution leaked out of a boiler onto the deck, and into a storm drain. The spill was secured and sodium bicarbonate was used to neutralize the acid solution.

- Environmental Incident Report No. 88-15: On February 19, 1988, an anonymous worker reported antifreeze solution being dumped from diesel generators into the storm drain at Building 32. The storm drain was flushed and a policy implemented that Shop 03 will drain all coolant into 55-gallon drums and turn them in to Code 106 for disposal.

2.30.2 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.30.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, soil gas, and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil, and groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.30.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.61 summarizes the types of samples and analytical parameters. Proposed sample locations for AOCs 559, 560, and 561 are illustrated in Figure 2-29. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding these sites, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the central power station, former disinfector, or electrical substation.

The proposed sample locations illustrated on Figure 2-29 have been chosen based on a number of variables including: the suspected direction of groundwater and surface water flow, proximity to the investigated units, suspected location of dielectric fluid releases from equipment, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both. Because soil gas is a migration pathway, all borings and samples will be screened with a PID. Nine concrete wipe samples have been proposed at various locations within Building 32. The wipe samples will be arranged surrounding equipment that formerly contained PCBs.

Table 2.61
AOC 559, AOC 560, and AOC 561
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	24	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides and PCBs.
Soil (3'-5' bgs)	24	
Groundwater (shallow wells)	5	
Groundwater (deep wells)	3	
Concrete Wipe Samples	9	

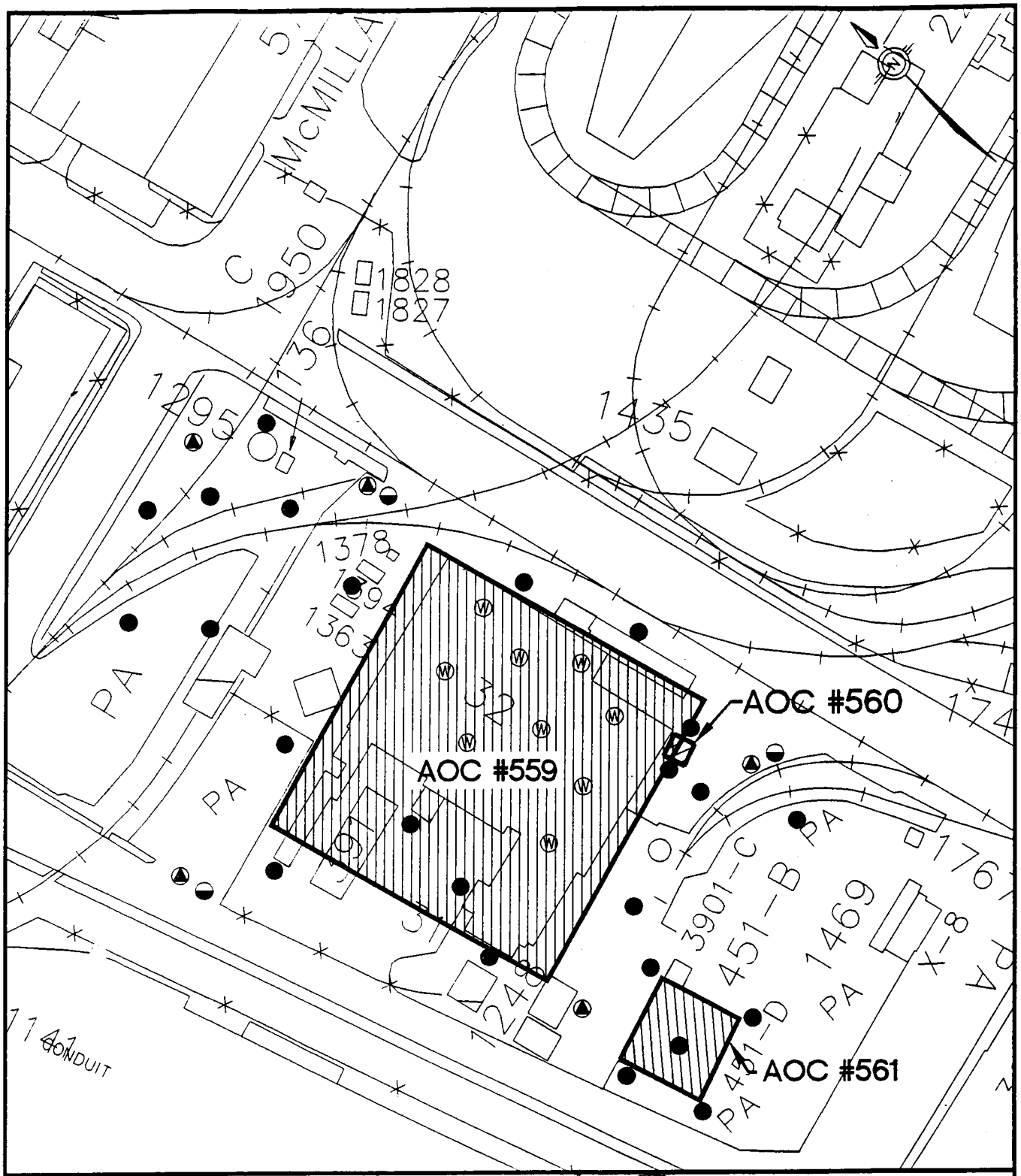
Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Concrete wipe samples will be analyzed for PCBs only.

Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ▲ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-29
AOC #559, CENTRAL POWER STATION
AOC #560, DISINFECTOR
FORMER BUILDING 34
AOC #561, SUBSTATION, BLDG 451-B

DWG DATE: 6/2/95 | DWG NAME: FIGURE29

2.31 AOC 562, Substation, Building 84

AOC 562 is Building 84, an electrical substation constructed in 1942 and still in use. This site has been designated for a CSI. Table 2.62 describes the site.

Table 2.62
AOC 562
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 562 Substation	Building 84 is a single-story structure with a concrete slab floor and roof. Adjacent to Building 84 is a concrete slab within a fenced area, containing several weatherproof metal-enclosed transformers.[1]	Dielectric Fluid (PCBs)[3]	**Soil** Sediment Groundwater Surface water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II , November 22, 1994.
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.31.1 Previous Investigations

In 1986, two transformers were reported to be leaking. Analytical test results showed the transformers to contain less than 50 ppm PCBs. Both transformers were removed in 1988. In 1987, samples taken from a third transformer at the site showed 249.7 ppm PCBs; this transformer was reported to be in good condition but was ultimately removed in 1988. During a site inspection, stains were noted inside Building 84 and on the concrete pad within the fenced area.

2.31.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.31.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and concrete surfaces will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.31.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.63 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 562 are illustrated in Figure 2-30. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the electrical substation.

The proposed soil boring locations illustrated on Figure 2-30 have been chosen based on a number of variables including: the suspected direction of surface water flow, proximity to the investigated unit, and suspected location of piling supports. Also, four wipe samples will be collected from the concrete slab area within the transformer vault. The wipe samples will be arranged in a pattern surrounding the transformer to detect any possible migration pathway of released dielectric fluid. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings will require coring through asphalt, concrete, or both.

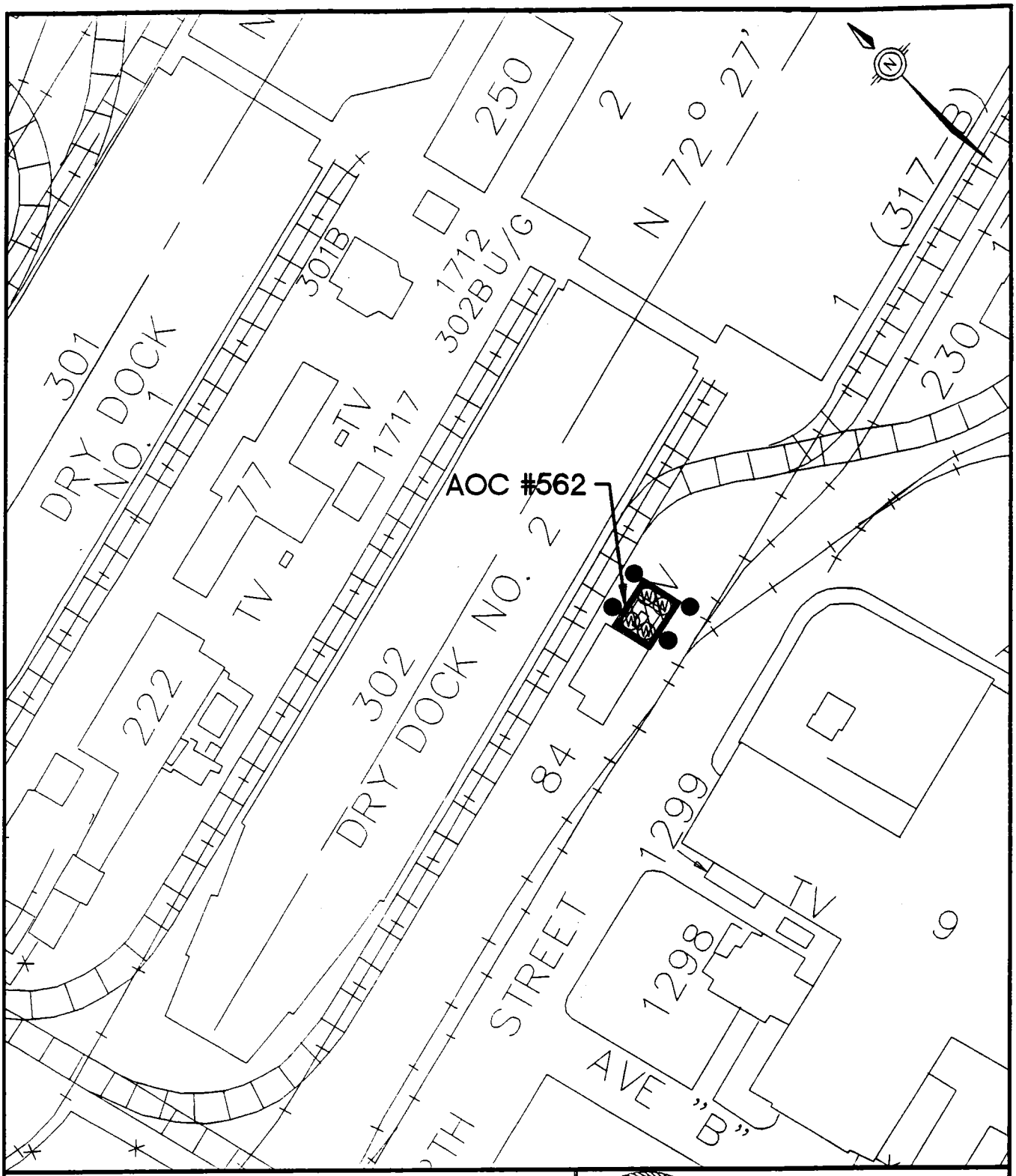
Table 2.63
AOC 562
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	PCBs
Soil (3'-5' bgs)	4	
Concrete Wipe Samples	4	

Notes:
Concrete wipe samples will be analyzed for PCBs only.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-30
AOC #562
SUBSTATION
BUILDING 84

DWG DATE: 6/2/95 | DWG NAME: FIGURE30

2.32 AOC 563, Locomotive House, Former Building 37

AOC 563 is former Building 37, a locomotive maintenance house constructed in 1913 and used until 1939. This site has been designated for a CSI. Table 2.64 describes the site.

Table 2.64
AOC 563
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 563 Locomotive House	Little is known about the operations of the maintenance house other than that the name implies maintenance to locomotive engines. Probable maintenance activities involved petroleum-based lubricants, chlorinated solvents and degreasers, and coal or petroleum fuels. Building 177 is currently on the site of former Building 37.[1]	Lubricants Heavy Metals Dielectric Fluid Petroleum Hydrocarbons Chlorinated Solvents and Degreasers Coal/Coal By-products (VOCs, SVOCs, Metals, PCBs)[3]	Air **Soil** Soil Gas **Groundwater** Surface water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II , November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.32.1 Previous Investigations

This site has not been investigated previously.

2.32.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.32.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.32.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.65 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 563 are illustrated in Figure 2-31. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan* unless otherwise stated. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the former locomotive house.

The proposed sample locations illustrated on Figure 2-31 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of Building 177 foundation supports, internal wall structures, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both. Because soil gas is a migration pathway, all samples and borings will be screened with a PID.

Table 2.65
AOC 563
Sampling Plan

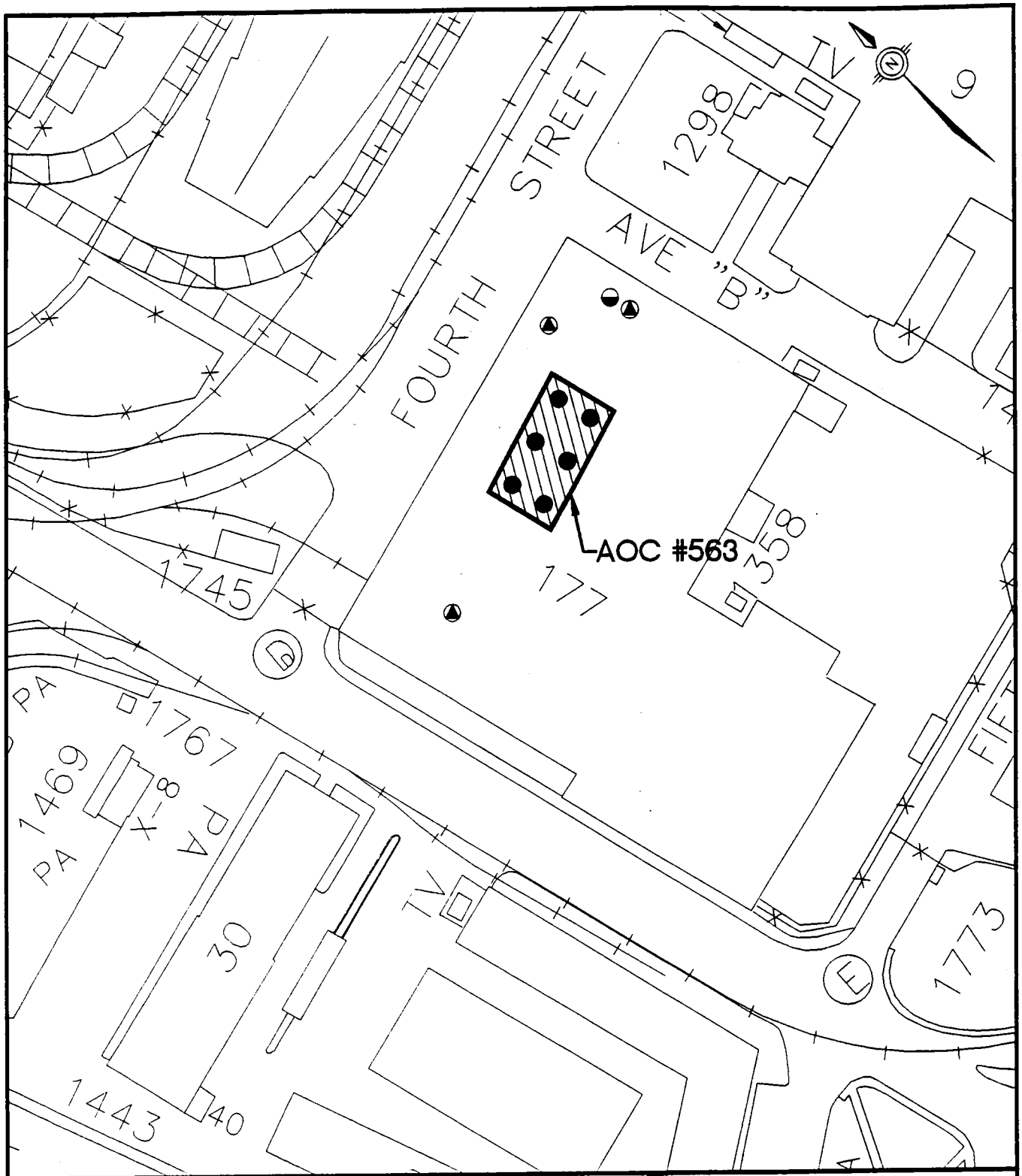
Matrix	Quantity	Analysis
Soil (0-1' bgs)	6	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides and PCBs.
Soil (3'-5' bgs)	6	
Groundwater (shallow wells)	3	
Groundwater (deep wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-31
AOC #563
LOCOMOTIVE HOUSE
FORMER BUILDING 37

DWG DATE: 6/2/95 | DWG NAME: FIGURE31

2.33 AOC 566, Paint Shop Storage, Building 194

AOC 566, a former paint storage area in Building 194, currently stores supplies such as tools, hoses, and equipment. This site has been designated for a CSI. Table 2.66 describes the site.

Table 2.66
AOC 566
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 566 Paint Storage Area	Building 194 was constructed in 1964. It has been used to store unused blasting grit and paints. At one time paints were mixed just outside the building on a tarp covered wooden pallet. Waste paints were stored in the SAA on the east side of the building. Currently the building stores items such as equipment and tools needed to repair ships.[1]	Metals (Lead) Paints Solvents Blasting Media (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.33.1 Previous Investigations

This site has not been investigated previously.

2.33.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.33.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.33.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.67 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 566 are illustrated in Figure 2-32. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the former paint storage area.

The proposed sample locations illustrated on Figure 2-32 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both. Because soil gas is a migration pathway, all samples and borings will be screened with a PID.

Table 2.67
AOC 566
Sampling Plan

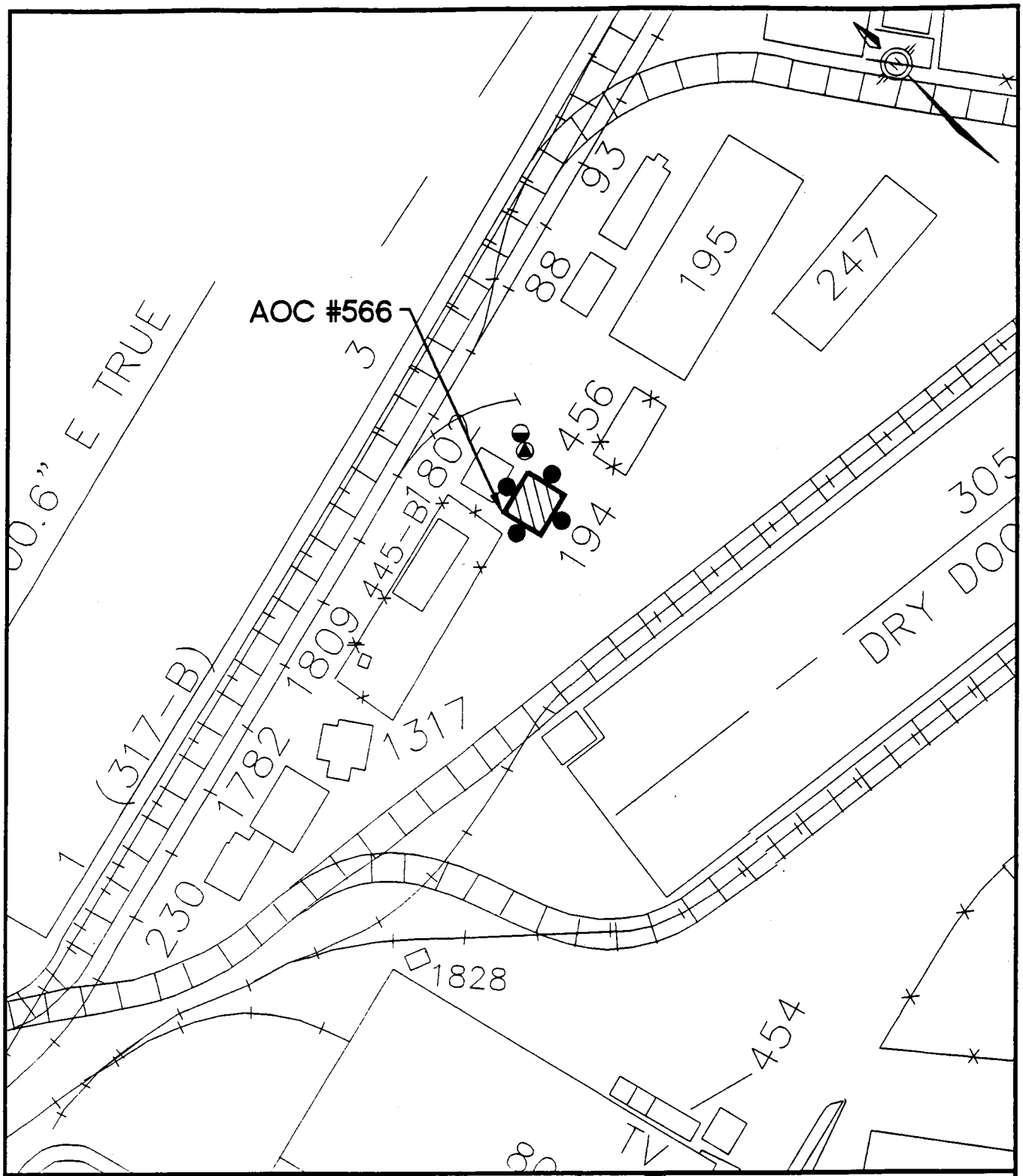
Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	VOA & SVOA w/ TICs, Metals.
Soil (3'-5' bgs)	4	
Groundwater (shallow wells)	1	
Groundwater (deep wells)	1	

Engineering Parameters:
Slug tests will be performed on two of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-32
AOC #566
BUILDING 194

DWG DATE: 6/2/95 | DWG NAME: FIGURE32

2.34 AOC 567, Substation, Building 75

AOC 567 is Building 75, an electrical substation constructed in 1942 and still in use. This site has been designated for a CSI. Table 2.68 describes the site.

Table 2.68
AOC 567
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 567 Substation	Building 75 is a single-story structure with a concrete slab floor and roof. Adjacent to Building 75 is a concrete slab within a fenced area, containing several weatherproof metal-enclosed transformers. The north side of Building 75 houses high-voltage switches, transformers, and a battery bank that provides emergency power for the facility. The transformer that now operates does not contain PCBs.	PCBs Lead Acids (Metals, PCBs, pH)[3]	Air **Soil** Soil Gas Sediment Groundwater Surface water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II , November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.34.1 Previous Investigations

This site has not been investigated previously.

2.34.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.34.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and concrete surfaces will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.34.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.69 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 567 are illustrated in Figure 2-33. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the electrical substation.

The proposed soil boring locations illustrated on Figure 2-33 have been chosen based on a number of variables including: the proximity to the investigated unit, suspected location of subsurface utilities, and suspected location of piling supports. Also, four wipe samples will be collected from the concrete slab in the transformer vault. The wipe samples will be arranged in a pattern surrounding the transformer to detect any possible migration pathway of released dielectric fluid. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings will require coring through asphalt, concrete, or both.

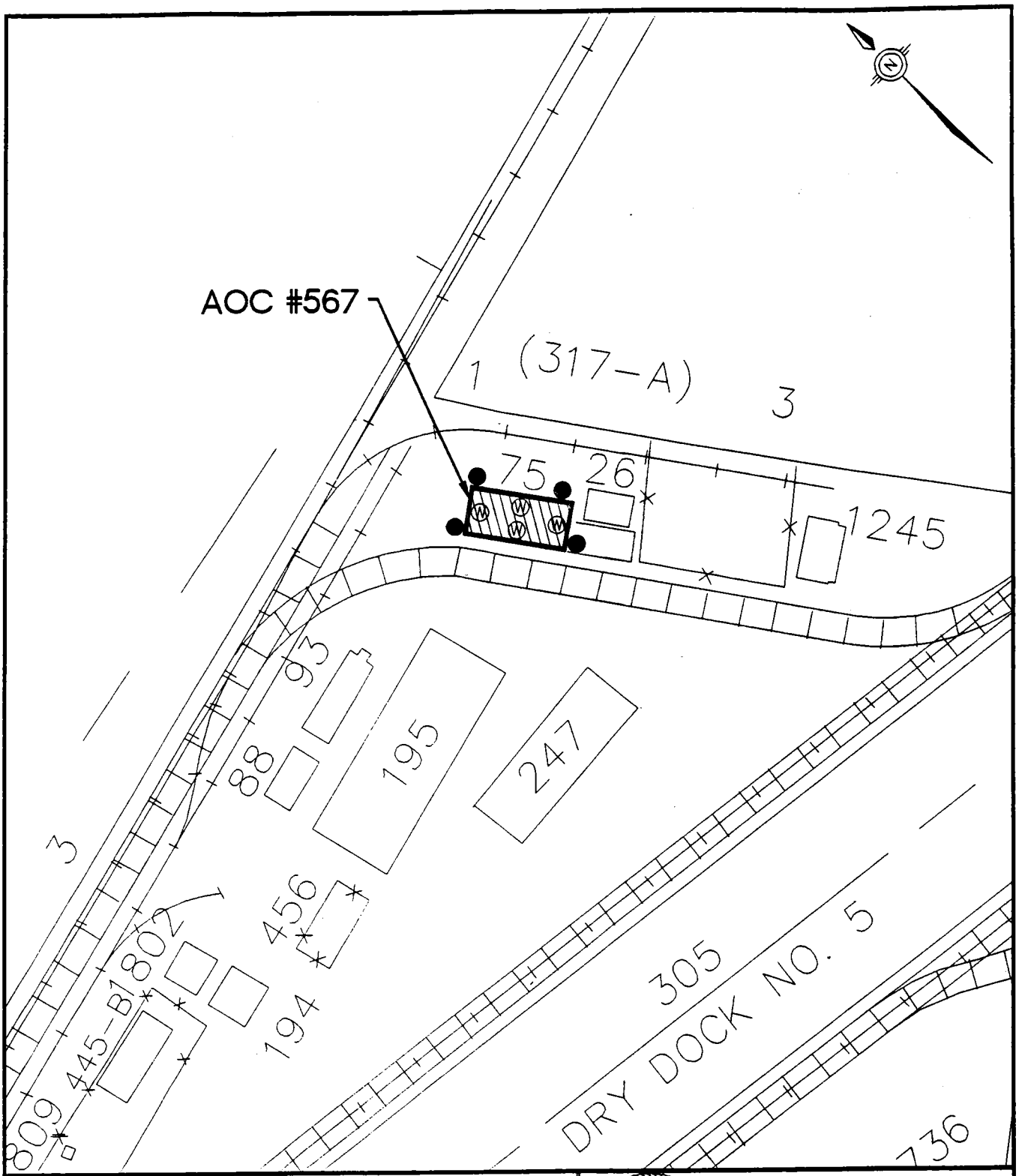
Table 2.69
AOC 567
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	Metals, PCBs, pH.
Soil (3'-5' bgs)	4	
Concrete Wipe Samples	4	

Notes:
Concrete wipe samples will be analyzed for PCBs only.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-33
AOC #567
SUBSTATION
BUILDING 75

DWG DATE: 6/2/95 | DWG NAME: FIGURE33

2.35 AOC 569, Gas Station and Oil Storage, Former Building 1279; AOC 570, Former Coal Storage Area; and AOC 578, Transportation Shop and Garage, Building 25

AOC 569, a gas station and oil storehouse, was once in former Building 1279. AOC 570, a former coal storage area, was south of Building 30. AOC 578, a transportation shop and garage, is in Building 25. Because their proximity enables these sites to share sampling locations, they will be discussed as a unit. Table 2.70 describes the sites.

Table 2.70
AOC 569, AOC 570, and AOC 571
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 569 **Former Gas Station and Oil Storehouse**	This site is a former gas station and oil storehouse once in Building 1279. The gas station was constructed in 1944 and had two pumps and two 2,500-gallon USTs. In 1986, an additional 3,000-gallon UST was installed. This site was destroyed and the tanks removed in 1992. Demolition activities consisted of pump and tank removal, filling vent lines, soil excavation, soil sampling, and placement of an asphalt parking area.[1]	Petroleum Hydrocarbons Heavy Metals (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff
AOC 570 **Former Coal Storage Area**	This site was a coal storage area which extended from Building 30 to Sixth Avenue and from Carolina Avenue to Hobson Avenue. This area was operated from 1919 to 1941, at which time the use of coal was replaced by steam.[1]	Coal Coal By-products (VOCs, SVOCs)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff
AOC 578 **Transportation Shop and Garage**	This site consists of a transportation shop and garage in Building 25. Built in 1940, this structure was originally used as an automobile garage and is currently a transportation and appliance maintenance shop. Building 25 includes: an air conditioning repair shop, a sheet metal shop, two electric shops, a paint shop, a sign shop, a carpenter's shop, a paper-shredding area, a restroom, an electrical maintenance area, a tool room, a maintenance shop with personnel lockers, and an emergency supply storage area.[1]	Acids Paints Solvents Anti-freeze Petroleum Hydrocarbons (VOCs, SVOCs, Metals, pH)[3]	Air **Soil** Soil Gas **Groundwater**

Notes:
[1] Described in the Draft Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.35.1 Previous Investigations

AOCs 570 and 578 have not been investigated previously. However, soil samples taken from AOC 569 in 1992 showed headspace-Organic Vapor Analysis (OVA) readings greater than 1,000 ppm and analytical samples in 1993 showed benzene, toluene, ethylbenzene, and xylene (BTEX)concentrations as high as 1,000 ppm. These samples were taken from the area where the USTs were once located.

2.35.2 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.35.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.35.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.71 summarizes the types of samples and analytical parameters. Proposed sample locations for AOCs 569, 570, and 578 are illustrated in Figure 2-34. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the limited information available regarding these sites, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from either of the sites.

The proposed sample locations illustrated on Figure 2-34 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated units, suspected location of underground utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both. Because soil gas is a migration pathway, all borings and samples will be screened with a PID.

Table 2.71
AOC 569, AOC 570, and AOC 578
Sampling Plan

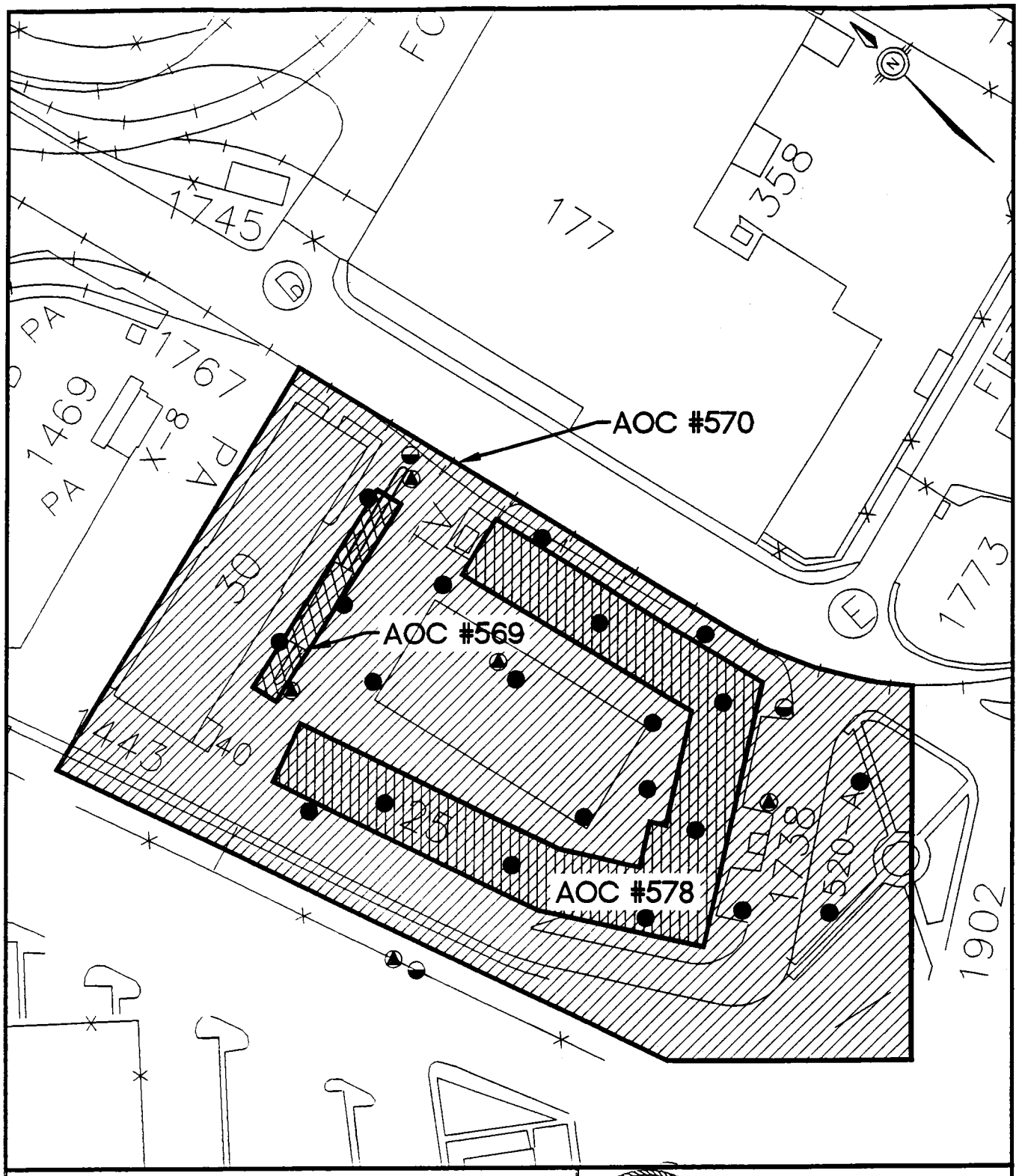
Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3'-5' bgs) Groundwater (shallow wells) Groundwater (deep wells)	21 21 5 3	VOA & SVOA w/ TICs, Metals, pH.

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-34
AOC #569, OIL & GAS SERVICE STA.
AOC #570, COAL STORAGE AREA
AOC #578, TRANSPORTATION SHOP
AND GARAGE, BUILDING 25

DWG DATE: 6/2/95 | DWG NAME: FIGURE34

2.36 AOC 571, Paint Booth No. 33, Building 177

AOC 571 is a paint booth (No. 33) in Building 177. This site has been designated for an RFI. Table 2.72 describes the site.

Table 2.72
AOC 571
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 571 Paint Booth (No. 33)	This site consists of a paint booth (No. 33) on the third floor of Building 177. The booth is used for painting miscellaneous metal parts. The booth is equipped with a water curtain to capture particulate matter. The booth is 12′ x 14′ x 8′ with a 3.5′ diam. 15′ high stack. This booth operates under South Carolina Bureau of Air Quality Control Permit No. 0560-0002. Prior to 1972, water used to capture particulate matter from the booth was discharged directly into the storm sewer system. Currently, the waste water from the curtain at this booth is periodically drained into the sanitary sewer system. The sludge is then removed and disposed of as a hazardous waste. [1]	Paints Solvents Metals (VOCs, SVOCs, Metals)[3]	**Air** **Floor Surface**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.36.1 Previous Investigations

This site has not been investigated previously.

2.36.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.36.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, concrete core and air will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any air and surface runoff contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.36.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.73 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 571 are illustrated in Figure 2-35. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Soil, groundwater, surface water, and soil gas are unlikely migration pathways due to the containment provided by the building and the booth structure: it is on the third floor of Building 177. A visual inspection of the floor found no cracking or deterioration near the unit. However, paint odors were detected during the site visit, and approximately one-half inch of dried paint coated the walls and floor of Booth 33.

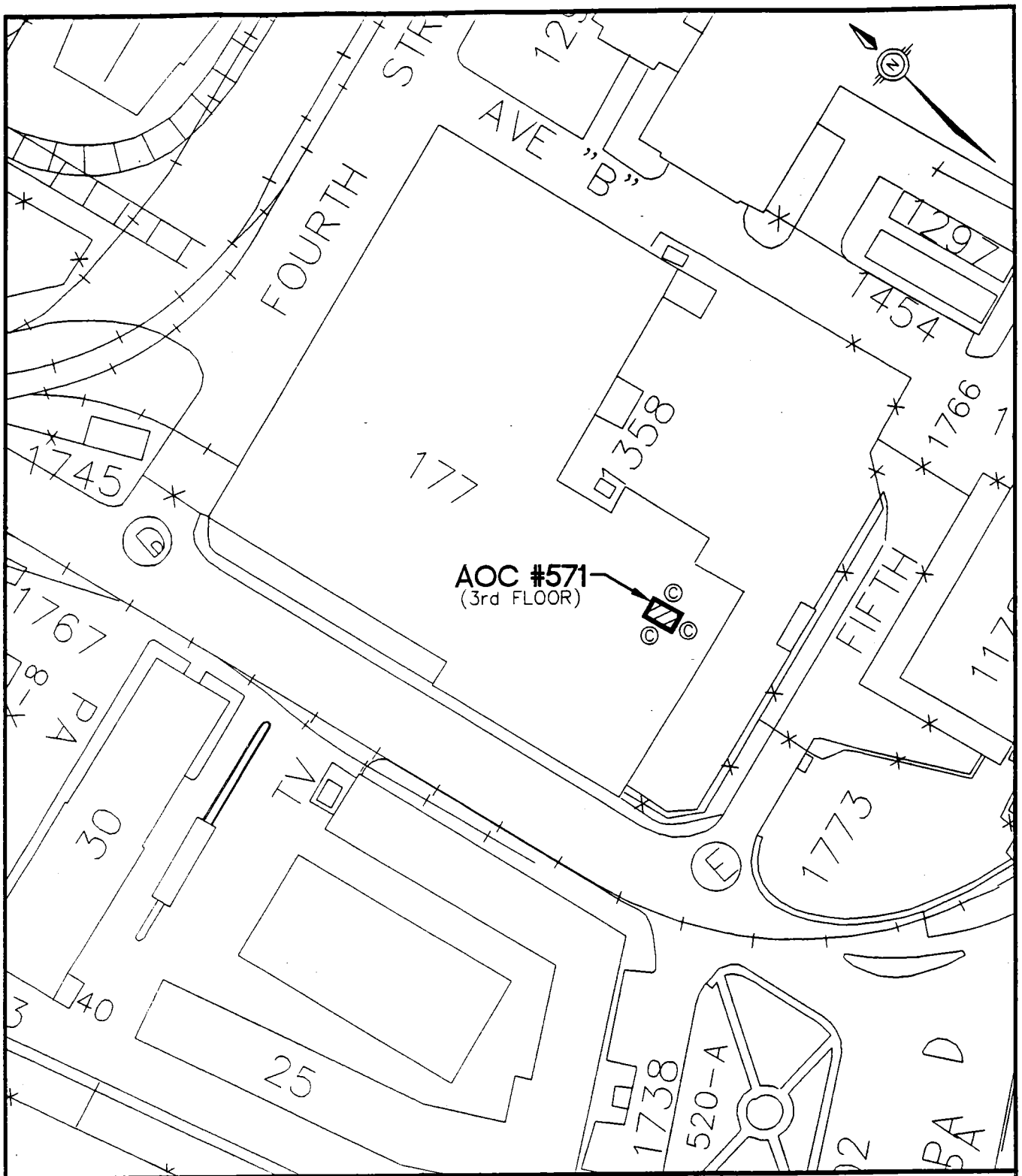
The paint booth is located against an interior wall. Three core samples will be collected from the concrete floor near the paint booth. The core samples will be arranged in a pattern surrounding the paint booth to detect any possible migration pathway of released paints or solvents. Three air samples will be collected, using the SUMMA canister method as noted in the CSAP, and analyzed for volatile organic chemicals.

Table 2.73
AOC 571
Sampling Plan

Matrix	Quantity	Analysis
Core Samples	3	VOA & SVOA w/ TICs, Metals.
Air	Random	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-35
AOC #571
BUILDING 177
PAINT SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE35

2.37 AOC 572, Motor Area, Building 177

AOC 572 is a former motor cleaning area in the fenced area south of Building 177. This site has been designated for an RFI. Table 2.74 describes the site.

Table 2.74
AOC 572
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 572 Motor Area	This site is a former motor cleaning area south of Building 177. This site at one time was used for steam cleaning electrical motors and equipment. No evidence of the steam cleaning activities are now present. While in operation, no containment structures were associated with the process. Wastewater drained from the site to the storm sewer system. No additional information could be found regarding the operating practices of this site.[1]	Solvents Petroleum Hydrocarbons Heavy Metals (VOCs, SVOCs, Metals)[3]	Air **Soil** Soil Gas **Groundwater** **Sediment** Surface Runoff Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume I, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.37.1 Previous Investigations

This site has not been investigated previously.

2.37.2 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.37.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, sediment, and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.37.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.75 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 572 are illustrated in Figure 2-36. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Due to the limited information available regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the motor cleaning area.

The proposed sample locations illustrated on Figure 2-36 have been chosen based on a number of variables including: the suspected direction of surface and groundwater flow, proximity to the investigated unit, suspected location of underground utilities, and suspected location of piling supports. One sediment sample will be taken from the storm drain west of the site. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through asphalt, concrete, or both. Because soil gas is a migration pathway, all samples and borings will be screened with a PID.

Table 2.75
AOC 572
Sampling Plan

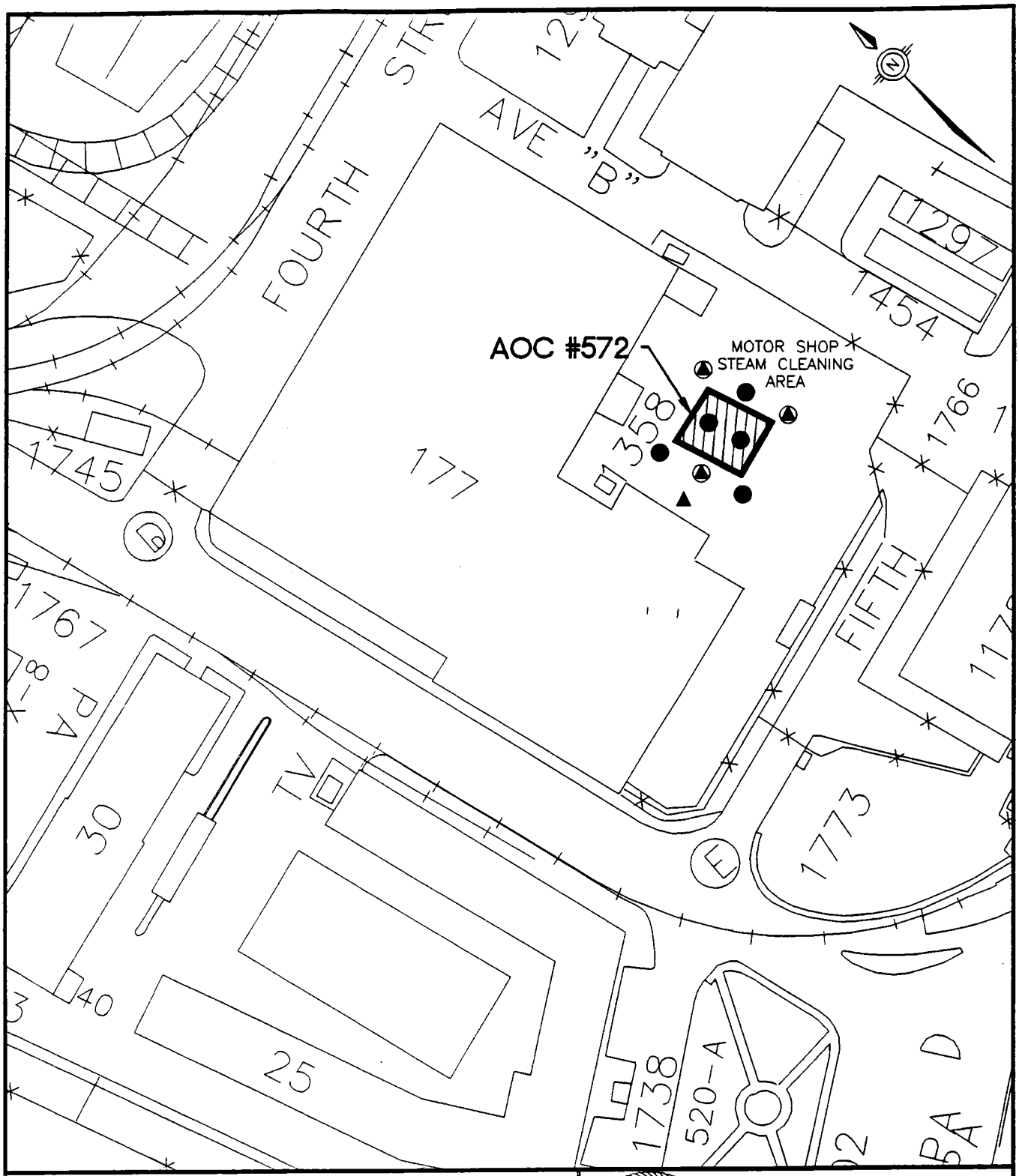
Matrix	Quantity	Analysis
Soil (0-1' bgs)	5	VOA & SVOA w/ TICs, Metals.
Soil (3'-5' bgs)	5	
Groundwater (shallow wells)	3	
Sediment Sample	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-36
AOC #572
BUILDING 177
SAA, MOTOR AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE36

2.38 AOC 573, Anodizing Process, Building 177

AOC 573 is an anodizing process conducted in an attachment to Building 177. This site has been designated for a CSI. Table 2.76 describes the site.

Table 2.76
AOC 573
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 573 Anodizing Process	This site is an anodizing process in a three-sided metal attachment to Building 177. The anodizing process includes a 2,000-gallon irradiate (chromic acid solution) dipping tank and a spray area with a 110-gallon sump. The sump is used to collect excess spray and rinse water. Metal parts and antennas are dipped or sprayed, and rinsed with tap water. This site is contained on three sides by a concrete berm and sloped back to the sump on the fourth side. Before 1972, the sump was connected to the storm water sewer. Currently, sump contents are pumped into 55-gallon drums and are disposed of as hazardous waste.[1]	Acids Hexavalent Chromium Metals Petroleum Hydrocarbons (VOCs, SVOCs, Metals, pH)[3]	Air **Soil** Soil Gas Sediment **Groundwater** Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.38.1 Previous Investigations

This site has not been investigated previously. A chromic acid spill of an unknown quantity reportedly reached the storm sewer in 1989.

2.38.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.38.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, sediment, and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.38.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.77 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 573 are illustrated in Figure 2-37. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the limited information available regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the anodizing process area.

The proposed sample locations illustrated on Figure 2-37 have been chosen based on a number of variables including: the suspected direction of surface and groundwater flow, proximity to the investigated unit, suspected location of underground utilities, and suspected location of piling supports. Two sediment samples will be taken, one from the sump and one from the floor drain associated with this site. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through asphalt,, concrete, or

both. Because soil gas is a migration pathway, all samples and borings will be screened with a PID.

Table 2.77
AOC 573
Sampling Plan

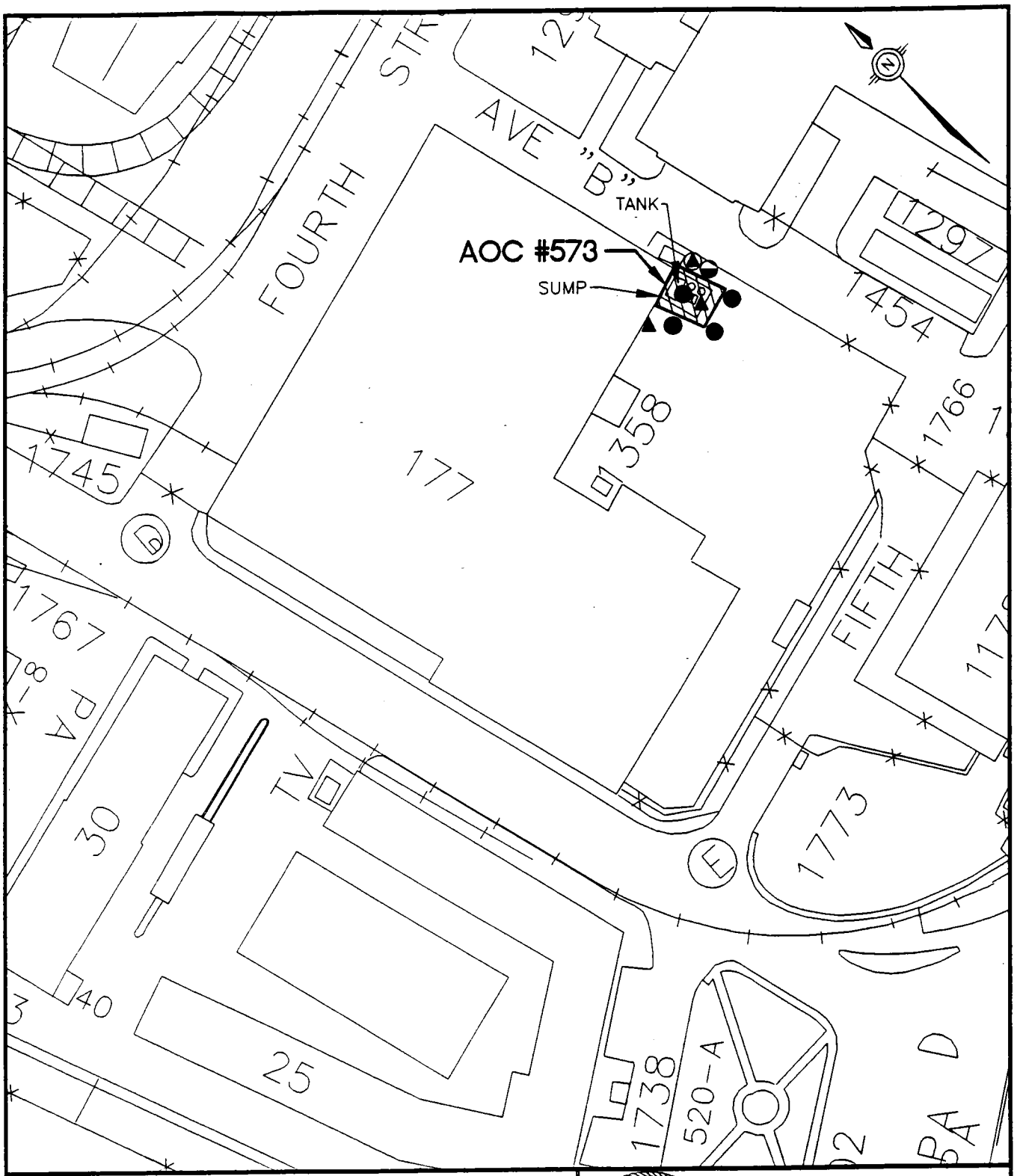
Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	VOA & SVOA w/ TICs, Metals, pH.
Soil (3'-5' bgs)	4	
Groundwater (shallow wells)	1	
Groundwater (deep wells)	1	
Sediment Sample	2	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-37
AOC #573
BUILDING 177
ANODIZING

DWG DATE: 6/2/95 | DWG NAME: FIGURE37

2.39 AOC 576, Oil and Paint Storehouse/Print Office, Former Building 1012

AOC 576, an oil and paint storehouse/print office, was in former Building 1012. This site has been designated for a CSI. Table 2.78 describes the site.

Table 2.78
AOC 576
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 576 Oil and Paint Storehouse/ Print Office	This site was an oil and paint storehouse once in former Building 1012. Operations were conducted from 1909 until 1930. No other information could be found regarding the operating practices of the storehouse or the printing office. Currently, this site is occupied by Building 80.[1]	Inks Paints Metals Solvents Petroleum Hydrocarbons (VOCs, SVOCs, Metals)[3]	Air **Soil** Sediment Soil Gas **Groundwater** Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.39.1 Previous Investigations

This site has not been investigated previously.

2.39.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.39.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.39.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.79 summarizes the types of samples and analytical parameters. Proposed sample locations for AOCs 576 are illustrated in Figure 2-38. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*. Due to the limited information available regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release has occurred from the former oil and paint storehouse/print office.

The proposed sample locations illustrated on Figure 2-38 have been chosen based on a number of variables including: the suspected direction of surface and groundwater flow, proximity to the investigated unit, suspected location of underground utilities, and suspected location of piling supports. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through asphalt,, concrete, or both. Because soil gas is a migration pathway, all samples and borings will be screened with a PID. Analytical data from SWMU 87, SWMU 172, and AOC 564, along the north side of building 80, will be used to further characterize AOC 576.

Table 2.79
AOC 576
Sampling Plan

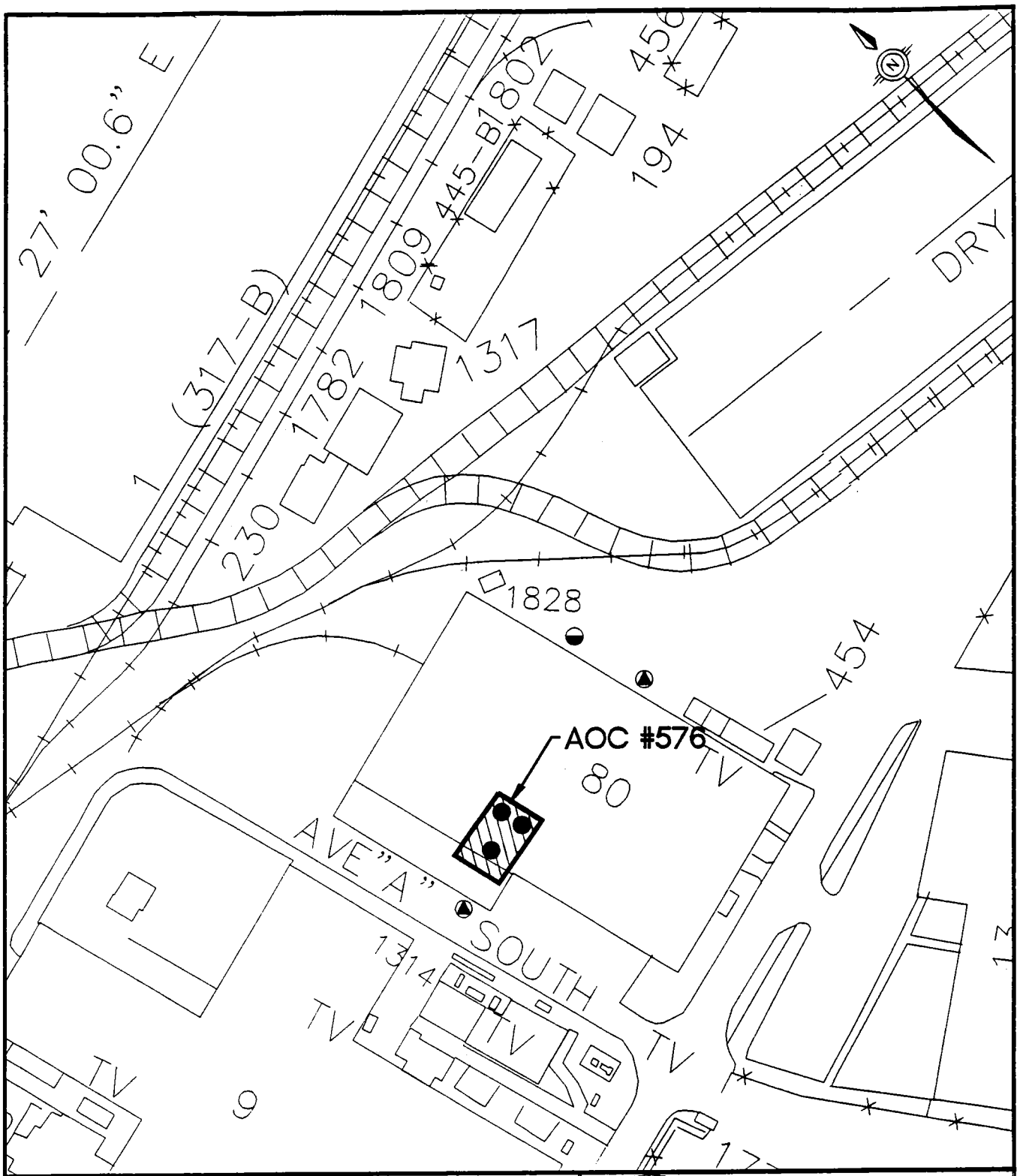
Matrix	Quantity	Analysis
Soil (0-1' bgs)	3	VOA & SVOA w/ TICs, Metals.
Soil (3'-5' bgs)	3	
Groundwater (shallow wells)	2	
Groundwater (deep wells)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ▲ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-38
AOC #576
OIL AND PAINT STOREHOUSE
FORMER BUILDING 1012

DWG DATE: 6/2/95 | DWG NAME: FIGURE38

2.40 AOC 579, Former Paint Shop, Building 1035

AOC 579, a former paint shop, was in Building 1035. This site has been designated for a CSI. Table 2.80 describes the site.

Table 2.80
AOC 579
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 579 Former Paint Shop	This site is a former paint shop in Building 1035. Built in 1919, it was used until 1943 for meat storage and inspection. From 1943 to 1955, this unit was used as a cafeteria storehouse. It stored paint from 1955 until approximately 1977. Currently, this site is used as an electrician's storehouse. No information could be found regarding the operating practices of the paint shop.[1]	Paints Solvents (VOCs, SVOCs and Metals)[3]	Air **Soil** Soil Gas Groundwater Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.40.1 Previous Investigations

This site has not been investigated previously. However, small paint stains were observed during the RFA.

2.40.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.40.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.40.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.81 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 579 are depicted in Figure 2-39. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if a release had occurred at the former paint shop.

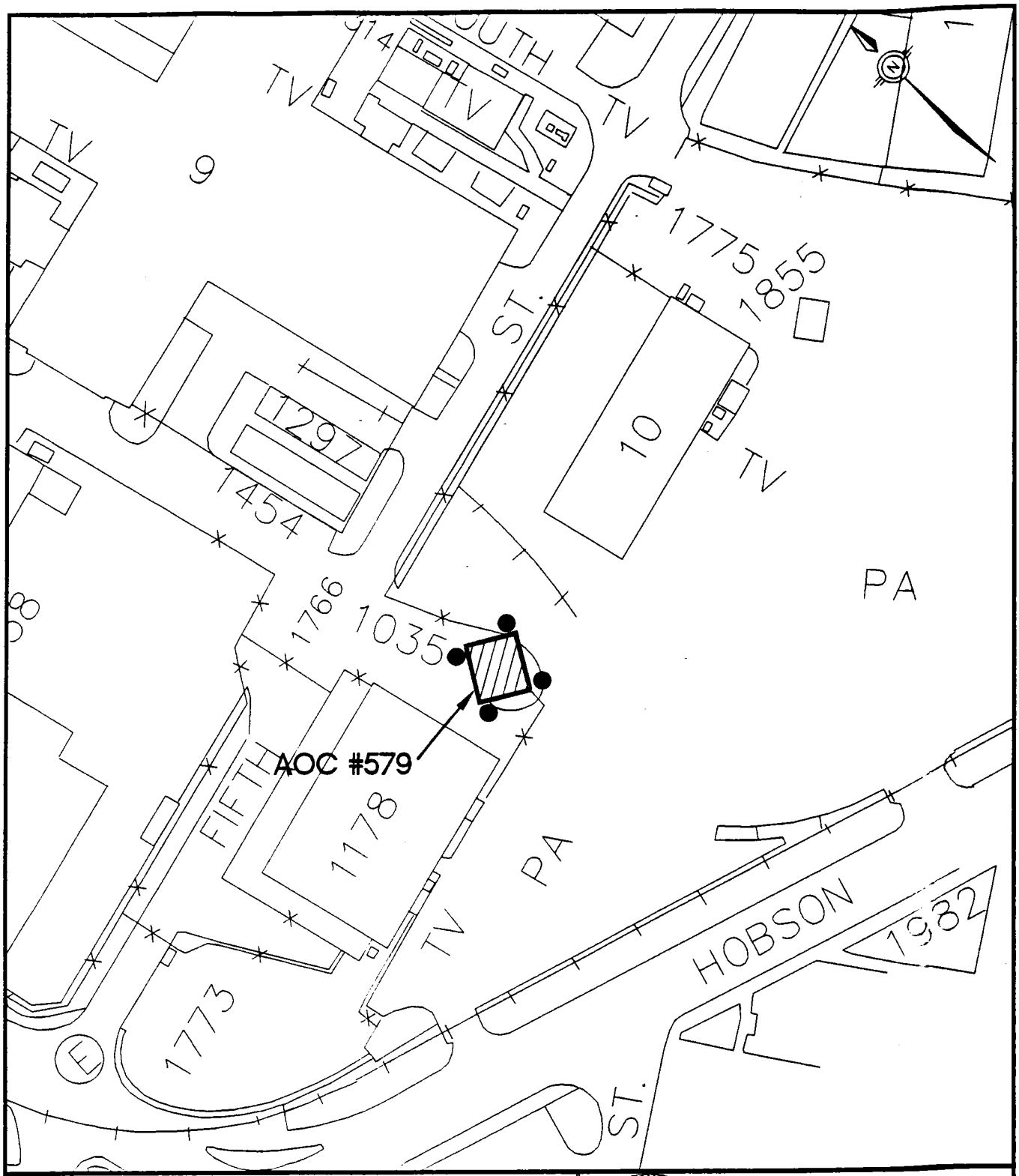
The proposed subsurface sample locations illustrated on Figure 2-39 have been chosen based on a number of variables including: proximity to AOC 579 and suspected location of subsurface utilities, pilings, and other obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings will require coring through concrete, asphalt or both. Because soil gas is a migration pathway, all borings and samples will be screened with a PID.

Table 2.81
AOC 579
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	VOAs and SVOAs w/ TICs and Metals.
Soil (3-5' bgs)	4	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- ⊘ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-39
AOC #579
PAINT SHOP
BUILDING 1035

DWG DATE: 6/2/95 | DWG NAME: FIGURE39

2.41 AOC 580, Former Pattern and Electric Shop, Building 10

AOC 580 is a former pattern and electric shop once in Building 10. This site has been designated for a CSI. Table 2.82 describes the site.

Table 2.82
AOC 580
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 580 Former Pattern and Electric Shop	This site is a former pattern and electric shop once in Building 10. Built in 1918, it was used until 1935 as a pattern and storage shop. From 1935 to 1955, this unit was an electric and pattern shop. In the early 1980s, the building became the office for the Nuclear Engineering Department. No information could be found regarding the operating practices of the facility.[1]	Solvents Degreasers (VOCs, SVOCs and Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.41.1 Previous Investigations

This site has not been investigated previously.

2.41.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.41.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill the data gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.41.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.83 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 580 are depicted in Figure 2-40. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if release had occurred at the former pattern and electric shop.

The proposed subsurface sample locations illustrated on Figure 2-40 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to AOC 580, and suspected location of subsurface utilities, pilings, and other obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through concrete, asphalt or both. Because soil gas is a migration pathway, all borings and samples will be screened with a PID.

Table 2.83
AOC 580
Sampling Plan

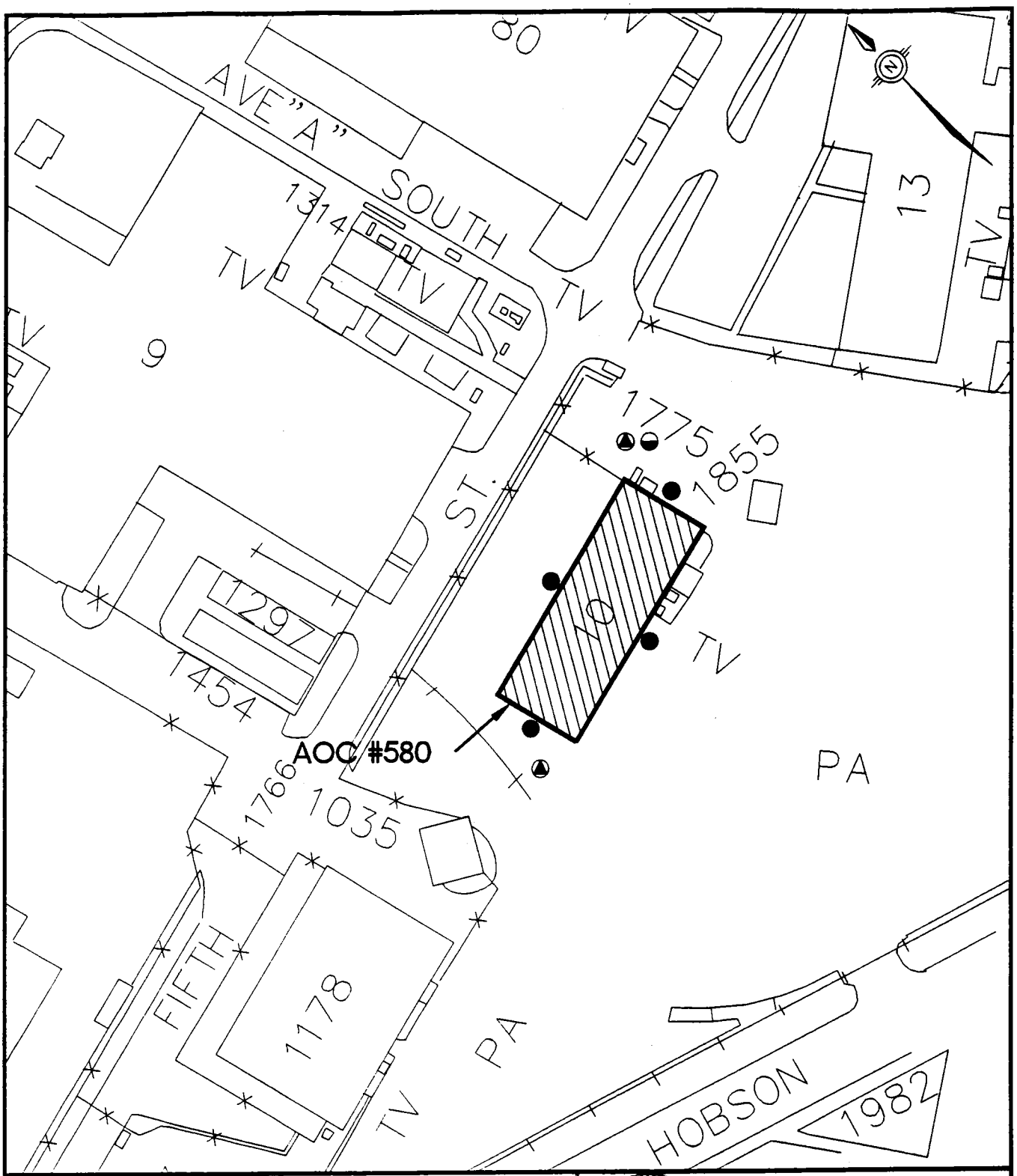
Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	VOAs and SVOAs w/TICs & Metals.
Soil (3-5' bgs)	4	
Groundwater		
(shallow well)	2	
(deep well)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow/deep well pairs. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-40
AOC #580
FORMER PATTERN & ELECTRIC SHOP
BUILDING 10

DWG DATE: 6/2/95 | DWG NAME: FIGURE40

2.42 AOC 583, Northeast Corner of Building 236

AOC 583 comprises the activities conducted in the northeast corner of Building 236. This site has been designated for an RFI. Table 2.84 describes the site.

Table 2.84
AOC 583
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 583 Northeast Corner Building 236	Building 236 was constructed in 1982. The north side of the building houses conference rooms, offices, a locker room, and a pipe-fitting shop. The shop area contains a Freon recycling and distillation system consisting of a distillation unit, associated piping, and three USTs. Five additional USTs containing petroleum products are outside the northeast corner of the building. In 1986, approximately 200 gallons of rinsate-containing paint stripper was discharged outside the northeast end of the building to the storm drain.[1]	Freon Paints Solvents Petroleum Hydrocarbons (VOCs, SVOCs and Metals)[3]	Air **Soil** Soil Gas **Groundwater**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.42.1 Previous Investigations

This site has not been investigated previously. However, in 1986 approximately 200 gallons of paint-stripping rinsate was discharged to the storm drain northeast of the building.

2.42.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The integrity of the eight USTs has not been confirmed. The USTs are scheduled for removal in March 1995.

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.42.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing the integrity of the USTs and determining whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.42.4 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.85 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 583 are depicted in Figure 2-41. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Proposed samples as illustrated represent the areas most likely to have been impacted if release had occurred from the USTs and Freon-recycling operations. They also represent the area in which the paint stripper was released. The stormwater drain will be sampled for sediment if sediment is present at the time of the investigation.

The proposed subsurface sample locations illustrated on Figure 2-41 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to

AOC 583, and suspected location of subsurface utilities, pilings, and other obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through concrete, asphalt, or both. Because soil gas is a migration pathway, all samples and borings will be screened with a PID.

Table 2.85
AOC 583
Sampling Plan

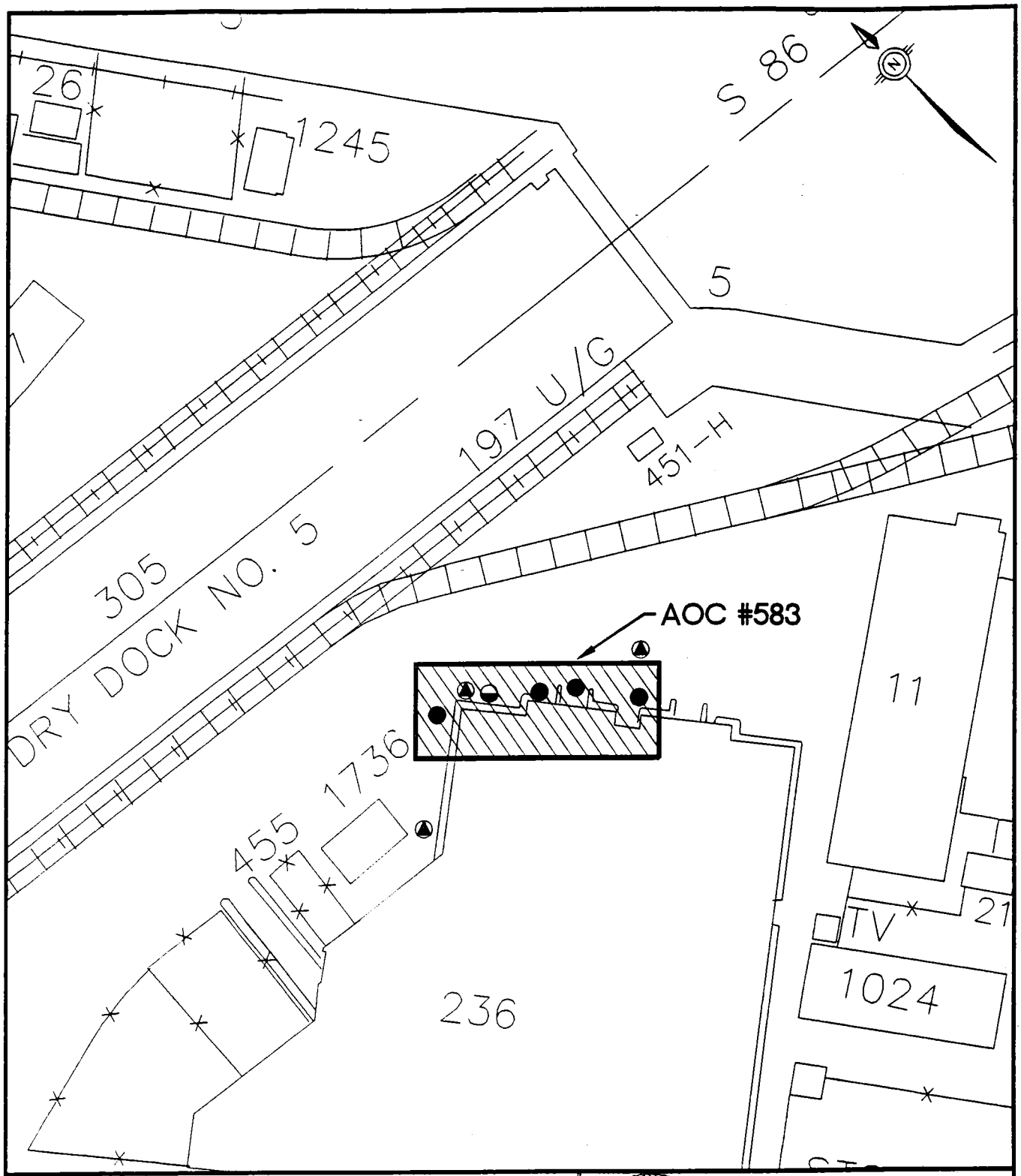
Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	VOAs and SVOAs w/TICs & Metals.
Soil (3-5' bgs)	4	
Groundwater		
(shallow well)	3	
(deep well)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the shallow/deep well pairs. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-41
AOC #583
BUILDING 236

DWG DATE: 6/2/95 | DWG NAME: FIGURE41

2.43 AOC 586, Temporary Powerhouse, Building 1014

AOC 586 was a temporary powerhouse designated as Buildings 1014. This site has been designated for a CSI. Table 2.86 describes the site.

Table 2.86
AOC 586
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 586 Former Temporary Powerhouse	This site was a temporary powerhouse designated as Building 1014. Building 1014 was built in 1905. In 1935 an annex was added. In 1944, Building 1014 was connected to Building 1077. The combined structure was used for industrial salvage, which included a battery shop. Building 1014 was demolished around 1957. No information regarding the operating practices of Building 1014 was found. Currently, the site is a concrete slab adjacent to the southeast corner of Building 11.[1]	Acids Solvents Dielectric Fluids Petroleum Hydrocarbons Lead/Acid Batteries Coal By-products (pH, VOCs, SVOCs, PCBs and Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.43.1 Previous Investigations

This site has not been investigated previously.

2.43.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.43.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.43.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.87 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 586 are depicted in Figure 2-42. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted if release had occurred at the temporary powerhouse.

The proposed subsurface sample locations illustrated on Figure 2-42 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to AOC 586, and suspected location of subsurface utilities, pilings, and other obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through concrete, asphalt, or both. Because soil gas is a migration pathway, all borings and samples will be screened with a PID.

Table 2.87
AOC 586
Sampling Plan

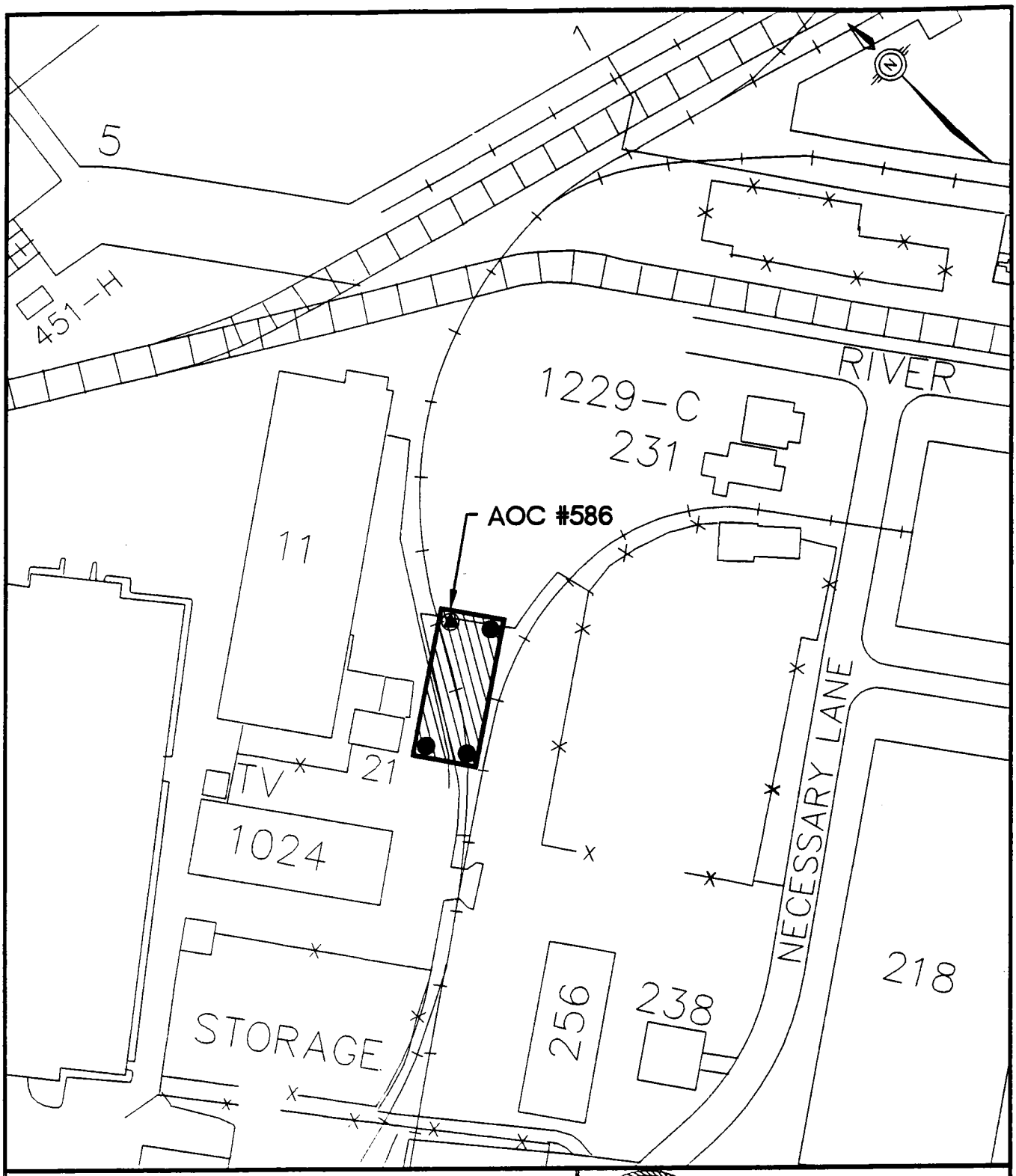
Matrix	Quantity	Analysis
Soil (0-1' bgs)	3	pH, VOAs and SVOAs w/TICs, Metals and PCBs.
Soil (3-5' bgs)	3	
Groundwater (shallow well)	1	

Engineering Parameters:
Slug tests will be performed on 25% of the wells. While installing wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-42
AOC #586
TEMPORARY POWERHOUSE
BUILDING 1014

DWG DATE: 6/2/95 DWG NAME: FIGURE42

2.44 AOC 590, Alley, Buildings 79 and 1760

AOC 590, the alley between Buildings 1760 and 79, has been designated for a CSI. Table 2.88 describes the site.

Table 2.88
AOC 590
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 590 Alley Between Buildings 1760 and 79	This site is the alley between Buildings 1760 and 79. Reportedly, this alley is the site of past releases of acetone and cutting oil. No information was found regarding the exact locations, volumes, or duration of the discharged wastes. Currently, the alley is paved with asphalt.[1]	Acetone Petroleum Hydrocarbons (VOCs, SVOCs and Metals)[3]	Air **Soil** Soil Gas **Groundwater** **Sediment** Surface Water

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.44.1 Previous Investigations

This site has not been investigated previously.

2.44.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The precise locations of the releases must be defined.
- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.
- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.44.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, sediment, and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil, sediment, and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.44.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.89 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 590 are depicted in Figure 2-43. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted by the releases occurring in the alley between Buildings 79 and 1760. AOC 590 is shown in a different location in the RFA. It is believed that Figure 2-43 depicts the most accurate location of AOC590.

The proposed subsurface sample locations illustrated on Figure 2-43 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to AOC 590, and suspected location of subsurface utilities, pilings, and other subsurface obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through concrete, asphalt, or both. In addition, two sediment samples are proposed for the storm drains adjacent to this site. Because soil gas is a migration pathway, all borings and samples will be screened with a PID.

Table 2.89
AOC 590
Sampling Plan

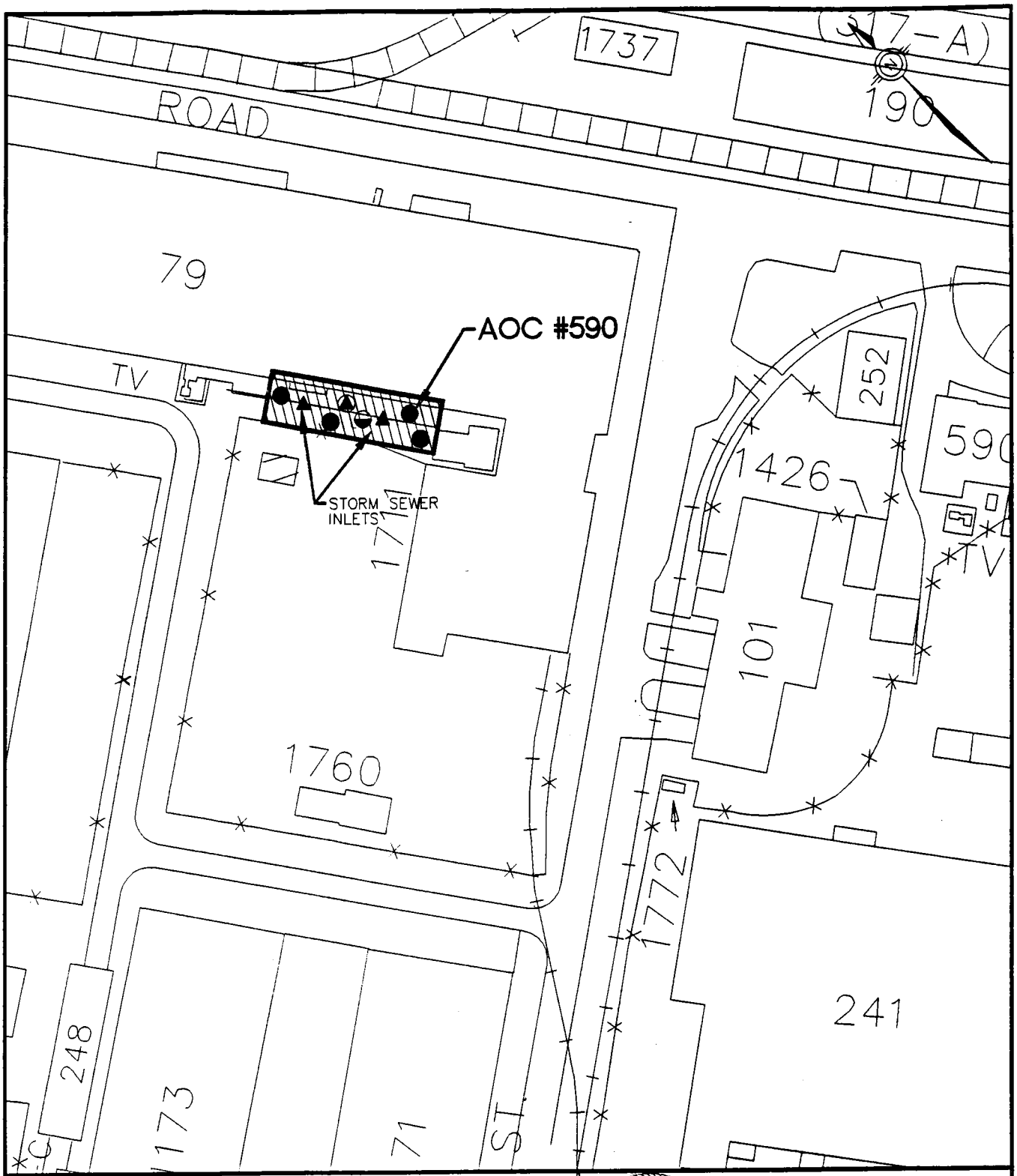
Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	VOAs & SVOAs w/ TICs, Metals
Soil (3-5' bgs)	4	
Groundwater		
(shallow well)	1	
(deep well)	1	
Sediment	2	

Engineering Parameters:
Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-43
AOC #590
ALLEY BETWEEN
BUILDINGS 79 & 1760

DWG DATE: 6/2/95 | DWG NAME: FIGURE43

2.45 AOC 592, Asbestos-Shredding Shelter, Former Building 1225

AOC 592, an asbestos-shredding shelter, was in former Building 1225. This site has been designated for a CSI. Table 2.90 describes the site.

Table 2.90
AOC 592
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 592 Former Asbestos Shredding Shelter	This site was an asbestos-shredding shelter housed in Building 1225. Building 1225 was built in 1944 and used for this purpose until it was removed in 1955. From 1955 to 1966, the site was a pipe storage area. After 1966, the area was vacated. Currently, the site is paved and bisected by a railroad spur.[1]	Asbestos[3]	**Air** **Soil**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.45.1 Previous Investigations

This site has not been investigated previously.

2.45.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.45.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill the data gaps, ambient air and soil will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.45.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.91 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 592 are depicted in Figure 2-44. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Due to the lack of information regarding this site, proposed samples as illustrated represent the areas most likely to have been impacted by the asbestos-shredding shelter.

The proposed subsurface sample locations illustrated on Figure 2-44 have been chosen based on a number of factors including: proximity to AOC 570, suspected location of subsurface utilities, pilings, and other subsurface obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings will require coring through concrete, asphalt, or both.

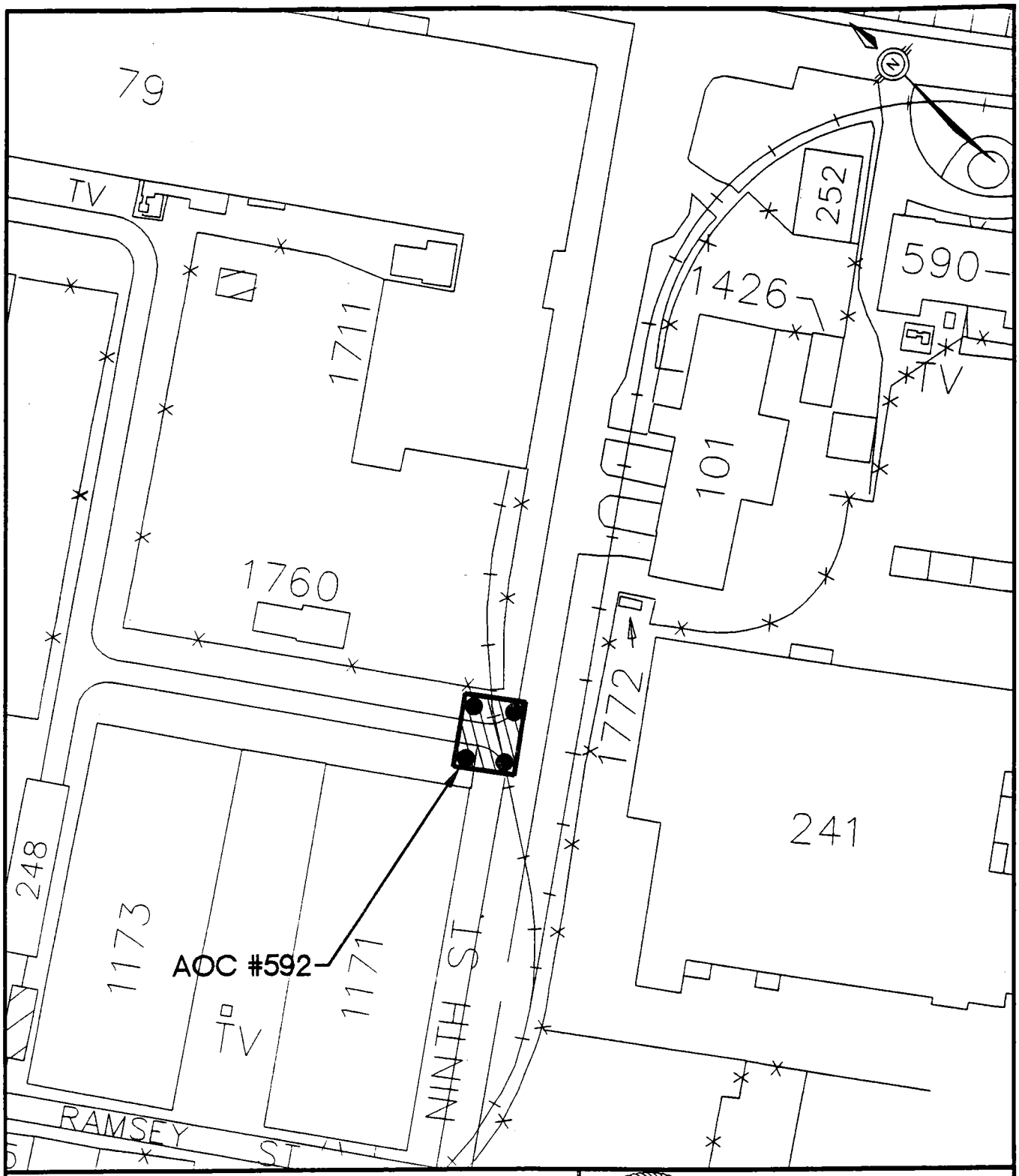
Air samples will be collected while conducting the soil borings to determine the airborne concentration of asbestos. A total of five samples will be collected. Sample locations will be: one upwind; three in the area of the borings; and one downwind. Sample flow rates, volumes and analysis shall be based on the sampling and analysis method contained in the Appendix of USEPA's Asbestos Hazard and Emergency Response Act (AHERA 40 CFR 763 Subpart E).

Table 2.91
AOC 592
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	Asbestos
Soil (3-5' bgs)	4	
Air	5	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

Ambient air analysis to be performed per AHERA 40 CFR 763 Subpart E except where other methods are specified. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTONI
CHARLESTON, S.C.

FIGURE 2-44
AOC #592
ASBESTOS SHREDDING SHELTER
FORMER BUILDING 1225

DWG DATE: 6/2/95 | DWG NAME: FIGURE44

2.46 AOC 596, Former Torpedo Storage, Building 101

AOC 596, a former torpedo storage area, was in Building 101. This site has been designated for a CSI. Table 2.92 describes the site.

Table 2.92
AOC 596
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 596 Former Torpedo Storage Area	This site was a torpedo storage area housed in Building 101. Building 101 was built in 1919 and stored torpedoes until 1943. From 1943 to 1946 the building was used as a machine shop. In 1946, the building was a storehouse for diesel parts and in 1947 it was a storehouse for galvanizing plant. From 1981 to present, it has been used to store radioactive-contaminated material.[1] SWMU 155 addresses mixed-waste storage within Building 101.	Solvents Degreasers Explosives Propellants Petroleum Hydrocarbons (VOCs, SVOCs and Metals)[3]	Air **Soil** Soil Gas **Groundwater** Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.46.1 Previous Investigations

This site has not been investigated previously.

2.46.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.46.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and groundwater will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.46.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.93 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 596 are depicted in Figure 2-45. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Proposed samples as illustrated represent the areas most likely to have been impacted if a release had occurred at the former torpedo storage.

The proposed subsurface sample locations illustrated on Figure 2-45 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to AOC 570, and suspected location of subsurface utilities, pilings, and other subsurface obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through concrete, asphalt, or both. Because soil gas is a migration pathway, a PID will be used to screen all borings and samples.

Table 2.93
AOC 596
Sampling Plan

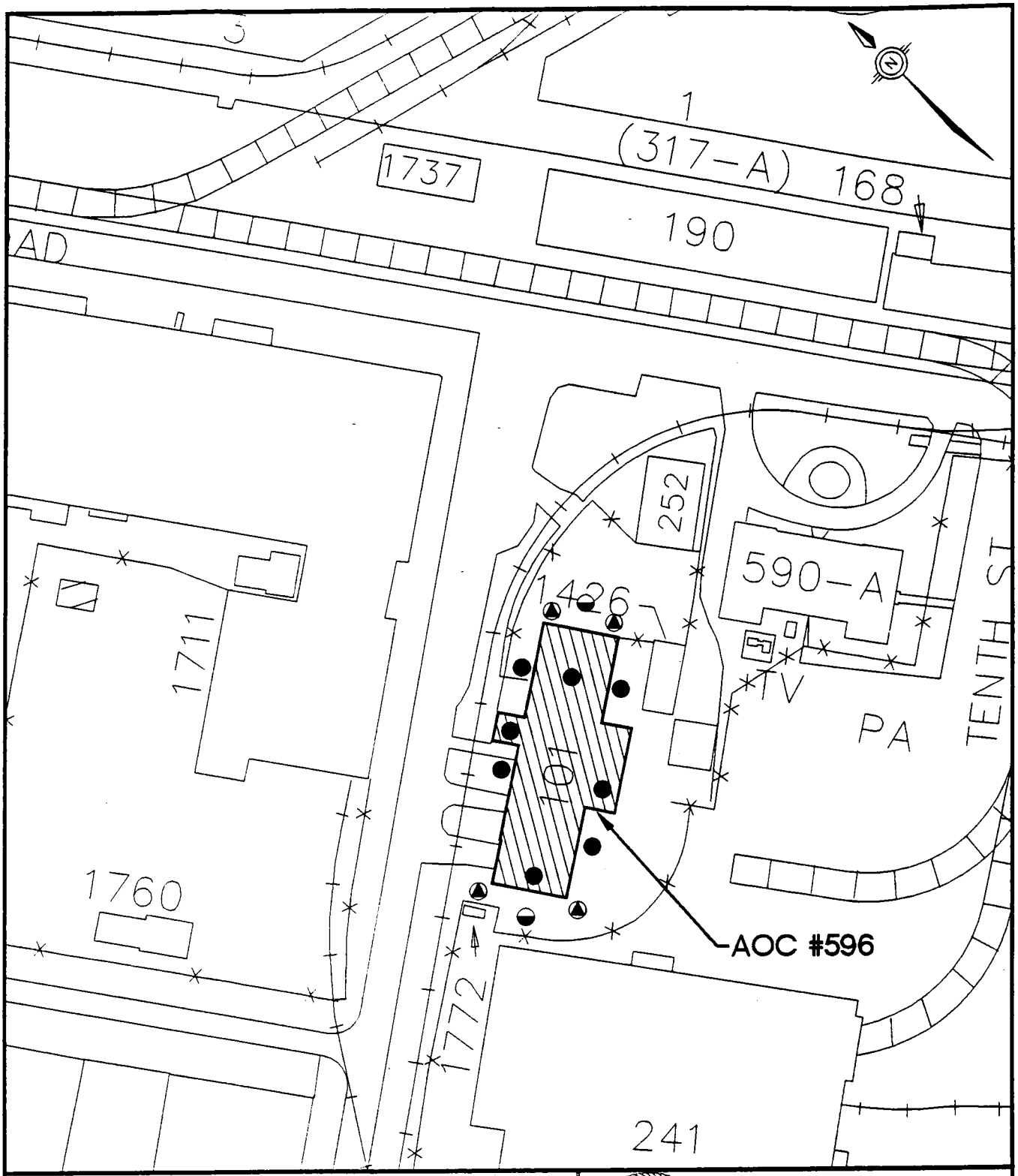
Matrix	Quantity	Analysis
Soil (0-1' bgs)	8	VOAs & SVOAs w/ TICs, Metals.
Soil (3-5' bgs)	8	
Groundwater		
(shallow well)	4	
(deep well)	2	

Engineering Parameters:
Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-45
AOC #596
FORMER TORPEDO STORAGE
BUILDING 101

DWG DATE: 6/2/95 | DWG NAME: FIGURE45

2.47 AOC 597, Substation, Building 91

AOC 597, a substation, is in Building 91. This site has been designated for a CSI. Table 2.94 describes the site.

Table 2.94
AOC 597
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 597 Substation	This site is an electrical substation in Building 91. Building 91 was constructed in 1942. Adjacent to Building 91 are several weatherproof metal enclosures housing two transformers. Two additional transformers are mounted within the building. The building also houses several high-voltage switches, breakers, and a battery bank which provides emergency power for the building.[1]	Dielectric Fluid Lead/Acid Batteries (pH, PCBs and Metals)[3]	Air **Soil** Soil Gas Groundwater **Surface Runoff**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.47.1 Previous Investigations

This site has not been investigated previously. Minor leaks in a transformer were reported in 1981 and 1982. A PCB audit conducted in 1985 found a moderate leak from the same transformer. This transformer was removed and disposed of in 1989. During the RFA, oil staining was evident in the building in the area of the transformer.

2.47.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.47.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and concrete surfaces will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or surface water contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.47.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.95 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 597 are depicted in Figure 2-46. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Proposed samples as illustrated represent the areas were leaking was noted in 1981, 1982, 1985, and in the RFA.

The proposed subsurface sample locations illustrated on Figure 2-46 have been chosen based on a number of variables including: proximity to AOC 597 and suspected location of subsurface utilities, pilings, and other subsurface obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings will require coring through concrete, asphalt, or both. In addition, one asphalt and three wipe samples will be collected.

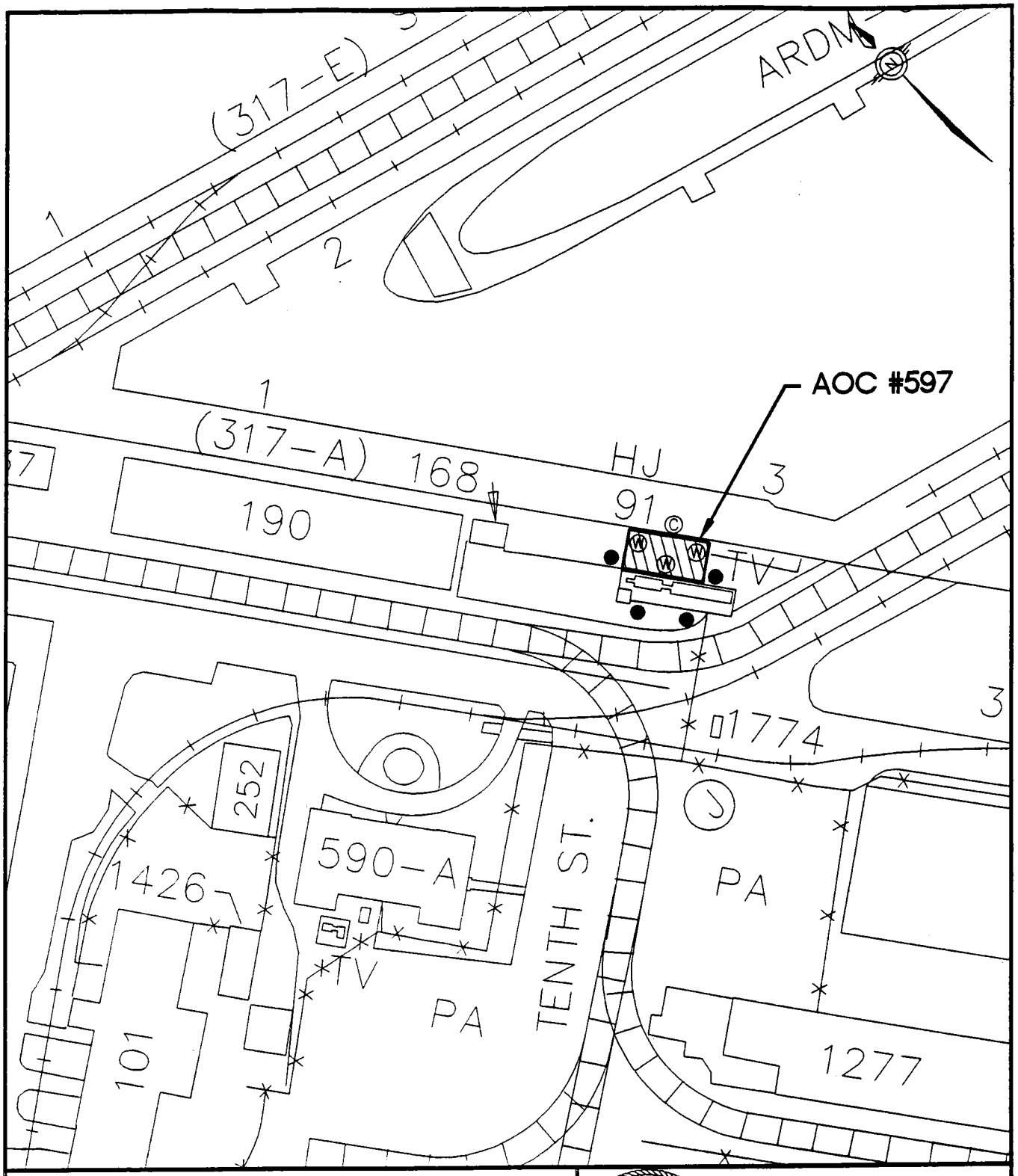
Table 2.95
AOC 597
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1′ bgs)	4	pH, PCBs and Metals.
Soil (3-5′ bgs)	4	
Core sample	1	
Wipe sample	3	

Notes:
Core and wipe samples will be analyzed for PCBs only.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-46
AOC #597
SUBSTATION
BUILDING 91

DWG DATE: 6/2/95 | DWG NAME: FIGURE46

2.48 AOC 598, Sonar Dome Area, End of Pier J; and AOC 599, Pump House, Pier J

AOC 598 is a sonar dome repair area adjacent to Pier J. AOC 599 is a pump house at Pier J. Because of their proximity, these sites will be grouped for work plan and investigation purposes. The sonar dome repair area, AOC 598, has been designated for a RFI, while the pump house, AOC 599, has been designated for a CSI. Table 2.96 describes the sites.

Table 2.96
AOC 598 and AOC 599
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[3]
AOC 598 Sonar Dome Repair Area	This site is a sonar dome repair area adjacent to Pier J. It consists of a temporary metal building on the asphalt pavement at Pier J. The site is used for repair work, both inside and outside the building. The area is used to clean and repaint sonar domes and to remove adhesives. Some sanding and media blasting operations are also conducted. Several storm drains are in the vicinity.[1]	Paints Solvents Adhesives Blasting Grit (VOCs, SVOCs and Metals)[4]	Air **Soil** Soil Gas **Sediment** **Groundwater** Surface Runoff
AOC 599 Pump House	This site is a pump house on Pier J. This pumphouse was damaged by Hurricane Hugo in 1989 and since rain water has accumulated in the below-grade structure. The pump house was formally a transfer station for diesel fuel.[2]	Petroleum Hydrocarbons (VOCs and SVOCs)[4]	Air **Soil** Soil Gas **Groundwater** Sediment Surface Runoff

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Described in the Draft Final RCRA Facility Assessment, Volume I, November 22, 1994
[3] Pathways scheduled for sampling are bold.
[4] Analyte groups associated with materials generated or stored.

2.48.1 Previous Investigations

These sites have not been investigated previously. Releases noted during the RFA include: the overspray of paint on the pavement, blasting media in the asphalt cracks, and waste material in the open drains in the area.

2.48.2 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.48.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil, groundwater, and sediment will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil, groundwater and/or sediment contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.48.4 Sampling and Analysis Plan

To fulfill the CSI and RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.97 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 598 and AOC 599 are depicted on Figure 2-47. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Proposed samples as illustrated represent the areas most likely to have been impacted if release had occurred at the sonar dome repair area and the pump house.

The proposed subsurface sample locations illustrated on Figure 2-47 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to both AOC 598 and AOC 599, and suspected location of subsurface utilities, pilings, and other obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings and monitoring wells will require coring through concrete, asphalt, or both. In addition, two sediment samples will be collected from storm drains near AOC 598. Because soil gas is a migration pathway, all borings and samples will be screened with a PID.

Table 2.97
AOC 598 and AOC 599
Sampling Plan

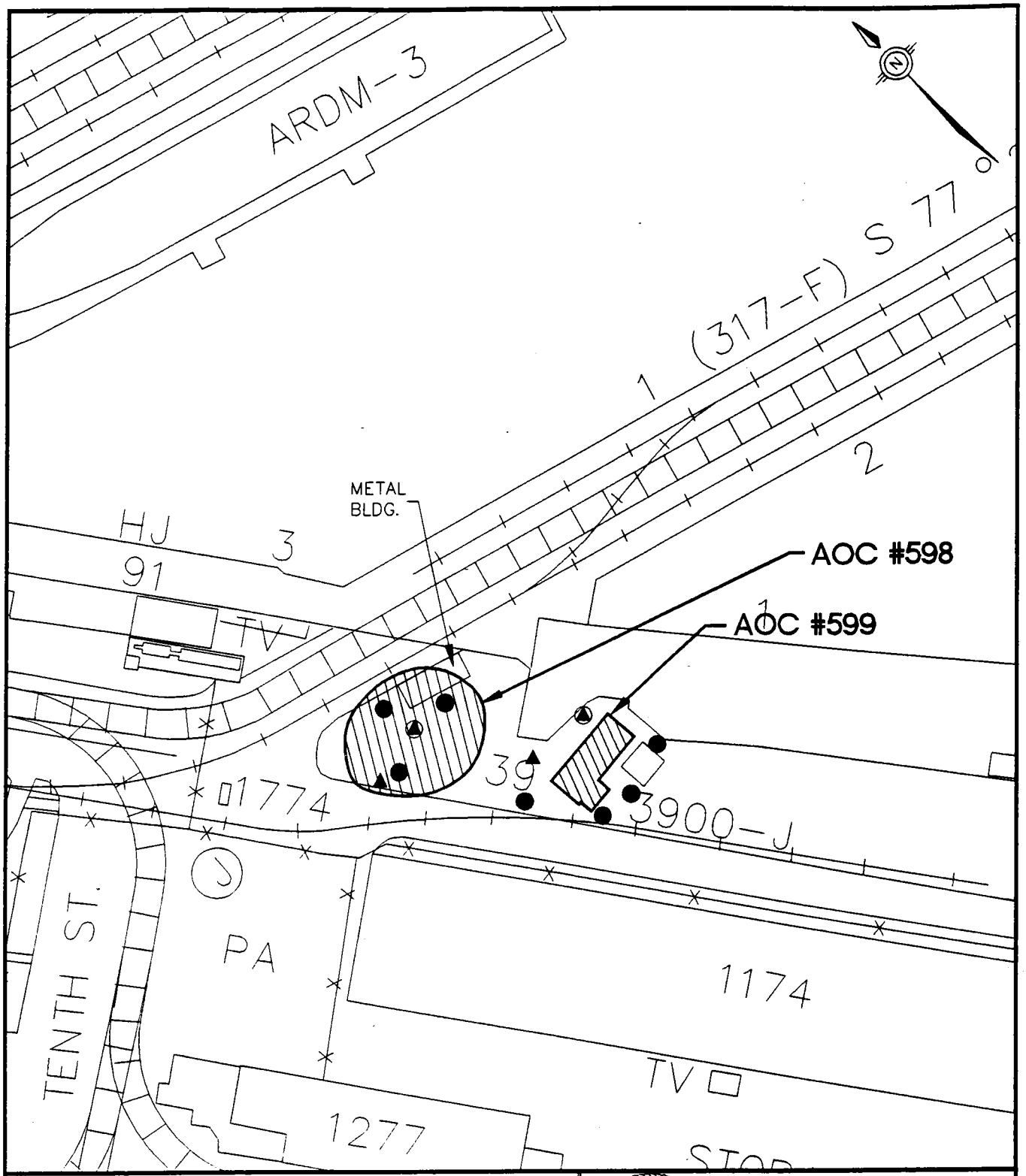
Matrix	Quantity	Analysis
Soil (0-1' bgs)	7	VOAs and SVOAs w/ TICs, Metals, Cyanide, PCBs and Pesticides.
Soil (3-5' bgs)	7	
Groundwater (shallow well)	2	
Sediment	2	

Engineering Parameters:
Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-47
AOC #598
SONAR DOME AREA, END OF PIER J
AOC #599
PIER J PUMP HOUSE

DWG DATE: 6/2/95 | DWG NAME: FIGURE47

2.49 AOC 602, Substation and Storage, Building 95

AOC 602, a former substation, was at Building 95. This site has been designated for a CSI. Table 2.98 describes the site.

Table 2.98
AOC 602
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 602 Former Substation	This site consists of a former electrical substation at Building 95. Building 95 was constructed in 1943. Originally used as an electrical substation for DD 3, the building housed PCB-containing transformers until renovation in 1989. This renovation was interrupted by Hurricane Hugo and the building was subsequently taken out of service. Currently this area is paved with concrete/asphalt.[1]	Dielectric Fluid (PCBs)[3]	**Soil** Groundwater **Surface Runoff**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.49.1 Previous Investigations

This site has not been investigated previously. However, in 1986 fluid samples collected from the transformer indicated PCB concentrations were less than 50 ppm. During the RFA, floor stains were observed.

2.49.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.49.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and concrete surface will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or surface runoff contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.49.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.99 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 602 are depicted in Figure 2-48. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Proposed samples as illustrated represent the areas most likely to have been impacted if a PCB release had occurred at the substation and storage area.

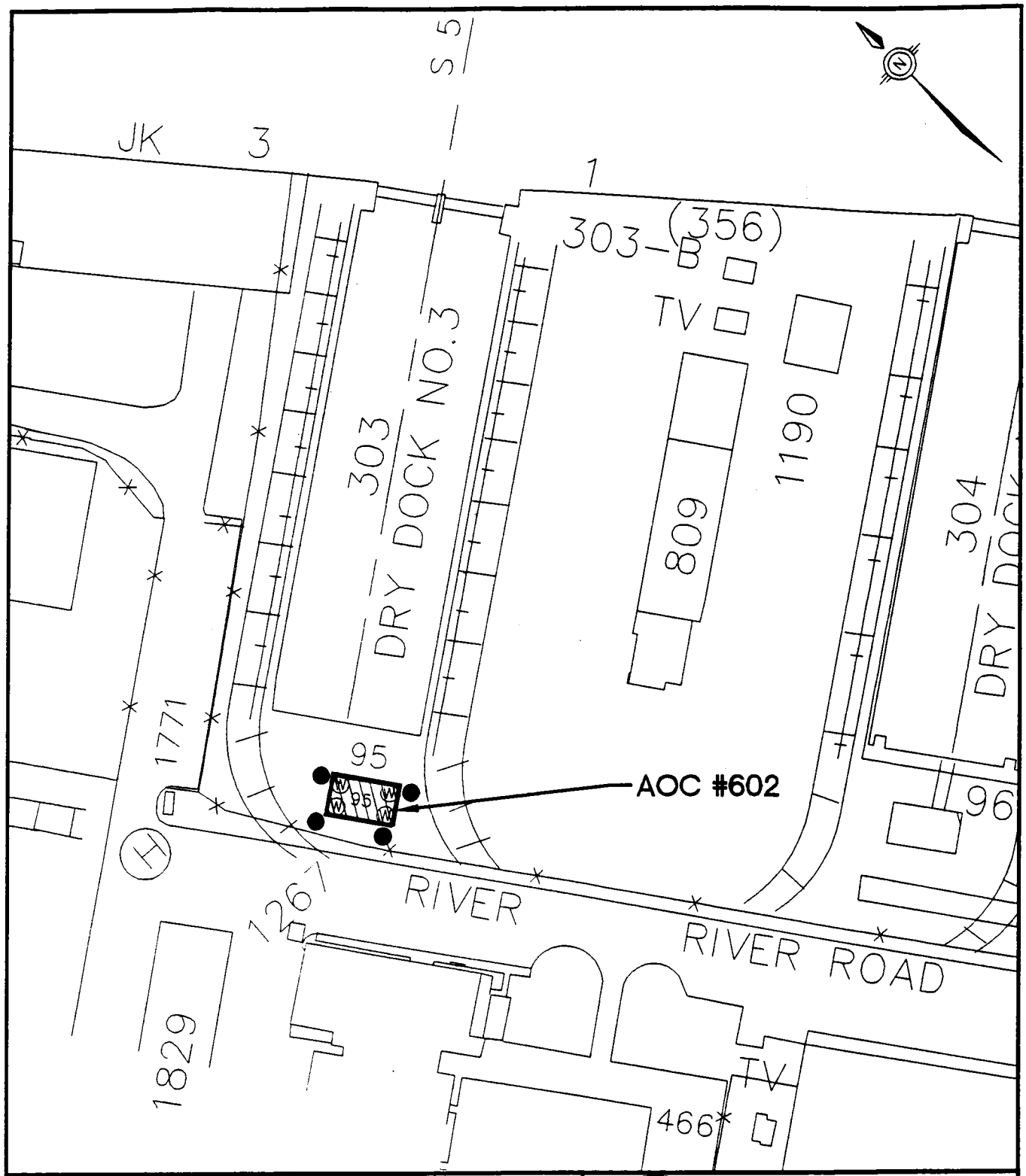
The proposed subsurface sample locations illustrated on Figure 2-48 have been chosen based on a number of variables including: proximity to AOC 602 and suspected location of subsurface utilities, pilings, and other subsurface obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field-checked. Installing soil borings will require coring through concrete, asphalt or both. Four wipe samples will be collected from the area the transformer once occupied. The wipe samples will be arranged in a pattern encompassing the stained areas and the transformer area.

Table 2.99
AOC 602
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	4	PCBs
Soil (3-5' bgs)	4	
Wipe sample	4	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-48
AOC #602
SUBSTATION
BUILDING 95

DWG DATE: 6/2/95 | DWG NAME: FIGURE48

2.50 AOC 604, Substation and Storage, Building 96

AOC 604, a substation and storage area, is in Building 96. This site has been designated for a CSI. Table 2.100 describes the site.

