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CNC CHARLESTON
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FINAL RESOURCE CONSERVATION AND RECOVERY WORK PLAN ADDENDUM ZONE F
WITH TRANSMITTAL CNC CHARLESTON SC
11/3/1999
ENSAFE INC.



DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

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Code 18B1
3 November, 1999

Mr. John Litton, P.E.
Director, Division of Hazardous and Infectious Waste Management
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Subj: SUBMITTAL OF FINAL ZONE F RCRA FACILITY INVESTIGATION WORKPLAN
ADDENDUM

Dear Mr. Litton,

The purpose of this letter is to submit the Final Zone F RCRA Facility Investigation Workplan Addendum for Naval Base Charleston. The Workplan is submitted to fulfill the requirements of condition II.E.1 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and U.S. Environmental Protection Agency.

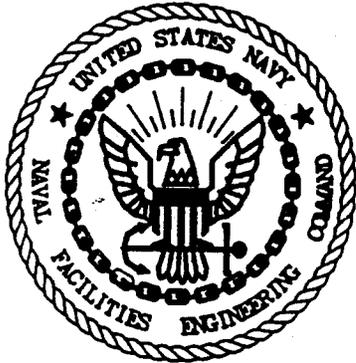
We request that the Department and the EPA review the addendum and provide comment or approval as appropriate. If you should have any questions, please contact Amy Daniel or myself at (843) 743-9985 and (843) 820-5525 respectively.

Sincerely,

M.A.HUNT, P.E.
BRAC Environmental Coordinator
BRAC Division

Encl: Final Zone F RFI Workplan Addendum, 3 November, 1999

Copy to:
SCDHEC (3)
USEPA (Dann Spariosu)
SOUTHNAVFACENGCOM (Matthew Hunt)
CSO Naval Base Charleston (Amy Daniel)



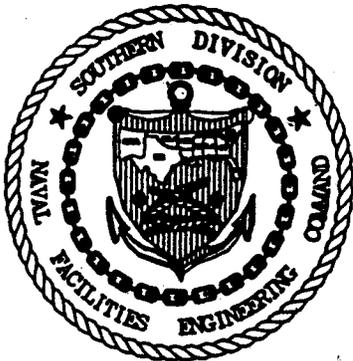
**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
CTO-029**

**FINAL ZONE F RFI
WORK PLAN ADDENDUM**

**SOUTHDIV Contract Number:
N62467-89-D-0318**

Prepared for:

**DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA**



Prepared by:

**ENSAFE, INC.
5724 SUMMER TREES DRIVE
MEMPHIS, TENNESSEE 38134
(901) 372-7962**

**NOVEMBER 3, 1999
Revision No.: 0**

Release of this document requires the prior notification of the Commanding Officer of the Southern Division, Naval Facilities Engineering Command, Naval Base Charleston, South Carolina.

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ACRONYMS AND ABBREVIATIONS

The following abbreviations, acronyms, and units of measurement are used in this report.

AOC	Area of Concern
BEQ	Benzo(a)pyrene Equivalent
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CMCOC	Contaminant Migration Contaminants of Concern
CNC	Charleston Naval Complex
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CPW	Charleston County Commissioners of Public Works
CSAP	Comprehensive Sampling and Analysis Plan
DAF	Dilution Attenuation Factor
DET	Environmental Detachment
DQO	Data Quality Objective
ft bgs	feet below ground surface
GEL	General Engineering Laboratories, Inc.
LNAPL	Light Nonaqueous Phase Liquid
MCL	Maximum Contaminant Level
OP	Organophosphorous pesticides
PAH	Polynuclear Aromatic Hydrocarbins
PCB	Polychlorinated biphenyl
QA	Quality Assurance
QC	Quality Control
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act

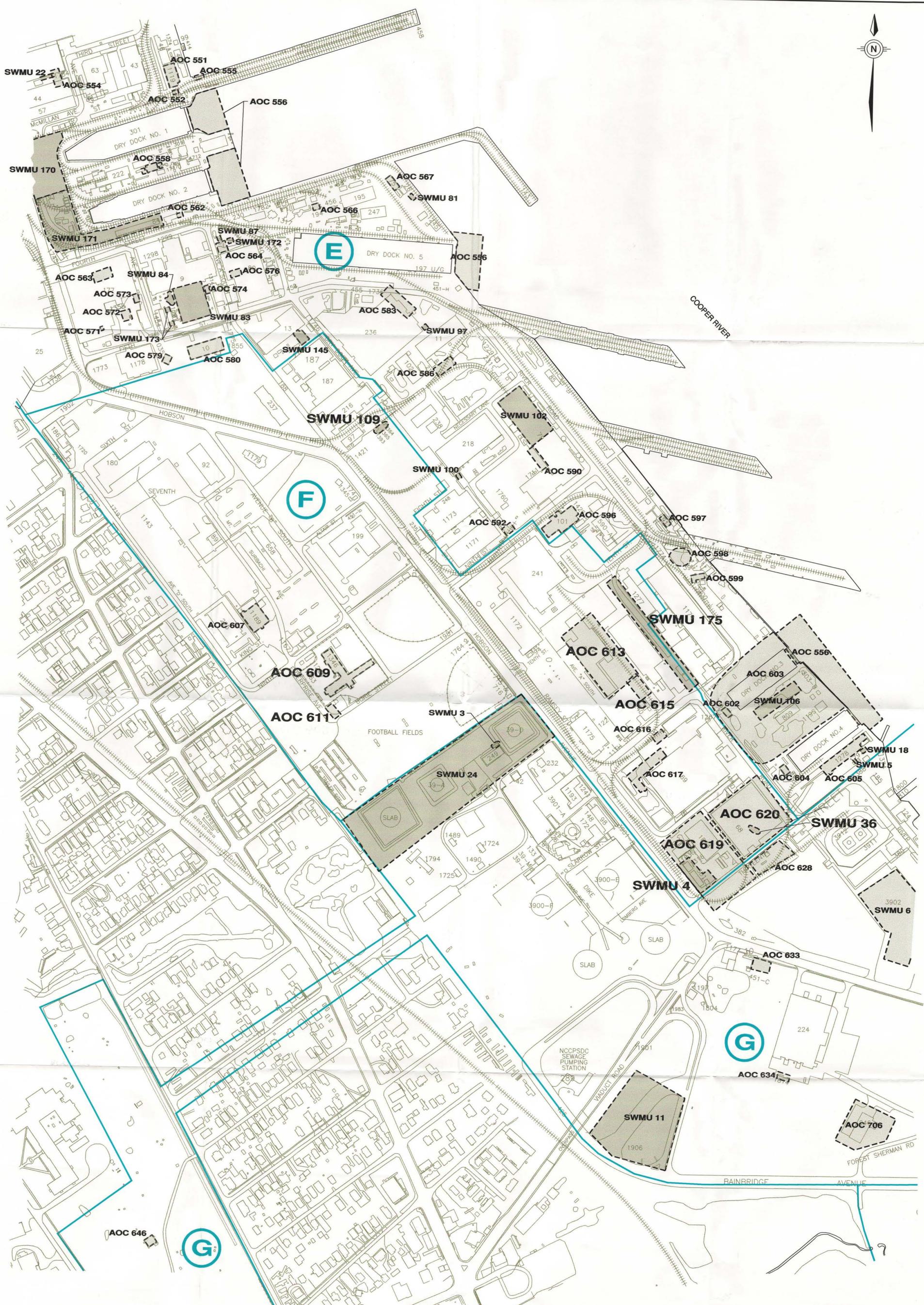
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SPLP	Synthetic Precipitation Leaching Procedure
SPORTENV-	
DETCASN	Supervisor of Shipbuilding, Conversion and Repair, USN, Portsmouth Detachment Environmental, Charleston, SC
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound
$\mu\text{g}/\text{kg}$	Microgram per kilogram

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 Addendum has been prepared for Zone F at Charleston Naval Complex (CNC). This addendum addresses sampling and analysis requirements specific to sites within Zone F and is intended to be used in conjunction with the *Final Comprehensive RFI Work Plan* and the *Final Zones D, F, and G RFI Work Plan* prepared for CNC. The Solid Waste Management Units (SWMU) and Areas of Concern (AOC) requiring further investigation within Zone F are presented in the plan.