Table 2.100
AOC 604
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways[2]
AOC 604 Substation and Storage	This site is a former electrical substation at Building 96. Building 96 was constructed in 1946. Originally used as an electrical substation for DD 4, the building housed PCB-containing transformers. Building 96 currently stores electrical items which do not contain PCBs. Two permanent and one temporary transformer are currently next to Building 96.[1]	Dielectric Fluid (PCBs)[3]	**Soil** Groundwater **Surface Runoff**

Notes:
[1] Described in the Draft-Final RCRA Facility Assessment, Volume II, November 22, 1994
[2] Pathways scheduled for sampling are bold.
[3] Analyte groups associated with materials generated or stored.

2.50.1 Previous Investigations

This site has not been investigated previously. However, during the RFA, stained soil from a small leak in the transformer was observed.

2.50.2 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no environmental data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives where necessary.

2.50.3 Objectives

The objectives of the proposed field investigation are to fill the identified data gaps by establishing whether COPCs are present for the identified migration pathways. In order to fill these gaps, soil and concrete surface will be sampled. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or surface water contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of treatment alternatives.

2.50.4 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.101 summarizes the types of samples and analytical parameters. Proposed sample locations for AOC 604 are depicted in Figure 2-49. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.* Proposed samples as illustrated represent the areas most likely to have been impacted if a dielectric fluid release had occurred at the substation.

The proposed subsurface sample locations illustrated on Figure 2-49 have been chosen based on a number of variables including: proximity to AOC 604 and suspected location of subsurface utilities, pilings, and other subsurface obstructions. Due to the limited accuracy of the available subsurface obstruction information, subsurface sample locations should be considered preliminary until field- checked. Installing soil borings will require coring through concrete, asphalt, or both. Four wipe samples will be collected from the area the transformer once occupied. The

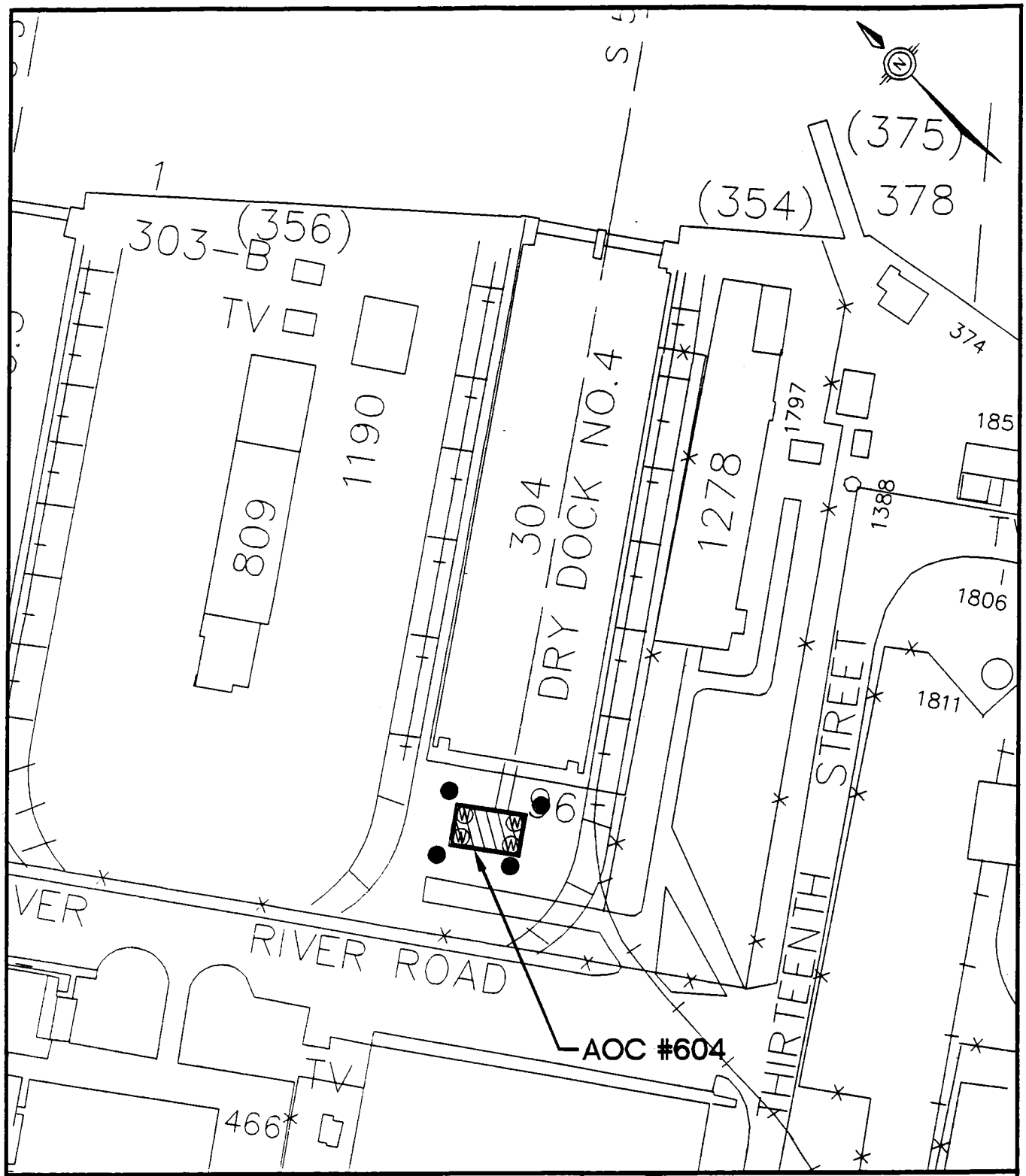
wipe samples will be arranged in a pattern encompassing the leaking transformer and stained area.

Table 2.101
AOC 604
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1′ bgs)	4	PCBs
Soil (3-5′ bgs)	4	
Wipe sample	4	

Notes:
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses as specified in sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-49
AOC #604
SUBSTATION
BUILDING 96

DWG DATE: 6/2/95 | DWG NAME: FIGURE49

3.0 SUPPLEMENTAL (ZONE-WIDE) SAMPLING PLAN

As noted in Section 1 of this plan, groundwater flow and hydrology are likely to be artificially influenced by man-made improvements and structures. Data gathered in this investigation will contribute to groundwater characterization of individual sites within Zone E. Site-specific data will ultimately be combined to develop a zone-wide conceptual model, but data gaps will exist where site density decreases. The objective of the supplemental sampling plan is to provide data points throughout Zone E where site-specific data are missing or fall short of the confidence levels stated in the BRA.

To accomplish this objective, a biased distribution of shallow/deep monitoring well pairs has been proposed across Zone E, complementing the sampling locations designated in the site-specific investigation plans. Twenty-five monitoring well pairs will be installed throughout Zone E, as Figure 3-1 shows. The algorithm proposed in the *Final Comprehensive RFI Work Plan* will not be implemented for Zone E due to the even distribution and high density of sites throughout the zone.

The sample locations proposed for the supplemental plan have been chosen based on a number of variables including: the suspected direction of groundwater flow, suspected location of subsurface utilities, suspected location of piling supports, density of site-specific sample locations, and in some cases the proximity to the Cooper River waterfront. Consistent with the site-specific sampling plans, subsurface sampling locations proposed in this plan should be considered preliminary until field-checked. Because soil gas is a potential migration pathway zone-wide, a PID will be used to screen all borings and samples. Installing monitoring wells associated with the supplemental sampling plan will require coring through asphalt, concrete, or both. Table 3.1 presents the number of soil and groundwater samples associated with the well pairs.

Table 3.1
Zone E
Supplemental Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3'-5' bgs) Groundwater (shallow wells) Groundwater (deep wells)	25 25 25 25	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides and PCBs.

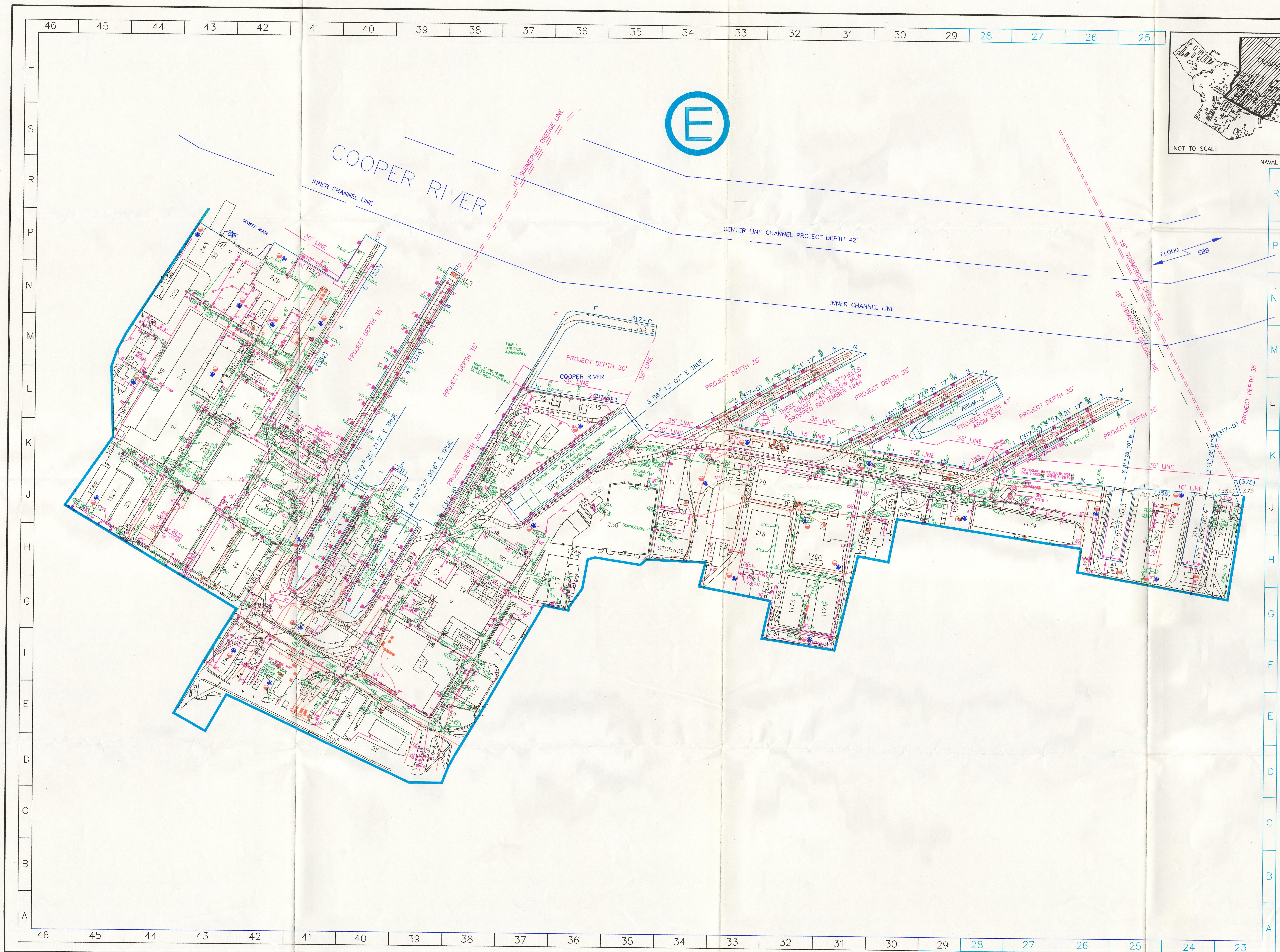
Engineering Parameters:

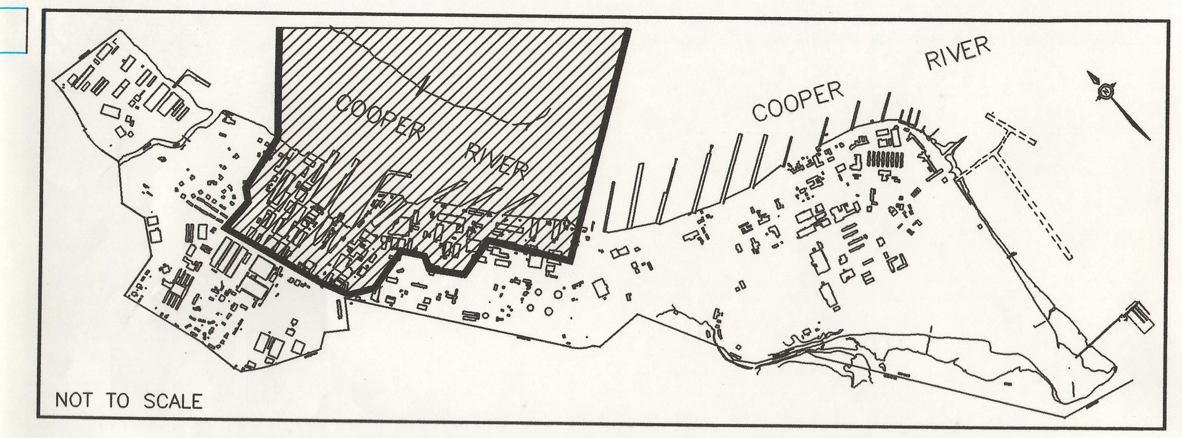
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:
Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.





NAVAL BASE CHARLESTON FACILITY LOCATION MAP

LEGEND

Ⓔ – RCRA INVESTIGATION ZONES

– PROPOSED DEEP MONITORING WELLS

– PROPOSED SHALLOW MONITORING WELLS

– EXISTING POTABLE WATER
– EXISTING SANITARY SEWER
– EXISTING ELECTRIC UTILITY

NOTE:
THE UTILITY INFORMATION INDICATED ON THESE SHEETS WAS PROVIDED BY THE NAVBASE DEPARTMENT OF PUBLIC WORKS. THE LOCATION AND ROUTING OF THESE UTILITIES ARE APPROXIMATE ONLY.

THESE SHEETS ONLY PROVIDE A SCHEMATIC REPRESENTATION OF THE KNOWN UTILITIES.

IN ORDER TO DETERMINE THE EXACT TYPE AND LOCATION OF EACH UTILITY, THE LINES MUST BE FIELD LOCATED.

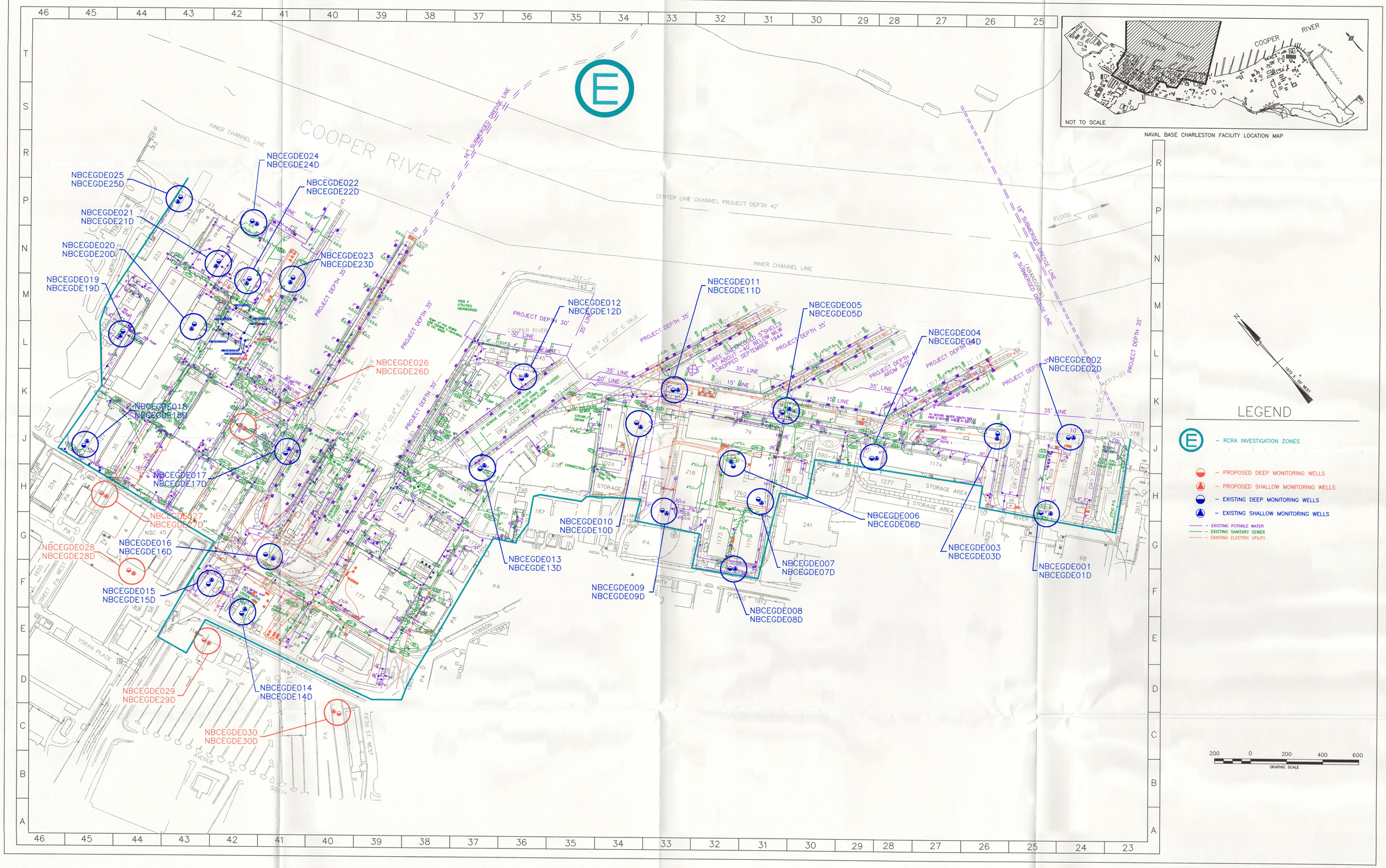
200 0 200 400 600
GRAPHIC SCALE

FINAL RCRA FACILITY INVESTIGATION
ZONE E
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 3–1
SUPPLEMENTAL SAMPLING LOCATIONS
SITE LOCATION AND UTILITY MAP
ZONE E

Dr by: J.MAYFIELD	Tr by: J.MAYFIELD	
Ck by: G.TEMPLE	App by: D.BACKUS	Sheet 1
Date: 7/5/95	DWG Name: PRESBASE	Of 1

11/06/97



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Rev Number:	Rev Date:	Rev By:

ZONE E
FINAL RCRA FACILITY INVESTIGATION
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 3-1
SUPPLEMENTAL SAMPLING LOCATIONS
SITE LOCATION
AND UTILITY MAP
ZONE E

Dr by: J. MAYFIELD	Tr by: –	
Ck by: G. TEMPLE	Appr by: D. BACKUS	Sheet 1
Date: 11/06/97	DWG Name: 29050003	Of 1

4.0 HEALTH AND SAFETY PLAN

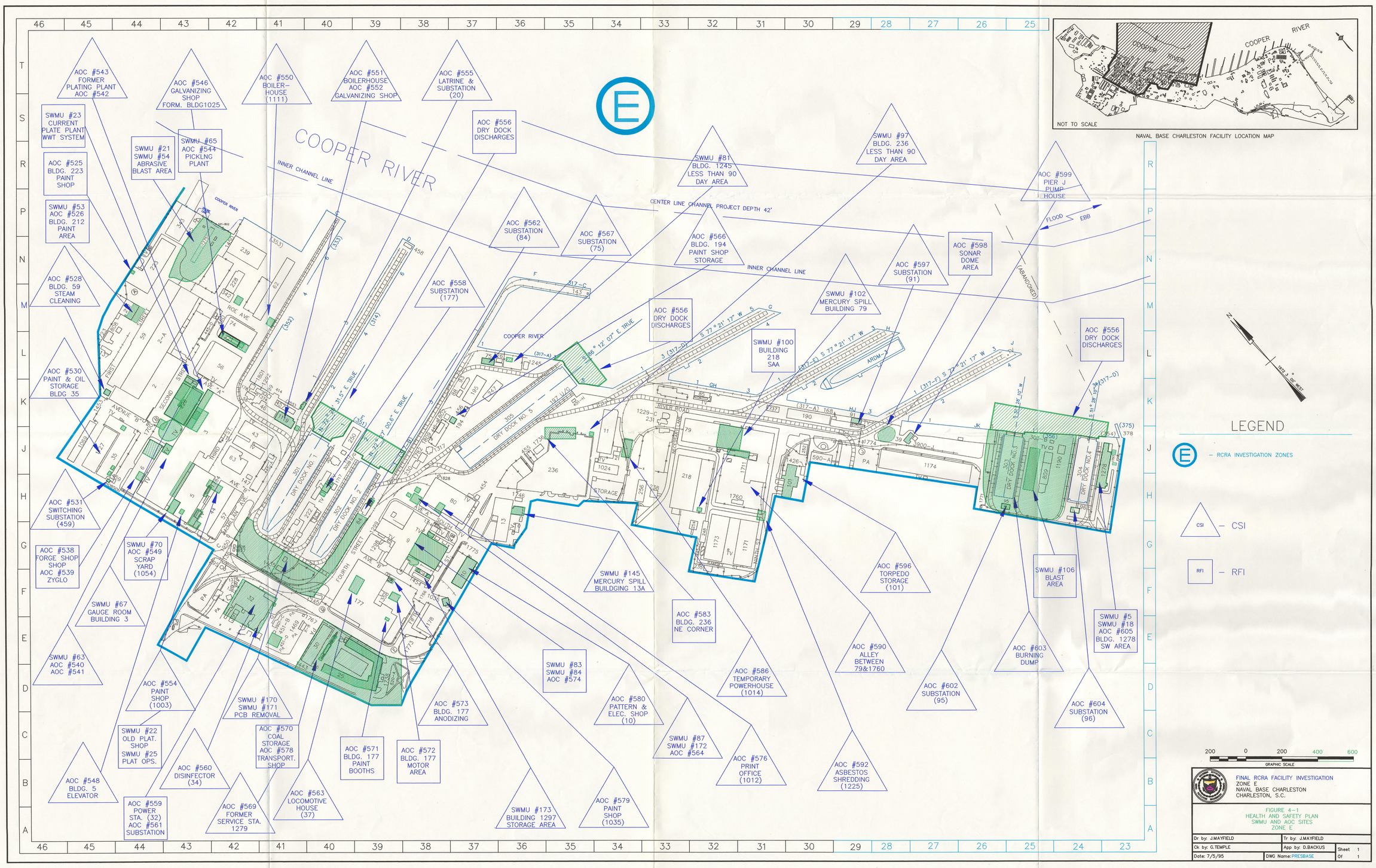
4.1 Introduction

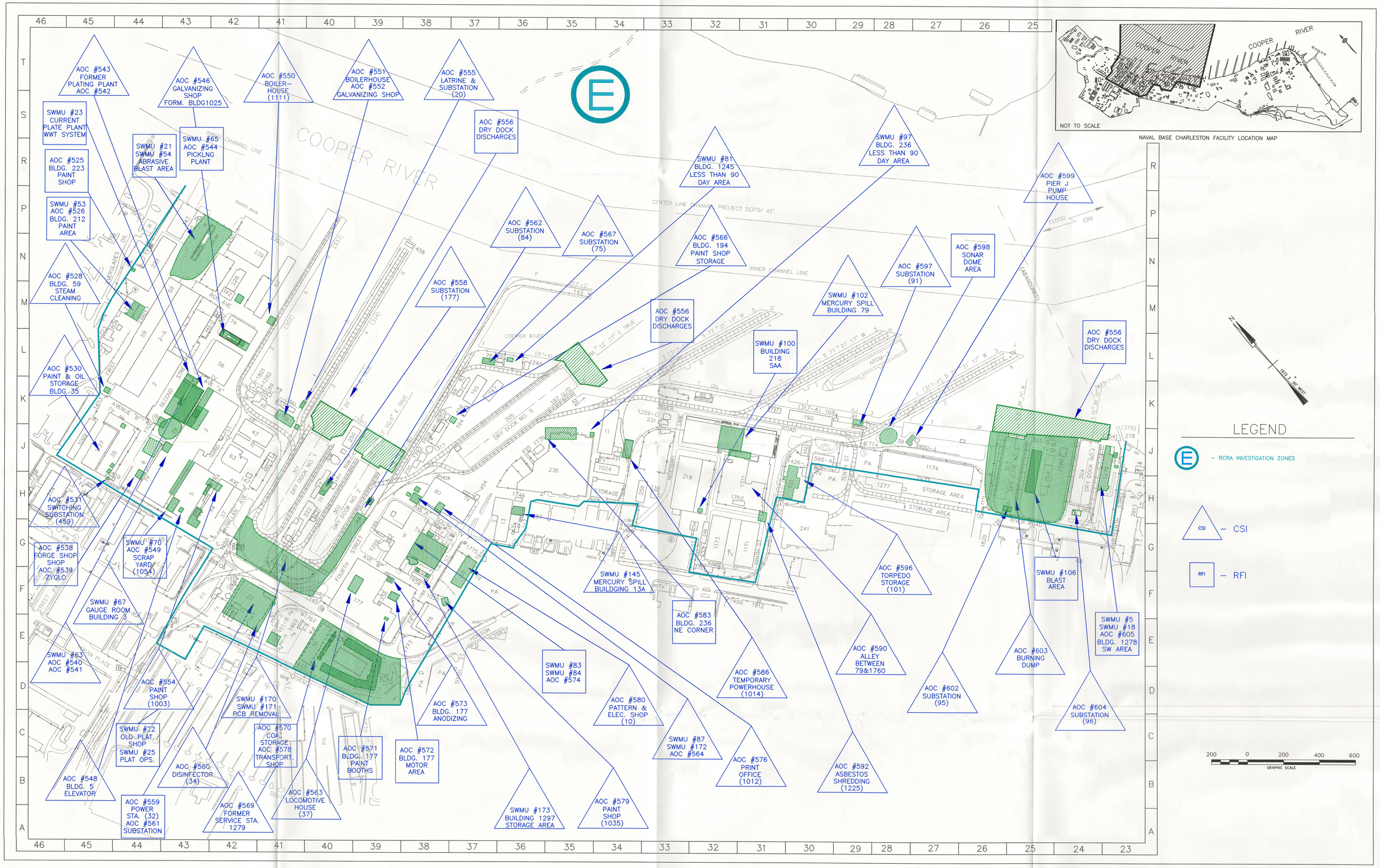
The following is designed to assure the safety and health of site workers throughout the completion of activities related to the U.S. Navy CLEAN Program, RCRA Facility Investigation for Zone E at NAVBASE. The Navy project contract number with EnSafe/Allen & Hoshall (E/A&H) is *N62467-89-D-0318.*

USEPA has divided the NAVBASE sites into SWMUs and AOCs which have been grouped into zones for investigative purposes. This Zone-Specific Health and Safety Plan (ZHASP) has been developed for tasks related to investigating SWMUs and AOCs in Zone E, the locations of which are illustrated on Figure 4-1.

This ZHASP is intended to complement the E/A&H NAVBASE Comprehensive Health and Safety Plan (CHASP) by providing site- and activity-specific details which are not addressed in the CHASP. The CIA of CNSY comprises the majority of Zone E. The CIA is an extensive industrial complex containing virtually all shipyard and dockside operations required to manufacture, repair, overhaul, and refuel naval vessels. Due to the CIA's industrial nature, most of the RFI sites are traversed by many different subsurface utilities, and may have been contaminated with a wide variety of hazardous wastes generated over the life of the shipyard (approximately 93 years). Due to the complexity of the sites to be investigated, considerable research dedicated to locating subsurface utilities and piling supports has gone into planning the site activities and placement of soil borings and groundwater monitoring wells.

This document is organized to provide site workers concise discussions of site conditions and expected hazards. Section 4.2, Employee Protection, will identify each of the hazards expected to be encountered throughout the Zone E investigation and will specify the procedures and controls to abate those hazards. Section 4.5, Site-Specific Information, will concisely describe


COOPER RIVER
INNER CHANNEL LINE
CENTER LINE CHANNEL PROJECT DEPTH 42'
FLOOD
EBB
AOC #543 FORMER PLATING PLANT AOC #542
SWMU #23 CURRENT PLATE PLANT WWT SYSTEM
AOC #525 BLDG. 223 PAINT SHOP
SWMU #53 AOC #526 BLDG. 212 PAINT AREA
AOC #528 BLDG. 59 STEAM CLEANING
AOC #530 PAINT & OIL STORAGE BLDG 35
AOC #531 SWITCHING SUBSTATION (459)
AOC #538 FORGE SHOP SHOP AOC #539 ZYGLO
SWMU #63 AOC #540 AOC #541
AOC #548 BLDG. 5 ELEVATOR
SWMU #21 SWMU #54 ABRASIVE BLAST AREA
SWMU #65 AOC #544 PICKLNG PLANT
AOC #546 GALVANIZING SHOP FORM. BLDG1025
SWMU #70 AOC #549 SCRAP YARD (1054)
SWMU #67 GAUGE ROOM BUILDING 3
AOC #554 PAINT SHOP (1003)
SWMU #22 OLD PLAT. SHOP SWMU #25 PLAT OPS.
AOC #559 POWER STA. (32) AOC #561 SUBSTATION
AOC #560 DISINFECTOR (34)
AOC #569 FORMER SERVICE STA. 1279
SWMU #170 SWMU #171 PCB REMOVAL
AOC #570 COAL STORAGE AOC #578 TRANSPORT. SHOP
AOC #563 LOCOMOTIVE HOUSE (37)
AOC #550 BOILER-HOUSE (1111)
AOC #551 BOILERHOUSE AOC #552 GALVANIZING SHOP
AOC #571 BLDG. 177 PAINT BOOTHS
AOC #572 BLDG. 177 MOTOR AREA
AOC #573 BLDG. 177 ANODIZING
AOC #555 LATRINE & SUBSTATION (20)
AOC #556 DRY DOCK DISCHARGES
AOC #558 SUBSTATION (177)
AOC #562 SUBSTATION (84)
AOC #567 SUBSTATION (75)
SWMU #173 BUILDING 1297 STORAGE AREA
SWMU #145 MERCURY SPILL BUILDGING 13A
SWMU #83 SWMU #84 AOC #574
AOC #579 PAINT SHOP (1035)
AOC #580 PATTERN & ELEC. SHOP (10)
SWMU #87 SWMU #172 AOC #564
AOC #583 BLDG. 236 NE CORNER
SWMU #81 BLDG. 1245 LESS THAN 90 DAY AREA
AOC #566 BLDG. 194 PAINT SHOP STORAGE
SWMU #100 BUILDING 218 SAA
SWMU #102 MERCURY SPILL BUILDING 79
AOC #586 TEMPORARY POWERHOUSE (1014)
AOC #576 PRINT OFFICE (1012)
AOC #590 ALLEY BETWEEN 79&1760
AOC #592 ASBESTOS SHREDDING (1225)
AOC #596 TORPEDO STORAGE (101)
SWMU #97 BLDG. 236 LESS THAN 90 DAY AREA
AOC #597 SUBSTATION (91)
AOC #598 SONAR DOME AREA
AOC #599 PIER J PUMP HOUSE
AOC #602 SUBSTATION (95)
AOC #603 BURNING DUMP
SWMU #106 BLAST AREA
SWMU #5 SWMU #18 AOC #605 BLDG. 1278 SW AREA
AOC #604 SUBSTATION (96)
AOC #556 DRY DOCK DISCHARGES
(ABANDONED)
NOT TO SCALE
NAVAL BASE CHARLESTON FACILITY LOCATION MAP
LEGEND
E – RCRA INVESTIGATION ZONES
CSI – CSI
RFI – RFI
GRAPHIC SCALE
FINAL RCRA FACILITY INVESTIGATION
ZONE E
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 4-1
HEALTH AND SAFETY PLAN
SWMU AND AOC SITES
ZONE E
Dr by: J.MAYFIELD
Tr by: J.MAYFIELD
Ck by: G.TEMPLE
App by: D.BACKUS
Sheet 1
Of 1
Date: 7/5/95
DWG Name: PRESBASE



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Rev Number:	Rev Date:	Rev By:

ZONE E
FINAL RCRA FACILITY INVESTIGATION
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 4–1
HEALTH AND SAFETY
SWMU AND AOC SITES
ZONE E

Dr by: J. MAYFIELD	Tr by: –	
Ck by: G. TEMPLE	Appr by: D. BACKUS	Sheet 1
Date: 11/06/97	DWG Name: 2905C002	Of 1

sites and expected chemical and physical hazards, will analyze the respective hazards with respect to the site activities, and will specify hazard abatement procedures and controls to be implemented at that site. Copies of both this plan and the CHASP should be onsite during all field operations.

4.1.1 Applicability

The provisions of this plan are mandatory for E/A&H personnel, who must read this plan and sign the acceptance form (see Appendix G) before starting site activities. In addition, personnel will adhere to the most current requirements of Title 29 Code of Federal Regulations (CFR) 1910.120, Standards for Hazardous Waste Operations and Emergency Response (HAZWOPER), as specified for workers involved with corrective actions under RCRA.

All non-E/A&H personnel present in E/A&H work areas shall either adopt and abide by this ZHASP and the corresponding CHASP or shall have their own safety plan which, at a minimum, meets the requirements of E/A&H's plans. Subcontractors who adopt the provisions of this plan will be wholly responsible for enforcing the requirements with their employees and shall provide each employee with personal protective equipment (PPE) and implement controls as specified in the ZHASP and the CHASP.

This ZHASP applies to specific planned activities and procedures such as soil boring, installing and developing groundwater monitoring wells, surveying, and collecting soil, groundwater, surface water, and sediment samples. Non-routine procedures and tasks involving non-routine hazards are not adequately addressed in this plan. Examples of such procedures are:

- Confined space entry
- Trenching
- Sampling, handling, or removing unidentified drums

Should it be necessary to conduct these or other high-risk tasks, specific health and safety procedures must be developed, approved, and implemented before proceeding.

4.1.2 Work Zones

Section 2.1 of the CHASP describes the function and interrelation of the three work zones which, in combination, compose the work area. The three work zones are:

- Exclusion Zone (EZ)
- Contaminant Reduction Zone (CRZ)
- Support Zone (SZ)

These work zones will be established and used during field work covered under this ZHASP.

4.1.3 Work Area Access

Authorized personnel will be allowed access to work areas as long as they follow the requirements of this ZHASP and the CHASP. See also Work Area Access, Section 2.2 of the CHASP.

Authorized Personnel — Only those individuals identified as necessary to the investigative operations at each work site will be considered authorized. The Navy and E/A&H will determine which personnel are necessary and authorized. E/A&H personnel who are to perform work in an E/A&H controlled area shall have current HAZWOPER training certificates on file onsite, shall be under appropriate medical surveillance, and shall be equipped and willing to don all PPE specified by the health and safety plan. Individuals whose current documentation is not on file, or those with more recent documentation (have attended a refresher course), will provide the onsite Supervisor copies of their documentation before entering any work area.

Subcontractors, DOD oversight personnel, and other site visitors shall also demonstrate compliance with the requirements specified above, prior to being designated "authorized personnel."

4.1.4 Zone Research

Section 4.5, site-specific information, will provide a specific site description including chemical and physical hazards, and appropriate controls and PPE. The EZ, CRZ, and SZ for each site will be established in the field. The location of these zones is dependent on the work task, layout of the site, weather, and logistical factors.

E/A&H has performed substantial research on the underground utilities associated with the CIA and each work area. All sample locations have been located with respect to that information. However, because very little of the underground utility locations are actually surveyed, the sample locations essentially were based on schematic engineering diagrams. Therefore, great care will be taken in performing any intrusive work within Zone E. Each site within Zone E is discussed in its own subsection of Section 4.5.

4.2 Employee Protection

Employee protection for the work to be completed under the Zone E RFI Work Plan was determined through research of site conditions and planned activities and identification of site-specific physical and chemical hazards. The following section will identify the chemical and physical hazards that are to be expected by site workers throughout completion of investigative activities in Zone E. The site hazards and hazard abatement procedures are discussed in general in the following sections and specifically for each work site in Section 4.5, Site-Specific Information:

- Section 4.2.1: Work Limitations
- Section 4.2.2: Physical Hazards
- Section 4.2.3: Chemical Hazards
- Section 4.2.4: Selection of Personal Protective Equipment
- Section 4.2.5: Air Monitoring

4.2.1 Work Limitations

All site activities will be conducted during daylight only. E/A&H is also assuming that shipyard activities will continue during completion of the work specified in the Zone E RFI. Therefore, all work activities and locations will be phased with Code 106 at least 10 work days before they begin. The project health and safety manager will coordinate all activities with Code 106 and the E/A&H Site Supervisor to assure that neither shipyard nor RFI activities are impacted negatively. Where RFI activities may impede shipyard traffic or movement of critical equipment, CIA security will be notified at least 10 days in advance.

4.2.2 Zone E Physical Hazards

Field personnel should be aware of, and act in a manner to minimize, the dangers associated with physical hazards typically encountered during environmental investigations. These hazards include heat- and cold-related illnesses, severe weather, above-ground and underground utilities,

working with and around drill rigs and heavy equipment, uneven terrain, slippery surfaces, and lifting. The poisonous flora and fauna, such as poison ivy and snakes, that may be expected within other zones of NAVBASE are not expected in this heavily industrialized zone.

In addition to physical hazards listed above, there are additional and significant physical hazards which site workers need to be aware of. These known, suspected and potential physical hazards include: underground utilities, high voltage, natural gas, MAPP gas (welding gas containing acetylene), oxygen, sewer, potable water, storm water, salt water, steam, and compressed-air lines; working in confined spaces; and drilling inside buildings.

4.2.2.1 Underground Utilities

A major safety concern throughout Zone E is the network of underground utilities. Due to the industrial nature of Zone E, most of the RFI sites are traversed by many different subsurface utilities. These utilities include but are not limited to: fresh water, salt water, steam, sanitary sewer, storm sewer, electric, natural gas, MAPP gas, oxygen, and high-pressure air. Additionally, coastal construction techniques for industrial facilities and heavy load-bearing cranes and rail systems require extensive pile supports. Research has indicated that virtually no area within Zone E is free of subsurface utilities or pile supports. Utility and piling densities increase near the waterfront and drydock areas. Most of the pilings extend 15 to 20 feet into the Cooper Marl formation beneath Zone E. The Public Works Engineering Department has stressed that the utility maps are highly subjective and only approximate the subsurface utility locations. Very few, if any, utility lines were surveyed upon installation, repair, or modification.

Considerable research dedicated to locating subsurface utilities and piling supports has gone into this work plan. The problems associated with subsurface obstructions predominantly relate to the health and safety of field personnel, but may also alter proposed subsurface sampling points. Proposed subsurface sampling locations shown in this work plan have been chosen based on a

number of variables including: the suspected direction of groundwater and surface water flow, proximity to the investigated unit, suspected location of subsurface utilities, suspected location of piling support structures, and above-ground improvements such as buildings, facilities, railways, and portal crane rails.

To assure site worker's safety during intrusive activities, a subcontractor specializing in utility-location techniques will be employed to assist the field teams in clearing locations for subsurface sampling points. Additionally, a coring subcontractor will be hired to core the asphalt or concrete surface before drilling or hand-augering activities begin. All subsurface borings will be advanced with a posthole digger or hand auger to 5 feet bgs to ensure that the drill rig will not encounter a subsurface utility or piling. If a subsurface obstruction is encountered, the boring will be terminated. When a boring is terminated, the borehole will be pressure-grouted to the soil/asphalt or concrete interface, and the asphalt or concrete plug will be cemented back in place flush with the existing surface grade. Due to the conditions outlined above, all intrusive work will be completed with respect to the requirements specified in 29 CFR 1926.416, including posting the area with appropriate warning signs and using insulated gloves and boots when appropriate.

4.2.2.2 Procedures and Equipment for Extreme Hot or Cold Weather

The Site Supervisor and the Site Health and Safety Officer (SHSO) shall be aware of the potential for heat stress and other environmental illnesses. When environmental or work conditions dictate, work regimens shall be implemented to minimize the potential for employee illness. Field staff will be responsible for monitoring co-workers for signs or symptoms of heat- or cold-induced illness. For a discussion of the more common heat- and cold-related illnesses and their associated symptoms, see CHASP Section 6.5.1.

Due to the ambient environmental conditions typical for Charleston, South Carolina, the heat index and/or core body temperature (area and/or personal) will be monitored during hot weather

and/or when elevated levels of PPE are used. In addition to using various work-rest regimens, employees also will use cool vests to help control core body temperature when conditions dictate.

4.2.2.3 Severe Weather

Field work shall not be conducted when lightning can be seen from the work area. When lightning is observed, cease work, perform emergency personal and equipment decontamination (see Section 4.3) as needed, then seek shelter.

During extreme weather conditions, the Site Supervisor shall use his/her best judgment and has the authority to stop field work or dismiss workers for the day. Examples of conditions that may warrant work stoppage include: high winds, hail, flooding, and ice storms.

4.2.2.4 Working Around Drill Rigs and Heavy Equipment

Heavy equipment and drill rig operations will adhere to the procedures outlined in the CHASP, Appendix B, Drilling Safety Guide.

4.2.2.5 Drilling or Coring Within Buildings

In addition to the hazards present during routine drilling and coring operations, drilling or coring in a building presents an additional hazard, the buildup of exhaust gases and, in particular, carbon monoxide. Carbon monoxide, a colorless and odorless gas, can affect a person with little advance warning or physiological indicators. Early symptoms of overexposure include drowsiness, lack of attention, and headaches. While severe cases of overexposure to carbon monoxide can cause death, a more likely scenario is that a lesser exposure would cause a worker to be inattentive, drowsy, or make a poor decision that results in an serious accident.

The Threshold Limit Value (TLV) (recommended standard) of carbon monoxide is 25 ppm and Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) is

35 ppm with a Ceiling Limit (not to exceed) of 200 ppm. When operating an internal-combustion-powered drill or coring rig indoors, even in large open spaces, the TLV and PEL can be reached in a few minutes. To minimize the potential of overexposure, whenever drilling or coring in an enclosed structure, regardless of its size, the following minimum procedures shall be followed:

- Exhaust ducts and "smoke ejectors" (or equivalent) shall be attached to the exhaust stack of the drill or coring rig and extended outside the building. (A smoke ejector is a fan that attaches to flexible ducting and is used to draw exhaust gases down through the duct and exhaust them outside.) The duct exhaust will be located such that the potential for re-entrainment of exhaust gases is negated.

- A real-time, direct-reading carbon monoxide meter shall continuously monitor the EZ. Carbon monoxide readings shall be taken and documented a regular intervals, no more than 30 minutes between readings. The rest of the time the instrument shall be left running in the work area. The audible alarm shall be set to trigger no higher than 25 ppm.

- To the extent practical, additional measures should be taken to assure adequate ventilation. Suggested measures include opening doors and windows to the outside, using exhaust fans to both draw exhaust fumes out of and circulate fresh air into the work area, and setting heating ventilation, and air conditioning systems to 100 percent outside air. Use these ventilation measures <u>before</u> initiating drilling operations.

- Should carbon monoxide readings reach 25 ppm, work shall be halted, drilling equipment deactivated, and personnel evacuated from the area. Work may not resume in the area until carbon monoxide concentrations are below 10 ppm.

4.2.2.6 Confined Space Entry

E/A&H is concerned about employee safety when working in or around confined spaces. Therefore, E/A&H personnel are required to characterize the potential hazards associated with entering any confined space. Refer to the following definitions for space characterization information.

Confined Space — A space that is: (1) large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit; and (3) is not designed for human occupancy. Confined spaces may include, but are not limited to, storage tanks, manholes, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, trenches, vats, and open-top spaces more than 4 feet deep such as pits, tubs, vaults, or any place with limited ventilation.

Permit-Required Confined Space (permit space) — A confined space with one or more of the following characteristics: (1) contains or has the potential to contain a hazardous atmosphere; (2) contains a material that can engulf an entrant; (3) has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section; or (4) contains any other recognized serious safety or health hazard.

Non-permit Confined Space — A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

NOTE: E/A&H PERSONNEL SHALL NOT PERFORM PERMIT- OR NON-PERMIT-REQUIRED CONFINED SPACE ENTRY WITHOUT FIRST OBTAINING WRITTEN APPROVAL FROM A COMPANY PRINCIPAL AND THE PROJECT HEALTH AND SAFETY MANAGER. ALL CONFINED SPACE ENTRY WILL BE SUPERVISED BY THE PROJECT HEALTH AND SAFETY MANAGER, AND WILL BE CONDUCTED WITH RESPECT TO THE E/A&H CORPORATE CONFINED SPACE ENTRY PROGRAM AND 29 CFR 1910.146.

As indicated above, E/A&H conducted extensive research into identifying sampling locations with respect to underground utilities and other operations or physical obstacles. It is not anticipated, based on that same research, that E/A&H or subcontractor personnel will be required to perform permit- or non-permit-required confined space entry to collect samples. However, if field conditions warrant performance of confined space entry for sample collection or investigation purposes, it will be conducted under the requirements of the E/A&H Corporate Confined Space Entry Program and 29 CFR 1910.146.

4.2.2.7 Radiation Protection

Radioactive materials/hazards are potentially present within Zone E as a result of past operational activities at the Charleston Naval Shipyard (CNSY).

As part of the CNSY and the Charleston Naval Base closure process, the Navy is required to conduct radiological surveys to verify that all Naval material has been removed.

Prior to EnSafe/Allen & Hoshall and contractors performing any of the below actions, the CNSY General Survey Project Superintendent of Zone E shall be contacted by E/A&H employees and contractors to determine if the CNSY verification surveys have been completed in Zone E. Once completion of the survys has been verified, work may be performed in the verified areas with no radiological precautions required. This applies to all E/A&H employees and their contractors while conducting field work in Zone E, including but not limited to walkover investigations, drilling, well development, soil sampling, water sampling, and trenching.

4.2.2.8 Waterborne Operations

All activities involving the use of motorized boats less than 26 feet in length shall be conducted in accordance with the following procedures:

- Each person shall wear a United States Coast Guard (USCG) — approved Type I, II, or III personal flotation device (PFD) while on board.

- Only personnel with boating experience may operate the boat.

- The boat shall be operated at safe speeds at all times.

- All required equipment (listed below) shall be on board before departure.

- Operations involving boating activities should be performed during warm periods (if possible) to minimize cold stress potential. Bulky clothing increases potential for falling overboard.

- Operations involving boating activities will not be performed in rough water or during severe weather conditions (e.g., thunder or lightning).

- Smoking is prohibited while on board.

Equipment Required for Each Boat Used by Field Personnel

- Type I, II, or III PFD per passenger
- Type IV PFD (throw cushion) with rope
- USCG B-I fire extinguisher
- Anchor and line (rope length should be approximately five times the water depth).
- Visual distress signal (flag)
- Airhorn
- First-aid kit
- Sunscreen with a sun protection factor (SPF) of 15 or greater
- Mobile phone with watertight carrying case

4.2.2.9 Standard Safe Work Practices

- When conducting field work personnel should walk. Running greatly increases the probability of slipping, tripping, and falling.

- Eating, drinking, chewing gum or tobacco, smoking, or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated, unless authorized by the SHSO.

- Hands and face must be thoroughly washed upon leaving the work area.

- No contact lenses will be worn in work areas during invasive activities.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as practical after leaving the CRZ.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, or discolored surfaces, or lean, sit, or place equipment on drums, containers, or on soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on cleanup or response operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Consumption of alcoholic beverages is prohibited.

- Adequate side and overhead clearance must be maintained to ensure that the drill rig boom does not touch or pass close to any overhead power lines or other overhead obstacles or obstructions.

- Utility lines should be marked using characteristic spray paint or labeled stakes. A buffer zone, 3 yards to either side of a utility line, should be maintained during all subsurface investigations.

- Due to the flammable properties of the potential chemical hazards, all spark or ignition sources should be bonded and/or grounded or mitigated before soil boring advancement or other site activities begin.

4.2.2.10 General Rules of Conduct

- Liquor, firearms, narcotics, tape recorders, and other contraband items are not permitted on the premises.

- Any violation of local, state, or federal laws, or conduct which is outside the generally accepted moral standards of the community is prohibited.

- Violation of the Espionage Act, willfully hindering or limiting production, or sabotage is not permitted.

- Willfully damaging or destroying property, or removing government records is forbidden.

- Misappropriation or unauthorized altering of any government records is forbidden.

- Securing government tools in a personal or contractor's tool box is forbidden.

- Gambling in any form, selling tickets or articles, taking orders, soliciting subscriptions, taking collections, etc., is forbidden.

- Doing personal work in government shop or office, using government property or material for unauthorized purposes, or using government telephones for unnecessary or unauthorized local or long-distance telephone calls is forbidden.

- Compliance with posted signs and notices is required.

- Boisterousness and noisy or offensive work habits, abusive language, or any verbal, written, symbolic, or other communicative expression which tends to disrupt the work or morale of others is forbidden.

- Fighting or threatening bodily harm to another is forbidden.

- Defacing any government property is forbidden.

- Wearing shorts of any type and/or offensive logos, pictures, or phrases on clothing is forbidden. Shirts, shoes, and pants, slacks, or coverall-type garments will be worn at all times on government property.

- All persons operating motor vehicles will obey all NAVBASE traffic regulations.

4.2.2.11 Medical Monitoring Program

See CHASP Section 7.0.

4.2.3 Chemical Hazards

Selecting Chemicals of Potential Concern

The COPC(s) for each investigative site are based on review of the RFA. Where the RFA identifies specific COPC(s), those chemicals are listed. However, where historical information does not identify the use or disposal of specific COPC(s), the work plan specifies only chemical classes. For the purposes of measuring, evaluating, and preventing worker exposures, the procedures outlined in this document will account for all available information and will base control procedures and PPE on worst-case scenario assumptions. Section 4.5, Site-Specific Information, will identify the specific chemical hazard, if known, and will base exposure monitoring, controls, and PPE on that information. If only chemical class is known, exposure monitoring, control procedures, and PPE will be designed to accommodate a wide range of chemicals within that class or classes. Due to the lack of reliable historical data for some sites within Zone E, and the documented use of solvents, heavy metals, and PCBs throughout the site, E/A&H will approach each site investigation with appropriate caution and with site workers trained and equipped to measure and identify chemical hazards potentially generated during each intrusive procedure. Chemical hazards are selected to represent the range of acute and chronic health (toxicological) hazards that are, or may foreseeably be present onsite. That is, not every chemical known or suspected of being present is listed as a chemical hazard. Rather, one or two of the most toxic or most prevalent contaminants within a class of chemicals are listed. To illustrate this principle, listed below are classes of chemicals or chemical categories in one column, and examples of chemical hazards in the second column.

Class of Chemical/Product	Chemical Hazard
• Chlorinated solvents	perchloroethylene, chloroform, trichloroethylene,
• Degreasers	methylene chloride, and 1,1,1-trichloroethane
• Non-chlorinated solvents	benzene, toluene, xylene, ethylbenxene, 2-butanone (MEK) and hexane

Class of Chemical/Product	Chemical Hazard
• Metals/heavy metals	lead, cadmium, chromium (especially hexavalent chrome), mercury, silver, and copper
• Fuels — gasoline, fuel oil, diesel, lubricants, oils	benzene, toluene, tetraethyl lead, kerosene, xylene, hexane
• Paints	see Solvents and Metals above, plus tributyl tin
• Pesticides, chlorinated	DDT, DDE, chlordane, dieldrin, and endrin

Table 4.1 lists the specific chemical hazards as identified in the RFA and listed for each RFI site in Section 4.5, Site-Specific Information.

4.2.4 Selection of Personal Protective Equipment

It is important that specified PPE protects against known and suspected site hazards. Protective equipment is selected based on the types, concentrations, and routes of personal exposure that may be encountered. In situations where the types of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the PPE required, and greater emphasis is placed on experience and sound safety practices. As is discussed above, PPE for site workers will be based on previous site history and on the activities to be performed there. Section 4.5, Site-Specific Information, will describe the site, discuss the work planned there, and assess the hazards and specify PPE for those activities, based on the site chemical and physical hazards.

PPE requirements are subject to change as site information is updated or changes. **A decision to deviate from specified levels of PPE as contained in this ZHASP must be made or reviewed by the PHSO.** Table 4.2 presents the levels of PPE which may be employed at Zone E, and the criteria for upgrading PPE.

Table 4.1
Zone E Chemical Hazards
Exposure Information

Compound	Ionization Potential (ev)[3]	Odor Threshold (ppm)	OSHA PEL[1]	ACGIH TLV[2]	NIOSH REL[3]	Action Level
Solvents/Degreasers						
Perchloroethylene	9.3	5	25 ppm	25 ppm 100 ppm- STEL	Potential Occupational Carcinogen	12 ppm
Chloroform	11.4	205	2 ppm	10 ppm Suspected Human Carcinogen	2 ppm Potential Occupational Carcinogen	1 ppm
Trichloroethylene	9.5	50	50 ppm 200 ppm - STEL	50 ppm 100 ppm - STEL	25 ppm Potential Occupational Carcinogen	12 ppm
Vinyl Chloride	7.6	260	1 ppm 5 ppm - Ceiling Confirmed Carcinogen	5 ppm Confirmed Human Carcinogen	Potential Occupational Carcinogen	0.5 ppm
Methylene Chloride	11.4	214	500 ppm 1000 ppm - Ceiling	50 ppm Suspected Human Carcinogen	Potential Occupational Carcinogen	25 ppm
1,1,1-Trichloroethane	Not Listed	100	350 ppm 450 ppm - STEL	350 ppm 450 ppm - STEL	350 ppm - Ceiling	175 ppm
Benzene	9.25	4.7	1 ppm 5 ppm - STEL	10 ppm Suspected Human Carcinogen	0.1 ppm 1 ppm Ceiling Potential Occupation Carcinogen	0.5 ppm
Toluene	8.8	40	100 ppm 150 ppm	50 ppm Skin	100 ppm 200 ppm - Ceiling	25 ppm

Table 4.1
Zone E Chemical Hazards
Exposure Information

Compound	Ionization Potential (ev)[3]	Odor Threshold (ppm)	OSHA PEL[1]	ACGIH TLV[2]	NIOSH REL[3]	Action Level
Solvents/Degreasers						
Ethylbenzene	8.8	140	100 ppm 125 ppm - STEL	100 ppm 125 ppm - STEI	Not Listed	50 ppm
Xylene	8.6	0.05	100 ppm 150 ppm - STEL	100 ppm 150 ppm - STEL	100 ppm 200 ppm - Ceiling	50 ppm
Z-Butanone (MEK)	6.7	10	200 ppm 300 ppm - STEL	200 ppm 300 ppm - STEL	200 ppm	100 ppm
Hexane	10.2	130 ppm	500 ppm 1000 ppm - STEL	50 ppm	100 ppm	25 ppm
Polychlorinated Biphenyls (PCBs)	Not Listed	Not Listed	0.5 mg/m^3 Skin	0.5 mg/m^3 1 mg/m^3 Skin	Not Listed	0.25 mg/m^3
Ethylene Glycol	9.3	Not Listed	50 ppm - Ceiling	50 ppm - Ceiling	Not Listed	25 ppm
Metals						
Lead	N/A	N/A	0.05 mg/m^3	0.15 mg/m^3	<0.1 mg/m^3	0.025 mg/m^3
Cadmium	N/A	N/A	0.05 mg/m^3	0.002 mg/m^3 - Respirable Fraction 0.01 mg/m^3 - Total Dust	Lowest Feasible Concentration	0.01 mg/m^3
Chromium	N/A	N/A	1 mg/m^3	1 mg/m^3	0.5 mg/m^3	0.25 mg/m^3
Mercury	N/A	N/A	0.05 mg/m^3 - Skin	0.025 mg/m^3 - Skin	0.05 mg/m^3	0.012 mg/m^3
Silver	N/A	N/A	0.01 mg/m^3	0.1 mg/m^3	Not Listed	0.005 mg/m^3

Table 4.1
Zone E Chemical Hazards
Exposure Information

Compound	Ionization Potential (ev)[3]	Odor Threshold (ppm)	OSHA PEL[1]	ACGIH TLV[2]	NIOSH REL[3]	Action Level
Metals						
Copper	N/A	N/A	0.1 mg/m³ - Fume 1 mg/m³ - Dust	0.2 mg/m³ - Fume 1 mg/m³ - Dust	Not Listed	0.05 mg/m³ - Fume 0.5 mg/m³ - Dust
Potassium Cyanide	N/A	N/A	5 mg/m³	5 mg/m³ - Ceiling Skin	5 mg/m³ - Ceiling	2.5 mg/m³
Sodium Cyanide	N/A	N/A	5 mg/m³	5 mg/m³ - Ceiling Skin	5 mg/m³ - Ceiling	2.5 mg/m³
Nickel	Not Listed	Not Listed	1 mg/m³	1 mg/m³	0.015 mg/m³ Potential Occupational Carcinogen	0.007 mg/m³
Fuels						
Benzene	9.25	4.7	1 ppm 5 pp, - STEL	10 ppm Suspected Human Carcinogen	0.1 ppm 1 ppm - Ceiling Potential Occupational Carcinogen	0.5 ppm
Toluene	8.8	40	100 ppm 150 STEL	500 ppm - Skin	100 ppm 200 ppm - Ceiling	225 ppm
Ethyl Benzene	8.8	140	100 ppm 125 ppm - STEL	100 ppm 125 ppm - STEL	Not Listed	50 ppm
Xylene	8.6	0.05	100 ppm 150 ppm - STEL	100 ppm 150 - STEL	100 ppm 200 ppm - Ceiling	50 ppm

Table 4.1
Zone E Chemical Hazards
Exposure Information

Compound	Ionization Potential (ev)[3]	Odor Threshold (ppm)	OSHA PEL[1]	ACGIH TLV[2]	NIOSH REL[3]	Action Level
Fuels						
Tetraethyl Lead	11.1	Not Listed	0.075 mg/m³ - Skin	0.1 mg/m³ - Skin	<0.1 mg/m³	0.037 mg/m³
Kerosene	6.8	1	Not Listed	Not Listed	100 mg/m³	50 mg/m³
Acids						
Nitric Acid	N/A	N/A	2 ppm 4 ppm - STEL	2 ppm 4 ppm - STEL	2 ppm	1 ppm
Sulfuric Acid	N/A	N/A	1 mg/m³	1 mg/m³ 3 mg/m³ - STEL	1 mg/m³	0.5 mg/m³
Hydrochloric Acid	N/A	N/A	7 mg/m³ - Ceiling	7 mg/m³ - Ceiling	Not Listed	3.5 mg/m³
Chromic Acid	N/A	N/A	0.1 mg/m³ - Ceiling	0.05 mg/m³ - Confirmed Human Carcinogen	0.001 mg/m³	0.0005 mg/m³
Pesticides						
DDT	Not Listed	Not Listed	1 mg/m³ - Skin	1 mg/m³	0.5 mg/m³	0.25 mg/m³
DDE	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	—
Chlordane	13.4	Not Listed	0.5 mg/m³ - Skin	0.5 mg/m³ - Skin	Potential Occupational Carcinogen	0.25 mg/m³
Dieldrin	Not Listed	0.041	0.25 mg/m³ - Skin	0.25 mg/m³ - Skin	Potential Occupational Carcinogen	0.12 mg/m³

Table 4.1
Zone E Chemical Hazards
Exposure Information

Compound	Ionization Potential (ev)[3]	Odor Threshold (ppm)	OSHA PEL[1]	ACGIH TLV[2]	NIOSH REL[3]	Action Level
Pesticides						
Endrin	Not Listed	Not Listed	0.1 mg/m³ - Skin	0.1 mg/m³ - Skin	Not Listed	0.05 mg/m³
Malathion	Not Listed	Not Listed	10 mg/m³	10 mg/m³ - Skin	15 mg/m³	5 mg/m³
Parathion	Not Listed	Not Listed	0.1 mg/m³ - Skin	0.1 mg/m³ - Skin	0.05 mg/m³	0.025 mg/m³
Additional Site Contaminants						
Freon (Chlorodifluoro - Methane)	Not Listed	Not Listed	1000 ppm	1000 ppm	Not Listed	500 ppm
Benzo (a) pyrene	NA	NA	0.2 mg/m³	0.2 mg/m³ Confirmed Human Carcinogen	0.1 mg/m³ Potential Occupational Carcinogen	0.1 mg/m³
Benzo (b) Fluoranthene	NA	NA	0.2 mg/m³	0.2 mg/m³ Confirmed Human Carcinogen	0.1 mg/m³ Potential Occupational Carcinogen	0.1 mg/m³

Notes:
[1] = 29 CFR 1910.1000, Table Z-1-A. Limits For Air Contaminants.
[2] = 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH.
[3] = NIOSH Pocket Guide to Chemical Hazards, June 1990.
[4] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989, Range of All Reference Values.

Table 4.2
Level of Protection and Criteria

Level of Protection	Criteria for Use	Equipment
Level A	• When atmospheres are "immediately dangerous to life and health" (IDLH in the *NIOSH/OSHA Pocket Guide to Chemical Hazards* or other guides.) • When known atmospheres or potential situations exist that could affect the skin or eyes or be absorbed into the body through these surfaces. Consult standard references to obtain concentrations hazardous to skin, eyes, or mucous membranes. • Potential situations include those where immersion may occur, vapors may be generated, or splashing may occur through site activities. • Where atmospheres are oxygen-deficient. • When the type(s) and or potential concentration of toxic substances are not known.	• Positive-pressure, full-facepiece, self-contained breathing apparatus (SCBA) or positive-pressure supplied air respirator (SAR) with escape SCBA. • Fully encapsulating chemical protective suit. • Chemical-resistant inner and outer gloves. • Steel toe and steel shank chemical-resistant boots. • Hard hat under suit. • Two-way radios worn inside suit. • Optional: coveralls, long cotton underwear, disposable protective suit, gloves and boots, over fully encapsulating suit.
Level B	• When respiratory protection is warranted and cartridge respirators are not appropriate. Examples of these conditions are: — when work area may contain less than 19.5 percent oxygen, — when expected contaminants do not have appropriate warning properties, e.g., vinyl chloride, or — when cartridges are not available to protect against all COPs. • Hazards associated with limited dermal exposure are not significant.	• Chemical-resistant clothes, coveralls. • Positive-pressure, full-face SCBA or SAR with escape bottle. • Hard hat. • Chemical-resistant outer and inner gloves. • Steel toe and steel shank boots. • Chemical-resistant outer boots.
Level C	• When respiratory protection is warranted and cartridge respirators are appropriate. • When PID readings exceed the AL. • When air monitoring indicates airborne concentration of a chemical is 50 percent or more of the PEL or TLV. • And the work area contains at least 19.5 percent oxygen.	• Chemical-resistant coveralls. • Full-face, air-purifying respirator equipped with cartridges suitable for the hazard. • Hard hat. • Chemical-resistant outer and inner gloves. • Steel toe and steel shank boots. • Disposable outer boots.

Table 4.2
Level of Protection and Criteria

Level of Protection	Criteria for Use	Equipment
Modified Level D	• When chemical contamination is known or expected to be present, yet inhalation risk is low and respiratory protection is not required. • Site contaminants may be absorbed through the skin. • The "default level" of PPE required when the ZHASP does not specify another level of PPE. • And the work area has at least 19.5 percent oxygen. • When minimal or no chemical contamination is expected. • When ZHASP specifies Level D protection is adequate. • And the work area has at least 19.5 percent oxygen.	• Chemical-resistant coveralls. • Chemical-resistant outer gloves; inner gloves or glove liners, optional. • Steel toe and steel shank boots. • Hard hat. • Safety glasses with side shields or safety goggles. • Optional: chemical-resistant outer boots. • Inner gloves or chemical-resistant gloves needed to handle soil or water samples. • Optional: coveralls and disposable outer boots. • Work clothes.

4.2.5 Air Monitoring

Air monitoring for VOCs, respirable dust, oxygen, and flammable gases will be performed continuously during all intrusive investigative activities and those which activities which require that E/A&H personnel handle potentially contaminated materials. Personal monitoring will also be performed to determine exposure concentrations realized by personnel performing site investigative procedures. Personnel samples will be collected and analyzed with respect to National Institute for Occupational Safety and Health (NIOSH) *Manual of Analytical Methods*, as required per 29 CFR 1910.1000. Personal samples will collected during each site activity in which Level C PPE is prescribed. Additional personnel samples will be collected during each site activities which represent worst case exposure potential.

When possible, real-time monitoring instruments will be used to measure airborne contaminant levels. Air monitoring for VOCs will be accomplished using a PID. The PID will be field

calibrated to measure VOCs relative to a 100 ppm isobutylene standard. If VOCs are detected down-hole, colorimetric detector tubes and/or other sampling media may be used to determine the identification and approximate concentration of these compounds.

The PHSO reserves the right to require personal exposure monitoring or other types of air sample collection and analysis. These samples may be required for a variety of reasons such as: to identify a chemical odor, PID readings exceed or approach the AL, or to determine if personal exposures are below OSHA PELs.

Air monitoring for total (inspirable) dust will be performed using a real-time aerosol monitor to measure airborne dust concentrations. In addition to the real-time monitor, air samples will be collected to document the actual concentrations measured per a NIOSH-approved method.

A combustible gas indicator (CGI) will be used during all soil borings and well installations. The CGI will be field-calibrated to measure flammable gases relative to a methane standard. Downhole CGI readings will be collected periodically during soil-disturbing operations. Field activities will immediately cease if downhole readings exceed 20 percent of the lower explosive limit (LEL). If CGI readings do not subside, the area will be immediately evacuated and the situation re-evaluated to determine how to proceed. The area will be investigated; operations may not proceed until downhole readings are below 20 percent LEL.

Action Level and Ceiling Concentration

Each site at NAVBASE has a designated action level and ceiling concentration. For this project the AL is defined as the PID reading in the breathing zone above which respiratory protection must be upgraded; chemical protective clothing may also be upgraded. The AL is determined on a site-by-site basis. To exceed the AL, PID readings should be sustainable. Readings should remain above the AL for at least one or two minutes at a time. Readings that are elevated for

only a few seconds every 15 or 20 minutes do not exceed the AL and do not require workers to upgrade their level of PPE.

The general AL for this zone, as determined on a properly calibrated PID, is 5 PID units above background. PPE shall be upgraded to Level C (assuming that cartridge respirators are appropriate, otherwise Level B) if airborne VOC concentrations in the breathing zone exceed the AL, or if the concentration of any contaminant exceeds 50 percent of the OSHA PEL. This baseline AL and PPE requirement may be superseded by more stringent site-specific levels, as identified in each Site Chemical Hazard and PPE requirements section.

If breathing zone levels exceed the AL, or site conditions indicate that additional health and safety precautions are needed, field activities in the area shall stop. Field staff shall notify the Site Supervisor of the situation and he/she shall contact the Project Manager and/or the PHSO. The PHSO will be responsible for reassessing the hazards and prescribing revised health and safety requirements as necessary, including upgraded PPE requirements, revised work schedules, and revised decontamination procedures. See Table 4.2 for specific criteria for each protection level.

If PID readings exceed 10 units, the SHSO shall contact the PHSO and discuss the need to identify and quantify airborne contaminants. Work shall not proceed until breathing zone concentrations return to background levels and it is reasonably anticipated that breathing zone readings will stay approximately at background levels, or the chemical constituent(s) are identified and appropriate PPE is donned.

The ceiling concentration is defined as the maximum allowable PID reading in the breathing zone regardless of PPE. A ceiling concentration of 50 PID units has been established. Should VOC concentrations exceed 50 ppm in the breathing zone, field workers should secure their equipment and back off the site. Work shall not resume until the Site Supervisor understands

why VOC concentrations became elevated, knows the major constituents of the VOCs being generated, and the VOCs in the breathing zone are less than 5 ppm or workers have upgraded to Level C or B. The proper PPE upgrade shall be determined by the PHSO based on site-specific chemical information, i.e., is there enough information to determine that air-purifying respirators will provide sufficient protection.

Field monitoring values will be recorded in a field logbook and copies must be posted for field personnel review.

Equipment Maintenance

Before being used daily, PIDs, CGIs, and other monitoring equipment shall be calibrated or their proper function verified. Throughout the day this equipment shall be periodically checked to ensure that it is working properly. A final calibration shall be conducted at the end of the workday, at which time each instrument will be checked to ensure that it is free from surface contamination. Air monitoring equipment shall detect the calibration standard within a range of plus or minus 10 percent, otherwise the instrument shall be considered malfunctioning. Field staff shall note in their field notebooks that they conducted these calibrations and checks and note whether the equipment was functioning properly.

When equipment is not functioning properly, it should be brought to the attention of the Site Supervisor or SHSO, who will arrange to repair or replace that equipment as needed.

4.3 Decontamination

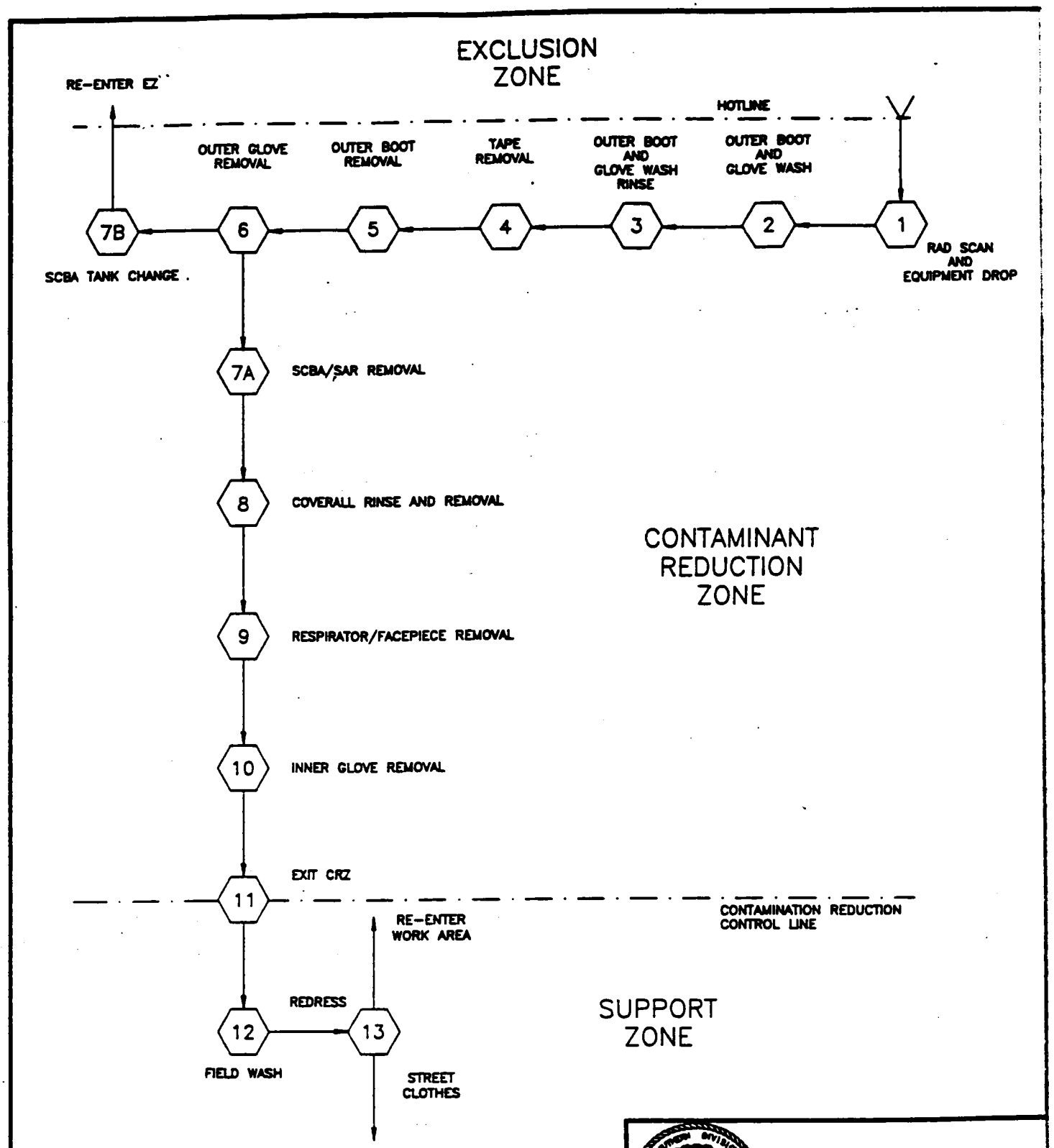
4.3.1 Personnel and Equipment Decontamination

As needed, a CRZ will be established adjacent to EZs established for invasive activities, and will include stations for decontaminating personnel, PPE, and hand tools. Typically, a portion of the CRZ will be covered with sheets of 6-mil polyethylene (generally, an area 20 feet by 20 feet is sufficient) with specific stations to accommodate the removal and disposal of the protective clothing, boot covers, gloves, and respiratory protection.

Heavy equipment and field equipment that cannot adequately be decontaminated in the CRZ may be decontaminated on a more centrally located decontamination pad. Table 4.3 lists of equipment that may be convenient to have onsite to decontaminate heavy equipment and vehicles; this table also explains how this equipment may be used.

The full contamination lay out provided on the following page shows one method of laying out an acceptable decontamination area for Level B PPE. There are numerous ways to lay out decontamination areas. Decontamination areas for Level C and Modified D PPE should be based on this concept of decontamination, but can be scaled back in accordance with the decontamination needs of the specific site and level of PPE. As a general rule, people working in the CRZ, assisting in the decontamination of workers leaving the EZ, shall be outfitted in PPE that is one protection level below what the exiting workers are using. For example, if workers leave the EZ in Level C, personnel in the CRZ should be in Modified D.

Often equipment may be adequately decontaminated using a soapy wash solution and following specified rinsing procedures. Normally equipment decontamination will be completed in Level D with gloves or Modified D PPE.



ZONE E HASP
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FULL DECONTAMINATION LAYOUT
LEVEL B PROTECTION

DWG DATE: 10/19/94 | DWG NAME: 29FDLLP

Table 4.3
Equipment Recommended for Decontaminating Heavy Equipment and Vehicles

- Tanks or drums to be store collected wash and rinse solutions, alternatively, equipment to treat collected wash and rinse solutions may be substituted.
- Pumps, and filters as needed to collect wash and rinsate solutions.
- Pressurized steam sprayers for steam cleaning equipment.
- Long-handled brushes for general cleaning of exterior surfaces. Also shovels and other equipment may be used to dislodge caked-on contaminated mud on the undercarriage or in the tires.
- Wash solutions, selected for their ability to remove (dissolve, etc.) contaminants
- Rinse solutions, selected for their ability to remove contaminants and wash solutions.
- Pressurized sprayers for washing and rinsing, particularly hard-to-reach areas.
- Clean buckets that can hold cleaning and rinsing solutions.
- Brooms and brushes that can be used to clean the interior, operator areas of vehicles and equipment.

In the event of inclement weather (e.g., lightning) or an emergency requiring immediate evacuation, contaminated equipment will be bagged or wrapped and taped in 6-mil polyethylene sheeting and tagged as "contaminated" for later decontamination. Respirators not only need to be decontaminated and cleaned between uses, but also need to be sanitized. Alcohol swabs are generally sufficient.

4.3.2 Full Decontamination Procedures

Workers shall use the following cleaning and decontamination procedures when exiting the EZ. These procedures should be followed when workers are leaving the area for lunch, at the end of their shift, or when work is completed for an EZ. Procedures for rest breaks and changing SCBA tanks and cartridges are described in Section 4.3.3. Not all steps apply to every situation; follow applicable procedures. Decontamination procedures shall start at the EZ/CRZ interface and continue away from the EZ toward the SZ.

Full Decontamination

1. ***Equipment drop***. Deposit equipment used onto plastic drop cloths or into a plastic-lined tub. All gross contamination should be removed here, fine cleaning and decontamination of equipment may be completed here or elsewhere. Before moving equipment that is still contaminated, it must be wrapped and taped.

2. ***Outer boot and glove wash***. Wash/remove gross contamination from outer boots, outer gloves, SCBA, and/or airline equipment.

3. ***Tape removal***. Remove tape from ankles and wrists and dispose of in plastic-lined drum.

4. ***Outer boot removal***. Remove outer boots; disposable outer boots may be disposed of in the same waste container used in Step 4. Non-disposable boots need a thorough cleaning before they can be removed from the site. (If non-disposable boots are used, it is preferable to have them dedicated to the project.)

5. ***Outer glove removal***. Remove and dispose of outer gloves. Gloves may be disposed in the same waste container as used in Step 4.

6. ***SCBA and SAR removal***. For Level B*.

   SCBA — With buddy or other site worker, remove backpack, remove facepiece, and shut off air flow.

   SAR — With buddy or other site worker, remove harness and escape bottle, remove face piece, and shut off air flow.

* If coveralls are significantly contaminated, leave the respirator facepiece on, disconnect the air hose just downstream of the regulator, turn off the flow of air, remove the backpack or equipment harness, and leave the facepiece in place. Remove the facepiece in Step 9.

7. ***Coverall removal.*** Rinse coveralls, if needed; remove coveralls and dispose of them. The same drum may be used as in Step 4. Non-disposable coveralls shall be double-bagged with the outer bag clearly labeled "contaminated."

8. ***Respirator removal.*** Remove respirator (or facepiece of Level B equipment, if it is still being worn). Dispose of spent cartridges, clean, disinfect, dry, and properly store respirator or facepiece.

9. ***Inner glove removal.*** Remove and dispose of inner gloves.

10. ***Exit area.*** Exit the CRZ via the SZ.

11. ***Field wash.*** Wash and rinse hands and face.

12. ***Re-dress.*** Re-dress into appropriate PPE for re-entry or change into street clothes.

Notes:

- All wastes (soil and water) generated during personal decontamination will be collected in 55-gallon drums. The drums will be labeled by E/A&H personnel; final disposal will be by the Navy.

- Hard hats and eye protection should be washed at the end of each workday with soap and water solution.

4.3.3 Partial Decontamination Procedures

To change a respirator cartridge or SCBA tank:

1. ***Outer boot and glove wash.*** Wash outer boots and gloves. Wash/remove gross contamination from SCBA and/or airline equipment.

2. ***Tape removal.*** Remove tape from ankles and wrists and dispose of it in a plastic-lined drum.

3. ***Facepiece removal.*** Disconnect facepiece and air hose just downstream of regulator. The facepiece may remain in place, or be removed and cleaned. Remove the spent tank from the backpack and replace it with a full tank. Connect air hose and turn on air.

4. ***Respirator removal.*** Remove respirator, remove used cartridges, clean and disinfect respirator, install new cartridges, and don respirator.

5. ***Respirator check.*** Check to make sure that respirator still seals properly to your face.

6. ***Don clean PPE.*** Put on clean outer gloves, tape wrists (as applicable), and re-enter EZ.

When taking a rest break:

1. ***Outer boot and glove wash.*** Wash outer boots and gloves. Wash/remove gross contamination from SCBA and/or SAR equipment.

2. ***Tape removal.*** Remove tape from ankles and wrists and dispose in a plastic-lined drum.

3. ***Respirator removal.*** Remove SCBA unit, SAR harness, or respirator, and place in a clean area; plastic sheeting may be needed.

4. ***Coverall removal.*** Remove outer wear if it is ripped or significantly contaminated. In hot weather, at least unzip and pull down upper half of coveralls.

5. ***Inner glove removal.*** Remove and dispose of inner gloves.

6. ***Wash.*** Wash and rinse hands and face at the field wash station.

7. ***Rest break.*** Take rest break. Remember to drink plenty of water, Gatorade, or other similar beverage.

8. ***Don inner gloves.*** Put on inner gloves.

9. ***Don PPE.*** Don coveralls, outer boots, and outer gloves. Tape wrists and ankles (as needed), and re-enter the EZ.

Decontamination procedures, based on Level D protection:

- Brush heavily soiled boots and rinse outer gloves and boots with soap and water.
- Remove gloves and deposit them in a trash container.
- Dispose gloves and other disposable PPE in a trash container.
- Wash hands and face, and preferably shower as soon as practical.

4.3.4 Closure of the Decontamination Station

All disposable clothing and plastic sheeting used during site activities at sites with Level D through Level C will be double-bagged and disposed of in a refuse container. Decontamination and rinse solutions and disposable PPE from Level B sites will be placed in a labeled 55-gallon drum (separate solids and liquids) for later analysis and disposal. All washtubs, pails, buckets, etc., will be washed and rinsed at the end of each workday.

4.4 Authorized Personnel

Personnel anticipated to be onsite at various times during site activities include:

- Engineers-in-Charge — Matthew A. Hunt, Thuane Fielding (SOUTHDIV)
- Site Contact — Earle Folger (NAVBASE)
- Principal-In-Charge — James Speakman (E/A&H)
- Task Order Manager/Project Manager — Todd Haverkost (E/A&H)
- Project Health and Safety Officer — John H. Borowski, CIH, CSP (E/A&H)
- Site Supervisor — Britton Dotson (E/A&H)
- Site Health and Safety Officer — TBD

Responsibilities of Key Field Staff

Key field staff for this project, in terms of health and safety are:

- Site Supervisor
- Site Health and Safety Officer
- (All) Field Staff

The primary health and safety responsibilities associated with each of these positions are delineated in CHASP, Sections 8.1, 8.2 and 8.3, respectively.

4.5 Site-Specific Information

The following sections provide site specific information regarding planned activities, specific chemical and physical hazards, and hazard abatement procedures.

4.5.1 SWMU 5, Battery Electrolyte Treatment Area, Pad 1278; SWMU 18, PCB Spill 4 Area; and AOC 605, Waste Paint Storage Area

Table 4.4 describes the site and chemical hazards.

Table 4.4
SWMU 5 and Associated Sites
Site Information and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
SWMU 5 Former Battery Electrolyte Treatment Area	This site is a former battery electrolyte treatment area adjacent to DD 4. This site operated from 1962 until 1985. Associated with battery salvaging, restoring, and recharging operations, this site was used to neutralize submarine battery acid. It consisted of a battery disassembly platform, two neutralization USTs and customized transporting railcars.	Solvents Lead/Acid Batteries
SWMU 18 Lead Storage	This site consists of a 20' x 20' PCB spill area at the Public Works Resource Recovery Facility Storage Area. The spill occurred on June 12, 1987, as a contractor was loading a group of PCB items, of which a transformer broke and discharged Pyranol insulating fluid. The transformer was placed in a drip pan, but the liquid overflowed onto the unprotected ground. Approximately 75 gallons of Pyranol fluid was spilled onto the ground. Three soil excavations were conducted to clean up the site.	Pyranol Insulating Fluid (PCBs)
AOC 605 Waste Paint Storage Area	This site is a waste paint storage area adjacent to DD 4 on Pad 1278. The 40' x 250' concrete pad was constructed in 1943 as a welding area. Since 1987, the pad has been used to store materials such as paints, used oils, solvents, and chemicals. A temporary permit was issued for this area in 1989; however, it has operated without a permit since 1990. The pad is bordered to the south and west by unpaved areas.	Acids Paints Solvents Petroleum Hydrocarbons Metals (Lead)

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard Material Safety Data Sheets (MSDS).

Site Activities

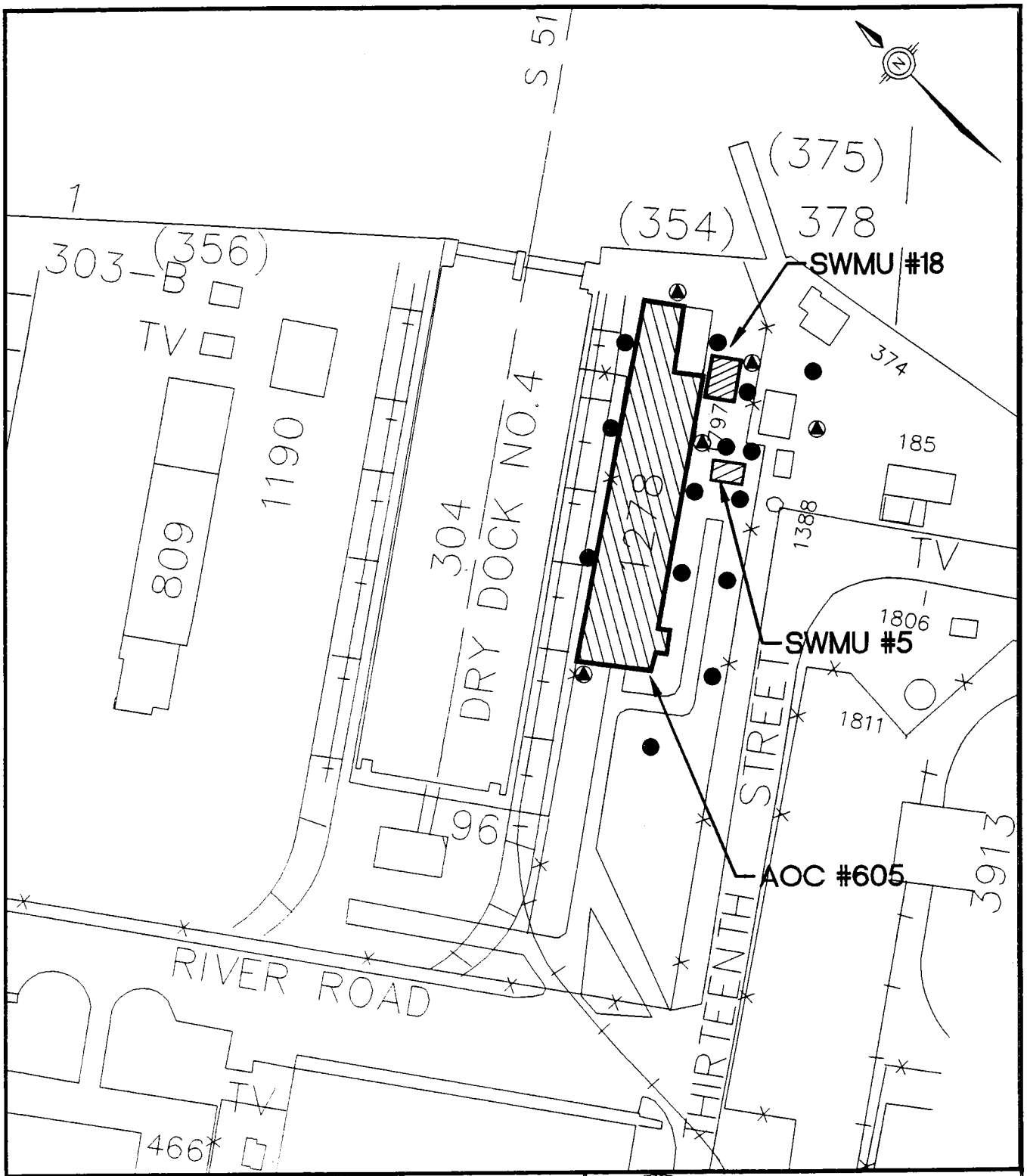
Activities will involve installing and developing groundwater monitoring wells and completing of soil borings and collecting samples. The proposed subsurface sample locations illustrated on Figure 4-2 have been chosen based on a number of variables including: the suspected direction

of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and of piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. A review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.4. If additional chemical hazards are discovered during the investigation, Material Safety Data Sheets (MSDS) will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and groundwater at this site, the initial PPE level specified for invasive field activities onsite is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-02
SWMU #5 AND SWMU #18
AOC #605, PAD 1278
WASTE PAINT STORAGE AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE01

4.5.2 SWMU 21, Old Paint Storage Area; and SWMU 54, Former Abrasive Blasting Area

Table 4.5 describes the sites using information extracted from the RFA.

Table 4.5
SWMU 21 and SWMU 54
Site Descriptions and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
SWMU 21 Old Paint Storage Area	This area consists of a 20' x 180' concrete pad formerly used to store containerized paint waste generated by ship repair and overhaul operations.	Paint Waste Solvents
SWMU 54 Former Abrasive Blasting Area	Area south of Building 223 formerly used for the abrasive blasting of ship components and hull sections. Additionally, ship components and anchor chains were painted in this area. Spent blast grit still remains on the ground.	Paint Waste Solvents Abrasive Blast Media

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

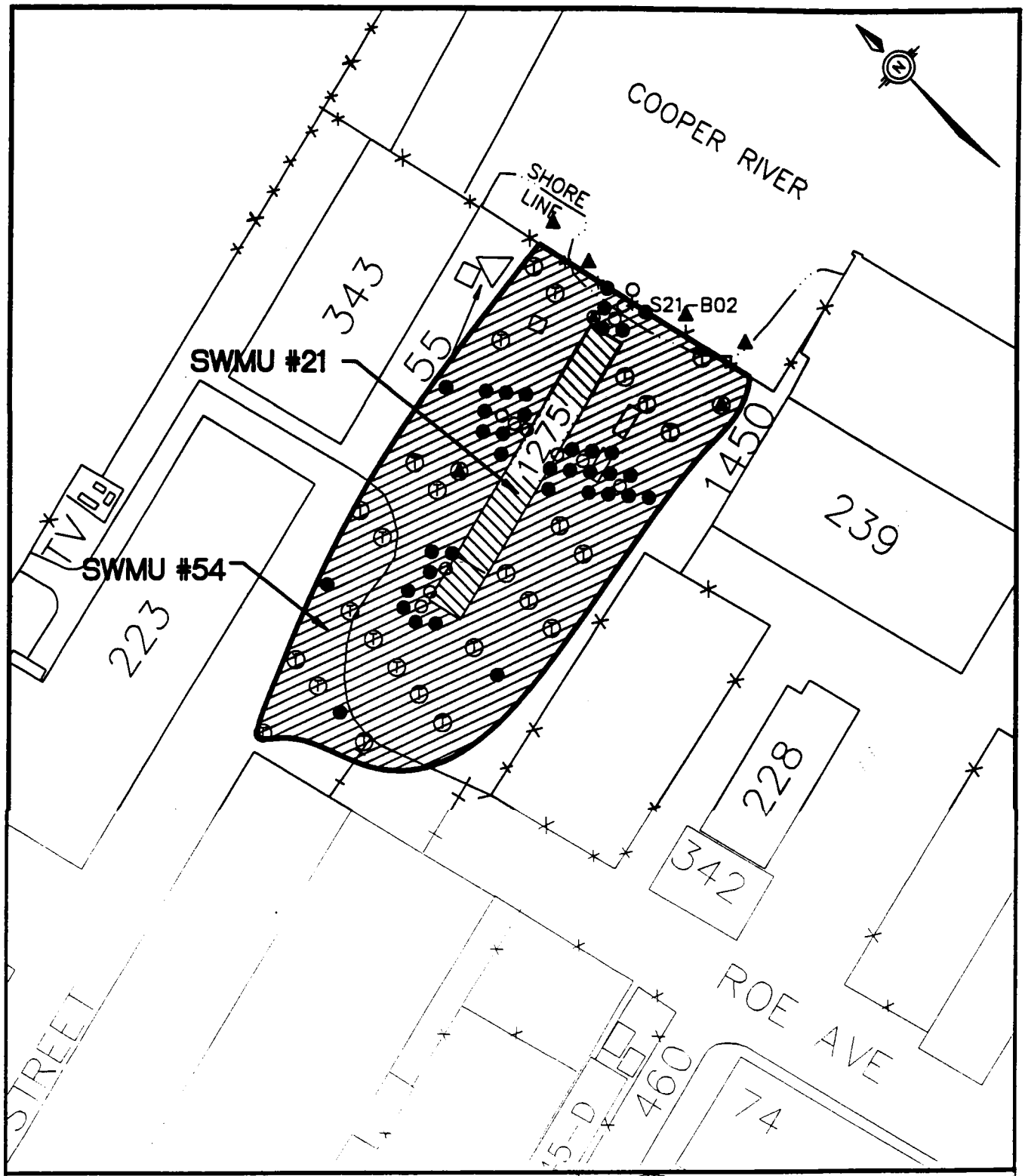
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting sediment and soil samples. The proposed sample locations illustrated on Figure 4-3 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing of soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

Previous site investigations have identified benzo(a)pyrene, benzo(b)fluoranthene (both of which are SVOCs), and lead as potential chemical hazards onsite. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.5. If additional chemical

hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediments, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
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- ● – PROPOSED SOIL BORINGS
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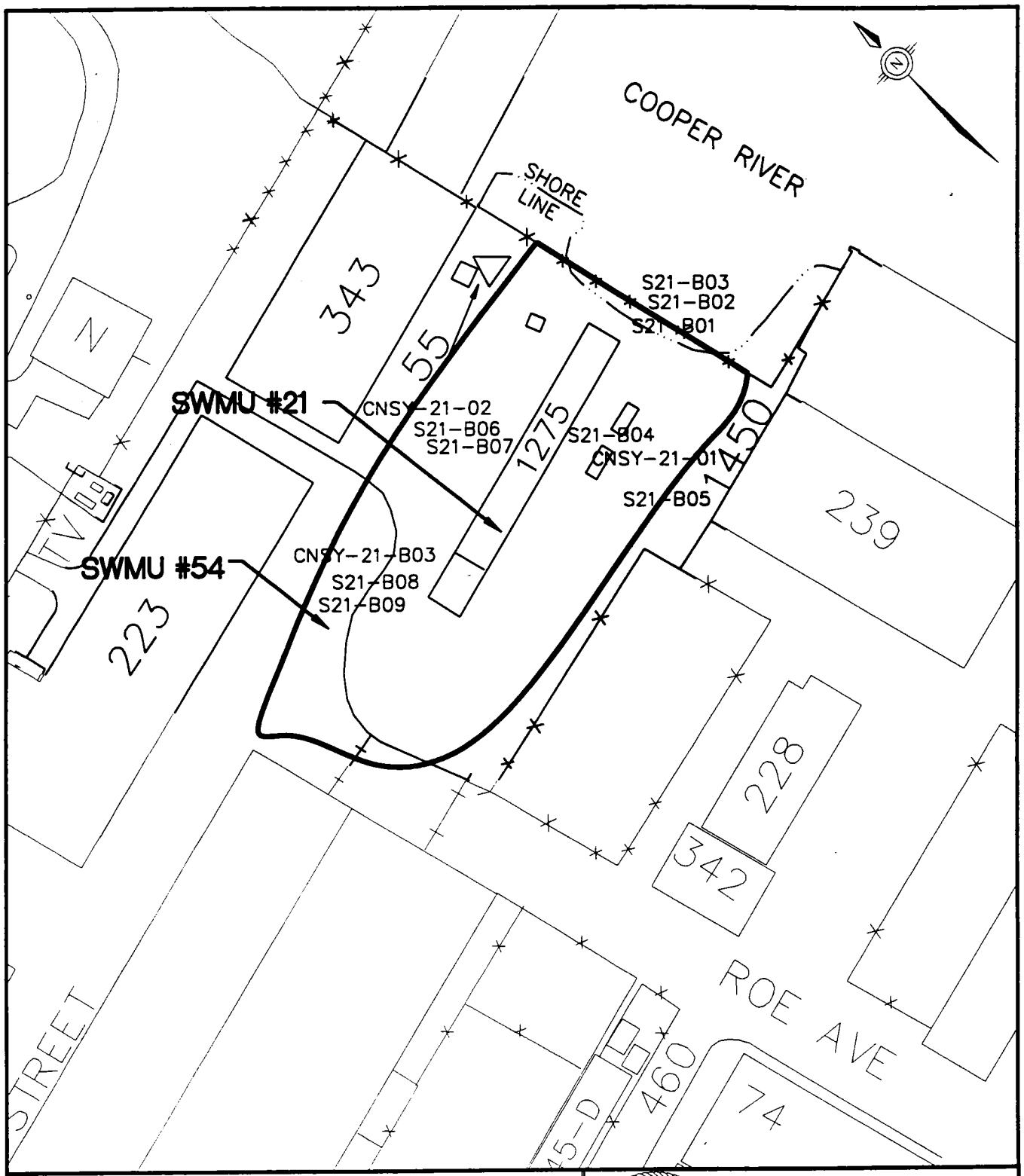
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓢ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-03
SWMU #21
SWMU #54
ABRASIVE BLAST AREA

DWG DATE: 6/2/95 | DWG NAME: FIGUR02



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
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- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-03A
SWMU #21
SWMU #54
EXISTING MONITOR WELL LOCATIONS

DWG DATE: 6/2/95 | DWG NAME: FIGUR02A

4.5.3 SWMU 22, Old Plating Shop Wastewater Treatment System; SWMU 25, Building 44, Old Plating Operation; and AOC 554, Paint Shop, Former Building 1003

Table 4.6 describes the sites.

Table 4.6
SWMUs 22 and 25 and AOC 554
Site Descriptions and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
SWMU 22 **Old Plating Shop WWTS**	This unit was formerly used to treat process wastewater from the metal plating shop in Building 44. The system consisted of two underground holding tanks and a clarifier.	Chromic Acid Cadmium Copper Chromium Lead Nickel Silver
SWMU 25 **Building 44, Old Plating Operation**	The southwestern portion of Building 44 housed an electroplating operation that was operational until 1983. The facility contained approximately 40 metal tanks that contained the solutions used in the plating process. The concrete floor shows signs of deterioration. The process tanks were removed in 1992.	Silver Cadmium Chromium Nickel Mercury Lead Cyanide Barium
AOC 554 **Paint Shop, Former Building 1003**	AOC 554 is the former Building 1003 location. Building 1003 was used as a paint shop from approximately 1909 to 1940. No additional information regarding size, design features, or operating practices is known concerning this unit.	Waste Paint Paint Thinner Solvents Heavy Metals

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

Activities will involve the installing and developing groundwater monitoring wells, performing soil borings and collecting wipe, sediment, soil and air samples. The proposed sample locations illustrated on Figure 4-4 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the

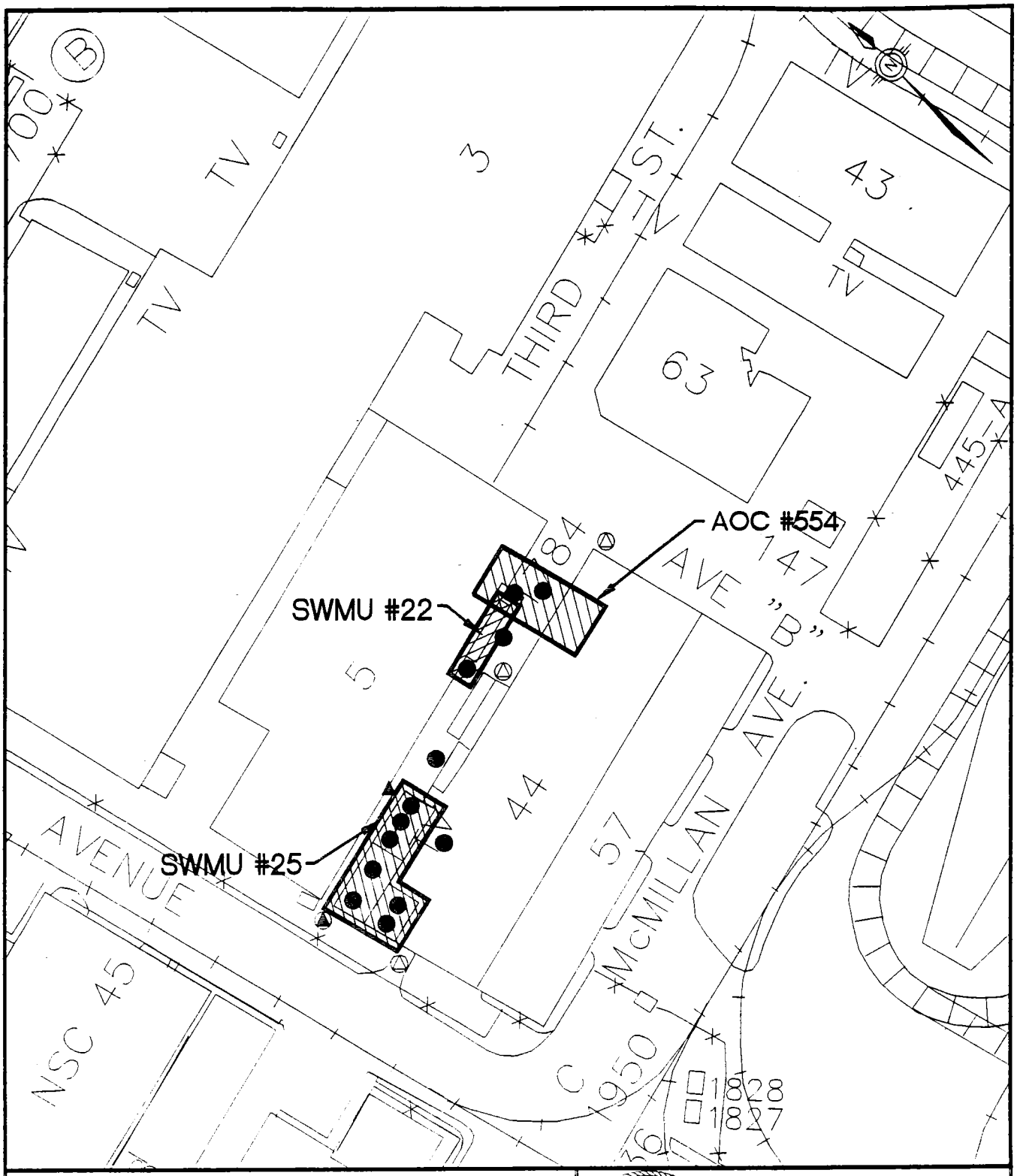
available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing of soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

Previous site investigations have identified substantial concentrations of metals and corrosive substances in soil and groundwater at SWMUs 22 and 25. The history of SWMU 25 and the general condition of the existing structure and building components indicates the potential for substantial contamination with acids and metals including chromium, cadmium, and cyanide. E/A&H will complete an initial industrial hygiene study of the sampling locations within Building 44. The conditions at those sites will be characterized with respect to surface and airborne concentrations of acids and metals. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.6. If additional chemical hazards are discovered during the industrial hygiene study or investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, drilling and coring inside Building 44, collecting wipe samples while working on scaffolding and at heights, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal and inhalation hazards associated with working in Building 44, and in collecting wipe samples, and handling soil, and groundwater onsite, the initial PPE level specified for field activities is Level C with combination acid gas/high-efficiency particulate air (HEPA) cartridge equipped air purifying respirator, polycoated protective coveralls with hood and boots, and silver shield inner and nitrile outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). Work in Building 44 will be monitored with colormetric tubes and by collecting air samples (NIOSH Methods) for acid mist and metals. Work outside of Building 44

will be monitored with colormetric tubes, by collecting air samples (NIOSH Methods) for acid mist and metals, and PID. If concentrations of airborne acids or metals exceed the ALs specified in Table 4.1, site activities will cease and ventilation alternatives and PPE upgrades will be implemented.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-04
SWMU #22, OLD PLATING SHOP WWTS
SWMU #25, OLD PLATING OPERATION
AOC #554, PAINT SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE03

4.5.4 SWMU 23, New Plating Waste Water Treatment System - Building 226; SWMU 63, Former Building 73 Battery Charging Station; AOC 540, Building 226 Plating Plant; AOC 541, Oil Storage Shop, Former Building 38; AOC 542, Old Oxy-Acetylene Plant and Paint Shop, Former Building 22; and AOC 543, Former Building 1026, Storage Facility

Table 4.7 describes the sites.

Table 4.7
SWMU 23 and Associated Sites
Site Information and Description

Number	Description	Chemical Hazards[11,12]
SWMU 23 Plating Shop Wastewater Treatment System	The treatment building is a concrete structure built around 1983 to replace an existing system (SWMU 23). The new WWTS currently handles chrome effluent, acid/alkali effluent from metal plating and cadmium effluent. The treatment system consists of rinse water pumps, holding tanks, transfer pumps, a clarifier, a neutralization tank, and a plate and frame filter press.	Sulfuric Acid Sodium Metabisulfite Sodium Hydroxide Potassium Hydroxide Chromium Cadmium
SWMU 63 Battery Charging Station	This site is a battery charging area (former Building 73) which operated from 1941 to approximately 1970. No records have been found providing information on its operating practices. Currently the site is covered by Building 226, a plating facility.	Acids Metals
AOC 540 Plating Plant	Building 226, plating plant, was constructed in 1976. Current operations consist of a pump and valve test area, a plating area, and a hydraulic repair area. A wet scrubber, 120 plating dip tanks, a sludge pit, and waste treatment facility are associated with this facility. An OWS and 300-gallon fuel oil tank are also on the south side.	Acids Metals Hydraulic Fluid Petroleum Hydrocarbons
AOC 541 Oil Storage Shop	This site was an oil storage area (former Building 38) which operated from 1909 until 1939, but was demolished in 1970. No other information was discovered regarding its operating practices. The site is currently an asphalt parking lot between Building 6 and Building 226.	Petroleum Hydrocarbons
AOC 542 Paint Shop and Oxy-Acetylene Plant	Former Building 22 is the site of an oxy-acetylene plant and paint shop. From approximately 1922 until 1942, Building 22 was the site of oxy-acetylene manufacturing. In 1943, the building was converted into a paint shop and served that purpose until demolished in 1976. During this period chemical and abrasive paint stripping were also conducted. Currently this site is an open paved area between Buildings 3, 6 and 226.	Acids Metals Paints Solvents Acetylene Gas Abrasive Grit

Table 4.7
SWMU 23 and Associated Sites
Site Information and Description

Number	Description	Chemical Hazards[1],[2]
AOC 543 Storage Facility	This is the site of former Building 1026, which was constructed in 1922 and used as a storehouse until 1943. From 1943 to 1955, the site was a field electric shop. From 1955 until approximately 1970, this site was a storehouse again. Currently this site is covered by Building 226.	Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

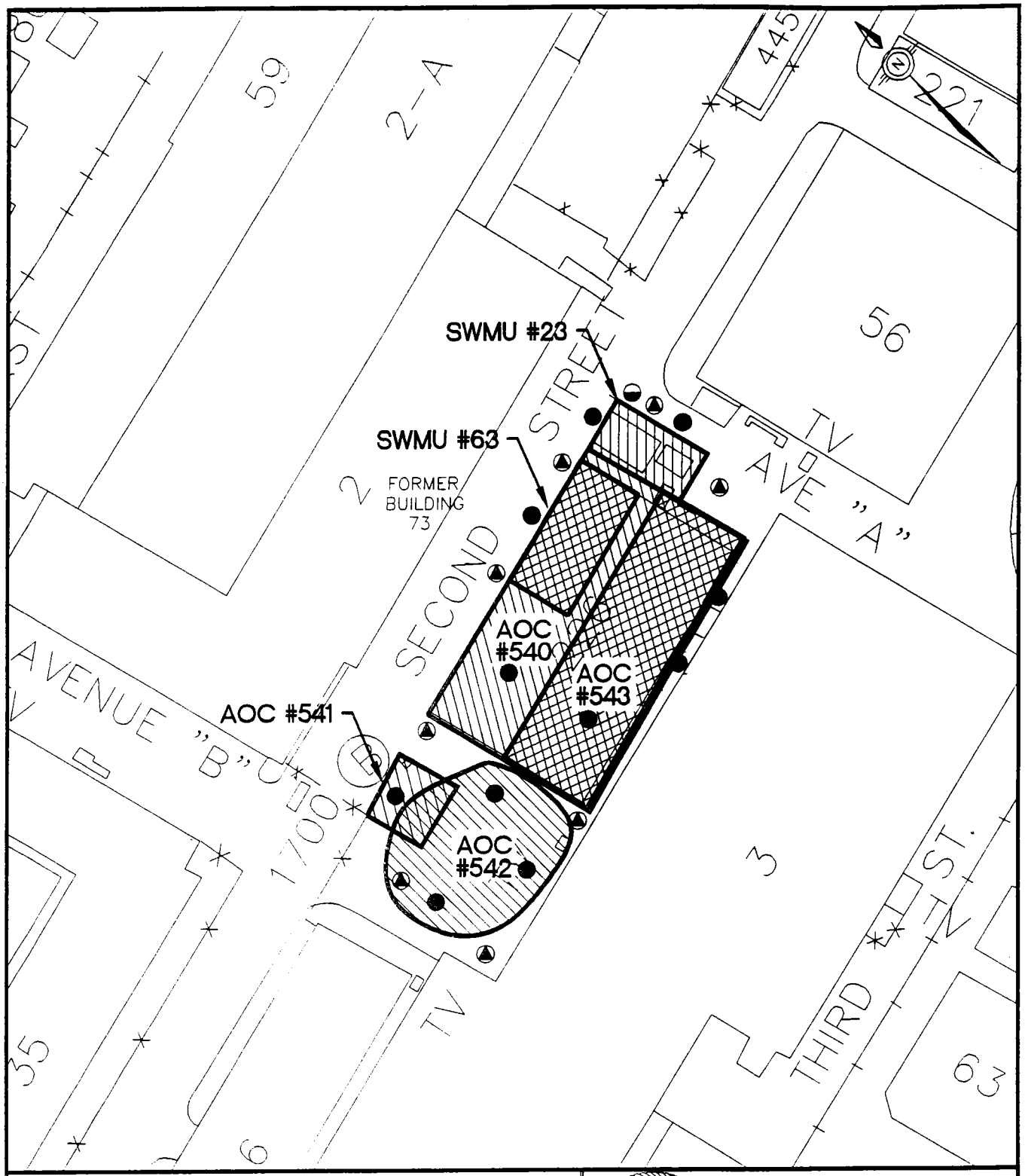
Site Activities

Activities will involve the installing and developing a groundwater monitoring wells and performing soil boring and sample collection. The proposed sample locations illustrated on Figure 4-5 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling support structures. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.7. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, coring and drilling inside Building 226, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediments, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- O – EXISTING SOIL BORINGS
- EXISTING MONITORING WELLS
- PROPOSED SOIL BORINGS
- PROPOSED DEEP MONITORING WELLS
- PROPOSED SHALLOW MONITORING WELLS
- PROPOSED SEDIMENT SAMPLES
- C – PROPOSED CORE SAMPLES
- G – PROPOSED SURFACE SOIL SAMPLE
- S – PROPOSED SURFACE WATER SAMPLES
- T – PROPOSED THICKNESS SAMPLES
- W – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-05
SWMU #23, SWMU#63/AOC#540
AOC #541, OIL STORAGE SHOP
AOC #542 AND AOC #543

DWG DATE: 6/2/95 | DWG NAME: FIGURE04

4.5.5 SWMU 53, Satellite Accumulation Area, Building 212; and AOC 526, Paint Area, Building 212

Table 4.8 describes the sites.

Table 4.8
SWMU 53 and AOC 526
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
SWMU 53 SAA 29	This site once contained an SAA unit used as an element of the CNSY hazardous waste management system. Wastes were accumulated in 55-gallon drums on an asphalt surface. The unit had no containment system. Use of the SAA has been discontinued and the unit has been removed from the site. The operation dates of this SAA are not known.	Acids Metals Paints Solvents Petroleum Hydrocarbons
AOC 526 Paint Area	This area was formerly used for spray painting ship components. Two types of metal-based paints were used for this process. Operations started in 1974 and continued until approximately 1993. This unit has been cleaned and all waste sludge has been removed and properly disposed.	Metals Solvents Paints (containing organotin- and tributylin-)

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

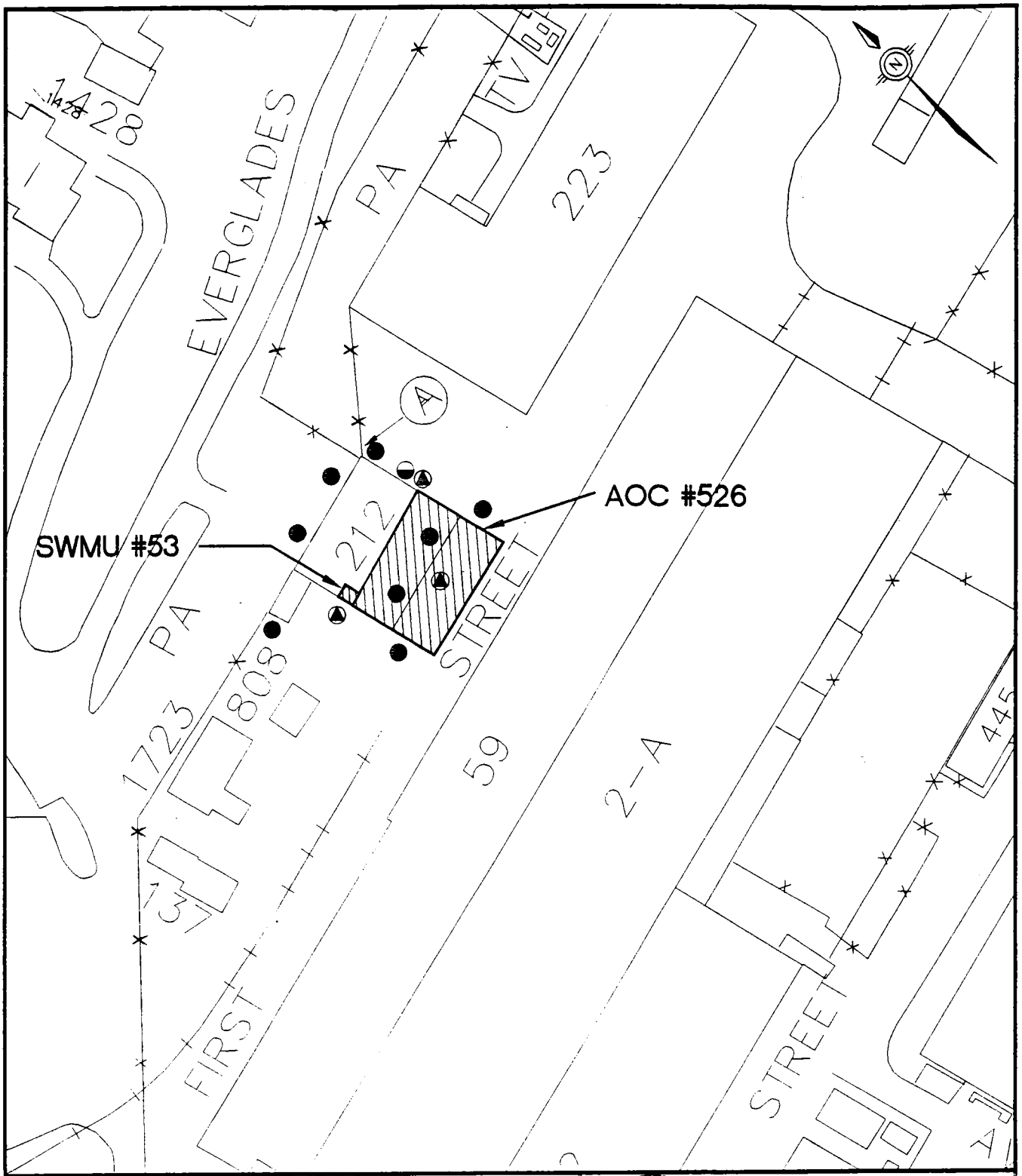
Site Activities

Activities will involve installing an developing groundwater monitoring wells, performing soil borings, and collecting wipe, soil, and air samples. The proposed sample locations illustrated on Figure 4-6 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site specific potential chemical hazards are listed in Table 4.8. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, drilling and coring inside of Building 212, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
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GRAPHIC SCALE 100 0 100 200

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HEALTH AND SAFETY PLAN
FIGURE 4-06
SWMU #53 AND AOC #526
BUILDING 212
PAINT AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE05

4.5.6 SWMU 65, Lead Storage (Includes AOC 544, Former Picking Plant, and AOC 546, Galvanizing/Pickling Shop)

Table 4.9 describes the site.

Table 4.9
SWMU 65 and Associated Sites
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
SWMU 65 Lead Storage	This site consists of a lead storage area. Lead blankets and shielding materials are stored on pallets and shelves inside and in a paved yard south of Building 221. The majority of the lead is encased in rubber; some exposed lead is stored beneath a tarp inside the building. This site is also a staging area for scrap lead awaiting disposal.	Metals (Lead)
AOC 544 Pickling Plant	This site consisted of a former pickling plant at Building 221. From 1940 to 1970, the pickling plant consisted of an open-air facility with only the pickling tanks covered by a roof. In 1970, a single-story structure was built to house the pickling operations. The pickling process used a series of chemical baths and water rinses. Until 1974, spent pickling bath solutions were discharged via the storm drainage system into the Cooper River. After 1974, a private contractor disposed of the wastes. Pickling plant operations were discontinued in 1984 and the process equipment was removed. Currently this site stores lead.	Acids Metals Solvents Petroleum Hydrocarbons
AOC 546 Galvanizing/ Pickling Shop	This unit consists of a galvanizing/pickling shop that operated within Building 1025 from the early 1920s until 1967. Building 1025 was at the current location of Building 3 until 1942, when it was relocated to southwest of Building 74. No information was found regarding its operational processes. Currently both sites are now covered with pavement or structures.	Acids Solvents

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

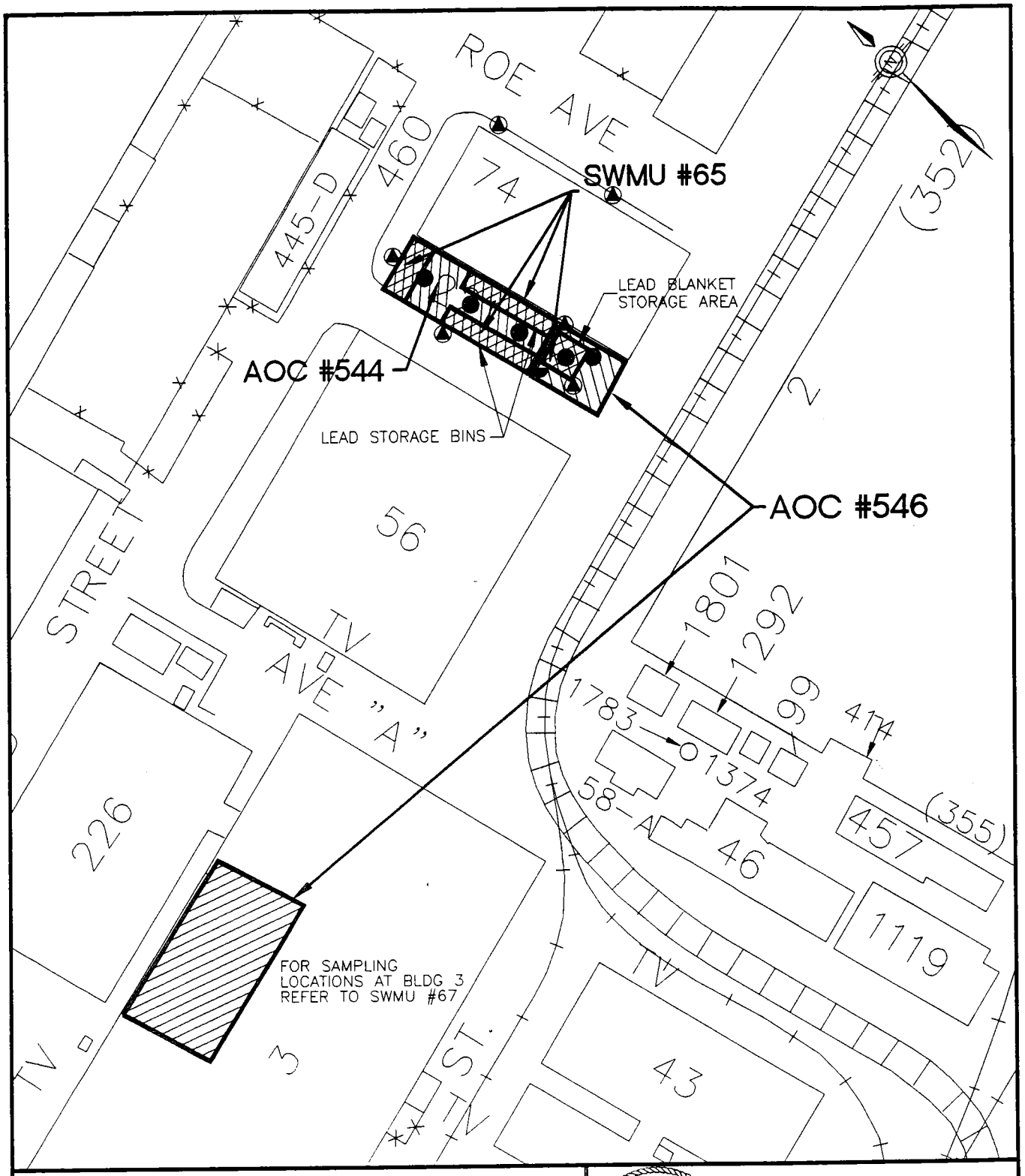
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting wipe, soil, and air samples. The proposed sample locations illustrated on Figure 4-7 have been chosen based on a number of variables including: the suspected

direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.9. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, drilling and coring operations in Building 221 and Building 3, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
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- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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ZONE E WORKPLAN
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CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-07
SWMU #65, LEAD STORAGE AREA
AOC #544, PICKLING PLANT
AOC #546, GALVANIZING SHOP

DWG DATE: 6/2/95 | DWG NAME: FIG-H07

4.5.7 SWMU 67, Mercury Gauge Room, Building 3

Table 4.10 describes the site.

Table 4.10
SWMU 67
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,1,2]
SWMU 67 **Mercury Gauge Room**	SWMU 67 consists of a mercury gauge room, a former mercury gauge room, and a mercury storage area, each in separate locations in Building 3. The building was constructed in 1905, with additions in 1939 and 1943. The mercury gauge room calibrates and leak-tests gauges. The current gauge room is on the mezzanine level. A room near the middle of the northwest wall of the ground floor was originally intended to serve as the gauge room. It is not known whether mercury gauges were ever handled in this room. Mercury gauge operations are known to have been conducted for 25 years in this building.	Mercury

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

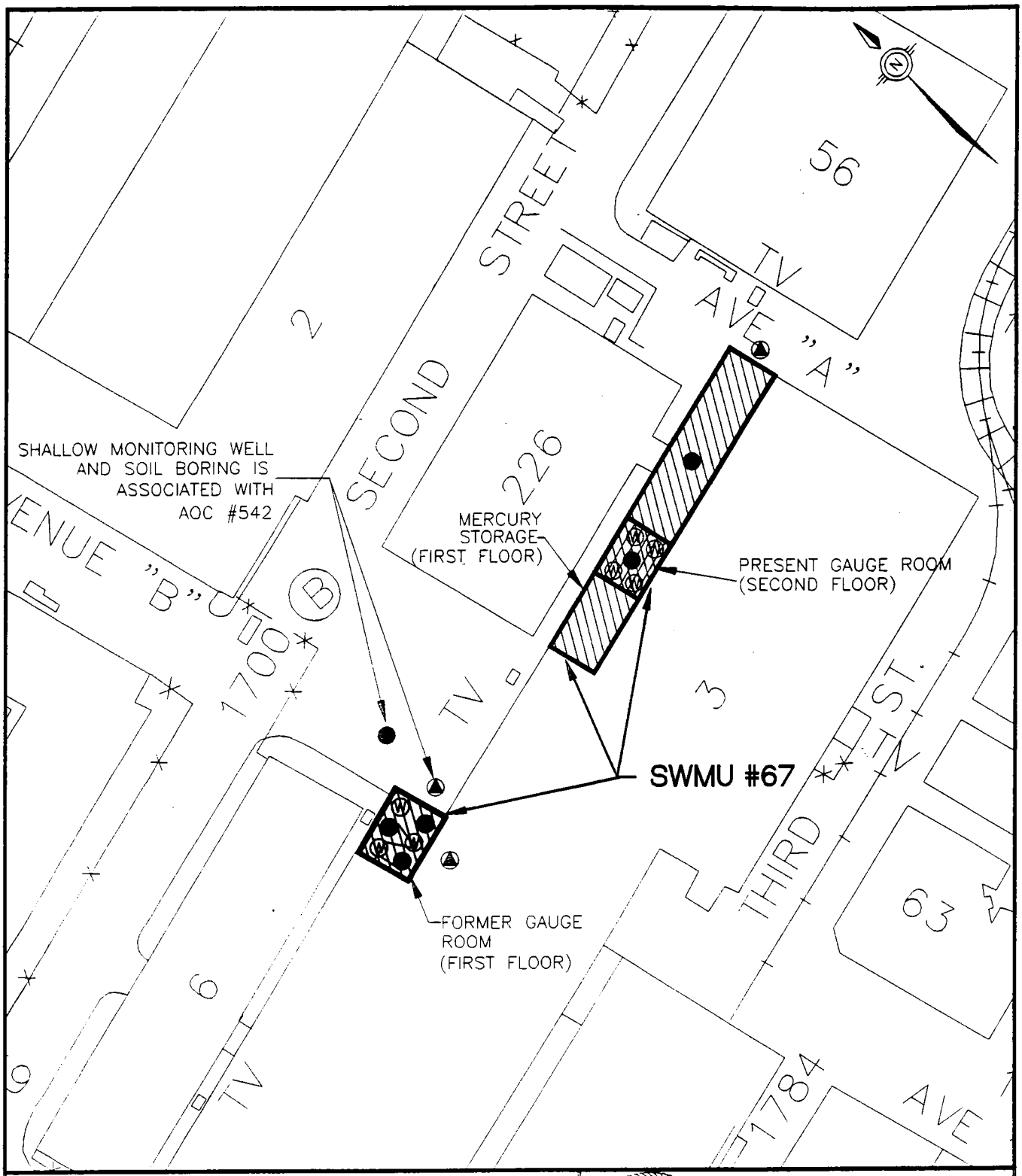
Site Activities

Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting wipe, soil, and air samples. The proposed sample locations illustrated on Figure 4-8 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. The history of SWMU 67 indicates the potential for substantial contamination with metallic liquid mercury. E/A&H will complete an initial industrial hygiene study of the sampling locations within Building 3. The conditions at those sites will be characterized with respect airborne concentrations of mercury vapor. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.10. If additional chemical hazards are discovered during the industrial hygiene study or investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, drilling and coring inside Building 3, collecting wipe samples while working on scaffolding and at heights, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal and inhalation hazards associated with working in Building 3, and in collecting wipe samples and handling soil, and groundwater onsite, the initial PPE level for field activities is Level C with mercury vapor cartridge equipped air-purifying respirator, polycoated protective coveralls with hood and boots, and silver shield inner and nitrile outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). Work in Building 3 will be monitored with a direct-reading, real-time mercury vapor analyzer. If concentrations of mercury vapor exceed the ALs specified in Table 4.1, site activities will cease and ventilation alternatives and PPE upgrades will be implemented.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
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- △ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
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- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

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CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-08
SWMU #67
GAUGE ROOM
BUILDING 3

DWG DATE: 2/10/95 | DWG NAME: FIGURE07

4.5.8 SWMU 70, Building 5 Dip Tank; AOC 548, Hydraulic Elevator, Building 5; and AOC 549, Scrap Yard 1054, Building 5

Table 4.11 describes the sites and potential chemical hazards.

Table 4.11
SWMU 70 and Associated Sites
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
SWMU 70 **Dip Tank Area**	This site consists of a former dip tank at the northwest corner of Building 5. The dip tank was used to treat wood with a fire retardant. The tank was removed in 1981 when the shop began receiving pre-treated lumber. No information was found indicating when the operations started	Acids Solvents Metals
AOC 548 **Hydraulic Elevator**	This site consists of an electric hydraulic elevator in Building 5. The elevator is in shaft that is paved on the bottom with approximately 8 inches of concrete. Containment is provided by a container that captures hydraulic fluid leaks and returns it to the main reservoir. However, this containment system has not been in place throughout the life of this unit.	Hydraulic Fluid Petroleum Hydrocarbons
AOC 549 **Scrap Yard**	This site consists of a former scrap yard north of Building 5. The scrap yard was operated in the 1920s and 1930s. No information was found concerning its operating practices. Currently this area is paved with concrete and asphalt.	Metals Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

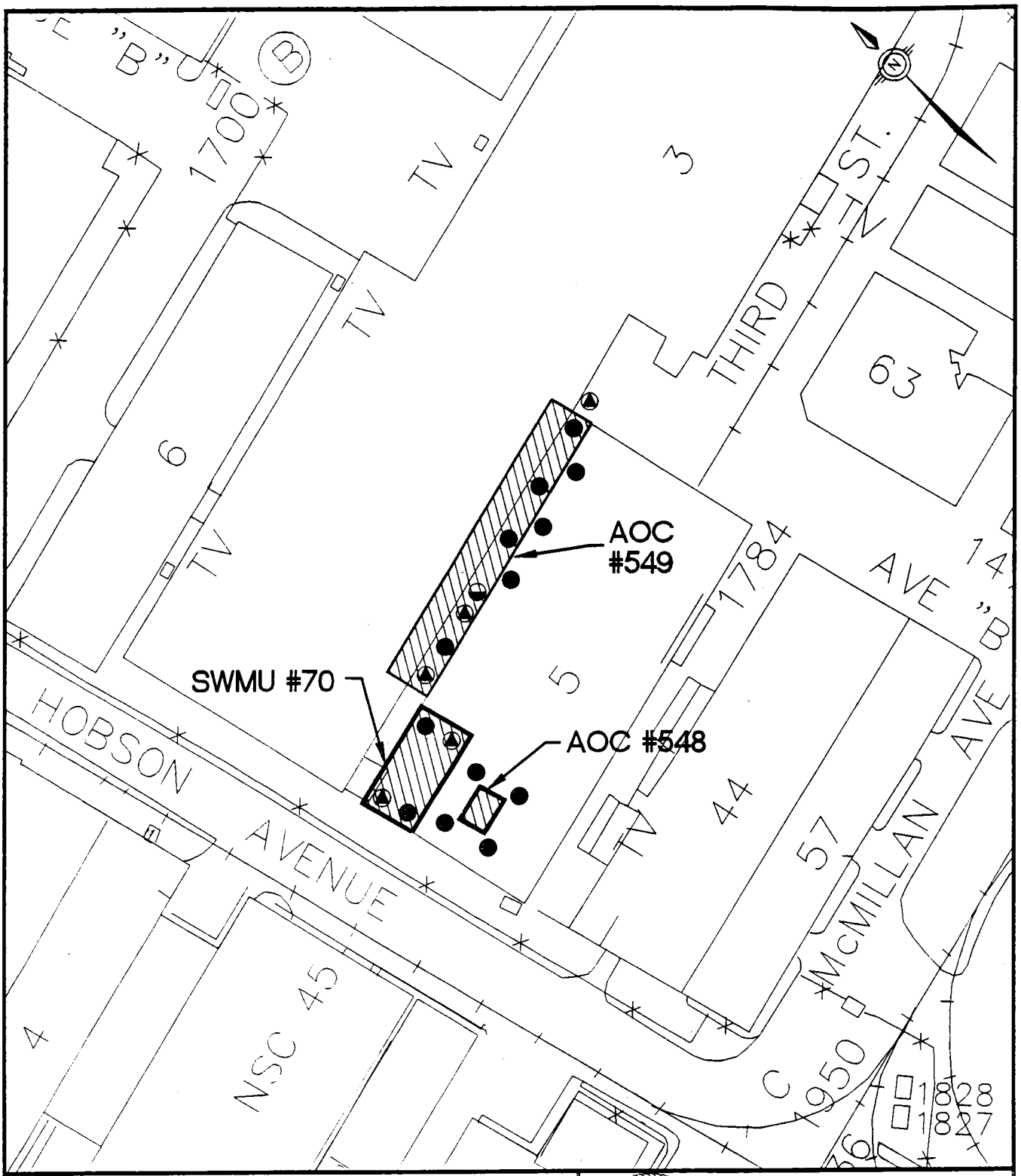
Activities will involve installing and developing groundwater monitoring wells and performing soil borings and sample collection. The proposed sample locations illustrated on Figure 4-9 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and location of piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered

preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.11. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment and groundwater at onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

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GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-09
SWMU #70, DIP TANK AREA, BUILD. 5
AOC #548, ELEVATOR, BUILDING 5
AOC #549, SCRAP YARD

DWG DATE: 6/2/95 | DWG NAME: FIGURE08

4.5.9 SWMU 81, Less-than-90-Day Accumulation Area, Building 1245

Table 4.12 describes the site.

Table 4.12
SWMU 81
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
SWMU 81 Less-than-90-Day Accumulation Area	The accumulation area was used to store hazardous waste for less than 90 days. The origin of the SAA is not known, but it was removed in May 1994. The structure had a wooden floor with no spill containment. Currently the site is a concrete and asphalt area.[1]	Lead Metals Paints Solvents

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

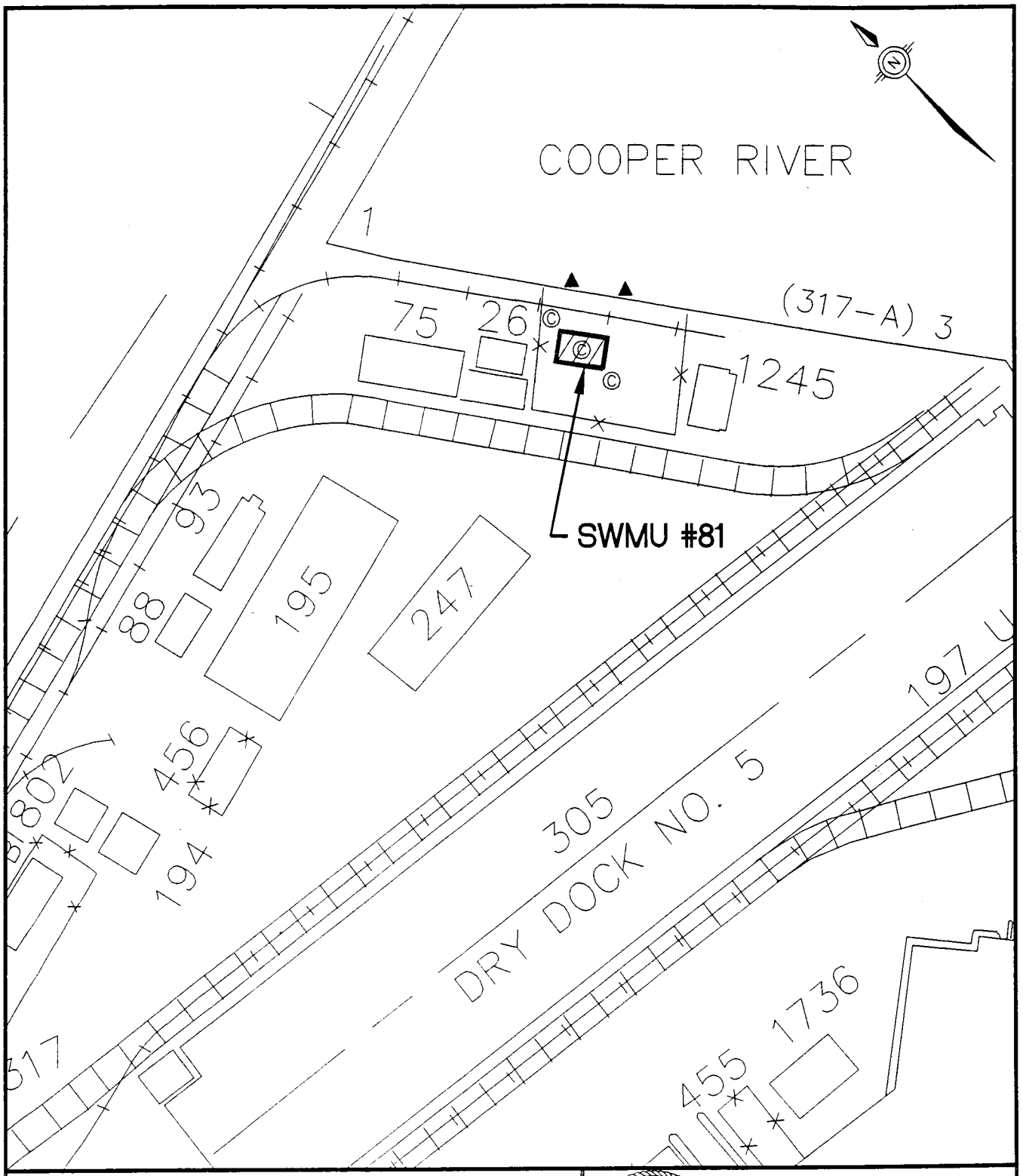
Activities will involve performing concrete coring and sediment samples. The proposed sample locations illustrated on Figure 4-10 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.12. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, water

berm operations and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

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- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
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HEALTH AND SAFETY PLAN
FIGURE 4-10
SWMU #81
BUILDING 1245
LESS THAN 90 DAY AREA

DWG DATE: 6/2/95 | DWG NAME: FIG-H10

4.5.10 SWMU 83, Foundry, Building 9; SWMU 84, Lead Storage, Building 9; and AOC 574, Building 9 Fuel Tank

Table 4.13 describes the site.

Table 4.13
SWMU 83 and Associated Sites
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
SWMU 83 **Former Foundry**	SWMU 83 is a former foundry in Building 9. The foundry operations have been discontinued and currently the building contains electrical power supply equipment, capacitors, transformers, rectifiers, furnaces, and ovens. The building is also used to repair hydraulic equipment. The foundry was built in 1906 and was used to cast metal parts in refitting ships. The primary industrial process associated with this facility was melting and casting copper alloy parts. This site has a Bureau of Air Quality Control Permit. Two fuel oil ASTs which have not been decommissioned are adjacent to the building. An abandoned oven contains a sign indicating that it contains PCBs. An approximately 10-cubic-foot pit of soot and metal scraps was observed below the electric furnace. The smoldering pots contain friable asbestos. Lead bricks and drums of hazardous materials from previous operations are present in the building.	Lead Paints Solvents Friable Asbestos Dielectric Fluid Petroleum Hydrocarbons
SWMU 84 **Lead Storage**	This site consists of an area outside of Building 9 used to store lead blankets and shielding. The majority of the lead is encased in either rubber or fabric; however, uncovered lead materials have been stored here. The lead-containing materials are placed either on pallets or directly on the concrete pavement. No containment structures are associated with this unit. No information could be found regarding the period of operation.	Lead (Metals)
AOC 574 Fuel Tank	This site consists of a 3,700-gallon AST east of Building 9. The fuel tank, which is no longer in use, formerly contained fuel oil for the furnaces and torches in Building 9. The tank is in an unpaved area and has no secondary containment. No information could be found regarding the period of operation.	Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

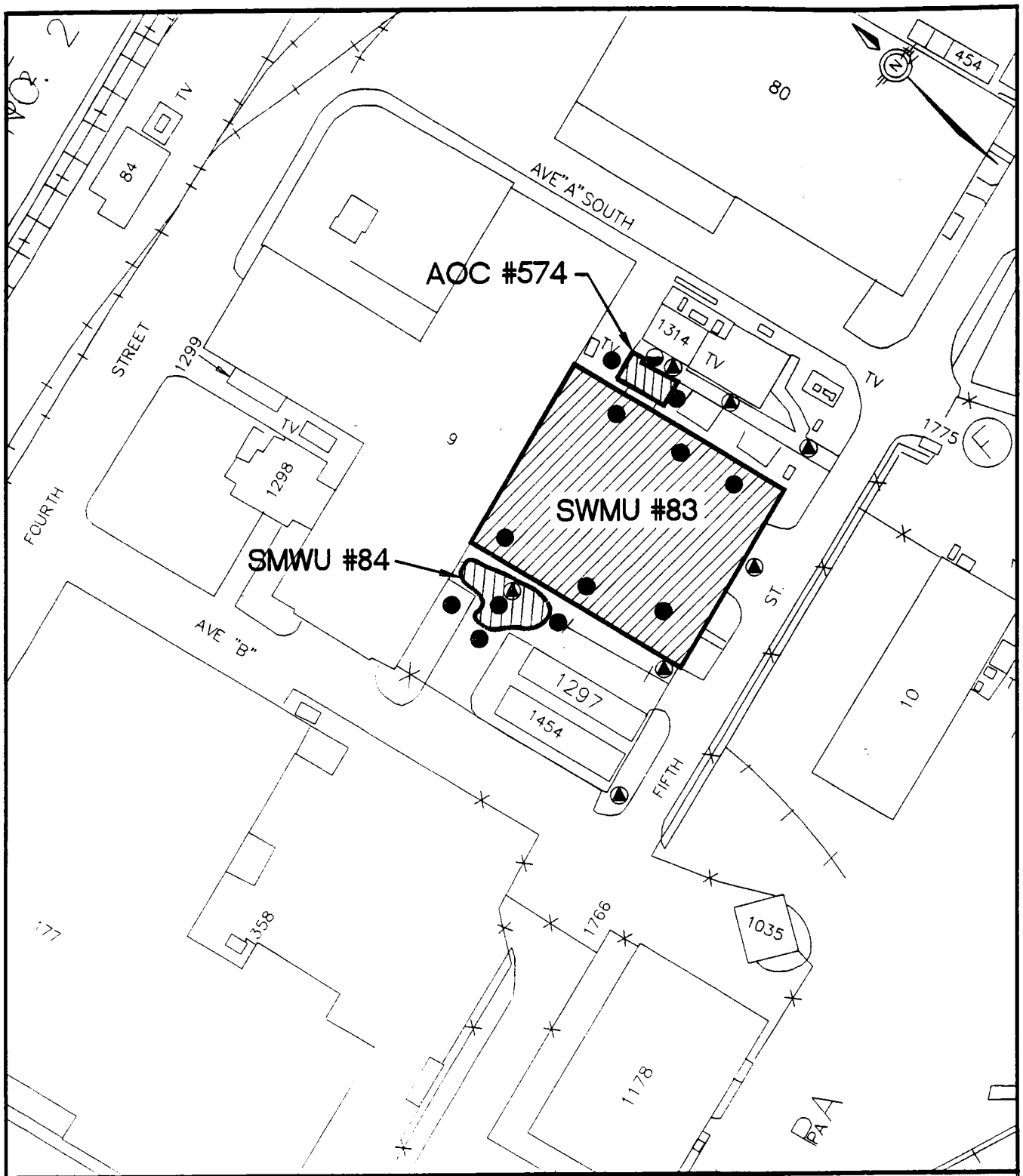
Site Activities

Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting wipe, soil, and air samples. The proposed sample locations illustrated on Figure 4-11 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

Previous investigations at these sites indicate the potential for PCB contamination of soil and groundwater, and lead and other heavy metals on surfaces within Building 9. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.13. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, working on scaffolding at heights, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and groundwater onsite, and collecting wipe samples within Building 9, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-11
SWMU #83, BUILDING 9
SWMU #84, LEAD STORAGE, BLDG 9
AOC #574, BUILDING 9, SAA

DWG DATE: 6/2/95 | DWG NAME: FIGURE10

4.5.11 SWMU 87, Less-than-90-Day Accumulation Area, Building 80; SWMU 172, Steam Cleaning Operations, Building 80; and AOC 564, Oil/Water Separator, Building 80

Table 4.14 describes the sites.

Table 4.14
SWMU 87 and Associated Sites
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
SWMU 87 **Less-Than-90-Day Accumulation Area**	This site consists of a former less-than-90-day accumulation area north of Building 80. This unit was an element of the CNSY hazardous waste management system. The unit was a metal building with an asphalt foundation. Within the unit, wastes were accumulated in closed palletized 55-gallon drums and palletized plastic bags. The unit was taken out of service in March 1994.	Paint Mercury Antifreeze Petroleum Hydrocarbons
SWMU 172 **Steam Cleaning Operations**	This site consists of a steam cleaning area north of Building 80. Steam cleaning is performed on various types of equipment, including small engines, generators, and construction equipment. The unit consists of a concrete-paved area designed with curbing and sloping surfaces so all liquids drain into two storm drains. This unit is not enclosed or roofed.	Petroleum Hydrocarbons
AOC 564 **Oil/Water Separator**	This site consists of a 3,000-gallon OWS north of Building 80. Wastewater from machining and parts cleaning in Building 80 drains onto a sloped asphalt ramp which feeds into an exterior drain connected to the OWS. The OWS has been in operation for more than 25 years.	Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

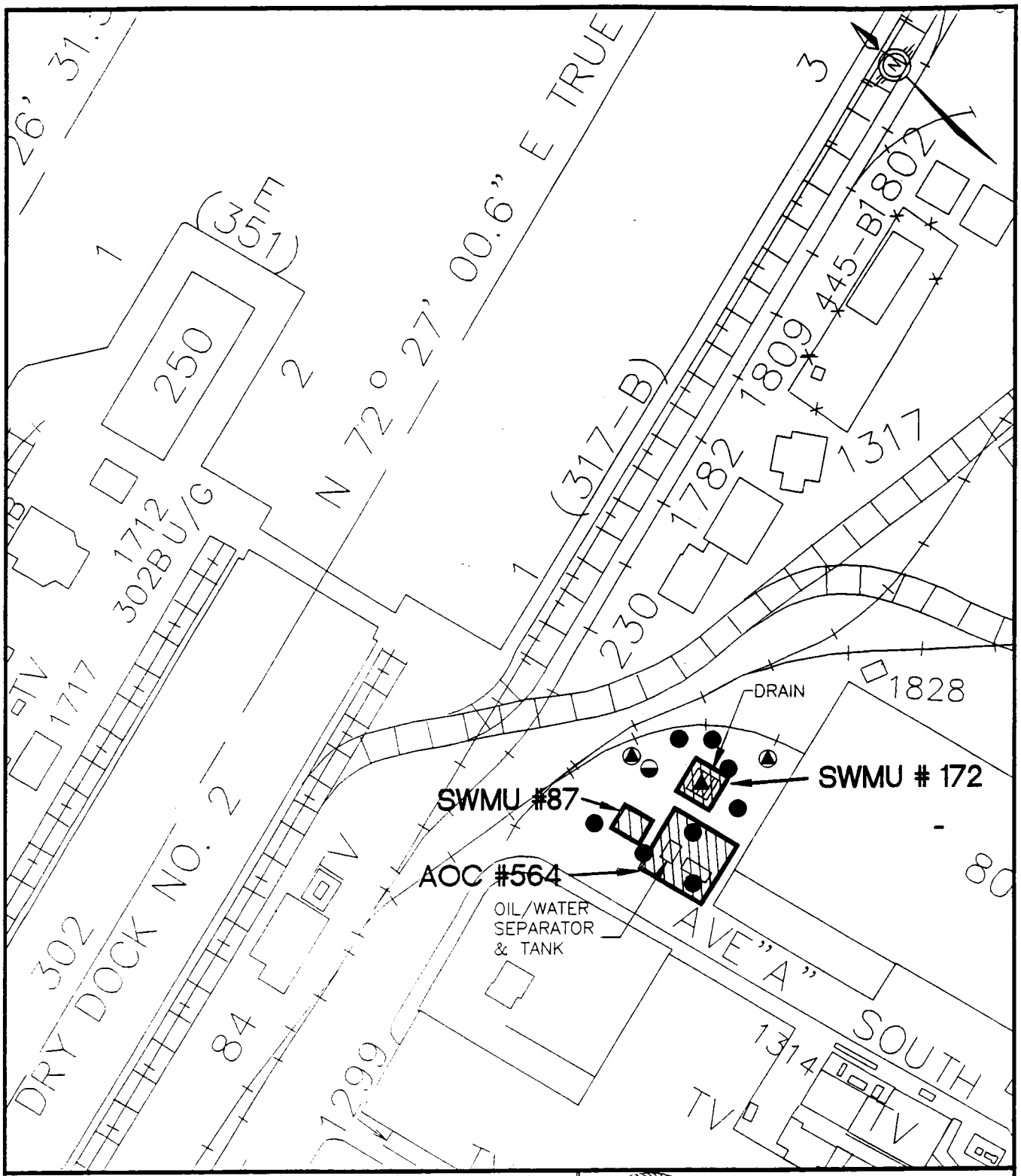
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-12 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information,

and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.14. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
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- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-12
SWMU#87,<90 DAY STORAGE AREA#11
SWMU #172, STEAM CLEANING OPS
AOC #564, DISPOSAL PIT

DWG DATE: 6/2/95 | DWG NAME: FIGURE11

4.5.12 SWMU 97, Less-than-90-Day Accumulation Area, Building 236

Table 4.15 describes the site.

Table 4.15
SWMU 97
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
SWMU 97 Less-than-90-Day Storage Area	The storage area, a 20' x 20' steel shed on asphalt pavement, was used to store hazardous waste for less than 90 days. Wastes were stored in palletized 55-gallon drums. The operation dates of this storage area are not known. It is currently empty.	Freon Metals Solvents Petroleum Hydrocarbons

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

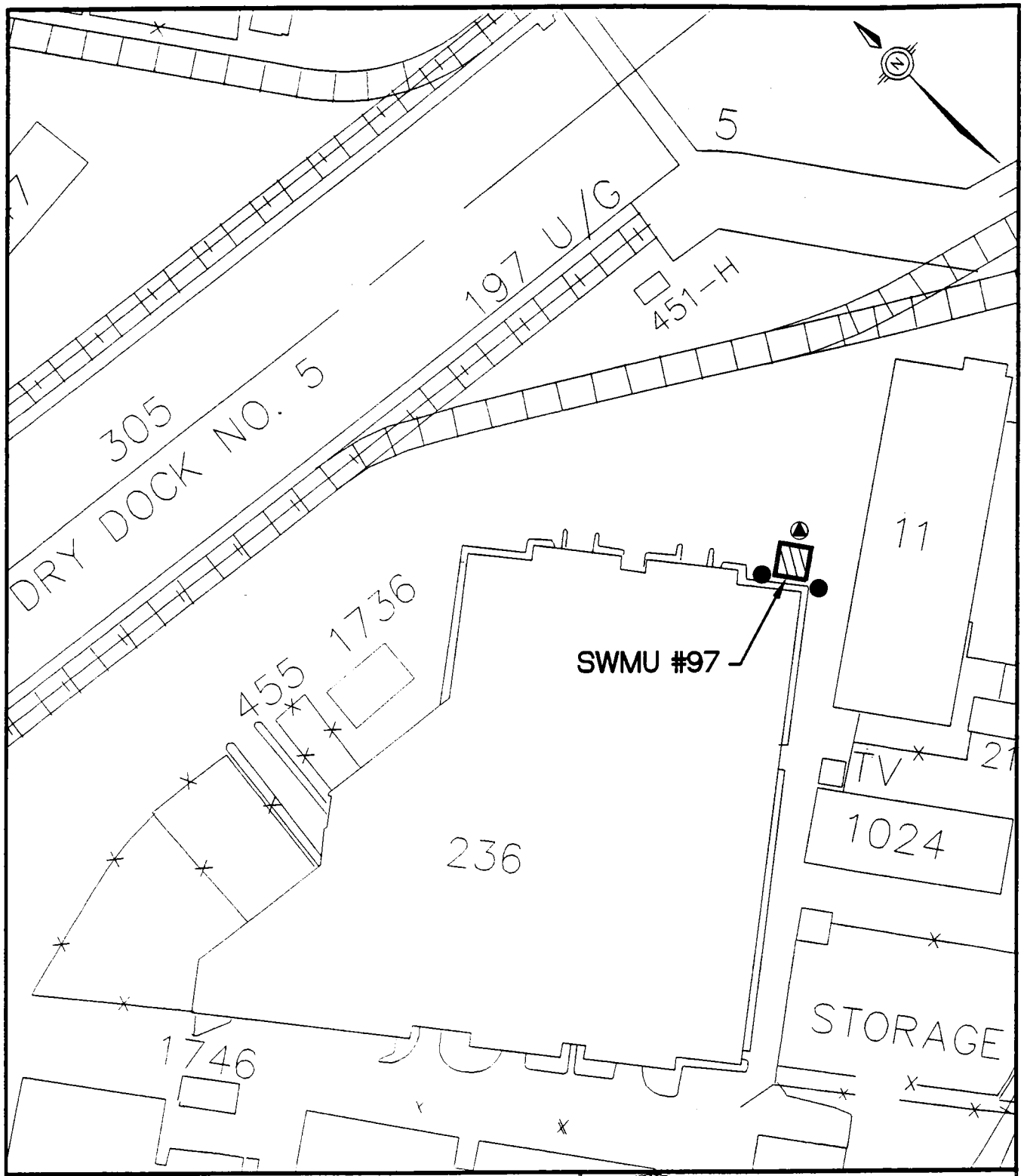
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-13 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.15. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated

into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◓ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-13
SWMU #97
BUILDING 236
<90 DAY STORAGE AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE12

4.5.13 SWMU 100, Satellite Accumulation Area, Building 218

Table 4.16 describes the site.

Table 4.16 SWMU 100 Site Description and Chemical Hazards		
Number	Description	Chemical Hazards[1,2]
SWMU 100 SAA 63	SAA 63 stores hazardous waste for less than 90 days. The operation dates of the SAA are not known. The unit consists of closed 55-gallon drums accumulated on an asphalt-paved area. This unit has no containment structures.	Metals Paints Epoxies Solvents Used Blasting Grit Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

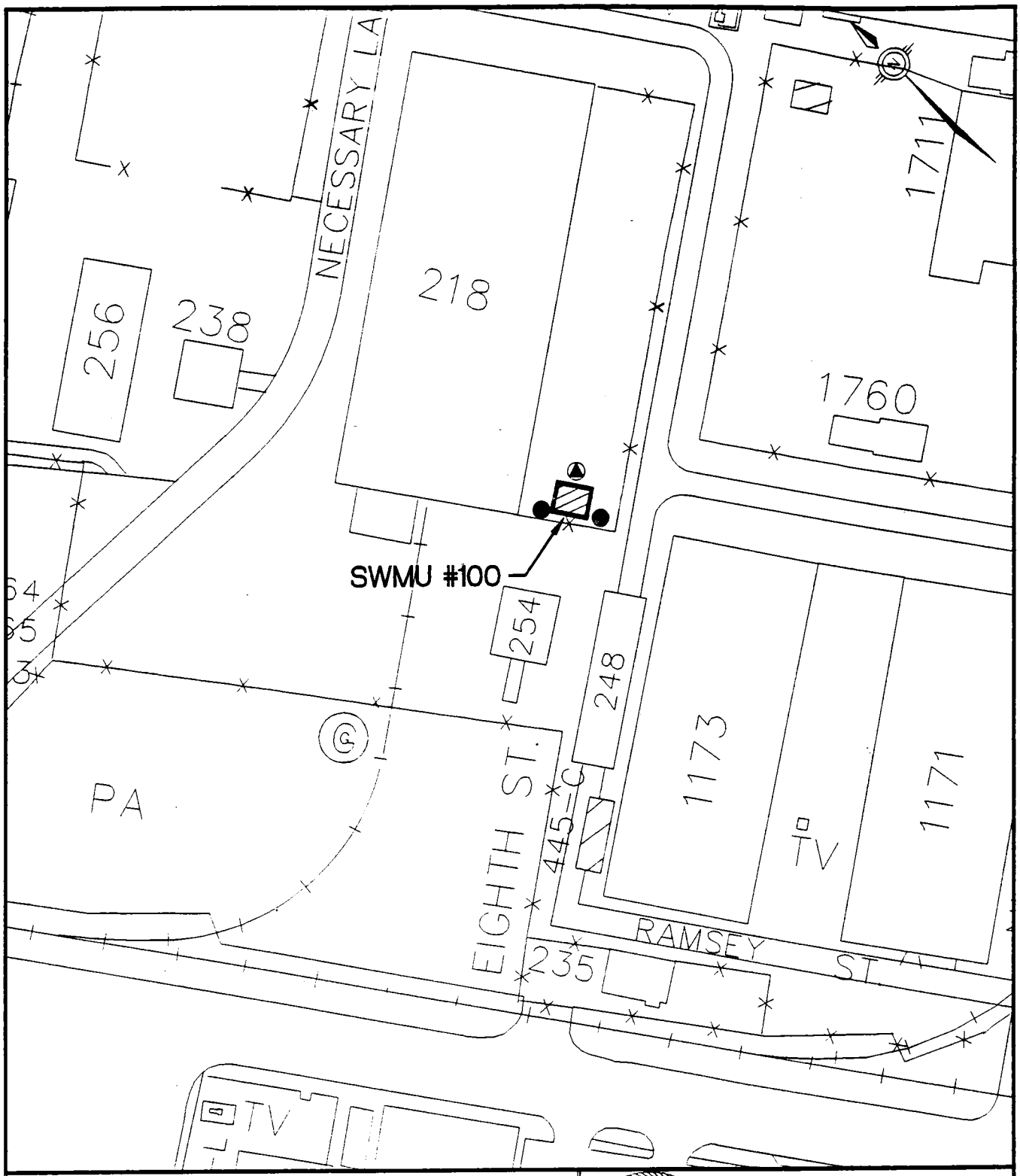
Activities involve installing and developing groundwater monitoring wells and performance of soil boring and sample collection. The proposed sample locations illustrated on Figure 4-14 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, suspected location of underground utilities, and suspected location of piling support structures. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.16. If additional chemical hazards

are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater on site, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◐ – PROPOSED DEEP MONITORING WELLS
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- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-14
SWMU #100
BUILDING 218
SAA

DWG DATE: 6/2/95 | DWG NAME: FIGURE13

4.5.14 SWMU 102, Mercury Spill, Building 79

Table 4.17 describes the site.

Table 4.17
SWMU 102
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
SWMU 102 Mercury Spill	Building 79 housed an ordnance shop from 1943 to 1966 and then served as a dental clinic until 1976. Currently it houses administrative offices (northeast), a ship storage area (center), a large nuclear repair shop (center), and a large nuclear repair shop and protective equipment storage area (northwest).	Metals Mercury Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

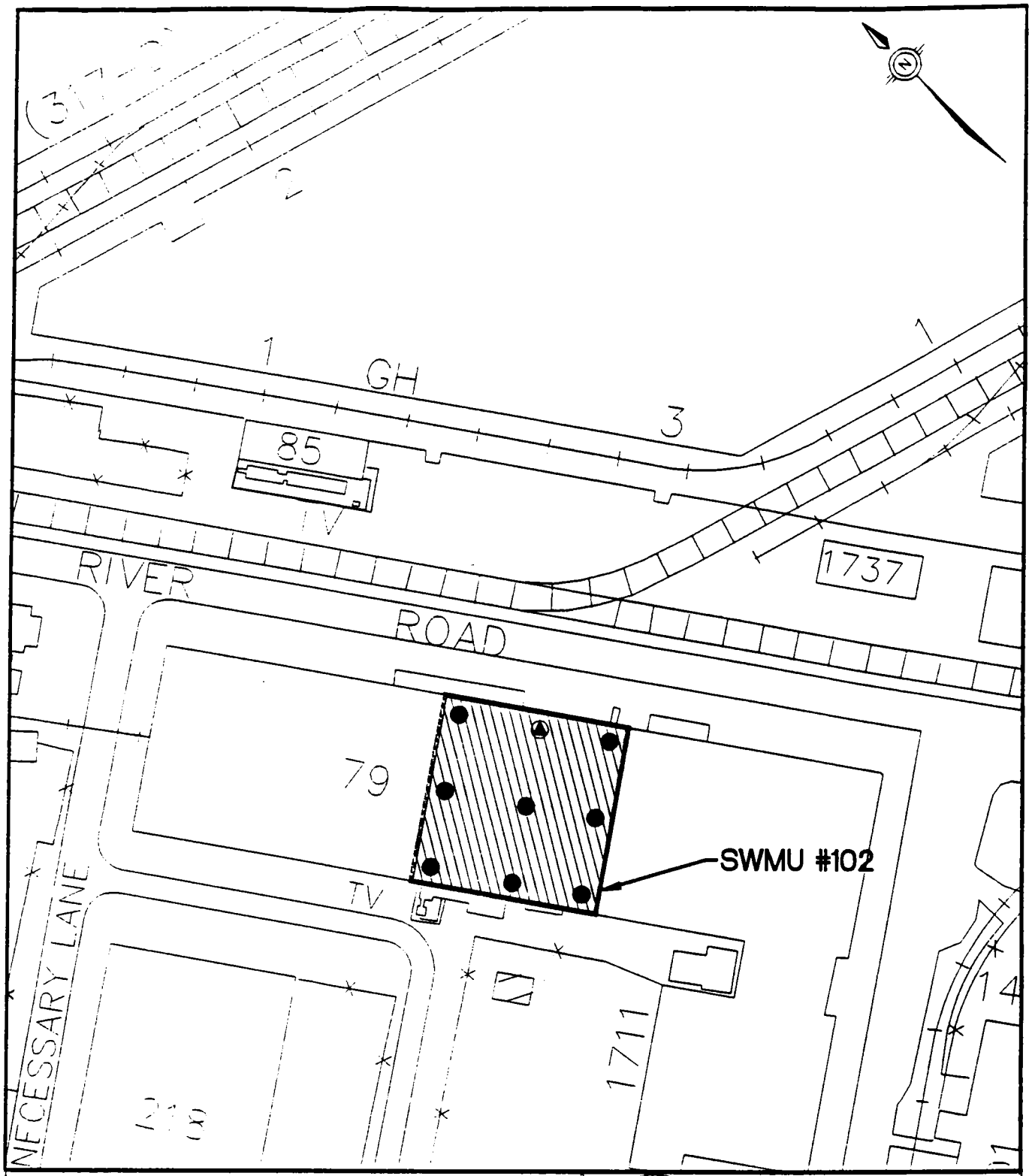
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting wipe, soil, and air samples. The proposed sample locations illustrated on Figure 4-15 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been previously investigated. The history of Building 79 indicates the potential for substantial contamination with metallic liquid mercury. E/A&H will complete an initial industrial hygiene study of the sampling locations within Building 79. The conditions will be

characterized with respect airborne concentrations of mercury vapor. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.17. If additional chemical hazards are discovered during the industrial hygiene study or investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, drilling and coring inside Building 3, collecting wipe samples while working on scaffolding and at heights, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal and inhalation hazards associated with working in Building 79, and in collecting wipe samples and handling soil and groundwater onsite, the initial PPE level for field activities is Level C with mercury vapor cartridge equipped air-purifying respirator, polycoated protective coveralls with hood and boots, and silver shield inner and nitrile outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). Work in Building 79 will be monitored with a direct-reading, real-time mercury vapor analyzer. If concentrations of mercury vapor exceed ALs specified in Table 4.1, site activities will cease and ventilation alternatives and PPE upgrades implemented.



LEGEND

- EXISTING SOIL BORINGS
- EXISTING MONITORING WELLS
- PROPOSED SOIL BORINGS
- PROPOSED DEEP MONITORING WELLS
- PROPOSED SHALLOW MONITORING WELLS
- PROPOSED SEDIMENT SAMPLES
- PROPOSED CORE SAMPLES
- PROPOSED SURFACE SOIL SAMPLE
- PROPOSED SURFACE WATER SAMPLES
- PROPOSED THICKNESS SAMPLES
- PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-15
SWMU #102
MERCURY SPILL
BUILDING 79

DWG DATE: 7/7/95 | DWG NAME: FIG-H15

4.5.15 SWMU 106, Blast Area, Drydock 3; and AOC 603, Burning Dump, Drydock 3 Area

Table 4.18 describes the sites.

Table 4.18
SWMU 106 and AOC 603
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
SWMU 106 Blast Area	This site consists of an abrasive blasting area near DDs 3 and 4. The blast area is outside on an asphalt/concrete pavement, however this area at one time was merely grade and covered with rock. When blasting occurs, temporary structures are erected using scaffolding and herculite to contain blast material. Abrasive blasting operations are rarely conducted. Steel grit and sodium bicarbonate are the reported materials used for blasting.	Metals Paints Solvents Blasting Material
AOC 603 Burning Dump	This site consists of a former burning dump near the present location of DD 3. The burning dump is believed to have operated from the late 1920s through the late 1930s. No information was found concerning the size or operating practices of the former burning dump.	Petroleum Hydrocarbons Products of Incomplete Combustion

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

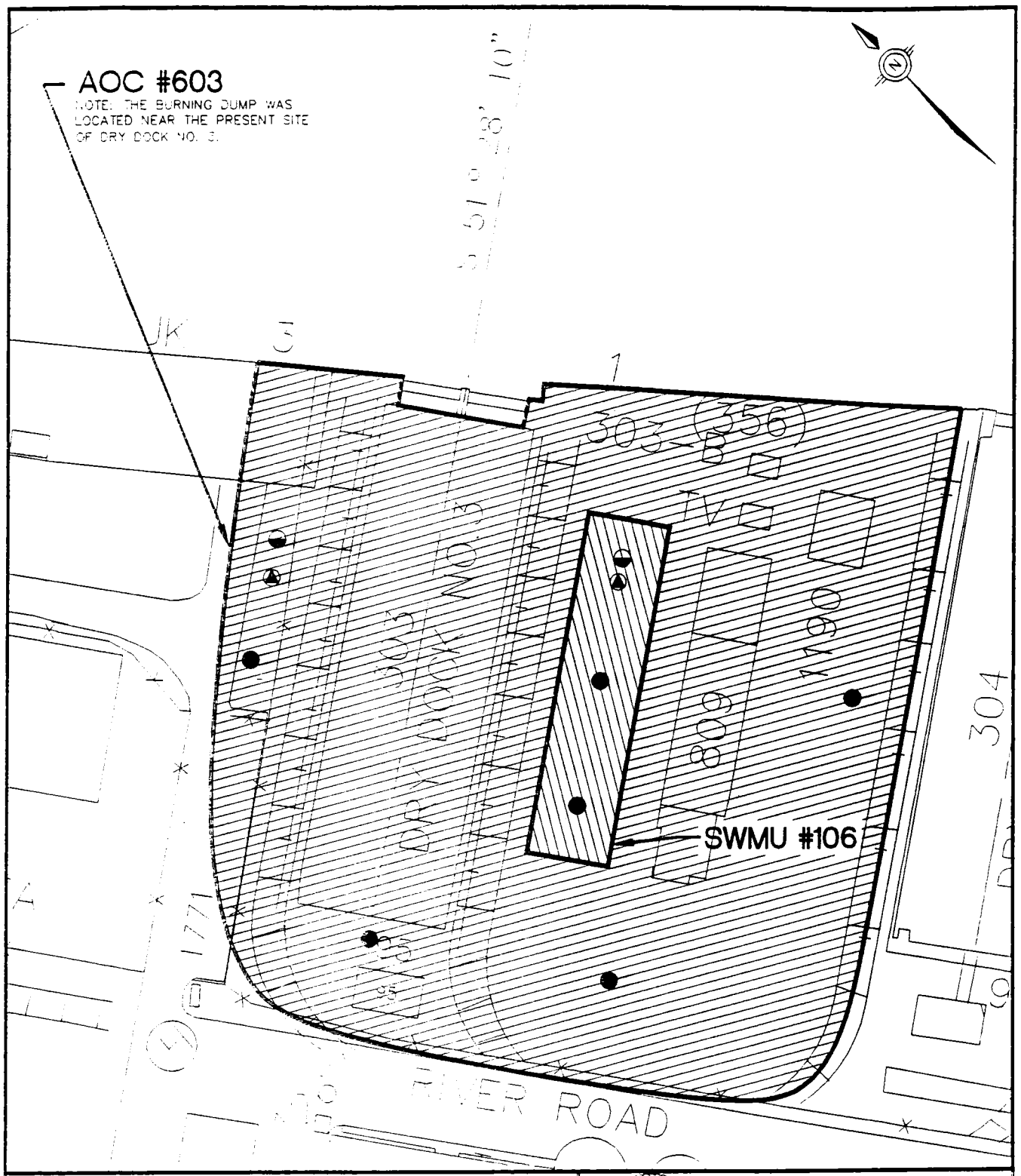
Site Activities

Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-16 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.18. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



- EXISTING SOIL BORINGS
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- PROPOSED SURFACE WATER SAMPLES
- PROPOSED THICKNESS SAMPLES
- PROPOSED WIPE SAMPLES

GRAPHIC SCALE

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-16
SWMU #106, DRY DOCK #3
AOC #603
BURNING DUMP DRY DOCK #3

DWG DATE: 7/5/95 | DWG NAME: FIG-H16

4.5.16 SWMU 145, Mercury Spill, Building 13A

Table 4.19 describes the site.

Table 4.19
SWMU 145
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
SWMU 145 Mercury Spill	This site consists of a reported mercury spill beneath Building 13A. No additional information could be found regarding the amount or duration of release(s).[1]	Mercury

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

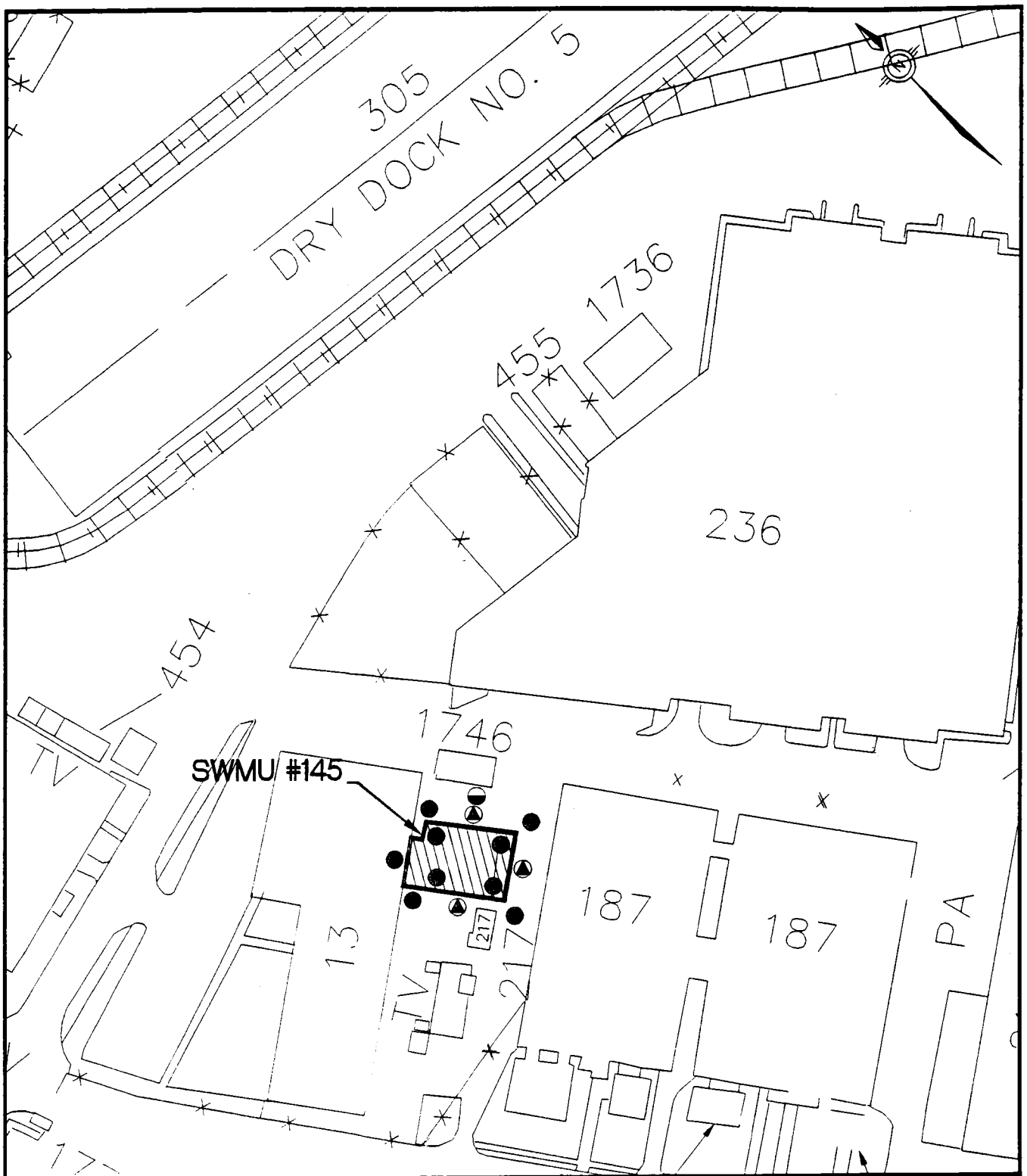
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting wipe, soil, and air samples. The proposed sample locations illustrated on Figure 4-17 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

The history of Building 13A indicates the potential for substantial contamination with metallic liquid mercury. A release of mercury was documented in 1969, with an unknown level of cleanup. E/A&H will complete an initial industrial hygiene study of the sampling locations within Building 13A. The conditions will be characterized with respect to airborne concentrations of mercury vapor. Review of available site information provides insufficient

information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.19. If additional chemical hazards are discovered during the industrial hygiene study or investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, drilling and coring inside Building 13A, collected wipe samples while working on scaffolding and at heights, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal and inhalation hazards associated with working in Building 13A, and in collecting wipe samples, and handling soil, and groundwater onsite, the initial PPE level for field activities is Level C with mercury vapor cartridge equipped air-purifying respirator, polycoated protective coveralls with hood and boots, and silver shield inner and nitrile outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). Work in Building 13A will be monitored with a direct-reading, real-time mercury vapor analyzer. If concentrations of mercury vapor exceed the ALs specified in Table 4.1, site activities will cease and ventilation alternatives and PPE upgrades will be implemented.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
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- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-17
SWMU #145
BUILDING 13A, FIRST FLOOR
MERCURY SPILL

DWG DATE: 6/2/95 | DWG NAME: FIGURE16

4.5.17 SWMU 170, PCB Removal Operations, Drydock 1 Area; and SWMU 171, PCB Removal Operations, Drydock 2 Area

Table 4.20 describes the sites.

Table 4.20
SWMU 170 and SWMU 171
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
SWMU 170 PCB Removal Operations	This site consists of a storage area immediately west of DD 1. Missile launching tubes removed from decommissioned ballistic missile submarines are stored in this area for removal of PCB-containing components. It is estimated that the missile tube dismantling began around the late 1980s. The missile tube dismantling area has no secondary containment.	PCBs
SWMU 171 PCB Removal Area	This site consists of a storage area immediately west of DD 2. Missile launching tubes removed from decommissioned ballistic missile submarines are stored in this area for removal of PCB-containing components. It is estimated that the missile tube dismantling began around the mid 1980s. The missile tube dismantling area has no secondary containment.	PCBs

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

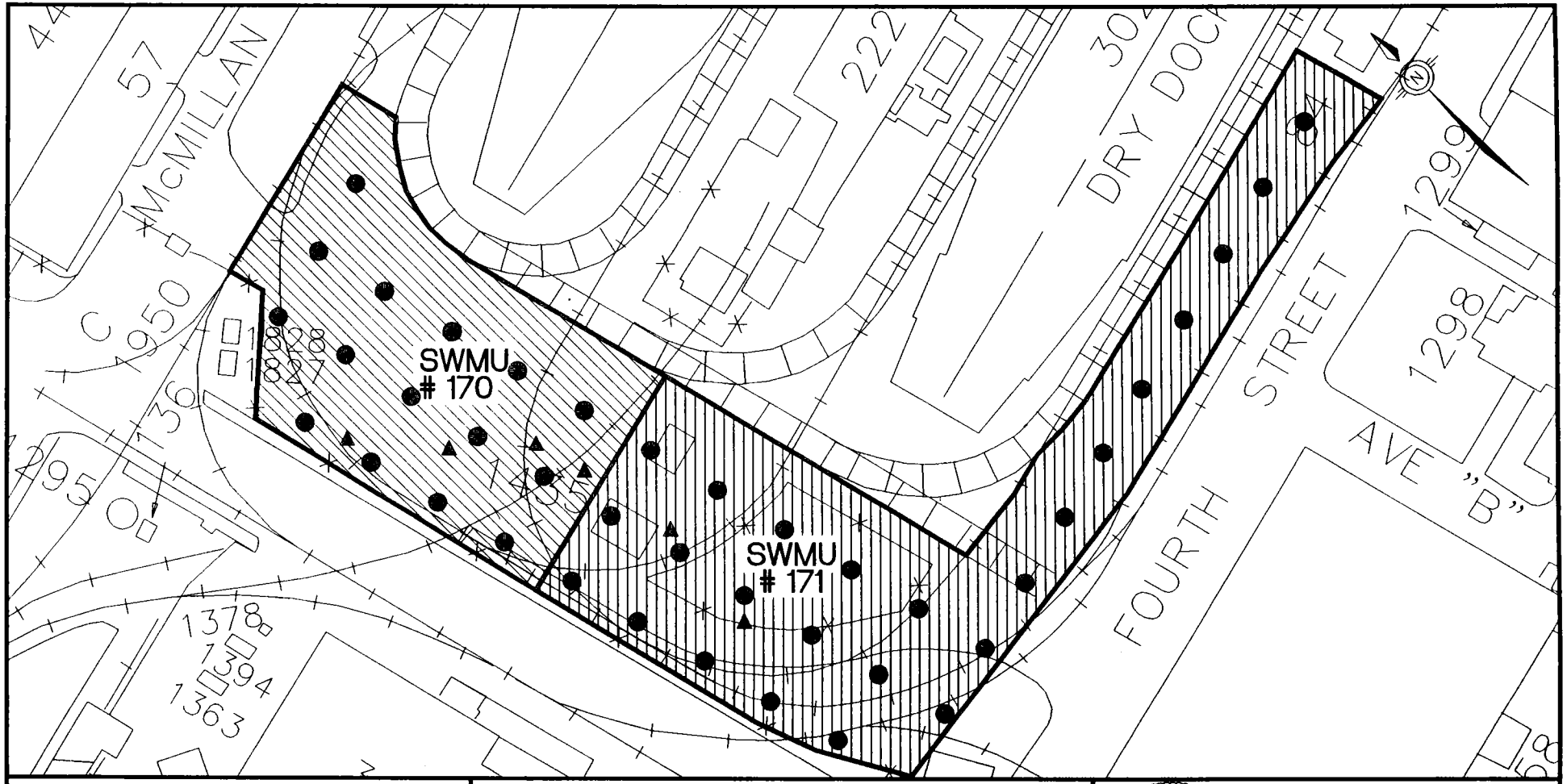
Site Activities

Activities will involve performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-18 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing asphalt/concrete borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.20. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soils and asphalt/concrete core samples onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



100 0 100

GRAPHIC SCALE

LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-18
SWMU #170, DRY DOCK #1 AREA
SWMU #171, DRY DOCK #2 AREA
PCB REMOVAL OPERATIONS

DWG DATE: 6/2/95 | DWG NAME: FIG-H18

4.5.18 SWMU 173, Building 1297 Storage Area

Table 4.21 describes the sites.

Table 4.21 SWMU 173 Site Description and Chemical Hazards		
Number	**Description**	**Chemical Hazards[1][2]**
SWMU 173 **Storage Areas**	This site consists of separate storage areas for lead ingots and hazardous materials in Building 1297. The building is divided into 10 storage areas, each accessed through an exterior door. Each storage room also has an opening in the roof, used to transfer materials. One area is used to store lead ingots. Its roof is protected by non-watertight wood cover. Another area is a hazardous materials storage area. Hazardous Material Information Codes on the labels of the material stored indicates they are classified as extreme hazards to human health, highly reactive, or having the possibility of detonating under certain conditions. Five storm drains are close to the building.	Metals (Lead) Unknown Highly Reactive

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

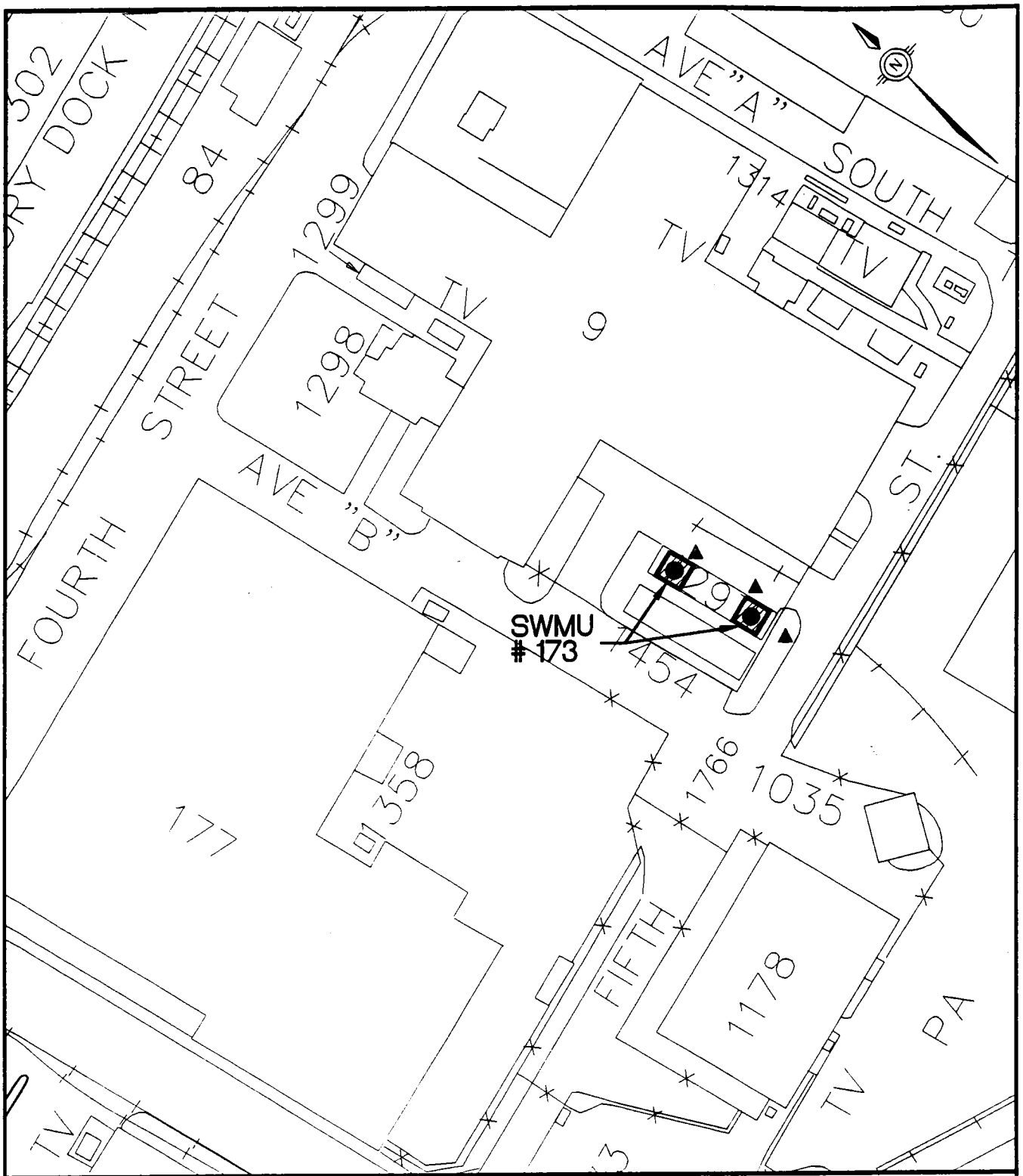
Site Activities

Activities will involve performing soil and sediment sampling. The proposed sample locations illustrated on Figure 4-19 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.21. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and sediment onsite the initial PPE level specified for invasive field activities is modified Level D with silver shield inner and nitrile outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-19
SWMU #173
BUILDING 1297
STORAGE AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE18

4.5.19 AOC 525, Paint Booth 35, Building 223

Table 4.22 describes the site.

Table 4.22 AOC 525 Site Description and Chemical Hazards		
Number	**Description**	**Chemical Hazards**[1][2]
AOC 525 Paint Booth (35)	This site consists of a paint booth No. 35 in Building 223. Booth 35 is the oldest of the paint booths and is used to paint miscellaneous parts. The booth is 20' x 20' x 15' with a 3' diam. 15' high stack. This booth operates under a South Carolina Bureau of Air Quality Control Permit. Before 1972, water used to capture paint dust from the booths was discharged directly into the storm sewer system.	Paints Solvents Metals

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

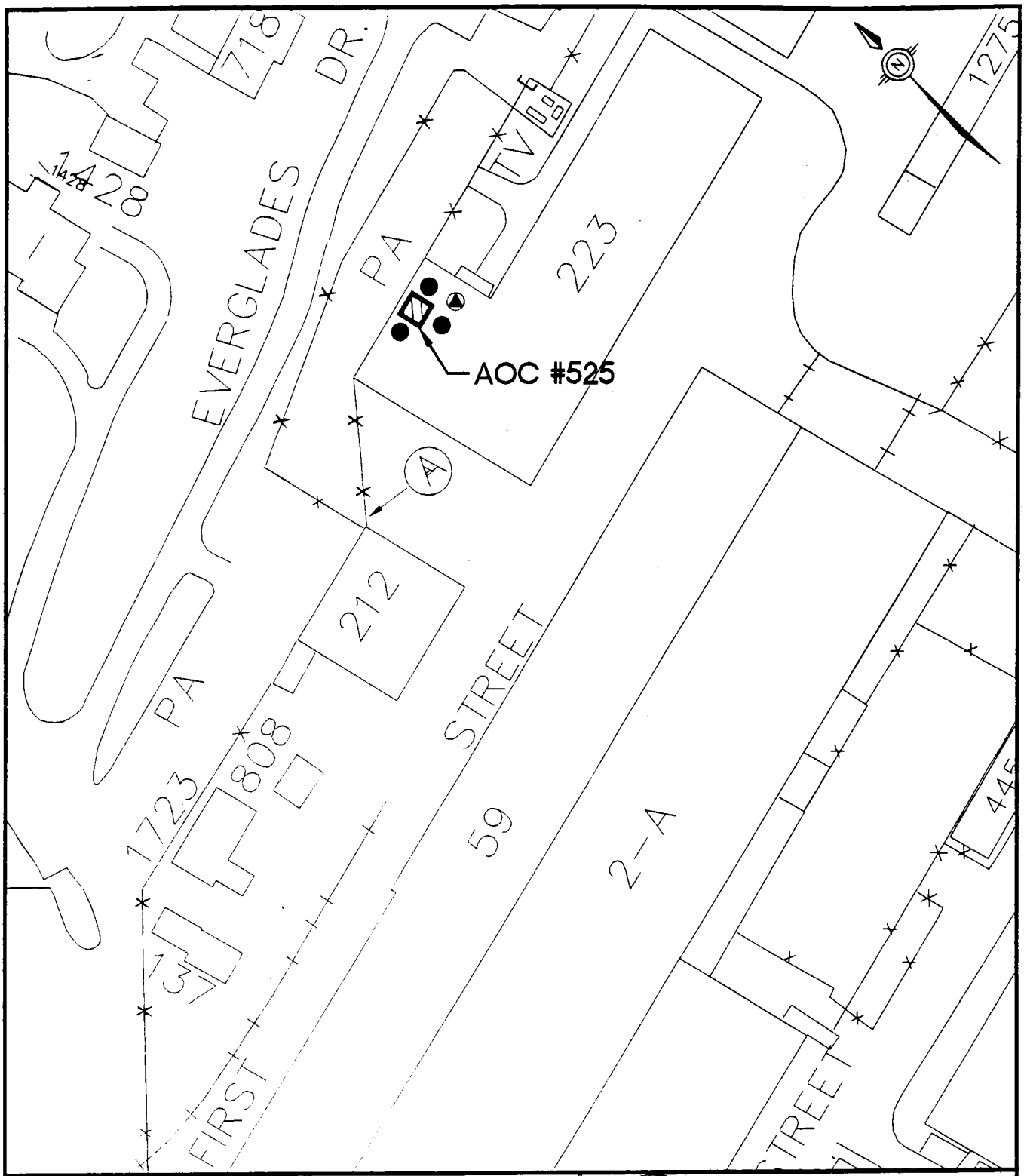
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-20 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.22. If additional chemical hazards

are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, coring operations inside of Building 223, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-20
AOC #525
PAINT SHOP
BUILDING 223

DWG DATE: 6/2/95 | DWG NAME: FIGURE19

4.5.20 AOC 528, Steam Cleaning Shop

Table 4.23 describes the site.

Table 4.23
AOC 528
Site Description and Chemical Hazards

Number	Description	Chemical Hazard[1][2]
AOC 528 Steam Cleaning Shop	The steam cleaning shop was used to clean boiler parts. Boiler tubes preserved with Cosmoline® grease to prevent rust, were received at the boiler shop. The Cosmoline® was removed in Building 59 by a bath of kerosene, and all remaining grease was removed in another bath of hot water, trisodiumphosphate, caustic, and detergents. After the second bath, the tubes were steam rinsed at the steam cleaning shop. Although this operation did not generate hazardous waste, it did produce approximately 800 gallons of contaminated kerosene semiannually. The contents of the second bath and the steam cleaning operation were discharged to the sanitary sewer. Before installation of the sanitary sewer, waste was discharged to the Cooper River via the combined sewer system.	Petroleum Hydrocarbons Kerosene Caustic

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

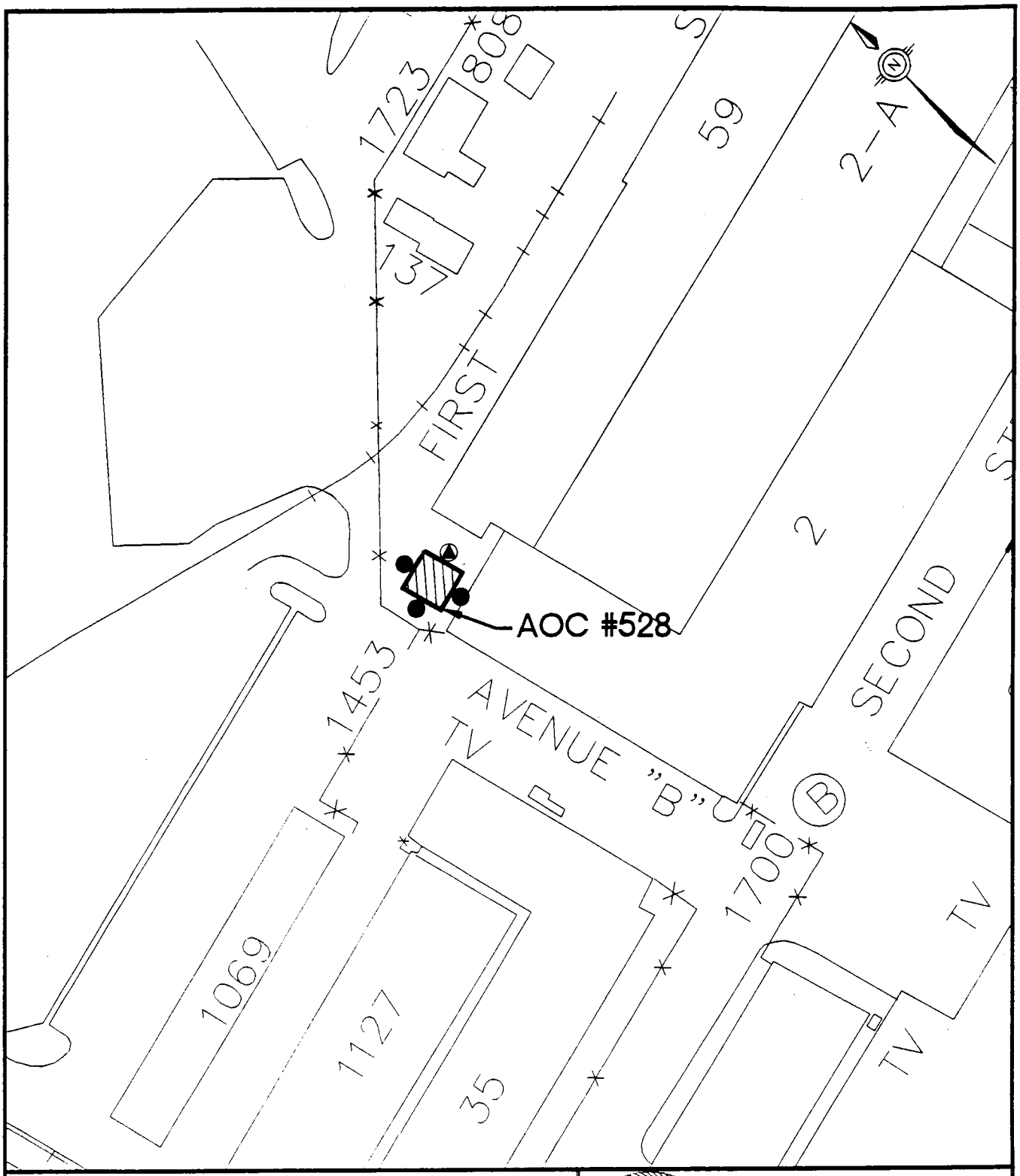
Site Activities

Activities will involve installing and developing groundwater monitoring wells, performing soil borings, and collecting soil sediment samples. The proposed sample locations illustrated on Figure 4-21 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.1.2 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.23. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-21
AOC #528
STEAM CLEANING SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE20

4.5.21 AOC 530, Paint and Oil Storage, Building 35

Table 4.24 describes the site.

Table 4.24
AOC 530
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 530 Paint and Oil Storage	From 1913 to 1939, Building 35 was used to store paint and oil. Additions were made to the building in the 1930s. The Publication and Printing Service was in Building 35 from 1949 to 1979. This service supplied the printing needs of much of the 6th Naval District. Before 1979, wastes generated at Building 35 included an unknown quantity of ferric chloride acid etching bath, lithographic developing solution, and photographic developing solution. The building was used to store paints and oils from 1913 to 1939. Currently, Building 35 is a training facility for welding students.	Alcohols Paints Solvents Petroleum Hydrocarbons Heavy Metals

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Tables 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

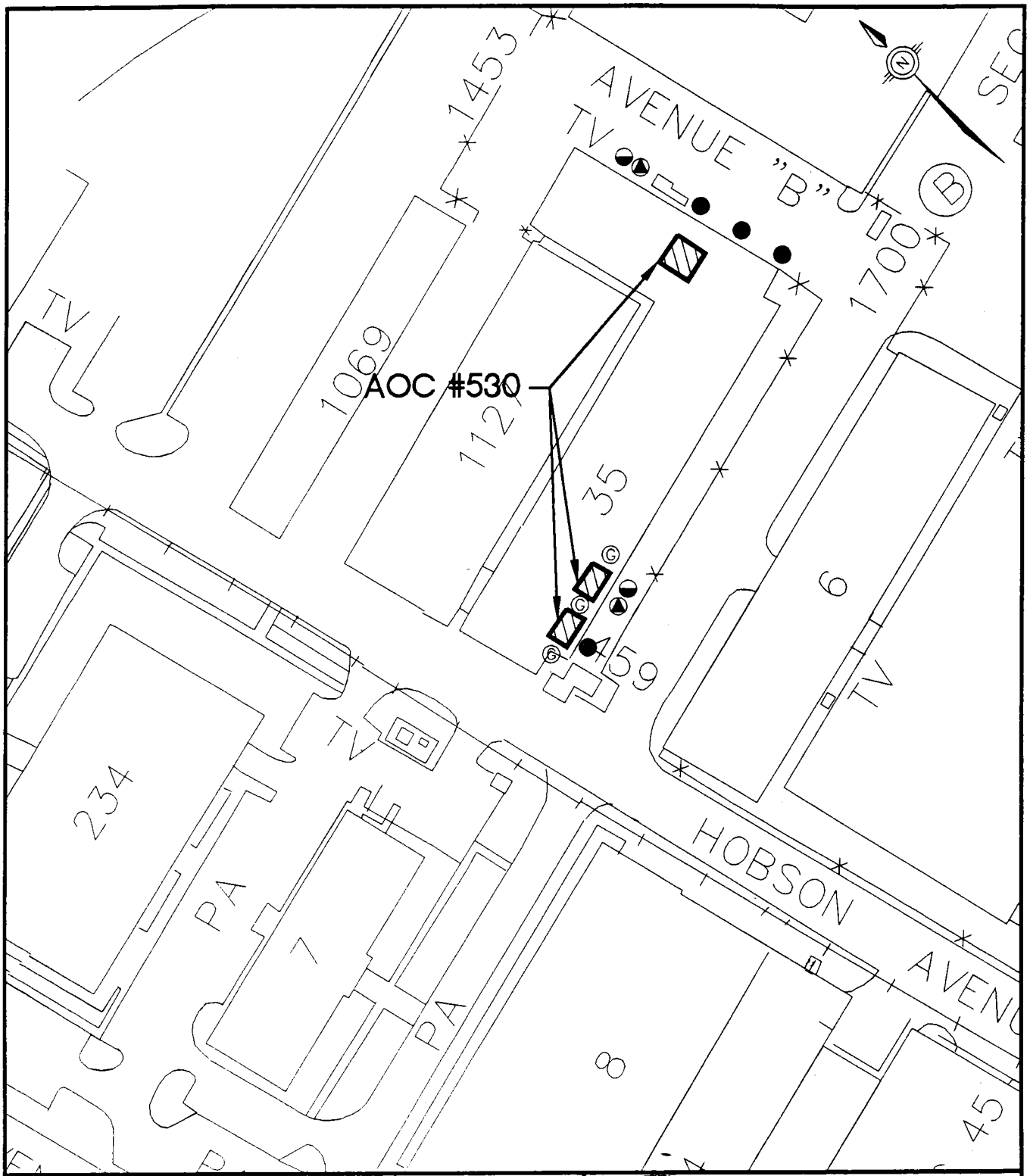
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-22 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site

specific potential chemical hazards are specified in Table 4-5. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, coring inside of Building 35, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soils, sediments and groundwater at this site, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4-2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
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- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-22
AOC #530
PAINT AND OIL STORAGE
BUILDING 35

DWG DATE: 6/2/95 | DWG NAME: FIGURE21

4.5.22 AOC 531, Substation and Storage, Building 459

Table 4.25 describes the site.

Table 4.25 AOC 531 Site Description and Chemical Hazards		
Number	**Description**	**Chemical Hazards[1,2]**
AOC 531 Substation and Storage	Building 459, used for storage and an enclosure for a substation was constructed in 1974. The building has two sections: a metal enclosure containing high-voltage switches and a transformer; and a concrete building containing a battery bank and supplies to maintain it. A 1986 UST Registration document reports the presence of a 20,000-gallon fuel oil tank.	Batteries Dielectric Fluid Petroleum Hydrocarbons

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

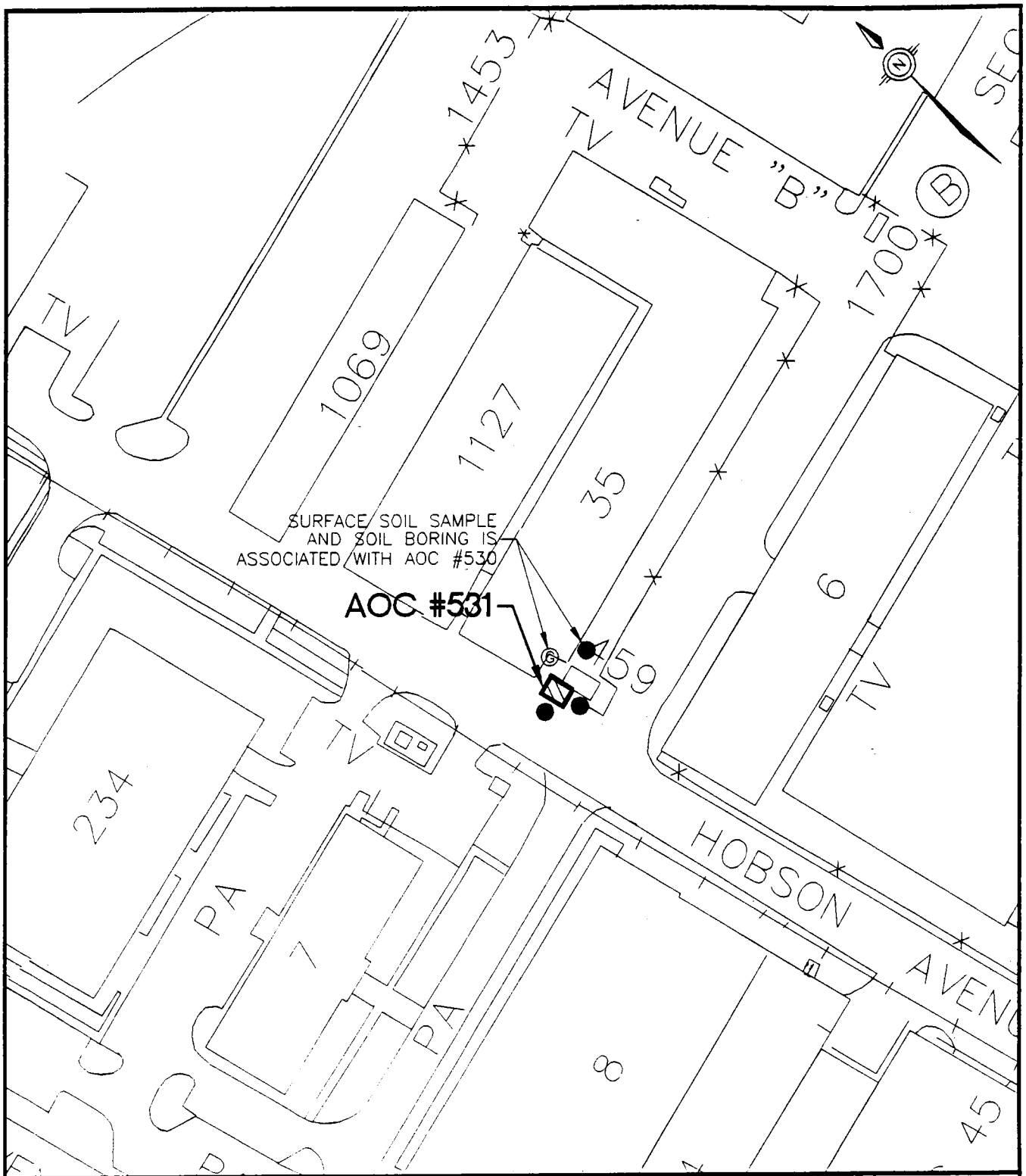
Activities will involve soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-23 have been chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.25. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated

into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
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- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-23
AOC #531
SWITCHING SUBSTATION
BUILDING 459

DWG DATE: 6/2/95 | DWG NAME: FIGURE22

4.5.23 AOC 538, Forge Shop, Building 6; and AOC 539, Propeller Shop, Building 6

Table 4.26 describes the sites.

Table 4.26
AOC 538 and AOC 539
Site Description and Chemical Hazards

Number	Description	Chemical Hazards [1][2]
AOC 538 **Forge Shop**	The forge shop is in the eastern portion of Building 6. Various metal-working processes are conducted in the shop. The forge furnaces are currently oil-fired. Numerous quench oil tanks are also present.	Waste Oils and Paints Heavy Metals Ceramic Refractory Materials Galvanizing Flux Coal and Charcoal Coke
AOC 539 **Propeller Shop**	The propeller shop is in the western extension of Building 6, added in 1967. The Zyglo process was used here until it was replaced by the existing red dye process in 1979. Zyglo reportedly was rinsed from the propellers onto the floor and then outside into the storm sewer. Current operations use a red dye magnaflux process, which is collected in a portable tank.	Zyglo Penetrant (99% 1,1,1-trichloroethane)

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

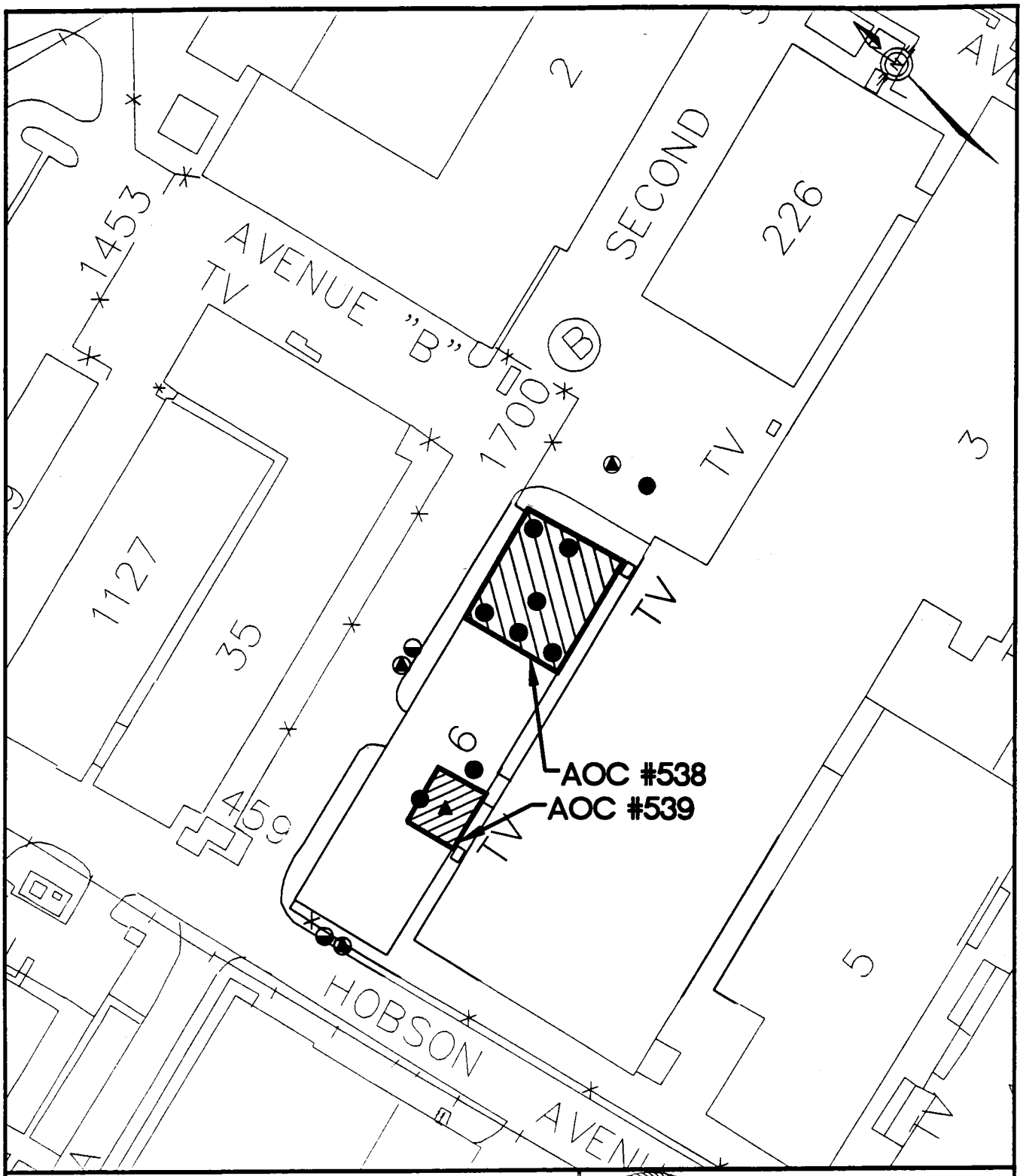
Site Activities

Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting soil, wipe, and air samples. The proposed sample locations illustrated on Figure 4-24 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E\A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.26. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, working on scaffolding at heights, drilling inside Building 6, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, wipe sample, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
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- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-24
AOC #538, BUILDING 6, FORGE SHOP
AOC #539
BUILDING 6, PROPELLER SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE23

4.5.24 AOC 550, Boiler House, Former Building 1111

Table 4.27 describes the site.

Table 4.27 AOC 550 Site Description and Chemical Hazard		
Number	**Description**	**Chemical Hazards[1,2]**
AOC 550 **Boiler House**	The dimensions of this facility are unknown, but it is known that former Building 1111 is shown at two locations on historic base maps. Personnel interviews indicate that this facility was transportable. No other information was found during the RFA regarding its design features or operating practices.	Petroleum Hydrocarbons Heavy Metals

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

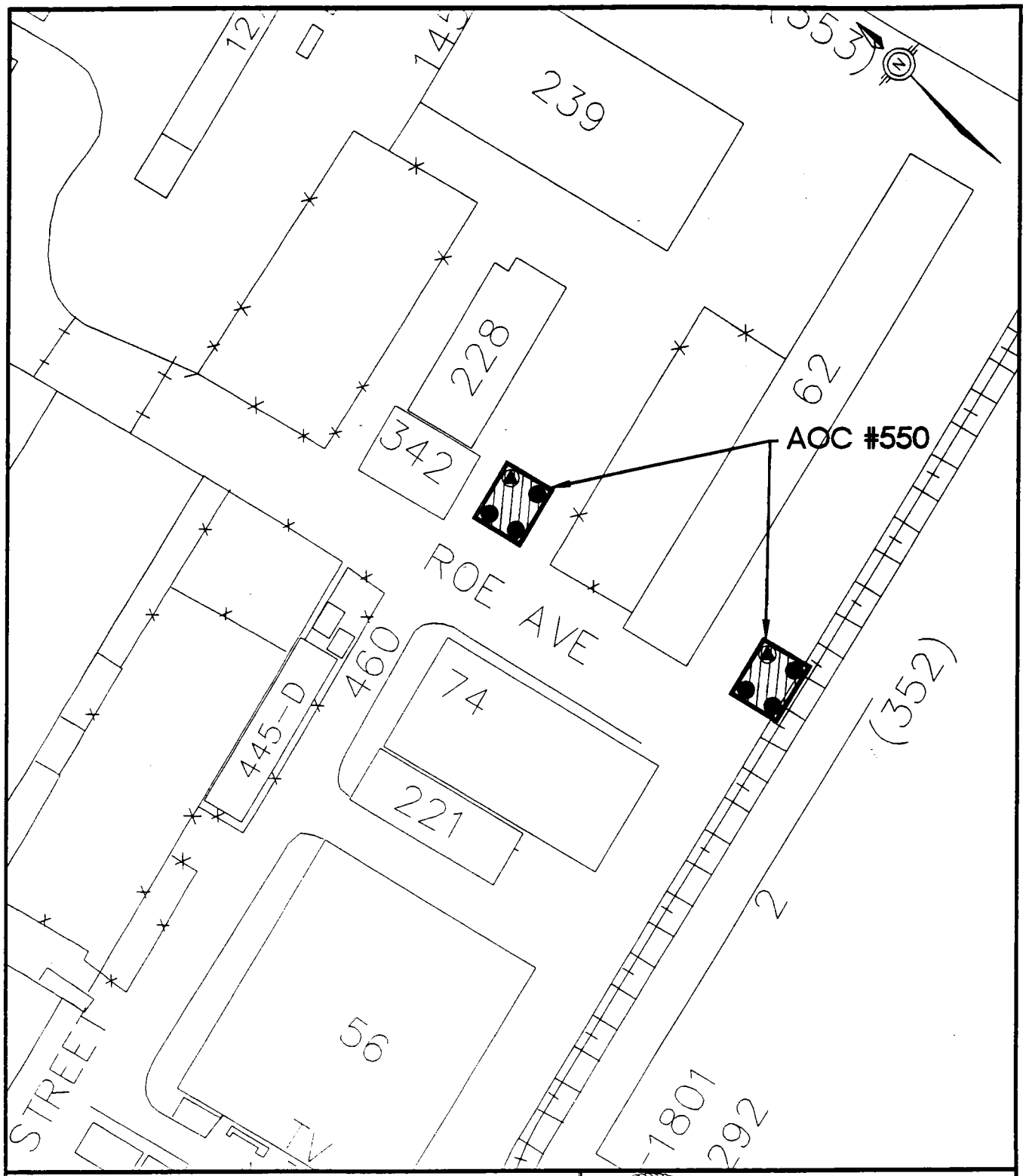
Activities at this site will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-25 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.27. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment,

and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- O – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-25
AOC #550
BOILER HOUSE
FORMER BUILDING 1111

DWG DATE: 6/2/95 | DWG NAME: FIGURE24

4.5.25 AOC 551, Boiler House, Building 1119; and AOC 552, Former Galvanizing Shop, Building 1030

Table 4.28 describes the sites.

Table 4.28
AOC 551 and AOC 552
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 551 Boiler House	The building appears to have undergone drastic renovations, or may have been demolished and rebuilt close to the original site. No records were found regarding the fuel used in the boiler.	Petroleum Hydrocarbons Heavy Metals
AOC 552 Former Galvanizing Shop	Building 1030 was constructed in 1922 and used as a galvanizing shop until 1926. From 1926 to 1929, the building was a tooling shop. In 1929, the building was converted to a storage shop and was demolished sometime after. Currently, the site is asphalt traversed by a pair of nuclear- grade railroad tracks.	Inorganic Acids Heavy Metals Zinc

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

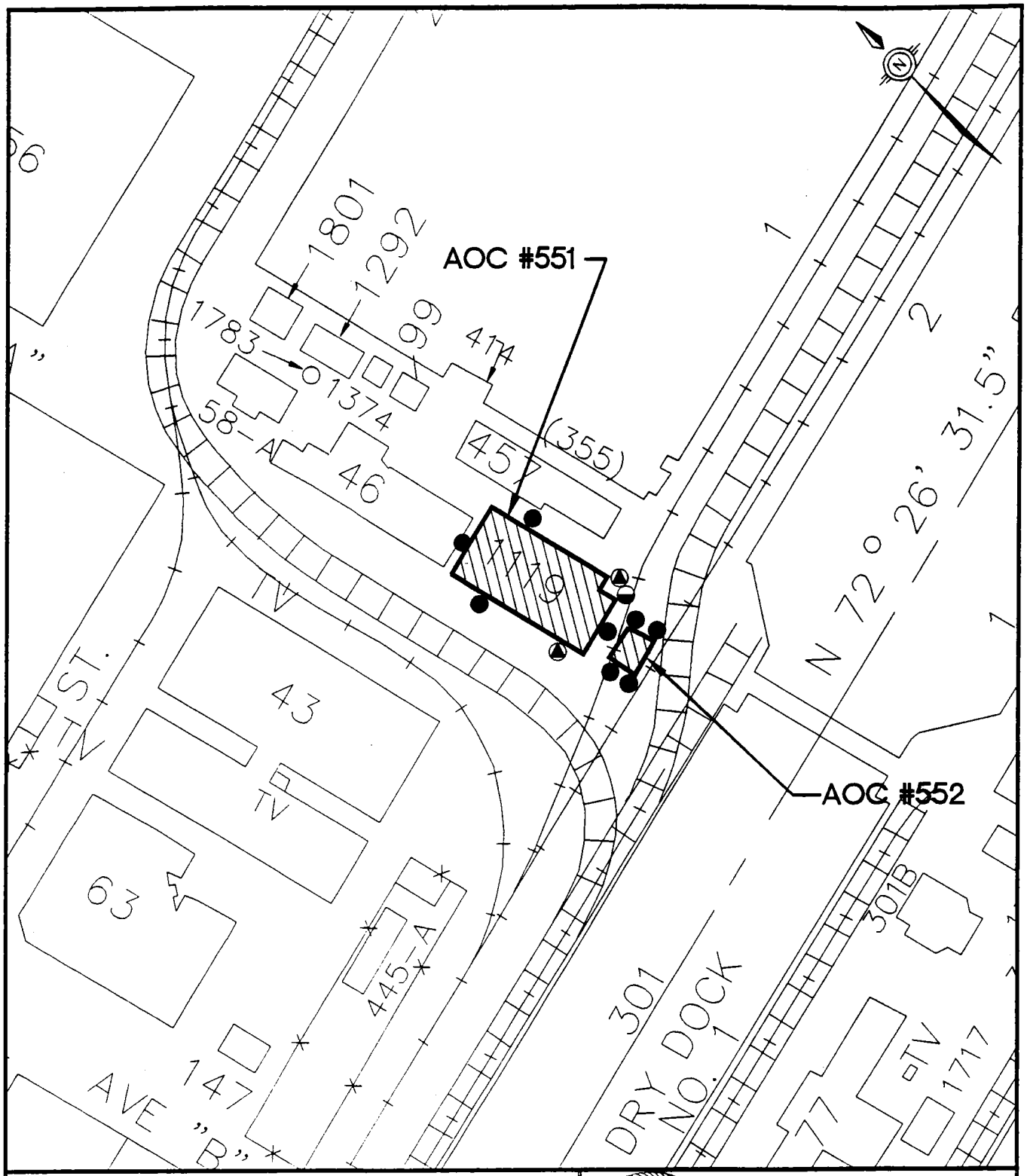
Site Activities

Activities will involve the installing and developing groundwater monitoring wells, performing soil borings, and collecting samples. The proposed sample locations illustrated on Figure 4-26 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.28. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-26
AOC #551
BOILER HOUSE, BUILDING 1119
AOC #552/GALVANIZING SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE25

4.5.26 AOC 555, Latrine and Substation, Former Building 29

Table 4.29 describes the site.

Table 4.29
AOC 555
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 555 Latrine and Substation	Aerial photos show that the facility did not exist after 1967. During operation, it is believed its contents were diverted directly into the Cooper River. No other information was found regarding the size, design features, or operating practices of the site. Presently, the site is asphalt at the corner of Pier D and Quaywall 414.	Organic Wastes Heavy Metals PCBs

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines
[2] Refer to Appendix E for site chemical hazard MSDS.

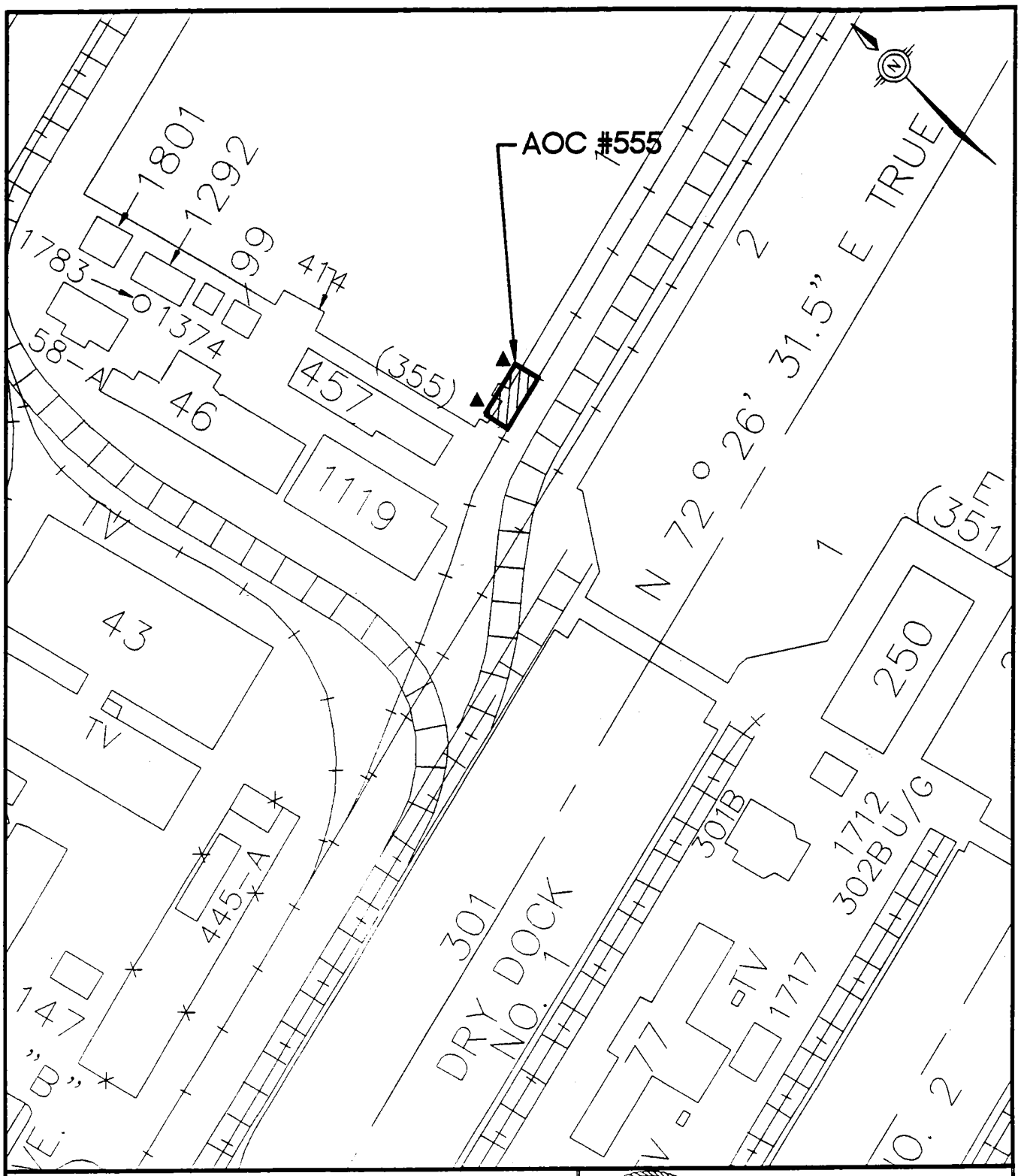
Site Activities

Activities will involve collecting sediment samples. The proposed sample locations illustrated on Figure 4-27 chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. It is not anticipated that underground utilities will be encountered while sampling sediment.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.29. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with sediment onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-27
AOC #555
LATRINE
FORMER BUILDING 29

DWG DATE: 6/2/95 | DWG NAME: FIGURE26

4.5.27 AOC 556, Drydock Discharges

Table 4.30 describes the sites.