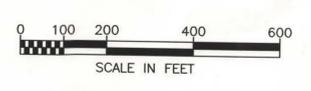
This addendum describes the proposed level of effort believed necessary to complete the delineation of contaminants of potential concern (COPCs) identified at six of the sites (or site groupings) discussed in the *Draft Zone F RCRA Facility Investigation Report* submitted in December 1997. Figure 1 shows the locations of the SWMUs and AOCs in Zone F, along with those in adjacent zones that have data which will assist in the Zone F site characterization. The proposed scope of work described herein was discussed at the scoping meeting held in conjunction with the Project Team meeting in October 1999. The addendum presents the rationale for the installation of soil borings and monitoring wells, specifically designed to delineate extent of contaminants detected which exceeded screening criteria resulting in data gaps at several AOCs and SWMUs. If the proposed sampling efforts do not achieve this goal, 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 risk-based concentrations (RBCs), soil screening levels (SSLs), maximum concentration limits (MCLs), or background concentrations, whichever is appropriate.

Soil boring and monitoring well locations proposed for each site are based upon existing boring and well locations, subsurface features such as utilities, building foundations, and pilings. Site-specific figures also include contingency sample locations which will be sampled should the initial locations sampled not define the extent of contamination. All samples will be collected in accordance with the procedures outlined in the Comprehensive and Zones D, F and G RFI Work Plans.



LEGEND:

-  AOC (AREA OF CONCERN)
-  SWMU (SOLID WASTE MANAGEMENT UNIT)
-  BOUNDARY STUDY ZONE



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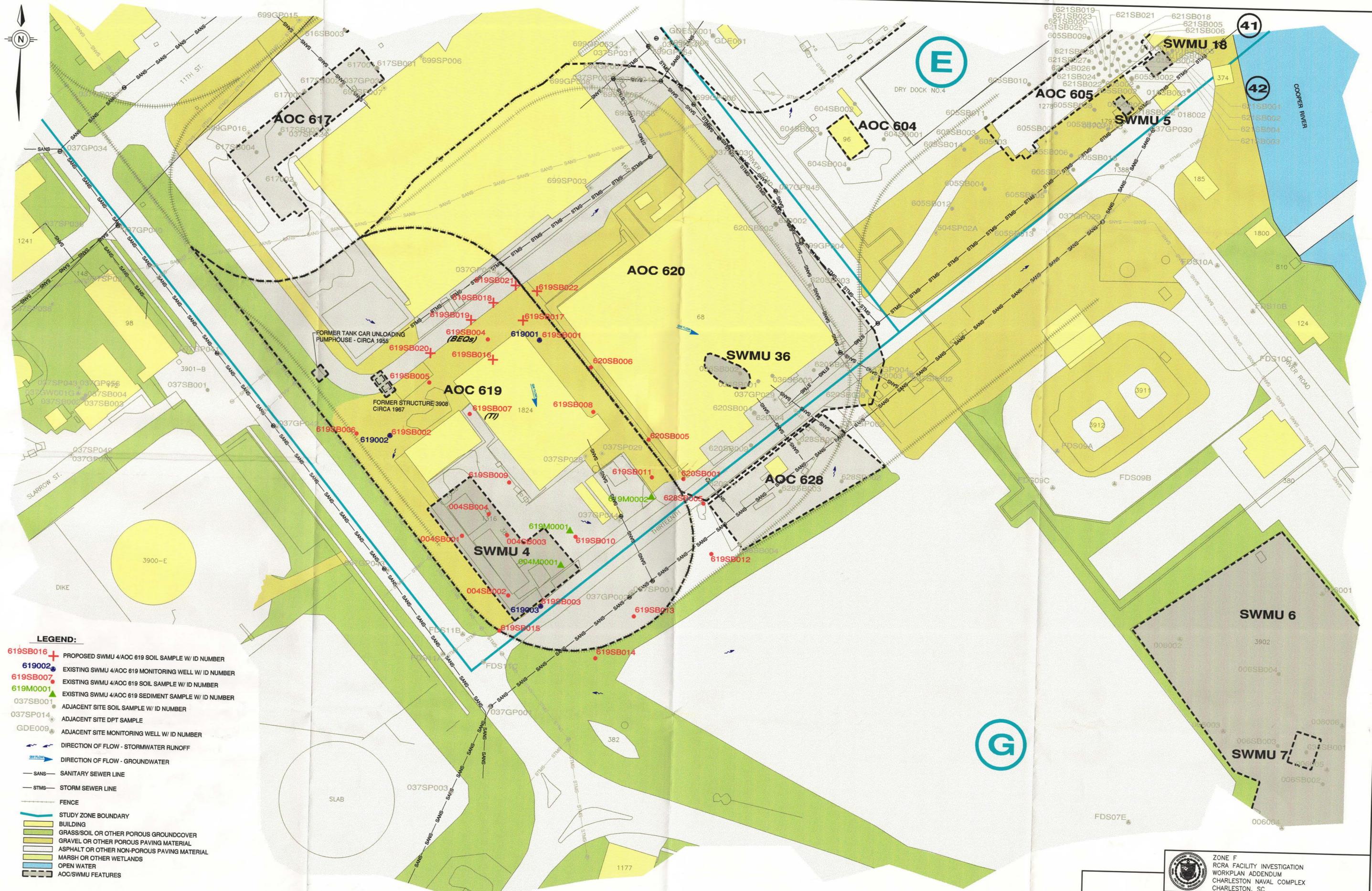
 ZONE F
RCRA FACILITY INVESTIGATION
WORKPLAN ADDENDUM
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC

FIGURE 1
AOC AND SWMU LOCATION MAP
ZONE F

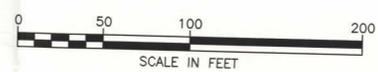
Dr by: W. FAULK	Tr by: -	Sheet 1
Ck by: C. SMITH	Appr by: T. HAVERKOST	Of 1
Date: 11/02/99	DWG Name: 2906C022	