Table 4.30
AOC 556
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 556 Drydock Discharges	The five drydocks were constructed in the following years: DD 1 1907 DD 2 1942 DD 3 1943 DD 4 1943 DD 5 1964 A large, grated drain runs along the middle of the entire length of each drydock. Underground pumps remove the water collected in the drain and direct it to the sanitary sewer system. Portable caissons, a form of floating gate, are constructed of creosote-treated wood and serve as dams during the docking and maintenance. Operations include ship overhaul, refueling, defueling, welding, painting, mechanical work, and light industrial work. The following outfall designations are based on the NPDES permit application (March 1992): DD 1 and DD 2 - Outfall 009; DD 3 and DD 4 - Outfall 010; and DD 5 - Outfall 011.	PCBs Lead Acids Freon Metals Paints Mercury Caustics Solvents Antifreeze Raw Sewage Hydraulic Fluid Cleaning Compounds Petroleum Hydrocarbons Abrasive Blasting Grit

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

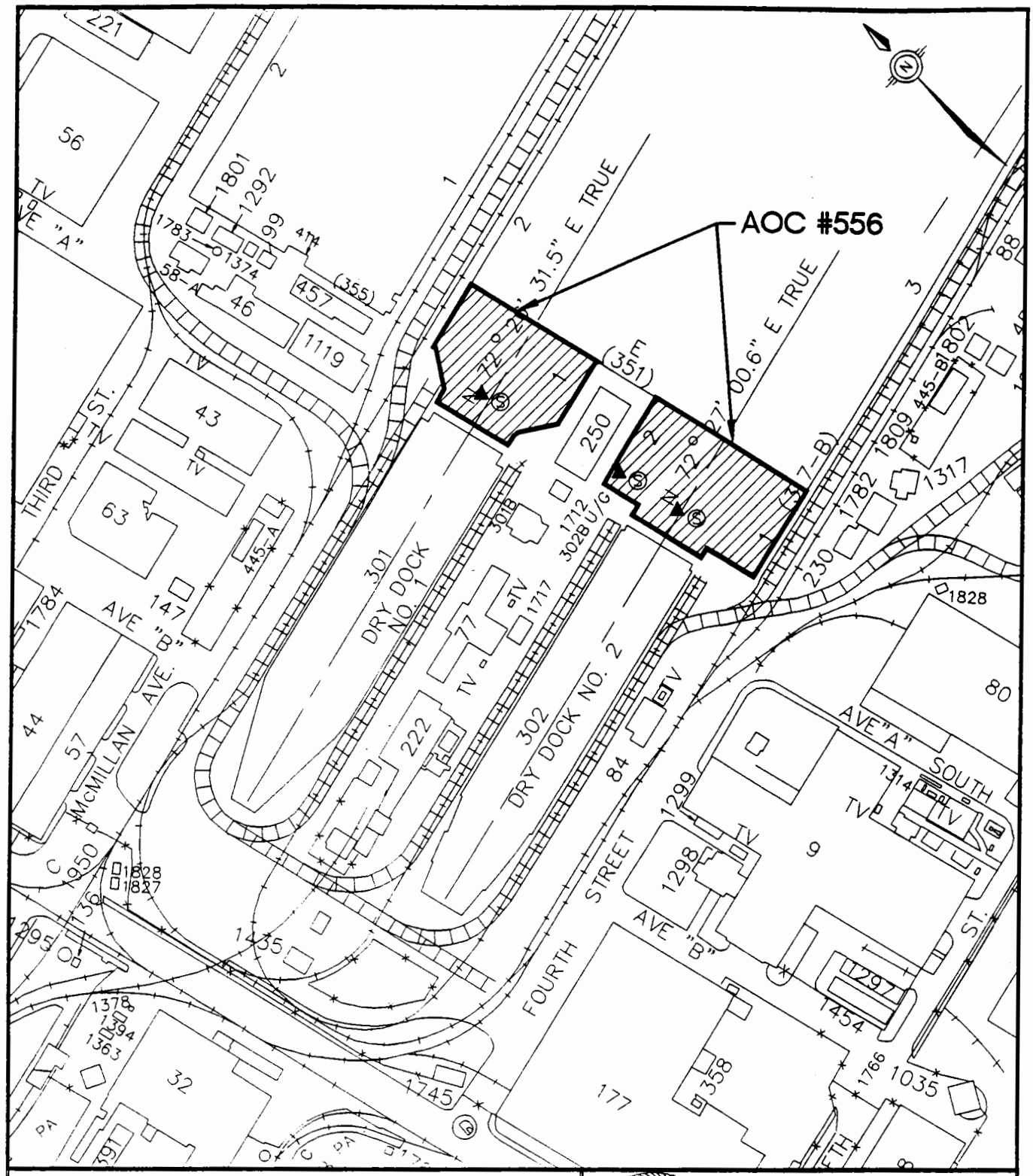
Site Activities

Activities will involve collecting surface water and sediment samples. The proposed sample locations illustrated on Figures 4-28A, 4-28B, and 4-28C were chosen based on proximity to the investigated unit. It is not anticipated that underground utilities will be encountered while sampling surface water or sediments.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.30. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to waterborne operations, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with sediment onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

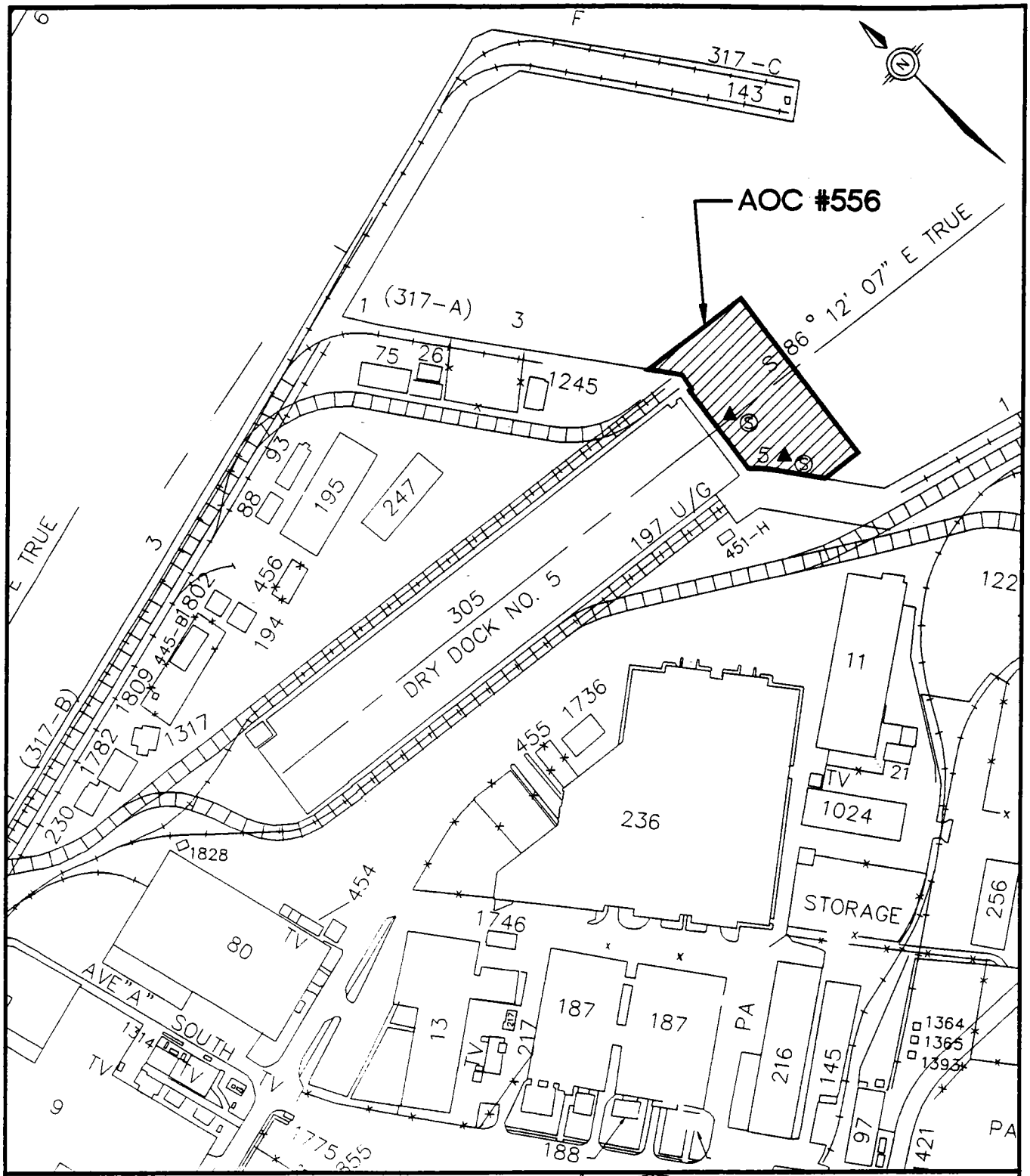
- O – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 250 0 250 500

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-28A
AOC #556
DRY DOCK DISCHARGES
DRY DOCKS #1 AND #2

DWG DATE: 6/2/95 | DWG NAME: FIGUR27A



LEGEND

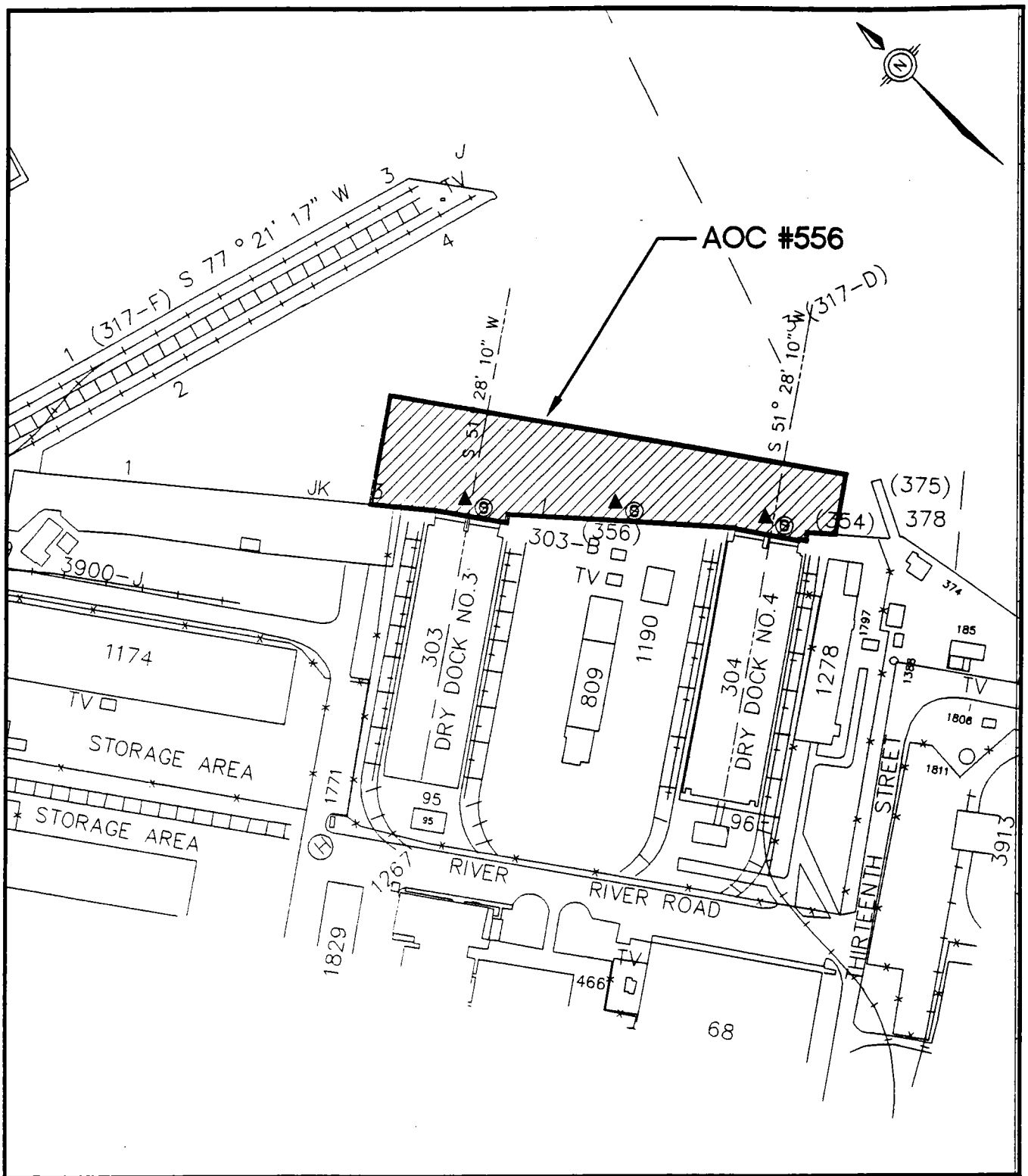
- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ▲ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 250 0 250 500

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-28B
AOC #556
DRY DOCK DISCHARGES
DRY DOCK #5

DWG DATE: 6/2/95 | DWG NAME: FIGUR27B



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 250 0 250 500

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-28C
AOC #556
DRY DOCK DISCHARGES
DRY DOCK #3 AND #4

DWG DATE: 6/2/95 | DWG NAME: FIGUR27C

4.5.28 AOC 557, Latrine, Former Building 1020; and AOC 558, Electrical Substation, Building 77

Table 4.31 describes the sites.

Table 4.31
AOC 557 and AOC 558
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 557 Latrine	Aerial photos show that the facility did not exist after 1939. During operation, it is believed its contents were diverted directly into the Cooper River. No other information was found regarding the size, design features or operating practices of the site. Presently, the site is covered with asphalt between Drydock 1 and Drydock 2.	Organic Wastes Heavy Metals
AOC 558 Substation	Building 77 is a two-story concrete structure built in 1942. Transformers, switches, and other electrical equipment are housed within the substation. The last PCB-containing equipment was removed in 1991. Reportedly, the cable vaults leading from the substation were cleaned to remove PCBs and asbestos in 1991.	Heavy Metals Ethylene Glycol Monoethanolamine Mercury Perchloroethylene TCE Petroleum Hydrocarbons PCBs

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

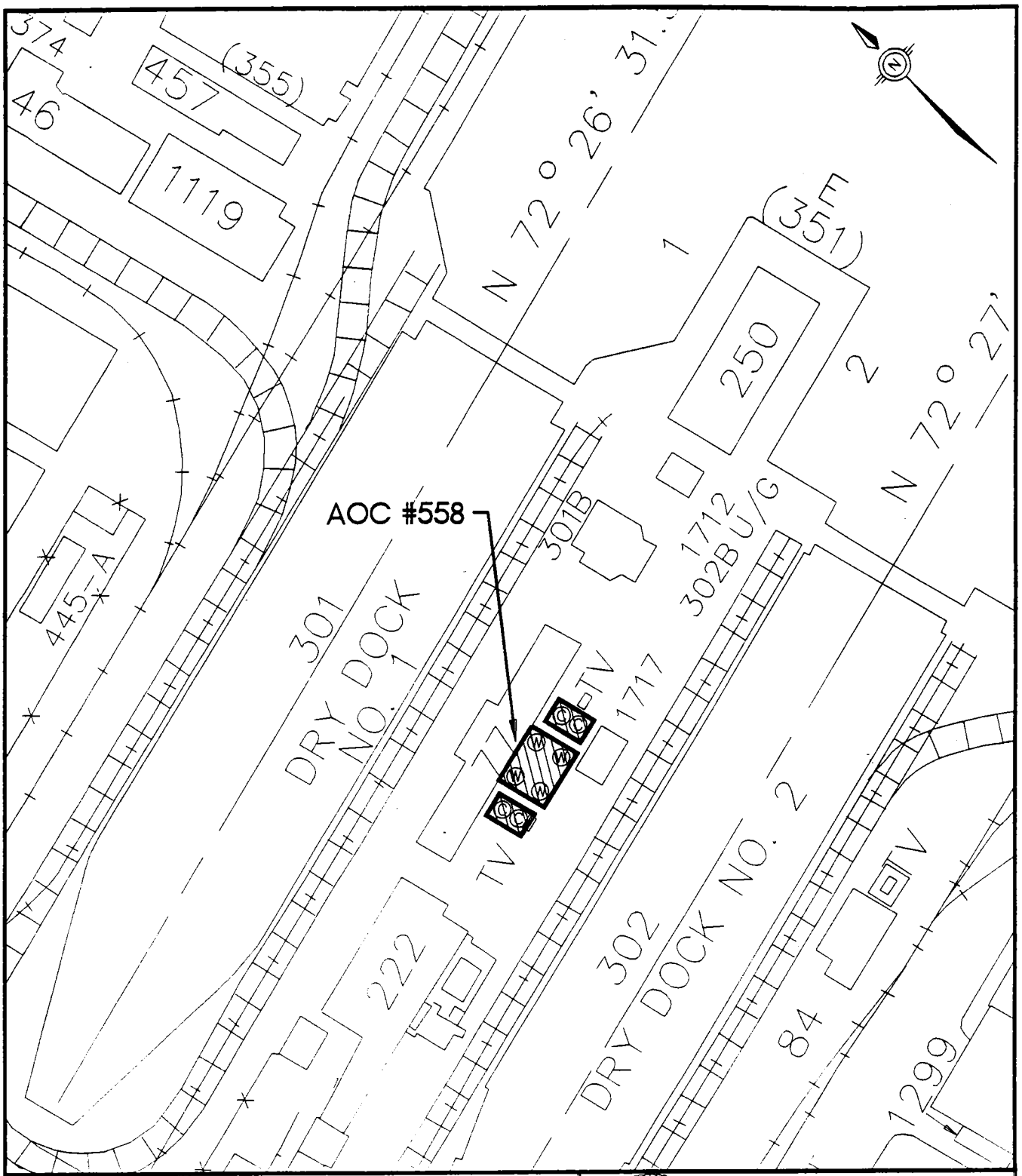
Activities will involve collecting concrete core and wipe samples. The proposed sample locations illustrated on Figure 4-29 were chosen based on proximity to the investigated unit.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.31. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated

into Appendix E. Site physical hazards are related to collecting wipe samples inside Building 77 and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling wipe samples, initial PPE level specified for field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-29
AOC #558
SUBSTATION
BUILDING 77

DWG DATE: 6/2/95 | DWG NAME: FIGURE28

4.5.29 AOC 559, Central Power Station, Building 32; AOC 560, Disinfector, Building 34; and AOC 561, Substation, Building 451B

Table 4.32 describes the sites.

Table 4.32
AOC 559, AOC 560, and AOC 561
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 559 Central Power Station	Building 32 is a three-story brick and concrete structure with concrete floors. The building was constructed in 1909 for steam and electric generation and still serves that purpose. The power plant has historically burned coal, fuel oil, and diesel fuel. Air emissions from this facility are permitted under CNSY Air Permit No. 0560-0002.	Solvents Heavy Metals Lube Oil Morpholene PCBs Acids/Caustics Oils/Oily Wastes Trisodiumphosphate
AOC 560 Disinfector	Former Building 34 was labeled as a disinfector on base maps during the 1920s and 1930s. No visible evidence of the disinfector remains. It is believed that the disinfector treated water prior to use in the power plant, or treated steam with a rust inhibitor after it was generated. Chlorine or iron-reducing agents are the most likely disinfection agents that may have been used.	Iron-Reducing Agent Chlorine
AOC 561 Substation	Building 451B is a substation constructed in 1944. The substation has three parts: a weatherproof metal enclosure containing the switch gear; a pad-mounted, high-voltage transformer with feed towers; and a battery bank housed in a two-room area. The substation is one of the principal feeds for electrical power to the shipyard and the CIA.	Dielectric Fluid (PCBs)

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

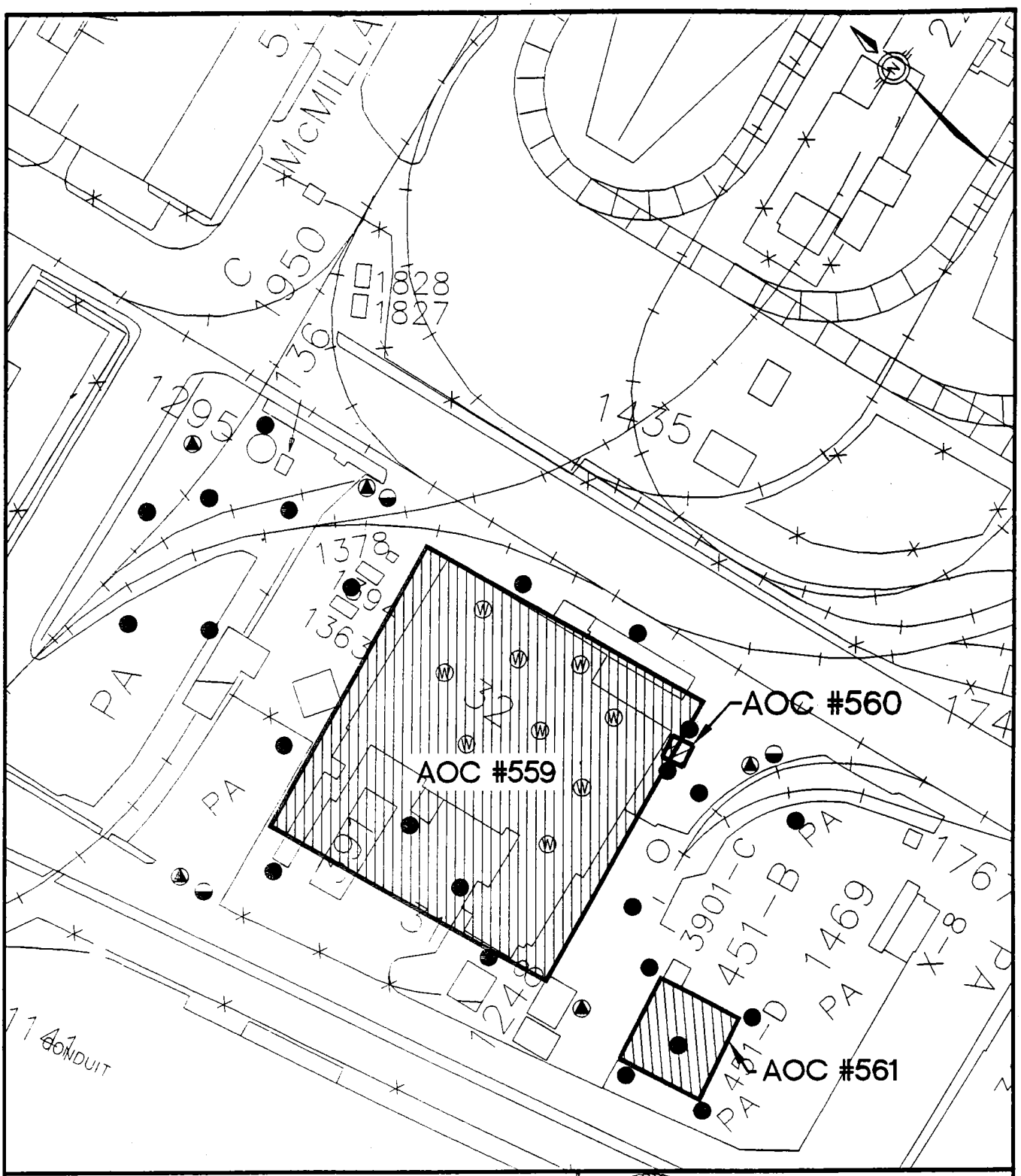
Activities will involve installing and developing groundwater monitoring wells, performing soil borings, and collecting wipe samples. The proposed sample locations illustrated on Figure 4-30 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities, piling

supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

Numerous chemical substance releases were reported at the central power station. Chemicals noted in those releases include transformer fluid, fuel oil, hydrochloric acid, and antifreeze. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.32. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, working on scaffolding at heights while collecting wipe samples, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- O – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-30
AOC #559, CENTRAL POWER STATION
AOC #560, DISINFECTOR
AOC #561, SUBSTATION, BLDG 451-B

DWG DATE: 6/2/95 | DWG NAME: FIGURE29

4.5.30 AOC 562, Substation, Building 84

Table 4.33 describes the site.

Table 4.33
AOC 562
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 562 Substation	Building 84 is a single-story structure with a concrete slab floor and roof. Adjacent to Building 84 is a concrete slab within a fenced area, containing several weatherproof metal-enclosed transformers.	Dielectric Fluid (PCBs)

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

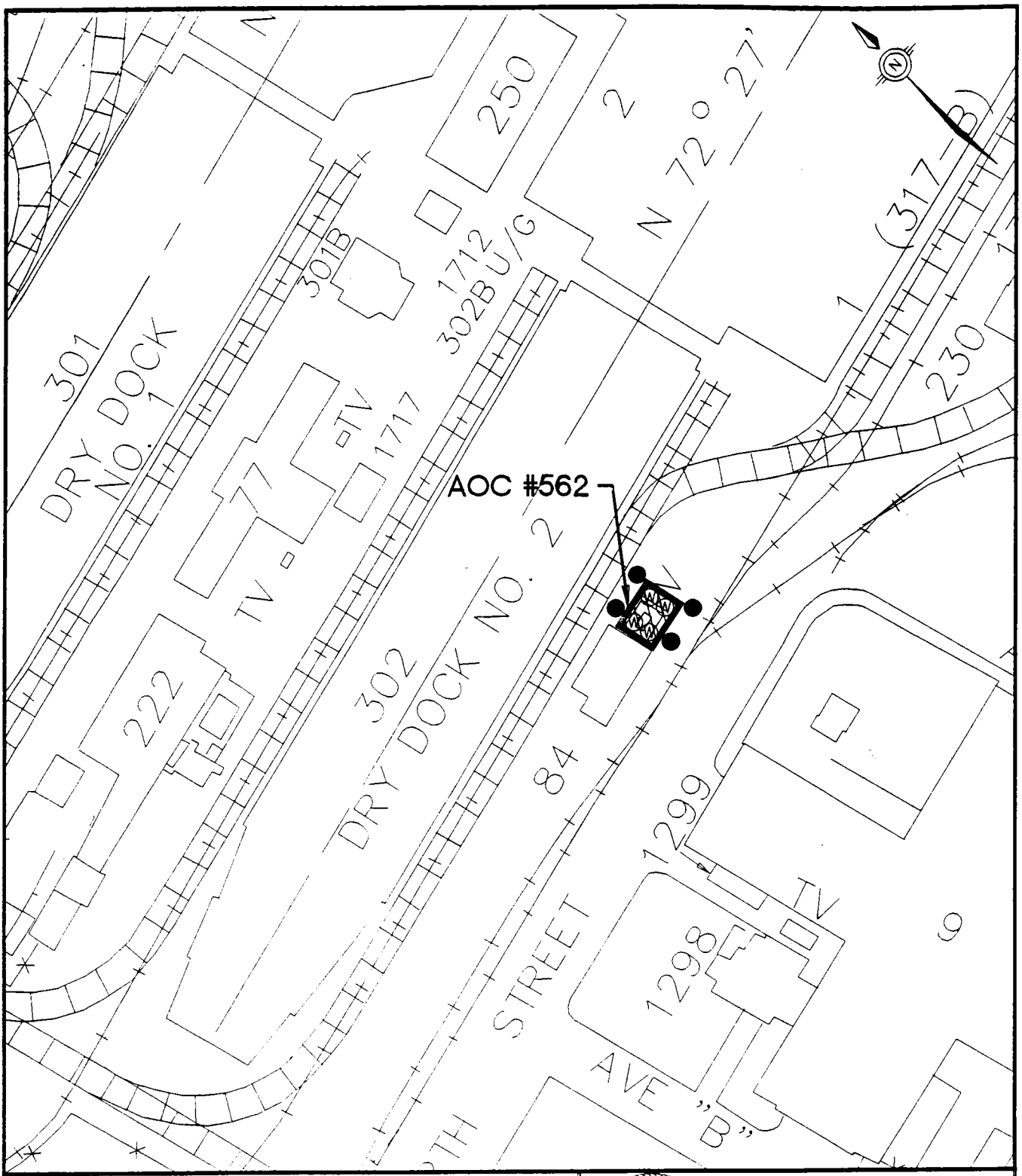
Activities will involve performing soil borings and collecting soil and wipe samples. The proposed sample locations illustrated on Figure 4-31 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

Previous investigations reported the that two transformers had leaked dielectric fluid containing less than 50 ppm PCBs. Staining of the concrete pad was also noted. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.33. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities,

heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and wipe samples onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◓ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-31
AOC #562
SUBSTATION
BUILDING 84

DWG DATE: 6/2/95 | DWG NAME: FIGURE30

4.5.31 AOC 563, Locomotive House, Former Building 37

Table 4.34 describes the site.

Table 4.34 AOC 563 Site Description and Chemical Hazards		
Number	**Description**	**Chemical Hazards[1,2]**
AOC 563 Locomotive House	Little is known about the operations of the maintenance house other than that the name implies maintenance to locomotive engines. Probable maintenance activities involved petroleum-based lubricants, chlorinated solvents and degreasers, and coal or petroleum fuels. Building 177 is currently on the site of former Building 37.	Lubricants Heavy Metals Dielectric Fluid Petroleum Hydrocarbons Chlorinated Solvents and Degreasers Coal/Coal By-products

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

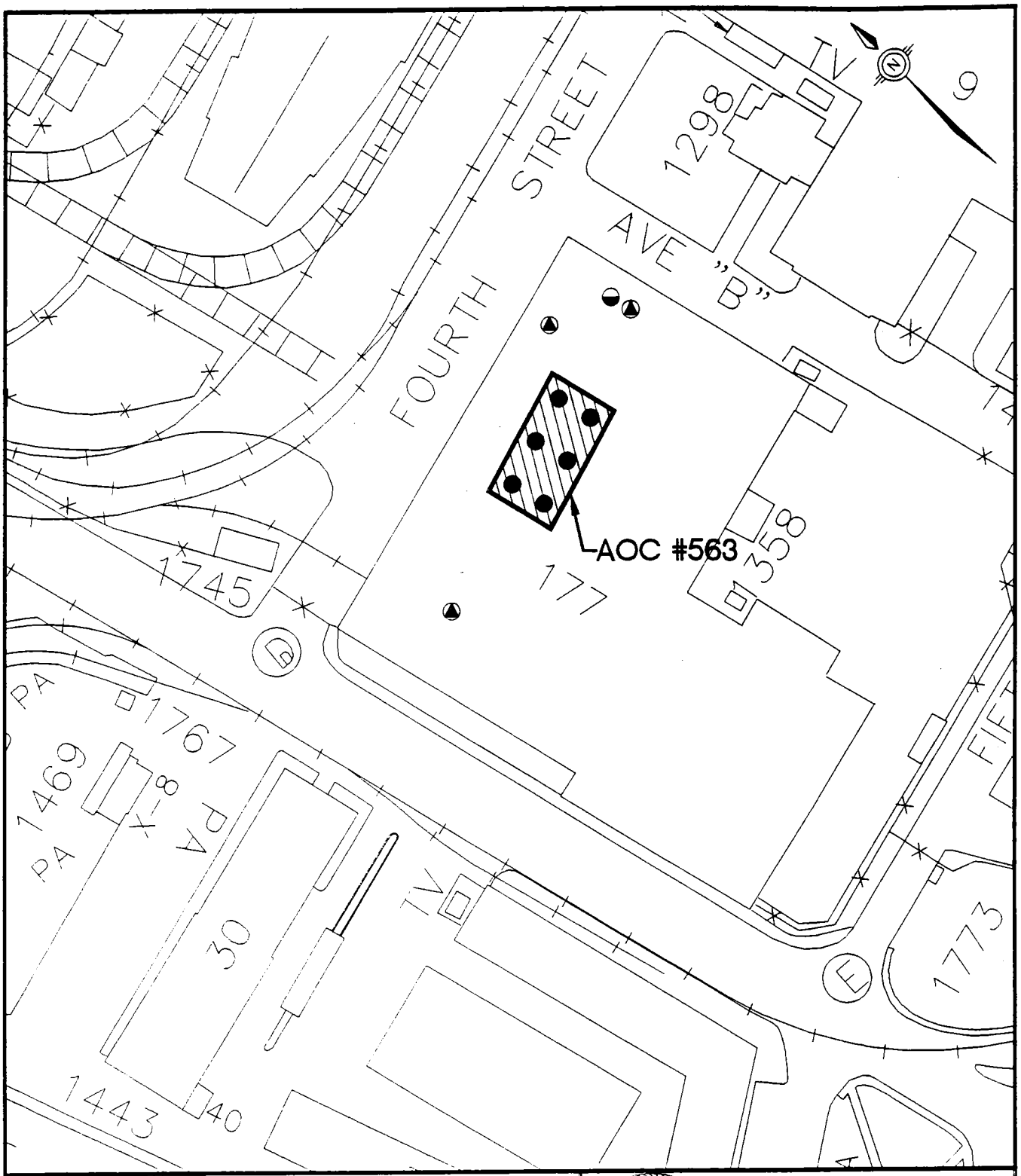
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-32 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.34. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated

into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-32
AOC #563
LOCOMOTIVE HOUSE
FORMER BUILDING 37

DWG DATE: 6/2/95 | DWG NAME: FIGURE31

4.5.32 AOC 566, Paint Shop Storage, Building 194

Table 4.35 describes the site.

Table 4.35
AOC 566
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 566 PAINT STORAGE AREA	Building 194 was constructed in 1964. It has been used to store unused blasting grit and paints. At one time paints were mixed just outside the building on a tarp-covered wooden pallet. Waste paints were stored in the SAA on the east side of the building. Currently the building stores items such as equipment and tools needed to repair ships.	Metals (Lead) Paints Solvents Blasting Media

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

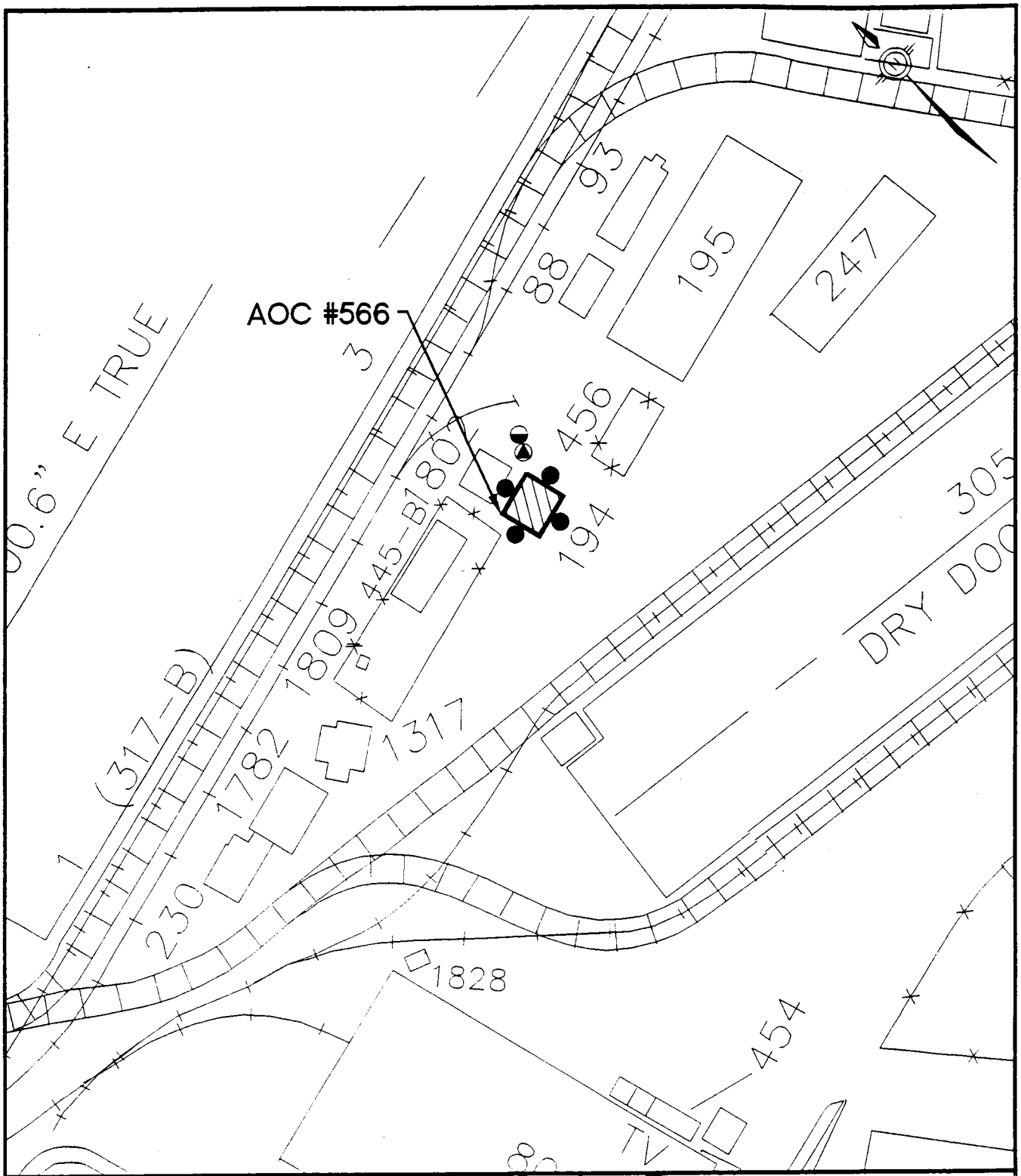
Activities will involve installing and developing groundwater monitoring wells, performing soil borings, and collecting samples. The proposed sample locations illustrated on Figure 4-33 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.35. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated

into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-33
AOC #566
BUILDING 194

DWG DATE: 6/2/95 | DWG NAME: FIGURE32

4.5.33 AOC 567, Substation, Building 75

Table 4.36 describes the site.

Table 4.36
AOC 567
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 567 Substation	Building 75 is a single-story structure with a concrete slab floor and roof. Adjacent to Building 75 is a concrete slab within a fenced area, containing several weatherproof metal-enclosed transformers. The north side of Building 75 houses high-voltage switches, transformers, and a battery bank that provides emergency power for the facility. The transformer that now operates does not contain PCBs.	PCBs Lead Acids

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

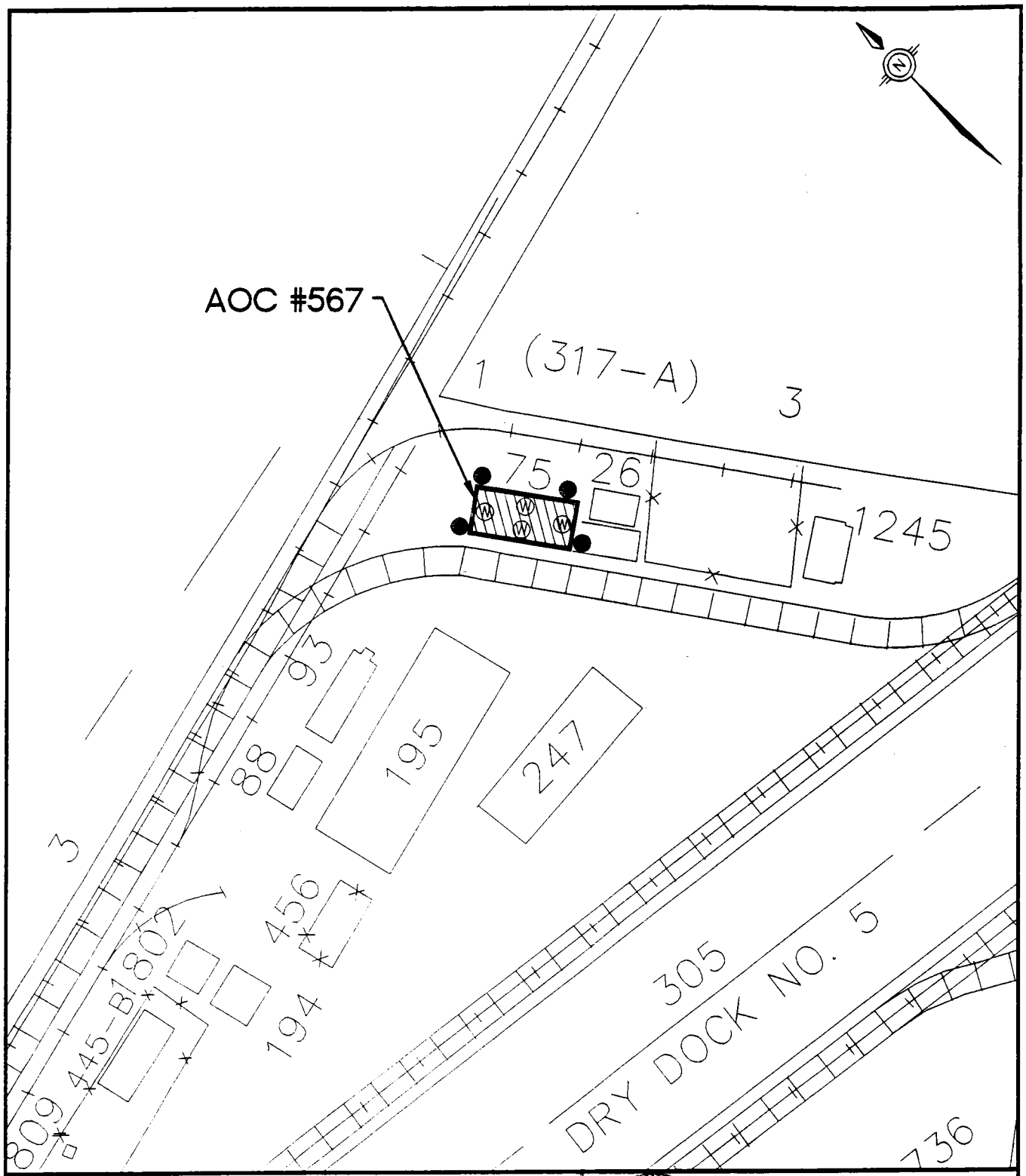
Activities will involve performing soil borings and collecting soil and wipe samples. The proposed sample locations illustrated on Figure 4-34 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.36. If additional chemical

hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground and above-ground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and wipe samples, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- Ⓐ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- Ⓐ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-34
AOC #567
SUBSTATION
BUILDING 75

DWG DATE: 6/2/95 | DWG NAME: FIGURE33

4.5.34 AOC 569, Gas Station and Oil Storage, Former Building 1279; AOC 570, Former Coal Storage Area; and AOC 578, Transportation Shop and Garage, Building 25

Table 4.37 describes the sites.

Table 4.37
AOC 569, AOC 570, and AOC 571
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 569 **Former Gas Station and Oil Storehouse**	This site is a former gas station and oil storehouse once in Building 1279. The gas station was constructed in 1944 and had two pumps and two 2,500-gallon USTs. In 1986, an additional 3,000-gallon UST was installed. This site was destroyed and the tanks removed in 1992. Demolition activities consisted of pump and tank removal, filling vent lines, soil excavation, soil sampling, and placement of an asphalt parking area.	Petroleum Hydrocarbons Heavy Metals
AOC 570 **Former Coal Storage Area**	This site was a coal storage area which extended from Building 30 to Sixth Avenue and from Carolina Avenue to Hobson Avenue. This area was operated from 1919 to 1941, at which time the use of coal was replaced by steam.	Coal Coal By-products
AOC 578 **Transportation Shop and Garage**	This site consists of a transportation shop and garage in Building 25. Built in 1940, this structure was originally used as an automobile garage and is currently a transportation and appliance maintenance shop. Building 25 includes: an air conditioning repair shop, a sheet metal shop, two electric shops, a paint shop, a sign shop, a carpenter's shop, a paper- shredding area, a restroom, an electrical maintenance area, a tool room with personnel lockers, and an emergency supply storage area.	Acids Paints Solvents Antifreeze Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

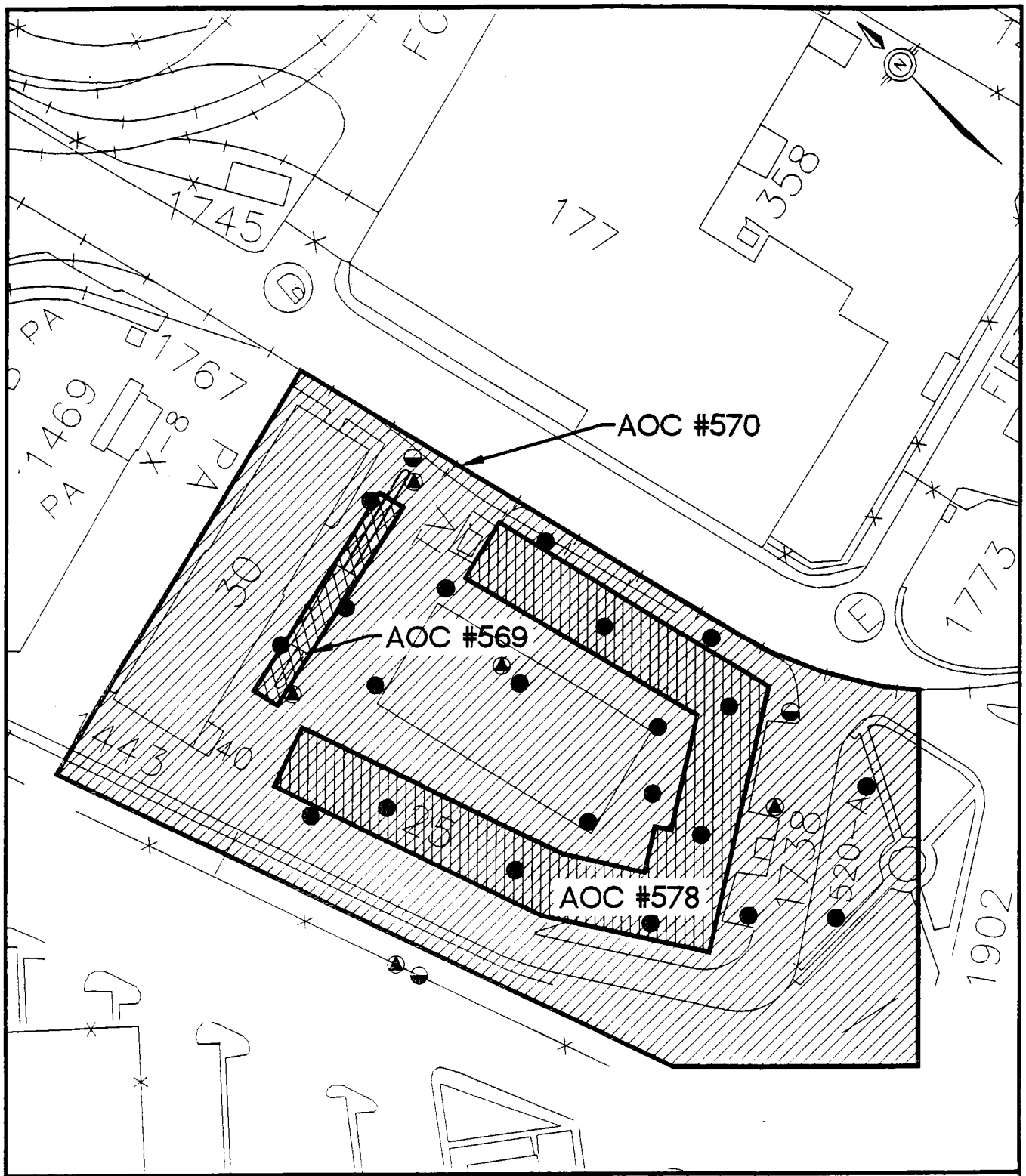
Activities will involve installing and developing of groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-35 were chosen based on a number of variables including: the suspected direction of groundwater

flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing of soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.37. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ▲ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4–35
AOC #569, OIL & GAS SERVICE STA.
AOC #570, COAL STORAGE AREA
AOC #578, TRANSPORTATION SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE34

4.5.35 AOC 571, Paint Booth 33, Building 177

Table 4.38 describes the site.

Table 4.38
AOC 571
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 571 Paint Booth (33)	This site consists of a paint booth (33) on the third floor of Building 177. The booth is used for painting miscellaneous metal parts. The booth is equipped with a water curtain to capture particulate matter. The booth is 12' x 14' x 8' with a 3.5' diam. 15' high stack. This booth operates under South Carolina Bureau of Air Quality Control Permit No. 0560-0002. Prior to 1972, water used to capture particulate matter from the booth was discharged directly into the storm sewer system. Currently, the waste water from the curtain at this booth is periodically drained into the sanitary sewer system. The sludge is then removed and disposed of as a hazardous waste.	Paints Solvents Metals

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

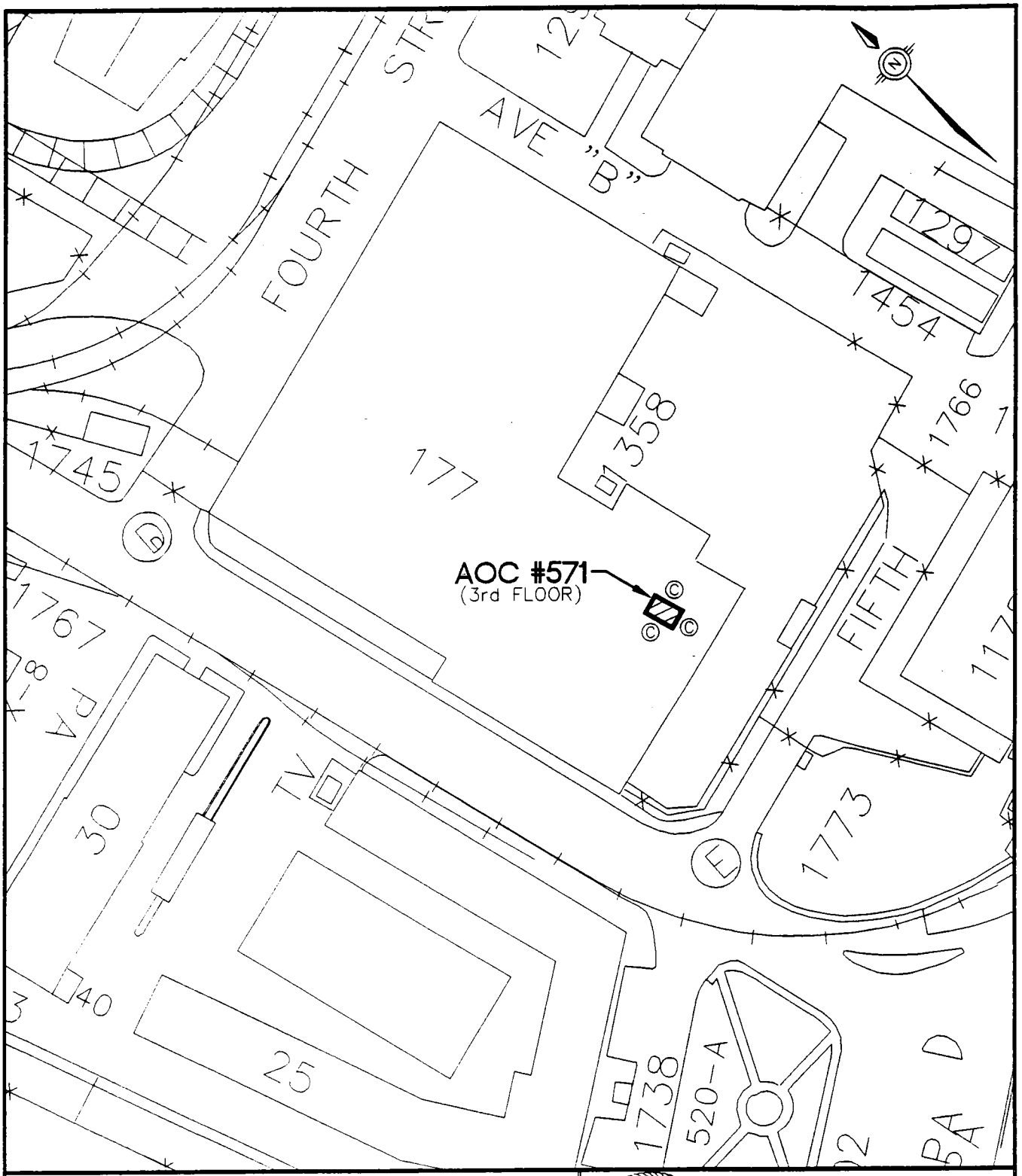
Site Activities

Activities will involve performing soil boring and collecting soil and air samples. The proposed sample locations illustrated on Figure 4-36 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.38. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◬ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-36
AOC #571
BUILDING 177
PAINT SHOP

DWG DATE: 6/2/95 | DWG NAME: FIGURE35

4.5.36 AOC 572, Motor Area, Building 177

Table 4.39 describes the site.

Table 4.39 AOC 572 Site Description and Chemical Hazards		
Number	**Description**	**Chemical Hazards[1,2]**
AOC 572 Motor Area	This site is a former motor cleaning area south of Building 177. This site at one time was used for steam cleaning electrical motors and equipment. No evidence of the steam cleaning activities is now present. While in operation, no containment structures were associated with the process. Wastewater drained from the site to the storm sewer system. No additional information could be found regarding the operating practices of this site.	Solvents Petroleum Hydrocarbons Heavy Metals

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

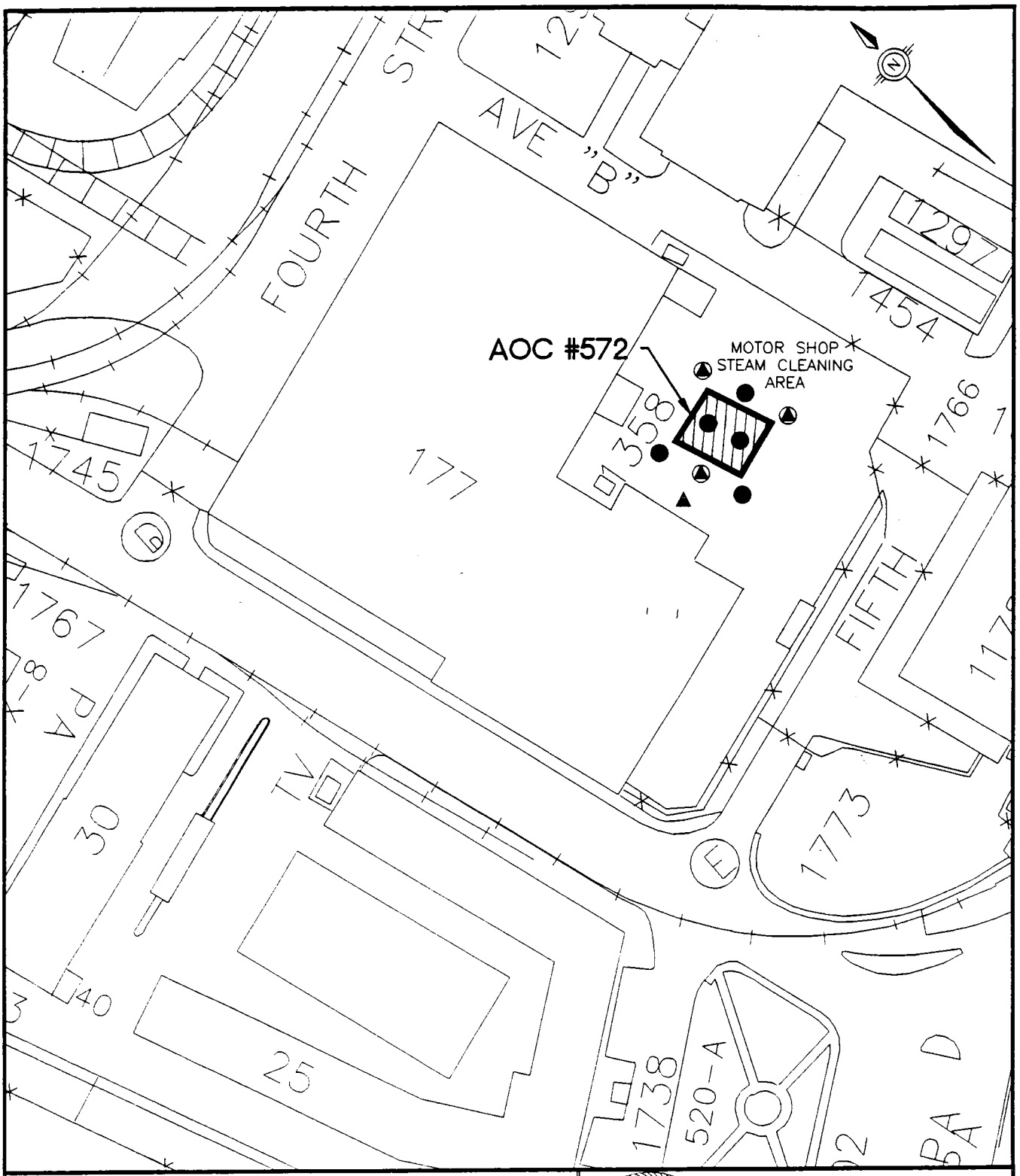
Activities will involve installing and developing groundwater monitoring wells, performing soil borings, and collecting samples. The proposed sample locations illustrated on Figure 4-37 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.39. If additional chemical

hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-37
AOC #572
BUILDING 177
SAA, MOTOR AREA

DWG DATE: 6/2/95 | DWG NAME: FIGURE36

4.5.37 AOC 573, Anodizing Process, Building 177

Table 4.40 describes the site.

Table 4.40 AOC 573 Site Description and Chemical Hazards		
Number	**Description**	**Chemical Hazards[1,2]**
AOC 573 Anodizing Process	This site is an anodizing process in a three-sided metal attachment to Building 177. The anodizing process includes a 2,000-gallon irridite (chromic acid solution) dipping tank and a spray area with a 110-gallon sump. The sump is used to collect excess spray and rinse water. Metal parts and antennas are dipped or sprayed, and rinsed with tap water. This site is contained on three sides by a concrete berm and sloped back to the sump on the fourth side. Before 1972, the sump was connected to the storm water sewer. Currently, sump contents are pumped into 55-gallon drums and are disposed of as hazardous waste.	Acids Hexavalent Chromium Metals Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

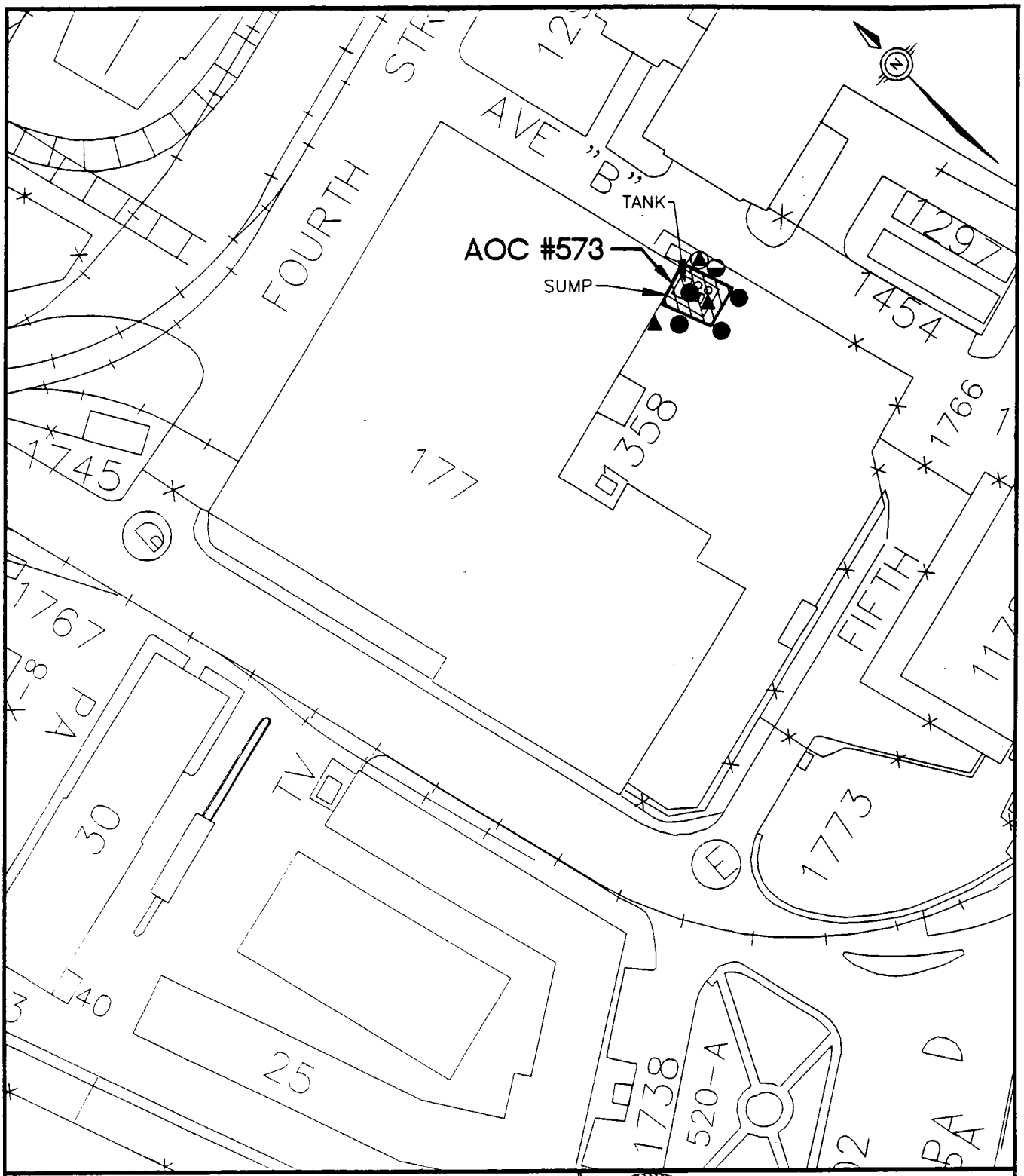
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-38 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing of soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously although spills of chromic acid have been reported. The area of primary concern is the sump currently used to collect waste process chemicals.

Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.40. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, coring inside Building 177, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal and inhalation hazards associated with working in the area of the sump, and dermal hazards associated with handling soil and groundwater onsite, the initial PPE level specified for invasive field activities in the area of the sump is Level C with full-face, air purifying respirator equipped with acid mist cartridges and silver shield inner and nitrile outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The PPE level specified for work at other site areas is modified Level D with nitrile inner and outer gloves (see Table 4-2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-38
AOC #573
BUILDING 177
ANODIZING

DWG DATE: 6/2/95 | DWG NAME: FIGURE37

4.5.38 AOC 576, Oil and Paint Storehouse/Print Office, Former Building 1012

Table 4.41 describes the site.

Table 4.41
AOC 576
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 576 Oil and Paint Storehouse/ Print Office	This site was an oil and paint storehouse once in former Building 1012. Operations were conducted from 1909 until 1930. No other information could be found regarding the operating practices of the storehouse or the printing office. Currently, this site is occupied by Building 80.	Inks Paints Metals Solvents Petroleum Hydrocarbons

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

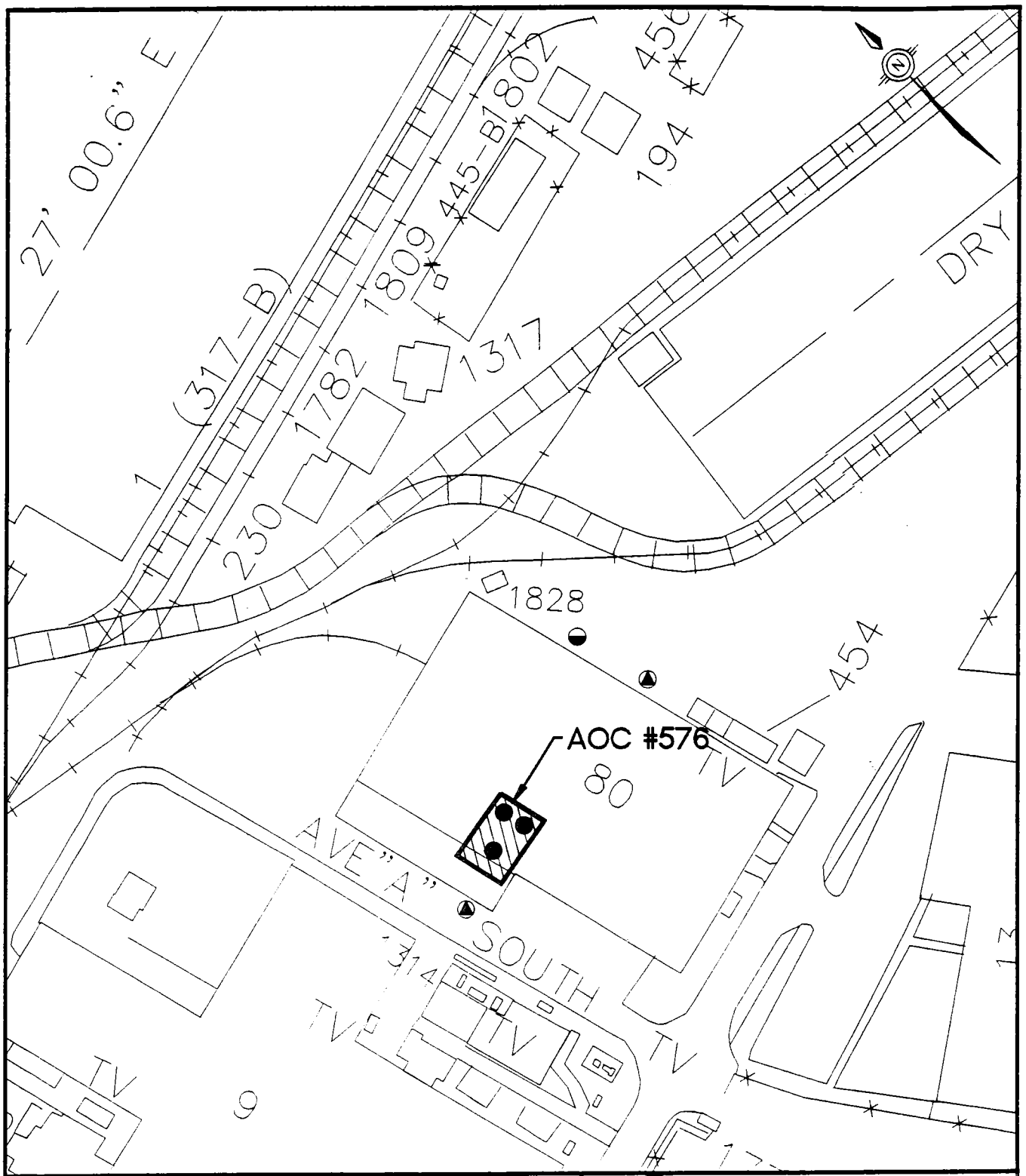
Activities will involve installing and developing groundwater monitoring wells and performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-39 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing of soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.41. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment,

coring inside Building 80, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-39
AOC #576
OIL AND PAINT STOREHOUSE
FORMER BUILDING 1012

DWG DATE: 6/2/95 | DWG NAME: FIGURE38

4.5.39 AOC 579, Former Paint Shop, Building 1035

Table 4.42 describes the site and potential chemical hazards.

Table 4.42
AOC 579
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 579 Former Paint Shop	This site is a former paint shop in Building 1035. Built in 1919, it was used until 1943 for meat storage and inspection. From 1943 to 1955, this unit was used as a cafeteria storehouse. It stored paint from 1955 until approximately 1977. Currently, this site is used as an electrician's storehouse. No information could be found regarding the operating practices of the paint shop.	Paints Solvents Metals

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

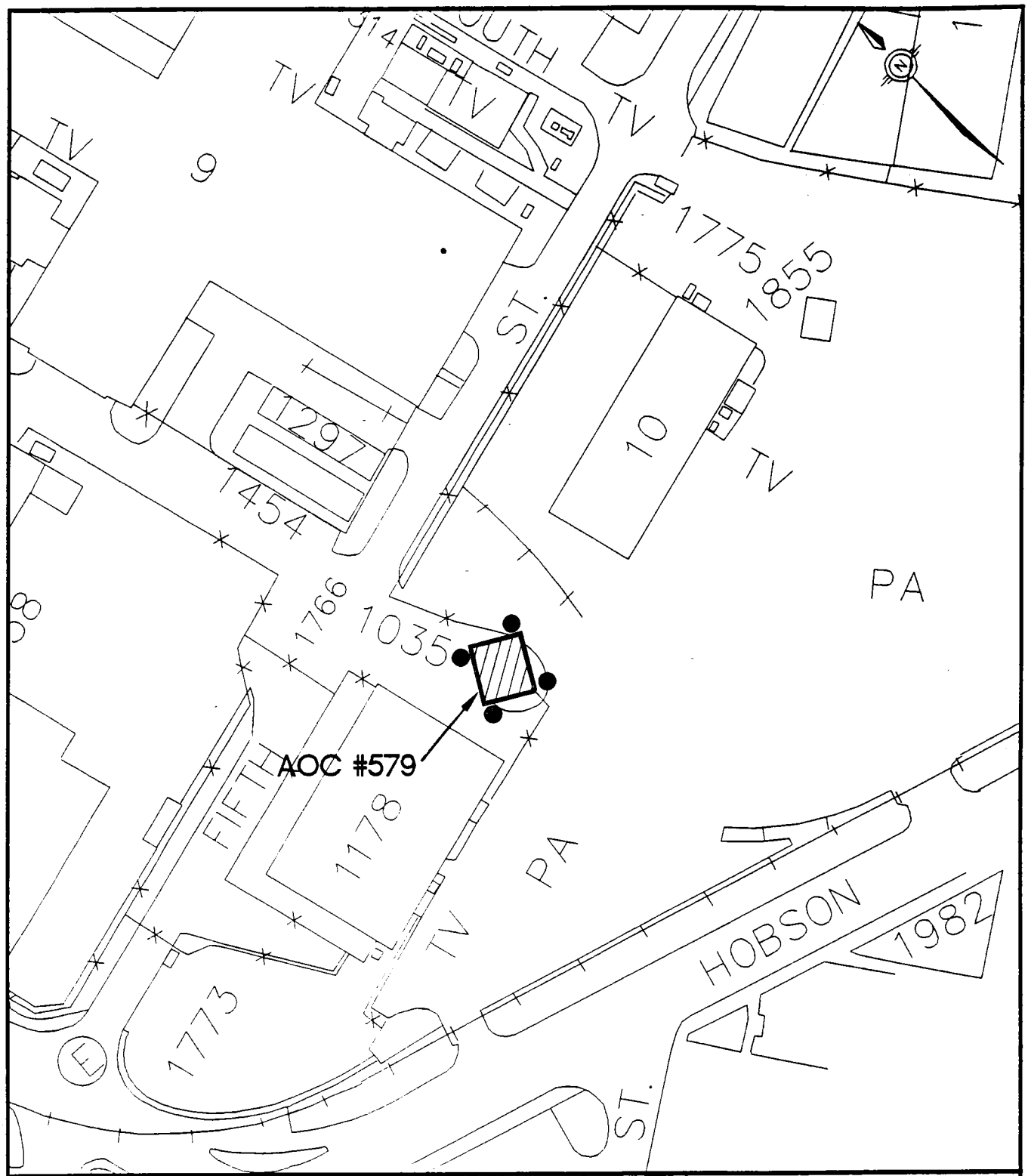
Activities will involve soil borings and sample collection. The proposed sample locations illustrated on Figure 4-40 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.42. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and

incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soils at this site, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
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- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-40
AOC #579
PAINT SHOP
BUILDING 1035

DWG DATE: 6/2/95 | DWG NAME: FIGURE39

4.5.40 AOC 580, Former Pattern and Electric Shop, Building 10

Table 4.43 describes the site and potential chemical hazards.

Table 4.43
AOC 580
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 580 Former Pattern and Electric Shop	This site is a former pattern and electric shop once in Building 10. Built in 1918, it was used until 1935 as a pattern and storage shop. From 1935 to 1955, this unit was an electric and pattern shop. In the early 1980's building became the office for the Nuclear Engineering Department. No information could be found regarding the operating practices of the facility.	Solvents Degreasers Metals

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

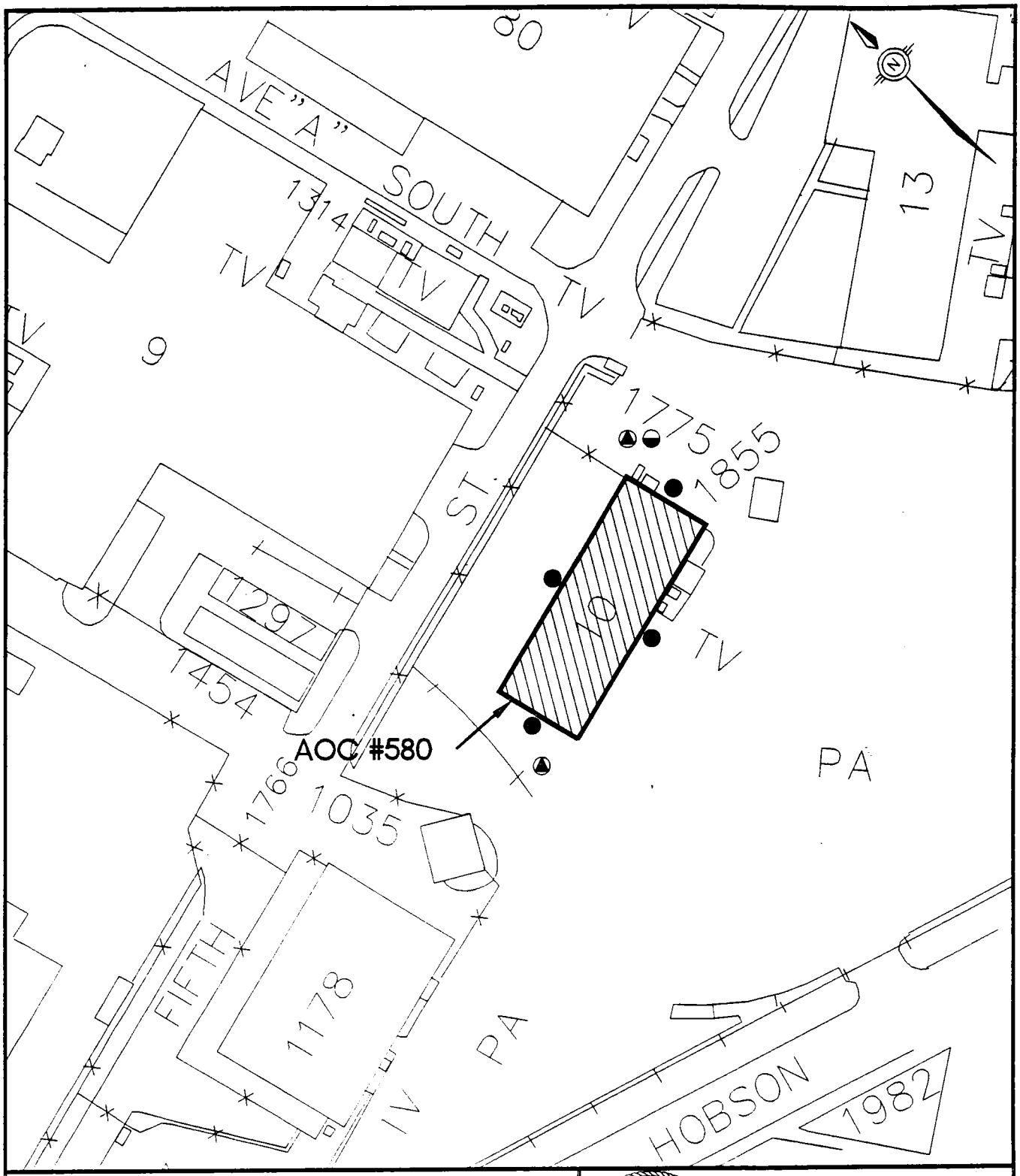
Activities site will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-41 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.43. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated

into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-41
AOC #580
FORMER PATTERN & ELECTRIC SHOP
BUILDING 10

DWG DATE: 6/2/95 | DWG NAME: FIGURE40

4.5.41 AOC 583, Northeast Corner of Building 236

Table 4.44 describes the site and potential chemical hazards.

Table 4.44
AOC 583
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 583 Northeast Corner Building 236	This site of activities that have taken place in the northeast corner of Building 236. Building 236 was constructed in 1982. The north side of the building houses conference rooms, offices, a locker room, and a pipe-fitting shop. The shop area contains a Freon recycling and distillation system consisting of a distillation unit, associated piping, and three USTs. Five additional USTs containing petroleum products are outside the northeast corner of the building. In 1986, approximately 200 gallons of rinsate-containing paint stripper was discharged outside the northeast end of the building to the storm drain.	Freon Paints Solvents Petroleum Hydrocarbons Metals

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

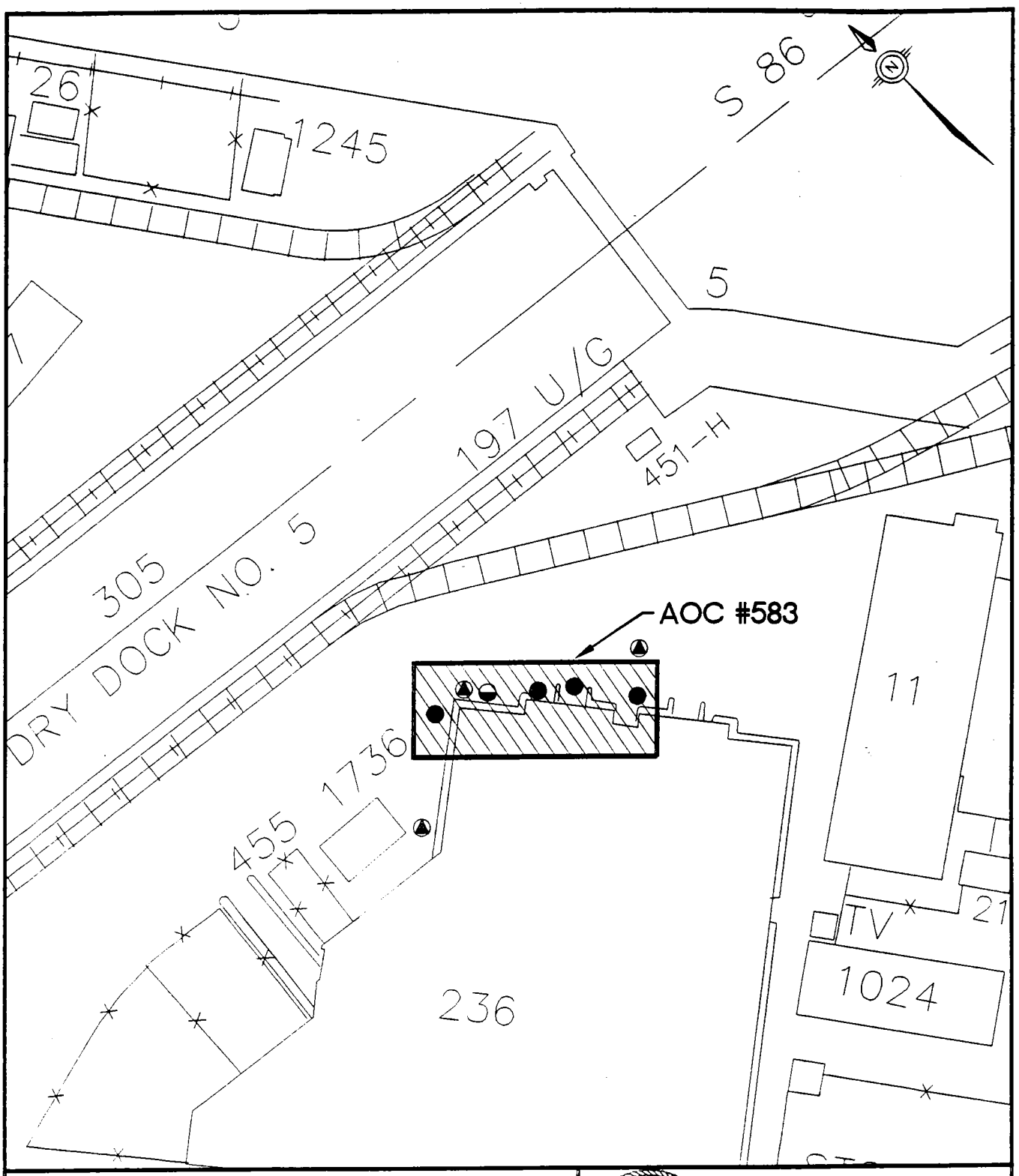
Site Activities

Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-42 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously although there is a documented release of 200 gallons of paint-stripping rinsate in 1986. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.44. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, drilling and coring operations inside Building 236, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ▲ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-42
AOC #583
BUILDING 236

DWG DATE: 6/2/95 | DWG NAME: FIGURE41

4.5.42 AOC 586, Temporary Powerhouse, Building 1014

Table 4.45 describes the site and potential chemical hazards.

Table 4.45
AOC 586
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 586 **Former Temporary Powerhouse**	This site was a temporary powerhouse designated as Building 1014. Building 1014 was built in 1905. In 1935 an annex was added. In 1944, Building 1014 was connected to Building 1077. The combined structure was used for industrial salvage, which included a battery shop. Building 1014 was demolished around 1957. No information regarding the operating practices of Building 1014 was found. Currently, the site is a concrete slab adjacent to the southeast corner of Building 11.	Acids Solvents Dielectric Fluids Petroleum Hydrocarbons Lead/Acid Batteries Coal By-products Metals

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

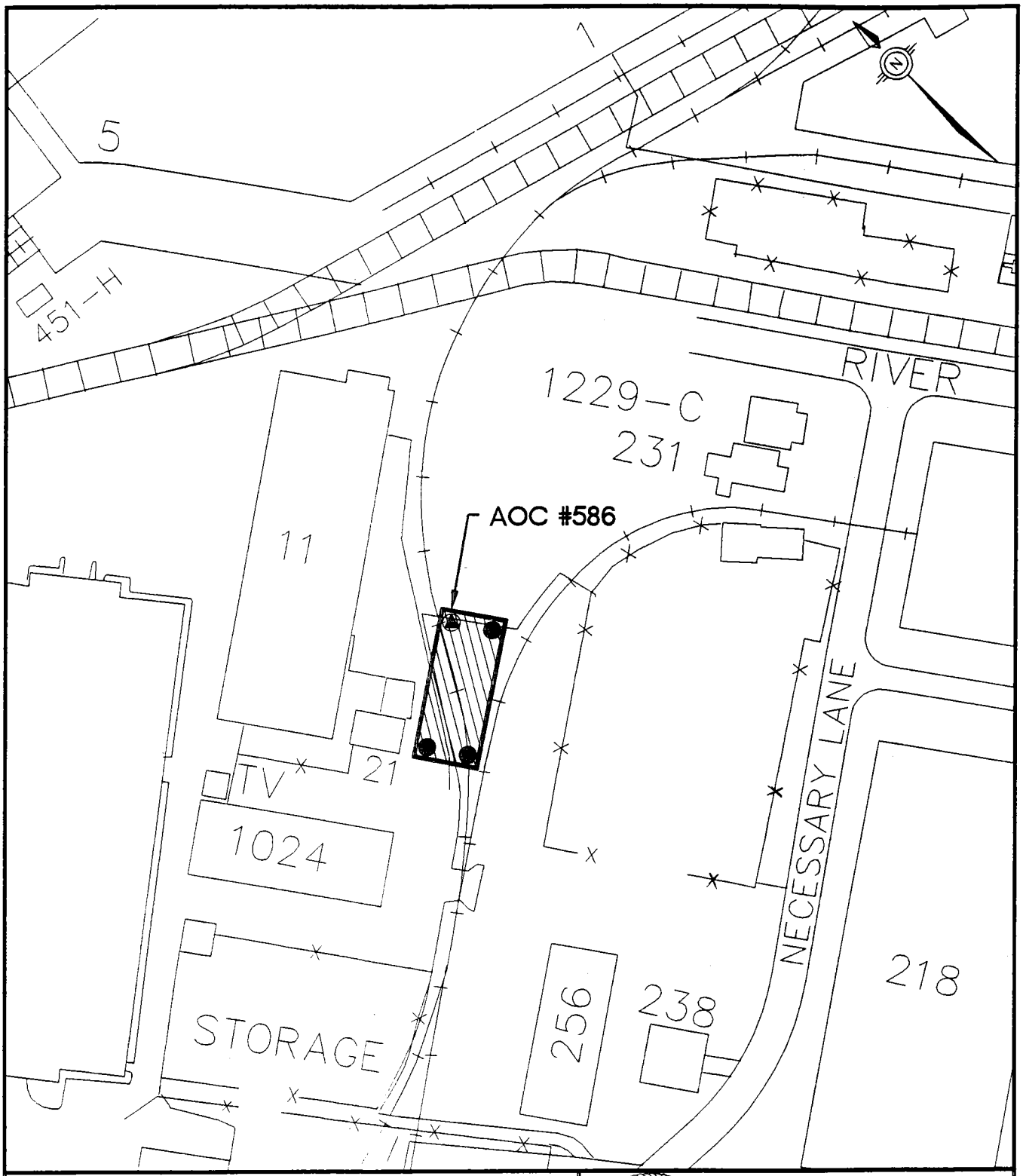
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-43 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and impacts of potential shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The

site-specific potential chemical hazards are listed in Table 4.45. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-43
AOC #586
TEMPORARY POWERHOUSE
BUILDING 1014

DWG DATE: 6/2/95 | DWG NAME: FIGURE42

4.5.43 AOC 590, Alley, Buildings 79 and 1760

Table 4.46 describes the site and potential chemical hazards.

Table 4.46
AOC 590
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 590 Alley Between Buildings 1760 and 79	This site is the alley between Buildings 1760 and 79. Reportedly, this alley is the site of past releases of acetone and cutting oil. No information was found regarding the exact locations, volumes, or duration of the discharged wastes. Currently, the alley is paved with asphalt.	Acetone Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

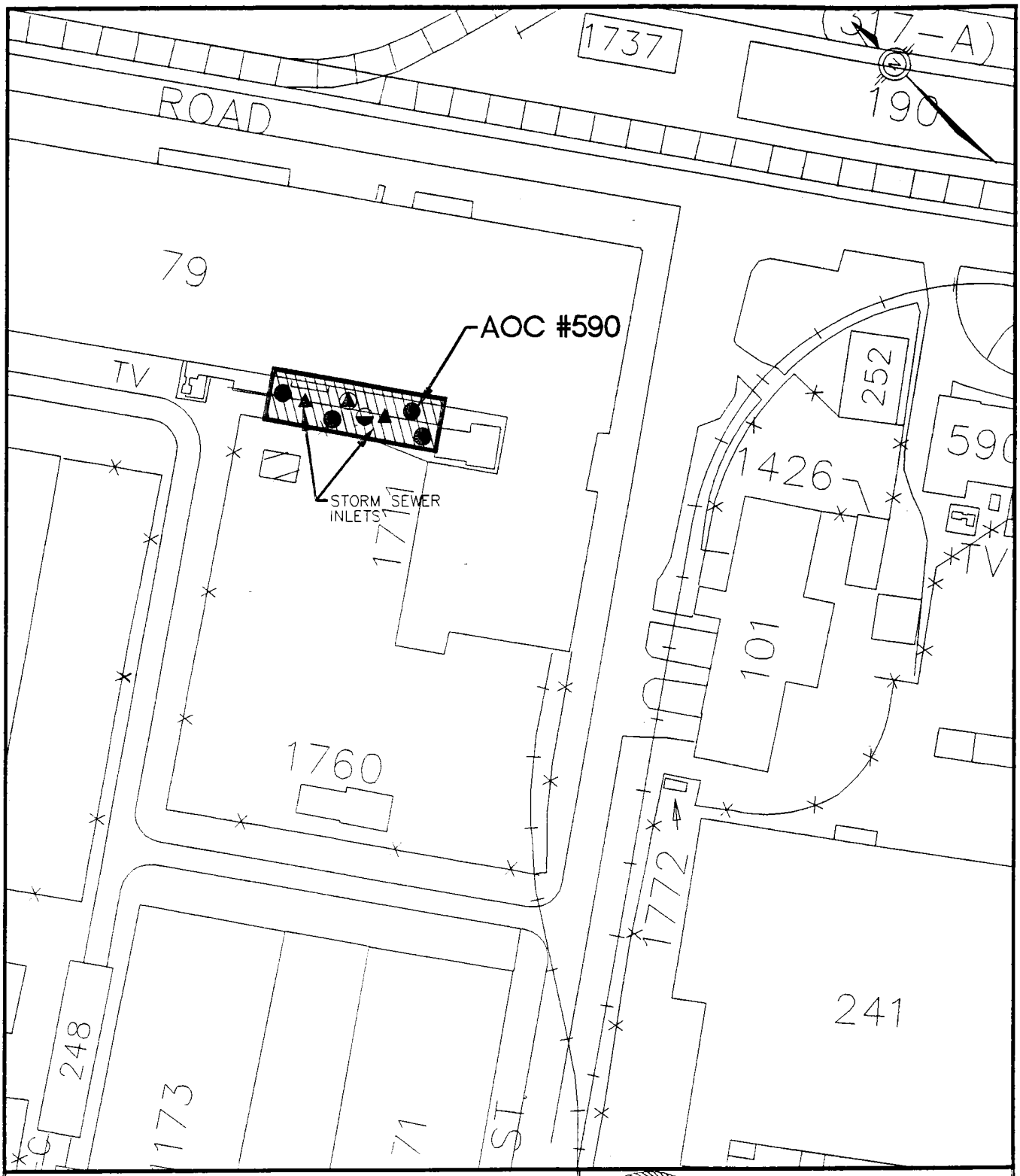
Activities will involve installing and developing groundwater monitoring wells, performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-44 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.46. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and

incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
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- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-44
AOC #590
ALLEY BETWEEN
BUILDINGS 79 & 1760

DWG DATE: 6/2/95 | DWG NAME: FIGURE43

4.5.44 AOC 592, Asbestos-Shredding Shelter, Former Building 1225

Table 4.47 describes the site and potential chemical hazards.

Table 4.47
AOC 592
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 592 Former Asbestos Shredding Shelter	This site was an asbestos-shredding shelter housed in Building 1?25. Building 1225 was built in 1944 and used for tnis purpose until it was removed in 1955. From 1955 to 1966, the site was a pipe storage area. After 1966, the area was vacated. Currently, the site is paved and bisected by a pair of railroad spurs.	Asbestos

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

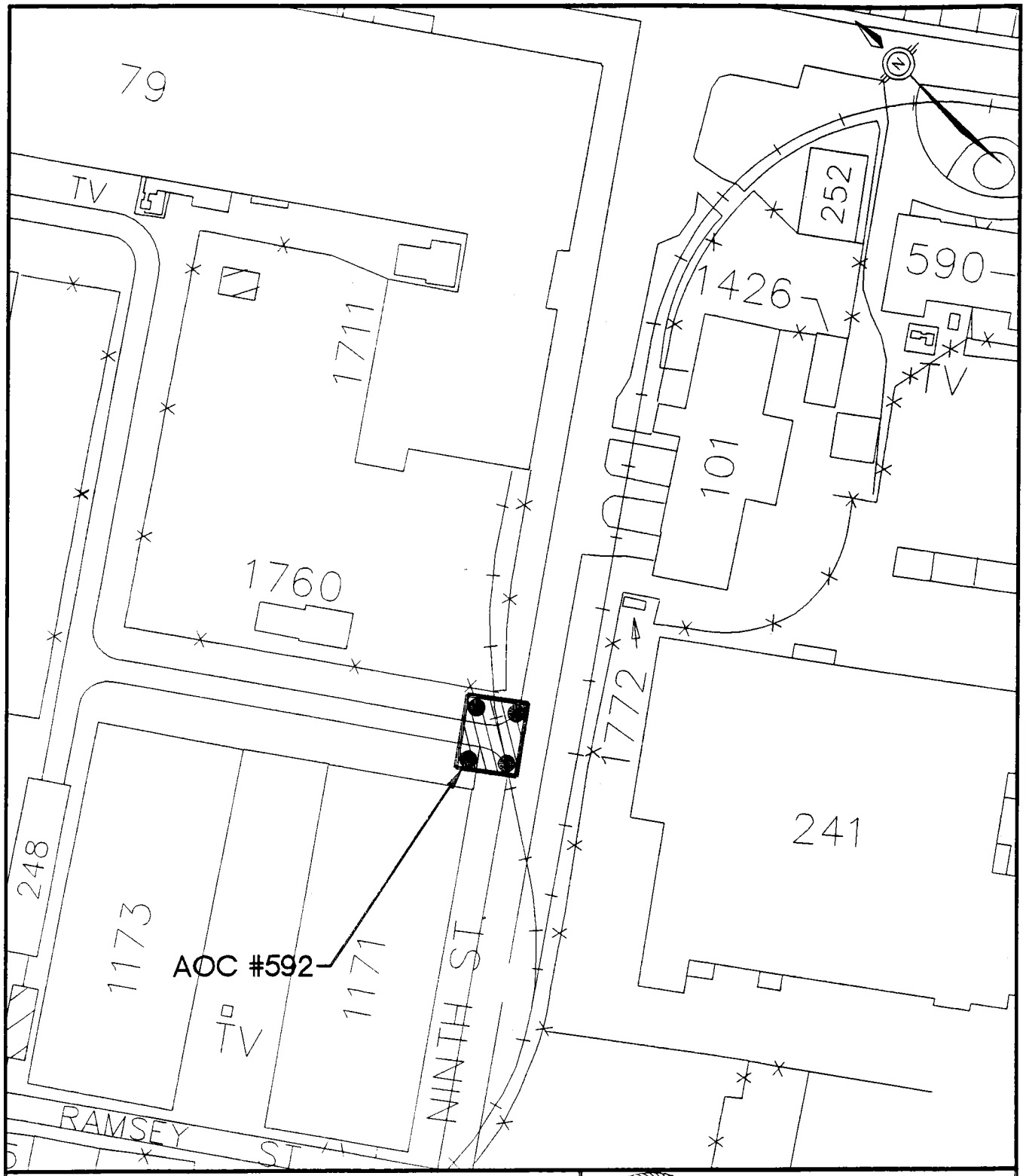
Activities will involve performing soil borings and collecting soil and air samples. The proposed sample locations illustrated on Figure 4-45 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.47. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated

into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soils onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
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- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-45
AOC #592
ASBESTOS SHREDDING SHELTER
FORMER BUILDING 1225

DWG DATE: 6/2/95 | DWG NAME: FIGURE44

4.5.45 AOC 596, Former Torpedo Storage, Building 101

Table 4.48 describes the site and potential chemical hazards.

Table 4.48
AOC 596
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 596 Former Torpedo Storage Area	This site was a torpedo storage area housed in Building 101. Building 101 was built in 1919 and stored torpedoes until 1943. From 1943 to 1946 the building was used as a machine shop. In 1946, the building was a storehouse for diesel parts and in 1947 it was a storehouse for galvanizing plant.	Solvents Degreasers Explosives Propellants Petroleum Hydrocarbons Metals

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

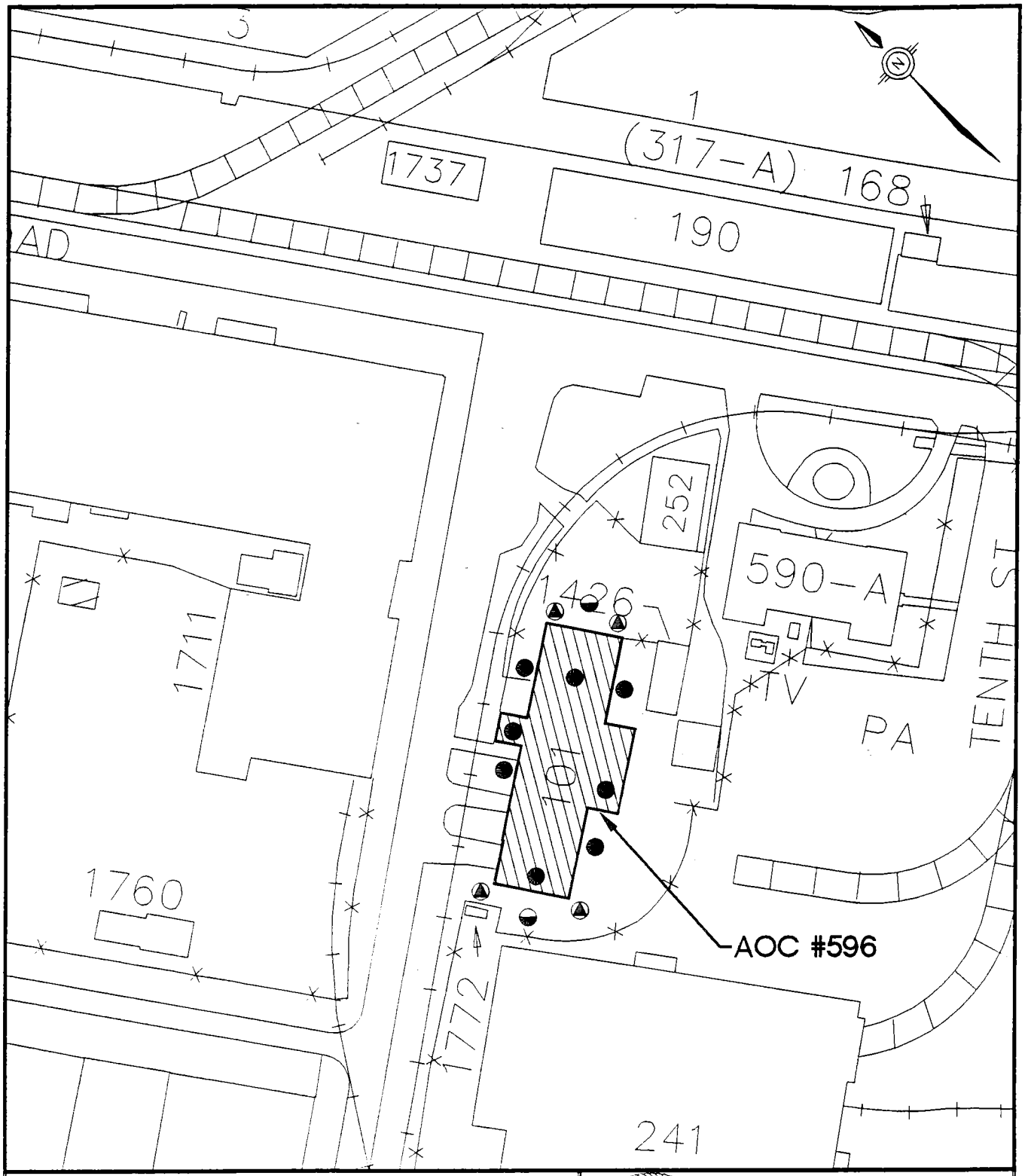
Activities will involve installing and developing groundwater monitoring wells, and performing soil borings and collecting samples. The proposed sample locations illustrated on Figure 4-46 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing of soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.48. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated

into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, coring and drilling within Building 101, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
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- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-46
AOC #596
FORMER TORPEDO STORAGE
BUILDING 101

DWG DATE: 6/2/95 | DWG NAME: FIGURE45

4.5.46 AOC 597, Substation, Building 91

Table 4.49 describes the site and potential chemical hazards.

Table 4.49
AOC 597
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 597 Substation	This site is an electrical substation in Building 91. Building 91 was constructed in 1942. Adjacent to Building 91 are several weatherproof metal enclosures housing two transformers. Two additional transformers are mounted within the building. The building also houses several high-voltage switches, breakers, and a battery bank which provides emergency power for the building.	Dielectric Fluid Lead/Acid Batteries (pH, PCBs and Metals)

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

Site Activities

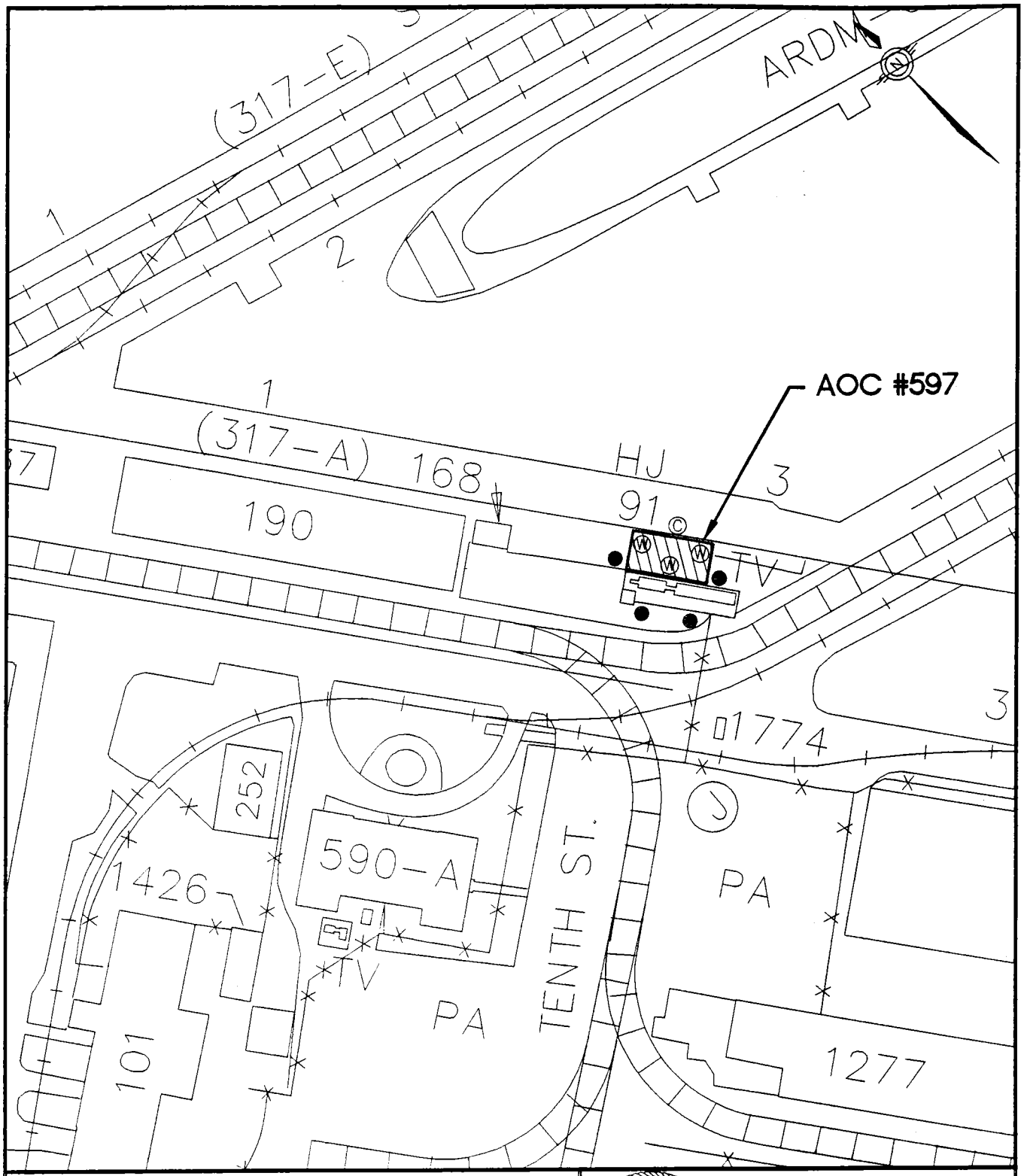
Activities will involve performing soil borings and collecting soil and wipe samples. The proposed sample locations illustrated on Figure 4-47 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.49. If additional chemical hazards

are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and collecting wipe samples onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
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- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-47
AOC #597
SUBSTATION
BUILDING 91

DWG DATE: 6/2/95 | DWG NAME: FIGURE46

4.5.47 AOC 598, Sonar Dome Area, End of Pier J; and AOC 599, Pump House, Pier J

Table 4.50 describes the sites and potential chemical hazards.

Table 4.50
AOC 598 and AOC 599
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 598 Sonar Dome Repair Area	This site is a sonar dome repair area adjacent to Pier J. It consists of a temporary metal building on the asphalt pavement at Pier J. The site is used for repair work, both inside and outside the building. The area is used to clean and repaint sonar domes and to remove adhesives. Some sanding and media blasting operations are also conducted. Several storm drains are in the vicinity.	Paints Solvents Adhesives Blasting Grit Metals
AOC 599 Pump House	This site is a pump house on Pier J. This pumphouse was damaged by Hurricane Hugo in 1989 and since rain water has accumulated in the below-grade structure. The pump house was formally a transfer station for diesel fuel.	Petroleum Hydrocarbons

Notes:
1 Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
2 Refer to Appendix E for site chemical hazard MSDS.

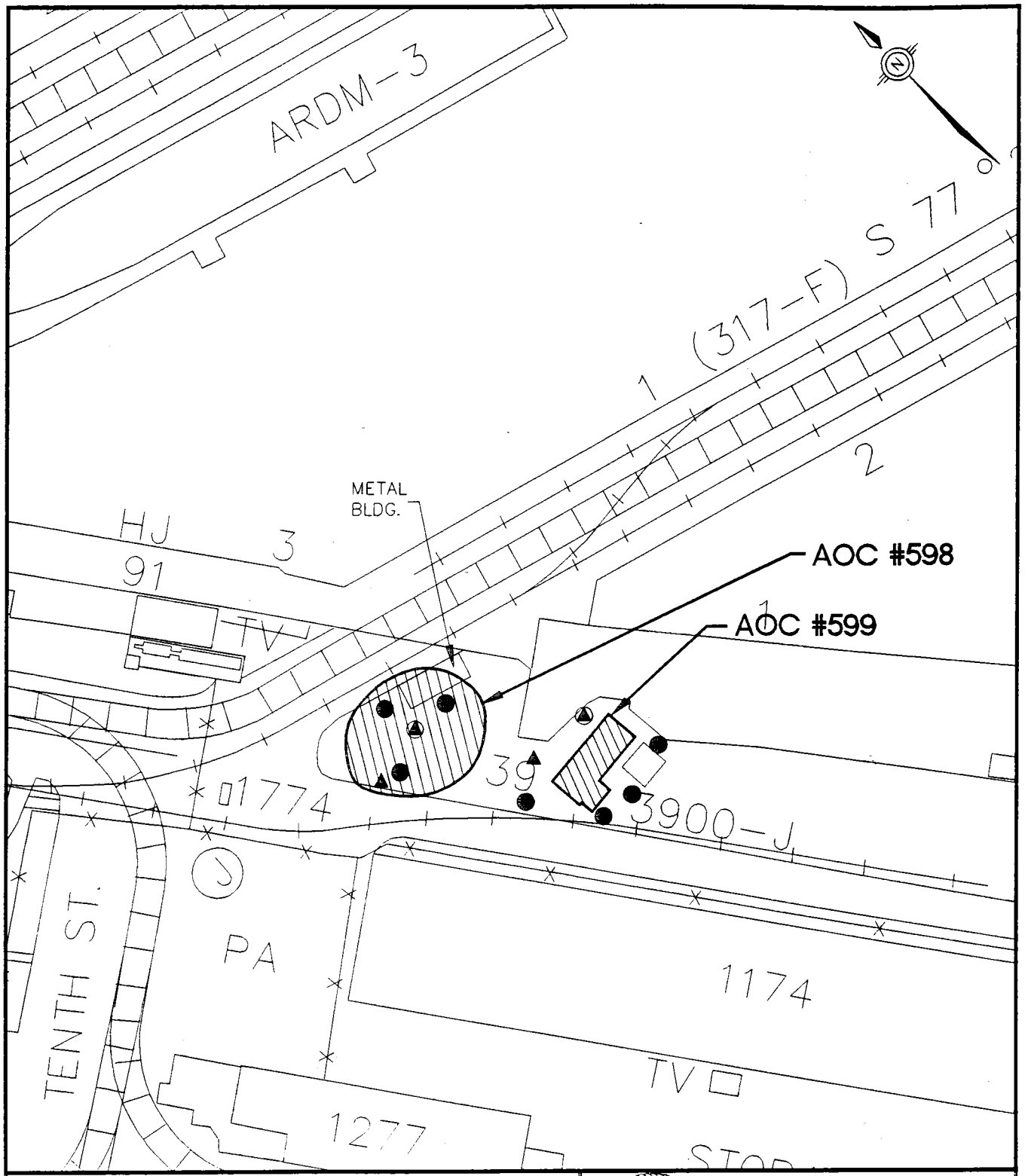
Site Activities

Activities will involve installing and developing groundwater monitoring wells, performing soil borings, and collecting soil and sediment samples. The proposed sample locations illustrated on Figure 4-48 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

These sites have not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.50. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
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- ▲ – PROPOSED SEDIMENT SAMPLES
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- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-48
AOC #598
SONAR DOME AREA, END OF PIER J
AOC #599, PIER J PUMP HOUSE

DWG DATE: 6/2/95 | DWG NAME: FIGURE47

4.5.48 AOC 602, Substation and Storage, Building 95

Table 4.51 describes the site and potential chemical hazards.

Table 4.51
AOC 602
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1][2]
AOC 602 **Former Substation**	This site consists of a former electrical substation at Building 95. Building 95 was constructed in 1943. Originally used as an electrical substation for DD 3, the building housed PCB-containing transformers until renovation in 1989. This renovation was interrupted by Hurricane Hugo and the building was subsequently taken out of service. Currently this area is paved with concrete/asphalt.	Dielectric Fluid (PCBs)

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

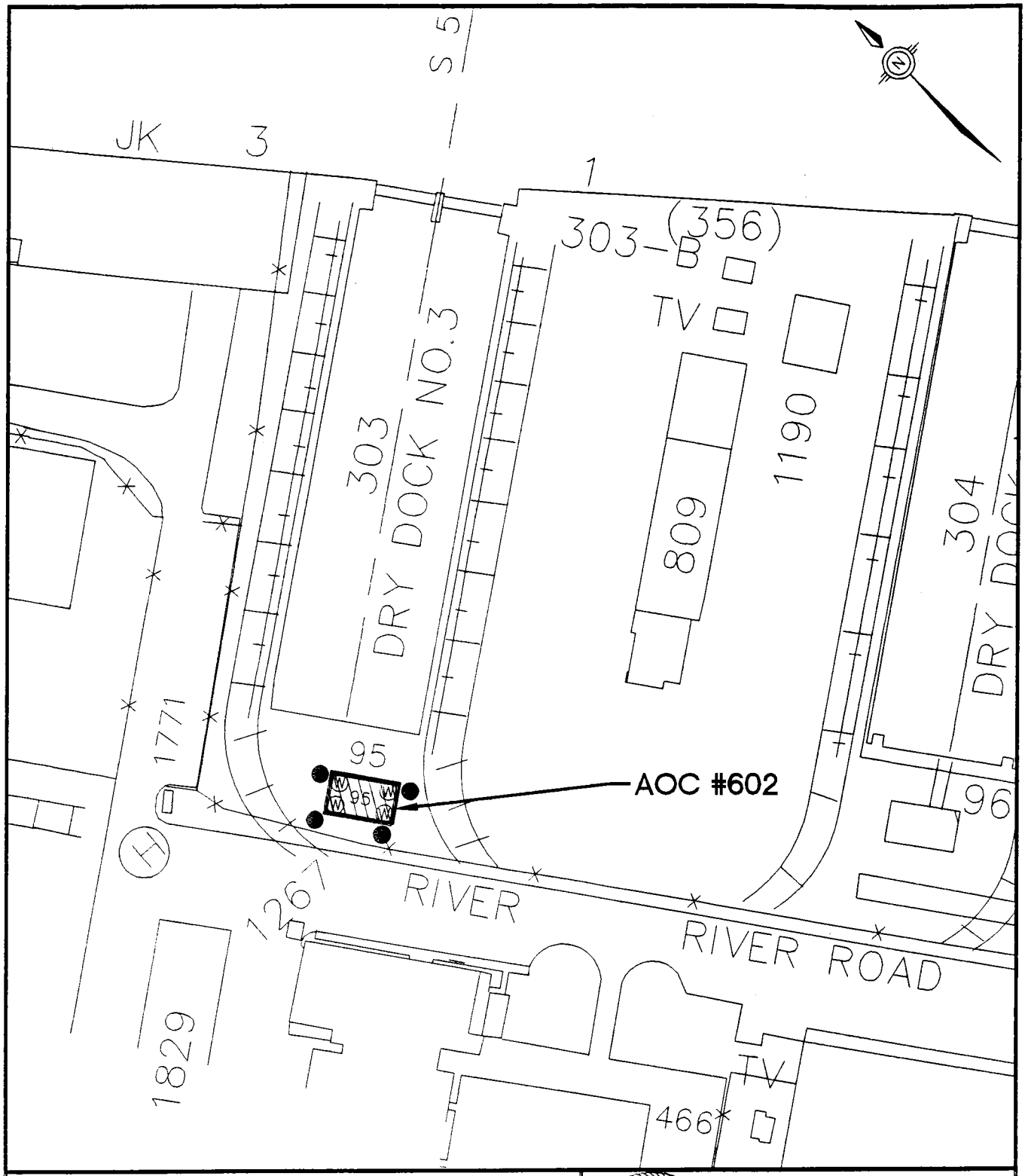
Activities will involve performing soil borings and collecting soil and wipe samples. The proposed sample locations illustrated on Figure 4-49 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are listed in Table 4.51. If additional chemical hazards

are discovered during the investigation, MSDS will be immediately obtained and incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil and wipe samples onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◮ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-49
AOC #602
SUBSTATION
BUILDING 95

DWG DATE: 6/2/95 | DWG NAME: FIGURE48

4.5.49 AOC 604, Substation and Storage, Building 96

Table 4.52 describes the site and potential chemical hazards.

Table 4.52
AOC 604
Site Description and Chemical Hazards

Number	Description	Chemical Hazards[1,2]
AOC 604 Substation and Storage	This site is a former electrical substation at Building 96. Building 96 was constructed in 1946. Originally used as an electrical substation for DD 4, the building housed PCB-containing transformers. Building 96 currently stores electrical items which do not contain PCBs. Two permanent and one temporary transformer are currently next to Building 96.[1]	Dielectric Fluid (PCBs)

Notes:
[1] Refer to Section 4.2.3 for chemical hazard information and Table 4.1 for chemical hazard exposure guidelines.
[2] Refer to Appendix E for site chemical hazard MSDS.

Site Activities

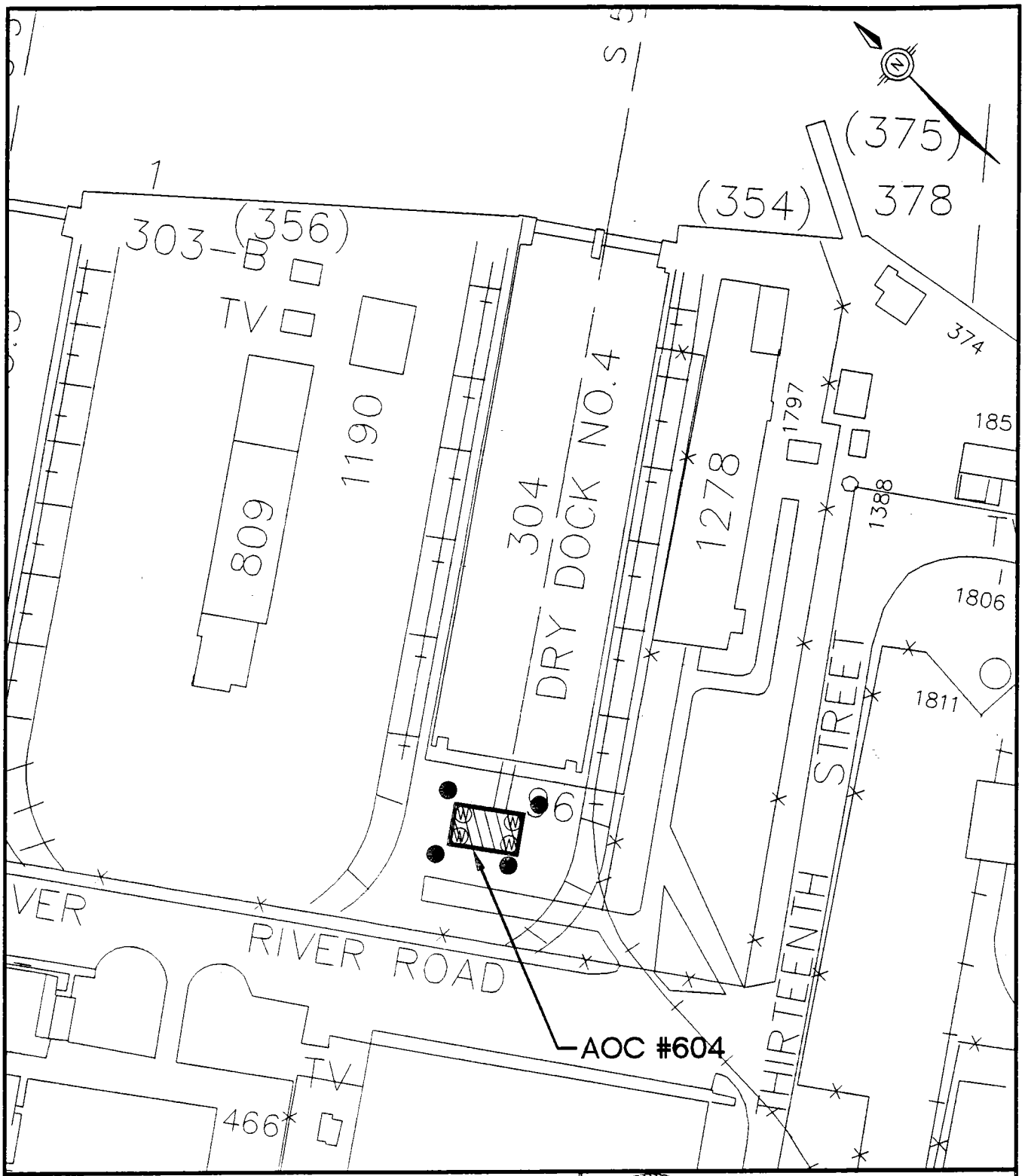
Activities will involve performing soil borings and collecting soil and wipe samples. The proposed sample locations illustrated on Figure 4-50 were chosen based on a number of variables including: the suspected direction of groundwater flow, proximity to the investigated unit, and suspected location of underground utilities and piling supports. Due to the limited accuracy of the available underground utility information, and potential impacts of shipyard operations, sample locations should be considered preliminary until cleared using procedures specified in Sections 4.2.1 and 4.2.2. Installing soil borings and monitoring wells will require coring through either concrete, asphalt, or both.

Hazard Analysis and Employee Protection

This site has not been investigated previously. Review of available site information provides insufficient information for E/A&H to narrow the list of potential chemical hazards. The site-specific potential chemical hazards are specified in Table 4.52. If additional chemical hazards are discovered during the investigation, MSDS will be immediately obtained and

incorporated into Appendix E. Site physical hazards are related to underground utilities, heavy equipment, and ambient weather conditions. Zone E physical hazards and hazard abatement procedures are discussed in Section 4.2.2.

Due to the potential dermal hazards associated with handling soil, sediment, and groundwater onsite, the initial PPE level specified for invasive field activities is modified Level D with nitrile inner and outer gloves (see Table 4.2 for PPE Protection Levels and Criteria). The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2 to 3 minutes), the required level of PPE shall be upgraded to Level C.



LEGEND

- ○ – EXISTING SOIL BORINGS
- △ – EXISTING MONITORING WELLS
- ● – PROPOSED SOIL BORINGS
- ◒ – PROPOSED DEEP MONITORING WELLS
- ◭ – PROPOSED SHALLOW MONITORING WELLS
- ▲ – PROPOSED SEDIMENT SAMPLES
- Ⓒ – PROPOSED CORE SAMPLES
- Ⓖ – PROPOSED SURFACE SOIL SAMPLE
- Ⓢ – PROPOSED SURFACE WATER SAMPLES
- Ⓣ – PROPOSED THICKNESS SAMPLES
- Ⓦ – PROPOSED WIPE SAMPLES

GRAPHIC SCALE 100 0 100 200

FINAL RFI
ZONE E WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY PLAN
FIGURE 4-50
AOC #604
SUBSTATION
BUILDING 96

DWG DATE: 6/2/95 | DWG NAME: FIGURE49

4.6 Emergency Information

All hazardous waste site activities present a potential risk to onsite personnel. During routine operations, risk is minimized by establishing good work practices, staying alert, and using proper PPE. Unpredictable events such as physical injury, chemical exposure, or fire may occur and must be anticipated.

If any situation or unplanned occurrence requires outside emergency, immediately call the appropriate contact from the following list:

Contact	Agency or Organization	Telephone
Earle Folger	Naval Base Charleston, Site Contact	(803) 743-5519
Matthew A. Hunt Thuane Fielding	SOUTHDIV Engineers-in-Charge	(803) 743-0525 (803) 743-0513
Law Enforcement	NAVBASE Security	(803) 743-5555
Fire Department	NAVBASE Fire Department	(803) 743-5333
Ambulance Service	NAVBASE Ambulance	(803) 743-5444
Hospital	Charleston Naval Hospital Baker Hospital	(803) 743-7000 (803) 744-2110
Southern Poison Control Center	———	(800) 922-1117
Todd Haverkost	EnSafe/Allen & Hoshall Task Order Manager	(803) 884-0029
John H. Borowski, CIH,CSP	EnSafe/Allen & Hoshall	(901) 372-7962
Dave Backus Ginny Gray	EnSafe/Allen & Hoshall Project Managers	(901) 372-7962

* Use Charleston Naval Hospital for (potentially) life-threatening situations, for less urgent medical needs, the Naval Hospital will not serve civilians; Baker Hospital is the next closest appropriate medical facility.

As soon as practical, Earle Folger, NAVBASE; Matthew Hunt and Thuane Fielding, SOUTHDIV Engineers-in-Charge; Todd Haverkost, E/A&H Project Manager; and John H. Borowski, CIH,CSP, E/A&H PHSO, shall be fully apprised of the situation. Other persons, as appropriate may also need to be contacted.

4.6.1 Site Resources

A cellular telephone will be available in the SZ for routine and emergency communication/ coordination with NAVBASE, SOUTHDIV, and the E/A&H field office. First-aid and eye wash equipment will be available at the work area and in each field vehicle.

4.6.2 Emergency Procedures

Examples of an emergency include:

- A fire, explosion, or similar event at or near the site whether related to this project or not;

- A member of the field crew sustains a significant injury, or experiences symptoms of a chemical exposure; or

- The discovery of a condition which suggests that site conditions are imminently more dangerous or hazardous than anticipated.

In an emergency, the following emergency procedures should be followed:

- If it is necessary to evacuate the area, immediately proceed to a rally point and remain there until instructed otherwise.

- Use planned escape routes.

- If a member of the field team experiences effects or symptoms of exposure while on the scene, the field crew will immediately halt work and act according to the instructions provided by the Site Supervisor or, in his absence, the SHSO.

- For applicable site activities, including all Level B activities, use wind indicators to continuously indicate downwind, preferred escape routes, from upwind routes.

- Investigate condition(s) suggesting that site conditions may be more hazardous than anticipated. The condition observed and the decisions made shall be recorded in the safety logbook, or in the field logbook if a safety logbook is not being maintained. If there are doubts about how to proceed, suspend work and leave the work area until the PHSO has evaluated the situation and provided the appropriate instructions to the field team.

- If an accident occurs, the Site Supervisor is to complete an Accident Report Form (see Appendix G) for submittal to the managing Principal-in-Charge of the project.

- If a member of the field crew suffers a personal injury, the SHSO will call **NAVBASE Fire Department 743-5333 or 5444** if an ambulance is needed. Next alert appropriate emergency response agencies as the situation dictates. Complete an Accident Report Form for any such incident.

- If a member of the field crew suffers chemical exposure, flush the affected areas immediately with copious amounts of clean water, and if the situation dictates, the SHSO should alert appropriate emergency response agencies, or personally ensure that the exposed individual is transported to the nearest medical treatment facility for prompt treatment. (See Appendix F for directions to the emergency medical facility.) An Accident Report Form will be completed for any such incident.

Additional information on appropriate chemical exposure treatment methods will be provided through MSDS in Appendix E of this ZHASP. Directions to the nearest emergency medical facility capable of providing general emergency medical assistance and treating chemical burns are provided in Appendix F of this ZHASP.

4.7 Forms

The following forms will be used in implementing this Health and Safety Plan:

- Plan Acceptance Form
- Plan Feedback Form
- Exposure History Form
- Accident Report Form

A ZHASP Plan Acceptance Form will be completed by all employees working onsite before site activities begin. The Plan Feedback Form will be filled out by the SHSO and any other onsite employee who wishes to do so. The Exposure History Form will be completed by both the Field Project Manager and the individual(s) for whom the form is intended. Examples of each form are provided in Appendix G of this plan.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.

5.0 SIGNATORY REQUIREMENT

Condition I.E. of the Hazardous and Solid Waste Amendments (HSWA) portion of RCRA Part B Permit (EPA SCO 170 022 560) states that "All applications, reports, or information submitted to the Regional Administrator shall be signed and certified in accordance with 40 CFR §270.11." The certification reads as follows:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Commander,
Charleston Naval Shipyard

5 June 1995
Date

6.0 REFERENCE LIST

40 CFR, Part 50. July 1, 1994, Appendix G. ***Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air.***

40 CFR, Part 50. July 1, 1994, Appendix J. ***Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.***

Ebasco Services, Inc. August 1987. Interim RCRA Facility Assessment of USN Charleston Naval Shipyard.

EnSafe/Allen & Hoshall. August 30, 1994. *Final Comprehensive Corrective Action Management Plan.*

EnSafe/Allen & Hoshall. May 31, 1994. *Final Comprehensive RFI Work Plan.*

EnSafe/Allen & Hoshall. November 22, 1994. *Draft Final RCRA Facility Assessment for Naval Base Charleston, Volume I.*

EnSafe/Allen & Hoshall. November 22, 1994. *Draft Final RCRA Facility Assessment for Naval Base Charleston, Volume II.*

EnSafe/Allen & Hoshall. November 22, 1994. *Draft Final RCRA Facility Assessment for Naval Base Charleston, Volume III.*

EnSafe/Allen & Hoshall. November 22, 1994. *Draft Final RCRA Facility Assessment for Naval Base Charleston, Volume IV.*

Environmental Science and Engineering, Inc. May 1983. *Initial Assessment Study for the Charleston Naval Base.*

Geraghty & Miller, Inc. 1982. *Confirmation Study — Assessment of Potential Oil and Hazardous-Waste Contamination of Soil and Groundwater at the Charleston Naval Shipyard.*

Graseby Anderson, *Instruction and Operation Manual High Volume PM_{10} Sampler.* July 1988.

Park, Drennan A., *The Groundwater Resources of Charleston, Berkeley and Dorchester Counties*, South Carolina Water Resources Commission, Report Number 139, 1985.

South Carolina Department of Health and Environmental Control; R.61-62.5. South Carolina Ambient Air Quality Standards; Standard Number 2. June 26, 1992.

The Bureau of Nationals Affairs, Inc.; Environment Reporter, Federal Regulations, Volume 2. Tab section 120 — Air Standards; section 120:0156 to 120:0166. October 16, 1992.

United States Environmental Protection Agency. Permit, USEPA I.D. No. SCD 170 022 260

United States Environmental Protection Agency. Region IV. Environmental Services Division. February 1, 1991. *Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual.*

APPENDIX A
ZONE E SUMMARY

Source: **EnSafe/Allen & Hoshall. November 22, 1994. Draft Final RCRA Facility Assessment for Naval Base Charleston, Volumes I, II, and III.**

Table A.1 Zone E SWMU Summary			
SWMU Number	**SWMU Name**	**Investigative Approach**	**Location**
5	Battery Electrolyte Treatment Area	RFI	Building 1797 Area
18	PCB Spill Area	RFI	Building 1278
21	Old Paint Storage Area (Waste Paint Storage Pad)	RFI	Building 1274 Area
22	Old Plating Shop Wastewater Treatment System	RFI	Alley Between Buildings 5 and 44
23	New Plating Shop Wastewater Treatment System	RFI	Building 226
25	Old Plating Operation Building 44	RFI	Building 44
53	Building 212 SAA 29	RFI Investigate w/ AOC 526	Building 212
54	Abrasive Blast Area at SWMU 21	RFI Investigate w/ SWMU 21	Building 1275 Area
63	Former Building 73 Battery Charging Station	CSI	Building 226 Area
65	Lead Storage Building 221	RFI	Building 221
67	Mercury Gauge Room Building 3	CSI	Building 3
70	Building 5 Dip Tank	RFI	Building 5
81	Less-than-90-Day Accumulation Area 23 Building 1245	CSI	Building 1245
83	Building 9 Foundry	RFI	Building 9
84	Building 9 Lead Storage	RFI	Building 9
87	Less-than-90-Day Accumulation Area 11 Building 80	CSI	Building 80
97	Less-than-90-Day Accumulation Area 20 Building 236	CSI	Building 236

Table A.1 Zone E SWMU Summary			
SWMU Number	**SWMU Name**	**Investigative Approach**	**Location**
100	SAA 26 Building 218	RFI	Building 218
102	Building 79 Mercury Spill	CSI	Building 79
106	Blast Area Drydock 3	RFI	Drydock 3
145	Building 13A	CSI	Building 13A
170	PCB Removal Operations Drydock 1 Area	CSI	Drydock 1 Area
171	PCB Removal Operations Drydock 2 Area	CSI	Drydock 2 Area
172	Building 80 Steam Cleaning Operations	CSI	Building 80
173	Building 1297 Storage Area	CSI	Building 1297

Table A.2 Zone E AOC Summary			
AOC Number	AOC Name	Investigative Approach	Location
525	Paint Booth 35 Building 223	RFI	Building 223
526	Paint Area Building 212	RFI	Building 212
528	Steam Cleaning Shop	CSI	Building 59
530	Paint and Oil Storage Building 35	CSI	Building 35
531	Substation and Storage Building 459	CSI	Building 459
538	Forge Shop Building 6	RFI	Building 6
539	Propeller Shop Building 6	RFI Investigate w/ AOC 538	Building 6
540	Building 226 Plating Plant Former Building 73 Battery Charging	CSI	Building 226
541	Oil Storage Shop Former Building 38	CSI	Between Buildings 6 and 226
542	Old Oxy-Acetylene Plant and Paint Shop Former Building 22	CSI	Building 226 Area
543	Building 226 Plating Plant Former Building 1026	CSI	Building 226
544	Former Pickling Plant Building 221	RFI	Building 221
546	Galvanizing/Pickling Shop Building 1025	CSI	Between South end of Buildings 56 and 74
548	Hydraulic Elevator Building 5	CSI	Building 5
549	Building 5 Scrap Yard Former Facility 1054	RFI	Building 5 Area
550	Boiler House Former Building 1111	CSI	SW of Building 62
551	Boiler House Building 1119	CSI	Pier 314
552	Galvanizing Shop Former Building 1030	CSI	NE Corner of Drydock 1

Table A.2 Zone E AOC Summary			
AOC Number	AOC Name	Investigative Approach	Location
554	Paint Shop Former Building 1003	CSI	Between Buildings 5 and 44
555	Latrine and Substation Former Building 29	CSI	SE Side of Building 1119
556	Drydock Discharges	RFI	Drydocks
558	Electrical Substation Building 77	CSI	Building 77
559	Central Power Station Building 32	RFI	Building 32
560	Disinfector Building 34	CSI	South of Building 32
561	Substation Building 451B	RFI	Along Carolina Avenue
562	Substation Building 84	CSI	Building 84
563	Locomotive House Former Building 37	CSI	Building 177
564	Oil/Water Separator	CSI	North of Building 80
566	Paint Shop Storage Building 194	CSI	Building 194
567	Substation Building 75	CSI	East of Building 175
569	Gas Station and Oil Storage Former Building 1279	RFI	Attached to SW Corner of Building 30
570	Former Coal Storage Area	RFI Investigate w/ AOC 578	Building 1199 Area
571	Paint Booth 33 Building 177	RFI	Building 177
572	Motor Area Building 177	RFI	Building 177
573	Anodizing Process Building 177	CSI	Building 177
574	Building 9 Fuel Tank	RFI	Building 9
576	Oil and Paint Storehouse/ Print Office Former Building 1012	CSI	Building 80

Table A.2 Zone E AOC Summary			
AOC Number	**AOC Name**	**Investigative Approach**	**Location**
578	Transportation Shop and Garage Building 25	RFI	Building 25
579	Former Paint Shop Building 1035	CSI	Building 1035
580	Former Pattern and Electric Shop Building 10	CSI	Building 10
583	Northeast Corner of Building 236	RFI	NE of Building 236
586	Temporary Powerhouse Building 1014	CSI	Adjacent to Building 11
590	Alley Between Buildings 79 and 1760	CSI	Between Buildings 70 and 1760
592	Asbestos Shredding Shelter Former Building 1225	CSI	South of Building 1760
596	Former Torpedo Storage Building 101	CSI	Building 101
597	Substation Building 91	CSI	Building 91
598	Sonar Dome Area End of Pier J	RFI	End of Pier J
599	Pump House Pier J	CSI	Pier J
602	Substation and Storage Building 95	CSI	Building 95
603	Burning Dump Drydock 3 Area	CSI	Drydock 3 Area
604	Substation and Storage Building 96	CSI	Building 96
605	Waste Paint Storage Area Pad 1278	RFI Investigate w/ SWMU 5	Pad 1278 Drydock 4 Area

APPENDIX B
TREATMENT ALTERNATIVES

Table ~~B-1~~ C-3 Treatment Alternatives For Groundwater/Leachate				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Vertical barrier	Slurry wall	Trench around site or hot spot is excavated and filled with bentonite slurry.	Organic/inorganic water chemistry[d] Soil type Soil moisture Particle size distribution Porosity Hydraulic conductivity (saturated and unsaturated) Relative permeability Clay content Soil sorptive capacity Cation exchange capacity Organic carbon content Soil pH Depth to groundwater Groundwater velocity and direction Depth to aquitard (Pilot - Compatibility testing with slurry wall material)
	Groundwater collection	Vertical extraction wells	Vertical wells are used to extract contaminated groundwater.	Use of aquifer Depth to water table Direction of flow Rate of flow Hydraulic conductivity (vertical and horizontal) Effective porosity Aquifer type Hydraulic gradient Identification of recharge and discharge areas Identification of aquifer boundaries Aquitard characteristics (Pilot - slug test)
	Leachate collection	Subsurface drains	System of perforated pipe laid in trenches onsite to collect contaminated groundwater.	Use of aquifer Depth to water table Direction of flow Rate of flow Hydraulic conductivity (vertical and horizontal) Effective porosity Aquifer type Hydraulic gradient Identification of recharge and discharge areas Identification of aquifer boundaries Aquitard characteristics (Pilot - slug test)

Table B.1 Treatment Alternatives For Groundwater/Leachate				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Chemical treatment	Ion exchange	Ion exchange is the process of exchanging selected dissolved ionic contaminants with a set of substitute ions. Ion exchangers are primarily used for recovery of dilute solutions of metals or to soften water by removing calcium and manganese.	Organic/inorganic water chemistry[d] Indicator parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total organic carbon (TOC) Total suspended solids Zinc
		Oxidation	Oxidation is a chemical reaction in which one or more electrons are transferred from the chemical being oxidized to an oxidizing agent. Chemical oxidation include destruction of cyanide transformation of organics to biodegradable forms, or detoxification of organics and inorganics.	Organic/inorganic water chemistry[d] Indicator parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total organic carbon (TOC) Total suspended solids Zinc (Pilot - reagent consumption, optimal pH, and reaction time)

Table B.1 Treatment Alternatives For Groundwater/Leachate				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Chemical treatment	Metal precipitation	Precipitation is a chemical unit process in which soluble metallic ions are removed from solution by conversion to an insoluble form. Precipitation is commonly used to treat heavy metals, phosphorus, and hardness.	Organic/inorganic water chemistry[d] Indicator parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total organic carbon (TOC) Total Suspended Solids Zinc (Pilot - chemical dosage, contact time, mixing rate, optimal pH, and sludge handling)
		pH adjustment	Neutralizing agents are added to adjust pH.	Indicator parameters Bicarbonate Calcium Chloride Iron Magnesium Manganese pH Potassium Sodium Sulfate Total Suspended Solids (Pilot - titration curve)

Table B.1 Treatment Alternatives For Groundwater/Leachate				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Biological treatment	Aerobic	Aerobic is the use of oxygen-utilizing micro-organisms to biodegrade contaminants.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Metals, dissolved Nitrogen, ammonia Nitrogen, kjeldahl Nitrogen, nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Total solids Specific conductance Sulfate Sulfide Suspended solids Temperature Volatile suspended solids
	Biological treatment	Anaerobic	Anaerobic is the use of non-oxygen-utilizing micro-organisms to biodegrade contaminants.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Metals, dissolved Nitrogen, ammonia Nitrogen, kjeldahl Nitrogen, nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Total solids Specific conductance Sulfate Sulfide Suspended solids Volatile suspended solids

Table B.1 Treatment Alternatives For Groundwater/Leachate				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Physical treatment	Adsorption (granular activated carbon)	Adsorption is a physical separation process in which organic and inorganic materials are removed by sorption or the attraction and accumulation of one substance on the surface of another.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, kjeldahl Nitrogen, nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids
		Air Stripping	Stripping refers to the removal of relatively volatile components from wastewater by passage of air, steam, or other gas through the contaminated liquid. Stripping is effective in removing ammonia, chlorinated solvents, monoaromatics, and other VOCs.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Biochemical oxygen demand Chemical oxygen demand Hardness Iron Manganese Metals, dissolved Oil and grease pH

Table B.1 Treatment Alternatives For Groundwater/Leachate				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Physical treatment	Sedimentation	Sedimentation is a physical process that removes suspended solids from a liquid matrix by gravitational settling.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, kjeldahl Nitrogen, nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids
		Filtration	Filtration is a physical process used to remove suspended solids from wastewater and is generally proceeded by chemical precipitation and reutralization.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, kjeldahl Nitrogen, nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids

Table B.1 Treatment Alternatives For Groundwater/Leachate				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Disposal	POTW	A chemical, physical, or biological wastewater treatment plant designed and constructed to treat municipal domestic wastewater.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, kjeldahl Nitrogen, nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids
		RCRA TSDF	The process of chemical, physically, or biologically treating the wastewater in an offsite permitted commercial hazardous waste facility.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, kjeldahl Nitrogen, nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids

Table B.1
Treatment Alternatives For Groundwater/Leachate

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Disposal	Land application	The process of applying wastewater directly on the land for or to infiltration into the soil.	Depth to water table Total phosphorous Chloride Ammonia Nitrate Alkalinity pH Sodium Total dissolved solids Soil type hydraulic conductivity application rate
		Injection	The process of hydraulically placing wastewater into the aquifer using either vertical or horizontal wells.	Depth to water table Total phosphorous Chloride Ammonia Nitrate Alkalinity pH Sodium Total dissolved solids Total organic carbon Soil type hydraulic conductivity application rate (2.5 gallons/ft^2/day or 5/square root of slowest percolation rate.

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Municipal Landfill Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA and SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

Table B.2
Treatment Alternatives For Hot Spots, Soil, Sediments, and Waste Materials

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls to prevent contact or runoff	Cap	Native Soil Single Barrier Double Barrier	This is the process of placing a physical horizontal barrier across the site.	Moisture content Permeability In-Situ density Atterberg limits Grain size analysis Porosity Depth
	Excavation	Dig up	This is the process of physically removing the hot spot, soil, or waste from the site.	Organic/inorganic water chemistry[d] Moisture content Permeability In-Situ density Atterberg limits Grain size analysis Porosity Depth
	Surface Water Controls	Erosion and runon/runoff controls	System of vegetation and site grading for preventing soil erosion and stormwater runon/runoff.	Organic/inorganic water chemistry[d] Indicator parameters Acidity-alkalinity Nitrogen, ammonia Nitrogen, kjeldahl Nitrogen, nitrate-nitrite Phosphorus Suspended solids
To evaluate the feasibility and implementability of treatments for contaminated soil and contaminants	Thermal Treatment	Thermal Destruction	Thermal destruction is the process of oxidizing organic and inorganics using high temperature.	Organic/inorganic water chemistry[d] Moisture content Particle size BTU content TCLP
		Thermal Desorption	Thermal desorption is the process of using low temperature to volatilize organics and inorganics from a solid matrix.	Organic/inorganic water chemistry[d] Moisture content Particle size TCLP

Table B.2
Treatment Alternatives For Hot Spots, Soil, Sediments, and Waste Materials

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil and contaminants	Biological Treatment	Aerobic	Aerobic is the use of oxygen-utilizing micro-organisms to biodegrade contaminants.	Organic/inorganic water chemistry[d] Moisture content Soil Texture Temperature pH Soil microorganisms Total nitrogen Total phosphorus Depth to groundwater Dissolved oxygen Methane Chemical oxygen Demand
		Anaerobic	Anaerobic is the use of non-oxygen-utilizing micro-organisms to biodegrade contaminants.	Organic/inorganic water chemistry[d] Moisture content Soil Texture Temperature pH Soil microorganisms Total nitrogen Total phosphorus Depth to groundwater Methane Chemical oxygen Demand
	Physical Treatment	Solidification/ fixation	Solidification is a physical process in which organic and inorganic materials are bound to the surface of another.	Organic/inorganic water chemistry[d] Moisture content Soil Texture Suspended Solids Bulk Density Grain size analysis Atterberg limits Cone index Unconfined Compressive strength Temperature pH

Table B.2
Treatment Alternatives For Hot Spots, Soil, Sediments, and Waste Materials

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil and contaminants	Physical Treatment	Vacuum Extraction	Vacuum extraction refers to the removal of relatively volatile components from soil or waste by passage of air, steam, or other gas through the contaminated matrix. Stripping is effective in removing chlorinated solvents, monoaromatics, and other VOCs.	Organic/inorganic water chemistry[d] Moisture content Air Permeability Temperature pH Depth to groundwater
		Solvent Extraction	Solvent extraction is a physical separation process in which organic and inorganic materials are removed from the surface of a solid matrix to a liquid matrix.	Organic/inorganic water chemistry[d] Total Organic Carbon Total Recoverable Hydrocarbons Moisture content Soil Texture Permeability Bulk Density Grain size analysis Clay Content Temperature pH Chemical oxygen Demand Cation Exchange Capacity Depth to groundwater TCLP
	Disposal	Consolidation	This is the process of consolidating the waste, soil, and other debris in a properly designed and constructed landfill.	Organic/inorganic water chemistry[d] Moisture content Permeability In-Situ density Atterberg limits Grain size analysis Depth to Groundwater TCLP

Table B.2 Treatment Alternatives For Hot Spots, Soil, Sediments, and Waste Materials				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of treatments for contaminated soil and contaminants (continued)	Disposal (continued)	RCRA TSDF	The process of chemical, physically, or biologically treating the contaminant, soil, and other debris in an offsite permitted commercial hazardous waste facility.	Organic/inorganic water chemistry[d] Moisture content Soil Texture Temperature pH Soil microorganisms Total nitrogen Total phosphorus Depth to groundwater Dissolved oxygen TCLP

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA and SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

Table B.3 Treatment Alternatives For Soil Gas				
Data Quality Objective Elements	**Remedial Technology[a]**	**Process Option[b,c]**	**Description**	**Data Quality Needs**
To evaluate the feasibility and implementability of controls for subsurface gas	Cap	Native Soil Single Barrier Double Barrier	This is the process of placing a physical horizontal barrier across the site.	Moisture content Permeability In-Situ density Atterberg limits Grain size analysis Porosity Depth
	Vent	Vertical Horizontal	Vertical or horizontal wells are used to vent gases.	Moisture content Air Permeability Atterberg limits Grain size analysis Porosity Depth
To evaluate the feasibility and implementability of treatments for contaminated soil and contaminants	Thermal Treatment	Thermal Destruction	Thermal destruction is the process of oxidizing organic and inorganics using high temperature.	Organic/inorganic water chemistry[d] Moisture content Particle size BTU content TCLP
		Thermal Desorption	Thermal desorption is the process of using low temperature to volatilize organics and inorganics from a solid matrix.	Organic/inorganic water chemistry[d] Moisture content Particle size BTU content TCLP
	Physical Treatment	Carbon Absorption	Adsorption is a physical separation process in which organic and inorganic materials are removed by sorption or the attraction and accumulation of one substance on the surface of another.	Organic/inorganic water chemistry (VOA and SVOA w/TICs, Pesticides, and PCBs) Moisture content Temperature Total Organic Carbon

Table B.3
Treatment Alternatives For Soil Gas

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil and contaminants (continued)	Physical Treatment (continued)	Vacuum Extraction	Vacuum extraction refers to the removal of relatively volatile components from soil or waste by passage of air, steam, or other gas through the contaminated matrix. Stripping is effective in removing chlorinated solvents, monoaromatics, and other VOCs.	Organic/inorganic water chemistry[d] Moisture content Air Permeability Temperature pH Depth to groundwater
To evaluate the feasibility and implementability of treatments for contaminated soil and contaminants	Disposal	RCRA TSDF	The process of chemical, physically, or biologically treating the contaminant in an offsite permitted commercial hazardous waste facility.	Organic/inorganic water chemistry[d] Moisture content Soil Texture Temperature pH Soil microorganisms Total nitrogen Total phosphorus Depth to groundwater Dissolved oxygen TCLP

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA and SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

APPENDIX C
ANALYTICAL DATA FROM PREVIOUS INVESTIGATIONS

SWMU 21
ANALYTICAL RESULTS
(SOIL, SEDIMENT AND GROUNDWATER)

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)					
Site Sample Type Boring Number Sample Interval	SWMU 21 Soil S21-B01 0' - 1'	SWMU 21 Soil S21-B01 3' - 5'	SWMU 21 Soil S21-B02 0' - 1'	SWMU 21 Soil S21-B02 3' - 5'	SWMU 21 Soil S21-B03 0' - 1'
PARAMETER					
***INORGANICS* (units of concentration mg/kg)**					
Aluminum	2100	5700	5100	3400	3100
Antimony	-	-	8.3 J	-	16 J
Arsenic	1.6 J	6.5 J	3.2 J	2.5 J	26 J
Barium	33	38	82	62	460
Beryllium	-	-	2.8	1.6	-
Cadmium	-	-	-	-	3.3
Calcium	6400	12000	6800	4600	8600
Chromium	30 J	24 J	70 J	35 J	100
Cobalt	5.5	4.1	15	5.0	7.4
Copper	120 J	68 J	800 J	1300 J	720
Iron	7900	19000	27000	8200	19000
Lead	150 J	110 J	800 J	280 J	2900 J
Magnesium	7100	890	1200	690	670
Manganese	62	81	240	76	210 J
Mercury	0.18 J	0.14 J	0.35 J	0.13 J	20
Nickel	81	13	85	17	33
Potassium	280	410	620	260	320
Sodium	99	140	380	370	140
Vanadium	5.1	20	12	7.1	100
Zinc	590 J	260 J	2100 J	590 J	1800 J

J - Indicates an estimated value

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)					
Site Sample Type Boring Number Sample Interval	SWMU 21 Soil S21-B01 0' - 1'	SWMU 21 Soil S21-B01 3' - 5'	SWMU 21 Soil S21-B02 0' - 1'	SWMU 21 Soil S21-B02 3' - 5'	SWMU 21 Soil S21-B03 0' - 1'
SEMIVOLATILES **(units of concentration μg/kg)**					
Anthracene	39J	25J	62J	20J	58J
Benzo(a)anthracene	150J	120J	200J	-	260J
Benzo(a)pyrene	110J	140J	150J	55J	230J
Benzo(b)fluoranthene	170J	230J	260J	80 J	360J
Benzo(g,h,i)perylene	45J	95J	-	-	-
Benzo(k)fluoranthene	84J	100J	120J	-	120J
bis(2-Ethylhexyl)phthalate	91J	76J	2000	380	-
Butylbenzylphthalate	52J	-	-	-	-
Carbazole	45J	-	54J	-	-
Chrysene	140J	140J	240J	68J	290J
Di-n-butylphalate	68J	-	260J	51J	-
Fluoranthene	580	290J	650	190J	480
Indeno(1,2,3-cd)pyrene	48J	98J	-	-	140J
Phenanthrene	190J	62J	370	110J	310J
Pyrene	370	240J	440	130J	540
VOLATILES **(units of concentration μg/kg)**					
Acetone	-	-	-	68	-
Chlorobenzene	-	-	-	-	14 J
Methylene chloridee	-	-	-	-	6.1 J
Toluene	-	-	-	-	7.2 J

J - Indicates an estimated value

NAVBASE Soil and Sediment Analytical Results (Fall, 1993)					
Site Sample Type Boring Number Sample Interval	SWMU 21 Soil S21-B04 0' - 1'	SWMU 21 Soil S21-B04 3' - 5'	SWMU 21 Soil S21-B05 0' - 1'	SWMU 21 Soil S21-B05 3' - 5'	SWMU 21 Soil S21-B06 0' - 1'
PARAMETER					
***INORGANICS* (units of concentration mg/kg)**					
Aluminum	3600	1300	3200	3200	3300
Arsenic	-	6.4 J	2.7	-	3.6
Barium	44	33	37	6.7	78
Beryllium	-	-	0.53	-	1.2
Cadmium	-	1900	1.8	-	2.1
Calcium	1900	3.4 J	17000	960	25000
Chromium	28	-	68	4.5	63
Cobalt	1.3	64 J	4.2	-	9.8
Copper	32	3300	290	3.6	440
Iron	3500	340 J	18000	660	18000
Lead	151	230	467	9.4	422
Magnesium	300	16 J	740	87	2600
Manganese	30 J	0.53 J	110 J	3.9 J	180 J
Mercury	0.059	-	0.18	0.029	0.23
Nickel	6.3	-	27	-	51
Potassium	140	-	510	-	320
Sodium	-	2.2	100	-	350
Vanadium	3.8	260 J	10	-	7.3
Zinc	220	260 J	690	6.7	1000

J - Indicates an estimated value

NAVBASE Soil and Sediment Analytical Results (Fall, 1993)					
Site Sample Type Boring Number Sample Interval	SWMU 21 Soil S21-B04 0' - 1'	SWMU 21 Soil S21-B04 3' - 5'	SWMU 21 Soil S21-B05 0' - 1'	SWMU 21 Soil S21-B05 3' - 5'	SWMU 21 Soil S21-B06 0' - 1'
SEMIVOLATILES **(units of concentration μg/kg)**					
Acenaphthene	-	64J	-	-	-
Anthracene	-	270J	21J	-	-
Benzo(a)anthracene	-	1200	150J	-	120J
Benzo(a)pyrene	-	990	150J	-	100J
Benzo(b)fluoranthene	100J	1400	290J	-	190 J
Benzo(g,h,i)perylene	-	410J	86J	-	72J
Benzo(k)fluoranthene	75J	490	-	-	-
bis(2-Ethylhexyl)phthalate	55J	-	300J	-	1300
Butylbenzylphthalate	190J	-	80J	-	81J
Carbazole	-	87J	-	-	-
Chrysene	87J	1100	150J	-	140J
dibennz (a,h) anthracene	-	140J	-	-	-
Di-n-butylphalate	-	-	66J	260J	150J
Fluoranthene	140J	1900	300J	-	320J
Indeno(1,2,3-cd)pyrene	-	470	-	-	-
Phenanthrene	110J	1100	130J	-	200J
Pyrene	290J	2000	670	-	730
VOLATILES **(units of concentration μg/kg)**					
Chlorobenzene	4.4J	11	16	-	4.0J

J - Indicates an estimated value

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)					
Site Sample Type Sample Number Sample Interval	SWMU 21 Soil S21-B06 3' - 5'	SWMU 21 Soil S21-B07 0'- 1'	SWMU 21 Soil S21-B07 3'- 5'	SWMU 21 Soil S21-B08 0'- 1'	SWMU 21 Soil S21-B08 3' - 5'
PARAMETER					
***INORGANICS* (units of concentration mg/kg)**					
Aluminum	3200	2300	1700	1300	3600
Antimony	-	2.3	-	-	
Arsenic	8.5 J	78	17	2.4 J	8.7 J
Barium	120N	0.56	-	18 J	63 J
Cadmium	-	1.4	2.2	1.2	0.89
Calcium	5000	26000	2300	240000	65000
Chromium	39 J	110	23	15 J	15 J
Cobalt	3.6	14	-	4.7	3.9
Copper	59 J	350	14	60 J	270 J
Iron	5000	22000	3300	4700	14000
Lead	85	411	22	27	380
Magnesium	590 J	24000	340	10000 J	2600 J
Manganese	32 J	200 J	21 J	300 J	130 J
Mercury	0.069	0.15	0.11	0.013	0.90 J
Nickel	21	220	-	61	27
Potassium	270 J	370	150	360 J	400 J
Sodium	350	83	-	410	350
Vanadium	8.5	6.9	3.7	4.9	11
Zinc	120 J	1300	120	84 J	370 J

J - Indicates an estimated value

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)					
Site Sample Type Sample Number Sample Interval	SWMU 21 Soil S21-B06 3' - 5'	SWMU 21 Soil S21-B07 0'- 1'	SWMU 21 Soil S21-B07 3'- 5'	SWMU 21 Soil S21-B08 0'- 1'	SWMU 21 Soil S21-B08 3' - 5'
SEMIVOLATILES **(units of concentration μg/kg)**					
Benzo(a)pyrene	-	-	-	-	66 J
Benzo(b)fluoranthene	-	-	-	-	100 J
Benzo(g,h,i)perylene	-	-	120 J	-	-
Benzo(k)fluoranthene	-	8700	100 J	-	-
bis(2-Ethylhexyl)phthalate	-	100 J	190 J	80 J	-
Butylbenzylphthalate	-	-	72 J	-	-
Chrysene	-	-	1300	54 J	66 J
dibenz (a,h) anthracene	-	-	81 J	-	-
Di-n-butylphthalate	-	62 J	140 J	-	-
Fluoranthene	55 J	-	150 J	150 J	110 J
Indeno(1,2,3-cd)pyrene	-	-	320 J	-	-
Phenanthrene	55 J	-	200 J	49 J	55 J
Pyrene	52 J	-	730	150 J	130 J
VOLATILES **(units of concentration μg/kg)**					
Chlorobenzene	-	30	4.0 J	-	-

J - Indicates an estimated value

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)			
Site Sample Type Sample Number Sample Interval	SWMU 21 Sediment S21-S01 0" - 6"	SWMU 21 Sediment S21-S02 0" - 6"	SWMU 21 Sediment S21-S03 0" - 6"
PARAMETER			
***INORGANICS* (units of concentration mg/kg)**			
Aluminum	2600	3200	1500
Antimony	-	-	22 J
Arsenic	8.2	5.1	3.3
Barium	48	62	210
Beryllium	0.76	1.6	-
Cadmium	1.4	2.0	13
Calcium	45000	58000	13000
Chromium	60	58	380
Cobalt	15	19	15
Copper	270	510	910
Iron	26000	3700	79000
Lead	180 J	280 J	450 J
Magnesium	23000	13000	4200
Manganese	290 J	320 J	780 J
Mercury	0.062	0.060	0.053
Nickel	230	160	200
Potassium	400	540	220
Sodium	540	890	2100
Vanadium	8.4	11	14
Zinc	710	2100	1700

J - Indicates an estimated value

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)			
Site **Sample Type** **Sample Number** **Sample Interval**	**SWMU 21** **Sediment** **S21-S01** **0" - 6"**	**SWMU 21** **Sediment** **S21-S02** **0" - 6"**	**SWMU 21** **Sediment** **S21-S03** **0" - 6"**
***SEMIVOLATILES* (units of concentration μg/kg)**			
Anthracene	26 J	-	-
Benzo(a)anthracene	170 J	-	74 J
Benzo(a)pyrene	120 J	-	78 J
Benzo(b)fluoranthene	170 J	-	99 J
Benzo(g,h,i)perylene	67 J	-	-
Benzo(k)fluoranthene	83 J	-	-
bis(2-Ethylhexyl)phthalate	3900	400 J	950
Butylbenzylphthalate	88 J	-	-
Chrysene	190 J	-	88 J
Di-n-butylphalate	160 J	-	-
Fluoranthene	570	58 J	130 J
Phenanthrene	190 J	-	46 J
Pyrene	560	74 J	160 J
VOLATILES (units of concentration μg/kg)			
Chlorobenzene	6.4	-	-

J - Indicates an estimated value

NAVBASE CHARLESTON Groundwater Analytical Results (Fall, 1993)			
Site Sample Type Well Number	SWMU 21 Water CNSY-21-02	SWMU 21 Water CNSY-21-01	SWMU 21 Water CNSY-21-03
PARAMETER			
INORGANICS **(units of concentration μg/l)**			
Aluminum	710	-	-
Arsenic	15	-	-
Barium	44	90	220
Calcium	93000	100000	82000
Iron	22000	2900	3500
Lead	6.1	-	-
Magnesium	42000	23000	23000
Manganese	500	380	840
Potassium	36000	14000	18000
Sodium	66000	160000	65000
Zinc	23	-	30
SEMIVOLATILES **(units of concentration μg/l)**			
Acenaphthene	-	22	-
Carbazole	-	0.93 J	-
Dibenzofuran	-	3.9 J	-
Fluorene	-	4.0 J	-
2-Methylnaphthalene	-	0.71 J	-
Naphthalene	-	11	-
Phenanthrene	-	1.3 J	-
VOLATILES **(units of concentration μg/l)**			
Tetrachloroethene	-	-	-
Xylenes (total)	-	-	-

J - Indicates an estimated value

SWMUs 21 and 22
ANALYTICAL DATA
(SOIL)

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

5102 LaRoche Avenue • Savannah, GA 31404 • (912) 354-7858 • Fax (912) 352-0165

LOG NO: S3-45710

Received: 09 OCT 93

Purchase Order: 041100/93

Mr. Paul Stoddard
EnSafe/Allen & Hoshall
5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-1	CNSY/S21-B03-01	10-08-93/0810	CNS09
45710-2	CNSY/S22-B01-01	10-08-93/1105	CNS09
45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
Volatiles by GC/MS (8240)					
Chloromethane, ug/kg dw	11U	11U	12U	11U	11U
Bromomethane, ug/kg dw	11U	11U	12U	11U	11U
Vinyl Chloride, ug/kg dw	11U	11U	12U	11U	11U
Chloroethane, ug/kg dw	11U	11U	12U	11U	11U
Methylene Chloride, ug/kg dw	6.1	5.7U	6.2U	5.4U	5.6U
Acetone, ug/kg dw	56U	57U	62U	88	5.6U
Carbon Disulfide, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
1,1-Dichloroethene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
1,1-Dichloroethane, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Trans-1,2-Dichloroethylene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Cis-1,2-Dichloroethene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Chloroform, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
1,2-Dichloroethane, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
2-Butanone (MEK), ug/kg dw	56U	57U	62U	54U	56U
1,1,1-Trichloroethane, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Carbon Tetrachloride, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Vinyl Acetate, ug/kg dw	11U	11U	12U	11U	11U
Bromodichloromethane, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

5102 LaRocne Avenue • Savannan, GA 31404 • (912) 354-7858 • Fax (912) 352-0165

LOG NO: S3-45710

Received: 09 OCT 93

Purchase Order: 041100/93

Mr. Paul Stoddard
EnSafe/Allen & Hoshall
5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-1	CNSY/S21-B03-01	10-08-93/0810	CNS09
45710-2	CNSY/S22-B01-01	10-08-93/1105	CNS09
45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
1,1,2,2-Tetrachloroethane, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
1,2-Dichloropropane, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Trans-1,3-Dichloropropene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Trichloroethene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Dibromochloromethane, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
1,1,2-Trichloroethane, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Benzene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Cis-1,3-Dichloropropene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Bromoform, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
2-Hexanone, ug/kg dw	56U	57U	62U	54U	56U
4-Methyl-2-pentanone (MIBK), ug/kg dw	56U	57U	62U	54U	56U
Tetrachloroethene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Toluene, ug/kg dw	7.2	5.7U	6.2U	5.4U	5.6U
Chlorobenzene, ug/kg dw	14	5.7U	6.2U	5.4U	5.6U
Ethylbenzene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Styrene, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Xylenes, ug/kg dw	5.6U	5.7U	6.2U	5.4U	5.6U
Surrogate - Toluene-d8	122 %	109 %	102 %	94 %	103 %
Surrogate - 4-Bromofluorobenzene	63 %	74 %	78 %	75 %	77 %
Surrogate - 1,2-Dichloroethane-d4	96 %	94 %	91 %	85 %	95 %
Date Analyzed	10.19.93	10.19.93	10.19.93	10.21.93	10.19.93

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

5102 LaRoche Avenue • Savannah, GA 31404 • (912) 354-7858 • Fax (912) 352-0165

LOG NO: S3-45710

Received: 09 OCT 93

Mr. Paul Stoddard
EnSafe/Allen & Hoshall
5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Purchase Order: 041100/93

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-1	CNSY/S21-B03-01	10-08-93/0810	CNS09
45710-2	CNSY/S22-B01-01	10-08-93/1105	CNS09
45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
Semivolatiles (8270)					
Phenol, ug/kg dw	370U	380U	410U	360U	370U
bis(2-Chloroethyl)ether, ug/kg dw	370U	380U	410U	360U	370U
2-Chlorophenol, ug/kg dw	370U	380U	410U	360U	370U
1,3-Dichlorobenzene, ug/kg dw	370U	380U	410U	360U	370U
1,4-Dichlorobenzene, ug/kg dw	370U	380U	410U	360U	370U
1,2-Dichlorobenzene, ug/kg dw	370U	380U	410U	360U	370U
2-Methylphenol (o-cresol), ug/kg dw	370U	380U	410U	360U	370U
Bis(2-chloroisopropyl)ether , ug/kg dw	370U	380U	410U	360U	370U
3-Methylphenol/4-Methylphenol(m&p-cresol), ug/kg dw	370U	380U	410U	360U	370U
N-Nitroso-di-n-propylamine, ug/kg dw	370U	380U	410U	360U	370U
Hexachloroethane, ug/kg dw	370U	380U	410U	360U	370U
Nitrobenzene, ug/kg dw	370U	380U	410U	360U	370U
Isophorone, ug/kg dw	370U	380U	410U	360U	370U
2-Nitrophenol, ug/kg dw	370U	380U	410U	360U	370U
2,4-Dimethylphenol, ug/kg dw	370U	380U	410U	360U	370U

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REPORT OF RESULTS

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45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
bis(2-Chloroethoxy)methane, ug/kg dw	370U	380U	410U	360U	370U
2,4-Dichlorophenol, ug/kg dw	370U	380U	410U	360U	370U
1,2,4-Trichlorobenzene, ug/kg dw	370U	380U	410U	360U	370U
Naphthalene, ug/kg dw	370U	380U	410U	360U	370U
4-Chloroaniline, ug/kg dw	730U	750U	810U	720U	730U
Hexachlorobutadiene, ug/kg dw	370U	380U	410U	360U	370U
4-Chloro-3-methylphenol, ug/kg dw	370U	380U	410U	360U	370U
2-Methylnaphthalene, ug/kg dw	370U	380U	410U	360U	370U
Hexachlorocyclopentadiene, ug/kg dw	370U	380U	410U	360U	370U
2,4,6-Trichlorophenol, ug/kg dw	370U	380U	410U	360U	370U
2,4,5-Trichlorophenol, ug/kg dw	1900U	1900U	2100U	1800U	1900U
2-Chloronaphthalene, ug/kg dw	370U	380U	410U	360U	370U
2-Nitroaniline, ug/kg dw	1900U	1900U	2100U	1800U	1900U
Dimethylphthalate, ug/kg dw	370U	380U	410U	360U	370U
Acenaphthylene, ug/kg dw	370U	380U	410U	360U	370U
3-Nitroaniline, ug/kg dw	1900U	1900U	2100U	1800U	1900U
Acenaphthene, ug/kg dw	370U	380U	410U	360U	370U
2,4-Dinitrophenol, ug/kg dw	1900U	1900U	2100U	1800U	1900U

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Received: 09 OCT 93

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5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Purchase Order: 041100/93

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-1	CNSY/S21-B03-01	10-08-93/0810	CNS09
45710-2	CNSY/S22-B01-01	10-08-93/1105	CNS09
45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
4-Nitrophenol, ug/kg dw	1900U	1900U	2100U	1800U	1900U
Dibenzofuran, ug/kg dw	370U	380U	410U	360U	370U
2,4-Dinitrotoluene, ug/kg dw	370U	380U	410U	360U	370U
2,6-Dinitrotoluene, ug/kg dw	370U	380U	410U	360U	370U
Diethylphthalate, ug/kg dw	370U	380U	410U	360U	370U
4-Chlorophenyl-phenyl ether, ug/kg dw	370U	380U	410U	360U	370U
Fluorene, ug/kg dw	370U	380U	410U	360U	370U
4-Nitroaniline, ug/kg dw	1900U	1900U	2100U	1800U	1900U
4,6-Dinitro-2-methylphenol, ug/kg dw	1900U	1900U	2100U	1800U	1900U
N-Nitrosodiphenylamine/Diphenylamine, ug/kg dw	370U	380U	410U	360U	370U
4-Bromophenyl-phenyl-ether, ug/kg dw	370U	380U	410U	360U	370U
Hexachlorobenzene, ug/kg dw	370U	380U	410U	360U	370U
Pentachlorophenol, ug/kg dw	1900U	1900U	2100U	1800U	1900U
Phenanthrene, ug/kg dw	310J	380U	410U	360U	370U
Anthracene, ug/kg dw	58J	42J	410U	360U	370U
Di-n-butylphthalate, ug/kg dw	370U	380U	410U	360U	55J

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45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
Fluoranthene, ug/kg dw	480	42J	410U	360U	370U
Pyrene, ug/kg dw	540	45J	410U	360U	370U
Butylbenzylphthalate, ug/kg dw	370U	380U	410U	360U	370U
3,3'-Dichlorobenzidine, ug/kg dw	730U	750U	810U	720U	730U
Benzo(a)anthracene, ug/kg dw	260J	380U	410U	360U	370U
bis(2-Ethylhexyl)phthalate, ug/kg dw	370U	380U	410U	360U	370U
Chrysene, ug/kg dw	290J	380U	410U	360U	370U
Di-n-octylphthalate, ug/kg dw	370U	380U	410U	360U	370U
Benzo(b)fluoranthene, ug/kg dw	360J	40J	410U	360U	370U
Carbazole, ug/kg dw	370U	380U	410U	360U	370U
Benzo(k)fluoranthene, ug/kg dw	120J	380U	410U	360U	370U
Benzo(a)pyrene, ug/kg dw	230J	380U	410U	360U	370U
Indeno(1,2,3-cd)pyrene, ug/kg dw	140J	380U	410U	360U	370U
Dibenz(a,h)anthracene, ug/kg dw	370U	380U	410U	360U	370U
Benzo(g,h,i)perylene, ug/kg dw	370U	380U	410U	360U	370U
Surrogate - Phenol d 5	89 %	68 %	76 %	89 %	86 %
Surrogate - 2-Fluorophenol	85 %	63 %	73 %	85 %	82 %
Surrogate - 2,4,6-Tribromophenol	74 %	72 %	74 %	72 %	75 %
Surrogate - Nitrobenzene d-5	93 %	68 %	79 %	92 %	91 %
Surrogate - 2-Fluorobiphenyl	106 %	87 %	92 %	106 %	102 %
Surrogate - Terphenyl	106 %	112 %	106 %	111 %	108 %
Date Extracted	10.15.93	10.15.93	10.15.93	10.15.93	10.15.93
Date Analyzed	10.22.93	10.22.93	10.22.93	10.22.93	10.22.93

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LOG NO: S3-45710

Received: 09 OCT 93

Mr. Paul Stoddard
EnSafe/Allen & Hoshall
5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Purchase Order: 041100/93

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-1	CNSY/S21-B03-01	10-08-93/0810	CNS09
45710-2	CNSY/S22-B01-01	10-08-93/1105	CNS09
45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
Aluminum (6010)					
Aluminum (6010) , mg/kg dw	3100	5100	7200	6500	5400
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Antimony (6010)					
Antimony (6010) , mg/kg dw	16N	5.7UN	6.2UN	5.4UN	5.6UN
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Arsenic (7060)					
Arsenic (7060), mg/kg dw	26N	5.7UN	9.9N	1.1UN	1.1UN
Date Analyzed	11.02.93	11.02.93	11.01.93	11.02.93	11.01.93
Barium (6010)					
Barium (6010), mg/kg dw	460	30	290	37	15
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Beryllium					
Beryllium (6010), mg/kg dw	0.56U	0.57U	0.62U	0.54U	0.56U
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Cadmium (6010)					
Cadmium (6010), mg/kg dw	3.3	0.57U	0.69	0.54U	0.56U
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Calcium (6010)					
Calcium (6010), mg/kg dw	8600	1300	440	2300	630
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93

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Project: CTO-029 (SDG CNS09)
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REPORT OF RESULTS

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45710-1	CNSY/S21-B03-01	10-08-93/0810	CNS09
45710-2	CNSY/S22-B01-01	10-08-93/1105	CNS09
45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
Chromium (6010)					
Chromium (6010), mg/kg dw	100	10	26	31	8.0
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Cobalt (6010)					
Cobalt (6010), mg/kg dw	7.4	1.1U	1.3	1.1U	1.1U
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Copper (6010)					
Copper (6010), mg/kg dw	720	6.1	3.1U	4.8	2.8U
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Iron (6010)					
Iron (6010), mg/kg dw	19000	6700	43000	4000	3200
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Lead (7421)					
Lead (7421), mg/kg dw	2900N*	7.9N*	8.2N*	15N*	2.2N*
Date Analyzed	11.02.93	11.10.93	11.04.93	11.04.93	11.04.93
Magnesium (6010)					
Magnesium (6010), mg/kg dw	670	270	430	210	150
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Manganese (6010)					
Manganese (6010), mg/kg dw	210N	37N	39N	73N	29N
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93

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REPORT OF RESULTS

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45710-2	CNSY/S22-B01-01	10-08-93/1105	CNS09
45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
Mercury					
Mercury (7470/7471), mg/kg dw	20	0.18	0.029	0.048	0.029
Date Analyzed	11.01.93	10.29.93	10.29.93	10.29.93	10.29.93
Nickel (6010)					
Nickel (6010), mg/kg dw	33	4.5U	4.9U	4.3U	4.4U
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Potassium (6010)					
Potassium (6010), mg/kg dw	320	240	500	170	140
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Selenium (7740)					
Selenium (7740), mg/kg dw	2.2UWN	1.1UWN	6.2UWN	5.4UN	5.6UWN
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Silver (6010)					
Silver (6010), mg/kg dw	1.1U	1.1U	1.2U	1.1U	1.1U
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Sodium (6010)					
Sodium (6010) , mg/kg dw	140	57U	120	54U	56U
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Thallium (7841)					
Thallium (7841) , mg/kg dw	1.1UW	1.1UW	1.2UW	1.1UW	1.1U
Date Analyzed	11.04.93	11.04.93	11.04.93	11.04.93	11.04.93

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LOG NO: S3-45710

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Purchase Order: 041100/93

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45710-3	CNSY/S22-B01-02	10-08-93/1115	CNS09
45710-4	CNSY/S22-B02-01	10-08-93/1420	CNS09
45710-5	CNSY/S22-B02-02	10-08-93/1430	CNS09

PARAMETER	45710-1	45710-2	45710-3	45710-4	45710-5
Vanadium (6010)					
Vanadium (6010), mg/kg dw	100	12	50	5.1	4.1
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Zinc (6010)					
Zinc (6010), mg/kg dw	1800N	15N	6.2N	8.6N	3.2N
Date Analyzed	11.02.93	11.02.93	11.02.93	11.02.93	11.02.93
Cyanide					
Cyanide, Total (9011/9012), mg/kg dw	1.1UN	1.1UN	1.2UN	1.1UN	1.1UN
Date Analyzed	10.19.93	10.19.93	10.19.93	10.19.93	10.19.93
Percent Solids, %	90	88	81	92	90

SWMUS 21 AND 25
ANALYTICAL DATA
(GROUNDWATER)

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

5102 LaRoche Avenue • Savannah, GA 31404 • (912) 354-7858 • Fax (912) 352-0165

LOG NO: S3-46442

Received: 13 NOV 93

Mr. Paul Stoddard
EnSafe/Allen & Hoshall
5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Purchase Order: 041100/93

Project: CTO-029 (SDG CNS22)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
46442-1	CNSY/S21-W02-01	11-12-93/0840	CNS22
46442-2	CNSY/S21-W01-01	11-12-93/0935	CNS22
46442-3	CNSY/S25-W01-01	11-12-93/1020	CNS22
46442-4	CNSY/S25-W02-01	11-12-93/1100	CNS22
46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
Volatiles by GC/MS (8240)					
Chloromethane, ug/l	10U	10U	10U	10U	10U
Bromomethane, ug/l	10U	10U	10U	10U	10U
Vinyl Chloride, ug/l	10U	10U	10U	10U	10U
Chloroethane, ug/l	10U	10U	10U	10U	10U
Methylene Chloride (Dichloromethane), ug/l	50U	50U	50U	50U	50U
Acetone, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Carbon Disulfide, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
1,1-Dichloroethene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
1,1-Dichloroethane, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Trans-1,2-Dichloroethylene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Cis-1,2-Dichloroethene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Chloroform, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
1,2-Dichloroethane, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
2-Butanone (MEK), ug/l	50U	50U	50U	50U	50U
1,1,1-Trichloroethane, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Carbon Tetrachloride, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Vinyl Acetate, ug/l	10U	10U	10U	10U	10U
Bromodichloromethane, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U

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LOG NO: S3-46442

Received: 13 NOV 93

Mr. Paul Stoddard
EnSafe/Allen & Hoshall
5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Purchase Order: 041100/93

Project: CTO-029 (SDG CNS22)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
46442-1	CNSY/S21-W02-01	11-12-93/0840	CNS22
46442-2	CNSY/S21-W01-01	11-12-93/0935	CNS22
46442-3	CNSY/S25-W01-01	11-12-93/1020	CNS22
46442-4	CNSY/S25-W02-01	11-12-93/1100	CNS22
46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
1,1,2,2-Tetrachloroethane, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
1,2-Dichloropropane, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Trans-1,3-Dichloropropene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Trichloroethene, ug/l	5.0U	5.0U	5.0U	5.0U	2.3J
Dibromochloromethane, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
1,1,2-Trichloroethane, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Benzene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Cis-1,3-Dichloropropene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Bromoform, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
2-Hexanone, ug/l	50U	50U	50U	50U	50U
4-Methyl-2-pentanone (MIBK), ug/l	50U	50U	50U	50U	50U
Tetrachloroethene, ug/l	5.0U	5.0U	5.0U	5.0U	7.3
Toluene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Chlorobenzene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Ethylbenzene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Styrene, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Xylenes, ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Surrogate - Toluene-d8	98 %	95 %	97 %	94 %	95 %
Surrogate - 4-Bromofluorobenzene	103 %	103 %	104 %	110 %	105 %
Surrogate - 1,2-Dichloroethane-d4	104 %	108 %	107 %	110 %	110 %
Date Analyzed	11.23.93	11.23.93	11.23.93	11.23.93	11.23.93

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46442-4	CNSY/S25-W02-01	11-12-93/1100	CNS22
46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
Semivolatiles (8270)					
Phenol, ug/l	10U	10U	10U	10U	10U
bis(2-Chloroethyl)ether, ug/l	10U	10U	10U	10U	10U
2-Chlorophenol, ug/l	10U	10U	10U	10U	10U
1,3-Dichlorobenzene, ug/l	10U	10U	10U	10U	10U
1,4-Dichlorobenzene, ug/l	10U	10U	10U	10U	10U
1,2-Dichlorobenzene, ug/l	10U	10U	10U	10U	10U
2-Methylphenol (o-cresol), ug/l	10U	10U	10U	10U	10U
Bis(2-chloroisopropyl)ether, ug/l	10U	10U	10U	10U	10U
3-Methylphenol/4-Methylphenol(m&p-cresol), ug/l	10U	10U	10U	10U	10U
N-Nitroso-di-n-propylamine, ug/l	10U	10U	10U	10U	10U
Hexachloroethane, ug/l	10U	10U	10U	10U	10U
Nitrobenzene, ug/l	10U	10U	10U	10U	10U
Isophorone, ug/l	10U	10U	10U	10U	10U
2-Nitrophenol, ug/l	10U	10U	10U	10U	10U
2,4-Dimethylphenol, ug/l	10U	10U	10U	10U	10U
bis(2-Chloroethoxy)methane, ug/l	10U	10U	10U	10U	10U
2,4-Dichlorophenol, ug/l	10U	10U	10U	10U	10U
1,2,4-Trichlorobenzene, ug/l	10U	10U	10U	10U	10U

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46442-4	CNSY/S25-W02-01	11-12-93/1100	CNS22
46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
Naphthalene, ug/l	10U	11	10U	10U	3.7J
4-Chloroaniline, ug/l	20U	20U	20U	20U	20U
Hexachlorobutadiene, ug/l	10U	10U	10U	10U	10U
4-Chloro-3-methylphenol, ug/l	10U	10U	10U	10U	10U
2-Methylnaphthalene, ug/l	10U	0.71J	10U	10U	10U
Hexachlorocyclopentadiene, ug/l	10U	10U	10U	10U	10U
2,4,6-Trichlorophenol, ug/l	10U	10U	10U	10U	10U
2,4,5-Trichlorophenol, ug/l	10U	10U	10U	10U	10U
2-Chloronaphthalene, ug/l	10U	10U	10U	10U	10U
2-Nitroaniline, ug/l	50U	50U	50U	50U	50U
Dimethylphthalate, ug/l	10U	10U	10U	10U	10U
Acenaphthylene, ug/l	10U	10U	10U	10U	10U
3-Nitroaniline, ug/l	50U	50U	50U	50U	50U
Acenaphthene, ug/l	10U	22	10U	10U	10U
2,4-Dinitrophenol, ug/l	50U	10U	50U	50U	50U
4-Nitrophenol, ug/l	50U	10U	50U	50U	50U
Dibenzofuran, ug/l	10U	3.9J	10U	10U	10U
2,4-Dinitrotoluene, ug/l	10U	10U	10U	10U	10U
2,6-Dinitrotoluene, ug/l	10U	10U	10U	10U	10U
Diethylphthalate, ug/l	10U	10U	10U	10U	10U

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46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
4-Chlorophenyl-phenyl ether, ug/l	10U	10U	10U	10U	10U
Fluorene, ug/l	10U	4.0J	10U	10U	10U
4-Nitroaniline, ug/l	50U	50U	50U	50U	50U
4,6-Dinitro-2-methylphenol, ug/l	50U	50U	50U	50U	50U
N-Nitrosodiphenylamine/Diphenylamine, ug/l	10U	10U	10U	10U	10U
4-Bromophenyl-phenyl-ether, ug/l	10U	10U	10U	10U	10U
Hexachlorobenzene, ug/l	10U	10U	10U	10U	10U
Pentachlorophenol, ug/l	50U	50U	50U	50U	50U
Phenanthrene, ug/l	10U	1.3J	10U	10U	10U
Anthracene, ug/l	10U	10U	10U	10U	10U
Di-n-butylphthalate, ug/l	10U	10U	10U	10U	10U
Fluoranthene, ug/l	10U	10U	10U	10U	10U
Pyrene, ug/l	10U	10U	10U	10U	10U
Butylbenzylphthalate, ug/l	10U	10U	10U	10U	10U
3,3'-Dichlorobenzidine, ug/l	20U	20U	20U	20U	20U
Benzo(a)anthracene, ug/l	10U	10U	10U	10U	10U
bis(2-Ethylhexyl)phthalate, ug/l	10U	10U	10U	10U	10U
Chrysene, ug/l	10U	10U	10U	10U	10U
Di-n-octylphthalate, ug/l	10U	10U	10U	10U	10U

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PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
Benzo(b)fluoranthene, ug/l	10U	10U	10U	10U	10U
Carbazole, ug/l	10U	0.93J	10U	10U	10U
Benzo(k)fluoranthene, ug/l	10U	10U	10U	10U	10U
Benzo(a)pyrene, ug/l	10U	10U	10U	10U	10U
Indeno(1,2,3-cd)pyrene, ug/l	10U	10U	10U	10U	10U
Dibenz(a,h)anthracene, ug/l	10U	10U	10U	10U	10U
Benzo(g,h,i)perylene, ug/l	10U	10U	10U	10U	10U
Surrogate - Phenol d 5	77 %	78 %	75 %	82 %	67 %
Surrogate - 2-Fluorophenol	66 %	68 %	66 %	68 %	56 %
Surrogate - 2,4,6-Tribromophenol	107 %	105 %	92 %	103 %	96 %
Surrogate - Nitrobenzene d-5	86 %	90 %	87 %	76 %	61 %
Surrogate - 2-Fluorobiphenyl	83 %	80 %	81 %	72 %	62 %
Surrogate - Terphenyl	79 %	87 %	96 %	79 %	71 %
Date Extracted	11.18.93	11.18.93	11.18.93	11.18.93	11.18.93
Date Analyzed	11.28.93	11.28.93	11.28.93	12.09.93	12.09.93
Aluminum (6010)					
Aluminum (6010) , ug/l	710	200U	220	200U	200
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Antimony (6010)					
Antimony (6010) , ug/l	50U	50U	50U	50U	50U
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93

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46442-3	CNSY/S25-W01-01	11-12-93/1020	CNS22
46442-4	CNSY/S25-W02-01	11-12-93/1100	CNS22
46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
Arsenic (7060)					
Arsenic (7060), ug/l	15	10U	10U	10U	10U
Date Analyzed	11.22.93	11.22.93	11.22.93	11.22.93	11.22.93
Barium (6010)					
Barium (6010), ug/l	44	90	26	19	10U
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Beryllium					
Beryllium (6010), ug/l	5.0U	5.0U	5.0U	5.0U	5.0U
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Cadmium (6010)					
Cadmium (6010), ug/l	5.0UN	5.0UN	5.0UN	5.0UN	17N
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Calcium (6010)					
Calcium (6010), ug/l	93000	100000	2200	12000	56000
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Chromium (6010)					
Chromium (6010), ug/l	10U	10U	18	670	390
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Cobalt (6010)					
Cobalt (6010), ug/l	10U	10U	10U	10U	10U
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93

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46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
Copper (6010)					
Copper (6010), ug/l	25U	25U	25U	25U	25U
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Iron (6010)					
Iron (6010), ug/l	22000	2900	55	50U	210
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Lead (7421)					
Lead (7421), ug/l	6.1	5.0U	5.0U	5.0U	5.0U
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Magnesium (6010)					
Magnesium (6010), ug/l	42000	23000	2000	2700	4900
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Manganese (6010)					
Manganese (6010), ug/l	500	380	16	27	530
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Mercury					
Mercury (7470/7471), ug/l	0.20U	0.20U	0.20U	0.20U	0.20U
Date Analyzed	11.22.93	11.22.93	11.22.93	11.22.93	11.22.93
Nickel (6010)					
Nickel (6010), ug/l	40U	40U	40U	40U	150
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93

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46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
Potassium (6010)					
Potassium (6010), ug/l	36000	14000	8600	10000	5000
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Selenium (7740)					
Selenium (7740), ug/l	10UWN	10UWN	10UN	10UN	10UN
Date Analyzed	11.22.93	11.22.93	11.22.93	11.22.93	11.22.93
Silver (6010)					
Silver (6010), ug/l	10U	10U	10U	10U	10U
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Sodium (6010)					
Sodium (6010) , ug/l	66000	160000	4800	3700	17000
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Thallium (7841)					
Thallium (7841) , ug/l	50U	10UW	10U	10U	10U
Date Analyzed	11.30.93	11.29.93	11.29.93	11.29.93	11.29.93
Vanadium (6010)					
Vanadium (6010), ug/l	10U	10U	10U	10U	10U
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93
Zinc (6010)					
Zinc (6010), ug/l	23	20U	30	20U	20
Date Analyzed	11.29.93	11.29.93	11.29.93	11.29.93	11.29.93

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46442-4	CNSY/S25-W02-01	11-12-93/1100	CNS22
46442-5	CNSY/S25-W03-01	11-12-93/1155	CNS22

PARAMETER	46442-1	46442-2	46442-3	46442-4	46442-5
Cyanide					
Cyanide, Total (9012), ug/l	10UN	10UN	10UN	10UN	10UN
Date Analyzed	11.23.93	11.26.93	11.23.93	11.22.93	11.22.93

SWMU 22
ANALYTICAL RESULTS
(SOIL AND GROUNDWATER)

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)				
Site Sample Type Sample Number Sample Interval	SWMU 22 Soil S22-B01 0' - 1'	SWMU 22 Soil S22-B01 3' - 5'	SWMU 22 Soil S22-B02 0' - 1'	SWMU 22 Soil S22-B02 3' - 5'
PARAMETER				
***INORGANICS* (units of concentration mg/kg)**				
Aluminum	5100	7200	6500	5400
Arsenic	-	9.9 J	-	-
Barium	30	290	37	15
Cadmium	-	0.69	-	-
Calcium	1300	440	2300	630
Chromium	10	26	31	8.0
Cobalt	-	1.3	-	-
Copper	6.1	-	4.8	-
Iron	6700	43000	4000	3200
Lead	7.9 J	8.2 J	15 J	2.2 J
Magnesium	270	430	210	150
Manganese	37 J	39 J	73 J	29 J
Mercury	0.18	0.029	0.048	0.029
Potassium	240	500	170	140
Sodium	-	120	-	-
Vanadium	12	50	5.1	4.1
Zinc	15 J	6.2 J	8.6 J	3.2 J

J - Indicates an estimated value

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)				
Site **Sample Type** **Sample Number** **Sample Interval**	**SWMU 22** **Soil** **S22-B01** **0' - 1'**	**SWMU 22** **Soil** **S22-B01** **3' - 5'**	**SWMU 22** **Soil** **S22-B02** **0' - 1'**	**SWMU 22** **Soil** **S22-B02** **3' - 5'**
***SEMIVOLATILES* (units of concentration μg/kg)**				
Anthracene	42 J	-	-	-
Benzo(b)fluoranthene	40 J	-	-	-
Di-n-butylphalate	-	-	-	55 J
Fluoranthene	42 J	-	-	-
Pyrene	45 J	-	-	-
***VOLATILES* (units of concentration μg/kg)**				
Acetone	-	-	88	-

J - Indicates an estimated value

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

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LOG NO: S3-45710

Received: 09 OCT 93

Mr. Paul Stoddard
EnSafe/Allen & Hoshall
5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Purchase Order: 041100/93

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-6	CNSY/S22-R1008	10-08-93/1630	CNS09

PARAMETER	45710-6
Volatiles by GC/MS (8240)	
Chloromethane, ug/l	10U
Bromomethane, ug/l	10U
Vinyl Chloride, ug/l	10U
Chloroethane, ug/l	10U
Methylene Chloride, ug/l	5.0U
Acetone, ug/l	50U
Carbon Disulfide, ug/l	5.0U
1,1-Dichloroethene, ug/l	5.0U
1,1-Dichloroethane, ug/l	5.0U
Trans-1,2-Dichloroethylene, ug/l	5.0U
Cis-1,2-Dichloroethene, ug/l	5.0U
Chloroform, ug/l	5.0U
1,2-Dichloroethane, ug/l	5.0U
2-Butanone (MEK), ug/l	50U
1,1,1-Trichloroethane, ug/l	5.0U
Carbon Tetrachloride, ug/l	5.0U
Vinyl Acetate, ug/l	5.0U
Bromodichloromethane, ug/l	5.0U
1,1,2,2-Tetrachloroethane, ug/l	5.0U
1,2-Dichloropropane, ug/l	5.0U
Trans-1,3-Dichloropropene, ug/l	5.0U
Trichloroethene, ug/l	5.0U
Dibromochloromethane, ug/l	5.0U

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Received: 09 OCT 93

Purchase Order: 041100/93

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EnSafe/Allen & Hoshall
5720 Summer Trees Dr. Suite 8
Memphis, TN 38134

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-6	CNSY/S22-R1008	10-08-93/1630	CNS09

PARAMETER	45710-6
1,1,2-Trichloroethane, ug/l	5.0U
Benzene, ug/l	5.0U
Cis-1,3-Dichloropropene, ug/l	5.0U
Bromoform, ug/l	5.0U
2-Hexanone, ug/l	50U
4-Methyl-2-pentanone (MIBK), ug/l	50U
Tetrachloroethene, ug/l	5.0U
Toluene, ug/l	5.0U
Chlorobenzene, ug/l	5.0U
Ethylbenzene, ug/l	5.0U
Styrene, ug/l	5.0U
Xylenes, ug/l	5.0U
Surrogate - Toluene-d8	104 %
Surrogate - 4-Bromofluorobenzene	87 %
Surrogate - 1,2-Dichloroethane-d4	92 %
Date Analyzed	10.21.93

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Received: 09 OCT 93

Purchase Order: 041100/93

Mr. Paul Stoddard
EnSafe/Allen & Hoshall
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Memphis, TN 38134

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-6	CNSY/S22-R1008	10-08-93/1630	CNS09

PARAMETER	45710-6
Semivolatiles (8270)	
Phenol, ug/l	10U
bis(2-Chloroethyl)ether, ug/l	10U
2-Chlorophenol, ug/l	10U
1,3-Dichlorobenzene, ug/l	10U
1,4-Dichlorobenzene, ug/l	10U
1,2-Dichlorobenzene, ug/l	10U
2-Methylphenol (o-cresol), ug/l	10U
Bis(2-chloroisopropyl)ether, ug/l	10U
3-Methylphenol/4-Methylphenol(m&p-cresol), ug/l	10U
N-Nitroso-di-n-propylamine, ug/l	10U
Hexachloroethane, ug/l	10U
Nitrobenzene, ug/l	10U
Isophorone, ug/l	10U
2-Nitrophenol, ug/l	10U
2,4-Dimethylphenol, ug/l	10U
bis(2-Chloroethoxy)methane, ug/l	10U
2,4-Dichlorophenol, ug/l	10U
1,2,4-Trichlorobenzene, ug/l	10U
Naphthalene, ug/l	10U
4-Chloroaniline, ug/l	20U
Hexachlorobutadiene, ug/l	10U
4-Chloro-3-methylphenol, ug/l	10U
2-Methylnaphthalene, ug/l	10U

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Memphis, TN 38134

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-6	CNSY/S22-R1008	10-08-93/1630	CNS09

PARAMETER	45710-6		
Hexachlorocyclopentadiene, ug/l	10U		
2,4,6-Trichlorophenol, ug/l	10U		
2,4,5-Trichlorophenol, ug/l	10U		
2-Chloronaphthalene, ug/l	10U		
2-Nitroaniline, ug/l	50U		
Dimethylphthalate, ug/l	10U		
Acenaphthylene, ug/l	10U		
3-Nitroaniline, ug/l	50U		
Acenaphthene, ug/l	10U		
2,4-Dinitrophenol, ug/l	50U		
4-Nitrophenol, ug/l	50U		
Dibenzofuran, ug/l	10U		
2,4-Dinitrotoluene, ug/l	10U		
2,6-Dinitrotoluene, ug/l	10U		
Diethylphthalate, ug/l	10U		
4-Chlorophenyl-phenyl ether, ug/l	10U		
Fluorene, ug/l	10U		
4-Nitroaniline, ug/l	50U		
4,6-Dinitro-2-methylphenol, ug/l	50U		
N-Nitrosodiphenylamine/Diphenylamine, ug/l	10U		
4-Bromophenyl-phenyl-ether, ug/l	10U		
Hexachlorobenzene, ug/l	10U		
Pentachlorophenol, ug/l	50U		
Phenanthrene, ug/l	10U		

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Purchase Order: 041100/93

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-6	CNSY/S22-R1008	10-08-93/1630	CNS09

PARAMETER	45710-6
Anthracene, ug/l	10U
Di-n-butylphthalate, ug/l	10U
Fluoranthene, ug/l	10U
Pyrene, ug/l	10U
Butylbenzylphthalate, ug/l	10U
3,3'-Dichlorobenzidine, ug/l	20U
Benzo(a)anthracene, ug/l	10U
bis(2-Ethylhexyl)phthalate, ug/l	10U
Chrysene, ug/l	10U
Di-n-octylphthalate, ug/l	10U
Benzo(b)fluoranthene, ug/l	10U
Carbazole, ug/l	10U
Benzo(k)fluoranthene, ug/l	10U
Benzo(a)pyrene, ug/l	10U
Indeno(1,2,3-cd)pyrene, ug/l	10U
Dibenz(a,h)anthracene, ug/l	10U
Benzo(g,h,i)perylene, ug/l	10U
Surrogate - Phenol d 5	80 %
Surrogate - 2-Fluorophenol	75 %
Surrogate - 2,4,6-Tribromophenol	109 %
Surrogate - Nitrobenzene d-5	85 %
Surrogate - 2-Fluorobiphenyl	82 %
Surrogate - Terphenyl	106 %
Date Extracted	10.13.93
Date Analyzed	10.23.93

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Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-6	CNSY/S22-R1008	10-08-93/1630	CNS09

PARAMETER	45710-6
Aluminum (6010)	
Aluminum (6010) , ug/l	200U
Date Analyzed	10.21.93
Antimony (6010)	
Antimony (6010) , ug/l	50U
Date Analyzed	10.21.93
Arsenic (7060)	
Arsenic (7060), ug/l	10U
Date Analyzed	10.26.93
Barium (6010)	
Barium (6010), ug/l	10U
Date Analyzed	10.21.93
Beryllium	
Beryllium (6010), ug/l	5.0U
Date Analyzed	10.21.93
Cadmium (6010)	
Cadmium (6010), ug/l	5.0U
Date Analyzed	10.21.93
Calcium (6010)	
Calcium (6010), ug/l	610
Date Analyzed	10.21.93
Chromium (6010)	
Chromium (6010), ug/l	10U
Date Analyzed	10.21.93

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Project: CTO-029 (SDG CNS09)
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REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-6	CNSY/S22-R1008	10-08-93/1630	CNS09

PARAMETER	45710-6
Cobalt (6010)	
Cobalt (6010), ug/l	10U
Date Analyzed	10.21.93
Copper (6010)	
Copper (6010), ug/l	25U
Date Analyzed	10.21.93
Iron (6010)	
Iron (6010), ug/l	50U
Date Analyzed	10.21.93
Lead (7421)	
Lead (7421), ug/l	5.0U
Date Analyzed	10.29.93
Magnesium (6010)	
Magnesium (6010), ug/l	500U
Date Analyzed	10.21.93
Manganese (6010)	
Manganese (6010), ug/l	10U
Date Analyzed	10.21.93
Mercury	
Mercury (7470/7471), ug/l	0.20U
Date Analyzed	10.22.93
Nickel (6010)	
Nickel (6010), ug/l	40U
Date Analyzed	11.02.93

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REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
45710-6	CNSY/S22-R1008	10-08-93/1630	CNS09

PARAMETER	45710-6
Potassium (6010)	
Potassium (6010), ug/l	1000U
Date Analyzed	10.21.93
Selenium (7740)	
Selenium (7740), ug/l	10U
Date Analyzed	10.26.93
Silver (6010)	
Silver (6010), ug/l	10U
Date Analyzed	10.21.93
Sodium (6010)	
Sodium (6010) , ug/l	500U
Date Analyzed	10.21.93
Thallium (7841)	
Thallium (7841) , ug/l	10U
Date Analyzed	10.29.93
Vanadium (6010)	
Vanadium (6010), ug/l	10U
Date Analyzed	10.21.93
Zinc (6010)	
Zinc (6010), ug/l	20U
Date Analyzed	10.21.93
Cyanide	
Cyanide, Total (9011/9012), ug/l	10U
Date Analyzed	10.14.93

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Received: 09 OCT 93

Purchase Order: 041100/93

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Memphis, TN 38134

Project: CTO-029 (SDG CNS09)
Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE SAMPLED	SDG#
45710-7	CNSY/S22-T1008	10-08-93	CNS09

PARAMETER	45710-7
Volatiles by GC/MS (8240)	
Chloromethane, ug/l	10U
Bromomethane, ug/l	10U
Vinyl Chloride, ug/l	10U
Chloroethane, ug/l	10U
Methylene Chloride, ug/l	5.0U
Acetone, ug/l	50U
Carbon Disulfide, ug/l	5.0U
1,1-Dichloroethene, ug/l	5.0U
1,1-Dichloroethane, ug/l	5.0U
Trans-1,2-Dichloroethylene, ug/l	5.0U
Cis-1,2-Dichloroethene, ug/l	5.0U
Chloroform, ug/l	5.0U
1,2-Dichloroethane, ug/l	5.0U
2-Butanone (MEK), ug/l	50U
1,1,1-Trichloroethane, ug/l	5.0U
Carbon Tetrachloride, ug/l	5.0U
Vinyl Acetate, ug/l	10U
Bromodichloromethane, ug/l	5.0U
1,1,2,2-Tetrachloroethane, ug/l	5.0U
1,2-Dichloropropane, ug/l	5.0U
Trans-1,3-Dichloropropene, ug/l	5.0U
Trichloroethene, ug/l	5.0U
Dibromochloromethane, ug/l	5.0U

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Sampled By: Client

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE SAMPLED	SDG#
45710-7	CNSY/S22-T1008	10-08-93	CNS09

PARAMETER	45710-7
1,1,2-Trichloroethane, ug/l	5.0U
Benzene, ug/l	5.0U
Cis-1,3-Dichloropropene, ug/l	5.0U
Bromoform, ug/l	5.0U
2-Hexanone, ug/l	50U
4-Methyl-2-pentanone (MIBK), ug/l	50U
Tetrachloroethene, ug/l	5.0U
Toluene, ug/l	5.0U
Chlorobenzene, ug/l	5.0U
Ethylbenzene, ug/l	5.0U
Styrene, ug/l	5.0U
Xylenes, ug/l	5.0U
Surrogate - Toluene-d8	112 %
Surrogate - 4-Bromofluorobenzene	85 %
Surrogate - 1,2-Dichloroethane-d4	92 %
Date Analyzed	10.21.93

SWMU 25
ANALYTICAL RESULTS
(SOIL AND GROUNDWATER)

NAVBASE CHARLESTON Soil and Sediment Analytical Results (Fall, 1993)		
Site Sample Type Sample Number	SWMU 25 Soil S25-B01 0' - 1'	SWMU 25 Soil S25-B01 3' - 5'
PARAMETER		
***INORGANICS* (units of concentration µg/l)**		
Aluminum	3500	2100
Arsenic	1.1 J	2.5 J
Barium	10 J	13 J
Cadmium	-	1.5
Calcium	1900	1500
Chromium	6.9 J	4.5 J
Copper	10 J	-
Iron	1800	3300
Lead	16	4.7
Magnesium	280 J	130 J
Manganese	11 J	16 J
Mercury	0.26	0.015
Potassium	120 J	120 J
Vanadium	4.7	6.2
Zinc	31 J	8.4 J
SEMIVOLATILES (units of µg/kg)		
Fluoranthene	33 J	-
Pyrene	48 J	-

J - Indicates an estimated value

NAVBASE CHARLESTON Groundwater Analytical Results (Fall, 1993)			
Site Sample Type Well Number	SWMU 25 Water CNSY-25-01	SWMU 25 Water CNSY-25-02	SWMU 25 Water CNSY-25-03
PARAMETER			
INORGANICS **(units of concentration μg/l)**			
Aluminum	220	-	200
Barium	26	19	-
Cadmium	-	-	17 J
Calcium	2200	12000	56000
Chromium	18	670	390
Iron	55	-	210
Magnesium	2000	2700	4900
Manganese	16	27	530
Nickel	-	-	150
Potassium	8600	10000	5000
Sodium	4800	3700	17000
Zinc	30	-	20
SEMIVOLATILES **(units of concentration μg/l)**			
Naphthalene	-	-	3.7 J
VOLATILES **(units of concentration μg/l)**			
Tetrachloroethene	-	-	7.3

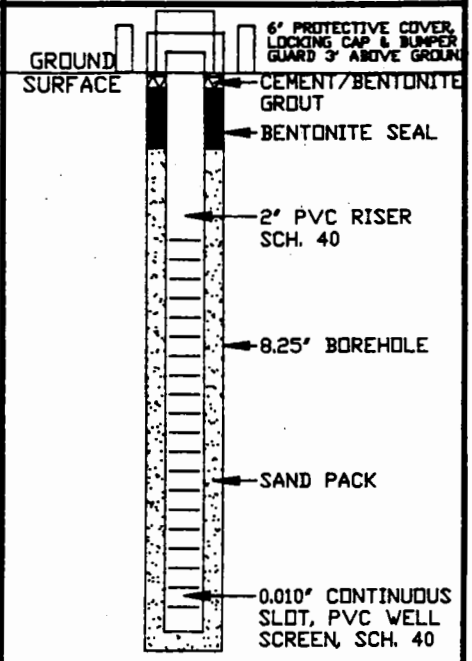
J - Indicates an estimated value

APPENDIX D
LOCATION MAPS AND WELL CONSTRUCTION LOGS FROM PREVIOUS INVESTIGATIONS

SWMU 21 WELL CONSTRUCTION LOGS

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	BLOWS/FT.	USCS SYMBOL	DESCRIPTION OF SUBSURFACE MATERIALS
					SURFACE – SAND BLAST GRIT
	HA	100			
	SS	80	8–10 12–14	SC/ PT	BLACK/DARK BROWN SAND; HIGHLY ORGANIC (WOOD CHIPS); SOME CLAY; WET; METAL SCREW IN SPOON
5					WATER AT 6 FT.
	SS	25	6–8 10–12	SM/ PT	BLACK/BROWN SAND; HIGHLY ORGANIC; SPONGY; SOME SILT AND GRAVEL
10					
	SS	100	6–8 2–3	SM/ PT SC/ PT PT	13–14' SAME AS ABOVE 14–14.5' SAME AS ABOVE WITH CLAY; LOCALLY MOSTLY CLAY 14.5–15' BLACK/BROWN ORGANICS; WOOD PULP; MODERATLEY COMPACTED; SATURATED
15					
20					
25					
30					
35					SS – SPLIT SPOON HA – HAND AUGER TR – TROWEL PD – POST HOLE DIGGER BA – BUCKET AUGER

WELL CONSTRUCTION DETAILS



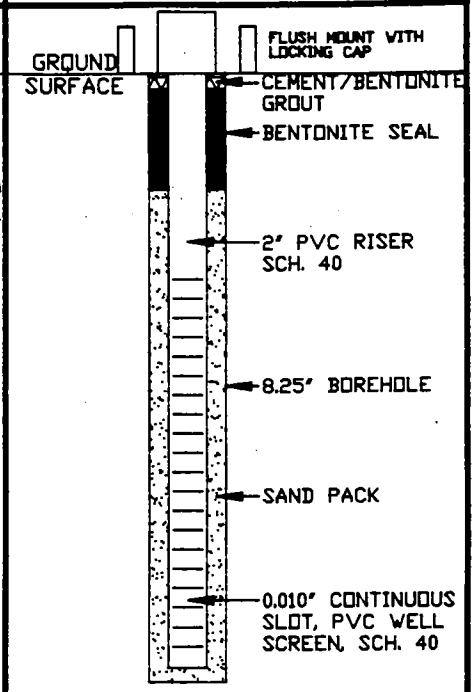
RFI
ZONE H WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

CNSY–21–01
MONITORING WELL
CHARLESTON NAVAL SHIP YARD
CHARLESTON, SC

DWG DATE: 07/22/94 | DWG NAME: 29CNS211

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	BLOWS/FT.	USCS SYMBOL	DESCRIPTION OF SUBSURFACE MATERIALS
					SURFACE – ASPHALT
	HA	100			
	HA			SP	LIGHT BROWN MEDIUM SAND; WELL SORTED; SATURATED
5					
	SS	50	3–5 9–10	ML ML ML	13–13.3' BROWN CLAYEY, SANDY SILT; SATURATED 13.3–13.6' BROWN SILT; STIFF; SATURATED 13.6–14' BROWN CLAYEY, SANDY SILT; SATURATED
10					
	SS	100	2–3 4–3	CL	BROWN/BLACK SILTY CLAY; STIFF TO FIRM; SATURATED
15					
20					
25					
30					
35					SS – SPLIT SPOON HA – HAND AUGER TR – TROWEL PD – POST HOLE DIGGER BA – BUCKET AUGER

WELL CONSTRUCTION DETAILS



RFI
ZONE H WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

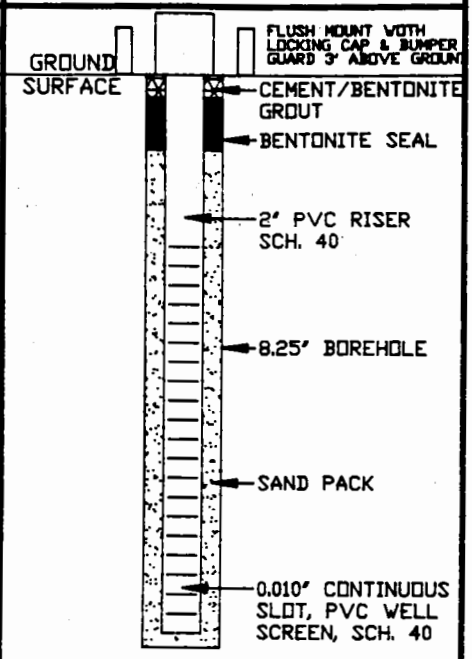
CNSY–21–02
MONITORING WELL
CHARLESTON NAVAL SHIP YARD
CHARLESTON, SC

DWG DATE: 07/22/94 | DWG NAME: 29CNS212

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	BLOWS/FT.	USCS SYMBOL	DESCRIPTION OF SUBSURFACE MATERIALS
					SURFACE – CONCRETE AND ASPHALT
	HA	100		SP	BROWN MEDIUM SAND
	SS	100	80+		3–3.5' RECOVERY PROBABLY SLOUGH (FILL MATERIAL – SAND, SILT AND GRAVEL; SPONGY)
5					WATER AT 6 FT.
	SS	50		PT	8–9' BLACK ORGANIC MATERIAL; CLAYEY WITH SAND AND WOOD/FIBER MATERIAL; STRONG H2S ODOR
10					
	SS	50	10–5 5–15	SP	13–14' LIGHT GRAY FINE TO MEDIUM SAND; SATURATED
15					
20					
25					
30					
35					

SS – SPLIT SPOON
HA – HAND AUGER
TR – TROWEL
PD – POST HOLE DIGGER
BA – BUCKET AUGER

WELL CONSTRUCTION DETAILS



RFI
ZONE H WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

CNSY–21–03
MONITORING WELL
CHARLESTON NAVAL SHIP YARD
CHARLESTON, SC

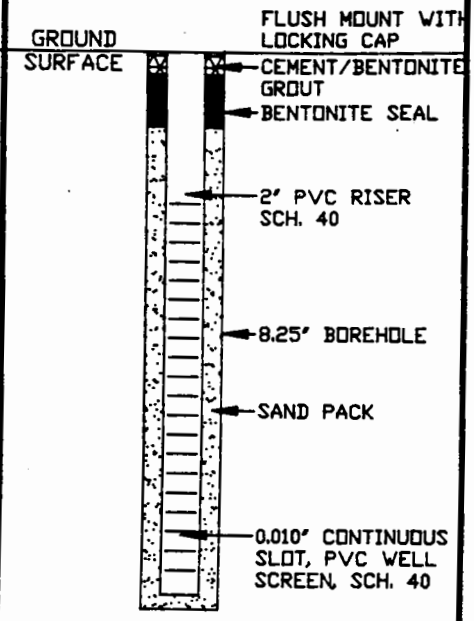
DWG DATE: 07/22/94 | DWG NAME: 29CNS213

SWMU 25 WELL CONSTRUCTION LOGS

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	BLOWS/FT.	USCS SYMBOL	DESCRIPTION OF SUBSURFACE MATERIALS
					SURFACE – ASPHALT
	HA	100			
	SS	80	8–12 30–30	SC	4–5.7' BROWN (WITH GRAY MOTTLING) CLAYED SAND; STIFF; FRIABLE; MOIST
5					
					WATER AT 6.25'
	SS	100	20–20 20–30	SC SP SC	8–9' BROWN CLAYEY SAND; STIFF 9–9.5' LIGHT GRAY FINE SAND; SOFT; WELL SORTED; SATURATED 9.5–10' BROWN/LIGHT BROWN MOTTLED CLAYEY SAND; SOME SILT AND GRAVEL; FRIABLE; SATURATED
10					
	SS	75	9–15 30–50	SP CL	13–13.5' LIGHT GRAY FINE SAND; SOFT; SATURATED 13.5–14.5' LIGHT GRAY SANDY CLAY; EXTREMELY STIFF; SATURATED
15					
20					
25					
30					
35					

SS – SPLIT SPOON
HA – HAND AUGER
TR – TROWEL
PD – POST HOLE DIGGER
BA – BUCKET AUGER

WELL CONSTRUCTION DETAILS



RFI
ZONE H WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

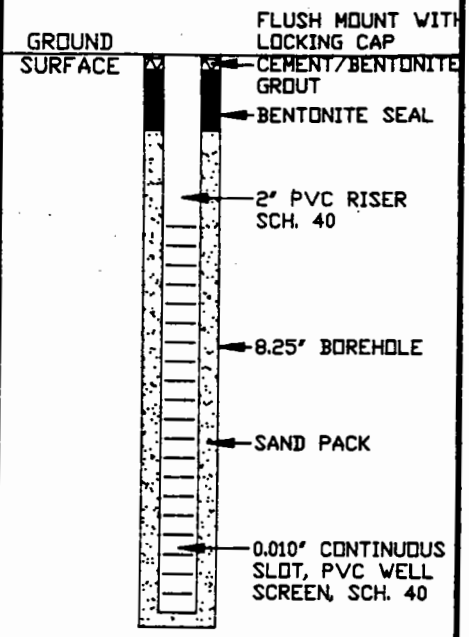
CNSY–25–01
MONITORING WELL
CHARLESTON NAVAL SHIP YARD
CHARLESTON, SC

DWG DATE: 07/22/94 | DWG NAME: 29CNS251

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	BLOWS/FT.	USCS SYMBOL	DESCRIPTION OF SUBSURFACE MATERIALS
					SURFACE – ASPHALT AND CONCRETE
	PD	100			
	PD	100		SP	3–5' BROWN FINE TO MEDIUM SAND; WELL SORTED; MOIST
5					
					WATER AT 6 FT.
	SS	75	20–10 15–30	SP/ SC	8–9.5' LIGHT BROWN FINE TO MEDIUM SAND; SOME CLAY FROM 8–8.5 FT.; WELL SORTED; SATURATED
10					
	SS	50	14–17 30–40	SP SC	13–13.5' SAME AS ABOVE 13.5–14' SAME AS ABOVE WITH CLAY; SATURATED
15					
20					
25					
30					
35					

SS – SPLIT SPOON
HA – HAND AUGER
TR – TROWEL
PD – POST HOLE DIGGER
BA – BUCKET AUGER

WELL CONSTRUCTION DETAILS



RFI
ZONE H WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

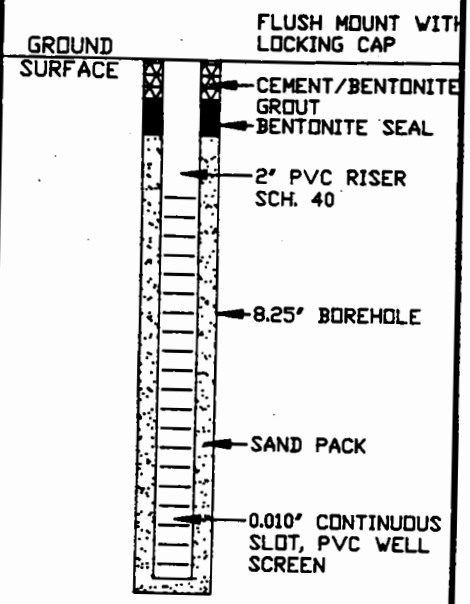
CNSY–25–02
MONITORING WELL
CHARLESTON NAVAL SHIP YARD
CHARLESTON, SC

DWG DATE: 07/22/94 | DWG NAME: 29CNS252

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	BLOWS/FT.	USCS SYMBOL	DESCRIPTION OF SUBSURFACE MATERIALS
					SURFACE – CONCRETE APPROX. 0.8 FT. – THICK
	HA	100		SP/SM	1–2' LIGHT BROWN FINE SAND; MINOR FINES, SLIGHTLY MOIST
	HA	100		SM	3–5' ORANGE–BROWN FINE SAND; SLIGHTLY MORE FINES AND MORE MOIST
5				SC	6' CLAYEY AND VERY MOIST
				SC	7–13' CUTTINGS ORANGE – BROWN FINE SAND WITH CLAY, SATURATED
10					
15					
20					
25					
30					
35					

SS – SPLIT SPOON
HA – HAND AUGER
TR – TROWEL
PD – POST HOLE DIGGER

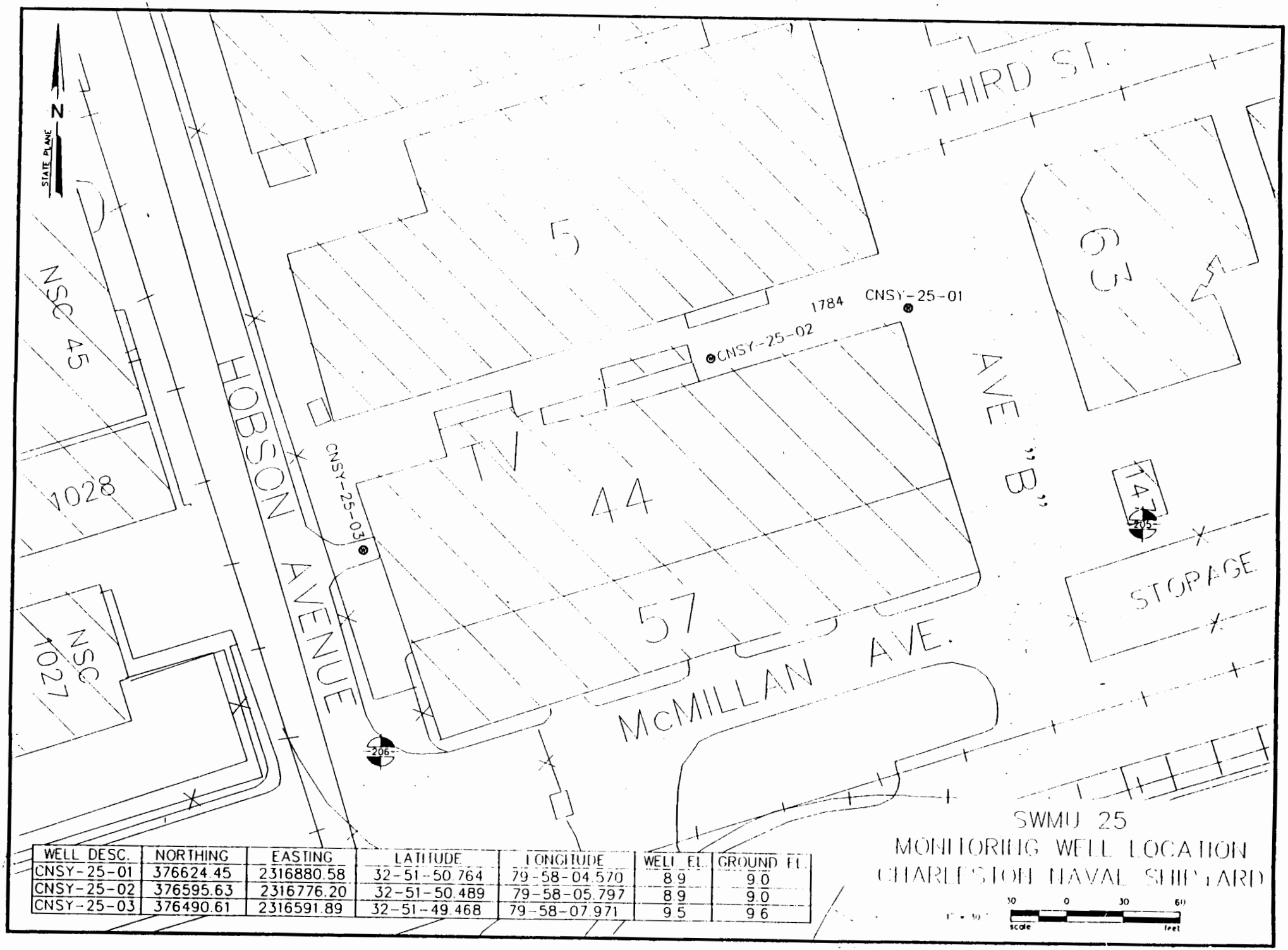
WELL CONSTRUCTION DETAILS



RFI
ZONE H WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

CNSY–25–03
MONITORING WELL
CHARLESTON NAVAL SHIP YARD
CHARLESTON, SC

DWG DATE: 07/22/94 | DWG NAME: 29CNS253



WELL DESC.	NORTHING	EASTING	LATITUDE	LONGITUDE	WELL EL.	GROUND EL.
CNSY-25-01	376624.45	2316880.58	32-51-50.764	79-58-04.570	8.9	9.0
CNSY-25-02	376595.63	2316776.20	32-51-50.489	79-58-05.797	8.9	9.0
CNSY-25-03	376490.61	2316591.89	32-51-49.468	79-58-07.971	9.5	9.6

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division — 2600 Bull Street — Columbia, S.C. 29201 — (803) 734-5331 — Water Well Record

CNSY-25-01

1. LOCATION OF WELL

County: See attached map — System Name:

Latitude: — Longitude:

Distance And Direction from Road Intersections

Street address & City of Well Location

Sketch Map: (See example on back)

2. CUTTING SAMPLES ☐ Yes ☑ No — Split spoon

Geophysical Logs ☐ Yes (Please enclose) ☑ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
See attached boring log.		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL: Charleston Naval Shipyard

Address: Environmental Division, Bldg 76, Charleston, SC 29408

Telephone No.

Engineer: Ron DeWitt

Address: Code 106

Telephone No. 803-743-5519

5. WELL DEPTH (Completed) ~~13.97 14.4~~ 13.97 — Date Started 10/8/93 — Date Completed 10/8/93

6. ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☑ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☑ Test Well ☐

8. CASING ☑ Threaded ☐ Welded

Diam. 2" ID — Height: Above/Below Surface N/A ft.

Type ☑ PVC ☐ Galvanized ☐ Steel ☐ Other — Weight N/A lbs./ft.

2 in. to 3.97 ft. depth — Drive Shoe? ☐ Yes ☐ No

____ in. to ____ ft. depth

9. SCREEN: Type PVC — Diam. 2" ID

Slot/Gauze 0.010" — Length 10'

Set Between 13.97 ft. and 3.97 ft. — NOTE: MULTIPLE SCREENS USE SECOND SHEET

____ ft. and ____ ft.

Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL 5.75 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test ☐ Yes (Please enclose) N/A ☐ No

Yield

12. WATER QUALITY

Chemical Analysis ☐ Yes ☐ No N/A — Bacterial Analysis ☐ Yes ☐ No

Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No

Installed from 13.97 ft. to 2.0 ft.

Effective size 0.02" — uniformity coefficient 1.5

14. WELL GROUTED? ☑ Yes ☐ No

Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☑ Bentonite Pellets

Depth From 2.0 ft. to 0.5 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ Feet ____ Direction

Type N/A — Well disinfected upon completion ☐ Yes ☐ No — Type ____ Amount ____

16. PUMP: Date Installed ____ not installed ☐

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe N/A ____ ft. capacity ____ gpm

TYPE ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME: Virongroup — ADDRESS: [illegible] — CERT. NO. [illegible]

Signed [illegible] — Date 11-22-93

AUTHORIZED REPRESENTATIVE

NAVY CLEAN
ENSAFE/ALLEN & HOSHALL
(901) 383-9115

JOB NO.	CLIENT CNSY	LOCATION 25 ~~S22~~
DRILLING METHOD: Hollow Stem		BORING NO. B01
		SHEET OF
SAMPLING METHOD: SS		DRILLING
		START / FINISH
WATER LEVEL		TIME / TIME
TIME		
DATE		DATE / DATE 11-8-93
CASING DEPTH		

LOCATION OF BORING

DATUM ELEVATION

DRILLING CONTRACTOR

BY ___ CHK BY ___

DATE ___

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	TIME	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH
						0	
						1	
						2	
						3	
SS	24/20	1110	4.5	8.12. 30.30	—	4	
						5	
						6	
						7	
SS	24/24	1120	8-10	20.20 20.30		8	
						9	
						0	
						1	
						2	
SS	24/18	1130	13-15	9.13. 30.50		3	
						4	
						5	
						6	
						7	
						8	
						9	
						0	

SURFACE CONDITIONS:

Surface sample collected from asphalt ~ 1' bgs.

Dug with posthole diggers to 4' bgs to check for utilities.

Hollow Stem from 4' bgs down

Clayey Sand Brown with gray mottling, Stiff + Friable, Moist. Collected for analysis

8-9 Brown Clayey Sand Stiff

9-9.5 Fine Lt. Gray Sand well Sorted, Saturated Soft

9.5-10 Brown Clayey Sand with silt and gravels, Lt. mottling, Friable Saturated

13-13.5 Fine Lt Gray Sand Saturated, Soft

13.5-14.5 STIFF Lt. Gray Sandy Clay, Saturated

Well set at 14' bgs, 10' of 10 slot Screen 12' of "#0" Sand, 1.5' of bentonite pellets

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

CNSY-25-02

1. LOCATION OF WELL

County: System Name:

See attached map

Latitude: Longitude:

Distance And Direction from Road Intersections

Street address & City of Well Location

Sketch Map: (See example on back)

2. CUTTING SAMPLES ☐ Yes ☑ No Split spoon

Geophysical Logs ☐ Yes (Please enclose) ☑ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
See attached boring log.		

* Indicate water bearing zones

(Use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL: Charleston Naval Shipyard
Address: Environmental Division, Bldg. 76
Charleston, SC 29408
Telephone No.

Engineer: Ron DeWitt
Address: Code 106
Telephone No. 803-743-5519

5. WELL DEPTH (Completed) 14.42 ft. Date Started 10/8/93 Date Completed 10/8/93

6. ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☑ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☑ Test Well ☐

8. CASING ☑ Threaded ☐ Welded
Diam. 2" ID
Type ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 4.42 ft. depth
in. to ft. depth
Height: Above/Below Surface N/A ft
Weight N/A lbs./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN:
Type PVC Diam. 2" ID
Slot/Gauge 0.010" Length 10'
Set Between 14.42 ft. and 4.42 ft.
ft. and ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☑ Yes (Please enclose) ☐ No

10. STATIC WATER LEVEL
5.80 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
ft. after hrs. pumping G.P.M.
Pumping Test ☐ Yes (Please enclose) N/A ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No N/A Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No
Installed from 14.42 ft. to 2.0 ft.
Effective size 0.02" uniformity coefficient 1.5

14. WELL GROUTED? ☑ Yes ☐ No
Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☑ Bentonite Pellets
Depth From 2.0 ft. to 0.5 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: Feet Direction
Type N/A Well disinfected upon completion ☐ Yes Type ☐ No Amount

16. PUMP Date Installed not installed ☐
Mfr. name model no.
H.P. volts length of drop pipe ft. capacity gpm
TYPE: ☐ Submersible N/A ☑ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: [illegible] and this report is true to the best of my knowledge and belief.
REGISTERED BUSINESS NAME: Vind Group ADDRESS
CERT. NO.
Signed Date 11-22-93
OR PER REPRESENTATIVE

NAVY CLEANER
~~ENSAFE/ALLEN & HOSFALL~~
(901) 383-9115
S22-3D1

JOB NO.	CLIENT	LOCATION
	NSY	S22

DRILLING METHOD: Hollow Stem

BORING NO. B02

SHEET 1 OF

SAMPLING METHOD: Split Spoon

DRILLING START TIME 1410 DATE 10/8 FINISH TIME DATE

LOCATION OF BORING: Building

DATUM: Building

ELEVATION

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

SURFACE CONDITIONS: Asphalt + Concrete

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	TIME	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	
PD						0		Surface to 1' bgs sample collected below asphalt at 6"
						1		
						2		
PD						3		3.5 Sample collected with push hole digger Brown medium to fine sand Well sorted, Moist
						4		
						5		
						6		Wet at 6' bgs.
						7		
SS	24 / 12	1430	8-10	20.10. 15.30	–	8		8.9.5 Lt. Brown Medium to fine sand Well sorted, Saturated. Some clay at top of spoon.
						9		
						0		
						1		
						2		13-13.5 Same as above. 13.5-14.0 Same as above with clay balls. Saturated.
SS	24 / 12	1440	13-15	14.17. 30.40	–	3		
						4		
						5		
						6		Well set at 14' bgs. 10' of 10 slot screen 12' of sand 1.5' of bentonite pellets.
						7		
						8		
						9		
						0		

DRILLING CONTRACTOR _____

BY _____ CHK BY _____

DATE _____

SOIL CONSULTANTS, INC.

P.O. DRAWER 698
CHARLESTON, S.C. 29402
(803) 723-4539

P.O. BOX 1907
SAVANNAH, GA. 31402
(912) 236-5022

ORDER NO:
DATE: 10/20/93
REPORT NO: 93-1383

REPORT OF SIEVE ANALYSIS TEST

CLIENT: ENSAFE/ALLEN & HOSHALL

PROJECT: CHARLESTON NAVAL SHIPYARD CT029

SPECS.: ASTM C136-84

SIEVE SIZE	SPEC. LIMITS ASTM C33-90	SPEC. LIMITS SCHD FA-10	TEST RESULTS SAMPLE(S)
	(% PASSING)		
3/8"	100	100	100
1/4"			
No. 4	95-100	96-100	100
No. 8	80-100	75-100	100
No. 10			
No. 16	50-85	55-98	100 *
No. 20			
No. 30	25-60	25-75	99.7*
No. 40			
No. 50	10-30	8-30	97.9*
No. 80			
No. 100	2-10	0-9	7.6
No. 200			.5
No. 200W			
FINENESS MODULUS			
ORGANIC IMPURITIES	ASTM C40-84 PLATE NO. 3 MAX.		

REMARKS: * Unsatisfactory

SAMPLED: BY CLIENT

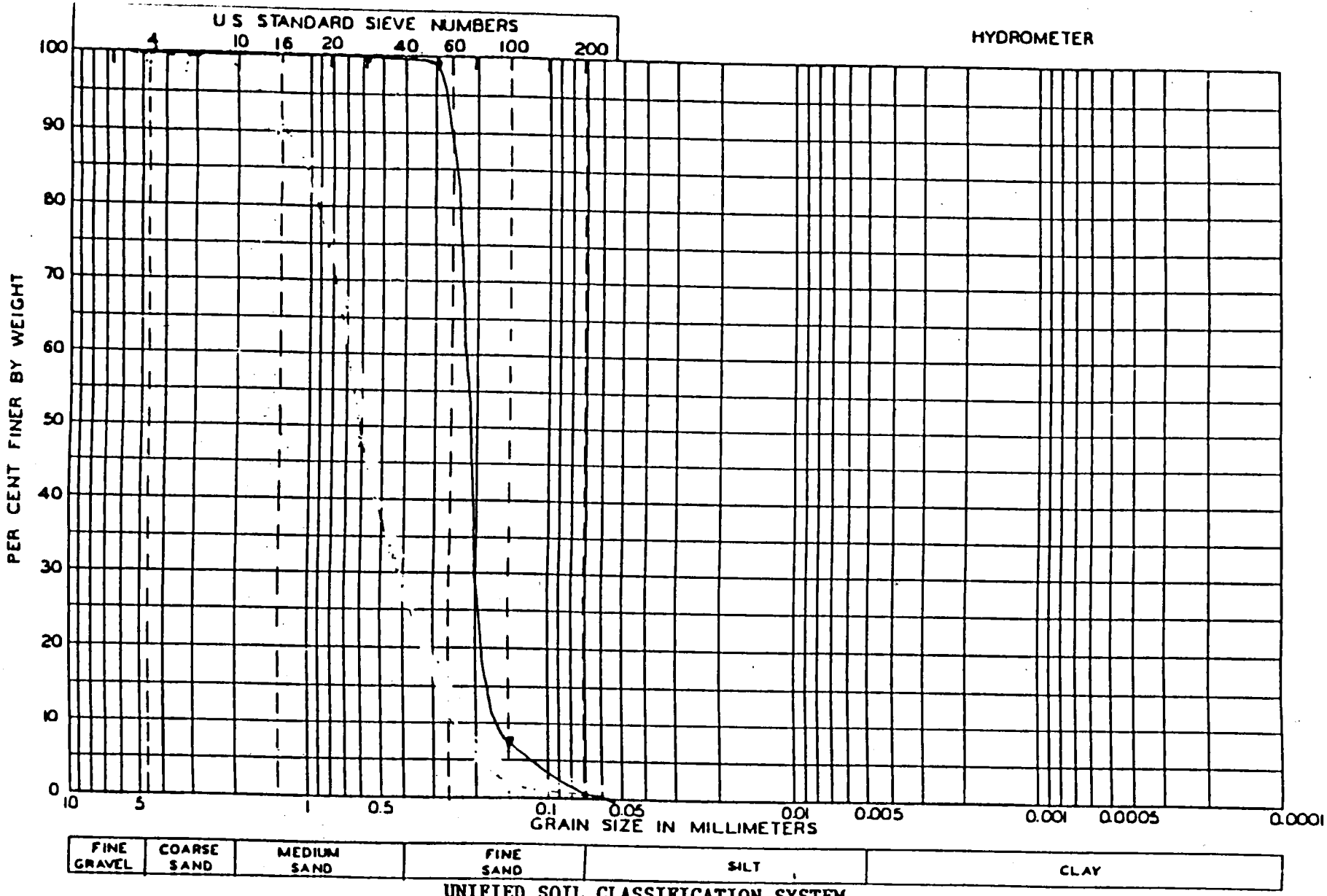
SOURCE : SAMPLE ID-CNSY-25-02 8'-10'

Respectfully Submitted:

SOIL CONSULTANTS, INC.