2.1 SWMU 4, Pesticide Storage Building; AOC 619, Former Oil Storage Yard

SWMU 4 and AOC 619 were combined into one investigation due to their close proximity and their potential for similar COPCs. Figure 1 shows the location of these sites and Figure 2 presents the site features. SWMU 4 consists of Building 381 which was built in 1980 to store various insecticides and rodenticides. Building 381 has a formulation and mixing room, equipment wash area, and sink and floor drains connected to the base sanitary sewer system. Pesticide storage at the facility was discontinued after 1985, and after this date the building was used for miscellaneous storage. AOC 619 is a former oil storage yard used from 1955 to 1982 in an area of CNC currently occupied by Building 381. What is known about the oil storage yard is only that which can be inferred from features shown on historic public works maps. The site was an open area between Building 68 and Hobson Avenue that was surrounded by railroad tracks with two spurs that led into the "yard" area. In addition to the yard and the tracks, the 1955 Public Works map shows a former Building 175 that is identified as a tank car unloading pump house. Maps between 1967 and 1977 show small structures identified as "3908" which appear to be two small above ground tanks. The facility numbering scheme for these structures is consistent with the number scheme of other tanks present as part of the former Naval Supply Center operations. Based on this information, it is assumed the area was used as a point for tank cars to offload petroleum fuel that was piped to various parts of the base through the fuel distribution system. AOC 619 was identified in the RCRA Facility Investigation (RFA) as a site which only required confirmation sampling. However, since COPCs were detected during the confirmation sampling event, the scope of the investigation for the AOC 619 area has changed to a RFI. Please refer to Section 10.1 of the *Draft Zone F RCRA Facility Investigation Report* for additional site information.



- LEGEND:**
- 619SB016 + PROPOSED SWMU 4/AOC 619 SOIL SAMPLE W/ ID NUMBER
 - 619002 ● EXISTING SWMU 4/AOC 619 MONITORING WELL W/ ID NUMBER
 - 619SB007 ● EXISTING SWMU 4/AOC 619 SOIL SAMPLE W/ ID NUMBER
 - 619M0001 ▲ EXISTING SWMU 4/AOC 619 SEDIMENT SAMPLE W/ ID NUMBER
 - 037SB001 ● ADJACENT SITE SOIL SAMPLE W/ ID NUMBER
 - 037SP014 ● ADJACENT SITE DPT SAMPLE
 - GDE009 ● ADJACENT SITE MONITORING WELL W/ ID NUMBER
 - DIRECTION OF FLOW - STORMWATER RUNOFF
 - DIRECTION OF FLOW - GROUNDWATER
 - SANS — SANITARY SEWER LINE
 - STMS — STORM SEWER LINE
 - FENCE
 - STUDY ZONE BOUNDARY
 - BUILDING
 - GRASS/SOIL OR OTHER POROUS GROUNDCOVER
 - GRAVEL OR OTHER POROUS PAVING MATERIAL
 - ASPHALT OR OTHER NON-POROUS PAVING MATERIAL
 - MARSH OR OTHER WETLANDS
 - OPEN WATER
 - AOC/SWMU FEATURES



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FIGURE 2
PROPOSED SAMPLE LOCATION MAP
SWMU 4/AOC 619

Dr by: W. FAULK	Tr by: —
Ck by: C. SMITH	Appr by: T. HAVERKOST
Date: 11/03/99	DWG Name: 2906C020

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2.1.1 Previous Field Work

Soil

Soil borings within the combined SWMU 4/AOC 619 area were advanced to assess the presence of any soil contamination at these two sites during the initial phase of the RFI. Soil samples were collected from 19 soil borings during the field investigation. Thirteen borings included both soil sampling intervals (0-1 foot below ground surface [bgs] and 3-5 feet bgs), while six included the 0-1 foot interval only. The lower interval sample was not collected due to either an obstruction in the borehole, or because of a shallow water table.

Soil samples from SWMU 4 were analyzed for metals, pesticide/Polychlorinated biphenyl (PCBs), Volatile Organic Compounds (VOCs), Semivolatile Organic Compounds (SVOCs), Organophosphorus (OP) pesticides, and herbicides. Soil samples from AOC 619 were analyzed for metals, pesticide/PCBs, VOCs, and SVOCs. An exception was 619SB003, which was located directly adjacent to SWMU 4. Samples from 619SB003 (both intervals) were analyzed for pesticide/PCB, and OP pesticide constituents only. Additionally, several samples at AOC 619 were also analyzed for cyanide. Three upper interval duplicate soil samples from SWMU 4/AOC 619 were collected for Appendix IX analyses at Data Quality Objective (DQO) Level IV. A summary of the soil dataset generated by the sampling and analysis described above can be found in Section 10.1.3 of the *Draft Zone F RCRA Facility Investigation Report*. The data were reviewed with respect to satisfying the RFI requirement for delineating the nature and extent of contamination. Soil data gaps that were identified are discussed below.

Groundwater

Three shallow monitoring wells were installed and subsequently sampled four times during the field investigation. Groundwater samples were analyzed for metals, pesticide/PCBs, VOCs, and SVOCs at DQO Level III. A summary of the groundwater dataset generated by the first three sampling events described above can be found in Section 10.1.5 of the *Draft Zone F RCRA Facility Investigation Report*. The data from the fourth round of sampling was reviewed for this work plan and will be included in the final RFI report.

2.1.2 Data Gaps

Surface Soil

Polynuclear aromatic hydrocarbons (PAHs) expressed as benzo(a)pyrene equivalents (BEQs) were detected above the residential risk-based concentration (RBC), (87 $\mu\text{g}/\text{kg}$) in surface soil at 9 of the 18 locations. Concentrations ranged from 0.082 $\mu\text{g}/\text{kg}$ to 540 $\mu\text{g}/\text{kg}$. In addition to the RBC, an anthropogenic background concentration of 289 $\mu\text{g}/\text{kg}$ has been calculated for BEQs in Zone F. The only detection that exceeded the background value occurred 619SB004 where a concentration of 540 $\mu\text{g}/\text{kg}$ was reported. Based on a review of the data, BEQs are not delineated to the west, north and northeast of 619SB004. Thallium was the only other COPC detected above its residential RBC (0.55 $\mu\text{g}/\text{kg}$) in surface soil. The detection of 0.57 $\mu\text{g}/\text{kg}$ occurred at 619SB007 and no additional delineation is required because it is surrounded by data points where the concentrations do not exceed the screening level. Figure 2 presents the distribution of analytes which exceed their respective screening levels. The constituents detected at individual locations are listed in parentheses below the sample identification number at each location. There were either no COPCs detected or the COPC detections were below their respective screening levels at those boring locations at which there is not an analyte listed in parentheses.

Subsurface Soil

Organic analytes exceeding their respective SSLs, dilution attenuation factor (DAF) = 1, are 1,1-dichloroethene, benzene, methylene chloride, trichloroethene, BEQs, naphthalene, and pentachlorophenol. Inorganic analytes exceeding their SSLs (DAF = 1) are antimony, arsenic, cadmium, chromium, iron, manganese, mercury, nickel, selenium, and thallium. Additional samples were collected and analyzed for VOCs, SVOCs, cyanide, pesticide/PCBs in October 1999 from locations where these exceedances occurred. The samples were analyzed for Total Organic Carbon (TOC), bulk metals, cyanide, VOCs, SVOCs, and pesticide/PCBs and for Synthetic Precipitation Leaching Procedure (SPLP) to provide the data necessary for calculating site specific SSLs in accordance with the United States Environmental Protection Agency (USEPA) soil screening guidance. Soil data will be reevaluated with respect to the calculated SSLs and additional data gaps may be identified based on the outcome of the site specific SSL evaluations. Results of the site specific SSL calculation and the subsequent screening for Contaminant Migration Contaminants of Concern (CMCOs) should be complete by mid November 1999.

Shallow Groundwater

The groundwater data was reviewed with respect to analyte detections, comparison to applicable screening levels, data trends, spatial distribution, and groundwater flow direction. Based on that evaluation, the nature and extent of groundwater contamination at these sites has been defined and no data gaps exist. This information will be presented in the final RFI report.

2.1.3 Sampling and Analysis Plan

The following site-specific sampling and analysis requirements are proposed. Table 2-1 summarizes the sample matrix to be collected and the analytical parameters proposed.

Seven additional soil borings are proposed to define the extent of BEQs in surface soil west, northwest, north, northeast, and south of 619SB004. Samples will be collected at two depth intervals for each soil boring (0-1 foot bgs and 3-5 feet bgs) and analyzed for SVOCs at DQO Level III. Each proposed sampling location is illustrated on Figure 2. All sampling procedures will adhere to the CNC *Final Comprehensive RFI Work Plan*.

Table 2-1
SWMU 4 & AOC 619
Sampling Plan

Proposed Sample Locations	Matrix	Quantity	Analysis	Rationale
619SB016 - 619SB022	Soil (0-1' bgs)	7	SVOCs	Delineate BEQs west, northwest, north, northeast, and south of 619SB004
619SB016 - 619SB022	Soil (3-5' bgs)	7	SVOCs	Delineate BEQs west, northwest, north, northeast, and south of 619SB004

Note:

All analyses will be performed per SW-846, except where other methods are specified. DQO Level III analyses will be performed as specified in *Final Comprehensive RFI Work Plan*, with a minimum of 10% duplicates. The sample quantities presented do not include Quality Assurance (QA)/Quality Control (QC) samples.

2.2 SWMU 36, Building 68 Battery Shop; AOC 620, Battery Shop, Building 68

These RFI sites were combined into one investigation due to their proximity and their potential for similar COPCs. The site area is located in and around Building 68, a 48,000 square foot concrete structure. From 1942 to 1952, the building was utilized as a paint and oil warehouse. From 1952, the building was used for destruction, assembly, and rebuilding of submarine batteries. Most recently the building was used for storage and charging of large acid batteries. SWMU 36 is the site of two sulfuric acid releases where acid was discharged to floor drains which had become separated from the floor allowing the acid to drain to the soil beneath the building. AOC 620 comprises all activities within Building 68 that were related to the battery shop. Materials released, stored or disposed of at the site included sulfuric acid, lead, paint, solvents, petroleum products, and batteries. Please refer to Section 10.2 of the *Draft Zone F RCRA Facility Investigation Report* for additional information.

2.2.1 Previous Field Work

Soil

Twelve soil borings were advanced during the field investigation, in two phases. Nine borings were advanced during the first phase of the field investigation. Upper (0-1 foot bgs) and lower (3-5 feet bgs) interval samples were collected from three borings while six borings included only the upper interval. The lower interval sample was not collected due to obstructions in the borehole or because of a shallow water table. Later, three additional borings were advanced to delineate lead and PCBs detected during the first sampling round. Upper and lower interval samples were collected from the second-round soil borings.

Initially, soil samples were analyzed for metals, SVOCs, and VOCs at DQO Level III. In addition, soil samples from four first-round borings from AOC 620 included pesticide/PCB analysis, while one first-round AOC 620 sample included cyanide. Two upper interval duplicate soil samples were collected during the first phase for Appendix IX analyses at DQO Level IV.

Second-round soil samples were analyzed for metals, pesticides/PCBs, and SVOCs at DQO Level III. A summary of the soil dataset generated by the sampling and analysis described above can be found in Section 10.2.3 of the *Draft Zone F RCRA Facility Investigation Report*. The data was reviewed with respect to satisfying the RFI requirement for delineating the nature and extent of contamination. Soil data gaps that were identified are discussed below.

Groundwater

Two shallow monitoring wells within the SWMU 36 and AOC 620 area were installed and sampled five times during the field investigation. Groundwater samples from these first two wells were analyzed for metals, SVOCs, and VOCs at DQO Level III. Later, two additional wells were installed to define the potential downgradient impact to groundwater from metals contamination in soil at SWMU 36. Groundwater samples from the two succeeding wells were analyzed for metal constituents at DQO Level III, and pH. A summary of the groundwater dataset generated by the first three sampling events described above can be found in Section 10.2.4 of the *Draft Zone F RCRA Facility Investigation Report*. The data from the fourth and fifth round of sampling were reviewed for this work plan and will be included in the final RFI report.

2.2.2 Data Gaps

Surface Soil

PAHs, expressed as BEQs, were detected above the residential RBC (87 $\mu\text{g}/\text{kg}$) in surface soil at 7 of the 12 locations. Concentrations ranged from 20 $\mu\text{g}/\text{kg}$ to 1173 $\mu\text{g}/\text{kg}$. In addition to the RBC, an anthropogenic background concentration of 289 $\mu\text{g}/\text{kg}$ has been calculated for BEQs in Zone F. Four locations (036SB001, 036SB003, 620SB004, and 620SB008) exhibited BEQs which exceeded the background. Based on a review of this data, BEQs are not delineated to the north, east and south of 620SB008. Aroclor-1260 exceeded its residential RBC (320 $\mu\text{g}/\text{kg}$) for surface soil samples at 620SB004. Additional delineation is required to determine the extent of PCBs to the east of 620SB004. Aluminum (620SB008), arsenic (620SB007 and 620SB008), chromium

(620SB008), iron (620SB008), and lead (036SB001 and 620SB004) concentrations were detected in surface soil samples above both their respective residential RBCs and background concentrations for Zone F surface soil. Additional delineation is required to determine the extent of these metals south, east, and north of 620SB008. Figure 3 presents the distribution of analytes which exceed their respective screening levels. The constituents detected at individual locations are listed in parentheses below the sample identification number. There were either no COPCs detected or the COPC detections were below their respective screening levels at those locations where no analyte is listed.