BY: Lonnie D. Dy
By Lee

FORM 8C



UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT _____ BORING NO _____ SAMPLE NO. 25-D2 (8-10')

DEPTH _____ ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION DIAGRAM

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

CNSY-25-03

1. LOCATION OF WELL

County: System Name:

See attached map.

Latitude: Longitude:

Distance And Direction from Road Intersections

Street address & City of Well Location

Sketch Map: See example on back)

2. CUTTING SAMPLES ☐ Yes ☑ No Split spoon

Geophysical Logs ☐ Yes (Please enclose) ☑ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
See attached boring log.		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL: Charleston Naval Shipyard

Address: Environmental Division, Bldg. 76, Charleston, SC 29408

Telephone No.

Engineer: Ron DeWitt

Address: Code 106

Telephone No. 803-743-5519

5. WELL DEPTH (Completed): 13.40 ft. Date Started: 11-2-93 Date Completed: 11-2-93

6. ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☑ Other

7. USE

☐ Domestic ☐ Public Supply Permit No. ☐ Industry

☐ Irrigation ☐ Air Conditioning ☐ Commercial

☑ Test Well ☐

8. CASING ☑ Threaded ☐ Welded

Diam: 2" ID

Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other

Height Above/Below Surface N/A ft. Weight N/A lbs. ft. ☐ Yes ☐ No

2 ft. to 3.40 ft. depth

ft. to ft. depth

9. SCREEN

Type: PVC Diam: 2" ID

Slot Gauze: 0.010" Length: 10'

Set Between 13.40 ft. and 3.40 ft.

ft. and ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL

5.70 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

ft. after N/A hrs. pumping G.P.M.

Pumping Test ☐ Yes (Please enclose) N/A ☐ No

Yield

12. WATER QUALITY

Chemical Analysis ☐ Yes ☐ No N/A Bacterial Analysis ☐ Yes ☐ No

Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No

Installed from 13.40 ft. to 2.0 ft.

Effective size uniformity coefficient

14. WELL GROUTED? ☑ Yes ☐ No

Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☑ Bentonite Pellets

Depth From 1.0 ft. to 2.0 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: Feet Direction

Type N/A Well disinfected upon completion ☐ Yes Type ☐ No Amount

16. PUMP Date Installed not installed ☐

Mfr. name model no.

H.P. volts N/A length of drop pipe ft. capacity gpm

TYPE ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME: Vico Group ADDRESS: [illegible]

CERT. NO. 426

Signed: [illegible] Date: 11-22-93

NAVY CLEAN
ENSAFE/ALLEN & HOSHALL
(901) 383-9115

JOB NO.	CLIENT	LOCATION
	EnSafe	S25

DRILLING METHOD: 4¼" HSA

BORING NO. ~~B01~~ B13

SHEET OF

SAMPLING METHOD: ~~SS~~ hand auger (HA)

LOCATION OF BORING: [illegible] west of Bldg. 44

DATUM ELEVATION

	START	FINISH
DRILLING TIME	0840	0920
DATE	11-2-93	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

SURFACE CONDITIONS: Concrete ≈ 0.2' thick

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	TIME	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH
						0	
HA		0900	01 / 1-2			1	
						2	
HA		0905	02 / 2-3			3	
						4	
						5	
						6	
						7	
						8	
						9	
						0	
						1	
						2	
						3	
						4	
						5	
						6	
						7	
						8	
						9	
						0	

01 sample – 1ft brown fine sand; some fines; slightly moist

[illegible] f. sand; slightly [illegible] fines; moist

[illegible] 1' – clay; very moist

cuttings to full depth: orange-brown silty f. sand w/ clay

Drilled depth 13'

0920 Begin well installation

1010 Finish sand pack installation (3½ bags) sand to 2'

Pour in bentonite pellets (≈ 1' thick)

DRILLING CONTRACTOR EPS

BY LAK CHK BY

DATE

APPENDIX E
MSDSs SHEETS

MSDSs are found in the MSDS Field Book, located in the EnSafe/Allen & Hoshall field trailer.

APPENDIX F
DIRECTIONS TO EMERGENCY MEDICAL FACILITIES

DIRECTIONS TO THE CHARLESTON NAVAL HOSPITAL

The nearest hospital to the site is the Charleston Naval Hospital. This hospital should be used for all life threating medical emergencies. For other medical services please use Baker Hospital.

Nearest Hospital

Charleston Naval Hospital
McMillan Avenue
Charleston, South Carolina

Emergency Room Telephone: (803) 743-7011
General Information Number: (803) 753-7000

Directions to Charleston Naval Hospital From the Main Gate of the Charleston Naval Shipyard.

1) Refer to following figure.

2) Exit Naval Base via Main Gate (McMillan Gate).

3) Proceed west, toward Rivers Road.

4) At the intersection of McMillan and Rivers, the hospital is on the left:
   - Hospital entrance is just before the intersection.
   - Hospital is approximately 1/2-mile from the Main Gate.

2000 Feet

1000 Meters

HEALTH AND SAFETY PLAN
NAVAL BASE
CHARLESTON
CHARLESTON, S.C.

HEALTH AND SAFETY
ZONE E
HOSPITAL DIRECTIONS

DWG DATE: 01/16/95 | DWG NAME: BOARD

APPENDIX G
HEALTH AND SAFETY PLAN ACCEPTANCE FORMS

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

INSTRUCTIONS: This form is to be completed by each person working on the project work site and returned to EnSafe/Allen & Hoshall, Memphis, Tennessee.

Job No:

Contract No: N62467-89-D-0318

Project:

I represent that I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

_____

Signed

_____

Print Name

_____

Company

_____

Date

PLAN FEEDBACK FORM

Problems with plan requirements:

_____

_____

_____

Unexpected situations encountered:

_____

_____

_____

_____

Recommendations for revisions:

_____

_____

_____

EMPLOYEE EXPOSURE HISTORY FORM

Employee: _____

Job Name: _____

Date(s) From/To: _____

Hours Onsite: _____

Contaminants (Suspected/Reported):

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(See Attached Laboratory Analysis)

ACCIDENT REPORT FORM

SUPERVISOR'S REPORT OF ACCIDENT	DO NOT USE FOR MOTOR VEHICLE OR AIRCRAFT ACCIDENTS
TO	FROM TELEPHONE (Include area code)

NAME OF INJURED OR ILL WORKER AND COMPANY

WORKER'S SOCIAL SECURITY NUMBER

DATE OF ACCIDENT	TIME OF ACCIDENT	EXACT LOCATION OF ACCIDENT

NARRATIVE DESCRIPTION OF ACCIDENT

NATURE OF ILLNESS OR INJURY AND PART OF BODY INVOLVED	LOST TIME YES ☐ NO ☐

PROBABLE DISABILITY (Check one)

FATAL ☐	LOST WORK DAY WITH ____DAYS AWAY FROM WORK	LOST WORK DAY WITH ____DAYS OF RESTRICTED ACTIVITY	NO LOST WORK DAY ☐ FIRST-AID ONLY ☐

CORRECTIVE ACTION RECOMMENDED (By whom and by when)

NAME OF SUPERVISOR	TITLE
	DATE

APPENDIX H
ZONE E HISTORIC STRUCTURE INVENTORY

TABLE H.1.a NAVBASE RCRA FACILITY INVESTIGATION ZONE E HISTORIC STRUCTURE INVENTORY					
Building Number	**Year Built**	**Current Use**	**AOC/SWMU Number**	**Foundation Sampling[1]**	**Perimeter Sampling[2]**
2	1906	Shipfitter Shop, Struc & Piping Group Office	***	***	***
2A	1937	Shipfitter Shop and Sail Loft	***	***	***
3	1905	Inside Machine Shop	SWMU 67	YES	YES
5	1905	Woodworking Shop	SWMU 22 SWMU 70 AOC 548 AOC 549 AOC 554	YES	YES
6	1906	Forge Shop and Propeller Repair Shop	AOC 538 AOC 539	YES	YES
9	1906	Temporary Services	SWMU 83 SWMU 84 AOC 574	YES	YES
10	1918	Nuclear Engineering Department	AOC 580	***	YES
13	1906	Quality Assurance Office & Supply Administration	SWMU 145	YES	YES
32	1909	Central Power Plant	AOC 559	YES	YES
35	1913	Welding School & Welding Engineers	AOC 530	YES	YES
43	1941	Central Tool Shop & Service Group Offices	***	***	***
44	1941	Supply & Shop Stores	SWMU 25	YES	YES
46	1941	Compressor & Salt Water Pumphouse	***	***	***
56	1937	Outside Machine Shop	***	***	***
57	1940	Rigger Shop	***	***	***
58A	1942	Shipyard Quality Field Office	***	***	***
59	1940	Sheetmetal Shop & Boiler Shop	***	***	***
62	1942	Operations Project Offices & Engineering	***	***	***

TABLE H.1.a NAVBASE RCRA FACILITY INVESTIGATION ZONE E HISTORIC STRUCTURE INVENTORY					
Building Number	**Year Built**	**Current Use**	**AOC/SWMU Number**	**Foundation Sampling[1]**	**Perimeter Sampling[2]**
63	1942	Yard Cafeteria No. 1	***	***	***
74	19422	Storehouse	***	***	***
77	1942	Substation, Restroom, Ship Support Office	AOC 558	YES	***
80	1943	Refueling Facility	AOC 576	YES	YES
84	1942	Substation DD No. 2	AOC 562	YES	YES
95	1943	Substation and Storage	AOC 602	YES	YES
96	1943	Substation and Storage	AOC 604	YES	YES
99	1943	Salt Water Pump House	***	***	***
147	1949	Storage (Shop 06)	***	***	***
221	1970	Pipe Shop Cleaning Plant	SWMU 65 AOC 544 AOC 546	YES	YES
222	1971	DD Support Repair Facility	***	***	***
226	1976	Plating Plant	SWMU 23 SWMU 63 AOC 540 AOC 543	YES	YES
250	N/A	Waterfront Service Support Building	***	***	***
301	1907	DD Number 1	SWMU 170 AOC 556	***	YES
301B	N/A	Pumphouse and Pumpwell	***	***	***
302	1942	DD Number 2	SWMU 171 AOC 556	***	YES
302B	1941	Pumpwell (Underground)	***	***	***
303	1943	Drydock (DD) Number 3	SWMU 106 AOC 556 AOC 603	***	YES
303B	1943	Pumpwell	***	***	***
304	1943	DD Number 4	AOC 556	***	YES
314	1942	Industrial Pier (D)	***	***	***

TABLE H.1.a NAVBASE RCRA FACILITY INVESTIGATION ZONE E HISTORIC STRUCTURE INVENTORY					
Building Number	**Year Built**	**Current Use**	**AOC/SWMU Number**	**Foundation Sampling[1]**	**Perimeter Sampling[2]**
317A	1942	Marginal Wharf	***	***	***
317B	1941	Repair Wharf (F)	***	***	***
317C	1916	Industrial Pier (F)	***	***	***
317D	1943	Industrial Pier (G)	***	***	***
317E	1942	Industrial Pier (H)	***	***	***
317F	1967	Industrial Pier (J)	AOC 598	YES	YES
333	1942	Industrial Pier (C)	***	***	***
342	1932	Substation	***	***	***
351	1936	Quaywall (E)	***	***	***
352	1942	Repair Wharf (C)	***	***	***
356	1943	Bulkhead, DD 3 to 4	***	***	***
414	1966	Fire Protection Pumping Station	***	***	***
457	1969	Switchgear, Substations & Production Offices	***	***	***
459	N/A	Switching Substation	AOC 531	***	YES
460	1974	Switching Substation	***	***	***
809	1988	Ship Work Support Building	***	***	***
1119	1942	Operations Support Offices (Waterfront)	AOC 551	***	YES
1127	1934	Preservation Shop & Bulk Storage	***	***	***
1190	1943	Compressor House	***	***	***
1292	1942	Time Clock Station No. 1	***	***	***
1298	1944	Brick Storage (Shop 41)	***	***	***
1299	1942	Shop Stores (Shop 41)	***	***	***
1314	1940	Materials Storage (Shop 81)	***	***	***
1712	1968	Storage	***	***	***
1717	N/A	Flushing Equipment Storage	***	***	***
1745	1970	Time Clock Station No. 9	***	***	***

TABLE H.1.a
NAVBASE RCRA FACILITY INVESTIGATION
ZONE E HISTORIC STRUCTURE INVENTORY

Building Number	Year Built	Current Use	AOC/SWMU Number	Foundation Sampling[1]	Perimeter Sampling[2]
1775	N/A	Sentry House	***	***	***
1783	1972	Sewage Pumping Station	***	***	***
1827	N/A	Time Clock Station	***	***	***
1828	N/A	Time Clock Station	***	***	***

Notes:

1 Zone E structures where soil borings and subsurface samples are proposed within the structure. Structure foundations will be repaired after sampling.

2 Structures where soil borings, subsurface samples, and/or groundwater monitoring wells are proposed along the outside perimeter of the structure.

TABLE H.1.b
NAVBASE RCRA FACILITY INVESTIGATION
ZONE E HISTORIC STRUCTURE INVENTORY

Building Number	Year Built	Current Use	AOC/SWMU Number	Foundation Sampling[1]	Perimeter Sampling[2]
5	1905	Woodworking Shop	SWMU 22 SWMU 70 AOC 548 AOC 549 AOC 554	YES	YES
226	1976	Plating Plant	SWMU 23 SWMU 63 AOC 540 AOC 543	YES	YES
44	1941	Supply & Shop Stores	SWMU 25	YES	YES
221	1970	Pipe Shop Cleaning Plant	SWMU 65 AOC 544 AOC 546	YES	YES
3	1905	Inside Machine Shop	SWMU 67	YES	YES
9	1906	Temporary Services	SWMU 83 SWMU 84 AOC 574	YES	YES
303	1943	Drydock (DD) Number 3	SWMU 106 AOC 556 AOOC 603	***	YES
13	1906	Quality Assurance Office & Supply Administration	SWMU 145	YES	YES
301	1907	DD Number 1	SWMU 170 AOC 556	***	YES
302	1942	DD Number 2	SWMU 171 AOC 556	***	YES
35	1913	Welding School & Welding Engineers	AOC 530	YES	YES
459	N/A	Switching Substation	AOC 531	***	YES
6	1906	Forge Shop and Propeller Repair Shop	AOC 538 AOC 539	YES	YES
1119	1942	Operations Support Offices (Waterfront)	AOC 551	***	YES
304	1943	DD Number 4	AOC 556	***	YES
77	1942	Substation, Restroom, Ship Support Office	AOC 558	YES	***

TABLE H.1.b
NAVBASE RCRA FACILITY INVESTIGATION
ZONE E HISTORIC STRUCTURE INVENTORY

Building Number	Year Built	Current Use	AOC/SWMU Number	Foundation Sampling[1]	Perimeter Sampling[2]
32	1909	Central Power Plant	AOC 559	YES	YES
84	1942	Substation DD No. 2	AOC 562	YES	YES
80	1943	Refueling Facility	AOC 576	YES	YES
10	1918	Nuclear Engineering Department	AOC 580	***	YES
317F	1967	Industrial Pier (J)	AOC 598	YES	YES
95	1943	Substation and Storage	AOC 602	YES	YES
96	1943	Substation and Storage	AOC 604	YES	YES
43	1941	Central Tool Shop & Service Group Offices	***	***	***
46	1941	Compressor & Salt Water Pumphouse	***	***	***
56	1937	Outside Machine Shop	***	***	***
57	1940	Rigger Shop	***	***	***
2A	1937	Shipfitter Shop and Sail Loft	***	***	***
2	1906	Shipfitter Shop, Struc & Piping Group Office	***	***	***
58A	1942	Shipyard Quality Field Office	***	***	***
59	1940	Sheetmetal Shop & Boiler Shop	***	***	***
62	1942	Operations Project Offices & Engineering	***	***	***
63	1942	Yard Cafeteria No. 1	***	***	***
74	19422	Storehouse	***	***	***
99	1943	Salt Water Pump House	***	***	***
147	1949	Storage (Shop 06)	***	***	***
222	1971	DD Support Repair Facility	***	***	***
250	N/A	Waterfront Service Support Building	***	***	***
301B	N/A	Pumphouse and Pumpwell	***	***	***

TABLE H.1.b NAVBASE RCRA FACILITY INVESTIGATION ZONE E HISTORIC STRUCTURE INVENTORY					
Building Number	**Year Built**	**Current Use**	**AOC/SWMU Number**	**Foundation Sampling[1]**	**Perimeter Sampling[2]**
302B	1941	Pumpwell (Underground)	***	***	***
303B	1943	Pumpwell	***	***	***
314	1942	Industrial Pier (D)	***	***	***
317C	1916	Industrial Pier (F)	***	***	***
317A	1942	Marginal Wharf	***	***	***
317E	1942	Industrial Pier (H)	***	***	***
317D	1943	Industrial Pier (G)	***	***	***
317B	1941	Repair Wharf (F)	***	***	***
333	1942	Industrial Pier (C)	***	***	***
342	1932	Substation	***	***	***
351	1936	Quaywall (E)	***	***	***
352	1942	Repair Wharf (C)	***	***	***
356	1943	Bulkhead, DD 3 to 4	***	***	***
414	1966	Fire Protection Pumping Station	***	***	***
457	1969	Switchgear, Substations & Production Offices	***	***	***
460	1974	Switching Substation	***	***	***
809	1988	Ship Work Support Building	***	***	***
1127	1934	Preservation Shop & Bulk Storage	***	***	***
1190	1943	Compressor House	***	***	***
1292	1942	Time Clock Station No. 1	***	***	***
1298	1944	Brick Storage (Shop 41)	***	***	***
1299	1942	Shop Stores (Shop 41)	***	***	***
1314	1940	Materials Storage (Shop 81)	***	***	***
1712	1968	Storage	***	***	***
1717	N/A	Flushing Equipment Storage	***	***	***
1745	1970	Time Clock Station No. 9	***	***	***

TABLE H.1.b
NAVBASE RCRA FACILITY INVESTIGATION
ZONE E HISTORIC STRUCTURE INVENTORY

Building Number	Year Built	Current Use	AOC/SWMU Number	Foundation Sampling[1]	Perimeter Sampling[2]
1775	N/A	Sentry House	***	***	***
1783	1972	Sewage Pumping Station	***	***	***
1827	N/A	Time Clock Station	***	***	***
1828	N/A	Time Clock Station	***	***	***

Notes:

1 Zone E structures where soil borings and subsurface samples are proposed within the structure. Structure foundations will be repaired after sampling.

2 Structures where soil borings, subsurface samples, and/or groundwater monitoring wells are proposed along the outside perimeter of the structure.

Attachment 1

Mercury Vapor Detector — Instrumentation and Procedures

INSTRUMENTATION AND PROCEDURES FOR MERCURY VAPOR MONITORING

The following procedure will be used to perform qualitative air monitoring as described in Section 2. The survey mode will be used during grid screening operations and during intensive activities. If mercury is detected, the sampling mode will be activated to determine concentration of mercury vapor for worker health and safety purposes only.

The Jerome Mercury Vapor Analyzer is a direct-reading gold film instrument. The gold film is part of a piezoelectric sensor whose electrical resistance increases proportional to the mass of mercury in ambient air. The mercury monitor has an internal pump that draws a precise volume of air over the gold film sensor. The mercury in the sample is adsorbed and integrated by the sensor, registering as a proportional change in electrical resistance. The resistance is converted into an equivalent concentration of mercury vapor. The instrument has a sensitivity of 0.003 milligrams per cubic meter (mg/m^3) and a measurement range of 0.000 to 1.999 mg/m^3 for mercury vapor.

The instrument has two modes: sample and survey. In the sample mode, samples are collected at 13-second intervals. The survey mode collects samples every 4 seconds. The sample mode has greater precision for determining ambient air concentrations of mercury vapor. The survey mode is useful for locating spills or to assess areas of potentially high mercury vapor concentration. Since mercury is adsorbed onto the gold film, the sensor may become saturated when sampling for extended periods or in high concentrations of mercury vapor. A 10-minute heating (regeneration) cycle is used to desorb contaminants on the gold film in order to increase sensitivity.

Operation of the Jerome Mercury Vapor Analyzer

(1) Turn the instrument on and allow it to warm up for 15 to 20 minutes.

(2) Check the percent of sensor saturation. If the sensor is more than half saturated, start the sensor regeneration cycle by pressing the REGEN button.

(3) Place the mercury-absorbent cartridge on the instrument's air intake. Zero the instrument by depressing the ZERO adjust button.

(4) The instrument will automatically be in the survey mode. If the sample mode is desired, press the SAMPLE button.

(5) The unit will display the mercury vapor concentration in appropriate units.

Attachment 2

SCDHEC R.61-62.5

40 CFR 50, Appendix G

40 CFR 50, Appendix J

Instruction and Operation Manual — High Volume PM10 Sampler

SOUTH CAROLINA AMBIENT AIR QUALITY STANDARDS

(South Carolina Department of Health and Environmental Control; Regulation 61-62.5 — Air Pollution Control Standards; Amended effective May 22, 1982; February 25, 1983; April 22, 1983; June 24, 1983; May 24, 1985; February 28, 1986; November 27, 1987; February 26, 1988; April 22, 1988; January 19, 1989; February 24, 1989; March 24, 1989; May 25, 1990; August 24, 1990; Corrected February 22, 1991; Amended effective May 24, 1991; June 26, 1992)

CONTENTS

Standard No. 1 — Emissions from Fuel Burning Operations
Standard No. 2 — Ambient Air Quality Standards
Standard No. 3 — Waste Combustion and Reduction
Standard No. 3.1 — Medical Waste Incineration
Standard No. 4 — Emissions from Process Industries
Standard No. 5 — Volatile Organic Compounds
Standard No. 5.1 — Lowest Achievable Emission Rate ("LAER") Applicable to Volatile Organic Compounds
Standard No. 6 — Alternative Emission Limitation Options
Standard No. 7 — Prevention of Significant Deterioration
Standard No. 8 — Toxic Air Pollutants

REGULATION NO. 62.5
AIR POLLUTION CONTROL STANDARDS

STANDARD NO. 1
EMISSIONS FROM FUEL BURNING OPERATIONS

SECTION I — VISIBLE EMISSIONS

A. Existing Sources

No one shall discharge to the ambient air from any existing source constructed prior to February 11, 1971, smoke which exceeds an opacity of forty (40) percent. For a total of six (6) minutes in one hour or twenty-four (24) minutes in a twenty-four (24) hour period, forty (40) percent opacity may be exceeded for soot blowing, but shall in no case exceed an opacity of sixty (60) percent.

B. New Sources

No one shall discharge to the ambient air from any source constructed on or after February 11, 1971, smoke which exceeds an opacity of twenty (20) percent. For a total of six (6) minutes in one hour or twenty-four (24) minutes in a twenty-four (24) hour period, twenty (20) percent opacity may be exceeded for soot blowing, but shall in no case exceed an opacity of sixty (60) percent.

C. Special Provisions

The opacity standards set forth above do not apply during startup or shutdown. Owners and operators shall, to the extent practicable, maintain and operate any source including associated air pollution control equipment in a manner consistent with good air pollution control practices for minimizing emissions. In addition, the owner or operator shall maintain a log of the time, magnitude, duration and any other pertinent information to determine periods of startup and shutdown and make available to the Department upon request.

D. Test Method

The method which is approved by the Department for determining compliance with opacity limitations under this Section is EPA Reference Method 9 (40 CFR 60, Appendix A, as revised July 1, 1986). Alternate methods may be utilized only if approved in advance by the Department and by the Environmental Protection Agency.

SECTION II — PARTICULATE MATTER EMISSIONS

A. Allowable Discharge

The allowable discharge of particulate matter resulting from fuel burning operations shall be limited to the values obtained by use of Figure 1 and/or Part B. (For the purpose of determining heat input, total equipment capacity refers to total equipment capacity discharging through each stack. If a boiler has more than one (1) stack the total rated capacity will be the boiler rated capacity discharging to these stacks). Interpolation of Figure 1 for fuel burning operations of 1300 million BTU per hour heat input and larger shall be accomplished by use of the equation:

$$E = 57.84\ P^{-0.637}$$

where E = the allowable emission rate in pounds per million BTU heat input, and P = million BTU heat input per hour

B. Special Provisions

All fuel burning operations of 10 million BTU per hour heat input and smaller constructed prior to February 11, 1971, shall be allowed 0.8 pounds per million BTU input.

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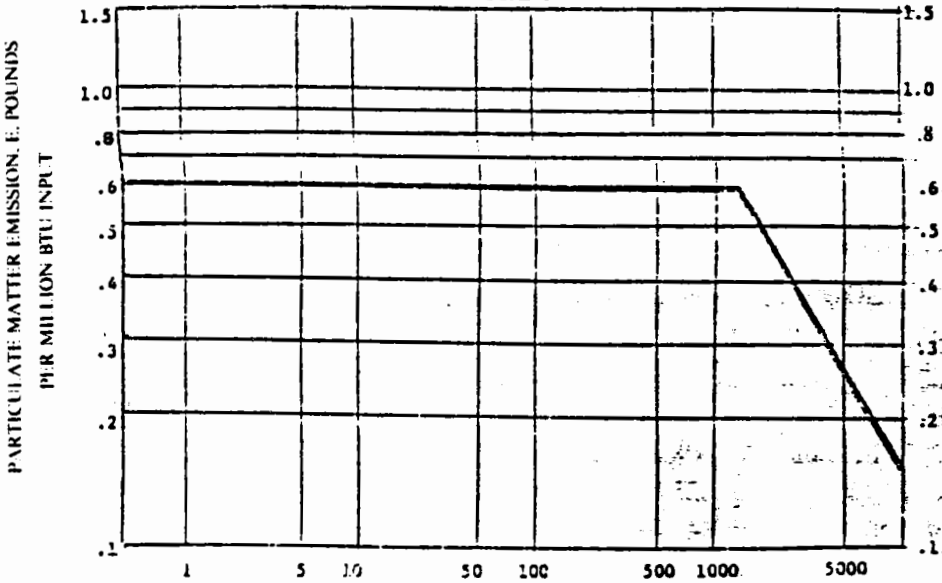
FIGURE I



TOTAL EQUIPMENT CAPACITY RATING (FUEL INPUT ONLY)
MILLION BTU PER HOUR INPUT

SECTION III — SULFUR DIOXIDE EMISSIONS

A. General

The maximum allowable discharge of sulfur dioxide (SO_2) from fuel burning operations shall be in accordance with a system of priorities as specified hereinafter in paragraph B. The classifications shall be delineated on a county basis. The maximum allowable discharge for the various classes is specified in paragraph C of this Section.

B. Classifications

1. The class into which a given county falls has been determined by mathematical atmospheric diffusion models and other methods which evaluate those factors which necessitate limits on sulfur dioxide emissions. These factors included but were not limited to: (1) total sulfur dioxide emissions; (2) spatial distribution of sulfur dioxide sources; (3) effects of single, large sources; (4) existing, measured air quality; (5) topographical features of the county; (6) contributions to background levels due to sources outside the county being considered; (7) population density.

2. The assigned classifications will be reviewed periodically at intervals not to exceed three years, and changes will be made as required. When a county is assigned to a more restrictive class, individual compliance schedules will be established in such a way that reasonable time will be allowed for the sources to make necessary changes in equipment and/or fuel contracts.

3. The following classifications are assigned:

Class I — Charleston County
Class II — Aiken County — Anderson County
Class III — All others

C. Allowable Discharges

Sulfur dioxide emissions from fuel burning sources located in various counties will not exceed the following limits:

1. Counties in Class I

Rated Source Size	Maximum Allowable Emissions (lb SO_2/million BTU Input)
Up to and including 10 million BTU/hr	3.5
Greater than 10 million BTU/hr	2.3

2. Counties in Class II

Rated Source Size	Maximum Allowable Emissions (lb SO_2/million BTU Input)
Up to 1000 million BTU/hr	3.5
1000 million BTU/hr and larger	2.3

3. Counties in Class III

Rated Source Size	Maximum Allowable Emissions (lb SO_2/million BTU Input)
All	3.5

D. Special Provisions

If it can be demonstrated to the satisfaction of the Board that ambient air standards will not be contravened by a source, alone or in combination with other sources, a greater allowance for sulfur dioxide discharges may be made on a case by case basis.

SECTION IV — OPACITY MONITORING REQUIREMENTS

A. Applicable Sources

1. Fossil Fuel Fired Boilers. The owner or operator of any fossil fuel-fired steam generator of more than 250 million BTU per hour heat input capacity shall install, calibrate, operate, and maintain no later than June 14, 1978, continuous monitoring system(s) for the measurement of opacity which meets the performance specifications of Paragraph D of this Section except where:

a. Gaseous fuel is the only fuel burned;

b. Oil or a mixture of gas and oil are the only fuels burned and the steam generator is able to comply with the provisions of Sections I and II of this Standard without utilization of particulate matter collection equipment, and where the steam generator has never been found, through any administrative or judicial proceedings, to be in violation of Section I of this Standard.

c. The steam generator operates with an annual average capacity factor of 30 percent or less, as reported to the Federal Power Commission for calendar year 1974 or otherwise adequately demonstrated to the Department; and has not subsequently increased this factor to more than 30 percent.

2. Woodwaste Boilers. The owner or operator of any woodwaste boiler, not equipped with a wet scrubber, will be required to install, calibrate, operate and maintain continuous monitoring system(s) approved by this Department for the measurement of opacity, if it meets one or more of the following criteria:

a. Any woodwaste boiler of at least 100×10^6 BTU/hr. rated heat input.

b. Any woodwaste boiler, regardless of size, that has been operating in non-com-

pliance with any applicable state air pollution control regulations and standards.

If a boiler is fired on more than one fuel, the total capacity will determine the applicability of above requirements.

B. Continuous Opacity Monitor Reporting Requirements

1. The owner or operator of any fossil fuel fired steam generator subject to the provisions of Paragraph A of this Section shall submit a written Continuous Opacity Monitor report to the Department quarterly or more often if requested. All quarterly reports must be postmarked by the 30th day following the end of each calendar quarter.

The report shall include the following minimum information:

a. All integrated six minute opacity measurements for periods during which the applicable provisions of Section I have been exceeded, together with their nature and cause.

b. For periods of monitoring system malfunction:

(i) The date and time identifying each period during which the monitoring system was inoperative, except for zero and span checks.

(ii) The nature of monitoring system repairs or adjustments.

(iii) Proof of opacity monitoring system performance may be required by the Department whenever repairs or adjustments have been made.

c. boiler system repairs or adjustments made to correct violations of the provisions of Section I.

If no reportable incidents occur during a quarter, a report is also required indicating as such.

2. Alternative data reporting procedures may be allowed if the owner or operator shows, to the satisfaction of the Department, that these procedures are at least as accurate as those described.

3. The owner or operator shall maintain a file of all information contained in the quarterly reports, calibration data for the opacity monitoring system(s), relevant records of adjustments and maintenance performed on such system(s), and all other data generated by the continuous opacity monitoring system(s), for a minimum of two years from the date of submission of such reports or collection of such data. The information contained on file must be made available for review by Department personnel upon request.

C. Exemption from Reporting Requirements

A temporary exemption from the opacity monitoring and reporting requirements of this Section may be granted during any period of monitoring system(s) malfunction, provided the owner or operator shows, to the satisfaction of the Department, that the malfunction was unavoidable and is being repaired as expeditiously as possible.

D. Equipment Performance Specifications

The continuous opacity monitoring system(s) required by Paragraph A.1 of this Section (for fossil fuel fired steam generators) shall conform with the performance specifications set forth in 40 CFR, Part 60, Appendix B, Performance Specification 1 as revised July 1, 1986, which is incorporated by reference as a part of this Standard except that where the term "Administrator" is used the term "Department" shall be substituted. In addition, the opacity monitoring system(s) shall complete a minimum of one cycle of operation for each successive 10-second period; be installed such that representative measurements of opacity from the affected steam generator are obtained; and have an instrument span of approximately 80 percent opacity.

The owner or operator shall record the zero and span drift in accordance with the method prescribed by the manufacturer of such opacity monitoring system(s); subject the system(s) to the manufacturer's recommended zero and span check at least once daily unless the manufacturer has recommended adjustments at shorter intervals, in which case such recommendations shall be followed; adjust the zero and span whenever the 24-hour zero drift or 24-hour calibration drift limits of 40 CFR, Part 60, Appendix B, Performance Specification 1 as revised July 1, 1986 are exceeded; adjust the opacity monitoring system(s) purchased prior to September 11, 1974 whenever the 24-hour zero drift or 24-hour calibration drift exceeds 4 percent opacity for those generators constructed prior to February 11, 1971 and 2 percent opacity for those generators constructed after February 11, 1971.

The monitoring systems must be approved by this agency prior to installation.

E. Monitor Location

When the effluents from two or more affected steam generators of similar design and operating characteristics are combined before being released to the atmosphere, the opacity monitoring system(s) shall be installed on the combined effluent. When the affected steam generators are not of similar design and operating characteristics, or when the effluent from one affected steam generator is released to the atmosphere through more than one point, the owner or operator shall apply for an alternate procedure to comply with the requirements of this Section.

F. Exemptions from Monitoring Requirements

Whenever the requirements for continuous opacity monitoring cannot be implemented by the owner or operator due to physical plant limitations, extreme economic burden, or infrequent steam generator operation of less than 30 days per year; or when the specified monitoring procedure would not provide accurate opacity determinations, alternate monitoring and reporting requirements may be approved on a case-by-case basis provided the owner or operator submits a written request to the Department which includes, but is not limited to:

1. The basis of reason(s) that alternate requirements are necessary;

2. A proposal of the alternate monitoring and reporting requirements; and.

3. Any other information needed by the Department to make a determination that the alternate requirements are adequate to meet the intent of this Section.

SECTION V — EXEMPTIONS

The following sources shall be exempt from the provisions of this standard:

A. Residences of four families or less.

B. Ocean-going vessels actually engaged in the physical process of national or international trade or defense.

SECTION VI — PERIODIC TESTING

Scheduled periodic tests for particulate matter emissions will be required of the sources listed below every two years, or as required by permit conditions to demonstrate compliance with this Standard. Compliance with sulfur dioxide will be by source testing, continuous monitoring, or fuel analysis as required by the permit conditions.

A. Oil-fired boilers greater than 250 × 10^6 BTU/hr. rated input.

B. Coal-fired boilers greater than 50 × 10^6 BTU/hr. rated input.

C. Woodwaste, or combination woodwaste boilers greater than 20 × 10^6 BTU/hr. rated input.

SECTION VII — SOURCE TEST REQUIREMENTS

A. The owner or operator required to comply with Section VI above shall conduct such tests as required by the Department in order to demonstrate compliance with this Standard. The test methods and procedures used shall be approved EPA test methods or such alternative methods as approved by the Department prior to testing.

Tests shall be conducted while the source is operating at the expected maxi-

mum production rate or other production rate or operating conditions which would result in the highest emissions. Any production rate less than rated capacity may result in production limitations on the permits.

All tests shall be made by, or under the direction of, a person qualified by training and/or experience in the field of air pollution testing.

B. Any source owner or operator proposing to conduct tests in accordance with paragraph A. above shall notify the Department in the manner set forth below of the intent to test, not less than two weeks before the proposed initiation of the tests so the Department may observe the test if it desires to do so.

Notification shall include the following minimum information:

1. the purpose of the proposed test.
2. a description of the source to be tested.
3. a description of the test procedures, equipment, and sampling sites.
4. a timetable, setting forth the dates on which the testing will be started and concluded.

C. The final test reports must be submitted no later than 30 days after completion of on-site testing, containing as a minimum, the following supporting information:

1. process weight rates (lb/hr).
2. process design and load rates at which the test was conducted.
3. procedure used for determining process weight rates.
4. calculations used to determine process weight rates.
5. signature of responsible company official.

D. The owner or operator proposing a source test under the provisions of this section shall be responsible for providing:

1. sampling ports, pipes, lines, or appurtenances for the collection of samples and data required by the test procedure.
2. safe access to the sample and data collection locations.
3. light, electricity, and other utilities required for sample and data collection.

E. Any proposed deviations from the procedures and requirements stated above must be thoroughly explained and must be approved by this Department prior to testing. Failure to observe any of these procedures or requirements may be grounds for not accepting the tests.

STANDARD NO. 2 - AMBIENT AIR QUALITY STANDARDS

The following table constitutes the ambient air quality standards for the State of South Carolina. The analytical methods to be used will be those applicable Federal Reference Methods published in 40 CFR 50, Appendices A-H as revised July 1, 1986. In the case of fluorides either the double paper tape sampler methods (ASTM D-3266-79) or the sodium bicarbonate-coated glass tube and particulate filter method (ASTM D-3268-78) may be used.

POLLUTANT	MEASURING INTERVAL	MICROGRAMS PER CUBIC METER UNLESS NOTED OTHERWISE (1)(2)
Sulfur Dioxide	3 hour	1300(4)
	24 hours	365(4)
	annual	80
Total Suspended Particulates	Annual Geometric Mean	75
PM_{10}	24 hours	150(3)
	annual	50(3)
Carbon Monoxide	1 hour	40 mg per cubic meter
	8 hour	10 mg per cubic meter
Ozone	1 hour	0.12 ppm (3)
Gaseous Fluorides (as HF)	12 hr. avg.	3.7
	24 hr. avg.	2.9
	1 wk. avg.	1.6
	1 mo. avg.	0.8
Nitrogen Dioxide	annual	100
Lead	Calendar Quarterly Mean	1.5

(1) Arithmetic Average except in case of total suspended particulate matter
(2) At 25° C and 760 mm Hg.
(3) Attainment determinations will be made based on the criteria contained in Appendices H and K, 40 CFR 50, July 1, 1987.
(4) Not to be exceeded more than once a year.

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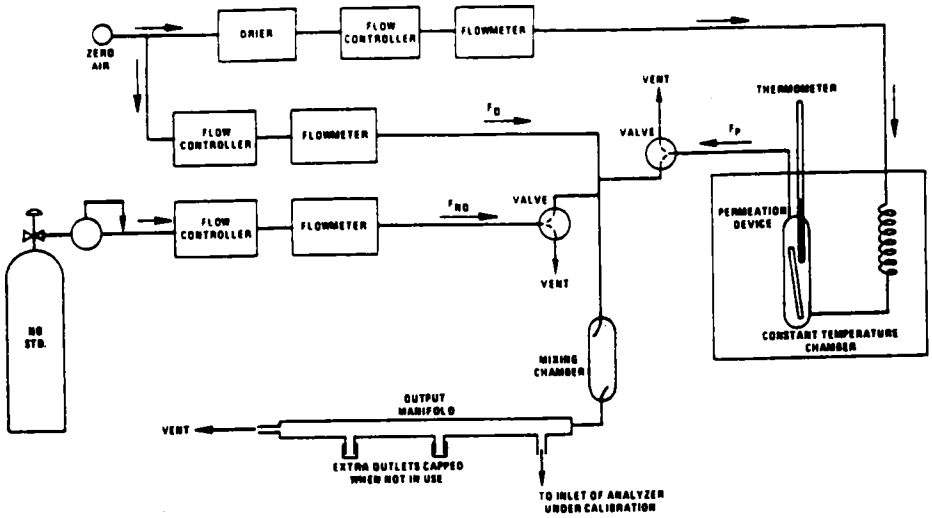

Figure 2. Schematic diagram of a typical calibration apparatus using an NO_2 permeation device.

[Appendix F added at 41 FR 52686, Dec. 1, 1976; amended at 48 FR 2529, Jan 20, 1983]

APPENDIX G TO PART 50—REFERENCE METHOD FOR THE DETERMINATION OF LEAD IN SUSPENDED PARTICULATE MATTER COLLECTED FROM AMBIENT AIR

1. *Principle and applicability.*

1.1 Ambient air suspended particulate matter is collected on a glass-fiber filter for 24 hours using a high volume air sampler. The analysis of the 24-hour samples may be performed for either individual samples or composites of the samples collected over a calendar month or quarter, provided that the compositing procedure has been approved in accordance with section 2.8 of Appendix C to Part 58 of this chapter—*Modifications of methods by users.* (Guidance or assistance in requesting approval under Section 2.8 can be obtained from the address given in section 2.7 of Appendix C to Part 58 of this chapter.)

1.2 Lead in the particulate matter is solubilized by extraction with nitric acid (HNO_3), facilitated by heat or by a mixture of HNO_3 and hydrochloric acid (HCl) facilitated by ultrasonication.

1.3 The lead content of the sample is analyzed by atomic absorption spectrometry using an air-acetylene flame, the 283.3 or 217.0 nm lead absorption line, and the optimum instrumental conditions recommended by the manufacturer.

1.4 The ultrasonication extraction with HNO_3/HCl will extract metals other than lead from ambient particulate matter.

2. *Range, sensitivity, and lower detectable limit.* The values given below are typical of the methods capabilities. Absolute values will vary for individual situations depending on the type of instrument used, the lead line, and operating conditions.

2.1 *Range.* The typical range of the method is 0.07 to 7.5 μg Pb/m^{3}assuming an upper linear range of analysis of 15 μg/ml and an air volume of 2,400 m^3.

2.2 *Sensitivity.* Typical sensitivities for a 1 percent change in absorption (0.0044 absorbance units) are 0.2 and 0.5 μg Pb/ml for the 217.0 and 283.3 nm lines, respectively.

2.3 *Lower detectable limit (LDL).* A typical LDL is 0.07 μg Pb/m^3. The above value was calculated by doubling the between-laboratory standard deviation obtained for the lowest measurable lead concentration in a collaborative test of the method.(*15*) An air volume of 2,400 m^{3}was assumed.

3. *Interferences.* Two types of interferences are possible: chemical and light scattering.

3.1 *Chemical.* Reports on the absence (*1, 2, 3, 4, 5*) of chemical interferences far outweigh those reporting their presence, (*6*) therefore, no correction for chemical interferences is given here. If the analyst suspects that the sample matrix is causing a chemical interference, the interference can be verified and corrected for by carrying out the analysis with and without the method of standard additions.(*7*)

3.2 *Light scattering.* Nonatomic absorption or light scattering, produced by high concentrations of dissolved solids in the sample, can produce a significant interference, especially at low lead concentrations. (*2*) The interference is greater at the 217.0 nm line than at the 283.3 nm line. No interference was observed using the 283.3 nm line with a similar method.(*1*)

Light scattering interferences can, however, be corrected for instrumentally. Since the dissolved solids can vary depending on the origin of the sample, the correction may be necessary, especially when using the 217.0 nm line. Dual beam instruments with a continuum source give the most accurate correction. A less accurate correction can be obtained by using a nonabsorbing lead line that is near the

lead analytical line. Information on use of these correction techniques can be obtained from instrument manufacturers' manuals.

If instrumental correction is not feasible, the interference can be eliminated by use of the ammonium pyrrolidine-carbodithioate-methylisobutyl ketone, chelation-solvent extraction technique of sample preparation.(*8*)

4. *Precision and bias.*

4.1 The high-volume sampling procedure used to collect ambient air particulate matter has a between-laboratory relative standard deviation of 3.7 percent over the range 80 to 125 $\mu g/m^3$.(*9*) The combined extraction-analysis procedure has an average within-laboratory relative standard deviation of 5 to 6 percent over the range 1.5 to 15 μg Pb/ml, and an average between laboratory relative standard deviation of 7 to 9 percent over the same range. These values include use of either extraction procedure.

4.2 Single laboratory experiments and collaborative testing indicate that there is no significant difference in lead recovery between the hot and ultrasonic extraction procedures.(*15*)

5. *Apparatus.*

5.1 *Sampling.*

5.1.1 *High-Volume Sampler.* Use and calibrate the sampler as described in Appendix B to this part.

5.2 *Analysis.*

5.2.1 *Atomic absorption spectrophotometer.* Equipped with lead hollow cathode or electrodeless discharge lamp.

5.2.1.1 *Acetylene.* The grade recommended by the instrument manufacturer should be used. Change cylinder when pressure drops below 50-100 psig.

5.2.1.2 *Air.* Filtered to remove particulate, oil, and water.

5.2.2 *Glassware.* Class A borosilicate glassware should be used throughout the analysis.

5.2.2.1 *Beakers.* 30 and 150 ml. graduated, Pyrex.

5.2.2.2 *Volumetric flasks.* 100-ml.

5.2.2.3 *Pipettes.* To deliver 50, 30, 15, 8, 4, 2, 1 ml.

5.2.2.4 *Cleaning.* All glassware should be scrupulously cleaned. The following procedure is suggested. Wash with laboratory detergent, rinse, soak for 4 hours in 20 percent (w/w) HNO_3 rinse 3 times with distilled-deionized water, and dry in a dust free manner.

5.2.3 *Hot plate.*

5.2.4. *Ultrasonication water bath, unheated.* Commercially available laboratory ultrasonic cleaning baths of 450 watts or higher "cleaning power," i.e., actual ultrasonic power output to the bath have been found satisfactory.

5.2.5 *Template.* To aid in sectioning the glass-fiber filter. See figure 1 for dimensions.

5.2.6 *Pizza cutter.* Thin wheel. Thickness 1mm.

5.2.7 *Watch glass.*

5.2.8 *Polyethylene bottles.* For storage of samples. Linear polyethylene gives better storage stability than other polyethylenes and is preferred.

5.2.9 Parafilm "M".[1] American Can Co., Marathon Products, Neenah, Wis., or equivalent.

6. *Reagents.*

6.1 *Sampling.*

6.1.1 *Glass fiber filters.* The specifications given below are intended to aid the user in obtaining high quality filters with reproducible properties. These specifications have been met by EPA contractors.

6.1.1.1 *Lead content.* The absolute lead content of filters is not critical, but low values are, of course, desirable. EPA typically obtains filters with a lead content of 75 μg/filter.

It is important that the variation in lead content from filter to filter, within a given batch, be small.

6.1.1.2 *Testing.*

6.1.1.2.1 For large batches of filters (>500 filters) select at random 20 to 30 filters from a given batch. For small batches (>500 filters) a lesser number of filters may be taken. Cut one 3/4"x8" strip from each filter anywhere in the filter. Analyze all strips, separately, according to the directions in sections 7 and 8.

6.1.1.2.2 Calculate the total lead in each filter as

$$F_b = \mu g\ Pb/ml \times \frac{100\ ml}{strip} \times \frac{12\ strips}{filter}$$

where:

F_b=Amount of lead per 72 square inches of filter, μg.

6.1.1.2.3 Calculate the mean, F_b, of the values and the relative standard deviation (standard deviation/mean 100). If the relative standard deviation is high enough so that, in the analysts opinion, subtraction of F_b, (section 10.3) may result in a significant error in the μg Pb/m^3, the batch should be rejected.

6.1.1.2.4 For acceptable batches, use the value of F_b to correct all lead analyses (section 10.3) of particulate matter collected using that batch of filters. If the analyses are below the LDL (section 2.3) no correction is necessary.

6.2 *Analysis.*

6.2.1 Concentrated (15.6 *M*) HNO_3. ACS reagent grade HNO_3 and commercially available redistilled HNO_3 has found to have sufficiently low lead concentrations.

6.2.2 Concentrated (11.7 *M*) HCl. ACS reagent grade.

6.2.3 *Distilled-deionized water.* (D.I. water).

6.2.4 3 *M* HNO_3. This solution is used in the hot extraction procedure. To prepare, add 192 ml of concentrated HNO_3 to D.I. water in a 1 *l* volumetric flask. Shake well, cool, and dilute to volume with D.I. water. *Caution:* Nitric acid fumes are toxic. Prepare in a well ventilated fume hood.

6.2.5 0.45 *M* HNO_3This solution is used as the matrix for calibration standards when using the hot extraction procedure. To prepare, add 29 ml of concentrated HNO_3 to D.I. water in a 1 *l* volumetric flask. Shake well, cool, and dilute to volume with D.I. water.

6.2.6 2.6 *M* HNO_3+0 to 0.9 *M* HCl. This solution is used in the ultrasonic extraction procedure. The concentration of HCl can be varied from 0 to 0.9 *M*. Directions are given for preparation of a 2.6 *M* HNO_3+0.9 *M* HCl solution. Place 167 ml of concentrated HNO_3 into a 1 *l* volumetric flask and add 77 ml of concentrated HCl. Stir 4 to 6 hours, dilute to nearly 1 *l* with D.I. water, cool to room temperature, and dilute to 1 *l*.

6.2.7 0.40 *M* HNO_3+ X *M* HCl. This solution is used as the matrix for calibration standards when using the ultrasonic extraction procedure. To prepare, add 26 ml of concentrated HNO_3, plus the ml of HCl required, to a 1 *l* volumetric flask. Dilute to nearly 1 *l* with D.I. water, cool to room temperature, and dilute to 1 *l*. The amount of HCl required can be determined from the following equation:

[1]Mention of commercial products does not imply endorsement by the U.S. Environmental Protection Agency.

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$$y = \frac{77ml \times 0.15 \times}{0.9M}$$

where:

y = ml of concentrated HCl required.

x = molarity of HCl in 6.2.6.

0.15 = dilution factor in 7.2.2.

6.2.8 Lead nitrate, $Pb(NO_3)_2$. ACS reagent grade, purity 99.0 percent. Heat for 4 hours at 120°C and cool in a desiccator.

6.3 *Calibration standards.*

6.3.1 Master standard, 1000 μg Pb/ml in HNO_3. Dissolve 1.598 g of $Pb(NO_3)_2$ in 0.45 *M* HNO_3 contained in a 1 *l* volumetric flask and dilute to volume with 0.45 *M* HNO_3.

6.3.2 Master standard, 1000 μg Pb/ml in HNO_3/HCl. Prepare as in section 6.3.1 except use the HNO_3/HCl solution in section 6.2.7.

Store standards in a polyethylene bottle. Commercially available certified lead standard solutions may also be used.

7. *Procedure.*

7.1 *Sampling.* Collect samples for 24 hours using the procedure described in reference *10* with glass-fiber filters meeting the specifications in section 6.1.1. Transport collected samples to the laboratory taking care to minimize contamination and loss of sample.(*16*).

7.2 *Sample preparation.*

7.2.1 *Hot extraction procedure.*

7.2.1.1 Cut a 3/4"x8" strip from the exposed filter using a template and a pizza cutter as described in Figures 1 and 2. Other cutting procedures may be used.

Lead in ambient particulate matter collected on glass fiber filters has been shown to be uniformly distributed across the filter.[1,3,11] Another study[12] has shown that when sampling near a roadway, strip position contributes significantly to the overall variability associated with lead analyses. Therefore, when sampling near a roadway, additional strips should be analyzed to minimize this variability.

7.2.1.2 Fold the strip in half twice and place in a 150-ml beaker. Add 15 ml of 3 *M* HNO_3 to cover the sample. The acid should completely cover the sample. Cover the beaker with a watch glass.

7.2.1.3 Place beaker on the hot-plate, contained in a fume hood, and boil gently for 30 min. Do not let the sample evaporate to dryness. *Caution:* Nitric acid fumes are toxic.

7.2.1.4 Remove beaker from hot plate and cool to near room temperature.

7.2.1.5 Quantitatively transfer the sample as follows:

7.2.1.5.1 Rinse watch glass and sides of beaker with D.I. water.

7.2.1.5.2 Decant extract and rinsings into a 100-ml volumetric flask.

7.2.1.5.3 Add D.I. water to 40 ml mark on beaker, cover with watch glass, and set aside for a minimum of 30 minutes. This is a critical step and cannot be omitted since it allows the HNO_3 trapped in the filter to diffuse into the rinse water.

7.2.1.5.4 Decant the water from the filter into the volumetric flask.

7.2.1.5.5 Rinse filter and beaker twice with D.I. water and add rinsings to volumetric flask until total volume is 80 to 85 ml.

7.2.1.5.6 Stopper flask and shake vigorously. Set aside for approximately 5 minutes or until foam has dissipated.

7.2.1.5.7 Bring solution to volume with D.I. water. Mix thoroughly.

7.2.1.5.8 Allow solution to settle for one hour before proceeding with analysis.

7.2.1.5.9 If sample is to be stored for subsequent analysis, transfer to a linear polyethylene bottle.

7.2.2 *Ultrasonic extraction procedure.*

7.2.2.1 Cut a 3/4"x8" strip from the exposed filter as described in section 7.2.1.1.

7.2.2.2 Fold the strip in half twice and place in a 30 ml beaker. Add 15 ml of the HNO_3/HCl solution in section 6.2.6. The acid should completely cover the sample. Cover the beaker with parafilm.

The parafilm should be placed over the beaker such that none of the parafilm is in contact with water in the ultrasonic bath. Otherwise, rinsing of the parafilm (section 7.2.2.4.1) may contaminate the sample.

7.2.2.3 Place the beaker in the ultrasonication bath and operate for 30 minutes.

7.2.2.4 Quantitatively transfer the sample as follows:

7.2.2.4.1 Rinse parafilm and sides of beaker with D.I. water.

7.2.2.4.2 Decant extract and rinsings into a 100 ml volumetric flask.

7.2.2.4.3 Add 20 ml D.I. water to cover the filter strip, cover with parafilm, and set aside for a minimum of 30 minutes. This is a critical step and cannot be omitted. The sample is then processed as in sections 7.2.1.5.4 through 7.2.1.5.9.

NOTE: Samples prepared by the hot extraction procedure are now in 0.45 *M* HNO_3. Samples prepared by the ultrasonication procedure are in 0.40 *M* HNO_3+X *M* HCl.

8. *Analysis.*

8.1 Set the wavelength of the monochromator at 283.3 or 217.0 nm. Set or align other instrumental operating conditions as recommended by the manufacturer.

8.2 The sample can be analyzed directly from the volumetric flask, or an appropriate amount of sample decanted into a sample analysis tube. In either case, care should be taken not to disturb the settled solids.

8.3 Aspirate samples, calibration standards and blanks (section 9.2) into the flame and record the equilibrium absorbance.

8.4 Determine the lead concentration in μg Pb/ml, from the calibration curve, section 9.3.

8.5 Samples that exceed the linear calibration range should be diluted with acid of the same concentration as the calibration standards and reanalyzed.

9. *Calibration.*

9.1 Working standard, 20 μg Pb/ml. Prepared by diluting 2.0 ml of the master standard (section 6.3.1 if the hot acid extraction was used or section 6.3.2 if the ultrasonic extraction procedure was used) to 100 ml with acid of the same concentration as used in preparing the master standard.

9.2 *Calibration standards.* Prepare daily by diluting the working standard, with the same acid matrix, as indicated below. Other lead concentrations may be used.

Volume of 20 μg/ml working standard, ml	Final volume, ml	Concentration μg Pb/ml
0	100	0
1.0	200	0.1
2.0	200	0.2
2.0	100	0.4
4.0	100	0.8
8.0	100	1.6
15.0	100	3.0
30.0	100	6.0
50.0	100	10.0
100.0	100	20.0

9.3 *Preparation of calibration curve.* Since the working range of analysis will vary depending on which lead line is used and the type of instrument, no one set of instructions for preparation of a calibration curve can be given. Select standards (plus the reagent blank), in the same acid concentration as the samples, to cover the linear absorption range indicated by the

[Part 50, Appendix G]

instrument manufacturer. Measure the absorbance of the blank and standards as in section 8.0. Repeat until good agreement is obtained between replicates. Plot absorbance (y-axis) versus concentration in μg Pb/ml (x-axis). Draw (or compute) a straight line through the linear portion of the curve. Do not force the calibration curve through zero. Other calibration procedures may be used.

To determine stability of the calibration curve, remeasure-alternately-one of the following calibration standards for every 10th sample analyzed: Concentration ≦ 1μg Pb/ml; concentration ≦ 10 μg Pb/ml. If either standard deviates by more than 5 percent from the value predicted by the calibration curve, recalibrate and repeat the previous 10 analyses.

10. *Calculation.*

10.1 *Measured air volume.* Calculate the measured air volume at Standard Temperature and Pressure as described in Reference 10.

10.2 *Lead concentration.* Calculate lead concentration in the air sample.

$$C = \frac{(\mu g\ Pb/ml \times 100\ ml/strip \times 12\ strips/filter) - \bar{F}_b}{V_{STP}}$$

where:

C=Concentration, μg Pb/sm^3.

μg Pb/ml=Lead concentration determined from section 8.

100 ml/strip=Total sample volume.

12 strips=Total useable filter area, 8″ 9″.

Exposed area of one strip, 3/4″ 7″.

Filter=Total area of one strip, 3/4″ 8″.

F_b=Lead concentration of blank filter, μg, from section 6.1.1.2.3.

V_{STP}=Air volume from section 10.2.

11. *Quality control.*

3/4″ 8″ glass fiber filter strips containing 80 to 2000 μg Pb/strip (as lead salts) and blank strips with zero Pb content should be used to determine if the method-as being used-has any bias. Quality control charts should be established to monitor differences between measured and true values. The frequency of such checks will depend on the local quality control program.

To minimize the possibility of generating unreliable data, the user should follow practices established for assuring the quality of air pollution data, (*13*) and take part in EPA's semiannual audit program for lead analyses.

12. *Trouble shooting.*

1. During extraction of lead by the hot extraction procedure, it is important to keep the sample covered so that corrosion products-formed on fume hood surfaces which may contain lead-are not deposited in the extract.

2. The sample acid concentration should minimize corrosion of the nebulizer. However, different nebulizers may require lower acid concentrations. Lower concentrations can be used provided samples and standards have the same acid concentration.

3. Ashing of particulate samples has been found, by EPA and contractor laboratories, to be unnecessary in lead analyses by atomic absorption. Therefore, this step was omitted from the method.

4. Filtration of extracted samples, to remove particulate matter, was specifically excluded from sample preparation, because some analysts have observed losses of lead due to filtration.

5. If suspended solids should clog the nebulizer during analysis of samples, centrifuge the sample to remove the solids.

13. *Authority.*

(Secs. 109 and 301(a), Clean Air Act, as amended (42 U.S.C. 7409, 7601(a)))

14. *References.*

1. Scott, D. R. et al. "Atomic Absorption and Optical Emission Analysis of NASN Atmospheric Particulate Samples for Lead." *Envir. Sci. and Tech., 10,* 877-880 (1976).

2. Skogerboe, R. K. et al. "Monitoring for Lead in the Environment." pp. 57-66, Department of Chemistry, Colorado State University, Fort Collins, CO 80523. Submitted to National Science Foundation for publications, 1976.

3. Zdrojewski, A. et al. "The Accurate Measurement of Lead in Airborne Particulates." *Inter. J. Environ. Anal. Chem., 2,* 63-77 (1972).

4. Slavin, W., "Atomic Absorption Spectroscopy." Published by Interscience Company, New York, NY (1968).

5. Kirkbright, G. F., and Sargent, M., "Atomic Absorption and Fluorescence Spectroscopy." Published by Academic Press, New York, NY 1974.

6. Burnham, C. D. et al., "Determination of Lead in Airborne Particulates in Chicago and Cook County, IL, by Atomic Absorption Spectroscopy." Envir. Sci. and Tech., 3, 472-475 (1969).

7. "Proposed Recommended Practices for Atomic Absorption Spectrometry." *ASTM Book of Standards,* part 30, pp. 1596-1608 (July 1973).

8. Koirttyohann, S. R. and Wen, J. W., "Critical Study of the APCD-MIBK Extraction System for Atomic Absorption." *Anal. Chem., 45,* 1986-1989 (1973).

9. *Collaborative Study of Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method).* Obtainable from National Technical Information Service, Department of Commerce, Port Royal Road, Springfield, VA 22151, as PB-205-891.

10. [Reserved]

11. Dubois, L., et al., "The Metal Content of Urban Air." JAPCA, *16,* 77-78 (1966).

12. EPA Report No. 600/4-77-034, June 1977, "Los Angeles Catalyst Study Symposium." Page 223.

13. *Quality Assurance Handbook for Air Pollution Measurement System. Volume 1-Principles.* EPA-600/9-76-005, March 1976.

14. Thompson, R. J. et al., "Analysis of Selected Elements in Atmospheric Particulate Matter by Atomic Absorption." *Atomic Absorption Newsletter, 9,* No. 3, May-June 1970.

[Part 50, Appendix G]

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15. To be published. EPA, QAB, EMSL, RTP, N.C. 27711

16. *Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II-Ambient Air Specific Methods.* EPA-600/4-77/027a, May 1977.

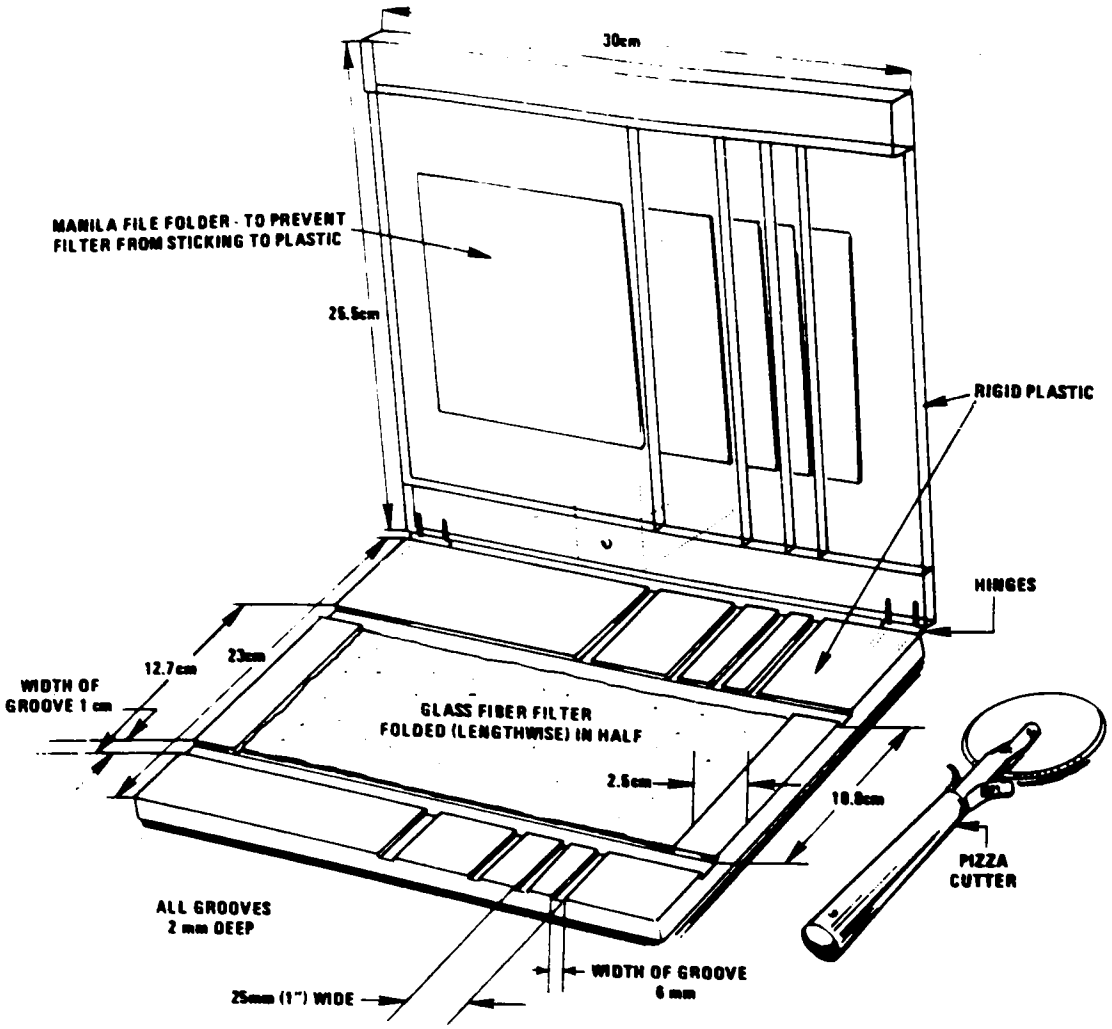

Figure 1

[Part 50, Appendix G]

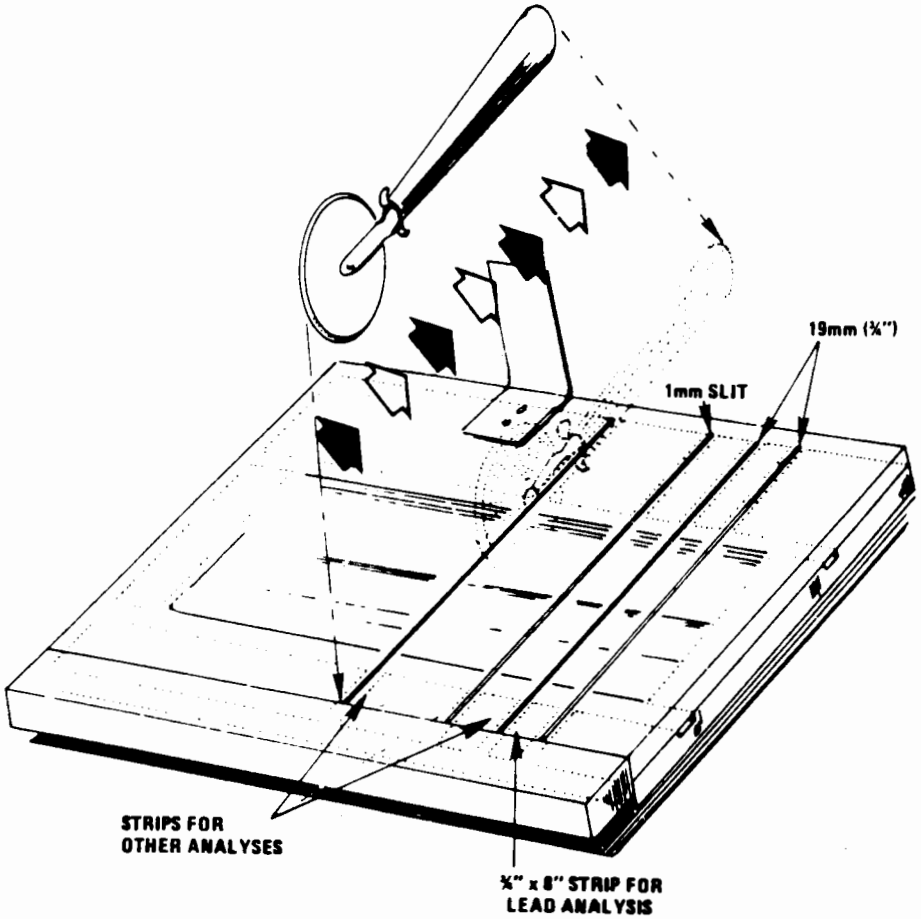

Figure 2

(Secs. 109, 301(a) of the Clean Air Act, as amended (42 U.S.C. 7409, 7601(a)); secs. 110, 301(a) and 319 of the Clean Air Act (42 U.S.C. 7410, 7601(a), 7619))

[Appendix G added at 43 FR 46258, Oct. 5, 1978; amended at 44 FR 37915, June 29, 1979; 46 FR 44163, Sept. 3, 1981; 52 FR 24663, July 1, 1987]

APPENDIX H TO PART 50—INTERPRETATION OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR OZONE

1. *General*

This appendix explains how to determine when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm (235 $\mu g/m^3$) is equal to or less than 1. An expanded discussion of these procedures and associated examples are contained in the "Guideline for Interpretation of Ozone Air Quality Standards." For purposes of clarity in the following discussion, it is convenient to use the term "exceedance" to describe a daily maximum hourly average ozone measurement that is greater than the level of the standard. Therefore, the phrase "expected number of days with maximum hourly average ozone concentrations above the level of the standard" may be simply stated as the "expected number of exceedances."

The basic principle in making this determination is relatively straightforward. Most of the complications that arise in determining the expected number of annual exceedances relate to accounting for incomplete sampling. In general, the average number of exceedances per calendar year must be less than or equal to 1. In its simplest form, the number of exceedances at a monitoring site would be recorded for each calendar year and then averaged over the past 3 calendar years to determine if this average is less than or equal to 1.

2. *Interpretation of Expected Exceedances*

The ozone standard states that the expected number of exceedances per year must be less than or equal to 1. The statistical term "expected number" is basically an arithmetic average. The following example explains what it would mean for an area to be in compliance with this type of standard. Suppose a monitoring station records a valid daily maximum hourly average ozone value for every day of the year during the past 3 years. At the end of

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each year, the number of days with maximum hourly concentrations above 0.12 ppm is determined and this number is averaged with the results of previous years. As long as this average remains "less than or equal to 1," the area is in compliance.

3. *Estimating the Number of Exceedances for a Year*

In general, a valid daily maximum hourly average value may not be available for each day of the year, and it will be necessary to account for these missing values when estimating the number of exceedances for a particular calendar year. The purpose of these computations is to determine if the expected number of exceedances per year is less than or equal to 1. Thus, if a site has two or more observed exceedances each year, the standard is not met and it is not necessary to use the procedures of this section to account for incomplete sampling.

The term "missing value" is used here in the general sense to describe all days that do not have an associated ozone measurement. In some cases, a measurement might actually have been missed but in other cases no measurement may have been scheduled for that day. A daily maximum ozone value is defined to be the highest hourly ozone value recorded for the day. This daily maximum value is considered to be valid if 75 percent of the hours from 9:01 a.m. to 9:00 p.m. (LST) were measured or if the highest hour is greater than the level of the standard.

In some areas, the seasonal pattern of ozone is so pronounced that entire months need not be sampled because it is extremely unlikely that the standard would be exceeded. Any such waiver of the ozone monitoring requirement would be handled under provisions of 40 CFR Part 58. Some allowance should also be made for days for which valid daily maximum hourly values were not obtained but which would quite likely have been below the standard. Such an allowance introduces a complication in that it becomes necessary to define under what conditions a missing value may be assumed to have been less than the level of the standard. The following criterion may be used for ozone:

A missing daily maximum ozone value may be assumed to be less than the level of the standard if the valid daily maxima on both the preceding day and the following day do not exceed 75 percent of the level of the standard.

Let z denote the number of missing daily maximum values that may be assumed to be less than the standard. Then the following formula shall be used to estimate the expected number of exceedances for the year:

$$e = v + [(v/n)8(N-n-z)] \quad (1)$$

(*Indicates multiplication.)

where:

e=the estimated number of exceedances for the year,

N=the number of required monitoring days in the year,

n=the number of valid daily maxima,

v=the number of daily values above the level of the standard, and

z=the number of days assumed to be less than the standard level.

This estimated number of exceedances shall be rounded to one decimal place (fractional parts equal to 0.05 round up).

It should be noted that N will be the total number of days in the year unless the appropriate Regional Administrator has granted a waiver under the provisions of 40 CFR Part 58.

The above equation may be interpreted intuitively in the following manner. The estimated number of exceedances is equal to the observed number of exceedances (v) plus an increment that accounts for incomplete sampling. There were (N-n) missing values for the year but a certain number of these, namely z, were assumed to be less than the standard. Therefore, (N-n-z) missing values are considered to include possible exceedances. The fraction of measured values that are above the level of the standard is v/n. It is assumed that this same fraction applies to the (N-n-z) missing values and that (v/n)*(N-n-z) of these values would also have exceeded the level of the standard.

[Appendix H added at 44 FR 8220, Feb. 8, 1979]

APPENDIX I—[Reserved]

APPENDIX J TO PART 50—REFERENCE METHOD FOR THE DETERMINATION OF PARTICULATE MATTER AS PM_{10} IN THE ATMOSPHERE

1.0 *Applicability.*

1.1 This method provides for the measurement of the mass concentration of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) in ambient air over a 24-hour period for purposes of determining attainment and maintenance of the primary and secondary national ambient air quality standards for particulate matter specified in §50.6 of this chapter. The measurement process is nondestructive, and the PM_{10} sample can be subjected to subsequent physical or chemical analyses. Quality assurance procedures and guidance are provided in part 58, appendices A and B, of this chapter and in References 1 and 2.

2.0 *Principle.*

2.1 An air sampler draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within the PM_{10} size range. Each size fraction in the PM_{10} size range is then collected on a separate filter over the specified sampling period. The particle size discrimination characteristics (sampling effectiveness and 50 percent cutpoint) of the sampler inlet are prescribed as performance specifications in part 53 of this chapter.

2.2 Each filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain due to collected PM_{10}. The total volume of air sampled, corrected to EPA reference conditions (25°C, 101.3 kPa), is determined from the measured flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is computed as the total mass of collected particles in the PM_{10} size range divided by the volume of air sampled, and is expressed in micrograms per standard cubic meter ($\mu g/std\ m^3$). For PM_{10} samples collected at temperatures and pressures significantly different from EPA reference conditions, these corrected concentrations sometimes differ substantially from actual concentrations (in micrograms per actual cubic meter), particularly at high elevations. Although not required, the actual PM_{10} concentration can be calculated from the corrected concentration, using the average ambient temperature and barometric pressure during the sampling period.

2.3 A method based on this principle will be considered a reference method only if (a) the associated sampler meets the requirements specified in this appendix and the requirements in part 53 of this

chapter, and (b) the method has been designated as a reference method in accordance with part 53 of this chapter.

3.0 *Range.*

3.1 The lower limit of the mass concentration range is determined by the repeatability of filter tare weights, assuming the nominal air sample volume for the sampler. For samplers having an automatic filter-changing mechanism, there may be no upper limit. For samplers that do not have an automatic filter-changing mechanism, the upper limit is determined by the filter mass loading beyond which the sampler no longer maintains the operating flow rate within specified limits due to increased pressure drop across the loaded filter. This upper limit cannot be specified precisely because it is a complex function of the ambient particle size distribution and type, humidity, filter type, and perhaps other factors. Nevertheless, all samplers should be capable of measuring 24-hour PM_{10} mass concentrations of at least 300 $\mu g/std\ m^3$ while maintaining the operating flow rate within the specified limits.

4.0 *Precision.*

4.1 The precision of PM_{10} samplers must be 5 $\mu g/m^3$ for PM_{10} concentrations below 80 $\mu g/m^3$ and 7 percent for PM_{10}concentrations above 80 $\mu g/m^3$, as required by Part 53 of this chapter, which prescribes a test procedure that determines the variation in the PM_{10} concentration measurements of identical samplers under typical sampling conditions. Continual assessment of precision via collocated samplers is required by Part 58 of this chapter for PM_{10} samplers used in certain monitoring networks.

5.0 *Accuracy.*

5.1 Because the size of the particles making up ambient particulate matter varies over a wide range and the concentration of particles varies with particle size, it is difficult to define the absolute accuracy of PM_{10} samplers. Part 53 of this chapter provides a specification for the sampling effectiveness of PM_{10} samplers. This specification requires that the expected mass concentration calculated for a candidate PM_{10} sampler, when sampling a specified particle size distribution, be within ± 10 percent of that calculated for an ideal sampler whose sampling effectiveness is explicitly specified. Also, the particle size for 50 percent sampling effectivensss is required to be 10 ± 0.5 micrometers. Other specifications related to accuracy apply to flow measurement and calibration, filter media, analytical (weighing) procedures, and artifact. The flow rate accuracy of PM_{10} samplers used in certain monitoring networks is required by Part 58 of this chapter to be assessed periodically via flow rate audits.

6.0 *Potential Sources of Error.*

6.1 *Volatile Particles.* Volatile particles collected on filters are often lost during shipment and/or storage of the filters prior to the post-sampling weighing[3]. Although shipment or storage of loaded filters is sometimes unavoidable, filters should be reweighed as soon as practical to minimize these losses.

6.2 *Artifacts.* Positive errors in PM_{10} concentration measurements may result from retention of gaseous species on filters[4, 5]. Such errors include the retention of sulfur dioxide and nitric acid. Retention of sulfur dioxide on filters, followed by oxidation to sulfate, is referred to as artifact sulfate formation, a phenomenon which increases with increasing filter alkalinity[6]. Little or no artifact sulfate formation should occur using filters that meet the alkalinity specification in section 7.2.4. Artifact nitrate formation, resulting primarily from retention of nitric acid, occurs to varying degrees on many filter types, including glass fiber, cellulose ester, and many quartz fiber filters[5, 7, 8, 9, 10]. Loss of true atmospheric particulate nitrate during or following sampling may also occur due to dissociation or chemical reaction. This phenomenon has been observed on Teflon® filters[8] and inferred for quartz fiber filters[11, 12]. The magnitude of nitrate artifact errors in PM_{10} mass concentration measurements will vary with location and ambient temperature; however, for most sampling locations, these errors are expected to be small.

6.3 *Humidity.* The effects of ambient humidity on the sample are unavoidable. The filter equilibration procedure in section 9.0 is designed to minimize the effects of moisture on the filter medium.

6.4 *Filter Handling.* Careful handling of filters between presampling and post-sampling weighings is necessary to avoid errors due to damaged filters or loss of collected particles from the filters. Use of a filter cartridge or cassette may reduce the magnitude of these errors. Filters must also meet the integrity specification in section 7.2.3.

6.5 *Flow Rate Variation.* Variations in the sampler's operating flow rate may alter the particle size discrimination characteristics of the sampler inlet. The magnitude of this error will depend on the sensitivity of the inlet to variations in flow rate and on the particle distribution in the atmosphere during the sampling period. The use of a flow control device (section 7.1.3) is required to minimize this error.

6.6 *Air Volume Determination.* Errors in the air volume determination may result from errors in the flow rate and/or sampling time measurements. The flow control device serves to minimize errors in the flow rate determination, and an elapsed time meter (section 7.1.5) is required to minimize the error in the sampling time measurement.

7.0 *Apparatus.*

7.1 *PM_{10} Sampler.*

7.1.1 The sampler shall be designed to:

a. Draw the air sample into the sampler inlet and through the particle collection filter at a uniform face velocity.

b. Hold and seal the filter in a horizontal position so that sample air is drawn downward through the filter.

c. Allow the filter to be installed and removed conveniently.

d. Protect the filter and sampler from precipitation and prevent insects and other debris from being sampled.

e. Minimize air leaks that would cause error in the measurement of the air volume passing through the filter.

f. Discharge exhaust air at a sufficient distance from the sampler inlet to minimize the sampling of exhaust air.

g. Minimize the collection of dust from the supporting surface.

7.1.2 The sampler shall have a sample air inlet system that, when operated within a specified flow rate range, provides particle size discrimination characteristics meeting all of the applicable performance specifications prescribed in part 53 of this chapter. The sampler inlet shall show no significant wind direction dependence. The latter requirement can generally be satisfied by an inlet shape that is circularly symmetrical about a vertical axis.

7.1.3 The sampler shall have a flow control device capable of maintaining the sampler's operating flow rate within the flow rate limits specified for the sampler inlet over normal variations in line voltage and filter pressure drop.

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7.1.4 The sampler shall provide a means to measure the total flow rate during the sampling period. A continuous flow recorder is recommended but not required. The flow measurement device shall be accurate to ±2 percent.

7.1.5 A timing/control device capable of starting and stopping the sampler shall be used to obtain a sample collection period of 24 ± 1 hr (1,440 ± 60 min). An elapsed time meter, accurate to within ± 15 minutes, shall be used to measure sampling time. This meter is optional for samplers with continuous flow recorders if the sampling time measurement obtained by means of the recorder meets the ± 15 minute accuracy specification.

7.1.6 The sampler shall have an associated operation or instruction manual as required by part 53 of this chapter which includes detailed instructions on the calibration, operation, and maintenance of the sampler.

7.2 *Filters.*

7.2.1 *Filter Medium.* No commercially available filter medium is ideal in all respects for all samplers. The user's goals in sampling determine the relative importance of various filter characteristics (e.g., cost, ease of handling, physical and chemical characteristics, etc.) and, consequently, determine the choice among acceptable filters. Furthermore, certain types of filters may not be suitable for use with some samplers, particularly under heavy loading conditions (high mass concentrations), because of high or rapid increase in the filter flow resistance that would exceed the capability of the sampler's flow control device. However, samplers equipped with automatic filter-changing mechanisms may allow use of these types of filters. The specifications given below are minimum requirements to ensure acceptability of the filter medium for measurement of PM_{10} mass concentrations. Other filter evaluation criteria should be considered to meet individual sampling and analysis objectives.

7.2.2 *Collection Efficiency.* ± 99 percent, as measured by the DOP test (ASTM-2986) with 0.3 μm particles at the sampler's operating face velocity.

7.2.3 *Integrity.* ±5 $\mu g/m^3$ (assuming sampler's nominal 24-hour air sample volume). Integrity is measured as the PM_{10} concentration equivalent corresponding to the average difference between the initial and the final weights of a random sample of test filters that are weighed and handled under actual or simulated sampling conditions, but have no air sample passed through them (i.e., filter blanks). As a minimum, the test procedure must include initial equilibration and weighing, installation on an inoperative sampler, removal from the sampler, and final equilibration and weighing.

7.2.4 *Alkalinity.* <25 microequivalents/gram of filter, as measured by the procedure given in Reference 13 following at least two months storage in a clean environment (free from contamination by acidic gases) at room temperature and humidity.

7.3 *Flow Rate Transfer Standard.* The flow rate transfer standard must be suitable for the sampler's operating flow rate and must be calibrated against a primary flow or volume standard that is traceable to the National Bureau of Standards (NBS). The flow rate transfer standard must be capable of measuring the sampler's operating flow rate with an accuracy of ± 2 percent.

7.4 *Filter Conditioning Environment.*

7.4.1 Temperature range: 15° to 30°C.

7.4.2 Temperature control: ±3°C.

7.4.3 Humidity range: 20% to 45% RH.

7.4.4 Humidity control: ± 5% RH.

7.5 *Analytical Balance.* The analytical balance must be suitable for weighing the type and size of filters required by the sampler. The range and sensitivity required will depend on the filter tare weights and mass loadings. Typically, an analytical balance with a sensitivity of 0.1 mg is required for high volume samplers (flow rates >0.5 m^3/min). Lower volume samplers (flow rates > 0.5 m^3/min) will require a more sensitive balance.

8.0 *Calibration.*

8.1 *General Requirements.*

8.1.1 Calibration of the sampler's flow measurement device is required to establish traceability of subsequent flow measurements to a primary standard. A flow rate transfer standard calibrated against a primary flow or volume standard shall be used to calibrate or verify the accuracy of the sampler's flow measurement device.

8.1.2 Particle size discrimination by inertial separation requires that specific air velocities be maintained in the sampler's air inlet system. Therefore, the flow rate through the sampler's inlet must be maintained throughout the sampling period within the design flow rate range specified by the manufacturer. Design flow rates are specified as actual volumetric flow rates, measured at existing conditions of temperature and pressure (Q_a). In contrast, mass concentrations of PM_{10} are computed using flow rates corrected to EPA reference conditions of temperature and pressure (Q_{std}).

8.2 *Flow Rate Calibration Procedure.*

8.2.1 PM_{10} samplers employ various types of flow control and flow measurement devices. The specific procedure used for flow rate calibration or verification will vary depending on the type of flow controller and flow indicator employed. Calibration in terms of actual volumetric flow rates (Q_a) is generally recommended, but other measures of flow rate (e.g., Q_{std}) may be used provided the requirements of section 8.1 are met. The general procedure given here is based on actual volumetric flow units (Q_a) and serves to illustrate the steps involved in the calibration of a PM_{10} sampler. Consult the sampler manufacturer's instruction manual and Reference 2 for specific guidance on calibration. Reference 14 provides additional information on the use of the commonly used measures of flow rate and their interrelationships.

8.2.2 Calibrate the flow rate transfer standard against a primary flow or volume standard traceable to NBS. Establish a calibration relationship (e.g., an equation or family of curves) such that traceability to the primary standard is accurate to within 2 percent over the expected range of ambient conditions (i.e., temperatures and pressures) under which the transfer standard will be used. Recalibrate the transfer standard periodically.

8.2.3 Following the sampler manufacturer's instruction manual, remove the sampler inlet and connect the flow rate transfer standard to the sampler such that the transfer standard accurately measures the sampler's flow rate. Make sure there are no leaks between the transfer standard and the sampler.

8.2.4 Choose a minimum of three flow rates (actual m^3/min), spaced over the acceptable flow rate range specified for the inlet (see 7.1.2) that can be obtained by suitable adjustment of the sampler flow rate. In accordance with the sampler manufacturer's instruction manual, obtain or verify the calibration relationship between the flow rate (actual m^3/min) as

indicated by the transfer standard and the sampler's flow indicator response. Record the ambient temperature and barometric pressure. Temperature and pressure corrections to subsequent flow indicator readings may be required for certain types of flow measurement devices. When such corrections are necessary, correction on an individual or daily basis is preferable. However, seasonal average temperature and average barometric pressure for the sampling site may be incorporated into the sampler calibration to avoid daily corrections. Consult the sampler manufacturer's instruction manual and Reference 2 for additional guidance.

8.2.5 Following calibration, verify that the sampler is operating at its design flow rate (actual m^3/min) with a clean filter in place.

8.2.6 Replace the sampler inlet.

9.0 *Procedure.*

9.1 The sampler shall be operated in accordance with the specific guidance provided in the sampler manufacturer's instruction manual and in Reference 2. The general procedure given here assumes that the sampler's flow rate calibration is based on flow rates at ambient conditions (Q_a) and serves to illustrate the steps involved in the operation of a PM_{10} sampler.

9.2 Inspect each filter for pinholes, particles, and other imperfections. Establish a filter information record and assign an identification number to each filter.

9.3 Equilibrate each filter in the conditioning environment (see 7.4) for at least 24 hours.

9.4 Following equilibration, weigh each filter and record the presampling weight with the filter identification number.

9.5 Install a preweighed filter in the sampler following the instructions provided in the sampler manufacturer's instruction manual.

9.6 Turn on the sampler and allow it to establish run-temperature conditions. Record the flow indicator reading and, if needed, the ambient temperature and barometric pressure. Determine the sampler flow rate (actual m^3/min) in accordance with the instructions provided in the sampler manufacturer's instruction manual.

NOTE.—No onsite temperature or pressure measurements are necessary if the sampler's flow indicator does not require temperature or pressure corrections or if seasonal average temperature and average barometric pressure for the sampling site are incorporated into the sampler calibration (see step 8.2.4). If individual or daily temperature and pressure corrections are required, ambient temperature and barometric pressure can be obtained by on-site measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampling site and the airport.

9.7 If the flow rate is outside the acceptable range specified by the manufacturer, check for leaks, and if necessary, adjust the flow rate to the specified setpoint. Stop the sampler.

9.8 Set the timer to start and stop the sampler at appropriate times. Set the elapsed time meter to zero or record the initial meter reading.

9.9 Record the sample information (site location or identification number, sample date, filter identification number, and sampler model and serial number).

9.10 Sample for 24 ± 1 hours.

9.11 Determine and record the average flow rate (Q_a) in actual m^3/min for the sampling period in accordance with the instructions provided in the sampler manufacturer's instruction manual. Record the elapsed time meter final reading and, if needed, the average ambient temperature and barometric pressure for the sampling period (see note following step 9.6).

9.12 Carefully remove the filter from the sampler, following the sampler manufacturer's instruction manual. Touch only the outer edges of the filter.

9.13 Place the filter in a protective holder or container (e.g., petri dish, glassine envelope, or manila folder).

9.14 Record any factors such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement on the filter information record.

9.15 Transport the exposed sample filter to the filter conditioning environment as soon as possible for equilibration and subsequent weighing.

9.16 Equilibrate the exposed filter in the conditioning environment for at least 24 hours under the same temperature and humidity conditions used for presampling filter equilibration (see 9.3).

9.17 Immediately after equilibration, reweigh the filter and record the postsampling weight with the filter identification number.

10.0 *Sampler Maintenance.*

10.1 The PM_{10} sampler shall be maintained in strict accordance with the maintenance procedures specified in the sampler manufacturer's instruction manual.

11.0 *Calculations.*

11.1 Calculate the average flow rate over the sampling period corrected to EPA reference conditions as Q_{std}. When the sampler's flow indicator is calibrated in actual volumetric units (Q_a), Q_{std} is calculated as:

$$\overline{Q}_{std} = \overline{Q}_a \times (P_{av}/T_{av})(T_{std}/P_{std})$$

where

$\overline{Q}_{std}$=average flow rate at EPA reference conditions, std m^3/min;

$\overline{Q}_a$=average flow rate at ambient conditions, m^3/min;

P_{av}=average barometric pressure during the sampling period or average barometric pressure for the sampling site, kPa (or mm Hg);

T_{av}=average ambient temperature during the sampling period or seasonal average ambient temperature for the sampling site, K;

T_{std}=standard temperature, defined as 298 K;

P_{std}=standard pressure, defined as 101.3 kPa (or 760 mm Hg).

11.2 Calculate the total volume of air sampled as:

$$V_{std} = \overline{Q}_{std} t$$

where

V_{std}=total air sampled in standard volume units, std m^3;

t=sampling time, min.

11.3 Calculate the PM_{10} concentration as:

$$PM_{10} = (W_f - W_i) \times 10^6/V_{std}$$

where

PM_{10} =mass concentration of PM_{10}, μg/std m^3;

W_f, W_i=final and initial weights of filter collecting PM_{10}particles, g;

10^6=conversion of g to μg.

NOTE: If more than one size fraction in the PM_{10} size range is collected by the sampler, the sum of the net weight gain by each collection filter [$\Sigma S(W_f - W_i)$] is used to calculate the PM_{10} mass concentration.

12.0 *References.*

1. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I, Principles. EPA-600/9-76-005, March

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1976. Available from CERI, ORD Publications, U.S. Environmental Protection Agency, 26 West St. Clair Street, Cincinnati, OH 45268.

2. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods. EPA-600/4-77-027a, May 1977. Available from CERI, ORD Publications, U.S. Environmental Protection Agency, 26 West St. Clair Street, Cincinnati, OH 45268.

3. Clement, R.E., and F.W. Karasek. Sample Composition Changes in Sampling and Analysis of Organic Compounds in Aerosols. Int. J. Environ. Analyt. Chem., 7:109, 1979.

4. Lee, R.E., Jr., and J. Wagman. A Sampling Anomaly in the Determination of Atmospheric Sulfate Concentration. Amer. Ind. Hyg. Assoc. J., 27:266, 1966.

5. Appel, B.R., S.M. Wall, Y. Tokiwa, and M. Haik. Interference Effects in Sampling Particulate Nitrate in Ambient Air. Atmos. Environ., 13:319, 1979.

6. Coutant, R.W. Effect of Environmental Variables on Collection of Atmospheric Sulfate. Environ. Sci. Technol., 11:873, 1977.

7. Spicer, C.W., and P. Schumacher. Interference in Sampling Atmospheric Particulate Nitrate. Atmos. Environ., 11:873, 1977.

8. Appel, B.R., Y. Tokiwa, and M. Haik. Sampling of Nitrates in Ambient Air. Atmos. Environ., 15:283, 1981.

9. Spicer, C.W., and P.M. Schumacher. Particulate Nitrate: Laboratory and Field Studies of Major Sampling Interferences. Atmos. Environ., 13:543, 1979.

10. Appel, B.R. Letter to Larry Purdue, U.S. EPA, Environmental Monitoring and Support Laboratory. March 18, 1982, Docket No. A-82-37, II-I-1.

11. Pierson, W.R., W.W. Brachaczek, T.J. Korniski, T.J. Truex, and J.W. Butler. Artifact Formation of Sulfate, Nitrate, and Hydrogen Ion on Backup Filters: Allegheny Mountain Experiment. J. Air Pollut. Control Assoc., 30:30, 1980.

12. Dunwoody, C.L. Rapid Nitrate Loss From PM_{10} Filters. J. Air Pollut. Control Assoc., 36:817, 1986.

13. Harrell, R.M. Measuring the Alkalinity of Hi-Vol Air Filters. EMSL/RTP-SOP-QAD-534, October 1985. Available from the U.S. Environmental Protection Agency, EMSL/QAD, Research Triangle Park, NC 27711.

14. Smith, F., P.S. Wohlschlegel, R.S.C. Rogers, and D.J. Mulligan. Investigation of Flow Rate Calibration Procedures Associated With the High Volume Method for Determination of Suspended Particulates. EPA-600/4-78-047, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, 1978.

[Appendix J added at 52 FR 24663, July 1, 1987; amended at 52 FR 29467, Aug. 7, 1987]

APPENDIX K TO PART 50—INTERPRETATION OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER

1.0 *General.*

This appendix explains the computations necessary for analyzing particulate matter data to determine attainment of the 24-hour and annual standards specified in 40 CFR 50.6. For the primary and secondary standards, particulate matter is measured in the ambient air as PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers) by a reference method based on Appendix J of this part and designated in accordance with part 53 of this chapter, or by an equivalent method designated in accordance with part 53 of this chapter. The required frequency of measurements is specified in part 58 of this chapter.

Several terms used throughout this appendix must be defined. A "daily value" for PM_{10} refers to the 24-hour average concentration of PM_{10} calculated or measured from midnight to midnight (local time). The term "exceedance" means a daily value that is above the level of the 24-hour standard after rounding to the nearest 10 $\mu g/m^3$ (i.e., values ending in 5 or greater are to be rounded up). The term "average" refers to an arithmetic mean. All particulate matter standards are expressed in terms of expected annual values: expected number of exceedances per year for the 24-hour standards and expected annual arithmetic mean for the annual standards. The "expected annual value" is the number approached when the annual values from an increasing number of years are averaged, in the absence of long-term trends in emissions or meteorological conditions. The term "year" refers to a calendar year.

Although the discussion in this appendix focuses on monitored data, the same principles apply to modeling data, subject to EPA modeling guidelines.

2.0 *Attainment Determinations.*

2.1 *24-Hour Primary and Secondary Standards.*

Under 40 CFR 50.6(a) the 24-hour primary and secondary standards are attained when the expected number of exceedances per year at each monitoring site is less than or equal to one. In the simplest case, the number of expected exceedances at a site is determined by recording the number of exceedances in each calendar year and then averaging them over the past 3 calendar years. Situations in which 3 years of data are not available and possible adjustments for unusual events or trends are discussed in Sections 2.3 and 2.4. Further, when data for a year are incomplete, it is necessary to compute an estimated number of exceedances for that year by adjusting the observed number of exceedances. This procedure, performed by calendar quarter, is described in Section 3. The expected number of exceedances is then estimated by averaging the individual annual estimates for the past 3 years.

The comparison with the allowable expected exceedance rate of one per year is made in terms of a number rounded to the nearest tenth (fractional values equal to or greater than 0.05 are to be rounded up; e.g., an exceedance rate of 1.05 would be rounded to 1.1, which is the lowest rate for nonattainment).

2.2 *Annual Primary and Secondary Standards.*

Under 40 CFR 50.6(b), the annual primary and secondary standards are attained when the expected annual arithmetic mean PM_{10} concentration is less than or equal to the level of the standard. In the simplest case, the expected annual arithmetic mean is determined by averaging the annual arithmetic mean PM_{10} concentrations for the past 3 calendar years. Because of the potential for incomplete data and the possible seasonality in PM_{10} concentrations, the annual mean shall be calculated by averaging the four quarterly means of PM_{10} concentrations within the calendar year. The formulas for calculating the annual arithmetic mean are given in Section 4. Situations in which 3 years of data are not available and possible adjustments for unusual events or trends are discussed in Sections 2.3 and 2.4. The expected annual arith-

INSTRUCTION AND OPERATION MANUAL

HIGH VOLUME PM10 SAMPLER

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ATTENTION!

1. To avoid an electrical shock, disconnect the 115 volt A.C. power prior to performing any maintenance activities on the HVPM10 sampler.

2. Proper alignment of the Model 1200 Inlet halves is required to maintain a proper seal. Check alignment pins and holes for proper seating before locking the inlet hook-catches.

3. Handling care and technique should be developed to ensure the quartz fiber filter media is not damaged prior to or after a sample run (this media is extremely brittle). A filter cartridge is mandatory with all ASI/GMW HVPM10 systems.

4. Because of the size of the PM10 fractionating inlet, it is required that the sampler be firmly anchored to the site platform or a pallet. Model 2021 (PN G2021) accessory support feet are recommended.

5. The Model 1200 collection shim must be checked routinely for overloading. Refer to Section 7.1 for procedures.

6. Adequate voltage is required for HVPM10 samplers equipped with mass flow controllers. A minimum line voltage of 90 VAC is necessary to ensure proper operation. Ground fault interrupters are recommended for all HVPM10 systems.

1.0
Introduction

On July 1, 1987, the U.S. Environmental Protection Agency (U.S. EPA) promulgated a new size-specific air quality standard (refer to Appendix A) for ambient particulate matter. This new primary standard applies only to particles with aerodynamic diameters smaller than, or equal to, 10 micrometers (PM10), and replaces the original rules for total suspended particulate matter (TSP). To measure concentrations of these particles, the EPA also promulgated a new federal reference method (FRM). This method is based on the fractionation of non-PM10 particles from ther size distribution, followed by filtration and gravimetric analysis of PM10 mass on the filter substrate.

The new primary standard (adopted to protect human health) limits PM10 concentrations to 150 micrograms per standard cubic meter (µg/std. m^3) during a 24-hour period. It is believed that these smaller particles are able to reach the lower regions of the human respiratory tract, and thus be responsible for most of the adverse health effects associated with suspended particulate pollution. The secondary standard, used to assess the impact of pollution on public welfare, has also been established 150 µg/std. m^3.

Andersen Samplers, Inc (ASI) and General Metal Works (GMW) High Volume PM10 (HVPM10) systems meet all FRM performance specifications for the measurement of PM10 and hence, have been designated as an approved method for the determination of suspended PM10 particulate concentrations. Each ASI/GMW HVPM10 sampler bears an identification label with an inlet-specific FRM designation number. Table 1.1 presents a description of each inlet and its respective designation number.

Regardless of the model of ASI/GMW inlet employed, the reference method also requires that the measurement system be equipped with the following components:

A. Anodized aluminum high volume shelter identified as G8500,
B. PM10 fractionating inlet identified as either Model 1200, 321-B, or 321-C,
C. Either an acrylonitrile-butadine styrene-plastic filter holder, motor housing and 0.6 hp motor (Sierra-Andersen Product and available only upon request), or a stainless-steel filter holder and phenolic plastic motor housing with a 0.6 hp motor (GMW product),

Table 1.1 Description of ASI/GMW HVPM10 Sampler Inlets

REFERENCE METHOD DESIGNATION and MODEL NUMBER	INLET DESCRIPTION
RFPS-1287-063 SA/G 1200	1. Single Accleration Nozzle Stage 2. 9.7µm, 50% cut point 3. Greased Collection Shim 4. Inlet Body Hinged for Cleaning
RFPS-1287-064 SA/G 321-B	1. Two Accleration Nozzle Stages 2. 9.7µm, 50% Cut Point 3. Greased Collection Shim on first stage 4. Inlet lid Removable for Cleaning
RFPS-1287-065 SA/G 321-C	1. Single Accleration Nozzle Stage 2. 9.7µm, 50% Cut Point 3. Greased Collection Shim 4. Inlet lid Removable for Cleaning

Note: An inlet originally purchased as Model 321 (single stage inlet without greased shim) or Model 321-A (two stage inlet without greased shim) must be modified to meet reference method designation. Please contact the factory.

D. Either an electronic mass flow or volumetric flow control system (Variacs and step-down transformers are not eligible flow control systems for PM10 sampling),

E. Either a digital timer/programmer, seven-day mechanical timer, six-day timer/programmer, solid state timer/programmer, or elapsed time indicator.

F. Either a continuous flow recorder or an alternate method for recording operation flow rate (e.g., pre-and post flow checks).

If an HVPM10 sampler is not equipped with a component from each of the above categories, data collected cannot be directly or ultimately reported to the U.S. EPA. If there are questions regarding the authenticity of the monitoring system, please contact the factory as soon as possible.

This document will address the recommended methods of operation for ASI/GMW HVPM10 monitoring systems. The procedures presented herein are within all quality assurance and operational specifications required by the FRM, compatible with procedures presented in the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Section 2.11 and are specific to ASI/GMW systems.

2.0
Principles of Operation

2.1 Method Summary

The FRM describes in detail the performance requirements for all PM10 samplers. The instrument must meet the basic requirements simplified in Table 2.1. All ASI/GMW HVPM10 monitoring systems satisfy these criteria. Only particles ≤10 µm are drawn through the inlet and a constant, controlled flow rate is maintained by either a mass flow (MFC) or volumetric flow controller (VFC). Particles are collected on a micro-quartz fiber filter that is equilibrated and weighed before (tare) and after (gross) sampling to determine the weight (net mass) gain of the sample. Sample duration is either controlled by a timer accurate to ±15 minutes over a 24-hour sample period or measured by an elapsed time indicator.

To calculate the mass concentration of PM10, the total volume of air sampled is determined from the measured actual flow rate and the sampling time. The concentration of PM10 in the ambient air is then computed as the net mass collected divided by the volume of air sampled. Since the sampler is operated in terms of actual or seasonal average conditions (to meet the design specifications of the inlet), the operational flow rate (and thus, the sample volume) must be corrected to U.S. EPA reference conditions (298°K, 760 mmHg) for data reporting. Reported concentrations must be expressed as micrograms per standard cubic meter (µg/std. m^3).

As previously indicated, the Size-Selective Inlet (SSI) is the sampler component that characterizes the reference method designation number of an HVPM10 sampler. Since several modifications have occurred, the following brief history of the evolution of the ASI/GMW SSI may be helpful.

The original SSI's were developed by Dr. A.R. McFarland under an U.S. EPA grant to meet a potential Inhalable Particulate standard. At that time, the U.S. EPA proposed to regulate only those particles with an aerodynamic diameter (a.d.) of 15 µm. After research and field studies, the U.S. EPA reconsidered this particulate indicator and decided that an indicator based on the concentration of Thoracic Particulates (those particles that can be entrained in the respiratory system, ≤10 µm a.d.) provided a better indication of the potential health effects from particulate pollution.

Table 2.1 Federal Reference Method HVPM10 Performance Requirements

SPECIFICATION	PART NUMBERS
1. Draw a measured quantity of ambient air through a specially designed, particle size discriminating inlet	SA/G 1200 SA/G 321-B* SA/G 321-C* (*no longer sold)
2. Maintain a constant flow rate within the design specifications of the HVPM10 inlet	SA350 / G310 (mass flow rate) G360 (volumetric flow rate)
3. Collect the sample on approved filter media	GQMA (Micro-Fiber Quartz)
4. Have a timing control system within accuracy limits stipulated by the FRM.	G70, G70i, G76,G76i, G302,G801,G8000 G901,G901R,G901,G901R

Dr. McFarland modified the single stage, 15 µm (Model 320) SSI to obtain a 10 µm cut point under funding from ASI and this inlet was sold from March, 1982 until May, 1984 under a Model 321 designation. Although the Model 321 inlet met all of the prevailing performance specifications for PM10 inlets, Dr. McFarland developed an improved SSI, the two stage Model 321-A. During subsequent U.S. EPA field performance evaluations however, it was determined that a greased collection surface was required (within the SSI) to prevent a potential "carry-through" of large particles (>20 µm) at PM10 monitoring sites subject to high concentration of wind-blown dust.

Later TAMU data analysis determined that the of 10.2 µm inlet cut point (original design of Model 321 and 321-A inlets) could be modified to a cut point of 9.7 µm by using a smaller diameter acceleration nozzle. A 9.7 µm cut point meets not only all Federal Reference Method (FRM) inlet specifications (inlet cut point of 10 µm ± 0.5 µm) but also results in lower mass concentration measurements. Hence, the development of greased shim and nozzle insert retro-fit kits for both the 321 and 321-A inlets. ASI/GMW offer these modification kits free to all customers who purchased Models 321 and 321-A inlets, it is only necessary to contact the manufacturer. Retro-fit instructions are presented in Appendix E of this manual.

Once modified with a greased collection surface, the 321 and 321-A inlets are designated Reference Methods (RFPS-1287-065 and RFPS-1287-064, respectively) and are referred to as Model 321-C and 321-B, respectively. Note: Nozzle inserts for Model 321-A inlets are not required for FRM designation, they are however, recommended by the manufacturer.

Since the greased collection shim all ASI/GMW HVPM10 inlets needs to be routinely cleaned, Dr. McFarland later developed a hinged-body (Model 1200) SSI to facilitate these maintenance procedures.

This section will examine each portion of the monitoring system and provide a discussion on the principle of operation for each individual component. For simplicity and organizational purposes, it will be assumed that the Model 1200 inlet will be mounted on a high-volume sampler fitted with a volumetric flow controller, elapsed time indicator, and a continuous flow recorder. It will also be assumed that the 321-B inlet (note: These inlets are no longer being manufactured; however, due to the number of these inlets in operation, their operational principles are being included here.) has been mounted on a high volume sampler equipped with a mass flow controller, continuous flow recorder, and a 6-day on/off timer. These configurations are not required nor necessarily recommended. As indicated in

Table 2.1, if the monitoring system satisfies the requirements presented in 40 CFR 53, Appendix J, the individual components are interchangeable; any combination of inlets, flow controllers and timers is allowed.

2.2 Model 1200/VFC HVPM10 Sampler, RFPS-1287-063

Figure 2.1 presents a schematic indicating the basic elements of the Model 1200 VFC HVPM10 sampler. As ambient air is drawn into the inlet, it is evacuated from the buffer chamber through nine acceleration nozzles into the impaction chamber where particles larger than 10 µm are impacted onto a greased collection shim. The air containing the PM10 particle fraction is then channeled through an additional 16 vent tubes and filtered through a specially formulated micro-quartz fiber filter. The acceleration nozzles have critical diameters calculated and performance tested to provide the necessary velocity to effect correct particle size fractionation within the impaction chamber. Because air velocities are critical to maintain a PM10 cut point within the inlet, maintaining the correct design flow rate of 1.13 m^3/min (±10%) at actual conditions is important.

Sample flow rate is controlled and maintained by a volumetric flow controller (VFC). Simply stated, the VFC is a dimensional venturi device used to control gas flow. When applied to a high volume air sampler, this flow control principle incorporates a smooth-wall venturi that gradually opens to a recovery section. Vacuum is provided by a blower/motor downstream of the venturi.

Flow control is accomplished by occluding, and thus accelerating, the air flow through the venturi. At some point in the flow stream, the air velocity will equal the acoustic velocity, and critical flow will be achieved. As long as downstream changes are small, all conditions at the venturi (including the flow rate) are determined by upstream conditions. This condition is referred to as "choking" and is a distinctive characteristic of all VFC's. The ASI/GMW VFC utilizes this principle of choked flow to maintain a constant actual flow rate of 1.13 m^3/min over a sample period. Note: If data are to be reported to the U.S. EPA, the flow rate must be corrected to standard conditions before calculating the sample volume. These calculations are presented in Section 6.0 of this document.

Since critical flow through the venturi is not greatly affected by changes in filter loading, ambient temperature or station barometric pressure, a stable volumetric flow rate is maintained as long as sufficient power is provided to the unit. To determine the sampler's operational flow rate (as required by the FRM) a calibration must be conducted. Specific calibration procedures are presented in

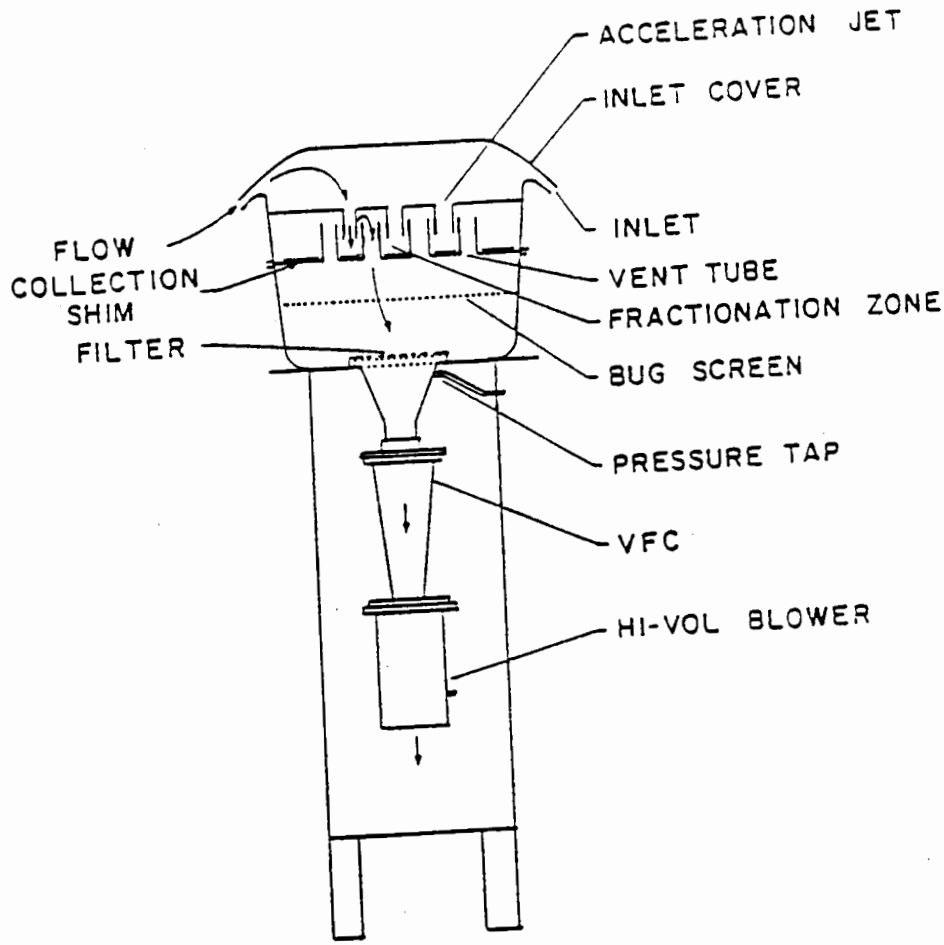


Figure 2.1 Schematic Diagram of Sierra - Andersen/GMW Model 1200 with VFC

Section 4.0. The sampler's indicated flow and the reading from an elapsed time meter, is then used to compute the sample volume. ASI/GMW have two models of elapsed time indicators: one that can be reset, the other provides a non-stop record of the samplers total operational time. The model selected is optional.

2.3 Model 321-B/MFC HVPM10 Sampler, RFPS-1287-064

It is assumed for simplicity that the Model 321-B inlet has been mated with a mass flow controller. However his is not necessarry since, a 321-B inlet will perform as designed with a volumetric flow controller.

Figure 2.2 presents a schematic indicating the basic elements of the Model 321-B/MFC HVPM10 sampler. As ambient air is drawn into the inlet, it is evacuated from the buffer chamber where the particles larger than 10 µm are impacted onto a greased collection shim. The air is then accelerated through an additional 16 jets into a second impaction chamber. The acceleration nozzles have critical diameters calculated and performance tested to provided the necessary velocity to effect correct particle size fractionation within the impaction chamber. The air flow finally exits the inlet through nine vent tubes onto a micro-quartz fiber filter. Currently, the micro-quartz filter is the only commercially available filter media that satisfies the requirements stipulated in 40 CFR 53, Appendix J for PM10 monitoring. ASI/GMW are researching alternate media and will inform our customers if any become available.

Air is pulled through the filter into the intake of a motor and subsequently exits into the atmosphere. The actual mass flow rate of the sampled air is controlled with a reference/sensing flow probe mounted in the throat section of the filter holder. The electrical output of the flow probe and associated solid state circuitry is used as the control signal to adjust the motor speed. Thus, as ambient conditions or filter loadings change, the controller increases or decreases the electrical power to the motor in such a manner that the mass flow rate is maintained at a constant velocity. The desired sampler flow rate is adjusted by a potentiometer following the sampler's calibration.