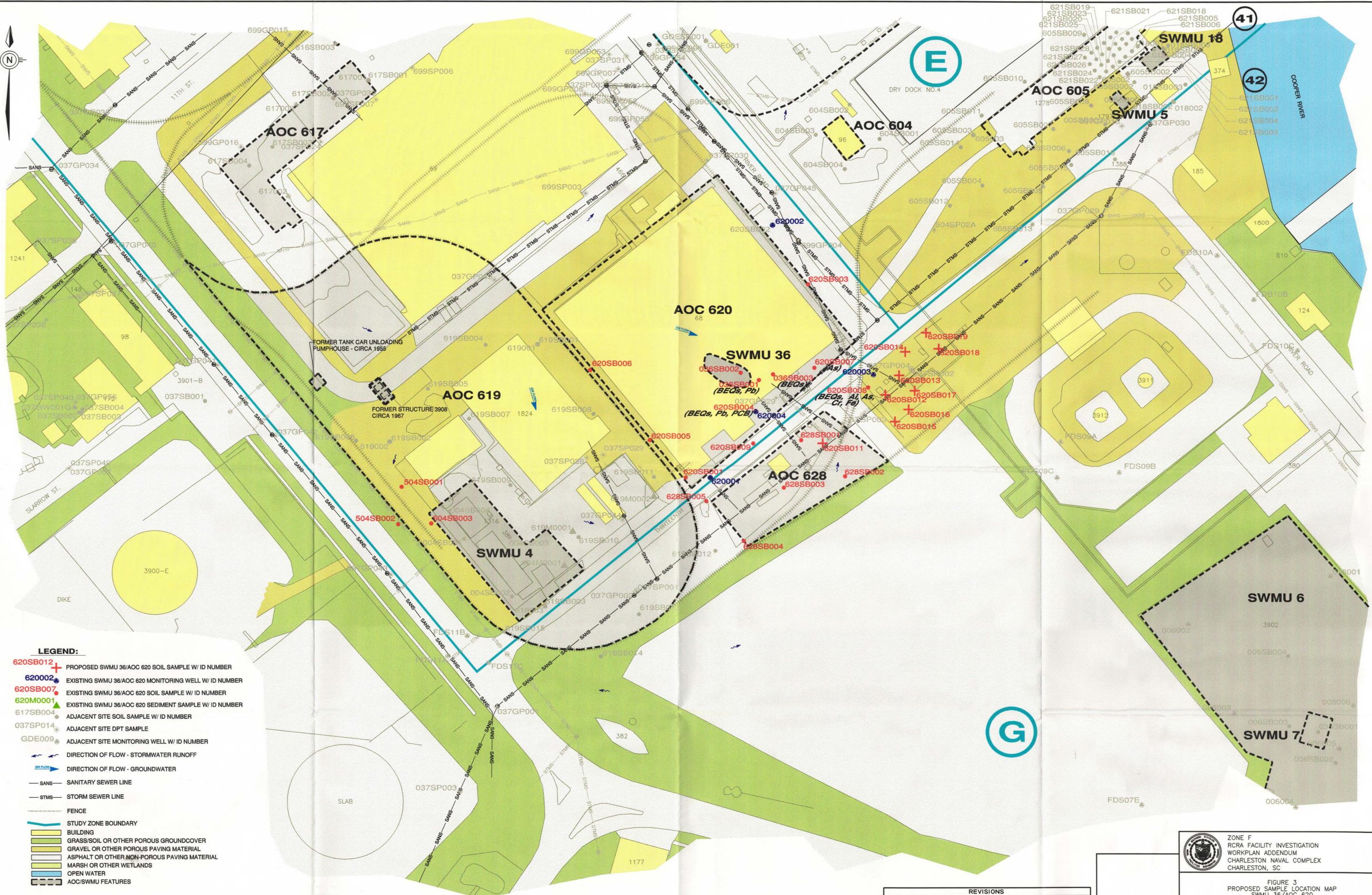
Subsurface Soil

Organic analytes exceeding their SSLs (DAF = 1) were BEQs, 4-methylphenol, naphthalene, and dinoseb. Inorganic analytes exceeding their SSLs (DAF = 1) were antimony, arsenic, cadmium, chromium, iron, lead, manganese, mercury, nickel, selenium, and thallium. Additional samples were collected and analyzed in October 1999 from locations where these exceedances occurred. The samples were analyzed for TOC, bulk VOCs, SVOCs, metals, cyanide, and pesticides/PCBs and, according to the SPLP, to provide the data necessary for calculating site-specific SSLs in accordance with the USEPA soil screening guidance. Soil data will be reevaluated with respect to the calculated SSLs and additional data gaps may be identified based on the outcome of the site-specific SSL calculations. Results of the site-specific SSL calculation and the subsequent screening for CMCOCs should be completed by mid November 1999.

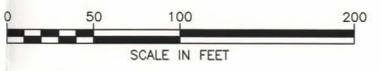
Groundwater

The groundwater data was reviewed with respect to analyte detections, comparisons to applicable screening levels, knowledge of the source, data trends, spatial distribution and groundwater flow. Because the waste acid pipeline, believed to be the source of groundwater exceedences, has been removed and no MCLs were exceeded during the most recent sampling event, no additional groundwater delineation is required. Based on this evaluation, the nature and extent of groundwater contamination at these combined sites has been defined and no data gap exist. This information will be presented in the final Zone F RFI report.

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- LEGEND:**
- 620SB012 + PROPOSED SWMU 36/AOC 620 SOIL SAMPLE W/ ID NUMBER
 - 620002 ● EXISTING SWMU 36/AOC 620 MONITORING WELL W/ ID NUMBER
 - 620SB007 ● EXISTING SWMU 36/AOC 620 SOIL SAMPLE W/ ID NUMBER
 - 620M0001 ▲ EXISTING SWMU 36/AOC 620 SEDIMENT SAMPLE W/ ID NUMBER
 - 617SB004 ● ADJACENT SITE SOIL SAMPLE W/ ID NUMBER
 - 037SP014 ● ADJACENT SITE DPT SAMPLE
 - GDE009 ● ADJACENT SITE MONITORING WELL W/ ID NUMBER
 - DIRECTION OF FLOW - STORMWATER RUNOFF
 - DIRECTION OF FLOW - GROUNDWATER
 - SANITARY SEWER LINE
 - STORM SEWER LINE
 - FENCE
 - STUDY ZONE BOUNDARY
 - BUILDING
 - GRASS/SOIL OR OTHER POROUS GROUND COVER
 - GRAVEL OR OTHER POROUS PAVING MATERIAL
 - ASPHALT OR OTHER NON-POROUS PAVING MATERIAL
 - MARSH OR OTHER WETLANDS
 - OPEN WATER
 - AOC/SWMU FEATURES



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 CHARLESTON, SC

FIGURE 3
 PROPOSED SAMPLE LOCATION MAP
 SWMU 36/AOC 620

Dr by: W. FAULK	Tr by: -
Ck by: C. SMITH	Appr by: T. HAVERKOST
Date: 11/03/99	DWG Name: 2906C021

Sheet 1
 Of 1

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2.2.3 Sampling and Analysis Plan

The following site-specific sampling and analysis requirements have been proposed. Table 2-2 summarizes the sample matrix to be collected and the analytical parameters proposed.

Two soil borings are proposed to define the extent of Aroclor-1260 in surface soil in the area east and southeast of 620SB004. Samples will be collected at two depth intervals for each soil boring where practical, surface (0-1 foot bgs) and subsurface (3-5 feet bgs), and analyzed for pesticides/PCBs at DQO Level III. Eight soil borings are proposed to delineate BEQs and metals in surface soil in the area northeast, east, southeast, and south of 620SB008. Samples will be collected at two depth intervals for each soil boring, surface (0-1 foot bgs) and subsurface (3-5 feet bgs), and analyzed for SVOCs and metals at DQO Level III. Each proposed soil sampling location is illustrated on Figure 3. All sampling procedures will adhere to the CNC *Final Comprehensive RFI Work Plan*.

**Table 2-2
 SWMU 36 and AOC 620
 Sampling Plan**

Proposed Sample Location	Matrix	Quantity	Analysis	Rationale
620SB010 - 620SB011	Soil (0-1' bgs)	2	Pesticides/PCB	Delineate Aroclor-1260 east and southeast of 620SB004.
620SB010 - 620SB011	Soil (3-5' bgs)	2	Pesticides/PCB	Delineate Aroclor-1260 east and southeast of 620SB004.
620SB012 - 620SB019	Soil (0-1' bgs)	8	SVOCs, metals	Delineate BEQs and metals southeast, northeast, east, and south of 620SB008.
620SB012 - 620SB019	Soil (3-5' bgs)	8	SVOCs, metals	Delineate BEQs and metals southeast, northeast, east, and south of 620SB008.