The specific mass flow rate at which the sampler should be set will depend upon local conditions of temperature and barometric pressure. The Model 321-B SSI is designed to maintain a 10± 0.5 µm cut point over a flow rate range of 1.02 to 1.24 m^3/min at actual conditions. It is imperative that the operator choose a set-point that will "center" the flow rate in respect to fluctuating run day temperature and barometric pressure conditions. To accomplish this, a seasonal average

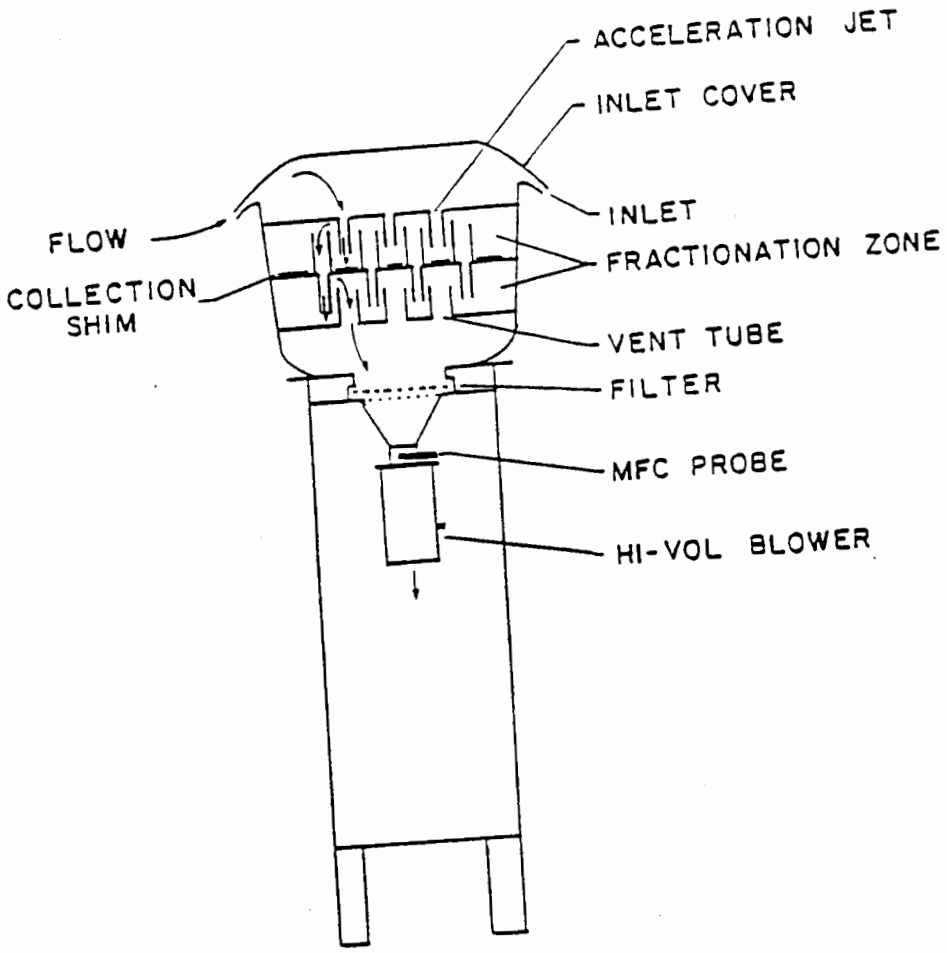


Figure 2.2 Schematic Diagram of Sierra - Andersen/GMW Model 321b HVPM10 with MFC

temperature and barometric pressure for each monitoring site should be determined. Using these values, an optimum seasonal average adjusted flow rate is calculated and a set-point determined. Calculations and set point adjustment procedures are presented in Section 4.4. A continuous recording of the sampler's flow rate is provided by a pressure transducer. This instrument is connected to the exhaust pressure port of the motor and monitors the difference in pressure between atmospheric and the motor plenum. The response of the flow recorder is calibrated and can be used to not only measure the sampler's flow rate, but also to monitor the line-voltage stability and flow controller performance. It is assumed that the Model 321-B/MFC sampler is also equipped with a mechanical 6-day timer. This timer is designed to operate with the HVPM10 sampler to comply with the sixth day format outlined in the Federal Register and is accurate to within ±15 minutes over a 24-hr sample period. Once properly set, this timer will energize the sampler every sixth day, at midnight, and allows rotation of the sample period over an entire week.

2.4 Calibration Equipment

A conventional orifice device, identical to that used in the calibration of a total suspended particulate sampler, is used to calibrate the ASI/GMW HVPM10 sampler. Two orifice models are available: one equipped with a set of five resistance plates (PN G25), and the other with a valve allowing for variable resistance (PN G335). In either case, the orifice device must be calibrated against a standard of known accuracy every year and provided with a calibration relationship (orifice pressure drop vs. actual flow rate) by either the calibrating agency or the operator.

3.0
HVPM10 Sampler Assembly Instructions

The ASI/GMW HVPM10 sampler is delivered in two cartons: one contains the Size-Selective Inlet (SSI), the second contains the sampler shelter or base unit. This section presents assembly instructions for the Model 1200 inlet and a basic base unit.

Specific instructions for retro-fitting HVPM10 samplers (e.g., exchanging a Model 321-B inlet for a Model 1200 or installing a VFC in a sampler previously equipped with an MFC) are available from the manufacturer and are not presented here. Retro-fit instructions for modifying a Model 321-A inlet to a Model 321-B are presented in Appendix E.

3.1 Model 1200 Size-Selective Inlet (SSI) Assembly Instructions

The Model 1200 SSI is packaged basically complete; only minor assembly is necessary. When removing the SSI from the shipping carton, take care not to drop the dome-shaped hood. The SSI is packaged with two protective cushions: one rests between the hood and the inlet, the second above the acceleration nozzles. Remove both cushions and the four cardboard corner braces. Gently lift the SSI from the carton and place it on the floor or on a workbench. Save the shipping container and packing material for future use. Locate the hardware bag taped to the acceleration nozzle plate and assemble the SSI as follows:

1. Place the hood (dome side up) onto the SSI housing.
2. Align one hole (8 total) on the hood with one located on the inlet rain deflector ramp (PN SSI-106). The rain deflector ramp is the gently curved section of the acceleration plate adjacent to the nozzles.
3. Place an aluminum spacer (PN SSI-60) between the hood and the acceleration nozzle plate.
4. For each spacer, place a thumb screw and nylon washer in-line. Loosely fasten the spacer to the nozzle plate and hood. Repeat steps 1-3 for the remaining spacers. When all spacers are installed, finger tighten the thumbscrews to ensure a complete seal.

5. Release the 4 stainless steel inlet hook-catches and tilt back the top portion of the SSI. Latch the inlet support strut in its upper most position.
6. Release the collection shim from its 2 shim clips. Lift the shim carefully past the nozzles and out of the inlet.
7. Place the shim on a clean flat surface and spray with a thick coating of Dow Corning Silicone #316. Do not substitute any other grease or oil without contacting the manufacturer; particle bounce characteristics may be affected by changing the viscosity of the oil.
8. Handling only the edges, return the collection shim (oiled side up) to the sampler inlet and secure.
9. While holding the inlet support strut forward, close and secure the top portion of the sampler inlet. Note: It may be necessary to adjust the inlet hook-catches. To accomplish this, loosen the lock-nut on the hook-catch rod. To shorten the catch length, turn the rod clockwise; counter-clockwise to lengthen. After adjustments are complete, re-tighten the lock-nut.

3.2 HVPM10 Sampler Shelter Assembly Instructions- VFC SAMPLERS

The instructions presented in this section are specific to ASI/GMW HVPM10 sampling systems ordered with Volumetric Flow Controllers (VFC).

The HVPM10 sampler shelter is easiest removed from the shipping container by tipping the carton horizontally and then slowly removing the shelter. The two additional boxes included in the shelter shipping carton house the motor and VFC and the filter holder assembly. The procedure to assemble the shelter are as follows:

1. Remove the VFC, motor (Figure 3.1) and filter holder assembly from their respective boxes.
2. Remove the male adapter (PN G2002) by removing the four (4) 1/4 20 x 1" hex-head bolts. This will expose the motor.
3. If a neoprene gasket has not been glued on the bottom of the VFC, install one (1) of the VFC flange gaskets directly on top of the motor housing. Make sure that the gasket is present and undamaged before continuing.

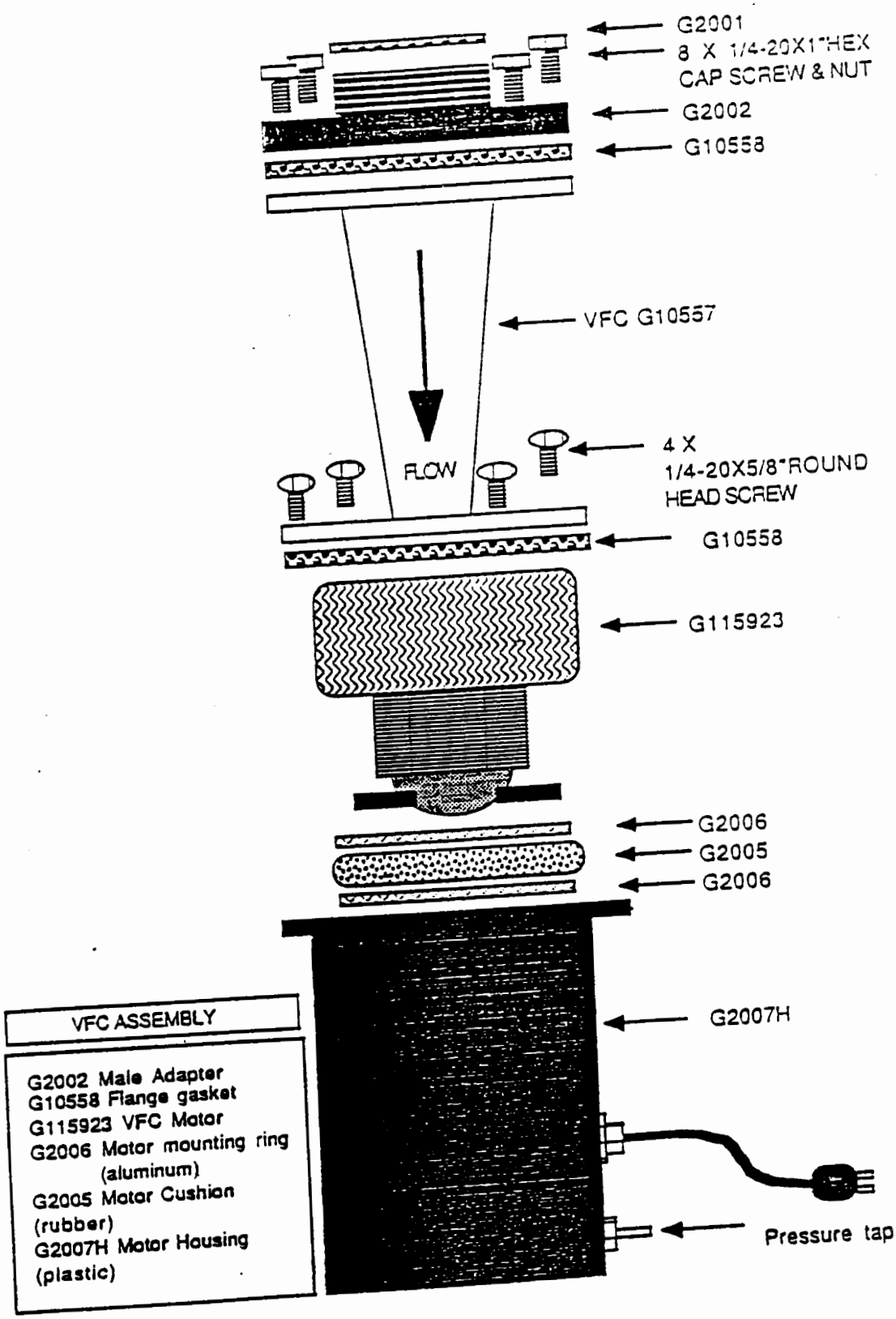


Figure 3.1 VFC Component Parts

4. Using the four (4) 1/4-20 x 5/8" hex-head screws, attach the VFC to the motor housing. Do not over-tighten as damage to the VFC flange gasket may result. Make sure that the arrow on the VFC is pointing down (toward the motor).
5. Place the second VFC flange gasket on the top of the VFC. Attach the male adapter to the VFC by installing and tightening the eight (8) 1/4 x 20 x1 hex-head bolts. Do not over-tighten.
6. Attach the assembled VFC system to the filter holder. Make sure that the motor plate gasket (PN G2001) is present before tightening.
7. Center the FH-sealing gasket (8 x 10 x 3/8") over the rectangular hole in the shelter pan. With the aid of another person, lift the entire filter holder/VFC assembly and gently drop it into the rectangular shelter pan hole. Make sure that FH-sealing gasket is centered evenly around the hole. Adjustment may be necessary after the assembly is placed inside.
8. Connect the tubing between the continuous recorder and the motor pressure tap. Connect the tubing between filter pressure tap and quik-connect fitting on shelter.

   Note: If the sampler is being assembled at a central location (not where it will be operated), it is recommended to skip steps 9-12 until the sampler is deployed. It is much easier to transport the sampler without the inlet attached. Once deployed, the shelter must be firmly anchored before installing the inlet. Extended support feet (PN G2021) are suggested.
9. With the aid of another person, carefully place the assembled SSI on the shelter.
10. Secure the inlet to the shelter body by installing the four (4) 10-24 x 1" machine screws in the sides of the shelter (refer to Figure 3.2) and through the shelter pan (PN G12006). Pre-punched holes are provided in each new shelter body.
11. Cut free the SSI shelter pan support strut (PN G120018). Unlatch the 6 draw catches that attach the base plate to the shelter pan section.
12. Attach the shelter pan support strut to the right side of the shelter pan. Make sure the large washer is placed on the outside of the shelter pan support strut. Carefully open the inlet.

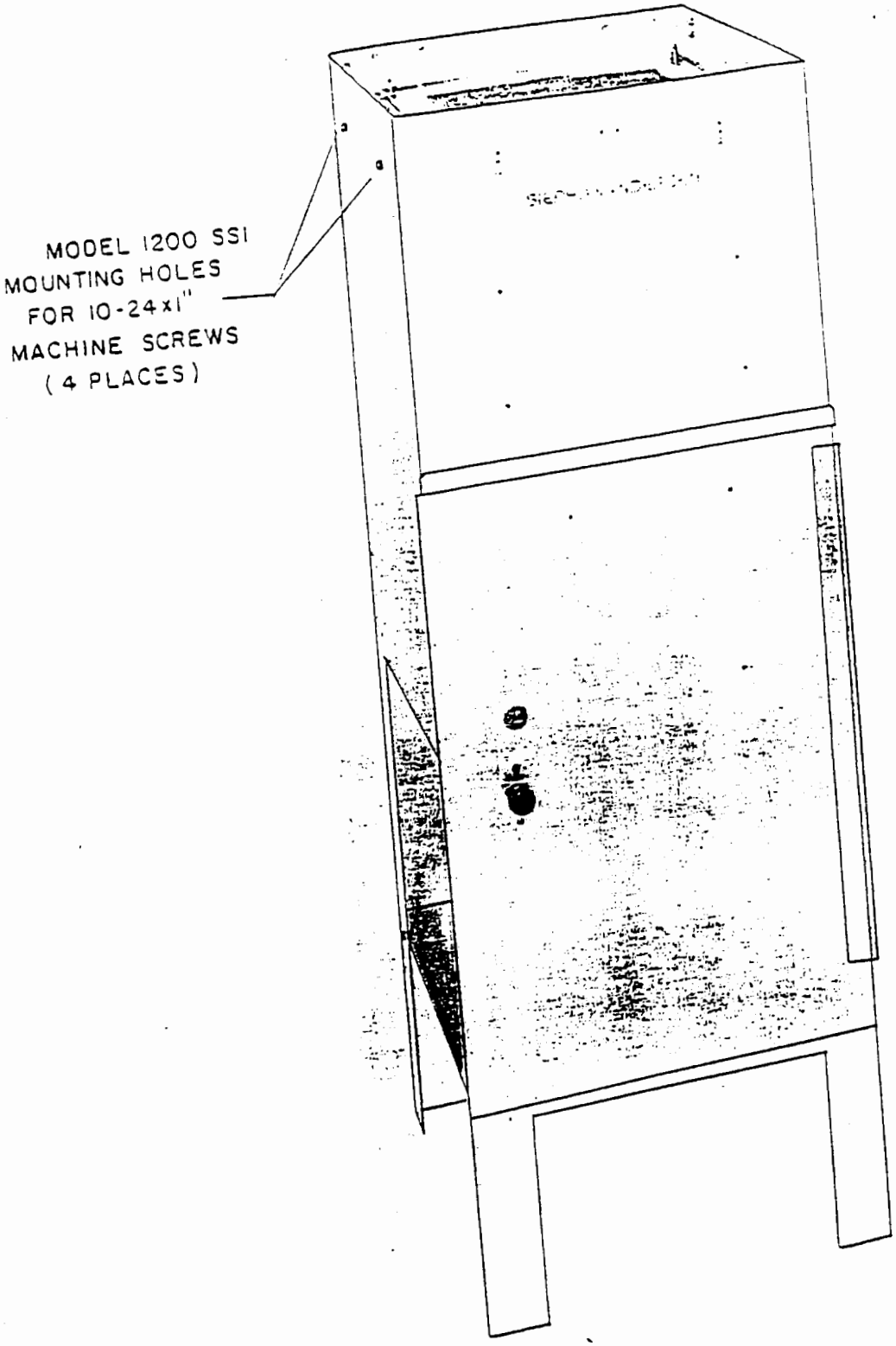


Figure 3.2 High Volume Shelter without TSP Gabled Roof or HVPM10 Inlet

13. Place a loaded filter cartridge on the sampler and connect the male power cord to line voltage. Energize the sampler and ensure that the recorder indicates an upscale response. Contact the manufacturer immediately if failure is suspected.
14. Turn off the sampler. Following instructions in Appendix D for the specific timer model installed, connect the motor to the timer and program, if necessary. Close the shelter door.
15. While holding the shelter pan support strut toward you, close the inlet. Latch the 6 shelter draw-catches. If necessary, adjust the shelter pan draw-catches following the procedure presented in Step 9, Section 3.1.
16. Conduct a leak test and calibration as presented in Section 4.2.

4.0
Flow Calibration Procedures

As discussed in Section 2.1, it is assumed in this document that the Model 1200 inlet has been mated with a volumetric flow controller; and Model 321-B with a mass flow controller (MFC). As mentioned previously, this is not required or necessarily recommended, either inlet will perform as designed regardless of which flow controller is employed. The type of flow controller does however, dictate the calibration method. Operating personnel should refer to the section dealing with their specific type: Section 4.3 presents procedures for VFC samplers and, Section 4.4 for MFC samplers. These two sections are completely independent; it is possible to remove and bind (if necessary) only those pages that deal with the type of sampler operated in the monitoring network. It is recommended however, that this entire section be reviewed and the two methods evaluated. In-house equipment, procedural simplicity, and subsequent data applications may warrant a new or retro-fitted PM10 measurement system.

To ensure an accurate calibration, ASI/GMW recommend a leak test be conducted after assembling the HVPM10 sampler and routinely thereafter. The leak test must be conducted after motor maintenance to determine the integrity of the seals. Complete leak test procedures are presented in Section 4.2

4.1 Discusion of Flow Rate Designations

The particle size discrimination characteristics of the Models 1200 and 321-B inlets are dependent upon the air velocity through the acceleration jets. A change in the entrance velocity will result in a change in the nominal particle size collected. For this reason, it is imperative that the flow rate through the inlet be maintained at a constant actual flow rate of 1.13 actual m^3/min (±10%).

Since this actual flow rate is so critical for particle fractionation, the operator must have an understanding of the flow rate designations used in PM10 monitoring. Confusion between various air monitoring units is the most frequent source of error in a particulate monitoring network. Table 4.1 presents a summary of PM10 flow rate designations; their primary use and conversion equations.

TABLE 4.1 COMMON FLOW RATE DESIGNATIONS USED IN PM10 MONITIORING

Flow Rate Designation	Temp. Conditions	Temp. Designation	Barometric Pressure Conditions	Barometric Pressure Designation	Primary Use	Conversion Calculations
Qa	Current	Ta	Current	Pa	1. Inlet Design Flow 2. Calibration Flows 3. Audits and Flow Checks	Qstd = Qa(Pa/Pstd)(Tstd/Ta)
	24-hour average	Tav	24-hour average	Pav	1. Operational Flow Rates	Qstd = Qa(Pav/Pstd)(Tstd/Tav)
Qstd	EPA reference	Tstd (298°K)	EPA reference	Pstd (760mmHg)	1. Data Reporting	Qa = Qstd (Pstd/Pa)(Ta/Tstd)
SQa* seasonally adjusted Qa flow rate	seasonal average	Ta	seasonal average	Pa	1. Operational Flow Rates	Qstd = SQa(Pa/Pstd)(Tstd/Ta)

*This is not a flow rate! Flow rates can only be expressed in terms of mass units (standard flow) or volume units (actual flow). This designation simply refers to a seasonally adjusted Qa flow rate.

4.2 Pre-Calibration Leak Test

4.2.1 VFC HVPM10 Sampler. This test should be conducted after sampler assembly, after motor maintenance and at routine intervals throughout the year. The following procedures should be followed:

1. Set up the calibration system as illustrated in Figure 4.1. VFC HVPM10 samplers are calibrated without a filter or filter cartridge in line. The operating filter pressure drop is simulated with multi-hole load plates, or an adjustable Vari-flo® orifice. When installing the orifice face plate adapter to the filter support screen, tighten the face place nuts on alternate corners first to prohibit leaks and to insure even tightening. The fittings should be hand tightened; too much compression can damage the sealing gasket. Make sure the orifice gasket is in place between the face plate adapter and orifice, tighten down the orifice to the face plate adapter making sure not to cross thread the lock-down ring.
2. Cover or tape over the inlet of the orifice unit with one or more strips of duct tape. Check that the manometer valves of both manometers are fully closed by removing the tubing to the orifice pressure tap and blowing into the tube. Valve are closed by turning the plastic elbows at the top of a monometer fully clockwise. If the valves are closed no movement of the fluid will take place. Replace the tube to the orifice pressure tap. Connect tubing to pressure tap on filter holder housing located 1.5 inches below screen on side of holder. This pressure tap is accessible through door of sampler. Close off this tube with a tubing clamp. This tube should be closed during operation and leak tests when a manometer is not connected to the tube. Production VFC units have a quick-connect valve located on the shelter which closes automatically when manometer is disconnected.
3. Connect the motor blower power cord to a stable voltage source which has a power switch (e.g. the sampler's on-off timer (if so equipped), or another source of line voltage, 60 hz /120 vac).
4. Turn on power to the sampler. Gently wiggle the orifice and listen for a whistling sound that would indicate a leak in the system. A leak-

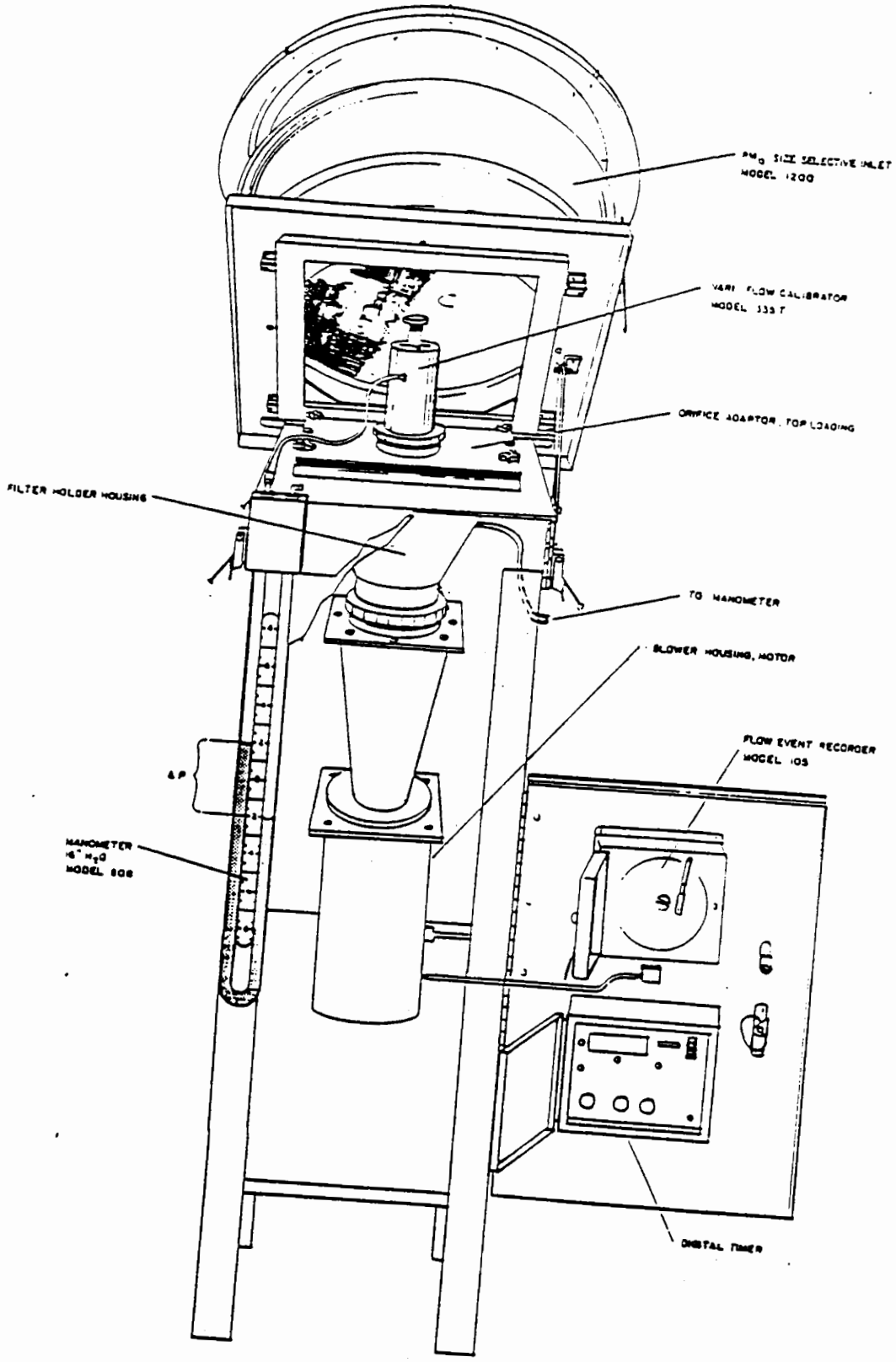


Figure 4.1 VFC Sampler Calibration Equipment

free system will also indicate no upscale response on the recorder. Leaks are usually caused by either a missing gasket at the junction of the orifice and face plate,cross threading the orifice to the face plate, or cross threading the VFC to the filter holder.

5. If the VFC HVPM10 is leak free, turn off the sampler and remove duct tape from the orifice.
6. Inspect the manometer connecting tubes for crimps or cracks. Open the valves on the manometers and gently blow through the tubing, watch for the free flow of the manometer fluid. Adjust the manometer sliding scale so that the zero line is at the bottom of the meniscii.
7. Proceed to one point flow verification of sampler, in Section 4.3.1.

4.2.2 MFC HVPM10 Sampler. This test should be conducted after sampler assembly, after motor maintenance and at routine intervals throughout the year. The following procedures should be followed:

1. Set up the calibration system as illustrated in Figure 4.2. MFC HVPM10 samplers are to be calibrated without a filter or filter cartridge in-line. When installing the orifice on the sampler filter support screen, tighten the face plate nuts on alternate corners to prohibit leaks and to ensure even tightening. The fittings should be hand tightened: too much compression can damage the sealing gasket. Make sure the the orifice gasket is in place and the orifice is not cross threaded on the face plate.
2. If possible, disconnect the motor from the flow controller and plug it directly into a stable voltage source (e.g. the sampler's on-off timer, if so equipped, or other source of line voltage).
3. Check that the continuous flow recorder is connected to the pressure tap on the lower side of the sampler motor housing and that there are no crimps or cracks along the tubing.
4. Install a clean recorder chart.
5. Cover or tape the inlet of the orifice calibration unit with one or more strips of duct tape. Check the manometer valves and verify that they are fully closed. Note: the valves are closed by turning the plastic elbows at the top of a manometer fully clockwise.

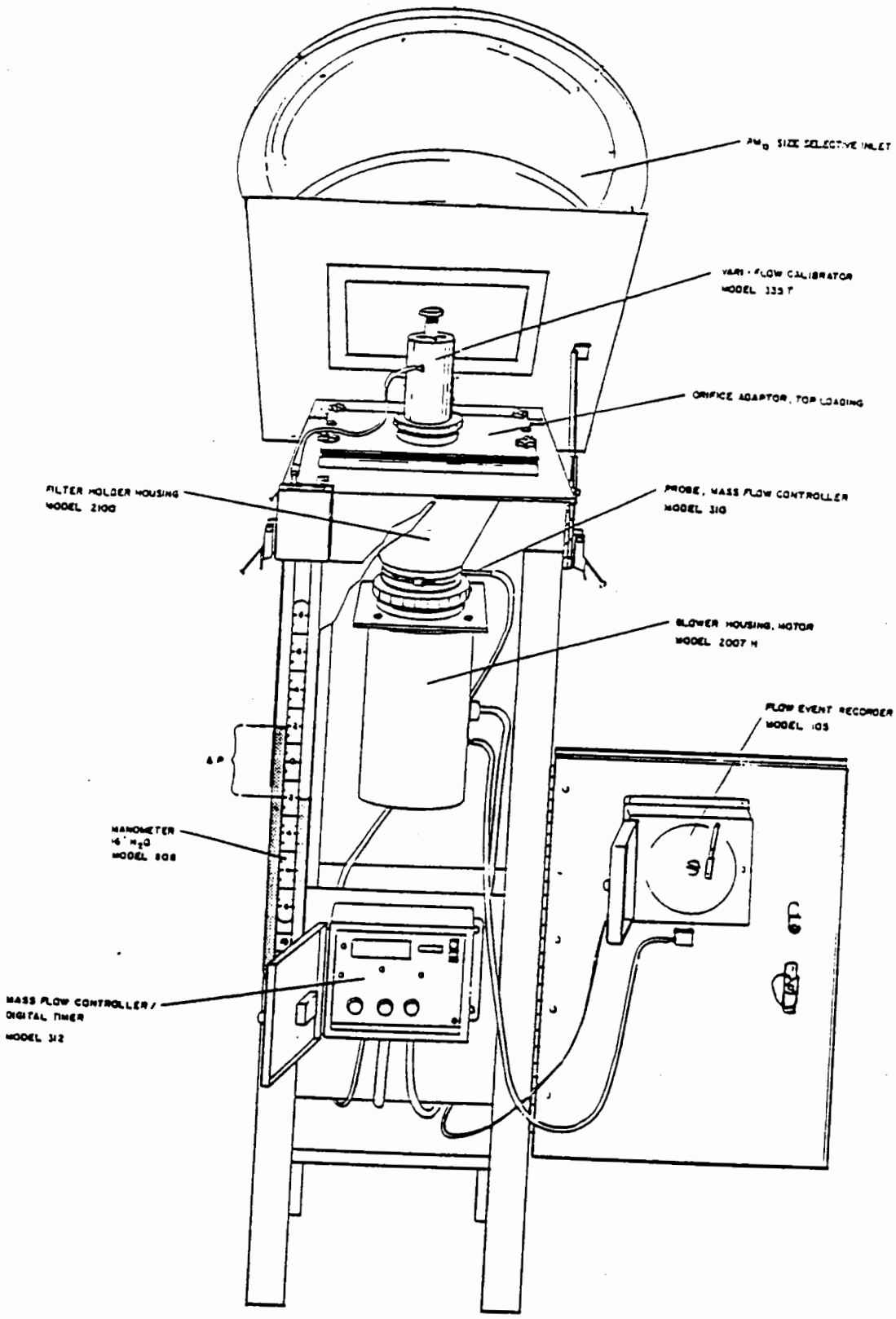


Figure 4.2 MFC Sampler Calibration Equipment

6. Energize the sampler. Gently wiggle the orifice and listen for a whistling sound that would indicate a leak in the system. A leak-free system will also indicate no upscale response on the recorder. Leaks are usually caused by either a missing gasket at the junction of the orifice and face plate, cross-threading the orifice on the face plate or cross threading the motor on the filter holder.
7. Turn off the sampler and remove the tape from the orifice.
8. Inspect the manometer for crimps or cracks in the connecting tubing. Open the valves and blow gently through the tubing, watch for the free flow of the fluid. Adjust the manometer sliding scale so that the zero line is at the bottom of the meniscii.
9. If the HVPM10 sampler is leak free, proceed to calibrate the sampler according to procedures presented in Section 4.4.

4.3 Basic Calibration Procedure for the VFC HVPM10 Sampler

The sampler calibration procedure in this section simply verifies the accuracy of the look-up chart and condition of the critical venturi used for flow control in VFC HVPM10 sampler. During operation of the sampler the flow controller will maintain an actual flow rate of 1.13 m^3/min (±10%). This flow rate is a function of ambient conditions and the pressure differential across the filter. The approved filter media is a quartz fiber filter GQMA. Clean filter media will have a pressure drop ranging from 15 to 20 Inches-of-water. The VFC is designed so that proper operating flow rate is maintained over a broad range of temperature and pressure conditions.

Regardless of which type of orifice calibrator used,(multi-hole load plate unit or the Vari-flo®) the calibration procedure remains the same (Figure 4.3). The sampler inlet should be opened completely to prevent flow interference with the calibration transfer orifice. Flexible tubing is used to connect the orifice pressure tap with a water manometer. The pressure tap on the filter housing is connected to a separate water manometer. Pressure drops and indicated flow recorder readings are measured and the results checked against a calibration curve for the top loading orifice and the lookup table for the VFC. The flows determined from the orifice and lookup table should be within ±3%. If this is not the case the VFC should be checked for internal obstructions and leakage in the system. Flow rate calculations should be repeated. If the difference in flow rates is not eliminated, contact the manufacturer.

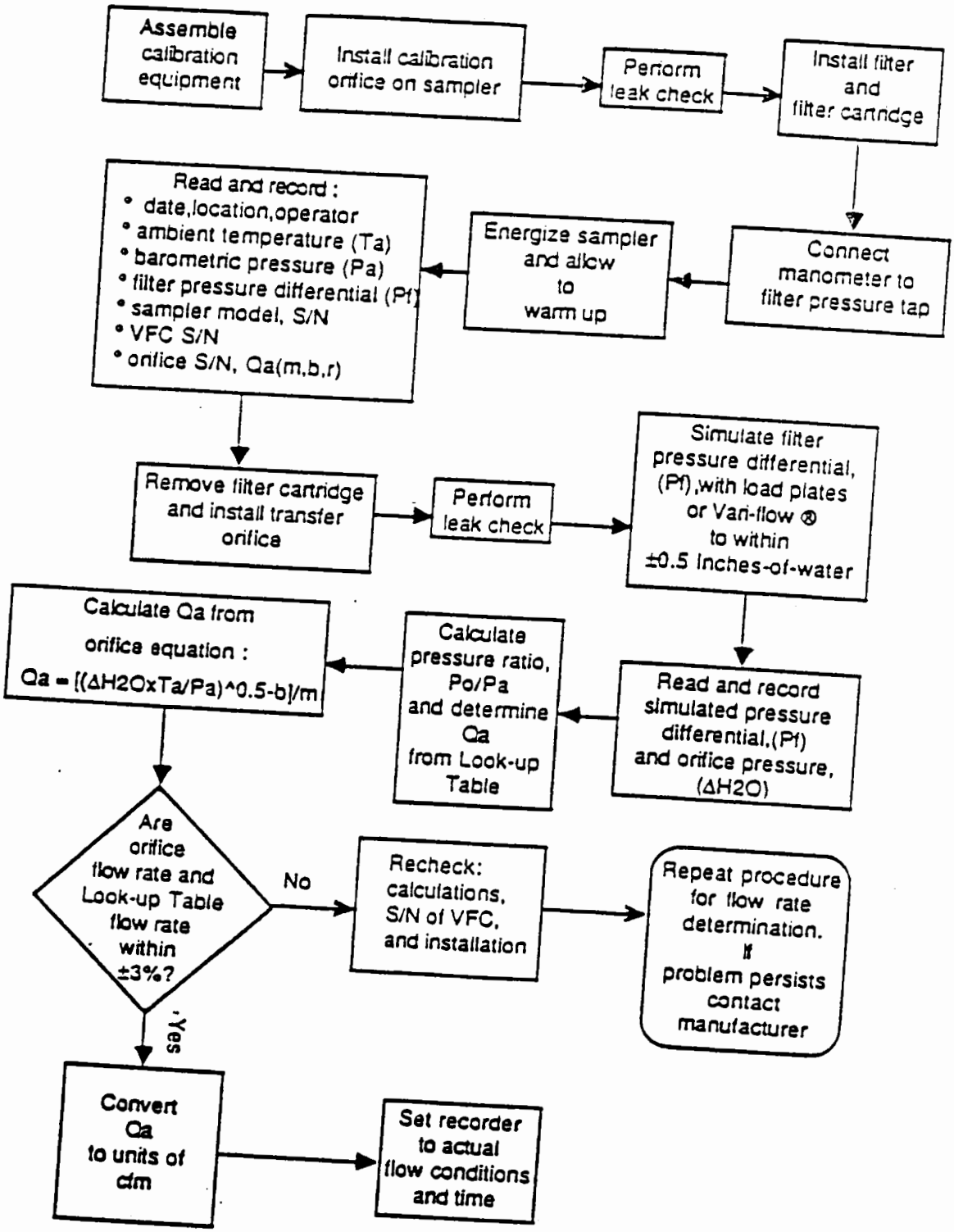


Figure 4.3 VFC Calibration Flow Chart

The U.S. EPA stipulates calibration frequencies for all samplers that are used to report data into the National data base. Please refer to "Quality Assurance Handbook of Air Pollution Systems, Volume II, Section 11.2 " for basic requirements. ASI/GMW recommend calibration at least twice a year.

Since the orifice transfer standard can be calibrated in terms of actual or standard conditions, the operating personnel must determine which calibration curve has been generated and modify their calibration curves accordingly. The HVPM10 sampler must be calibrated in terms of actual conditions. Two types of orifice calibrators are available: one equipped with multi-hole load plates (PN G25) to simulate various pressure drops, and the other with an adjustable flow restrictor valve, or "Vari-flo®" orifice (PN G335).

4.3.1 VFC One Point Flow Verification. For optimum accuracy and performance, the following calibration procedures are recommended:

1. Assemble the calibration equipment.
   - Calibrated (traceable to NBS) orifice device (load plate or Vari-flo®)
   - Duct tape
   - Manometer with a range of 0 to 16 Inches-of-water and a minimum scale division of 0.1 inch.
   - Manometer with a range of 0 to 30 Inches-of-water and a minimum scale division of 0.1 inch.
   - Thermometer (with verified accuracy). All temperatures must be expressed in degrees Kelvin for the calculations in this section to be correct. (°K = °C + 273).
   - Barometer (with verified accuracy). All pressures must be expressed in mmHg for the calculations in this section to be correct, (mmHg = Inches of Hg x 25.4). Note: Barometric pressure readings can be obtained from nearby weather station; however, such readings must be "station pressure" which is uncorrected to sea level. Pressures may however, need to be corrected for changes in elevation between the weather station and the monitoring site if elevatioon difference is greater than 1000 ft.

- Spare recorder charts, miscellaneous hand tools, calibration data sheets, or sampler log book.

2. To verify the flow during normal operating conditions, the filter pressure differential must be matched using the Vari-flo® restrictor or appropriate load plate. The approved filter media is a quartz fiber filter, GQMA. The pressure differential across a clean quartz fiber filter varies from15 to 20 Inches-of-water.
3. Remove the orifice and orifice transfer plate from filter holder. Place a clean filter and a filter cartridge on the filter holder. Tighten the filter holder nuts on alternate corners to ensure even tightening. Hand tighten the nuts to prevent over-compression of the gasket.
4. Connect tubing to the pressure tap on the filter screen holder. The tap is located 1.5 inches below the screen on the side of the holder. This pressure tap is accessible through the door of the sampler. Production VFC units have a quick-connect located on the shelter which closes automatically when manometer is disconnected. Connect tubing to one side of the manometer with 0-30 Inches-of-water range. The other side of the manometer is left open to the atmosphere.
5. Turn on the sampler blower and allow it to warm up to a stable operating temperature. Five minutes is usually sufficient .
6. Read and record the following parameters on a VFC HVPM10 Field Data sheet or in the log book of the sampler.
   - Ambient temperature, (Ta), °F or °C. Convert to °K
   - Ambient pressure , (Pa), mmHg
   - Sampler Model, S/N, and VFC S/N
   - Orifice S/N, and its Qa relationship (m,b,r)
   - Date, location and operator

7. Read the pressure differential (Pf) across the filter and filter cartridge. Record this on the VFC Data Sheet or log book of the sampler. This is the operating pressure differential that will be matched by the using the restrictor of theVari-flo® orifice or the load plate.
8. Turn off sampler and remove filter cartridge and filter. Install the orifice and perform precalibration leak test (Section 4.2).

9. Turn on sampler and, if necessary, allow to warm up to operating temperature.
10. Simulate filter pressure differential (Pf) by adjusting knob on Vari-flo® orifice or by placing appropriate load plate between orifice and face plate adapter. The approximate pressure drops across multi-hole load plates at 1.13 m^3/min (40 cfm) is given in Table 4.2
    Choose a load plate which has a pressure drop approximately the same, but not greater than the filter pressure to be simulated but not greater then the filter pressure drop. Fine tune the load plate by placing duct tape over holes one at a time until the pressure differential is matched. the pressure drop match should be within one Inch-of-water. A leak test should be performed each time the orifice is removed.
11. Once the differential pressure has been matched, the sampler will be operating at approximately the same flow conditions as will take place during sampling. Record the orifice and filter pressure differentials (ΔH_2O) and (Pf), respectively.
12. For the VFC, calculate pressure ratios and find the flow rate on the look-up table.See Section 6.1 for sample calculations.

Table 4.2. Approximate Values of Pressure Drop across Orifice and Load Plates

Load Plate Number of Holes	Pressure Differential, Inches-of-water
22	7.3
18	9.1
13	13.7
10	20.6
7	35.2
orifice only	3.9

13. If the orifice calibrator has not been furnished with a calibration curve in terms of Qa, use the calibration data provided with the orifice to generate a calibration relationship in the form of:

$$y=m(Qa) + b$$

where: Qa = orifice flow rate, actual m^3/min
y =\ r((ΔH2OxTa/Pa))
b = intercept of orifice calibration relationship
m = slope of orifice calibration relationship

See Section 6.3 for sample calculations.

14. Calculate Qa for the calibration point as :

$$Qa = [\sqrt{(\Delta H2OxTa/Pa)} - b]/m$$

where: ΔH2O = orifice pressure drop, Inches-of-water
Ta = ambient temperature, °K
Pa = ambient pressure, mmHg
b = intercept of orifice calibration relationship
m = slope of orifice calibration relationship

15. If a discrepancy greater then 3% appears between the orifice calculated flow rate (Qa) and the look-up table flow rate, recheck calculations and procedures. Make sure serial numbers of hardware and calibration curves match. Recheck for leaks in the system. Inspect the VFC for debris or corrosion in throat. If necessary clean with a bottle brush and soap and water. Inspect motor blower operation. Check to be sure there are no leaks in the manometers. To make this check, disconnect tubes from the sampler or orifice. Connect a second tube to the manometer that is used for the filter pressure drop. For each manometer blow air into one side of the manometer in order to get a differential reading of approximately 15 Inches-of-water. Next pinch the tubing on both sides of the manometer by doubling the tubing back onto itself and squeezing the

pinched location. This will prevent air from entering the manometer. Chreck the reading on the manometer. Wait approximately one minute and re-read the manometer. The reading should not have dropped by more the 0.3 inches. If it has, check the connections and tubes to determine the source of the problem. If problem cannot be resolved contact the manufacturer.

16. Continue to recorder calibration

4.3.2 One Point Calibration of Dixon Recorder. The Dixon flow event recorder simply verifies that the sampler operated without failure during the 24 hour sampling period and maintained normal operational flow rate. Large deviations from the mean flow rate on the recorder would indicate that there has been a power failure, or a motor blower, or power problem.

This calibration procedure is:

1. Install a new recorder chart (G106) into the Dixon event recorder which has been properly labeled on the back of the chart. Replace ink pen if needed.
2. Ensure that the continuous flow recorder is properly connected to the pressure tap on lower side of the sampler motor housing.
3. While sampler is running, determine the operating flow rate from the Look-up Table. Convert flow rate to actual cfm.
4. Adjust the reading on the Dixon recorder using the set screw. Gently tap the side of the recorder to make sure pen is not hung-up on the chart.
5. Lift the pen off the chart then rotate the chart by center slot using a coin or screw driverin the center slot until the time is properly indicated on recorder . Be sure the pen is back down on the chart surface.

4.4 Basic Calibration Procedure for the MFC HVPM10 Sampler

The sampler calibration procedure presented in this section relates known flow rates (as determined by a calibrated transfer standard orifice device) to the pressure differential across the orifice at the exit of the blower housing. This pressure differential is referred to as the plenum pressure, where the plenum is the region within the motor housing (downstream of the motor

unit) where the pressure level exceeds atmospheric pressure.

The calibration orifice used in this procedure may have been calibrated either in terms of "actual" or "standard" conditions. Operating personnel must determine which calibration curve has been supplied. The HVPM10 sampler must be calibrated in terms of actual conditions. Two types of orifice calibrators are available: one equipped with multi-hole load plates (PN G25) to simulate various pressure drops, and the other with an adjustable flow restrictor valve, or "Vari-flo®" orifice (PN 335).

Regardless of the type of orifice used, the calibration procedure remains the same (Figure 4.4). The calibrator is installed directly beneath the inlet of the HVPM10 sampler. Flexible tubing is used to connect the orifice pressure tap with a water manometer. Pressure drops and indicated flow recorder readings are recorded and checked against the calibration curve for the top loading orifice. The relationship between the flow rates determined by orifice and responses indicated by the sampler becomes the calibration equation. Note: When using the multi-hole load plates to calibrate the continuous flow recorders, use load plates in increasing resistance in order (e.g. 18-, 13-, 10-, and 7-, and 5-hole).

The U.S. EPA stipulates calibration frequencies for all samplers that are used to report data into the national data base. Please refer to "Quality Assurance Handbook of Air Pollution Systems, Volume II, Section 11.2", for basic requirements. ASI/GMW recommends calibration at least twice a year.

For optimum accuracy and performance, the following calibration procedures are recommended:

1. Assemble the calibration equipment.
   - Calibrated (traceable to NBS) orifice device
   - Manometer with a range of 0 to 16 Inches-of-water and a minimum scale division of 0.1 inch.
   - Thermometer (with verified accuracy). All temperatures must be expressed in Kelvin for the calculations in this section. (°K = °C + 273).
   - Barometer (with verified accuracy). All pressures must be expressed in mmHg for use in the calculations in this section, (mmHg = in.Hg x 25.4). Note: Barometric pressure readings can be obtained from nearby weather stations and must be "station

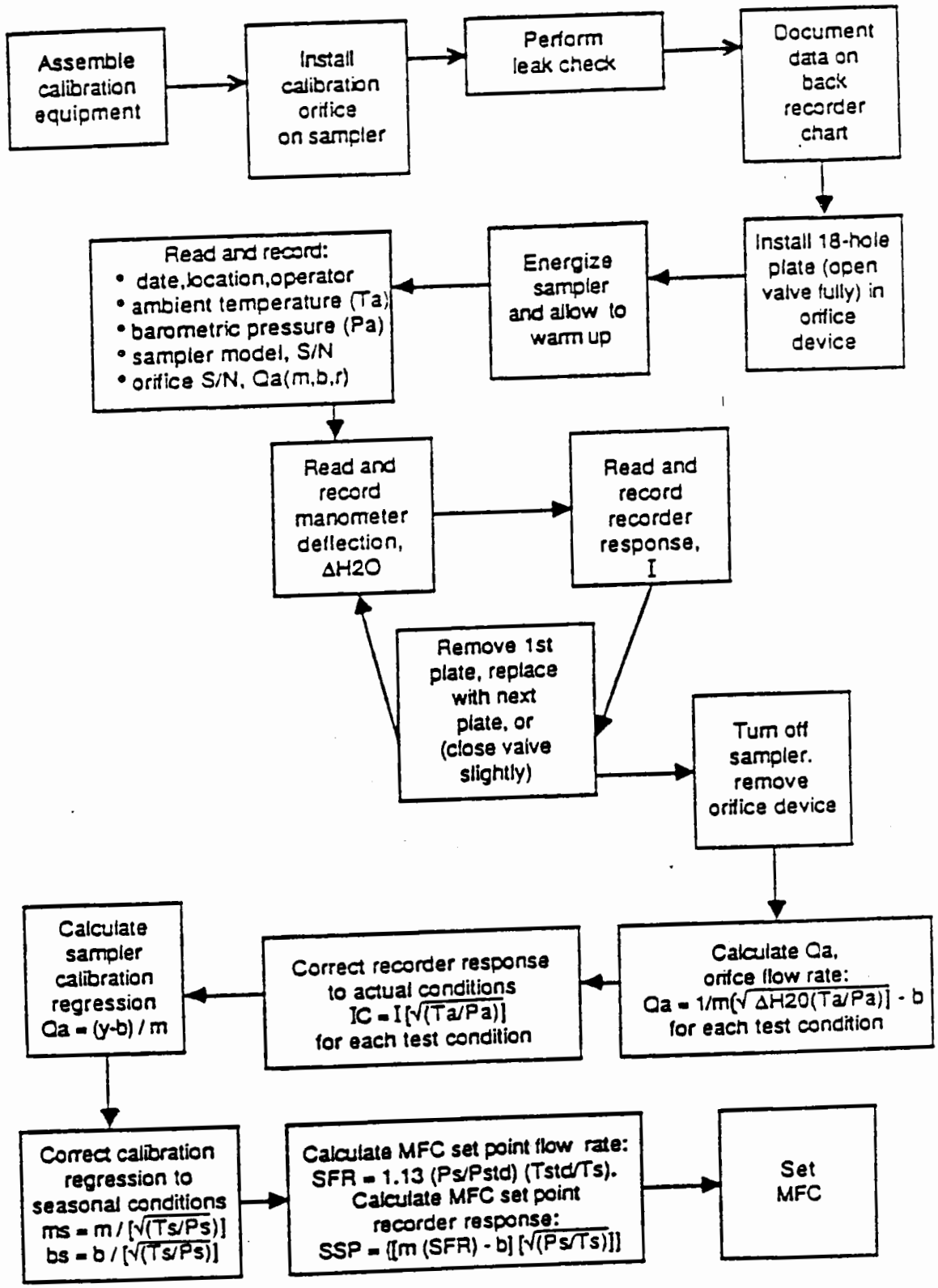


Figure 4.4 MFC Calibration Flow Chart

pressure" or uncorrected to sea level. Pressures may however, need to be corrected for changes in elevation between the weather station and monitoring site. If the diference in elevation is greater than 1000 ft.

- Spare recorder charts, miscellaneous hand tools, calibration data sheets; or sampler log book

2. Install the calibration system as pictured in Figure 4.2. Position the orifice faceplate on the sampler filter support screen and tighten the four corner nuts. Do not use a filter or filter cartridge during calibration. If a leak test is required, refer to Section 4.2.2
3. Install the 18-hole plate in the orifice calibrator by loosening the orifice retaining ring (or open the Vari-flo® valve fully). Make sure there is a gasket on the bottom of the restriction plate and on the bottom of the orifice device.
4. Check that the flow event recorder is properly connected to the pressure tap on the lower side of the sampler motor housing and that it is properly zeroed (pen rests on the inner most circle of the chart). Adjust the set-screw on the front of the recorder as necessary.
5. Record the site location, sampler S/N, date, and the operator's initials on the back of a clean recorder chart. The same chart used for the leak test (if performed) can be employed in this step.
6. Disconnect the mass flow controller. The motor is to be connected directly to a stable power source,110 VAC/60Hz. Energize the sampler and allow it to warm up to operating temperature. A period of five minutes is usually sufficient.
7. Read and record the following parameters on an MFC HVPM10 calibration data sheet (Table 4.3) or in the sampler log book.
   - Ambient temperature, (Ta), °K
   - Station barometric pressure (Pa), mmHg
   - Sampler S/N, model, and motor number
   - Orifice S/N and Qa relationship
   - Date and Location

8. Read and record the manometer deflection (in Inches-of-water) and its corresponding recorder response.

Table 4.3 MFC Calibration Data Sheet

HVPM10 SAMPLER CALIBRATION DATA SHEET
MASS FLOW CONTROLLED UNIT

Sampler Location: Date:

Conditions: Ta(K): Pa(mmHg):
Ts(K): Ps(mmHg):

Sampler Model: Sampler S/N: Motor No:.

Orifice S/N: Orifice Cal. Date: Orifice Model:

Orifice Qa Cal. Relationship: m=_____ b=_____ r=_____

Calibration Conducted by:_____

Cal. Point	Plate No.	Total ΔH20	Qa(orifice) flow rate m3/min	Sampler Response I	Corrected Response IC
1					
2					
3					
4					
5					

Qa(orifice): = 1/m $[\sqrt{\Delta H20(Ta/Pa)} - b]$
IC = I $\{\sqrt{(Ta/Pa)}\}$
Sampler's Qa Calibration Relationship:
Qa(orifice), x-axis, IC, y-axis
m=_____ b=_____ r=_____
Set Point Flow Rate:_____
SFR = 1.13(Ps/Pa)(Ta/Ts)

Sampler Seasonally Adjusted Calibration Relationship
ms = _____ bs=_____
$ms = m / [\sqrt{(Ts/Ps)}]$
$bs = b / [\sqrt{(Ts/Ps)}]$
Sampler Set Point:_____

9. Read the samplers response I, from the chart of the event recorder, and enter on data sheet or log book.
10. Repeat Step 3,8 and 9 for each of the remaining resistance plates or Vari-flo® settings. When installing each plate, be sure the orifice plate is properly seated and that no cross threading has taken place.
11. Turn off the sampler and remove the calibration orifice and recorder chart.
12. If the orifice calibrator has not been furnished with a calibration curve in terms of Qa, use the calibration data provided with the orifice to generate a calibration relationship in the form of:

$$y = m(Qa) + b$$

where: Qa = orifice flow rate, actual m^3/min
$y = \sqrt{(\Delta H2O x Ta/Pa)}$
b = intercept of orifice calibration relationship
m = slope of orifice calibration relationship

See Section 6.3 for sample calculations.

13. Verify that the correct event recorder response, I has been inscribed on the calibration data sheet and that the orifice calibration curve is current and traceable to an acceptable primary standard.
14. Calculate Qa for each calibration point as:

$$Qa = [\sqrt{(\Delta H2O x Ta/Pa)} - b]/m$$

where: Qa = Orifice flow rate, actual m^3/min
ΔH_2O = pressure drop across the orifice, Inches-of-water
Ta = ambient temperature, °K
Pa = station barometric pressure, mmHg
b = intercept of the orifice calibration relationship
m = slope of the orifice calibration relationship

15. Calculate and record the flow event recorder actual correction (IC) for each calibration point as:

$$IC = I\,[\,(Ta/Pa)^{1/2}]$$

where: IC = actual correction
I = recorder response, arbitrary units

16. On a sheet of graph paper, plot the sampler corrected recorder units, IC (y-axis) versus the corresponding calculated orifice flow rates Qa (x-axis), to obtain a visual calibration curve and indication of the calibration linearity. A five-point calibration should yield a regression equation with a correlation coefficient of $r > 0.990$. Since the determination of a Qa flow rate requires the addition of an ambient average temperature and pressure correction, it is not recommended to use a graphic plot of the calibration relationship for subsequent data reduction.

    Each sampler therefore, must be provided with a mathematical expression that indicates the slope, intercept, and the linearity of the calibration relationship. Using a programmable calculator, determine the best-fit straight line by the method of least squares. The equation for this fit is:

$$IC = m(Qa) + b$$

17. The slope, m, and intercept, b, are then calculated to determine the sampler's actual flow rate (Qa) from :

$$Qa = 1/m\,[I\,(Ta/Pa)^{1/2} - b]$$

18. To avoid making daily temperature and pressure corrections to determine the sampler's operational flow rate, adjust the sampler's slope and intercept to seasonal average conditions.

$$ms = m / [\sqrt{(Ts/Ps)}]$$
$$bs = b / [\sqrt{(Ts/Ps)}]$$

where: ms = seasonally adjusted sampler calibration slope
bs = seasonally adjusted sampler calibration intercept
Ts = seasonal average temperature, °K
Ps = seasonal average station barometric pressure, mmHg

The sampler is now equipped with two calibration relationships: actual (Qa) and seasonally adjusted actual (SQa). To calculate the sampler's instantaneous flow rate for flow checks or audits, use the formula presented in step 17.. For routine operation however, determine the flow rate as:

$$SQa = (I - bs) / ms$$

where: SQa = sampler's seasonally adjusted flow rate, m^3/min

19. Calculate and record on the calibration data sheet (or in the sampler log book) the set point flow rate (SFR).

$$SFR = 1.13 (Ps/Pa) (Ta/Ts)$$

where: SFR = sampler's seasonally adjusted set point flow rate, m^3/min.

20. Calculate and record the sampler's calibration data sheet the MFC set point (recorder response that corresponds to the SFR calculated in Step 19.

$$SSP = \{[m (SFR) - b] (Pa/Ta)^{1/2}\}$$

where: SSP = sampler's seasonally adjusted set point, recorder response

21. Re-connect the motor to the mass flow controller.
22. Install a clean filter (within a filter cartridge) in the sampler. Tighten the four wing-nuts to ensure an even seal, do not over-tighten or the gasket may warp.

22. Install a clean recorder chart in the flow recorder and verify that the recorder is zeroed (the pen rests on the innermost circle of the chart).Gently tap on side of sampler to seat ink pen. Rotate chart with coin or screw driver until chart indicates correct time.
24. Energize the sampler and allow it to warm up to operating temperature. Adjust the flow rate potentiometer (pot) on the mass flow controller until the recorder response indicates the sampler seasonally adjusted set point (SSP) as calculated in Step 20. Refer to Appendix B for the location of the flow rate pot for a particlular model of flow controller.
25. Verify that the flow controller will maintain this flow rate for at least 10 minutes. Turn off the sampler. The sampler can now be prepared for the next sampler run day.

5.0
Field Operation

This section presents information pertaining to the routine, basic operation of an HVPM10 sampler. Also included are references to direct the operator to information on U.S. EPA site requirements, laboratory procedures, and routine quality control/quality assurance activities. Since our customers are not exclusively governmental agencies, specific U.S. EPA-sanctioned guidelines are not presented here.

5.1 Siting Requirements

Complete siting criteria (for samplers collecting data to be directly or ultimately reported to the U.S. EPA) can be found in 40 CFR 58. Minimum ASI/GMW requirements are presented below:

1. Sampler should be at least 20 meters (m) from trees, buildings or other large obstacles. A general placement rule is that the sampler should be located at least twice as far away from the obstacle as the hieght of the obstacle..
2. Sampler inlet should be 2 to 7 m above the ground
3. Sampler must have unrestricted air flow
4. Sampler inlet should be at least 2 m from any other high-volume sampler inlet. For collocated samplers, the inlets must be within 4 m of each other.
5. Do not place the sampler directly upon the ground or gravel roof top.
6. Do not place sampler near exhaust flues or vents.
7. If samples are to be chemically analyzed (e.g. mass spec., A.A., etc.) evaluate the site for potential contamination.

5.2 Sampler Installation Procedures

1. Carefully transport the assembled inlet and sampler shelter to the monitoring site. The sampler must be either bolted or anchored to the site platform. Extended support feet (PN G2021) are available from the manufacturer and can be easily installed on the sampler to provide extra stability.
2. Attach the sampler inlet according to Assembly Procedures presented in Section 3.1.

3. Check all the power cords and pressure recorder tubing for crimps, cracks, etc..
4. Plug the male power cord into a grounded line voltage outlet of compatible AC voltage. Be sure that the electrical connectors are not exposed to inclement weather.

   An electrical surge suppressor and a ground fault interrupter (GFI) are recommended to protect the system from transient voltage spikesand for safety. For any sampler equipped with an MFC, an independent AC power circuit is suggested; alternating current voltage (VAC) at the sampler cannot be below 90 VAC for the 115 VAC system; or below 200 volts 220 VAC system. If it is necessary to run extension cords to provide power, a lower gauge (heavier conductor wire) is necessary.

5. Perform a flow rate calibration, as described in Section 4.

5.3 Sampling Operations

The HVPM10 sampler is a user-friendly instrument capable of providing accurate, reproducible data when calibrated, operated and maintained properly. If the calibration procedures presented in this manual are followed, the routine operation of the HVPM10 sampler can be highly simplified by:

1. Eliminating daily temperature and pressure readings,
2. Using identical calculations (for both MFC and VFC samplers) to determine the sampler's operational flow rate, and
3. Not requiring any extraneous equipment (i.e. manometer, orifice, etc) to determine the operational flow rate.

As with the calibration procedures presented in Section 4, all operational procedures are in accordance and agreement with U.S. EPA protocol and the FRM. If the operator has any questions regarding these procedures, please contact the factory.

With reference to Figure 5.1, the steps taken prior to sampling in the field are:

1. Collect the following monitoring equipment:
   - Filter Cartridge (PN G3000), *required on all ASI/GMW HVPM10 samplers*

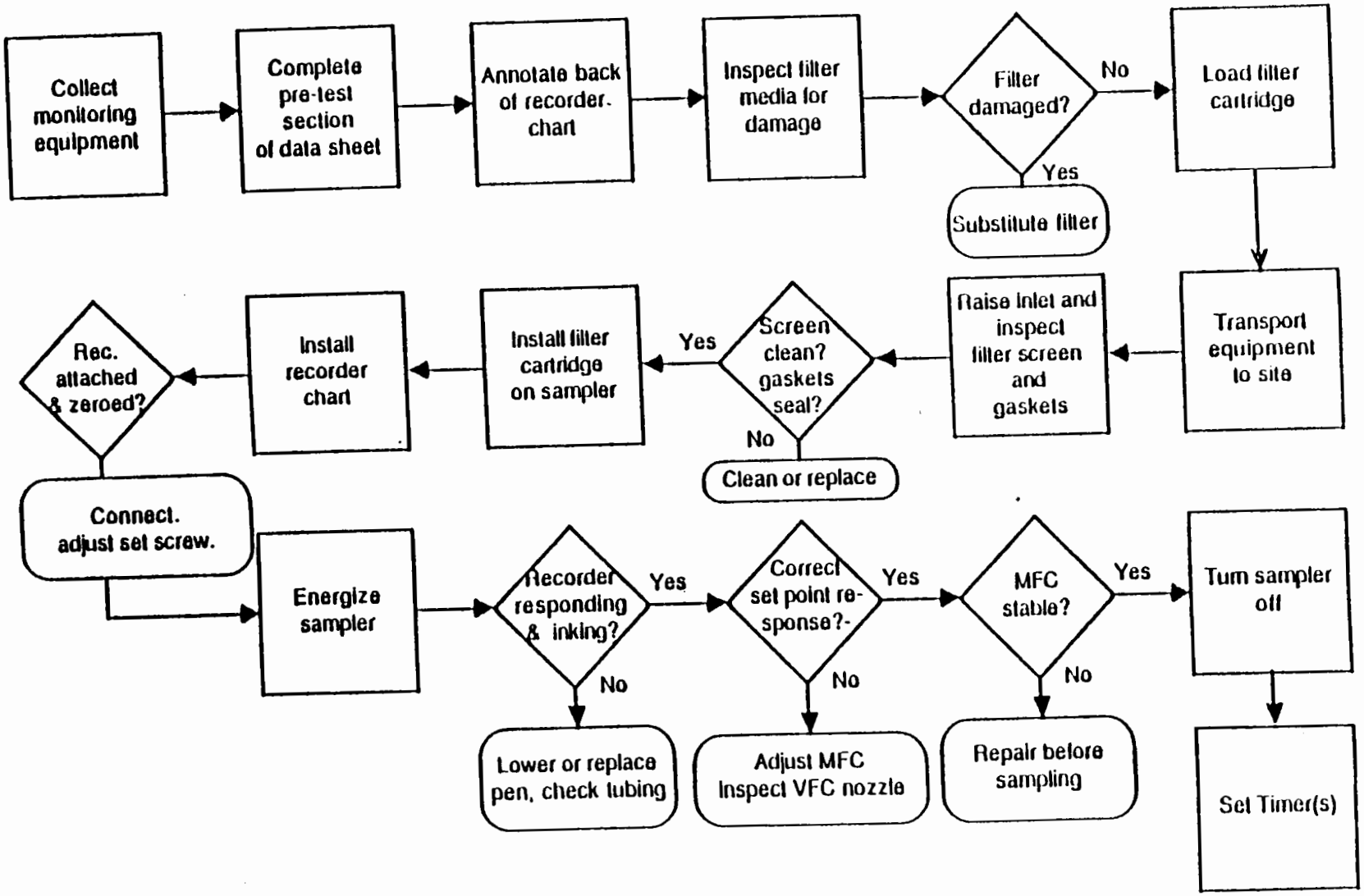


Figure 5.1 HVPM10 Pre-Sampling Flow Chart

- Quartz Fiber Filter (PN GQMA), *required for PM10 sampling*
- Clean Recorder Chart
- Sampler log book or field data sheet (Table 5.1 and 5.2 for VFC and MFC)

2. Fill out the top portion of the Field Data Sheet, Table 5.1 for VFC or Table 5.2 for MFC.
3. On the back side of the flow event recorder chart, record the sampler S/N, sampler location and date of the sample period.
4. Inspect the filter for any pinholes, tears, or irregularities. If found, reject and select another filter. Record the selected filter identification number (ID) on the back side of the recorder chart and on the Field Data Sheet.
5. Load the filter cartridge with 1 quartz filter.
   A. Loosen the four nuts that clamp the cartridge together and remove the upper portion of the filter cartridge .
   B. Inspect the filter cartridge screen for deposits or foreign material. Clean if necessary. Ensure that the cartridge gasket is not damaged or compressed.
   C. Center the filter on the cartridge support screen. Every filter has an "up" side on which the particulate matter should be deposited. For GQMA filters, this is the rough side. It is recommended that the purchaser request the analysis laboratory emboss the filter with a filter ID consistently on the <u>bottom</u> of the filter. This will allow access to the ID number when the sample is folded (post-sampling) and also provide the operator with a fool proof method for determining the "up" side.
   D. Replace the top cover and tighten the nuts.
   E. If the cartridge is equipped with a protective, snap-on screen, cover the cartridge.
6. Transport the monitoring equipment to the sampler location.
7. Raise the sampler inlet by releasing the six shelter pan draw-catches and gently tilting back the inlet until the shelter pan support strut is locked in the second position.
8. Inspect the sampler's filter screen and remove any deposits or foreign matter.

Table 5.1 Example HVPM10 Field Data Sheet

VFC HVPM10 FIELD DATA SHEET

Site Location: _____ Sample Date: _____

Sampler S/N: _____ Sampler Model: _____ Motor No. _____

VFC No. _____

Filter ID Number: _____ Average operating pressue drop _____ "H20

Seasonal operating conditions Ps, _____ mmHg Ts, _____ °C

Seasonal operating pressure ratio Po/Ps _____

Po/Ps =(1- Pf/Ps) ,note Pf and Ps are in mmHg

Seasonal operating flow rate from lookup table @Ts and Po/Ps, SQa _____ m3/min

Recorder pen setting, Actual flow conditions, Qa _____ cfm

Filter Differential Start (Pf) _____ "H20

Sample Start Time: _____

Sampler Timer Start _____

Filter Differential Stop (Pf) _____ "H20

Sample Stop Time: _____

Sampler Timer Stop _____

Average Recorder Response: _____

Average Filter Differential (Pfa) _____ "H2O

Pressure Ratio Po/Ps _____

Po/Ps=(1-Pfa/Ps)

Look-up Flow SQa = _____ m3/min

Circle One:

Qa between 1.02 and 1.24 m3/min? Yes No

Sampler recalibrated? Yes No

Pressure Ratio Po/Pa _____

Po/Pa=(1-Pfa/Pa)

Look-up Flow Qa = _____ m3/min

Qstd = _____ m3/min :

Qstd = SQa (Ps/Pstd) (Tstd/Ts)

Elapsed Time (min): (t) _____

Comments:

Std. Vol. _____ m3

Std. Vol. = Qstd (t)

* *Optional. Calculate periodically and when temperature and pressure conditions during sample period are unseasonal.*

Operator: _____

Table 5.2 Example HVPM10 Field Data Sheet

MFC HVPM10 FIELD DATA SHEET

Site Location: _____ Sample Date: _____

Sampler S/N: _____ Sampler Model: _____ Motor No. _____

Filter ID Number: _____

Sampler's Qa calibration relationship: m= _____ b= _____ r= _____

$Qa = 1/m\ (I\ \sqrt{(Ta/Pa)} - b$

Sampler's seasonal adj. calibration relationship: m= _____ b= _____ r= _____

$SQa = (I-bs)/ms$

Average Recorder Response: _____

SQa = _____ m3/min

Qa = _____ m3/min *

Optional. Calculate periodically and when temp.erature and pressure conditions during sample period are unseasonal.

Circle One:

Qa between 1.02 and 1.24 m3/min? Yes No

Sampler recalibrated? Yes No

Sample Start Time: _____

Sample Stop Time: _____

Elapsed Time (min): _____

Qstd = _____ m3/min :

$Qstd = SQa\ (Ps/Pstd)\ (Tstd/Ts)$

Std. Vol. _____ m3

Std. Vol. = Qstd (t)

Comments:

Operator: _____

9. Inspect the filter holder-sealing gasket located beneath the filter screen for compression or damage. Replace, if necessary, before the next sample period.
10. Remove the filter cartridge top cover (if so equipped) and center the cartridge on the the sampler's filter screen. Tighten the four swing bolts. The wing nuts should be tightened at diagonally opposite corners simultaneously to assure even compression of the gasket.
11. Open the shelter door and the flow event recorder. Install the annotated recorder chart by raising the pen arm and placing the chart center hole over the recorder slotted drive. Lower the pen arm. If the sampler is controlled by a master On/Off timer, and data are to be reported to the U.S. EPA, set the chart at 12 midnight. The chart is advanced by rotating the slotted drive clockwise, until the desired sample start time is beneath the pointed indicator on the lower right side of the recorder.
12. Make sure that the flow recorder is connected to the motor housing pressure tap and and it is properly zeroed (the pen rests on the inner most circle of the chart). Adjust the zero by the rotating the small set screw located on the bottom right of the recorder.
13. Energize the sampler. Ensure that the recorder pen is inking and indicates that the sampler is operating at its correct set-point.
    A. No adjustment can be made to the VFC sampler flow rate. If the recorder indicates that the sampler is not operating within 3 chart divisions of the correct set point, check the recorder connections. If problem persists, contact the manufacturer.
    B. If the sampler is equipped with an MFC, allow the sampler to operate for 3-5 minutes. If necessary, adjust the potentiometer on the MFC (refer to Appendix B) until the correct set point is indicated. Note: If the MFC is operating correctly, there will be no "searching" of the motor.
14. Turn off the sampler and close the recorder and shelter doors. Lower the sampler inlet and attach the six shelter pan draw-catches.
15. Following procedures presented in Appendix D, set the master timer (if so equipped) to activate the sampler on the next scheduled run day. Reset the elapsed time indicator to 0000.

The post sampling steps are illustrated in Figure 5.2. As soon as possible after the run day, the operator must:

1. Return to the monitoring site. Release the six shelter pan draw-catches and raise the sampler inlet. Reversing the installation procedure (step 10), remove the filter cartridge. Replace the snap-on cover.
2. Open the shelter door. Open the recorder door and remove the recorder chart. Examine the chart. The trace should be stable without peaks or interruptions. Investigate any irregularities before continuing.
   --spikes and peaks indicate power fluctuations
   --blank spots indicate power failures or that the pen failures
   --slow downward trend indicates MFC or motor brush failure
   --wavering trace indicates MFC failure
3. Observe conditions around the monitoring site and record any unusual activities that might affect the sample.
4. Complete the Field Data Sheet.
5. Calculate the sampler's operational flow rate:
   a) For the VFC:

Calculate average filter pressure differential Pfa

$$Pfa=(Pfi+Pff)/2$$

Calculate Pressure Ratio Po/Pa

$$Po/Ps=(1-Pfa/Ps)$$

Look-up seasonally ajusted flow

SQa, at Ts, Po/Ps

where: Pfi = initial filter pressure differential
Pff = final filter pressure differential
Ps = seasonal average barometeric pressure
Ts= seasonal average temperature

Note; If unseasonal weather conditions occur, perform calculations with ambient pressure and temperature.

b) For the MFC, use:

$$SQa = (I - bs) / ms$$

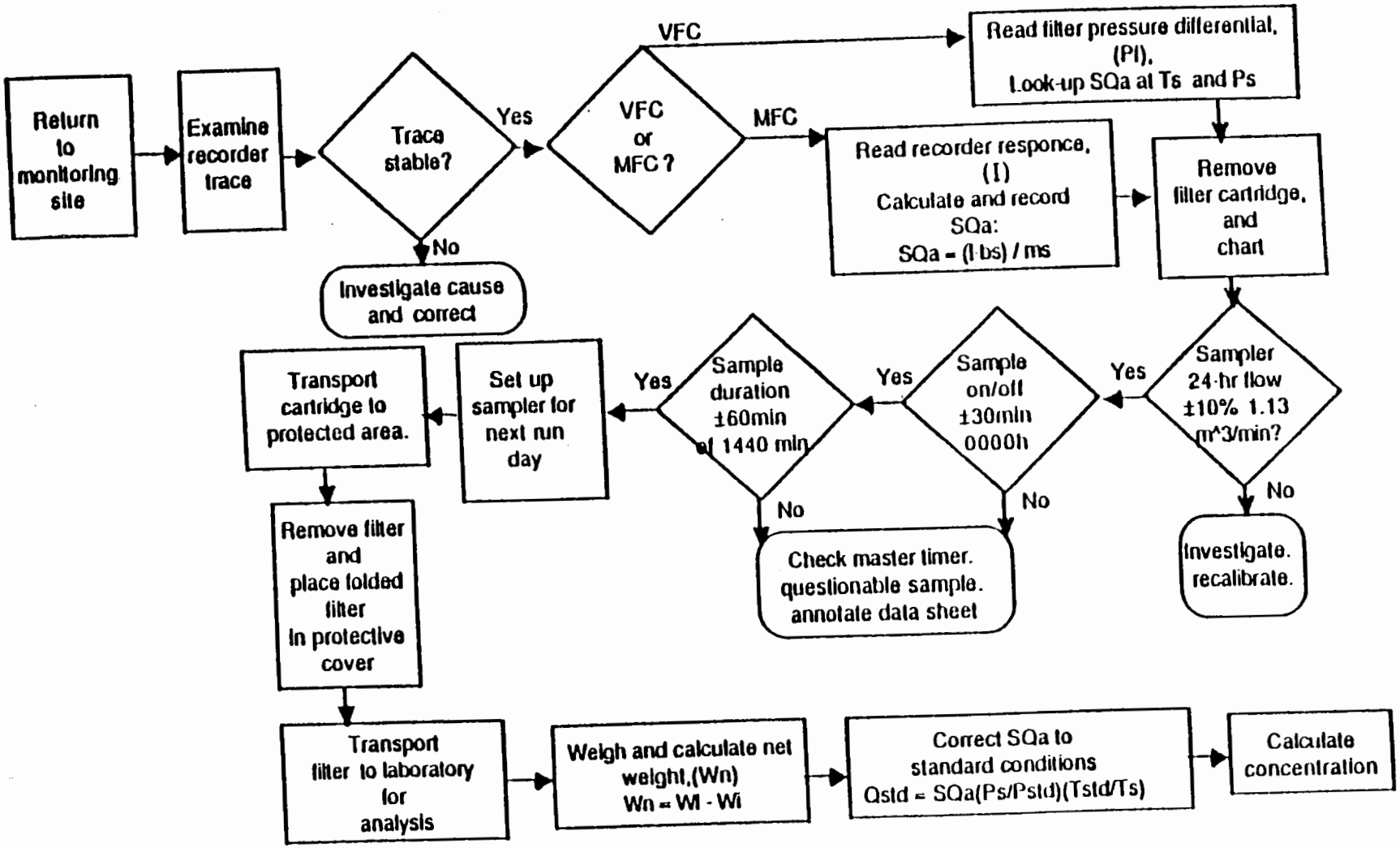


Figure 5.2 HVPM10 Post-Sampling Flow Chart

where: SQa = sampler's seasonally adjusted flow rate, m^3/min
I = continuous recorder response, arbitrary units
bs = seasonally adjusted sampler calibration intercept
ms = seasonally adjusted sampler calibration slope

6. Determine whether the operational flow rate is within design specification requirements of the HVPM10 sampler:

$$\% \text{ Difference} = [(SQa-1.13) / 1.13] (100)$$

where: SQa = sampler's seasonally adjusted flow rate, m^3/min
1.13 = sampler's design flow rate, m^3/min

Difference must be <10%. If exceeded, recalibrate the sampler before the next sample period .

7. Record the sample period's elapsed time. If reporting to the U.S. EPA, the sample duration must be 1440 min. ±60 min; and, the sampler must have turned on and off within 30 min. of midnight.
8. The sampler can now be prepared for the next sample period.
9. Transport the filter cartridge to a protected area.
10. Reversing the installation procedure, carefully remove the filter from the cartridge. Handle the filter only by the edges to avoid disturbing any of the deposit. Fold length-wise, aligning the deposit edges. Place the filter in a protective cover and transport it, the recorder chart and data sheet to the analysis laboratory.

5.4 Laboratory Procedures

Complete information regarding laboratory procedures and quality assurance functions can be found in the "Quality Assurance Handbook for Air Monitoring Systems, Volume II", Section 11.4.

The laboratory is responsible for providing tare (Wt) and gross (Wg) weights for each sample filter. The difference of these two weights, the net

mass (Wn), is then used to calculate the concentration of PM10 collected on the filter. The calculations necessary to report data to the U.S. EPA are as follows:

1. Correct all operational flow rates to standard reference conditions

$$Qstd = SQa\ (Ps/Ts)(298/760)$$

where: Qstd = flow rate at reference conditions, std. m^3/min
SQa = flow rate adjusted to seasonal conditions
Ps = seasonal average station barometric pressure, mmHg
Ts = seasonal average temperature, °K
298 = standard reference temperature, °K
760 = standard reference barometric pressure, mmHg

2. Calculate the standard sample volume

$$Vstd = Qstd\ (t)$$

where: Vstd = standard volume, std. m^3
t = sample duration, minutes

3. Calculate the net weight of the sample filter

$$Wn = Wg - Wt$$

where: Wn = net weight of the sample filter, g
Wg = gross weight of the sample filter, g
Wt = tare weight of the sample filter, g

4. Calculate the PM10 concentration of the sample filter

$$PM10 = (Wn)(10^6) / Vstd$$

where: PM10 = PM10 concentration, µg std. m^3
10^6 = conversion for grams to micrograms

5.5 Quality Control/Quality Assurance Procedures

The U.S. EPA stipulates that routine quality control and periodic quality assurance procedures be conducted in each monitoring network. These activities are used to assess data quality, precision and accuracy. Complete U.S. EPA requirements and procedures can be found in the "Quality Assurance Handbook for Air Monitoring Systems, Volume II," Sections 11.3 and 11.7.

6.0
PM10 Monitoring Routine Calculations

When an HVPM10 sampler is being operated with the intention of submitting data either directly or ultimately to the U.S. EPA, it must be must be reported as the mass concentration of PM10 expressed in micrograms per standard cubic meter ($\mu g/std.m^3$). For particulate sampling, standard or reference conditions are 298K and 760 mm Hg. This section presents the calculations required to compute and report ambient PM10 concentrations as per the U.S. EPA's Quality Assurance Manual.

As discussed in the Introduction, an HVPM10 sampler must be equipped with either a volumetric flow or mass flow controller.

The U.S. EPA stipulates that routine quality control data validation checks be conducted on all data collected in a PM10 monitoring network. These activities are used to assess data quality and accuracy. Complete U.S. EPA requirements and procedures can be found in the "Quality Assurance Handbook for Air Monitoring Systems, Volume II", Section 11.5.

The U.S EPA reference conditions of temperature and barometric pressure as reported in the Federal Register / Vol. 52, No. 126 / Wednesday, July 1, 1987 Appendix J are:

Tstd = standard temperature, defined as 298 °K
Pstd = standard barometric pressure, defined as 760 mm Hg

This standard reference condition, converted to some commonly used units is shown in Table 6.1

Table 6.1 Reference Conditions in Common Units

Standard Temperature		Standard Pressure	
298	°K	760	mm Hg
25	°C	101.3	kPA
537	°R	29.92	in Hg
77	°F		

Note: Existing calibration orifices, prior to the release of this manual, were supplied with calibration curves for standard flow rates. The VFC and MFC HVPM10 sampler flow rate is calculated at actual conditions so that the proper operating flow rate may be determined.

6.1 VFC Look-up Table Use and Sample Calculations

6.1.1 Use of Look up Table for Determination of Flow

1. Determine and record the atmospheric properties:
   - ambient temperature (Ta), °F or °C
   - ambient barometric pressure (Pa), mm Hg or In Hg

2. Operate sampler and allow to warm up. Perform leak test as per instructions in Section 4.2.

3. Read the differential pressure across the filter (Pf), inches or mm of water. Reading is taken with a differential manometer with one side of the manometer connected to the pressure tap on the filter housing and the other side open to the atmosphere. Filter must be in place during this measurement or pressure drop is being simulated by lead plates.

4. Convert filter pressure drop readings to units consistent with those of barometric pressure using the conversions given in Table 6.2.

Table 6.2 Pressure Conversion Factors

To convert from:	To units of:	Divide by:
In H2O	In Hg	13.61
mm H2O	mm Hg	13.61
mm H2O	In H2O	25.4
mm Hg	In Hg	25.4
mm	In	25.4

5. Calculate pressure ratio, Po/Pa.

$$Po/Pa = (1 - Pf/Pa)$$

Note: Pf and Pa must have consistent units.

6. Read flow rate from look-up table that is supplied with each VFC unit. Table 1 (provided with the unit), is set up with temperature in °F and the flow rate is read in units of actual cfm (acfm). In Table 2 (provided with unit), the temperature is in °C and the flow rate is read in m^3/min (actual).

7. Determine flow rate in units of standard air, Qstd

$$Qstd = Qa\left(\frac{Pa}{Pstd}\right)\left(\frac{Tstd}{Ta}\right)$$

<u>In English units</u>

$$Qstd = Qa\left(\frac{Pa}{29.92\ in\ Hg}\right)\left(\frac{537°R}{460 + Ta}\right)$$

where the units of Pa and Ta are:

[Pa] = inches Hg
[Ta] = °F

<u>In Metric Units</u>

$$Qstd = Qa\left(\frac{Pa}{760\ mm\ Hg}\right)\left(\frac{298°K}{273 + Ta}\right)$$

where the units of Pa and Ta are:

[Pa] = mm Hg
[Ta] = °C

6.1.2 VFC Example of Flow Rate Determination

1. Suppose the ambient conditions are:

   Temperature: Ta = 27.5 °C
   Barometric Pressure: Pa = 752 mm Hg (this must be station pressure which is not corrected to sea level pressure but is corrected for density changes in Hg due to temperature)

2. Assume system is allowed to warm up for stable operation.

3. Measure filter pressure differential, Pf. Assume that:

   Pf= 16.85 in H2O

4. Convert Pf to same units as barometric pressure..

$$Pf = (16.85 \text{ in } H_2O)\left(\frac{\text{in Hg}}{13.61 \text{ in } H_2O}\right) \times 25.4 \frac{\text{mm}}{\text{Inch}} = 31.45 \text{ mm Hg}$$

   Pf = 31.45 mm Hg

5. Calculate Pressure Ratio.

   Po/Pa = (1- Pf/Pa)

   = (1- 31.45 / 752)

   Po/Pa = 0.958

6. Determine actual Flow rate from Look up Table.

   a) on Table 2 (provided with VFC unit), locate the temperature and pressure ratio entries nearest the conditions of:

   Ta = 27.5 °C
   Po/Pa = 0.958

Example: Look-up Table for Actual Flow Rate in Units of m^3/min

Temperature °C

Po/Pa	26	28	30	32	34
0.950	1.121	1.124	1.126	1.129	1.131
0.952	1.125	1.127	1.130	1.133	1.135
0.954	1.128	1.131	1.134	1.136	1.139
0.956	1.132	1.135	1.138	1.140	1.143
0.958	1.135	1.138	1.141	1.144	1.147
0.960	1.139	1.142	1.145	1.148	1.150

b) by interpolation, the reading of the flow rate is:

$$Qa = 1.137\ m^3/min\ (actual)$$

7. Determine flow rate in terms of standard air.

$$Qstd = 1.137\ \frac{m^3}{min}\left(\frac{752\ mm\ Hg}{760\ mm\ Hg}\right)\left(\frac{298°K}{(273+27.5)°K}\right)$$

$$Qstd = 1.116\ m^3/min$$

6.2 MFC Flow Determination and Sample Calculations

6.2.1 MFC Determination of Flow with Calibration Orifice

1. Determine and record the atmospheric properties:
   - ambient temperature (Ta), °C or °F
   - ambient barometric pressure (Pa), mm Hg or In Hg

2. Operate sampler and allow to warm up. Perform leak test as per instructions in Section 4.2.

3. Read the differential pressure drop across the orifice (ΔH2O), Inches of water. Reading is taken with a differential manometer with one side of the manometer connected to the pressure tap on the calibration orifice and the other side open to the atmosphere. Do not use a filter or filter cartridge when calibrating the sampler.

4. Convert ambient temperature and barometric pressure to units consistent with those required for the orifice calibration curve, which are °K and mm Hg.

Temperature Conversion Formulas

$$°K = 273 + °C$$
$$°C = (°F - 32)x5/9$$

Table 6.3 Pressure Conversion Factors

To convert from:	To units of:	Divide by:
In H2O	In Hg	13.61
mm H2O	mm Hg	13.61
mm H2O	In H2O	25.4
mm Hg	In Hg	25.4
mm	In	25.4

5. Read and record the orifice calibrator's calibration relationship constants, m and b. The calibration relationship is in the form of:

$$Qa = (y - b) / m$$

where: Qa = Orifice flow rate, actual m^3/min
$y = \sqrt{(\Delta H2O \times Ta/Pa)}$
b = intercept of the orifice calibration relationship
m = slope of the orifice calibration relationship
$\Delta H2O$= orifice differential pressure, Inches-of-water
Ta = ambient temperature in °K
Pa = station barometric pressure in mm Hg

6. Calculate Qa for the calibration point as:

$$Qa = [\sqrt{(\Delta H2O \times Ta/Pa)} - b]/m$$

7. Determine flow rate in units of standard air, Qstd

$$Qstd = Qa\left(\frac{Pa}{Pstd}\right)\left(\frac{Tstd}{Ta}\right)$$

<u>In English units</u>

$$Qstd = Qa\left(\frac{Pa}{29.92 \text{ in Hg}}\right)\left(\frac{537°R}{460 + Ta}\right)$$

where the units of Pa and Ta are:

[Pa] = inches Hg
[Ta] = °F

In Metric Units

$$Qstd = Qa\left(\frac{Pa}{760\ mm\ Hg}\right)\left(\frac{298°K}{273 + Ta}\right)$$

where the units of Pa and Ta are:

[Pa] = mm Hg
[Ta] = °C

6.2.2 Example of Flow Rate Determination

1. Suppose the ambient conditions are:

   Temperature: Ta = 27.5 °C
   Barometric Pressure: Pa = 752 mm Hg (this pressure must be station pressure which is not corrected to sea level pressure but is corrected for density changes in Hg due to temperature)

2. Assume system is allowed to warm up for stable operation.

3. Measure orifice pressure differential, ΔH2O. Assume that:

   ΔH2O = 3.1 in H2O

4. Convert ambient temperature and barometric pressure to units °K and mm Hg.

   Temperature: Ta = 273 + 27.5 °C
   Ta = 300 °K
   Pressure: Pa= 752 mm Hg (no change)

5. Assume the calibration relationship constants are:

   b = -0.01851, intercept of orifice calibration relationship
   m = 0.96162, slope of orifice calibration relationship

6. Calculate calibration point as:

$$Qa = [\sqrt{(\Delta H2O \times Ta/Pa)} - b]/m \quad ,m^3/min$$

$$Qa = \left(\sqrt{\frac{(3.1 \text{ in } H2O) \times (300.5\ ^\circ K)}{(752 \text{ mm Hg})}} + 0.01851\right) / 0.976162$$

$$Qa = 1.159\ m^3/min$$

7. Determine flow rate in terms of standard air.

$$Qstd = 1.159 \frac{m^3}{min}\left(\frac{752 \text{ mm Hg}}{760 \text{ mm Hg}}\right)\left(\frac{298^\circ K}{(273+27.5)^\circ K}\right)$$

$$Qstd = 1.137\ m^3/min$$

6.3 Orifice Calibration Relationship and Sample Calculations

6.3.1 Procedure for Determining Calibration Relationship

1. Obtain the following information from the orifice calibration sheet supplied with the unit and enter in the sampler log book or Table 6.1:

   - Orifice calibration S/N
   - Roots meter S/N
   - Date of calibration
   - Date in Service
   - Ambient temperature during calibration (Ta)°K

Table 6.1 Orifice Calibration Relationship Worksheet

Cal. Point	Plate No. VDC	Volume Initial	Volume Final	ΔVolume	ΔTime (minutes)	ΔHg (mm)	ΔH20 (inches)

DATA TABULATION

Va (m^3)	x-axis Qa (m^3/min)	y-axis $\sqrt{(\Delta H20 \times Ta/Pa)}$

Orifice S/N _____

Rootsmeter S/N _____

Date of Calibration _____

Date in Service _____

Ta (°K) _____

Pa (mmHg) _____

Calibration. performed by: _____

CALCULATIONS AND CONVERSIONS

Va = ΔVolume ((Pa - ΔHg) / Pa

mm = inches x 25.4
ft^3 = m^3 x 35.31

Qa = Va/ΔTime Linear Regression: Qa, x-axis; $\sqrt{[\Delta H20(Ta/Pa)]}$, y-axis

m= _____
b= _____
r= _____

- Station barometric pressure during calibration (Pa) mmHg
- Operator

2. Record the orifice differential pressure ($\Delta H2O$) and corresponding pressure differential at inlet of roots meter (ΔHg), run time (t), and volume passed through system for each test condition (ΔV).

3. Calculate the actual flow rate for each test condition

$$Qa = \left(\frac{Pa-\Delta Hg}{Pa}\right) \times \Delta V / t$$

Note: Pa and ΔHg must be in consistent units.

4. The orifice calibration relationship is in the form

$$Qa = (y - b)/m$$

where: Qa = orifice flow rate, actual m^3/min
$y = \sqrt{(\Delta H2O \times Ta/Pa)}$
b = intercept of orifice calibration relationship
m = slope of orifice calibration relationship

Calculate y for each test condition.

$$y = \sqrt{(\Delta H2O \times Ta/Pa)}$$

5. Using a programmable calculator, determine the best-fit straight line by method of least squares. The equation to be fit is:

$$y = m(Qa) + b$$

Enter the date pairs of Qa and y for each test condition into the calculator. perform the linear regression on the data set and record the intercept (b), slope (m), and the correlation coefficient (r) of the curve fit.

6. the correlation coefficient (r) must be ≥0.99 in order for the calibration to be valid. If r < 0.99, recheck calculations. If necessary, repeat calibration procedure.

7. To determine the actual flow rate in m^3/min from the orifice calibration relation, use:

$$Qa = [\sqrt{(\Delta H2O \times Ta/Pa)} - b] / m$$

6.3.2 Example for Determination of Calibration Relationship

1. Assume the following data are applicable to an orifice which is to be calibrated:

Orifice S/N F-139
Roots S/N 7064132
Date of calibration 5-9-1988
Date in service 6-1-1988
Ta = 300.65 °K
Pa = 752.6 mm Hg

Test Condition	Volume Through Roots meter (ΔV), m^3	Time (t), min	Roots Pressure Differential (ΔHg), mm Hg	Orifice Pressure Differential (ΔH2O), Inches-of -water
1	2.562	1	104.1	11.73
2	2.025	1	78.7	7.98
3	1.774	1	63.5	6.34
4	1.512	1	53.3	4.69
5	1.249	1	43.2	3.29

2. For test condition 1:

where: $\Delta Hg = 104.1$ mm Hg
$\Delta V = 2.562\ m^3$
$(t) = 1$ min
$Pa = 752.6$ mm Hg

$$Qa = \left(\frac{Pa - \Delta Hg}{Pa}\right) \times \Delta V / t$$

$$Qa = \left(\frac{(752.6\ \text{mm Hg} - 104.1\ \text{mm Hg})}{(752.6\ \text{mm Hg})}\right) \times \left(\frac{2.563\ m^3}{1\ \text{min}}\right)$$

$$Qa = 2.208\ m^3/\text{min}$$

3. Calculate y for test condition 1:

where: $\Delta H2O = 11.73$ Inches-of-water
$Ta = 300.65$ °K
$Pa = 752.6$ mm Hg

$$y = \sqrt{(\Delta H2O \times Ta/Pa)}$$

$$y = \sqrt{\frac{(11.73\ \text{Inches-of-water} \times 300.65\ °K)}{(752.6\ \text{mm Hg})}}$$

$$y = 2.165 \left(\frac{\text{Inches-of-water} \times °K}{\text{mm Hg}}\right)^{1/2}$$

4. For all the test conditions there results:

Qa, m^3/min (Qa-value)	$\sqrt{\Delta H2O \times Ta/Pa}$ (y-value)
2.208	2.165
1.813	1.785
1.624	1.591
1.405	1.369
1.177	1.146

Performing a linear regression of this data provides the slope, intercept and correlation coefficient for the orifice; namely, m= 0.991556,b =-0.02014, and r = 0.9999

5. The correlation coefficient meets the criteria of: $r > 0.99$.

7.0
Maintenance

A regular maintenance schedule will allow a monitoring network to operate for longer periods of time without system failure. Our customers may find that adjustments in routine maintenance frequencies are necessary due to the operational demands on their sampler(s). ASI/GMW recommend however, that these cleaning and maintenance activities intervals be observed until a stable operating history of the sampler has been established. Table 7.1 presents a summary of recommended maintenance procedures and frequencies.

This section presents maintenance procedures specific to a Model 1200 SSI, the sampler shelter and both VFC and MFC motors (Models GBM2000V and GBM2000H, respectively). For information concerning the Model 321-B inlets, please refer to Appendix E.

7.1 Model 1200 Size-Selective Inlet (SSI)

The SSI hood should be inspected every sampling period for dents or irregularities in the inlet gap. Contact the manufacturer if dents exceeding 1/2" are noted.

In general, ASI/GMW recommends a thorough cleaning of the SSI after 15 days of sampling; which, on a 6 day schedule would correspond to 3 calender months. If the TSP can be estimated from historical data to the site, It is recommended that the schedule shown in Table 7.1 be used.

Table 7.1 Inlet Cleaning and Maintenance Schedule

	MAINTENANCE FREQUENCY	
AVERAGE ESTIMATED TSP AT SITE STD. $\mu g/m^3$	NUMBER OF SAMPLING DAYS	INTERVAL, ASSUMING 6-DAY SAMPLING SCHEDULE
40	30	6 months
75	15	3 months
150	10	2 months
200	5	1 months

Procedures for cleaning and maintaining the Model 1200 inlet (Figure 7.1) are as follows:

1. Inspect the four inlet hook-catches for proper tension. The sealing gasket should be slightly compressed when the inlet is closed. Adjust as necessary by the first loosening the lock-nut on the hook-catch rod. To shorten the catch length, turn the rod clockwise; counter-clockwise to loosen. After adjustments are complete, re-tighten the lock-nut.
2. Remove the hood (reverse assembly procedure presented in Section 3.1) and clean the nine acceleration nozzles with a small bottle brush. Wipe all internal surfaces with a damp cloth or Kimwipe. Replace the hood.
3. Release the four inlet hook-catches located on the sides of the SSI. Open the inlet fully; the support strut should lock on the second slot and support the inlet. The sixteen vent tubes and the collection shim (Figure 7.2) will be visible. Inspect the collection shim pattern. A normal greased shim pattern is indicated by a circular pattern of particle collection directly beneath the acceleration nozzles. An overloaded shim can be identified by bars or stripes of deposit between the vent tube holes.
4. Remove the collection shim (PN G120027) by rotating the shim clips 90°.
5. Carefully lift the shim (handling by the edges only) over the vent tubes. Use a putty knife to first remove bulk of deposited material. Wipe with a clean cloth or Kimwipe to remove oil and place on a workbench. (Acetone can be applied to completely clean the shim.)
6. Inspect all gaskets for wear and compression. Replace as necessary.
   a. Carefully remove the gasket by scraping with a small, dull knife and wiping with acetone. The RTU adhesive must be thoroughly removed to ensure a complete seal for the new gasket.
   b. Evenly spread silicone adhesive to the surface of the gasket and gently press on the inlet edge.
   c. Wait at least 24-hours before resuming sampling to allow the adhesive to "cure." As with all chemicals, caution must be exercised if any organic analysis will

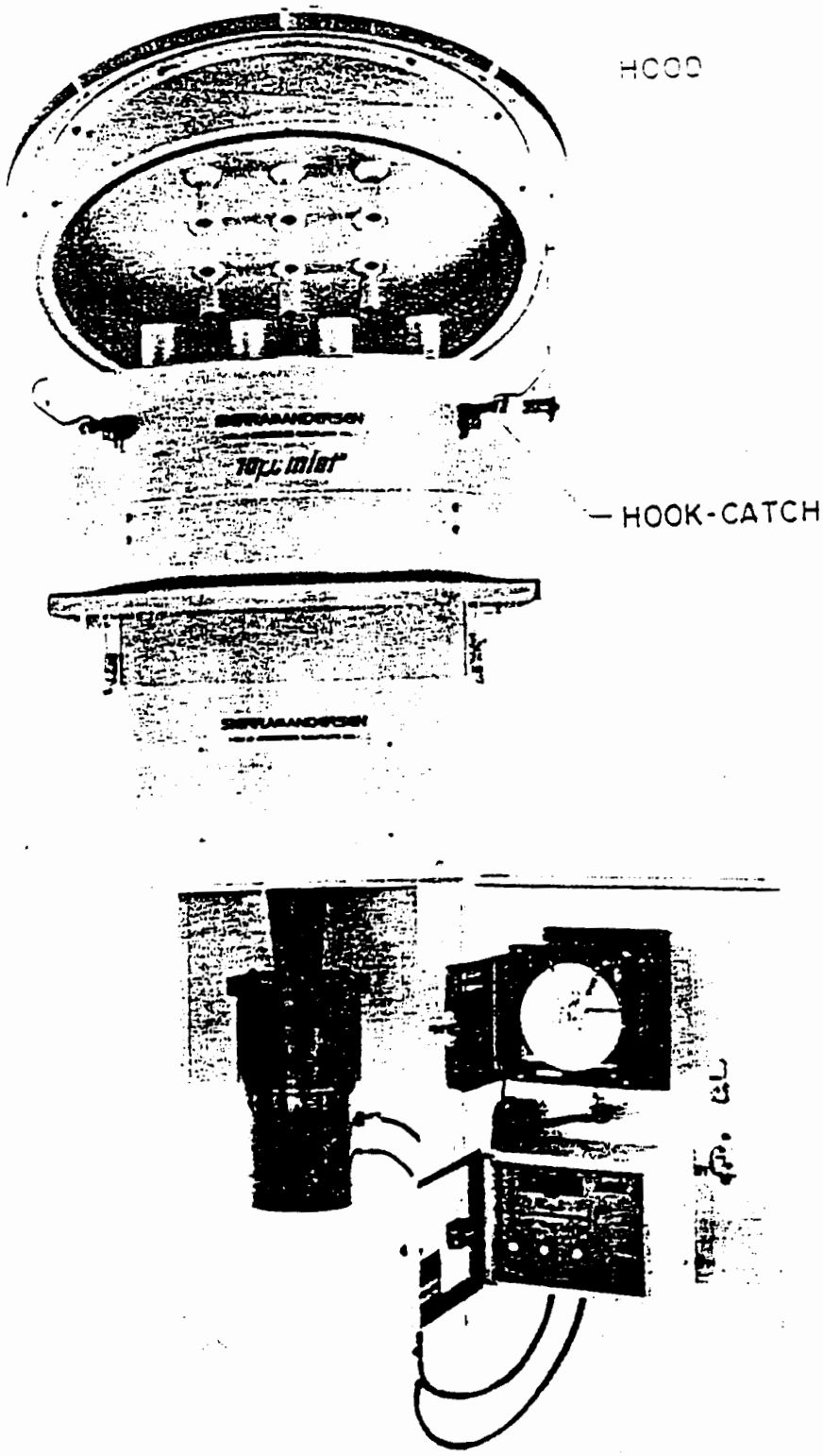


Figure 7.1 Sierra - Andersen/GMW Model 1200 HVPM10 Inlet

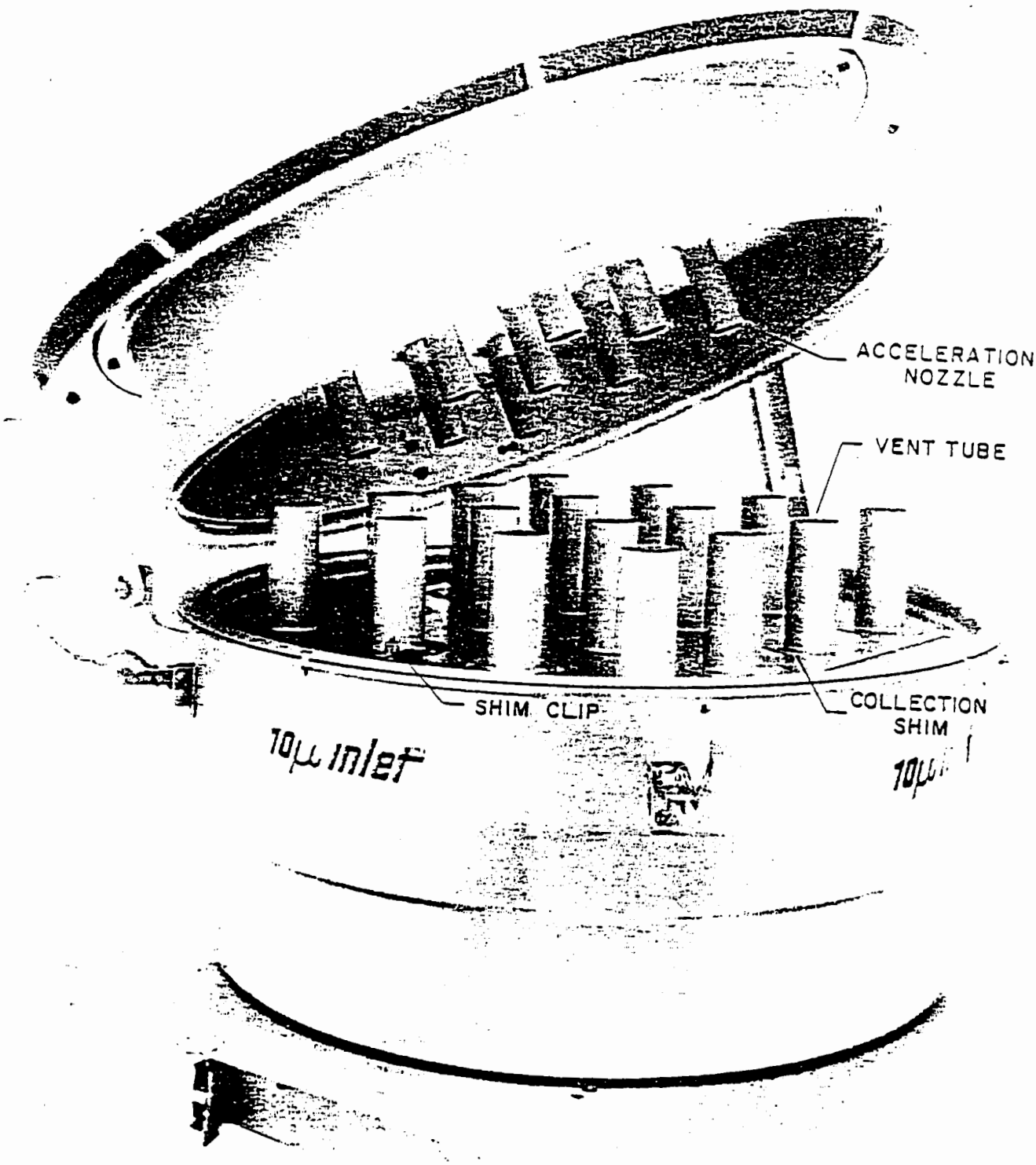


Figure 7.2 Sierra - Andersen/GMW Model 1200 HVPM10 Inlet Access to Collection Shim

be conducted on future samples. Contact the manufacturer or the analysis laboratory for additional information.

7. Remove the first stage plate by carefully lifting it above the two male centering pins located on each side of the plate. Inspect the TM-bead gasket for wear and replace if necessary (see Step 6) before resuming sampling.
8. Remove the bug screen located beneath the first stage plate. All internal surfaces should be cleaned with a damp cloth and the bug screen inspected for contamination.
9. Reassemble the inlet by reversing steps 6-8. Caution: When replacing the first stage plate, ensure the male pins are aligned with the centering holes. The first stage plate should seat completely on bead-sealing gasket, (PN 1200-21).
10. Re-grease the collection shim. On a clean surface, spray the shim with a thick coating of Dow Silicone #316 (this grease is available from ASI/GMW) . DO NOT SUBSTITUTE ANY OTHER SUBSTANCE WITHOUT CONTACTING THE MANUFACTURER. Particle bounce characteristics within the inlet may be affected by a change in viscosity. Shake the can, and holding it upright 8 to10-in. away, apply a "generous" amount of the silicone spray. Over-spraying will not affect the performance of the inlet, so when in doubt, apply more spray.
11. Allow 3-5 minutes for drying; the shim should be tacky (not slippery) and slightly cloudy when returned to the inlet.
12. Replace the collection shim in the inlet (oiled-side up) and secure with the shim clips.
13. Close the SSI. It is important to ensure that the male guide pin centers in the clearance hole.

7.2 High Volume Shelter

The HVPM10 sampler shelter should be routinely inspected and maintained as follows:

1. Power cords should be checked for crimps, cracks or exposed junctions each sample day. Do not allow power cords or outlets to be immersed water; if necessary raise the cords above the ground by

taping them to the shelter legs. Interlocking plugs can be purchased from the factory to preclude shock hazards.

2. With reference to Figure 7.3, inspect the filter screen,the filter holder gaskets (PN 3003 and 3005) and the sealing gasket each sample period. Remove any deposits on the filter screen and replace gaskets as necessary.
3. The filter cartridge used to support the sample filter should be checked each time a filter is installed. These gaskets may become warped or cracked due to over-tightening. Replace routinely.
4. Ensure that the continuous recorder pen is still inking each time the sampler is prepared for a sample period. Inspect the tubing to the motor for crimps and cracks. The recorder door should seal completely; replace the gasket as necessary.
5. The MFC (if so equipped) should operate without failure. The probe however, should be cleaned routinely with water followed by isopropyl alcohol. The use of a small camel hair brush is recommended. An electronic schematic of the MFC is presented in Appendix B.

7.3 VFC Motor (PN GBM 2000V) Maintenance Activities:

HVPM10 motors are durable and have a long life if maintained properly. The only routine maintenance required is : 1) inspecting and replacing the motor's neoprene gaskets routinely and 2) replacing the motor's carbon brushes every 300 to 400 hours of operation. The brushes have a higher rate of wear than the brushes used in an MFC motor. It is imperative that the brushes be replaced before the brush shunt touches the motor commutator. If this occurs, contact the manufacturer.

The procedure for motor gasket and brush replacement is as follows:

CAUTION: Ensure all electrical power to the HVPM10 sampler is disconnected prior to opening the motor housing. Unplug the motor power cord from the line voltage source.

1. Open the shelter door. Disconnect the rubber hose that connects the motor housing pressure tap to the continuous recorder.

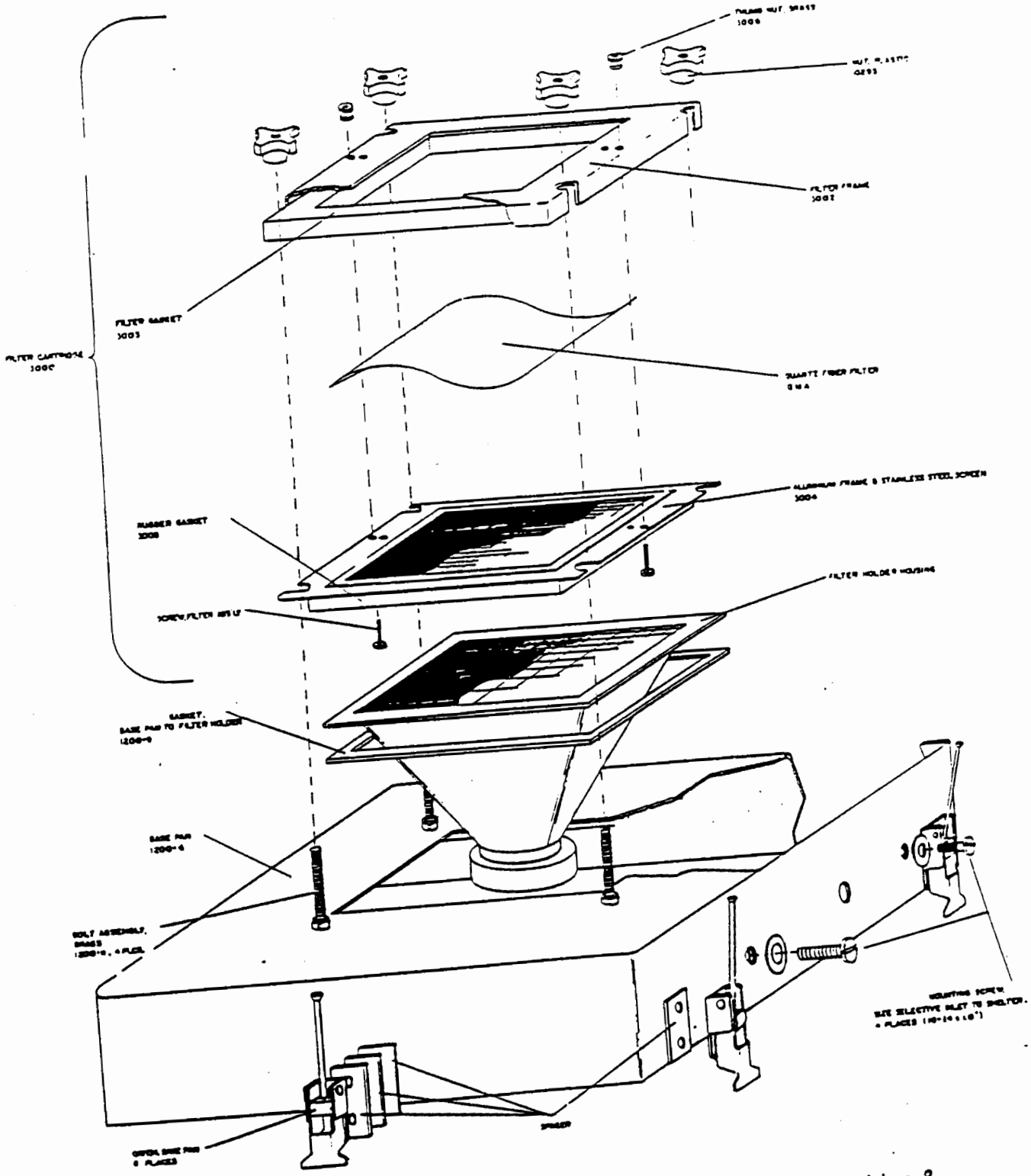


Figure 7.3 Sierra - Andersen/GMW Model 3000 Filter Cartridge & Model FH2100 SS Filter Holder

2. While supporting the motor housing with one hand, loosen the four (4) 1/4-20 x 5/8" hex-head screws that attach the motor to the bottom of the VFC. Inspect the VFC flange gasket for wear. Replace if necessary. To facilitate access to the motor , the filter holder, VFC and motor can be removed from sampler by lifting the assembly through the top of the sampler base.
3. Remove the motor and motor housing from the sampler.
4. Inspect the mounting plate gasket (PN G2001) and replace as necessary (at least twice each year).
5. By looking down through the filter screen, inspect the VFC for any debris or large particles. Disassemble and clean as necessary.
6. Release the power cord by turning the cap of the power cord connector (PN G2010H) counter-clockwise.
7. Carefully let the motor slide from the housing exposing the brushes.
8. Remove each brush holder clamp and release the expended brush.
9. Insert new brush and replace the clamps.
10. Assemble motor after brush replacement by returning the motor to the housing. Do not pinch any motor wires beneath the motor mounting ring (PN G2006).
11. Gently pull the power cord back out of the motor housing and secure it with the connector cap.
12. Return the motor to its position beneath the VFC. Replace the four (4) 1/4-20 x 5/8" hex-head screws and tighten cross-corners simultaneously to ensure an even seal.
14. For proper motor performance and maximum brush life expectancy,it is necessary to seat or "break-in" the brushes. Apply approximately 50% voltage to the motor for at least thirty minutes. A brush miser (PN G900) can be used or simply connect two motors of similar rating in series.