Note: All analyses will be performed per SW-846, except where other methods are specified. DQO Level III analyses will be performed as specified in *Final Comprehensive RFI Work Plan*, with a minimum of 10% duplicates. The sample quantities presented do not include QA/QC samples.

2.3 SWMU 109, Abrasive Blast Media Storage Area

SWMU 109 is the abrasive blast media storage area. The site consists of three hoppers identified as Buildings 1364, 1365, and 1393, used to store the abrasive blast media. Hoppers 1364 and 1365 began operation in 1949, while hopper 1393 was added in 1962. Particulate air emissions were permitted at the site in 1992. Materials potentially released, stored, or disposed of at the site included aluminum oxide and "black beauty" blast media. SWMU 109 was identified in the RFA as a site of possible contaminations which only required confirmation sampling. However, since COPCs were detected, the scope of the investigation for SWMU 109 area has been changed to a RFI. Please refer to Section 10.3 of the *Draft Zone F RCRA Facility Investigation Report* for additional site information.

2.3.1 Previous Field Work

Soil

Soil borings within the SWMU 109 area were advanced to detect the presence of any soil contamination from this site during the initial RFI field work. The soil sampling was performed in 2 phases with 6 locations sampling in the first phase and an additional 3 locations sampling in the second phase. During the first round of the field investigation with upper and lower interval samples collected at each location. First-round samples were analyzed for metals and SVOCs at DQO Level III. In addition, four of the first-round borings included analyses for pesticides/PCBs while samples from three of the borings were also analyzed for cyanide. One upper interval duplicate soil sample was also collected for Appendix IX analyses at DQO Level IV. The purpose of the 3 second phase borings was to delineate the extent of arsenic in surface soil. As a result only upper interval samples were collected and laboratory analysis was only performed for arsenic. A summary of the soil dataset generated by the sampling and analysis described above can be found in Section 10.3.3 of the *Draft Zone F RCRA Facility Investigation Report*. The data was reviewed with respect to satisfying the RFI requirement for delineating the nature and extent of contamination. Soil data gaps that were identified are discussed below.

Groundwater

One shallow monitoring well (109001) was installed and subsequently sampled four times during the field investigation. The groundwater sample from this well was analyzed for metals and SVOCs at DQO Level III. To address South Carolina Department of Health and Environmental Control's (SCDHEC) concerns, an additional monitoring well (109002) was installed and sampled for metals, SVOCs, VOCs, and pesticides/PCBs in early 1999. This well has been sampled once. A summary of the groundwater dataset, generated by the first three sampling events described above, can be found in Section 10.3.5 of the *Draft Zone F RCRA Facility Investigation Report*. The data from the fourth round of sampling at 109001 and the subsequent sampling at 109002 was reviewed for this work plan and will be included in the final RFI report.

2.3.2 Data Gaps

Surface Soil

PAHs, expressed as BEQs, were detected above the residential RBC ($87 \mu\text{g}/\text{kg}$) in surface soil at 1 of the 6 locations analyzed for SVOCs. BEQ concentrations ranged from $0.66 \mu\text{g}/\text{kg}$ to $637 \mu\text{g}/\text{kg}$. In addition to the RBC, an anthropogenic background concentration of $289 \mu\text{g}/\text{kg}$ has been calculated for BEQs in Zone F. The only detection that exceeded the background value occurred at 109SB004 where a concentration of $637 \mu\text{g}/\text{kg}$ was reported. Based on a review of this data, BEQs are not delineated to the southwest of 109SB004. Although delineation is incomplete, the Project Team concluded that because 109SB004 lies in the rail road bed, the BEQs are related to this source and therefore do not warrant additional delineation sampling.

Arsenic (109SB004, 109SB005, 109SB007, 109SB008), chromium (109SB004), iron (109SB004 and 109SB005), and vanadium (109SB005) were the other COPCs detected above their residential RBCs and Zone F background concentrations in surface soil. The detections at each of these locations represent potential data gaps since those sample locations are along the perimeter of the sampling pattern. However, with the exception of the detections at 109SB004, the COPCs

exceed their respective RBCs and/or background by very marginal amounts so additional 1
delineation is not proposed. The lack of data to the southwest of boring 109SB004 represents a 2
significant data gap that should be addressed. Figure 4 presents the distribution of analytes which 3
exceed their respective screening levels. The constituents detected at individual locations are listed 4
in parentheses below the sample identification number at each location. There were either no 5
COPCs detected or the COPC detections were below their respective screening levels at those 6
boring locations where there is not an analyte listed. 7

Subsurface Soil

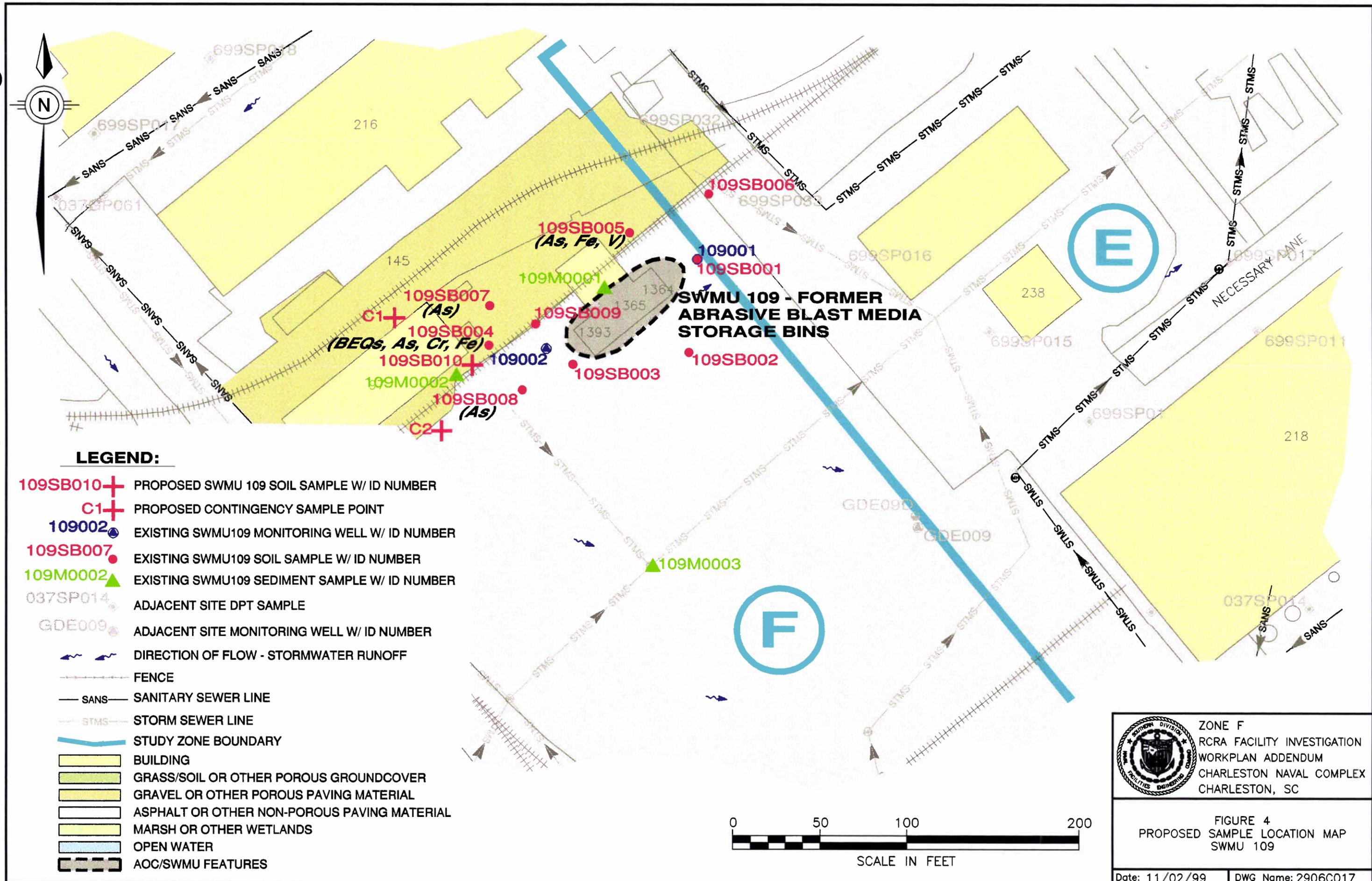
 8

Organic analytes exceeding SSLs (DAF = 1) were BEQs and naphthalene. Inorganic analytes 9
exceeding SSLs (DAF = 1) were antimony, arsenic, barium, cadmium, chromium, iron, 10
manganese, nickel, mercury, selenium, and zinc. Additional samples were collected in 11
October 1999, from locations where these exceedences occurred. The samples were analyzed for 12
TOC, bulk metals, cyanide, VOCs, SVOCs, and pesticide/PCBs and according to the SPLP to 13
provide the data necessary for calculating site-specific soil screening levels in accordance with the 14
USEPA soil screening guidance. Soil data will be reevaluated with respect to the calculated SSLs. 15
Additional data gaps may be identified based on the results of the site-specific SSL evaluations. 16
Results of the site-specific SSL calculations and the subsequent screening for CMCOCs should be 17
complete by mid November 1999. 18

Shallow Groundwater

 19

The groundwater data was reviewed with respect to analyte detections, comparison to applicable 20
screening levels, data trends, spacial distribution, and groundwater flow direction. Based on that 21
evaluation, the nature and extent of groundwater contamination at this site has been defined and 22
no data gaps exist. This information will be presented in the final RFI report. 23



LEGEND:

- 109SB010+ PROPOSED SWMU 109 SOIL SAMPLE W/ ID NUMBER
- C1+ PROPOSED CONTINGENCY SAMPLE POINT
- 109002● EXISTING SWMU109 MONITORING WELL W/ ID NUMBER
- 109SB007● EXISTING SWMU109 SOIL SAMPLE W/ ID NUMBER
- 109M0002▲ EXISTING SWMU109 SEDIMENT SAMPLE W/ ID NUMBER
- 037SP014● ADJACENT SITE DPT SAMPLE
- GDE009● ADJACENT SITE MONITORING WELL W/ ID NUMBER
- ~ DIRECTION OF FLOW - STORMWATER RUNOFF
- - - FENCE
- SANS - SANITARY SEWER LINE
- - - STMS - STORM SEWER LINE
- STUDY ZONE BOUNDARY
- BUILDING
- GRASS/SOIL OR OTHER POROUS GROUNDCOVER
- GRAVEL OR OTHER POROUS PAVING MATERIAL
- ASPHALT OR OTHER NON-POROUS PAVING MATERIAL
- MARSH OR OTHER WETLANDS
- OPEN WATER
- AOC/SWMU FEATURES


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FIGURE 4
 PROPOSED SAMPLE LOCATION MAP
 SWMU 109

00295VV042

2.3.3 Sampling and Analysis Plan

The following site-specific sampling and analysis requirements have been proposed. Table 2-3 summarizes the sample matrix to be collected and the analytical parameters proposed.

One soil boring is proposed to define the extent of metals in surface soil southwest of 109SB004. Surface soil samples (0-1' bgs) will be collected and analyzed for metals at DQO Level III. The proposed soil sampling location is illustrated on Figure 4. All sampling procedures will adhere to the CNC *Final Comprehensive RFI Work Plan*.

Table 2-3
 SWMU 109
 Sampling Plan

Proposed Sample				
Location	Matrix	Quantity	Analysis	Rationale
109SB010	Soil (0-1' bgs)	1	Metals	Delineate metals southwest of 109SB004
109SB010	Soil (3-5' bgs)	1	Metals	Delineate metals southwest of 109SB004

Note:
 All analyses will be performed per SW-846, except where other methods are specified. DQO Level III analyses will be performed as specified in *Final Comprehensive RFI Work Plan*, with a minimum of 10% duplicates. The sample quantities presented do not include QA/QC samples.

2.4 AOC 609, Service Station, Building 1346

AOC 609 is the former gasoline station, automotive repair and maintenance shop at Building 1346, which was built in 1962. The focus of this RFI is the waste oil Underground Storage Tank (UST) at Building 1346. Materials potentially released, stored, or disposed of at the site included gasoline, diesel fuel, motor/lubricating oils, degreasing solvents, antifreeze and various automotive products.

The 560 gallon steel waste oil UST on the west side of the building being assessed in this RFI was removed in 1996. This tank received waste oil from drains in the maintenance garage, and was periodically emptied by suctioning to a waste oil truck. This removal was performed by the Supervisor of Shipbuilding, Conversion and Repair, USN, Portsmouth Environmental Detachment, Charleston, SC (SPORTENVDETCNASN). The *UST Assessment Report, UST 1346, Naval Base Charleston, Charleston, SC (SPORTENVDETCNASN, September 3, 1996)*, prepared for the Department of the Navy, Southern Division, Naval Facilities Engineering Command (SOUTHDIV), stated the UST was in good condition upon removal, having no holes or leaks, with its protective coating intact. However, a loose mechanical joint along the drain pipe leading to the tank was responsible for some leakage to soil about four feet from the tank. The north half of the removal excavation contained petroleum soils. Both tank and drain piping were removed. Ten soil samples were collected during this removal, along with one groundwater sample. Sample results for both soil and groundwater revealed the presence of inorganic, total recoverable petroleum hydrocarbon, and volatile constituents. A Rapid Assessment of the release is currently being performed under the SCDHEC UST program. This work is being performed by TetraTech NUS under contract to SOUTHDIV and is scheduled for completion in November 1999. Please refer to Section 10.6 of the *Draft Zone F RCRA Facility Investigation Report* for additional site information.

This site also included nine gasoline and diesel fuel USTs. Three of the original nine steel USTs were found to be leaking in 1991 and were removed. They were replaced with fiberglass tanks in 1992. Subsequently, six monitoring wells were installed by S&ME, Inc., to define the horizontal and vertical extent of groundwater contamination. The assessment report submitted to SCDHEC in February, 1993 resulted in the installation of two additional perimeter wells near the site. All site wells were resampled in November 1994, with the results confirming previous findings. A source well near the site exhibited concentrations of benzene (36,100 $\mu\text{g/L}$), toluene (47,800 $\mu\text{g/L}$), ethylbenzene (3,620 $\mu\text{g/L}$), xylene (16,800 $\mu\text{g/L}$) and methyl tertiary butyl ether (62,200 $\mu\text{g/L}$). All perimeter wells were below detection limits for the same parameters. A free-product recovery system installed in 1995 is still in operation. This investigation activity was reported in the *Assessment Report Addendum Building No. 1346, Charleston Naval Base, Charleston, SC* (S&ME, March 29, 1995), prepared for the Navy Public Works Center Jacksonville.