    Caution: Direct application of full voltage after changing brush will cause arcing, commutator pitting, and reduce overall life.
15. A leak test is recommended after brush changes, refer to Section 4.0.

7.4 MFC Motor (PN GBM 2000H) Maintenance Activities:

HVPM10 motors are durable and have a long life if maintained properly. The only routine maintenance required is : 1) inspecting and replacing the motor's neoprene gaskets routinely and 2) replacing the motor's carbon brushes every 400 to 500 hours of operation. It is imperative that the brushes be replaced before the brush shunt touches the motor commutator. If this occurs, contact the manufacturer.

The procedure for motor gasket and brush replacement is as follows:

CAUTION: Ensure all electrical power to the HVPM10 sampler is disconnected prior to opening the motor housing. Unplug the motor power cord from the line voltage source.

1. Open the shelter door and disconnect the rubber pressure hose that connects the motor to the continuous recorder.
2. Using both hands, clasp the motor mounting ring and turn counter-clockwise to loosen the ring.
3. Remove the motor and motor housing from the sampler.
4. Inspect the motor housing gaskets and replace as necessary (at least twice a year).
5. Remove the mounting plate motor cover (PN G2002) by removing the four (4) 1/4 20 x 3/8" round-head bolts. This will expose the motor.
6. Release the power cord by turning the cap of the power cord connector (PN G2010H) counter-clockwise.
7. Carefully let the motor slide from the housing exposing brushes.
8. Remove each brush holder clamp and release the expended brush.
9. Insert a new brush and replace the clamps.
10. Assemble motor after brush replacement by returning the motor to the housing. Do not to pinch any motor wires beneath the motor mounting ring (PN G2006).
11. Replace the mounting plate motor cover and bolts.
12. Gently pull the power cord back out of sampler housing and secure it with the connector cap.
13. Return the motor to its mounting ring beneath the filter holder. It is a common error to cross thread the ring or to forget the gasket. Ensure

there is a proper seal and all wires are free from rotating motor parts and the motor frame.

14. For proper motor performance and maximum brush life expectancy, it is necessary to seat or "break-in" the brushes. Apply approximately 50% voltage to the motor for at least thirty minutes. A brush miser (PN G900) can be used or simply connect two motors of similar rating in series.

    Caution: Direct application of full voltage after changing brush will cause arcing, commutator pitting, and reduce overall life.

15. A leak test is recommended after brush changes, refer to Section 4.0.

REPLACEMENT PARTS
ASI/GMW HVPM10 SAMPLERS

Model 1200 SSI
(numbers refer to parts indicated in Figure 7.1)

Item	Part Number
1. Upper Tub Housing	G12001
2. Lower Tub Housing	G12002
3. First Stage Plate	G12003
4. Acceleration Nozzle	G12004
5. Acceleration Nozzle Plate	SSI-109
6. Shelter	G12006
7. Shelter Draw-Catch	G12007
8. BP-sealing Gasket (16 x 16")	G12008
9. FH-sealing Gasket (8 x 10")	G12009
10. Vent Tube	G12005
11. Brass Bolt Assembly	G120011
12. Shelter Hinge Bracket	G120012
13. Shelter Shoulder Bolt	G120013
14. Inlet Base Plate	G120014
15. Inlet Base Plate Hinge Bracket	G120015
16. Inlet Base Plate Strike	G120016
17. Support Strut	G120018
18. Inlet Base Plate Shoulder Bolt	G120019
19. Bug Screen With Edging	G120020
20. TM-bead Gasket	G120021
21. Inlet Hook-Catch	G120022
22. Inlet Hook	G120024
23. Lower Tub Hinge	G120025
24. Upper Tub Hinge	G120026
25. Collection Shim Plate	G120027
26. Collection Shim Clips	G120028
27. Filter Holder Support Frame	G120029
28. Collection Shim Kit	G120030
29. Nozzle Plate Gasket	SSI-20
30. Hood	SSI-106
31. Nozzle Modification Kit (9.2µm)	G120034
32. Shim and Nozzle Modification Kit	G120035
33. Dow Silicone 316 Grease	G10596 or SE290G

Model G3000 Filter Cartridge

Item	Part Number
Filter Cartridge Complete	G3000
Aluminum Cover	G3001
Aluminum Filter Frame	GFH2017
Rubber Filter Gasket	GFH2018
Aluminum Frame with Stainless Steel Screen	G3004
Rubber Frame Gasket	GFH2018
Brass Thumb Nut (2 per set)	G3006

REPLACEMENT PARTS
ASI/GMW HVPM10 SAMPLERS

Model GFH2100 Filter Steel Filter Holder

Item	Part Number
Aluminum Filter Holder Complete	GFH2100
Aluminum Hold Down Filter Frame	GFH2017
Rubber Filter Gasket	GFH2018

Model GBM2000V Motor Assembly *for VFC units*

Item	Part Number
Motor Assembly Complete (does not include filter holder)	GBM2000V
Mounting Plate Gasket	G2001
Male Adapter	G2002
Top Motor Gasket	G2003
110 volt VFC Motor (Note: Different then MFC motor)	G115923
Carbon Motor Brushes, *motors purchased after 1/78* (set of 2)	GB1
Motor Armature with Bearings	G215276
Motor Cushion Gasket	G2005
Motor Mounting Metal Ring	G2006
Motor Housing	G2007H
Power Cord Retainer	G2010H
Male Power Cord	G2011
Motor Pressure Tap	G2015
Pressure Recorder Tubing	G2016

Model GBM2000H Motor Assembly *for MFC units*

Item	Part Number
Motor Assembly Complete (does not include filter holder)	GBM2000H
Mounting Plate Gasket	G2001
Male Adapter	G2002
Top Motor Gasket	G2003
110 volt MFC Motor (Note: different than VFC motor.)	G115750
Carbon Motor Brushes, *motors purchased after 1/78* (set of 2)	GB1
Carbon Motor Brushes, *motors purchased before 1/78* (set of 2)	GB3
Motor Armature with Bearings	G215276
Motor Cushion Gasket	G2005
Motor Mounting Metal Ring	G2006
Motor Housing	G2007H
Power Cord Retainer	G2010H
Male Power Cord	G2011
Motor Pressure Tap	G2015
Pressure Recorder Tubing	G2016

REPLACEMENT PARTS
ASI/GMW HVPM10 SAMPLERS

Model G105 Continuous Recorder (Dickson)

Item	Part Number
Continuous Recorder (complete assembly)	G105
Circular Charts (Box of 100)	G106
Ink Pen Cartridge (Red)	G127
Recorder Chart Motor (115 volts, 60Hz)	G108
Door Gasket	G113
Tube Hose-Barb Fitting	G115
Back Gasket	G123
Pen Arm Lifter	G124
Cartridge Pen Arm	G126
Cartridge Pen Point	G127

8.0
References

Federal Register, Volume 52, No. 52, July 1, 1987, 40 CFR Parts 50, 51, 52, 53 and 58. Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere.

Federal Register, Volume 47, No.48, December 6,1982, 40 CFR Part 50. Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).

Federal Register, Volume 52, No. 53, December 1987, Page 45684,January 1988, Page 1062. Andersen Samplers/General Metal Works Reference Method Designation Numbers for Model 1200, 321-B, and 321-C High Volume PM10 Samplers.

Aerosol Sampling Characteristics of the Sierra-Andersen Model 1200 PM-10 Inlet. Andrew R. McFarland, and Carlos A. Ortiz, Texas A & M University Aerosol Technology Laboratory Report 4716/01/08/87/ARM, August, 1987.

Aerosol Sampling Characteristics of the Sierra-Andersen Model 321-B PM-10 Inlet. Andrew R. McFarland, and Carlos A. Ortiz, Texas A & M University Aerosol Technology Laboratory Report 4716/02/08/87/ARM,August 1987.

Characterization of Sierra-Andersen Model 321-A Size Selective Inlet for Hi-Vol Samplers. Andrew R. McFarland, and Carlos A. Ortiz, Texas A & M University Air Quality Laboratory Report 4716/01/02/84ARM, February 1984.

Volumetric Flow Controller Field Tests High Volume PM 10 Sampler. T. Merrifield, D. Biddison-Palmer, Andersen Samplers/General Metal Works, January 1988.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods. EPA 600/4-77-027A, May 1977.

Investigation of Flow Rate Calibration Procedures Associated with the High Volume Method for Determination of Suspended Particulates. EPA 600/4-78-047, August 1978.

Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles. ASME / ANSI MFC-7M--1987, An American National Standard, May 1987

The Critical Flow Venturi: An Update. Henry S. Hillbrath, FLOW, Volume Two, St. Louis,1981.

A Relation Between Sonic Venturi Profile And Its Unchocking Back-Pressure Ratio. K. Komiya and N. Watanabe, FLOW, Volume Two, St. Louis, 1981

The Critical Flow Venturi: A Useful Device For Flow Measurement And Control. Henry S. Hillbrath, FLOW , ASME / Instrument Society of America Fluids Engineering Conference,Pittsburgh, 1971.

The Chocking Pressure Ratio Of A Critical Flow Venturi. H. S. Hillbrath, W. P. Dill, and W. A. Wacker, Journal of Engineering for Industry, November 1975.

Discharge Coefficient Correlations For Circular-Arc Venturi Flowmeters At Critical (Sonic) Flow. B. T. Arnberg, C. L. Britton, and W. F. Seidl, ASME Research Committee
On Fluid Meters, Winter Annual Meeting, Detroit, 1973

A Multiple Flow Venturi Airflow Metering System For Gas Turbine Engines. C. R. Varner, ASME Fluid Meters Division, Winter Annual Meeting, Los Angelas, 1969.

A Standard Chocked Nozzle For Absolute Calibration Of Air Flowmeters. D. W. Sparkes, National Gas Turbine Establishment, Pyestock, October, 1967.

A Theoretical Method Of Determining Discharge Coefficients For Venturis Operating At Critical Flow Conditions. R. E. Smith, and R. J. Matz, FLOW, ASME Fluids Research Committee, Winter Annual Meeting, New York, 1961.

APPENDIX A
CODE OF FEDERAL REGULATIONS

Appendix J—Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere

1.0 *Applicability.*

1.1 This method provides for the measurement of the mass concentration of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) in ambient air over a 24-hour period for purposes of determining attainment and maintenance of the primary and secondary national ambient air quality standards for particulate matter specified in § 50.6 of this chapter. The measurement process is nondestructive, and the PM_{10} sample can be subjected to subsequent physical or chemical analyses. Quality assurance procedures and guidance are provided in Part 58, Appendices A and B, of this chapter and in References 1 and 2.

2.0 *Principle.*

2.1 An air sampler draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within the PM_{10} size range. Each size fraction in the PM_{10} size range is then collected on a separate filter over the specified sampling period. The particle size discrimination characteristics (sampling effectiveness and 50 percent cutpoint) of the sampler inlet are prescribed as performance specifications in Part 53 of this chapter.

2.2 Each filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain due to collected PM_{10}. The total volume of air sampled, corrected to EPA reference conditions (25° C, 101.3 kPa), is determined from the measured flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is computed as the total mass of collected particles in the PM_{10} size range divided by the volume of air sampled, and is expressed in micrograms per standard cubic meter ($\mu g/std\ m^3$). For PM_{10} samples collected at temperatures and pressures significantly different from EPA reference conditions, these corrected concentrations sometimes differ substantially from actual concentrations (in micrograms per actual cubic meter), particularly at high elevations. Although not required, the actual PM_{10} concentration can be calculated from the corrected concentration, using the average ambient temperature and barometric pressure during the sampling period.

2.3 A method based on this principle will be considered a reference method only if (a) the associated sampler meets the requirements specified in this appendix and the requirements in Part 53 of this chapter, and (b) the method has been designated as a reference method in accordance with Part 53 of this chapter.

3.0 *Range.*

3.1 The lower limit of the mass concentration range is determined by the repeatability of filter tare weights, assuming the nominal air sample volume for the sampler. For samplers having an automatic filter-changing mechanism, there may be no upper limit. For samplers that do not have an automatic filter-changing mechanism, the upper limit is determined by the filter mass loading beyond which the sampler no longer maintains the operating flow rate within specified limits due to increased pressure drop across the loaded filter. This upper limit cannot be specified precisely because it is a complex function of the ambient particle size distribution and type, humidity, filter type, and perhaps other factors. Nevertheless, all samplers should be capable of measuring 24-hour PM_{10} mass concentrations of at least 300 $\mu g/std\ m^3$ while maintaining the operating flow rate within the specified limits.

4.0 *Precision.*

4.1 The precision of PM_{10} samplers must be 5 $\mu g/m^3$ for PM_{10} concentrations below 80 $\mu g/m^3$ and 7 percent for PM_{10} concentrations above 80 $\mu g/m^3$, as required by Part 53 of this chapter, which prescribes a test procedure that determines the variation in the PM_{10} concentration measurements of identical samplers under typical sampling conditions. Continual assessment of precision via collocated samplers is required by Part 58 of this chapter for PM_{10} samplers used in certain monitoring networks.

5.0 *Accuracy.*

5.1 Because the size of the particles making up ambient particulate matter varies over a wide range and the concentration of particles varies with particle size, it is difficult to define the absolute accuracy of PM_{10} samplers. Part 53 of this chapter provides a specification for the sampling effectiveness of PM_{10} samplers. This specification requires that the expected mass concentration calculated for a candidate PM_{10} sampler, when sampling a specified particle size distribution, be within ±10 percent of that calculated for an ideal sampler whose sampling effectiveness is explicitly specified. Also, the particle size for 50 percent sampling effectiveness is required to be 10±0.5 micrometers. Other specifications related to accuracy apply to flow measurement and calibration, filter media, analytical (weighing) procedures, and artifact. The flow rate accuracy of PM_{10} samplers used in certain monitoring networks is required by Part 58 of this chapter to be assessed periodically via flow rate audits.

6.0 *Potential Sources of Error.*

6.1 *Volatile Particles.* Volatile particles collected on filters are often lost during shipment and/or storage of the filters prior to the post-sampling weighing [3]. Although shipment or storage of loaded filters is sometimes unavoidable, filters should be reweighed as soon as practical to minimize these losses.

6.2 *Artifacts.* Positive errors in PM_{10} concentration measurements may result from retention of gaseous species on filters [4, 5]. Such errors include the retention of sulfur dioxide and nitric acid. Retention of sulfur dioxide on filters, followed by oxidation to sulfate, is referred to as artifact sulfate formation, a phenomenon which increases with increasing filter alkalinity [6]. Little or no artifact sulfate formation should occur using filters that meet the alkalinity specification in section 7.2.4. Artifact nitrate formation, resulting primarily from retention of nitric acid, occurs to varying degrees on many filter types, including glass fiber, cellulose ester, and many quartz fiber filters [4, 5, 8, 9, 10]. Loss of true atmospheric particulate nitrate during or following sampling may also occur due to dissociation or chemical reaction. This phenomenon has been observed on Teflon® filters [6] and inferred for quartz fiber filters [11, 12]. The magnitude of nitrate artifact errors in PM_{10} mass concentration measurements will vary with location and ambient temperature; however, for most sampling locations, these errors are expected to be small.

6.3 *Humidity.* The effects of ambient humidity on the sample are unavoidable. The filter equilibration procedure in section 9.0 is designed to minimize the effects of moisture on the filter medium.

6.4 *Filter Handling.* Careful handling of filters between presampling and postsampling weighings is necessary to avoid errors due to damaged filters or loss of collected particles from the filters. Use of a filter cartridge or cassette may reduce the magnitude of these errors. Filters must also meet the integrity specification in section 7.2.3.

6.5 *Flow Rate Variation.* Variations in the sampler's operating flow rate may alter the particle size discrimination characteristics of the sampler inlet. The magnitude of this error will depend on the sensitivity of the inlet to variations in flow rate and on the particle distribution in the atmosphere during the sampling period. The use of a flow control device (section 7.1.3) is required to minimize this error.

6.6 *Air Volume Determination.* Errors in the air volume determination may result from errors in the flow rate and/or sampling time measurements. The flow control device serves to minimize errors in the flow rate determination, and an elapsed time meter (section 7.1.5) is required to minimize the error in the sampling time measurement.

7.0 *Apparatus.*

7.1 *PM_{10} Sampler.*

7.1.1 The sampler shall be designed to:

a. Draw the air sample into the sampler inlet and through the particle collection filter at a uniform face velocity.

b. Hold and seal the filter in a horizontal position so that sample air is drawn downward through the filter.

c. Allow the filter to be installed and removed conveniently.

d. Protect the filter and sampler from precipitation and prevent insects and other debris from being sampled.

e. Minimize air leaks that would cause error in the measurement of the air volume passing through the filter.

f. Discharge exhaust air at a sufficient distance from the sampler inlet to minimize the sampling of exhaust air.

g. Minimize the collection of dust from the supporting surface.

7.1.2 The sampler shall have a sample air inlet system that, when operated within a specified flow rate range, provides particle size discrimination characteristics meeting all of the applicable performance specifications prescribed in Part 53 of this chapter. The sampler inlet shall show no significant wind direction dependence. The latter requirement can generally be satisfied by an inlet shape that is circularly symmetrical about a vertical axis.

7.1.3 The sampler shall have a flow control device capable of maintaining the sampler's operating flow rate within the flow rate limits specified for the sampler inlet over normal variations in line voltage and filter pressure drop.

7.1.4 The sampler shall provide a means to measure the total flow rate during the sampling period. A continuous flow recorder is recommended but not required. The flow measurement device shall be accurate to ±2 percent.

7.1.5 A timing/control device capable of starting and stopping the sampler shall be used to obtain a sample collection period of 24 ±1 hr (1,440 ±60 min). An elapsed time meter, accurate to within ±15 minutes, shall be used to measure sampling time. This meter is optional for samplers with continuous flow recorders if the sampling time measurement obtained by means of the recorder meets the ±15 minute accuracy specification.

7.1.6 The sampler shall have an associated operation or instruction manual as required by Part 53 of this chapter which includes detailed instructions on the calibration, operation, and maintenance of the sampler.

7.2 *Filters.*

7.2.1 *Filter Medium.* No commercially available filter medium is ideal in all respects for all samplers. The user's goals in sampling determine the relative importance of various filter characteristics (e.g., cost, ease of handling, physical and chemical characteristics, etc.) and, consequently, determine the choice among acceptable filters. Furthermore, certain types of filters may not be suitable for use with some samplers, particularly under heavy loading conditions (high mass concentrations), because of high or rapid increase in the filter flow resistance that would exceed the capability of the sampler's flow control device. However, samplers equipped with automatic filter-changing mechanisms may allow use of these types of filters. The specifications given below are minimum requirements to ensure acceptability of the filter medium for measurement of PM_{10} mass concentrations. Other filter evaluation criteria should be considered to meet individual sampling and analysis objectives.

7.2.2 *Collection Efficiency.* >99 percent, as measured by the DOP test (ASTM-2986) with 0.3 μm particles at the sampler's operating face velocity.

7.2.3 *Integrity.* ±5 μg/m³ (assuming sampler's nominal 24-hour air sample volume). Integrity is measured as the PM_{10} concentration equivalent corresponding to the average difference between the initial and the final weights of a random sample of test filters that are weighed and handled under actual or simulated sampling conditions, but have no air sample passed through them (i.e., filter blanks). As a minimum, the test procedure must include initial equilibration and weighing, installation on an inoperative sampler, removal from the sampler, and final equilibration and weighing.

7.2.4 *Alkalinity.* <25 microequivalents/gram of filter, as measured by the procedure given in Reference 13 following at least two months storage in a clean environment (free from contamination by acidic gases) at room temperature and humidity.

7.3 *Flow Rate Transfer Standard.* The flow rate transfer standard must be suitable for the sampler's operating flow rate and must be calibrated against a primary flow or volume standard that is traceable to the National Bureau of Standards (NBS). The flow rate transfer standard must be capable of measuring the sampler's operating flow rate with an accuracy of ±2 percent.

7.4 *Filter Conditioning Environment.*

7.4.1 Temperature range: 15° to 30° C.

7.4.2 Temperature control: ±3° C.

7.4.3 Humidity range: 20% to 45% RH.

7.4.4 Humidity control: ±5% RH.

7.5 *Analytical Balance.* The analytical balance must be suitable for weighing the type and size of filters required by the sampler. The range and sensitivity required will depend on the filter tare weights and mass loadings. Typically, an analytical balance with a sensitivity of 0.1 mg is required for high volume samplers (flow rates >0.5 m³/min). Lower volume samplers (flow rates <0.5 m³/min) will require a more sensitive balance.

8.0 *Calibration.*

8.1 *General Requirements.*

8.1.1 Calibration of the sampler's flow measurement device is required to establish traceability of subsequent flow measurements to a primary standard. A flow rate transfer standard calibrated against a primary flow or volume standard shall be used to calibrate or verify the accuracy of the sampler's flow measurement device.

8.1.2 Particle size discrimination by inertial separation requires that specific air velocities be maintained in the sampler's air inlet system. Therefore, the flow rate through the sampler's inlet must be maintained throughout the sampling period within the design flow rate range specified by the manufacturer. Design flow rates are specified as actual volumetric flow rates, measured at existing conditions of temperature and pressure (Q_a). In contrast, mass concentrations of PM_{10} are computed using flow rates corrected to EPA reference conditions of temperature and pressure (Q_{std}).

8.2 *Flow Rate Calibration Procedure.*

8.2.1 PM_{10} samplers employ various types of flow control and flow measurement devices. The specific procedure used for flow rate calibration or verification will vary depending on the type of flow controller and flow indicator employed. Calibration in terms of actual volumetric flow rates (Q_a) is generally recommended, but other measures of flow rate (e.g., Q_{std}) may be used provided the requirements of section 8.1 are met. The general procedure given here is based on actual volumetric flow units (Q_a) and serves to illustrate the steps involved in the calibration of a PM_{10} sampler. Consult the sampler manufacturer's instruction manual and Reference 2 for specific guidance on calibration. Reference 14 provides additional information on the use of the commonly used measures of flow rate and their interrelationships.

8.2.2 Calibrate the flow rate transfer standard against a primary flow or volume standard traceable to NBS. Establish a calibration relationship (e.g., an equation or family of curves) such that traceability to the primary standard is accurate to within 2 percent over the expected range of ambient conditions (i.e., temperatures and pressures) under which the transfer standard will be used. Recalibrate the transfer standard periodically.

8.2.3 Following the sampler manufacturer's instruction manual, remove the sampler inlet and connect the flow rate transfer standard to the sampler such that the transfer standard accurately measures the sampler's flow rate. Make sure there are no leaks between the transfer standard and the sampler.

8.2.4 Choose a minimum of three flow rates (actual m³/min), spaced over the acceptable flow rate range specified for the inlet (see 7.1.2) that can be obtained by suitable adjustment of the sampler flow rate. In accordance with the sampler manufacturer's instruction manual, obtain or verify the calibration relationship between the flow rate (actual m³/min) as indicated by the transfer standard and the sampler's flow indicator response. Record the ambient temperature and barometric pressure. Temperature and pressure corrections to subsequent flow indicator readings may be required for certain types of flow measurement devices. When such corrections are necessary, correction on an individual or daily basis is preferable. However, seasonal average temperature and average barometric pressure for the sampling site may be incorporated into the sampler calibration to avoid daily corrections. Consult the sampler manufacturer's instruction manual and Reference 2 for additional guidance.

8.2.5 Following calibration, verify that the sampler is operating at its design flow rate (actual m³/min) with a clean filter in place.

8.2.6 Replace the sampler inlet.

9.0 *Procedure.*

9.1 The sampler shall be operated in accordance with the specific guidance provided in the sampler manufacturer's instruction manual and in Reference 2. T

general procedure given here assumes that the sampler's flow rate calibration is based on flow rates at ambient conditions (Q_a) and serves to illustrate the steps involved in the operation of a PM_{10} sampler.

9.2 Inspect each filter for pinholes, particles, and other imperfections. Establish a filter information record and assign an identification number to each filter.

9.3 Equilibrate each filter in the conditioning environment (see 7.4) for at least 24 hours.

9.4 Following equilibration, weigh each filter and record the presampling weight with the filter identification number.

9.5 Install a preweighed filter in the sampler following the instructions provided in the sampler manufacturer's instructional manual.

9.6 Turn on the sampler and allow it to establish run-temperature conditions. Record the flow indicator reading and, if needed, the ambient temperature and barometric pressure. Determine the sampler flow rate (actual m^3/min) in accordance with the instructions provided in the sampler manufacturer's instruction manual. NOTE.—No onsite temperature or pressure measurements are necessary if the sampler's flow indicator does not require temperature or pressure corrections or if seasonal average temperature and average barometric pressure for the sampling site are incorporated into the sampler calibration (see step 8.2.4). If individual or daily temperature and pressure corrections are required, ambient temperature and barometric pressure can be obtained by on-site measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampling site and the airport.

9.7 If the flow rate is outside the acceptable range specified by the manufacturer, check for leaks, and if necessary, adjust the flow rate to the specified setpoint. Stop the sampler.

9.8 Set the timer to start and stop the sampler at appropriate times. Set the elapsed time meter to zero or record the initial meter reading.

9.9 Record the sample information (site location or identification number, sample date, filter identification number, and sampler model and serial number).

9.10 Sample for 24±1 hours.

9.11 Determine and record the average flow rate (Q_a) in actual m^3/min for the sampling period in accordance with the instructions provided in the sampler manufacturer's instruction manual. Record the elapsed time meter final reading and, if needed, the average ambient temperature and barometric pressure for the sampling period (see note following step 9.6).

9.12 Carefully remove the filter from the sampler, following the sampler manufacturer's instruction manual. Touch only the outer edges of the filter.

9.13 Place the filter in a protective holder or container (e.g., petri dish, glassine envelope, or manila folder).

9.14 Record any factors such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement on the filter information record.

9.15 Transport the exposed sample filter to the filter conditioning environment as soon as possible for equilibration and subsequent weighing.

9.16 Equilibrate the exposed filter in the conditioning environment for at least 24 hours under the same temperature and humidity conditions used for presampling filter equilibration (see 9.3).

9.17 Immediately after equilibration, reweigh the filter and record the postsampling weight with the filter identification number.

10.0 *Sampler Maintenance.*

10.1 The PM_{10} sampler shall be maintained in strict accordance with the maintenance procedures specified in the sampler manufacturer's instruction manual.

11.0 *Calculations.*

11.1 Calculate the average flow rate over the sampling period corrected to EPA reference conditions as Q_{std}. When the sampler's flow indicator is calibrated in actual volumetric units (Q_a), Q_{std} is calculated as:

$$Q_{std} = Q_a \times (P_{av}/T_{av})(T_{std}/P_{std})$$

where

Q_{std} = average flow rate at EPA reference conditions, std m^3/min;

Q_a = average flow rate at ambient conditions, m^3/min;

P_{av} = average barometric pressure during the sampling period or average barometric pressure for the sampling site, kPa (or mm Hg);

T_{av} = average ambient temperature during the sampling period or seasonal average ambient temperature for the sampling site, K;

T_{std} = standard temperature, defined as 298 K;

P_{std} = standard pressure, defined as 101.3 kPa (or 760 mm Hg).

11.2 Calculate the total volume of air sampled as:

$$V_{std} = Q_{std} \times t$$

where

V_{std} = total air sampled in standard volume units, std m^3;

t = sampling time, min.

11.3 Calculate the PM_{10} concentration as:

$$PM_{10} = (W_f - W_i) \times 10^6 / V_{std}$$

where

PM_{10} = mass concentration of PM_{10}, µg/std m^3;

W_f, W_i = final and initial weights of filter collecting PM_{10} particles, g;

10^6 = conversion of g to µg.

Note.—If more than one size fraction in the PM_{10} size range is collected by the sampler, the sum of the net weight gain by each collection filter ($\Sigma(W_f - W_i)$) is used to calculate the PM_{10} mass concentration.

12.0 *References.*

1. Quality Assurance Handbook for Air Pollution Measurement Systems. Volume I. Principles. EPA-600/9-76-005, March 1976. Available from CERI, ORD Publications, U.S. Environmental Protection Agency, 26 West St. Clair Street, Cincinnati, Ohio 45268.

2. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods. EPA-600/4-77-027a, May 1977. Available from CERI, ORD Publications, U.S. Environmental Protection Agency, 26 West St. Clair Street, Cincinnati, Ohio 45268.

3. Clement, R.E., and F.W. Karasek. Sample Composition Changes in Sampling and Analysis of Organic Compounds in Aerosols. Int. J. Environ. Analyt. Chem., 7:109, 1979.

4. Lee, R.E., Jr., and J. Wagman. A Sampling Anomaly in the Determination of Atmospheric Sulfate Concentration. Amer. Ind. Hyg. Assoc. J., 27:266, 1966.

5. Appel, B.R., S.M. Wall, Y. Tokiwa, and M. Haik. Interference Effects in Sampling Particulate Nitrate in Ambient Air. Atmos. Environ., 13:319, 1979.

6. Coutant, R.W. Effect of Environmental Variables on Collection of Atmospheric Sulfate. Environ. Sci. Technol., 11:873, 1977.

7. Spicer, C.W., and P. Schumacher. Interference in Sampling Atmospheric Particulate Nitrate. Atmos. Environ., 11:873, 1977.

8. Appel, B.R., Y. Tokiwa, and M. Haik. Sampling of Nitrates in Ambient Air. Atmos. Environ., 15:283, 1981.

9. Spicer, C.W., and P.M. Schumacher. Particulate Nitrate: Laboratory and Field Studies of Major Sampling Interferences. Atmos. Environ., 13:543, 1979.

10. Appel, B.R. Letter to Larry Purdue, U.S. EPA, Environmental Monitoring and Support Laboratory, March 18, 1982. Docket No. A-82-37, II-I-1.

11. Pierson, W.R., W.W. Brachaczek, T.J. Korniski, T.J. Truex, and J.W. Butler. Artifact Formation of Sulfate, Nitrate, and Hydrogen Ion on Backup Filters: Allegheny Mountain Experiment. J. Air Pollut. Control Assoc., 30:30, 1980.

12. Dunwoody, C.L. Rapid Nitrate Loss From PM_{10} Filters. J. Air Pollut. Control Assoc., 36:817, 1986.

13. Harrell, R.M. Measuring the Alkalinity of Hi-Vol Air Filters. EMSL/RTP-SOP-QAD-534, October 1985. Available from the U.S. Environmental Protection Agency, EMSL/QAD, Research Triangle Park, North Carolina 27711.

14. Smith, F., P.S. Wohlschlegel, R.S.C. Rogers, and D.J. Mulligan. Investigation of Flow Rate Calibration Procedures Associated With the High Volume Method for Determination of Suspended Particulates. EPA-600/4-78-047, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, 1978.

APPENDIX B
ELECTRONIC MASS FLOW CONTROLLER

ELECTRONIC MASS FLOW CONTROLLER (MFC)

1.0 Description

An electronic MFC adjust the sampler's motor speed and thus maintains a constant mass flow rate regardless of fluctuating ambient conditions (temperature and barometric pressure) and filter loadings. All ASI/GMW MFC models are designed to control HVPM10 motors with power ratings up to 3/4hp (ASI/GMW motors are rated at 0.6hp) and are available at both 50 and 60Hz, 115 VAC. All models have an adjustable flow range of 0.4 std. m^3/min to 1.7 std. m^3/min with an accuracy of ±0.03 std. m^3/min when operated in the temperature range of 0°C to 45°C.

An ASI/GMW MFC utilizes a set-screw potentiometer (pot) to adjust the sampler's flow rate. The pot is located (dependent upon the model) either: 1) on the front panel of the MFC, 2) on the printed circuit card (before 1982) behind the front panel or 3) on the front door of the MFC (USEPA units). This pot is adjusted after the sampler's calibration (refer to Section 4.0 of the Operator's Manual) to set the sampler at its seasonally adjusted set point flow rate (SFR).

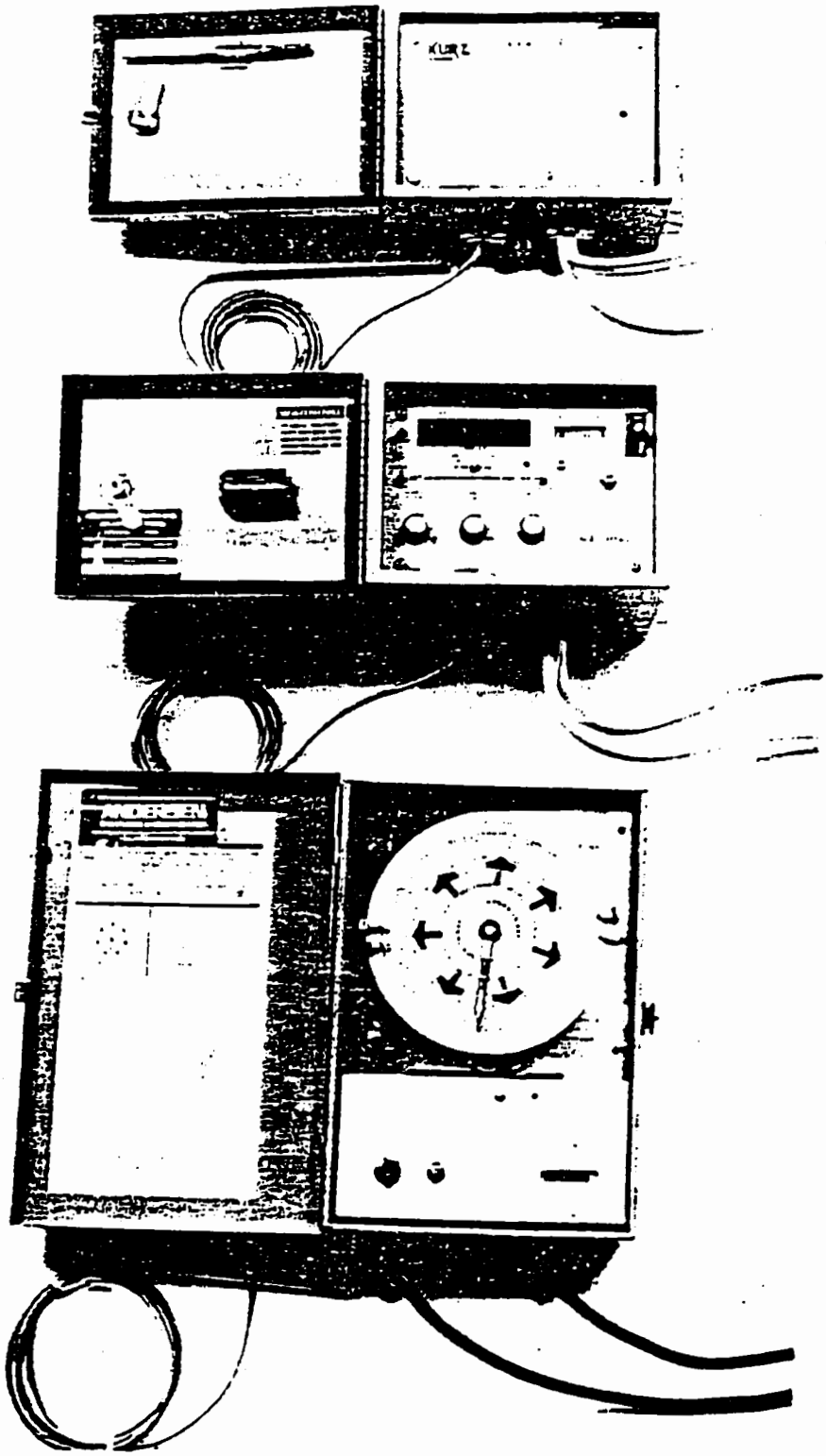
Elapsed time indicators (ETI) are included with all ASI/GMW MFC systems. . ETIs are mechanical devices that are activated only when the sampler is energized. Both resettable and non-resettable ETI are available; the purchaser should evaluate the options available and chose the model most useful in their monitoring network. The ETI's mechanical digital totalizer is read in either units of XXXX.X hours or XXXX.X minutes.

ASI/GMW offer a variety of MFC systems to our customers. The following is a brief description of the MFCs and combination MFC/timers provided with ASI/GMW HVPM10 samplers (Figure B-1).

1. Model SA350/G310

   This electronic MFC is sold as a single unit and is encased in a steel all-weather enclosure. In HVPM10 samplers, GMW-IP-801 AND GMW-IP-10-8000, it is electronically wired to activate when the master timer energizes the motor.

2. Model SA352/G312



- Model 310, 350

- Model 312, 352

- Model 313, 353

Electronic Flow Controllers

This is an MFC that has been mated with a Model 302 electronic digital timer/programmer. These two units are packaged in a single steel all-weather enclosure and are supplied in HVPM10 systems SAUV-10-H and GMW-IP-10.

3. Model SA353/G313

This is an MFC that has been mated with a with Model 70 mechanical 7-day master timer. These two units are packaged together in the enclosure that houses the Model 70 timer. A Model 76 master timer may be substituted for the Model 70 master timer at the user's option. The Model SA353 and G313 are supplied in HVPM10 systems SAUV-11H and GMW-IP-10-70.

Note: All MFC systems must have a minimum of 90VAC to operate correctly. It is recommended that each sampler equipped with a MFC have a separate circuit to preclude low-voltage failure. Due to amperage fluctuations, the use of portable generators for power supplies is strongly discouraged.

2.0 Theory of Operation

The electronic MFC is designed to control the sampler's mass flow rate over the range of 0.4 to 1.7 std. m^3/min. Since mass flow rates are always expressed in terms of standard conditions, and an HVPM10 sampler must be operated in terms of actual conditions, ASI/GMW calibration procedures use the MFC as a device to set the sampler's operational flow rate to a "centered" (in respect to the required design flow rate) seasonally adjusted flow rate. For further information, please refer to Section 4.0, "Calibration Procedures."

Simply stated, the MFC controls the sampler's flow rate by increasing or decreasing the motor speed by adjusting the input voltage to the motor. The MFC ability to operate correctly, is therefore dependent upon line voltage and to a lesser extent, the motor's power rating. A separate power circuit for each MFC sampler is recommended and a minimum of 90VAC is required.

Each MFC consists of two basic components: 1) a temperature differential sensor and a feedback control circuit that varies the voltage input into the motor. The temperature differential sensor is a short (4-in) metal-covered glass probe that is inserted into the throat of the sampler's filter holder. (Note: At one time, ASI/GMW also manufactured a long-probe model MFC that was compatible with HVPM10 samplers equipped with plastic filter holders.

These long probe MFC and plastic filter holders are no longer in production, please contact the factory for additional information.)

The temperature differential probe consists of a gas temperature sensor and constant temperature hot-wire anemometer. Gas passing the temperature sensor (the open area on the probe) has a cooling effect that is proportional to the pressure, temperature, and velocity of the gas. The anemometer, a heated, metal covered tungsten wire, provides a reference temperature. The ratio of temperature change between the temperature sensor and the anemometer determines the voltage input into the sampler's motor.

The probe and related electronic circuitry produce an output signal that is proportional to the mass of the gas flowing past the probe. The feedback control circuit contains the electronics necessary to vary the input voltage to the motor so as to maintain a constant, mass flow rate.

SPECIFICATIONS

Flow Range:	15-60 SCFM, adjustable.
Accuracy:	Better than ± 1 SCFM over -20°C to 55°C temperature range.
Sensor:	Rugged metal-covered type with temperature compensation.
Motor Type:	Compatible with series wound or universal or split-capacitor type.
Installation:	Electronics enclosure mounted on Hi-Vol shelter, sensor inserted into 17/64" dia. hole in filter holder.
Construction:	All solid-state electronics in a weatherproof enclosure.
Dimensions:	Electronics: 6.25" x 9.0" x 3.75" WLD; Metal-covered sensor: 0.25" dia. x 3.0" L.
Power:	115 VAC, 50/60 Hz, 10 amp. max. (200/230 VAC available).
Shpg. Wt:	8 lbs.

Meets all EPA Specifications:
Federal Register, Vol 47, No.
December 6, 1982

MAINTENANCE

The Model 310 requires little maintenance in most cases If the probe sensor gets contaminated by dust accumulation (e.g. if the 8" x 10" filter breaks and allows dust to be pulled across the sensor), it should be cleaned by brushing with a solvent such as acetone or methanol. Andersen recommends keeping the probe sheathed in its protective cover if it is removed from the throat of the Hi-Vol.

If the probe or electronics enclosure are damaged, call the factory:

ANDERSEN SAMPLERS, INC.
4215-C WENDELL DRIVE
ATLANTA, GEORGIA 30336

TOLL FREE (800) 241-6898
(404) 691-1910

TROUBLE SHOOTING

Symptom

1. Is 310 running too high or low?

Correction

a) Is the probe properly lined up?

b) Are the paper and probe clean?

c) Is there a leak upstream? (too low) if none then the unit probally needs recalibration.

Symptom

2. Does it oscillate?

Correction

a) Make sure filter paper is in place! (If there is no filter paper the system oscillates because the time constant of electronics is slower than the change in mass flow rate)

Symptom

3. Can't get full mass flow rate?

Correction

a) Check Hi-Vol motor first by bypassing 310.

b) Install brushes.

c) Change paper and Hi-Vol motor.

Symptom

4. Hi-Vol running full blast?

Correction

a) Either the diac or triac is bad. (See instruction manual for location) If the triac is bad your unit will run full force with the diac out of the system. (replace)

b) If not then diac is bad.

Symptom

5. Unit does not come on at all.

Correction

a) Check to see if the transformer primary or secondary leads have broken loose. If so resolder or replace transformer. Calibration procedures are outlined in the instruction manual. CAUTION DO NOT REMOVE PROBE WITH POWER APPLIED OR YOU WILL DESTROY IT. (The circuit sees infinate resistance and turns the Op Amp all the way on and with no current limit it burns up one of the sensors. Pay close attention to proper wiring as improper wiring of probe also can destroy one of the sensors. See instruction manual before attempting

component replacement on the circuit board. Check with the factory for proper procedures.

Symptom

6. Flow probe dirty?

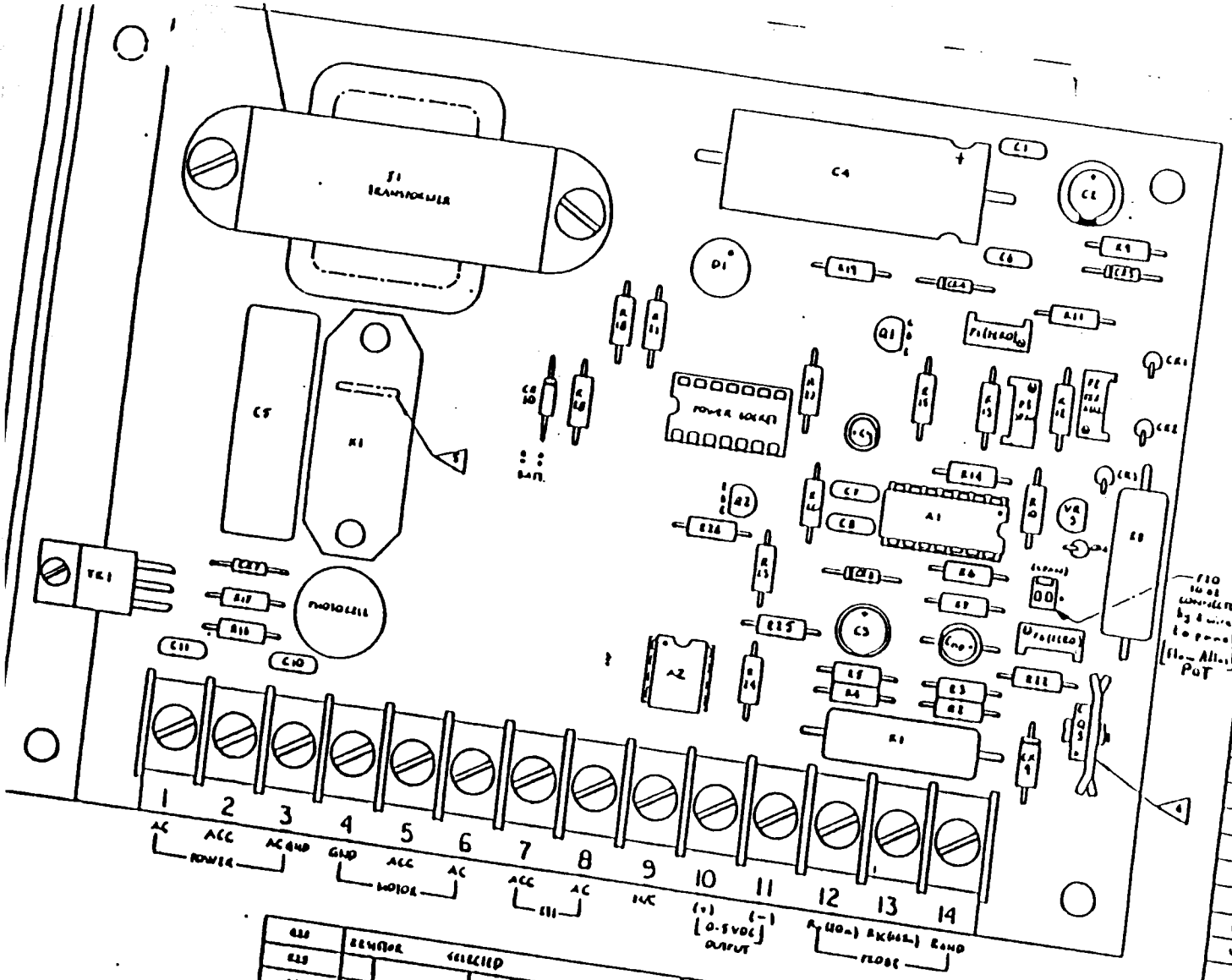
Correction

a) Disconnect all power plugs from the unit.
b) Remove flow probe.
c) Clean with water using camels hair brush.
d) Clean again in alcohol.
e) Re-install in Hi-Vol being certain not to re-connect power cords until operation is complete.

NOTE:

When returning the 310 to the factory.

a) Wrap the probe in a protective covering being certain it cannot be damaged in transit. In all cases the probe must be returned with the Model 310 as both are balanced and calibrated together.



REF	DESCRIPTION
R1	RESISTOR SELECTED (FOR SPAN)
R2	
R3,5	(FOR SPAN)
R4,5	(FOR VALUE)
R22	SELECTED (HI. VALUE)
R7	820Ω ½W
R11	150Ω ½W
R10	270Ω ½W
R12	36K ½W
R9	15K ½W
R13,8	470Ω ½W
CR1	RESISTOR 50Ω 5W
CR2	DIAC GE
CR3	DIODE 1N3893R
CR4	1N5294
CR5	1N4004
CR1,2,3,4,5,6,8	DIODE 1N914
C10	CAPACITOR 47 µf - 25V
C10,11	.01 µf - 100V
C5	.47 µf - 100V
C4	2200 µf - 35V
C3	100 µf - 16V
C2	220 µf - 25V
C1,6,8	CAPACITOR .01 µf - 50V
Q2	TRANSIST 2K + METAL CONNECTOR (M 1 F)
P2	POTENTIOMETER 2K + HARDWARE
P1	POTENTIOMETER 10K 1W WIRE
P_{MC}	PHOTOCELL VEL9410
D1	BRIDGE RECTIFIER 1N5610
VR3	VOLTAGE REGULATOR LM1330-8 8V
Q1	TRANSISTOR MJE 210 + HEATSINK + HARDWARE (#4-40 × ½" RD.HD SCR. + NUT + WASHER)
TR1	TRIAC (RCA) 3CH2 + HARDWARE (#6-32 × ⅜" RD HD SCR. + NUT + WASHER)
T1	TRANSFORMER + 6V 12A - 60W + HARDWARE (#10-32 × ½" RD HD SCR. + NUT + WASHER) ②
A1	OP. AMP LM 324
	14 PIN DIP SOCKET
	TERMINAL STRIP 14 PIN + TERMINAL BLOCKS
	PCB TERMINAL
	3-D-82 PCB #3016-018
REF. DES.	DESCRIPTION

PARTS LIST (3110 3-D OR 3101)

REF	DESCRIPTION
R26	RESISTOR SELECTED
R25	
R16	
R17	
R18,21,27	
CR10	RESISTOR .5Ω
Q2	DIODE 1N914
Q1	TRANSISTOR 2N3906
K1	TRANSISTOR 2N3904
A2	SIGMA RELAY 22ECC-1-12A1
	OP. AMP LM358
	8 PIN DIP SOCKET
	14 PIN DIP SOCKET
REF. DES.	DESCRIPTION

REF	DESCRIPTION
R15	RESISTOR SELECTED (FOR SPAN)
R11	SELECTED (FOR ZERO)
R13,14	
R10	RESISTOR 10K
P1,3	POTENTIOMETER 2K + HARDWARE
C9	CAPACITOR 10 µf - 25V
C1	CAPACITOR .02 µf
REF. DES.	DESCRIPTION

TRANSISTOR ASSEMBLY
PART # 0070-003
FOR WIRE TO BE USED
IF K1 IS OMITTED.
NUMBER'S WHICH TO BE
USED W/MOTOR OR EQUIVALENT.
COMMAND TO BE USED ON TR1 (43
• 5KΩ Ω (HI. VALUE)
• 334.1 Ω (LO. VALUE)
S SHOWN W/CAMLOCK TO 1V.

Model 310, 310B, and 310A

COMPONENT PARTS LIST

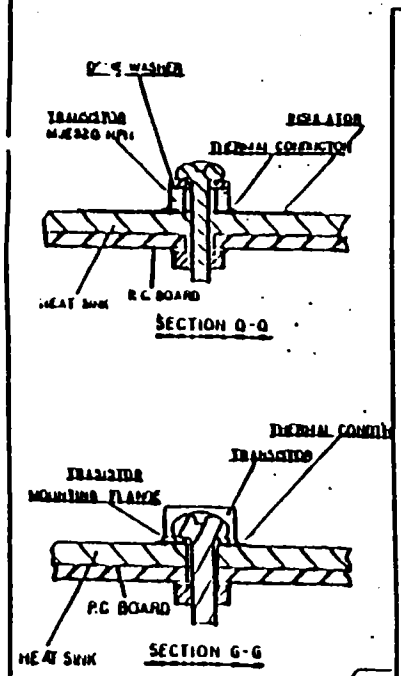
ITEM	DESCRIPTION	QUANITY
B1	PRINTED CIRCUIT BOARD	1
B2	TERMINAL STRIP 6 (1-6)	1
B3	TERMINAL STRIP 6 (7-12)	1
C1	CAPACITOR .022 MFD	4
C2	CAPACITOR 220 MFD @ 35V	1
C3	CAPACITOR 100 MFD @ 10V	1
C4	CAPACITOR 3300 MFD @ 25V	1
C5	CAPACITOR .47 MFD @ 200 V	1
D1	EROXY BRIDGE RECTIFER VE08 SK3105	1
D2	DIODE 1N914 (Replaced with Jumper)	1
D3	DIODE ZENER 1N823	1
D4	DIODE ZENER 1N5242	1
D5	DIODE ZENER 1N5242	1
P1	PHOTO RESISTOR VTL9A10	1
R1	RESISTOR 5 WATT 30.1 ohms	1
R2	RESISTOR RN60D } factory selected	1
R3	RESISTOR RN60D } factory selected	1
R4	RESISTOR RN60D } factory selected	1
R5	RESISTOR RN60D } factory selected	1
R6	RESISTOR RN60D 9.09K ohms	1
R7	RESISTOR RN60D 20K ohms	1
R8	RESISTOR VARIABLE 2K ohms	1
R9	RESISTOR CARBON 270 ohms	1
R10	RESISTOR CARBON 820 ohms	1
R11	RESISTOR RN60D factory selected 7K 1/4 watt 5%	1*
R12	RESISTOR RN60D 10K ohms	1*
R13	RESISTOR RN60D 9.09K ohms	1*
R14	RESISTOR RN60D 9.09K ohms	1*
R15	RESISTOR RN60D factory selected 24.9K 1/4 watt 5%	1*
R16	RESISTOR CARBON 36K ohms (75K ohms in 220 VAC version)	1*
R17	0-5V.1t Span Pots { RESISTOR VARIABLE, 25T, 2K ohms (Span)	1*
R18	{ RESISTOR VARIABLE, 25T, 2K ohms (zero)	1*
R19	RESISTOR CARBON 270 ohms 10%	1
R20	RESISTOR VARIABLE, 25T, 2K ohms	1
R20A	RESISTOR VARIABLE 10T, 2K ohms PANEL MOUNT	1***
T	TRANSFORMER, TRIAD F-40X, or Equiv.	1
Q1	OPERATIONAL AMPLIFIER, 741HC	1
Q2	OPERATIONAL AMPLIFIER, 741HC	1
Q3	TRANSISTOR, MJE 520	1
Q4	OPERATIONAL AMPLIFIER, 741HC	1*
Q5	OPERATIONAL AMPLIFIER, 741HC	1*
Q6	TRIAC 8 AMP ISOLATED TAB SC 142D	1
Q7	TRIGGER DIAC 1N5761	1
HS	HEAT SINK	1
M	METER READOUT, 310R	1**
N3001	FLOW PROBE ASSEMBLY	1
-	ENCLOSURE	1

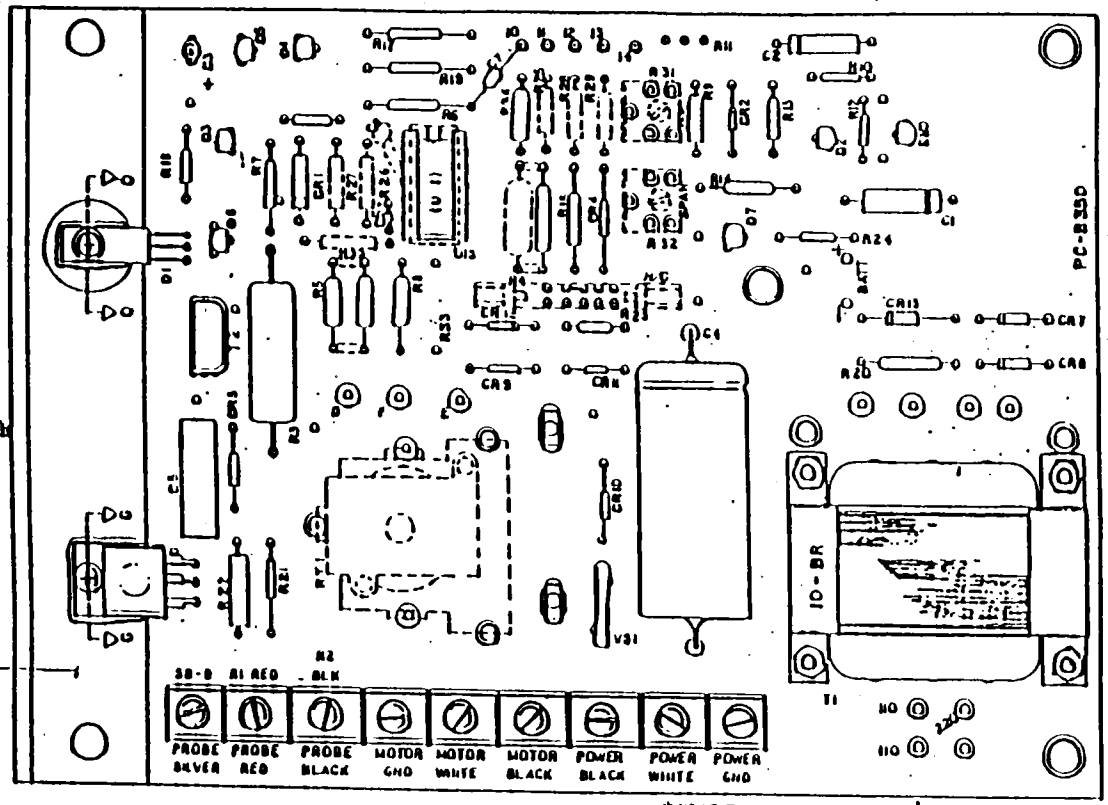
* FOR 310B
** FOR 310R
*** REMOTE FLOW ADJ.

COMPONENT PARTS LIST

TERMINAL STRIP NOMENCLATURE:

NO.	DESCRIPTION
1	+ OUTPUT FOR 0-5 VDC SIGNAL
2	- OUTPUT FOR 0-5 VDC SIGNAL (GROUND)
3	TRANSDUCER OUTPUT
4	RED LEAD TO PROBE
5	BLACK LEAD TO PROBE
6	SILVER LEAD TO PROBE (GROUND)
7	AC OUTPUT, TO HI-VOL MOTOR
8	AC COMMON (GROUND)
9	AC OUTPUT, TO HI-VOL MOTOR
10	AC LINE VOLTAGE
11	AC GROUND
12	AC LINE VOLTAGE





MODEL 310 / 350 (STD)		
DWG REF.	DESCRIPTION	QTY
R 3	RESISTOR 30 OHM 5W 1%	1
R 18	RESISTOR 33 OHM 25W 8%	1
R 22	RESISTOR 47 OHM 5W 8%	1
R 21	RESISTOR 510 OHM 25W 8%	1
R 10	RESISTOR 820 OHM 25W 8%	1
R 20	RESISTOR 1.8K OHM 5W 8%	1
R 16	RESISTOR 27K OHM 25W 8%	1
R6, 7, 15, 19	RESISTOR 8.2K OHM 25W 8%	4
R 8	RESISTOR FACTORY SELECTED	1
R 9	RESISTOR FACTORY SELECTED	1
R 4	RESISTOR FACTORY SELECTED	1
R 5	RESISTOR FACTORY SELECTED	2
R 11	POTENTIOMETER 10K 30TURN	1
C1,2	CAPCITOR 10 mf 16 vdc ELECTRO	2
C 3	CAPACITOR .33 mf 33 vdc mylar	1
C 4	CAPACITOR 2200 mf 35 vdc electro	1
C 5	CAPACITOR 1 mf 400 vdc (110 V)	1
C7,8	CAPACITOR 1 mf 80 vdc MC	2
CR2,5	DIODE 1N914A	2
CR7,8,13	DIODE 1N4002	3
VS1	VARISTOR (110 V)	1
CR3	DIODE, ZENER 1N2982 8.0V	1
Q1	TRIAC E600V 06015L6	1
Q1	TRANSISTOR MOTOROLA BU187	1
-	WASHER MICA FOR HJE320	1
-	INSULATOR FOR HJE320	1
U1	LM324N OP AMP	1
U13	SOCKET, 14 PIN IC	1
T1	TRANSFORMER 6V 1.5A	1
T2	TRANSFORMER PRI SE P9760	1
HS1	HEAT SINK	1
C6	CAPACITOR 1 mf (100 vdc) (220V)	1
VS1	VARISTOR (220V)	1
BS9	BARRIER STRIP 9 TERMINAL	1
10UA	BRACKET, TRANSFORMER	1
PCB 300	PRINTED CIRCUIT BOARD	1
SP	SHORT PROBE MODEL 30	1
LP	LONG PROBE MODEL 350	1
Q3	TRANSISTOR 2N3906 PNP	1
Q4,5	TRANSISTOR 2N3904 NPN	1
Q6	TRANSISTOR 2N3906 PNP	1

MODEL 312 & 352		
DWG REF.	DESCRIPTION	QTY
Q2	TRANSISTOR 2N3906	1
Q7	TRANSISTOR 2N3904	1
RY1	RELAY 12 VOLT	1
H/C	HEADER CONNECTOR 10-PIN M	1
	SOCKET CONNECTOR 10-PIN F	1
	CONNECTOR 14-PIN	1
	CABLE, 14 CONDUCTOR RIBBON	

MODEL A & B		
DWG REF	DESCRIPTION	QTY.
C6	CAPACITOR 10 mf 16 vdc ELECTROLYTIC	1
R 25	RESISTOR 6.8K OHM .25W 8%	1
R 26	RESISTOR, FACTORY SELECTED	1
R 27	RESISTOR 100K OHM .25W 8%	1
R 28	RESISTOR 15K OHM .25W 8%	1
R 29	RESISTOR, FACTORY SELECTED	1
R 31,32	POTENTIOMETER 10K 1 TURN	2
R 33	RESISTOR 27K OHM .25W 8%	1
R 36	RESISTOR 10K OHM .25W 8%	1

REVISIONS		
DESCRIPTION	DATE	BY

COMPONENT LAYOUT

MODEL 350

ANDERSEN

CHK BY	APPD BY	DATE	BY
SCALE	FRAC. TOLL.		
DEC. TOL.	ANG. TOLL.	DRAWING NUMBER	REV
CONCENTRICITY			
MATERIAL			
FINISH			

SERIES 350 FLOW CONTROLLER

PARTS LIST

ART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
350-001	Probe, 20ohm/160ohm	R1, R2
350-002	Resistor, 30.1 ohms, 3W, 1%	R3
350-003	Resistor(pair), Factory Selected	R4
350-004	Resistor(pair), Factory Selected	R5
350-005	Resistor, 80-100K, ¼W 1% selected	R9
350-006	Resistor, 200K, ¼W, 1%	R26
350-007	Resistor, 8.2K, ¼W, 5%	R6,7,13,17,19,23
350-008	Resistor, 820ohms, ½W, 5%	R10
350-009	Resistor, 240ohms, ¼W, 5%	R36
350-010	Resistor, 100K, ¼W, 1%	R27
350-011	Potentiometer, miniature, 10K 25 turn,1%	R11
350-012	Resistor, 30.1K, ¼W, 1%	R8,12,15,34
350-013	Resistor, 2.7K, ¼W, 1%	R16,24,33,37
350-014	Resistor, 33 ohms, ¼W, 5%	R18
350-015	Resistor, 1.8K, ½W, 5%	R20
350-016	Resistor, 330ohms, ¼W, 5%	R21
350-017	Resistor, 47 ohms, ½W, 5%	R22
350-018	Potentiometer, 10K, Ten Turn 1% Panel Mount	R30
350-019	Resistor, 15K, ¼W, 1%	R14,28
350-020	Resistor, 7.5K, ¼W, 1%	R29
350-021	Resistor, 5.1K, ¼W, 1%	R25
350-022	Potentiometer, Miniature, 10K Single Turn, 1%	R31,32
350-023	Resistor, 1K, ½W, 5%	R35
350-024	Diode, 1N914	CR1,2,4,5,9,10,11
350-025	Diode, 1N4002	CR6,7,8,13,14,15
350-026	Diode, Zener, 1N753A	CR3 (discontinued
350-027	IC, Zener, LM329BZ	CR3
350-028	Capacitor, 10mf, 16V elect.	C1,2
350-029	Capacitor, .33mf, 50V Tant.	C3
350-030	Capacitor, 2200mf, 35V elect.	C4
350-031	Capacitor, .1mf, 400V	C5
350-032	Capacitor, .1mf, 630V (for 230 VAC version)	C5
350-033	Bracket, Transformer	BKT-1
350-034	Transformer, PC-24-450	T1
350-035	Transformer, DPC-24-450 (for 230 VAC version)	T1
350-036	Transformer, PE-5760	T2
350-037	Screw, 6-32x½, T1 Hold down	4 each
350-038	Nut, Keps, 6-32, T1 Hold down	4 each
350-039	IC, LM324N, Quad Op-Amp	U1
350-040	Transistor, 2N2907	Q3
350-041	Regulator, LM317LZ	Q8
350-042		
350-043		
350-044		
350-045		
350-046		

PAGE TWO
SERIES 350 FLOW CONTROLLER
PARTS LIST

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
350-047	Transistor, MJE520, NPN	Q1
350-048	Transistor, 2N3906, PNP	Q2
350-049	Transistor, 2N3904, NPN	Q4,5,7
350-050	Transistor, 2N4871, UJT	Q6
350-051	Triac, SC142D Q601525	TH-1
350-052	Dome Washer, Q1 Mounting Hardware	WW-1
350-053	Insulator, Mica	IN-1
350-054	Socket, DIP, 14 pin	
350-055	Connector, Ribbon Cable assy.	
350-056	Header, Connector, P.C.B	
350-057	Relay, PC mount, 12VDC	RY1 (K-1)
350-058	Screw, 6-32x3/8, TH-1 Mtg. Hdwre.	1 each
350-059	Nut, Keps, 6-32, TH-1 Mtg. Hdwre.	1 each
350-060	Fuse clip, 2 each	FC-1
350-061	Fuse, 8 Amp, slo-blo 314-008	FU-1
350-062		
350-063		
350-064	Heat Sink	HS-1
350-065	Screw, 4-40x½, Q1 Mtg.Hdwre	1 each
350-066	Nut, Keps, 4-40 Q1 Mtg. Hdwre	1 each
350-067	Terminal Block, 9 Terminal	TB-1
350-068	Thermal Grease	Sn-1
350-069	Printed Circuit Board	PC-1
350-070	Box - Short	B-1
350-071		
350-072	Front Panel, Model 352	P-1
350-073	Shaft lock, for 350-018	SL-1
350-074	Stand-off, 1½", assy.	SO-1,4
350-075	Stand-off, 1 3/8", assy.	SO-2,3
350-076	Strain Relief, Pwr. Cord Set	SR-1,2
350-077	Strain Relief, Probe	SR-3
350-078	Cord Set, Male & Female	C-1
350-079		
350-080	Latch, Enclosure	L-1
350-081		
350-082	Model 302 Clock P.C.B. Assembly	PCB302-1
350-083		
350-084	Elapsed Time Indicator, 115VAC/60hz	ETI-1
350-085		
350-086	Circuit Breaker/Switch	CB-1
350-087		
350-088	Meter Movement, 1mA	Read-1
350-089		
350-090	Washer, 60 duro, retrofit	See I.M.
350-091	Bulkhead fitting, retrofit	See I.M.
350-092	15° Block, 2 part, retrofit	See I.M.

APPENDIX C
CONTINUOUS FLOW RECORDER

CONTINUOUS FLOW RECORDER

1.0 Description

Each ASI/GMW continuous flow recorder (PN#G105) comes equipped with a pen cartridge (PN# G107), a box of 100 recorder charts (PN# G106) and connecting tubing. The flow recorder is a borden-gauge unit which responds to changes in plenum pressure caused by either flow restriction during the sampler's calibration, or changes in flow rate during the sample period. It also provides a hard-copy of the sampler's flow rate stability and indicates any interruption of the sample period (i.e. power or motor failures).

The flow recorder is supplied with a female AC receptacle power cord. The recorder can be wired to be on continuously or only when the master timer energizes the HVPM10 sampler.

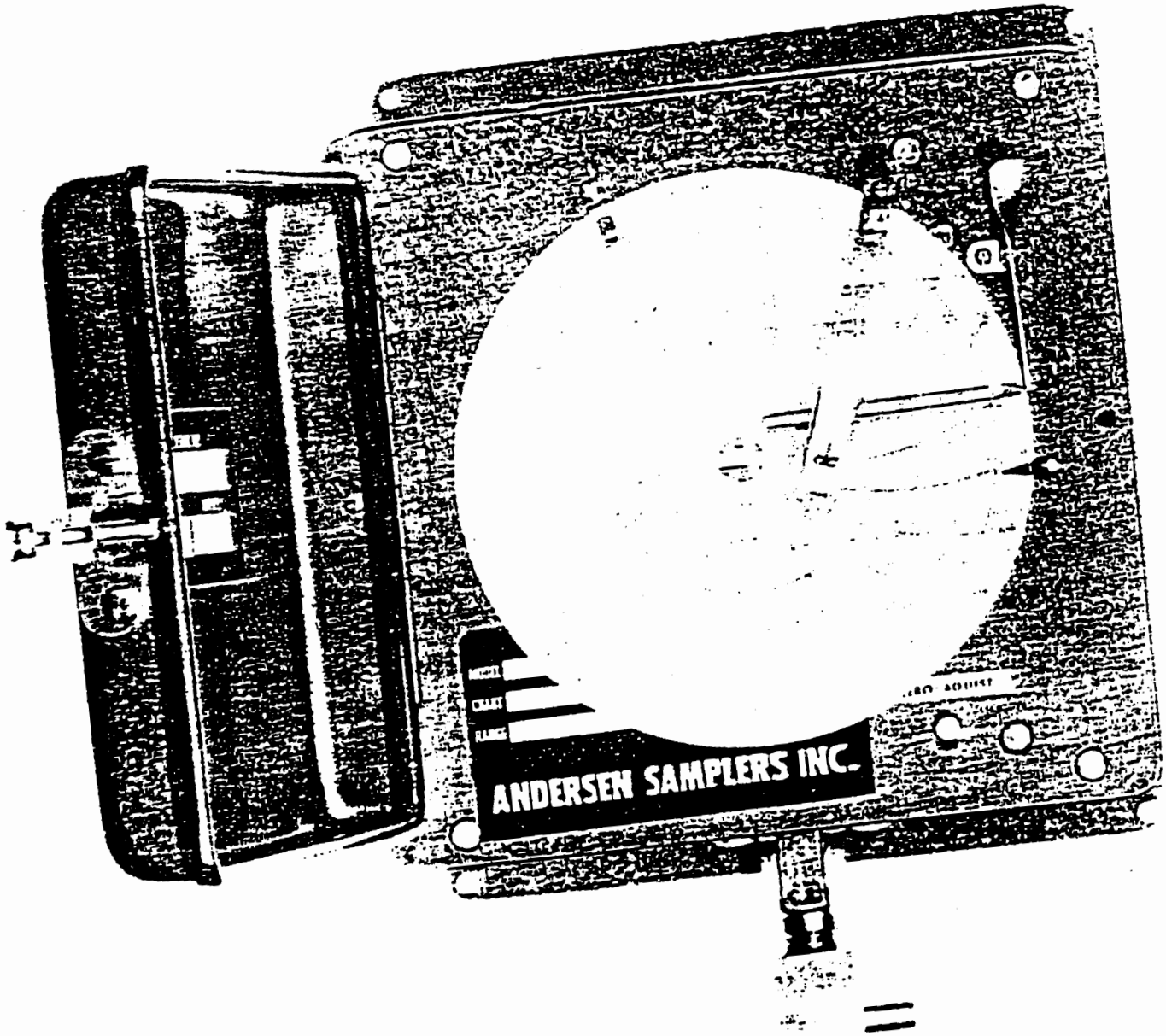
2.0 Theory of Operation:

The sampler calibration procedure presented in this Operator's Manual (Section 4.0) relates known flow rates (as determined by a calibrated transfer standard orifice device) with the ratio of atmospheric to plenum pressure. The plenum is the area within the motor housing (aft of the motor unit) in which pressures exceed atmospheric. To measure the plenum pressure, ASI/GMW equips all their HVPM10 samplers with a continuous flow recorder (Figure B-1) that is connected to the motor pressure tap by a length of rubber tubing.

The sampler's operator must install a clean recorder chart for each sample period. To install a chart, the following procedure should be followed:

1. Open the recorder door. Raise the pen arm by gently pressing against the flat portion of the pen lifter. Never energize the sampler while the pen arm is raised; this will result in a warp of the pen arm and possibly damage the spring inside the flow recorder.
2. Slip a clean recorder chart beneath the pen arm and over the slotted chart drive. Make sure that the chart is held by the two chart clips located on the face of the recorder.

   Note: During periods of inclement weather, or when the sampler is being operated in a humid environment, two recorder charts can be installed simultaneously. This practice will prohibit the



Flow Event Recorder

sample chart from becoming adhered to the recorder face and not advancing throughout the sample period.

3. Lower the pen arm. Ensure that the recorder is properly zeroed (the pen rests on the inner-most circle of the chart). Adjust the set screw (located on the bottom right corner of the recorder face) as necessary. Advance the chart to check the zero and to ensure that the pen is inking.
4. If the recorder is wired to operate continuously (e.g. plugged directly into line voltage) turn the slotted drive clockwise until the correct time is indicated by the pointed chart clip. If the recorder is plugged into a Master Timer, set the time for the beginning of the next sample period.
5. Close the recorder door and engage the locking mechanism. Inspect the connecting tubing for crimps or cracks.
6. The recorder is now ready for the next sample period.

Caution must always be exercised to ensure that the tubing does not become pinched in the shelter door.

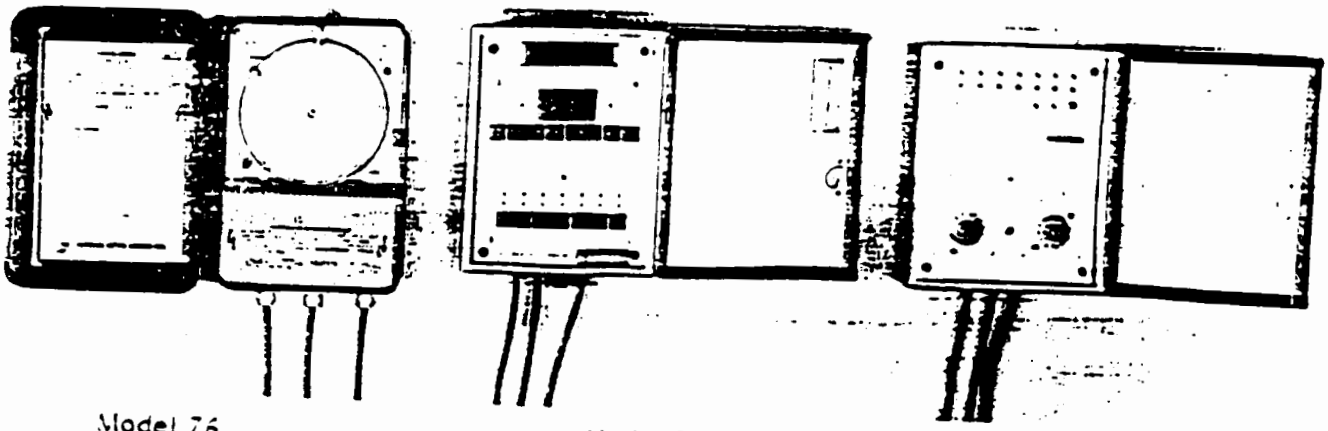
The pressure recorder is supplied with an pen cartridge that requires no filling. When operated in an arid environment, the pens may dry out before the ink is exhausted. If this occurs, place the pens in a sealed plastic bag with a damp cloth or Kimwipe. Pens have a life of approximately 3 to 6 months (dependent on the sample frequency) and should be replaced routinely as part of a preventative maintenance schedule. To replace the pen, follow the procedure presented below:

1. Lift the pen arm by pressing gently on the flat portion of the pen lifter.
2. Slide the old cartridge off the pen arm, being careful not to bend the arm.
3. Lay the new cartridge on the pen arm with the tip centered in the Vee cut.
4. With the forefinger and thumb, deflect the hinged retainer, and snap it into the engaged position around the pen arm.

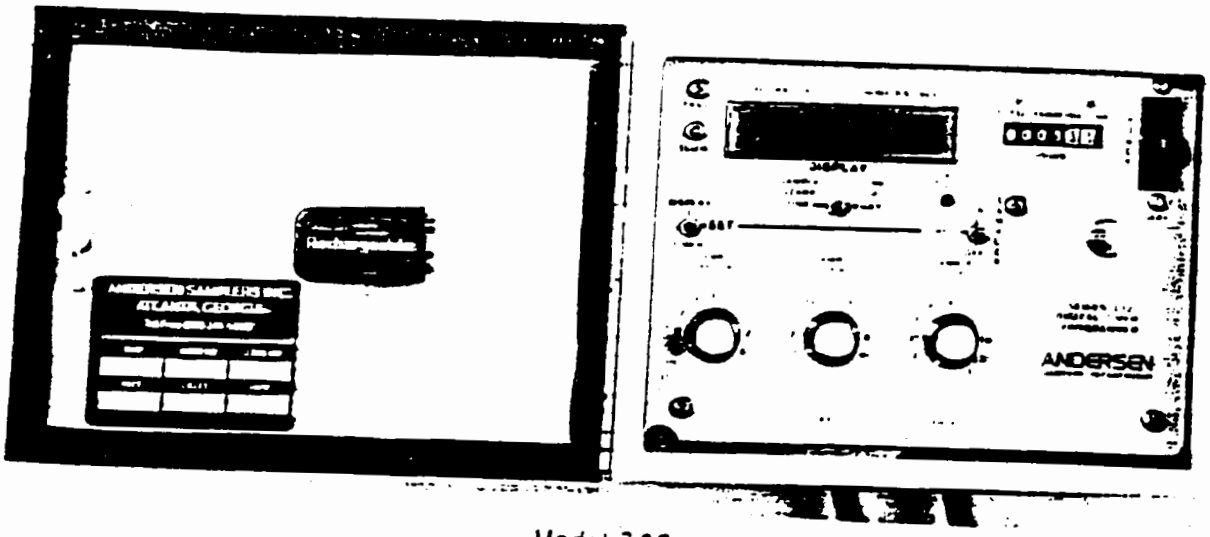
The circular chart paper is time marked and logarithmically scaled. The flow rates printed on the chart are only for reference purposes; the sampler must

be calibrated to determine operational flow rates. The continuous recorder is not designed as a direct readout instrument.

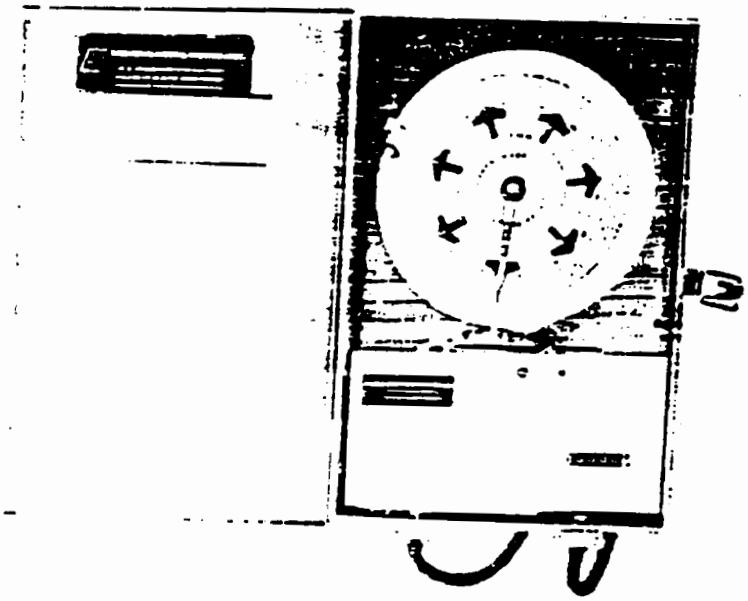
APPENDIX D
TIMING DEVICES



Model 76 Model 3000 Model 801



Model 302



Master Timers

sample duration (up to 24-h) to the discretion of the operator. A digital, non-resettable elapsed time indicator is included. The Model 801 provides three distinct programming modes: 24-h, episode, and 6-day sampling schedules.

5. Model 8000: Solid State Timer/Programmer

Provides the same programming capability of the Model 801 but includes additional features, including an auxiliary battery for clock operation in the event of power failure. When primary power is restored, the timer will cycle as originally programmed. The "power failure" indicator lamp continues flashing to signal that failure has occurred. By comparing the elapsed time with the programmed sampling time; it can be determined if the sampling period was affected. Model 801 provides three distinct programming modes: 24-h, episode, and 6-day sampling schedules. Changing from program modes or sample duration is achieved by simple manipulation of a thumb wheel. The actual and total elapsed times are verified and displayed on command.

2.1 Operating Procedures:

2.1.1 Models 70 and 76, Mechanical 7-Day and 6-Day Skip Timers, respectively

1. Place the timer's ON/OFF "Flipper" switch (located on the bottom of the timer wheel) in the OFF position.
2. Plug the male power cord of the timer into the line voltage and connect the remaining electrical components of the HVPM10 sampler.
3. Set the trippers by placing the "A", or bright trippers, at the sample start time. Place the "B" , or dark trippers, at the sampler stop time. Place the "Flipper" switch to its ON position.
4. The timer will now turn off and on the sampler automatically.

Note: For manual operation, use the timer's "Flipper" switch exclusively. Manual operation over-rides the automatic settings.

2.1.2 Model 302 Digital Timer/Programmer

1. Open the cover of the timer enclosure. Turn the sampler's main power switch to OFF.
2. Plug the male cord into line voltage (115 VAC for Model 302, 220VAC for Model 302X)
3. Plug the female cord into the sampler.

4. Press the "Power" switch to ON. The pump will not energize. If an optional battery is used, connect battery at this time. Note: When programming, the digits will flash until set.
5. Set present "Time of Day": Set "Display" switch to "Time of Day". Hold DOWN the "fast/slow" switch as necessary to set. The "Time of Day" is a 24-h format.
6. Set the "Sample Start Time": Set "Display" switch to "Sample Start Time". Hold DOWN the "fast/slow" switch as necessary to set.

   NOTE: The "Sample Start Time" must be at least 30 minutes after the present "Time of Day". The "Display" switch must not be in the "Sample Start Time" mode within 10 minutes of the initiation of the sample period.
7. To use the "Delay Start" programming capability (Sample after X days, 0-8 days, maximum), set the "Sample After" switch to the number of days to be skipped before the next sample period. Position "O" will initiate the first sampling period as soon as the time of day matches the sample start time. Or in other words, no days will be skipped. Position 1, the timer will skip one day, Position 2, two days, etc.
8. To use the "Skip Timer" (sample every X days, 1-9 days), set the "Sample Every" switch to initiate one sample every X days. Position 1 samples daily, Position 2, every second day, etc.
9. To set sample duration (sample for X hours, 1-24-h), set the "Sample For" switch for the number of hours that the sampler is to remain energized.

   Note: The switches referred to in steps 7-9 are positive detent switches that provide exact timing. If the switch is not in the detent, it is not useable.
10. Set the timer by pressing the "Set" switch DOWN to the "Timer" position momentarily. Place the "Sampler" switch in the "Timer" position.

Notes:

- Flashing time display indicates AC and battery power failure.
- AC Power Fail light indicates failure of AC power during sample period.

- Display may be left on. Battery life however, may be shortened to approximately 24-h if AC power fails.
- The ETI records the total time sample is left on. AC power failure stops ETI until power is restored.
- The power switch uses a circuit breaker. When circuit is broken, the ON button pops UP. If more than 15 amps are drawn, the circuit breaker will trip even if the button is held in. Reset is accomplished by pressing the ON button.

2.1.3 Model 801 Sixth Day, Timer Programmer

Model 801 provides three distinct programming modes: 24-h, episode, and 6-day sampling schedules. For all modes discussed below, the real time clocks, "A" and "B" are set to the actual time of day. Both clocks rotate clockwise together with the top position of the power switch.

The white ON and black OFF tabs of clock "A" are set at midnight. The function of clock "A" is to sequentially advance the indicator light every 24-h. The tabs are secured together under the clock face and must be moved together. The OFF tab of clock "A" must never be permitted to swing around in front of the ON tab. This will result in a burn out of the stepping mechanism coil.

The ON and OFF tabs of clock "B" are needed only while in the episode sampling mode. The function of clock "B" is to act as a series switch to the output, according to the setting of the ON and OFF tabs. The series switch of clock "B" can be brought into the circuit by placing the toggle switch between the two clocks in the right hand position.

The indicator lights are wired in parallel and indicate the day or position of the stepping mechanism. As a result, it is possible for more than one indicator light to glow when the timer output is activated. To reset the indicator light, all seven day switches must be in the DOWN position.

The timer is arranged with three power cords extending down from the bottom of the unit. The male cord is plugged into line voltage, the left-hand female cord is the timed output and should be plugged into the motor, the right-hand cord is an auxiliary output that is not timed.

24-H Sampling Schedule:

1. Set all seven "Day" switches and the "6-day Sample" switch in the DOWN position.

2. Reset the indicator light to the present day by pressing the "Day Reset" switch.
3. Set the toggle switch between clocks "A" and "B" to its left-hand position.
4. Place the desired "Sampling Day(s)" switch(es) in the UP position. The sampler will activate at midnight.

Episode Sampling:

1. Set all seven "Day" switches and the "6-day Sample switch in the DOWN position.
2. Reset the indicator light to the present day by pressing the "Day Reset" switch.
3. Set the toggle switch between clocks "A" and "B" to its right-hand position.
4. Place the desired "Sampling Day(s)" switch(es) in the UP position.
5. Set the ON and OFF tabs of clock "B" for the sample start and stop time.

6-Day Sampling Schedule:

Note: When programming for 6-day operation, disregard the names of the sample days. The days of the week should be referred to as positions and not as Monday, Tuesday, etc.

1. Set all seven "Day" switches in the DOWN position.
2. Reset the indicator light to the fifth from the left position (Thursday) by pressing the "Day Reset" switch.
3. Place the "6-Day Sample" switch in the UP position.
4. Place the sixth from the left switch (Friday) in the UP position.
5. Set the toggle switch between clocks "A" and "B" to its left-hand position.

The sample period is from midnight to midnight the following day or position, and every 6-days thereafter.

2.1.4 Model 8000 Solid State Timer /Programmer

1. Remove the battery compartment cover to expose the battery and loose battery clip. Attach the clip to the battery and replace the cover. This battery should be checked every six months and replaced annually (subject to frequency and duration of any power failures). This battery should be disconnected when the timer is in transit or storage to preclude unnecessary power drain.

2. Plug the male cord into line voltage. The left hand female cord is the timed output to be connected to the sampler motor; the right-hand cord is an auxiliary output that is not timed.
3. Press the "Display On/Total Time" button to activate the time display. Set the correct time (military time, 0000 hours) using the fast/slow time buttons. This display will remain on for seven minutes unless reset by repeating this step. If bright sunlight makes seeing the display or indicators difficult, close the door to partially block the sunlight and darken the power.
4. Reset the power failure indicator by pressing the "Power Failure Reset" button.
5. Manually activate the sampler to ensure that the motor is operating correctly. Press the ON button, the sampler should energize. Press the OFF button to turn off the sampler. No accumulated time results when using these manual controls. It is not possible however, to turn the sampler off within the first minute of programmed operation using these controls.
6. Reset the "Day Indicator" lamp (top row of lamps) to the present day by pressing the "Set Day" button.
7. Select the start and stop times on the thumb wheel switches (in military time). For a midnight to midnight sample, set both at 0000 hours.
8. Set the "Day Mode" thumb wheel to the frequency of sampling desired. Position 1 will sample every day, Position 2, every other day, etc. When using Position 7, more than one sample day can be selected and the sampler will activate on the same day(s) each week.
9. To check the elapsed time after a sample, press the "Display On/Total Time" button. To reset the total elapsed time, simultaneously press the "Display On/Total Time" and "Display Test" buttons. Note: If the power failure indicator blinks indicating loss of power, the failure could have occurred during a non-sampling period. Press the "Display On/Total Time" button and compare the elapsed time with the sampling time indicated on the thumb wheel switches. If the readouts are identical, the failure occurred during the non-sampling period. If a discrepancy exists, subtract the elapsed time to determine the sample's duration.

APPENDIX E
RETRO-FIT INSTRUCTIONS
SIZE SELECTIVE INLET
MODEL 321-A TO 321-B

RETRO-FIT INSTRUCTIONS, SIZE SELECTIVE INLET MODEL 321-A TO 321-B

1.0 Background:

The original SSI's were developed by Dr. A.R. McFarland of Texas A&M University (TAMU) under an U.S.Environmental Protection Agency (EPA) grant to meet a potential 15 micron (µm) ambient Inhalable Particulate (IP) standard. After research and field studies, the EPA reconsidered this particulate indicator and decided that an indicator based on the concentration of Thoracic Particulates (those particles that can be entrained in the respiratory system, <10µm aerodynamic diameter (a.d.) provided a better indication of the potential health effects from particulate pollution.

Dr. McFarland modified the single stage, 15µm SSI to obtain a 10.2 µm cut point under funding from Andersen Samplers, Inc. (ASI). This inlet was sold by ASI and General Metal Works (GMW) from March, 1982 until May,1984 under a Model 321 designation.

Although the Model 321 inlet met all of the prevailing performance specifications for PM10 inlets, Dr. McFarland developed an improved SSI, the two stage Model 321-A. During subsequent EPA field performance evaluations however, it was determined that a greased collection surface was required (within the SSI) to prevent a potential "carry-through" of large particles (>20µm) at PM10 monitoring sites subject to high winds.

Later TAMU data analysis determined that the of 10.2µm inlet cut point (original design of Model 321 and 321-A inlets) could be modified to a cut point of 9.7µm by using a smaller diameter acceleration nozzle. A 9.7µm cut point meets not only all Federal Reference Method (FRM) inlet specifications (inlet cut point of 10µm ± 0.5µ) but also results in lower mass concentration measurements. Hence, the development of greased shim and nozzle insert .retro-fit kits for both the 321 and 321-A inlets.

Once modified with a greased collection surface, the 321 and 321-A inlets are designated Reference Methods (RFPS-1287-065 and RFPS-1287-064, respectively) and are referred to as Model 321-C and 321-B, respectively. Note: Nozzle insertsfor Model 321-A inlets are not required for FRM designation, they are however, recommended by the manufacturer. Please refer to Table 1.1.

Reference Method Designation Number	Model Number	Inlet Description
RFPS-1287-064	Model 321-B	***Modified 321 -A inlet*** 1. Two Acceleration Nozzle Stages 2. 9.7µm, 50% cut point 3. Greased collection shim on first stage 4. Inlet hood removable for cleaning
RFPS-1287-065	Model 321-C	***Modified 321-Inlet*** 1. Single Acceleration Nozzle Stage 2. 9.7µm, 50% cut point 3. Greased collection shim 4. Inlet hood removable for cleaning
RFPS-1287-063	Model 1200	1. Single Acceleration Noz-zle Stage 2. 9.7µm, 50% cut point 3. Greased collection shim 4. Inlet body hinged for cleaning

Table 1.1 ASI/GMW Inlet Description

2.0 Description of Modification Kits

Each Greased Shim and Nozzle Modification Kit (PN#G 120035) consists of the following components and is offered free to all ASI/GMW customers who have purchased Model 321 or 321-A inlets. As indicated below, individual items can be ordered and purchased separately.

1. Collection Shim Kit: PN# G120030
   a. Collection Shim Plate: PN # G120027
   b. Collection Shim Clips: PN# G120028
   c. Dow Silicon #316 Grease PN# G10544 or SE290G
2. Nozzle Modification Kit (9.2µm): PN# G120034
   a. RTV adhesive: PN# G10596
   b. Nozzle Plate Gasket PN# SSI-20

Note: ASI/GMW will exchange any Model 321 or 321-A inlet for a new, hinged body Model 1200 SSI. The exchange price is 450.00 per unit plus freight. Please contact the factory.

3.0 Shim and Nozzle Modification Kit Installation Procedures

Note: The installation procedures presented below are applicable only to the Model 321-A SSI (Figure 1) . Contact the manufacturer for modification instructions for the Model 321.

1. Gather the following tools:
   - Flat Head Screwdriver
   - Power Drill with 7/32" Drill Bit
   - Crescent Wrench
2. Remove the inlet hood by removing all of the spacer bolts that affix the hood to the inlet body. Lift the hood carefully and place it on the floor or a workbench, dome-side-down to avoid warping. The acceleration nozzle plate will now be visible.
3.. Remove the twelve (12) bolts that attach the acceleration nozzle plate (PN#SSI-109) to the inlet housing. Gently lift the plate and place it on the floor or a workbench, nozzle-side-up to avoid contaminating or damaging the nozzles.
4. Discard the nozzle plate gasket (PN# SSI-20) that forms a seal between the acceleration nozzle plate and the inlet housing.

5. Remove the first stage collection plate by loosening the four (4) bolts and lifting over the inlet housing. Carefully place the collection plate onto a level, sturdy surface, top-side-up.
6. Using a power drill with a metal 7/32" drill bit, drill two holes in the collection plate at the locations shown in Figure 2. While drilling, exercise caution to avoid bending the plate.
7. Mount the two shim clips (PN# G120028) as shown in Figure 3.
8. Clean all interior surfaces of the SSI using a clean cloth or Kimwipe Inspect all nozzles and vent tubes and clean with a bottle brush as necessary. Ensure that the collection plate is completely clean; remove any metal shavings or residual debris.
9. Return the collection plate to the sampler inlet. Replace and tighten the four (4) retaining bolts.
10. Place the collection shim (PN# G120027) on a clean, flat surface at some distance from the rest of the inlet. Spray the shim with a thick coating of Dow Silicone #316 (PN# SE209G) Do not substitute any other substance without contacting the manufacturer. Shake the can, and holding it upright 8 to 10-in. away, apply a "generous" amount of silicone spray. Over spraying will not affect the performance of the inlet, so when in doubt, apply more spray.
11. Allow 3 to 5 minutes for drying; the shim should be tacky (not slippery) and have a slightly cloudy appearance before placing it in the inlet.
12. Lift the greased collection shim by the edges and place it on the collection plate, greased-side-up.
13. Rotate the two (2) shim clips 90° so that they are placed over the edge of the greased collection shim.
14. Inspect the acceleration nozzles and clean as necessary using a soft clean cloth or Kimwipe.
15. Install a new nozzle plate gasket (PN#SSI-20).
16. Reversing step 3, install the acceleration nozzle plate.
17. Place a small bead of RTV (silicone caulking) adhesive on the bottom lip of an acceleration nozzle insert (Figure 4). Press the nozzle insert firmly into an existing nozzle. Repeat for the remaining eight (8) inserts.
18. Remove any excess adhesive from the edges of the nozzle inserts.
19. Replace the inlet hood by reversing the procedures presented in step 2.

20. Attach the enclosed gummed label to the outside of the SSI. This label provides notice that the inlet has been modified to become a Model 321-B

4.0 Maintenance Activities:

The SSI hood should be inspected every sample period for dents or irregularities in the inlet gap. Contact the manufacturer if dents exceeding 1/2" are noted.

In general, ASI/GMW recommends a thorough cleaning of the SSI after 15 days of sampling; which, on a 6 day schedule would correspond to 3 calender months. If the TSP can be estimated from historical data to the site, It is recommended that the schedule shown be used.

AVERAGE ESTIMATED TSP AT SITE STD. $\mu g/m^3$	MAINTENANCE FREQUENCY: NUMBER OF SAMPLING DAYS	MAINTENANCE FREQUENCY: INTERVAL, ASSUMING 6-DAY SAMPLING SCHEDULE
40	30	6 months
75	15	3 months
150	10	2 months
200	5	1 months

Procedures for cleaning and maintaining the Model 321-B inlet are as follows:

1. Inspect the four shelter draw-catches for proper tension. Adjust as necessary by the first loosening the lock-nut on the hook-catch rod. To shorten the catch length, turn the rod clockwise; counter-clockwise to loosen. After adjustments are complete, re-tighten the lock-nut. Do not over-tighten, distortion in the inlet housing can result.
2. Remove the hood (reverse assembly procedure presented in section 3.0, step 2) and clean the nine (9) acceleration nozzles with a small bottle brush. Wipe all internal surfaces with a damp cloth or Kimwipe.
3. Remove the acceleration nozzle plate according to procedures presented in section 3.0. Clean the twelve (122)accleration nozzles with a bottle brush or clean cloth.
4. Inspect the collection shim pattern. A normal greased shim pattern is indicated by a circular pattern of particle collection directly beneath the acceleration nozzles. An overloaded shim can be identified by bars or stripes of deposit between the margins of the circular deposits.

5. Re-grease the collection shim by following procedures in section 3.0, steps 10 and 11.

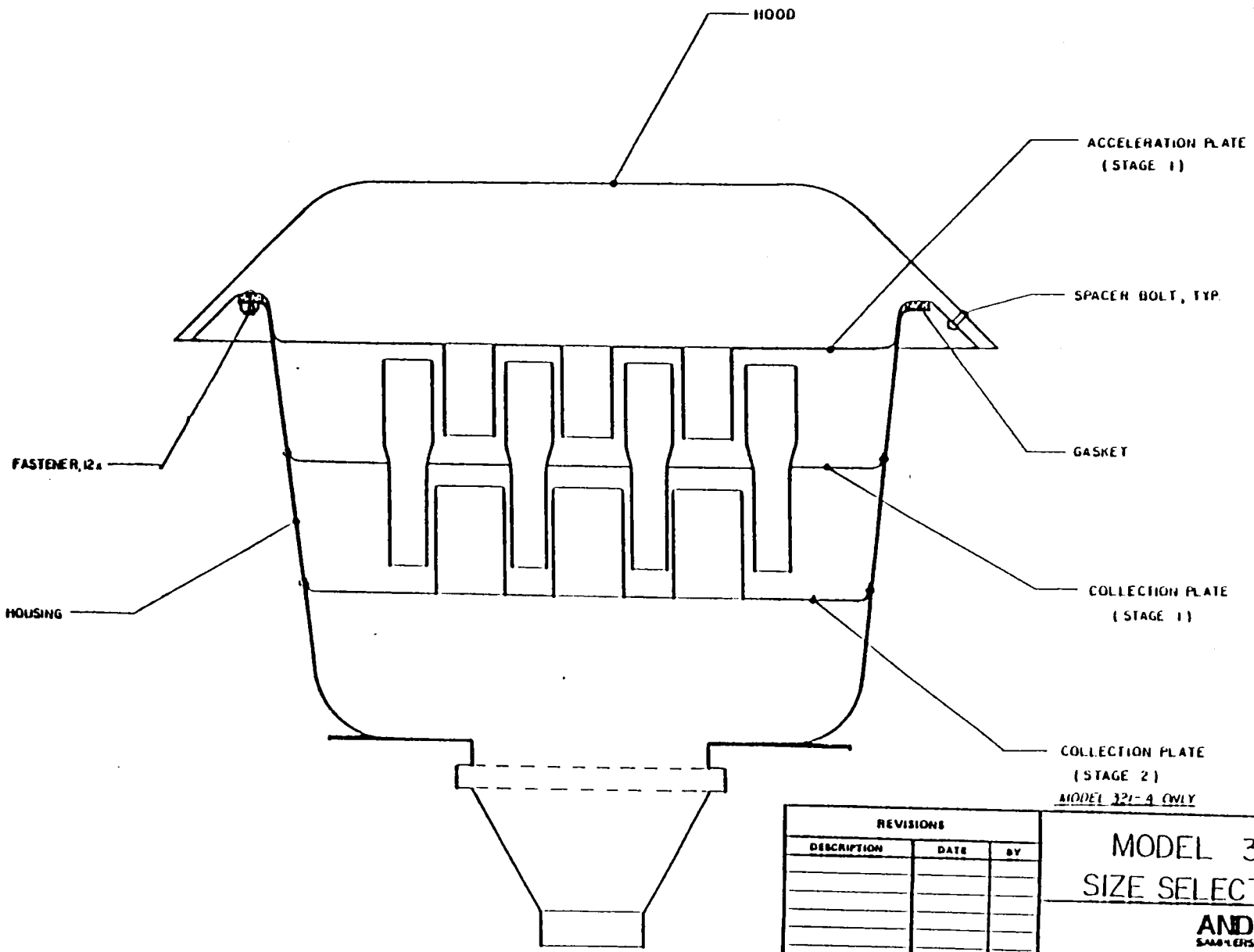


fig A

REVISIONS		
DESCRIPTION	DATE	BY

MODEL 321-A
SIZE SELECTIVE INLET

ANDERSEN
SAMPLERS INCORPORATED

CHK BY TA 9/22	APPD BY	DATE 8/26/86	BY
SCALE	FRAC TOLL	DRAWING NUMBER	REV
DEC TOL	ANG TOLL		
CONCENTRICITY			
MATERIAL			
FINISH			

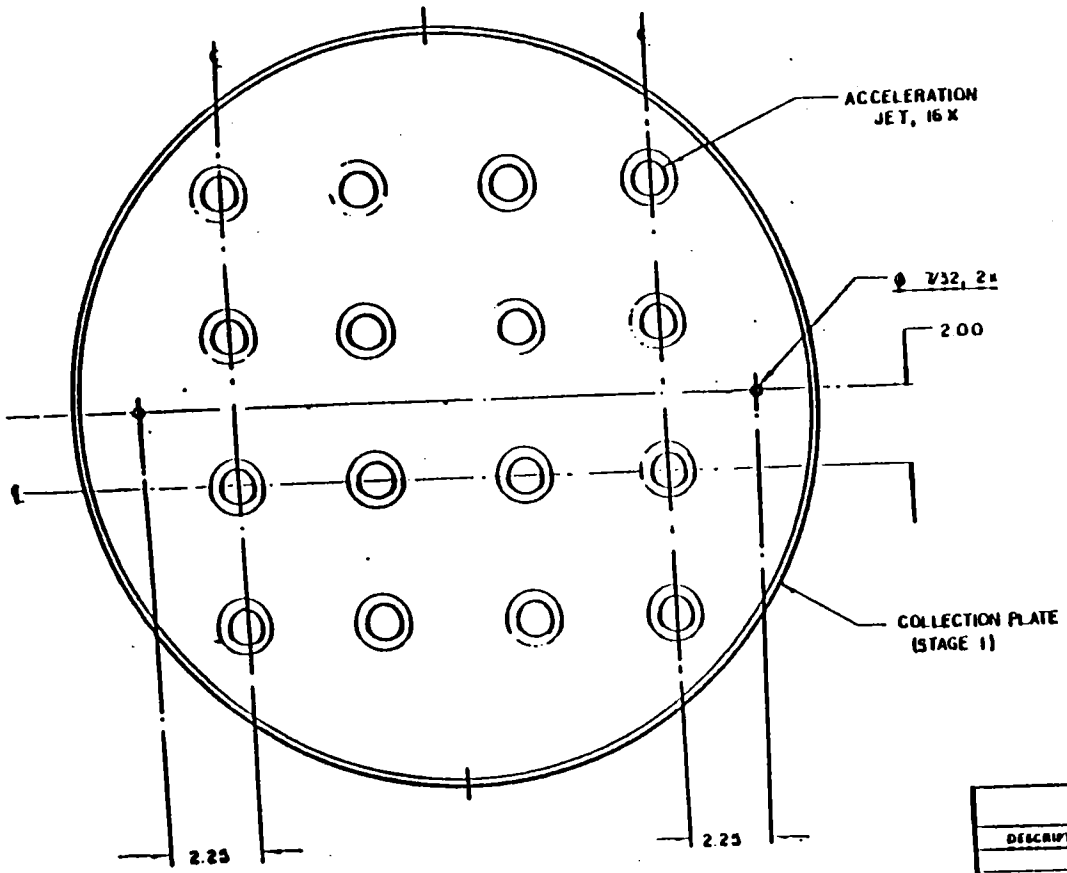


fig. B

REVISIONS		
DESCRIPTION	DATE	BY

COLLECTION PLATE
MODEL 321-A

ANDERSEN
SAMPLERS INCORPORATED

CHK. BY TM	APPD. BY	DATE 8/26/86	BY LY
SCALE	FRAC. TOLL.	DRAWING NUMBER	REV
DEC. TOL.	ANG. TOLL.		
CONCENTRICITY			
MATERIAL			
FINISH			

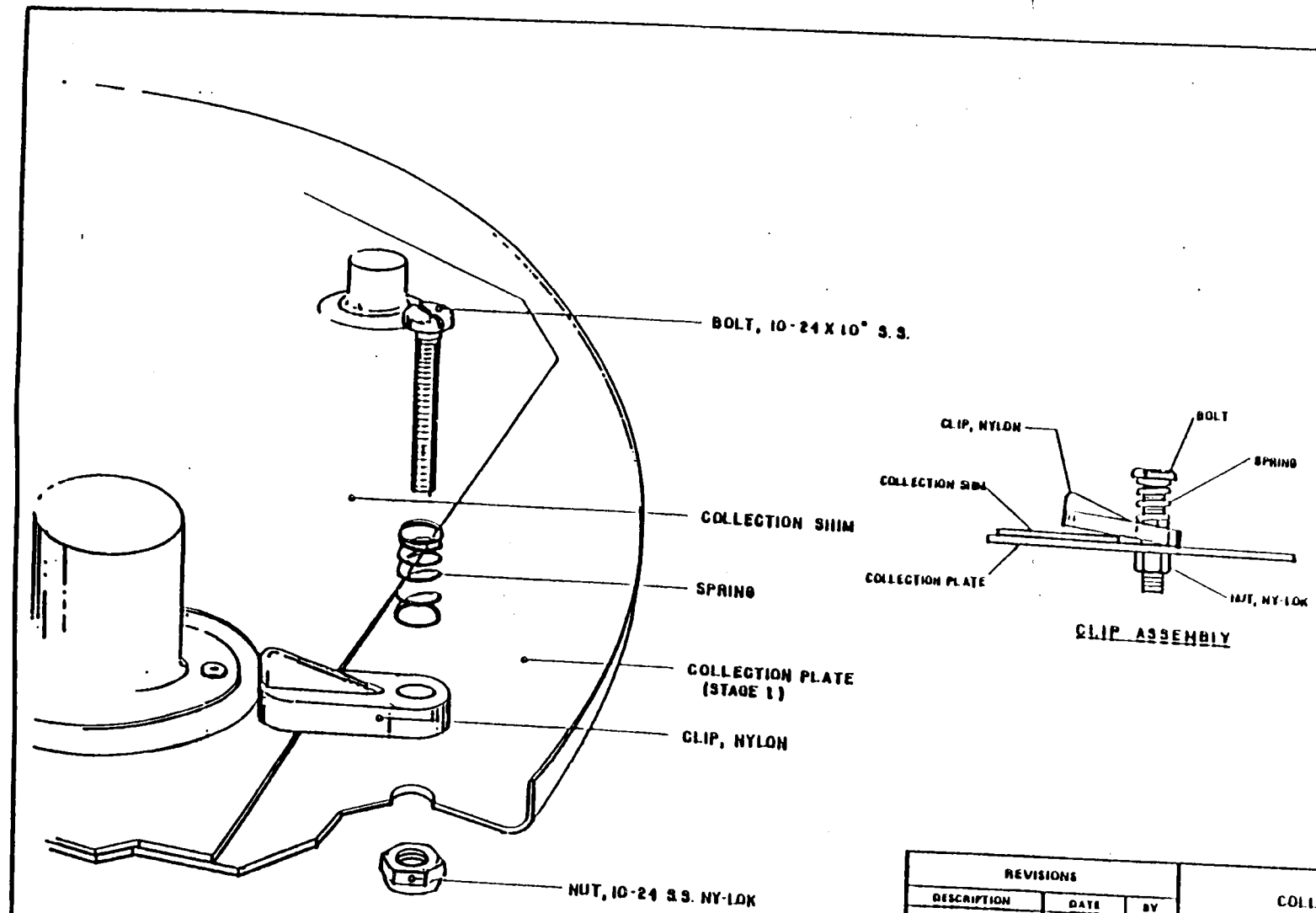


fig. c

REVISIONS		
DESCRIPTION	DATE	BY

COLLECTION-SHIM FASTENING ASSEMBLY

ANDERSEN
SAWYERS BRUNSWICK

CHK. BY TM	APPD. BY	DATE 9/2/86	BY
SCALE	FRAC. TOL.	DRAWING NUMBER	REV
DEC. TOL.	ANG. TOL.		
CONCENTRICITY			
MATERIAL			
FINISH			

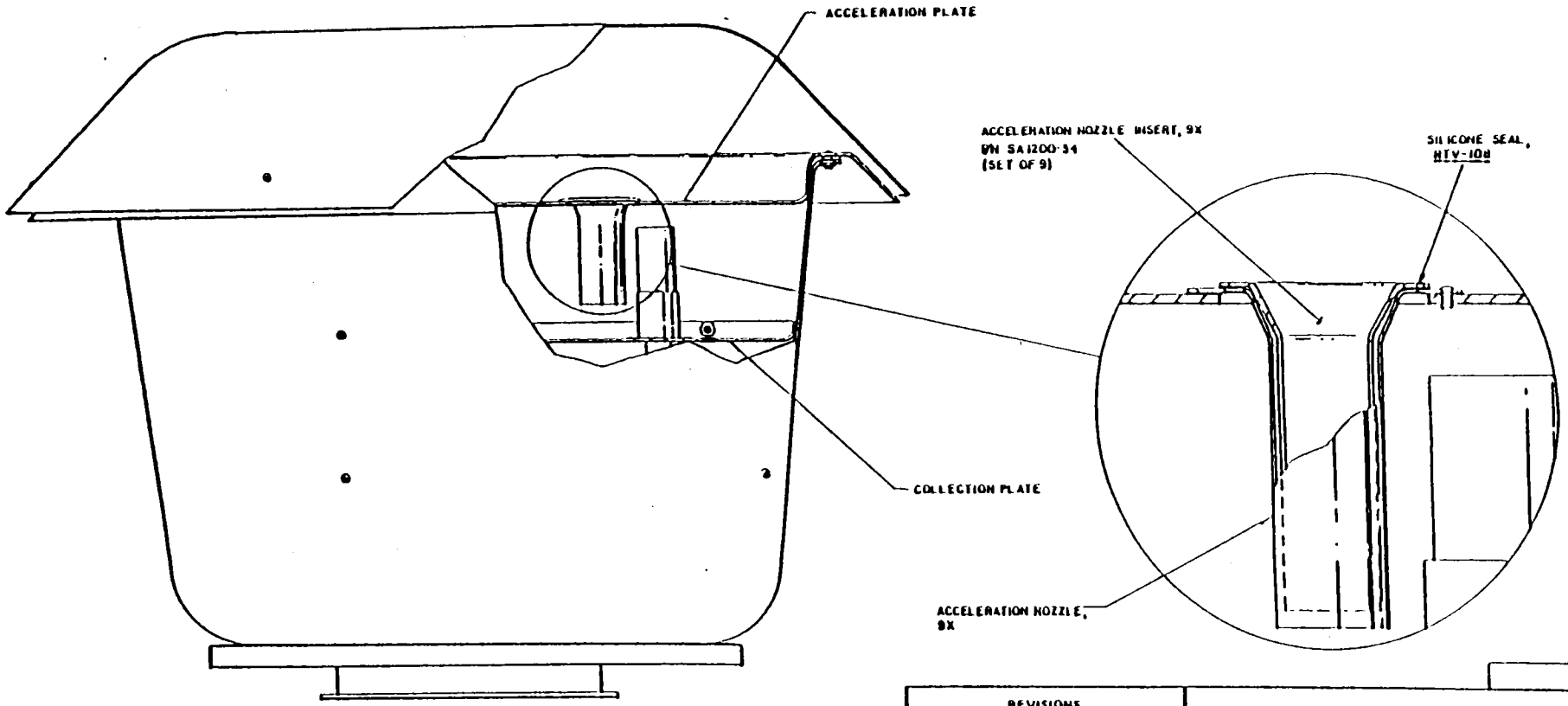


fig D

REVISIONS		
DESCRIPTION	DATE	BY

ACCELERATION NOZZLE MODIFICATION, 1200 - 34

ANDERSEN

CHK BY T.H.	APPD BY	DATE 12 1986	BY S Y
SCALE	FRAC TOLL	DRAWING NUMBER 1200 - 34	REV
DEC. TOL.	ANG TOLL		
CONCENTRICITY			
MATERIAL			
FINISH			