2.4.1 Previous Field Work

Soil

Soil borings within the AOC 609 area were advanced to assess the nature and extent of any soil contamination from this site. Six soil borings were advanced during the field investigation with six upper (0-1 foot bgs) and four lower (3-5 feet bgs) interval soil samples collected.

Soil samples were analyzed for metals, SVOCs, and VOCs at DQO Level III. Three upper interval duplicate soil samples were also collected for Appendix IX analyses at DQO Level IV. A summary of the soil dataset generated by the sampling and analysis described above can be found in Section 10.5.3 in the *Draft Zone F RCRA Facility Investigation Report*. The data was reviewed with respect to satisfying the RFI requirement for delineating nature and extent of contamination. Soil data gaps that were identified are discussed below.

Groundwater

The seven existing wells (six shallow, one deep) within the AOC 609 area were sampled four times during the field investigation. These wells had been previously installed during S&ME's 1995 investigation and removal of the fuel UST system at Building 1346. An additional monitoring well, SME002, was installed by S&ME but was not included in the investigation because it was damaged. In response to SCDHEC comments on the Zone F RFI report, two additional shallow monitoring wells (609001, 609002) were installed and sampled to further define extent of VOCs.

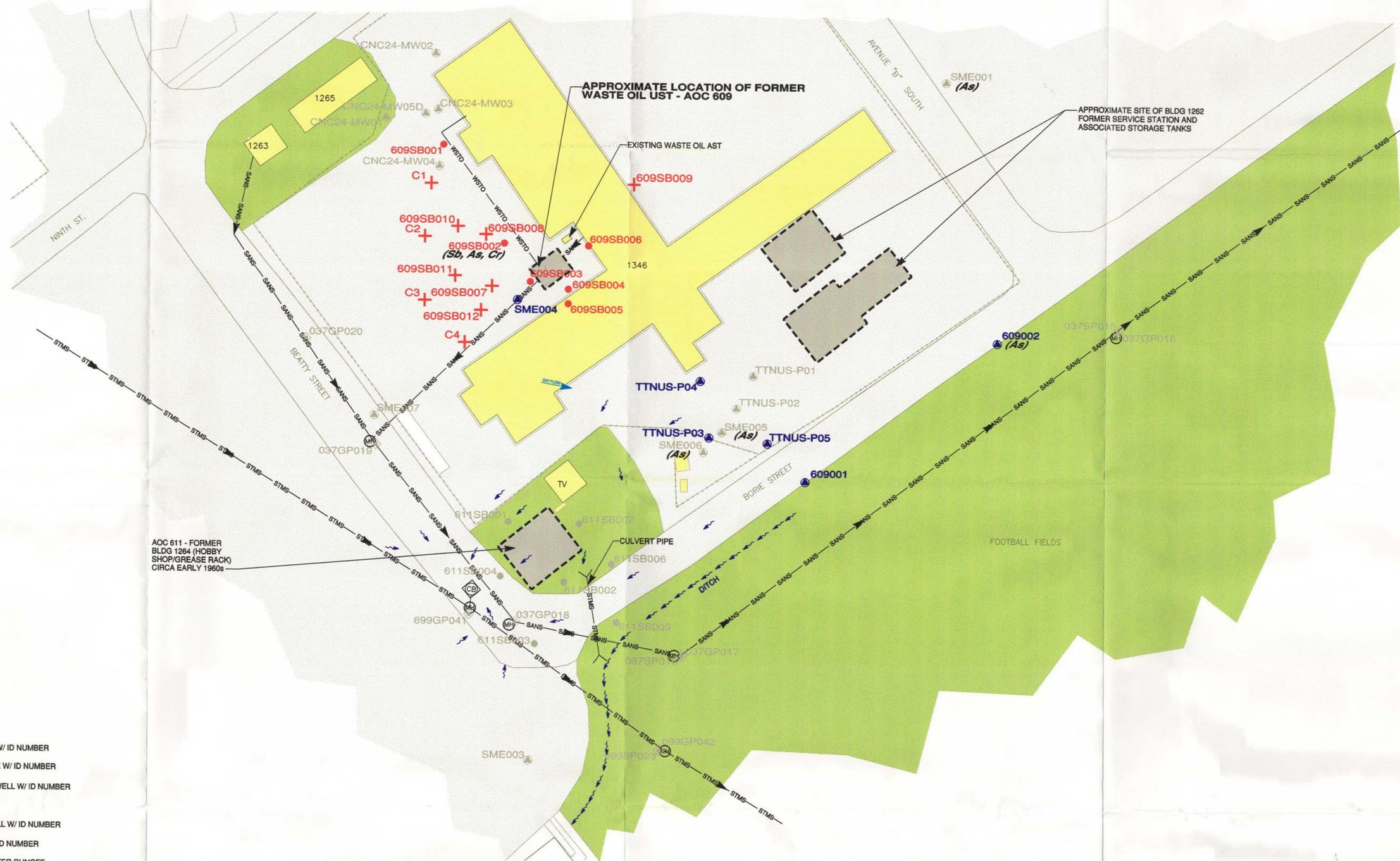
The initial groundwater samples were analyzed for metals, cyanide, pesticides/PCBs, SVOCs, and VOCs at DQO Level III. The newer wells were sampled for VOCs and metals. A summary of the groundwater dataset generated by the first three sampling events described above for the S&ME wells can be found in Section 10.5.4 of the *Draft Zone F RCRA Facility Investigation Report*. The data from the fourth round of sampling at the S&ME wells and the subsequent results from wells 609001 and 609002 were reviewed for this work plan and will be included in the final RFI report.

2.4.2 Data Gaps

Surface Soil

PAHs, expressed as BEQs, were detected at one of six locations, 609SB001 at a concentration which exceeded the surface soil residential RBC of 87 $\mu\text{g}/\text{kg}$. In addition to the RBC, an anthropogenic background concentration of 289 $\mu\text{g}/\text{kg}$ has been calculated for BEQs in Zone F. No detections exceeded this screening value. Twenty metals plus cyanide were detected in soil samples collected at AOC 609. Antimony, arsenic, and chromium concentrations exceeded both their respective RBCs and background concentrations for Zone F surface soil at 609SB002. The extent of these COPCs has not been defined to the west and northeast of 609SB002. Figure 5 presents the distribution of analytes which exceed their respective screening values. The

constituents detected at individual locations are listed in parentheses below the sample 1
identification number at each location. There were either no COPCs detected or the COPC 2
detections were below their respective screening levels at those locations at which there is no 3
analyte listed. 4



LEGEND:

- 609SB002 ● EXISTING AOC 609 SOIL SAMPLE W/ ID NUMBER
- 609SB008 + PROPOSED AOC 609 SOIL SAMPLE W/ ID NUMBER
- 609001 ● EXISTING AOC 609 MONITORING WELL W/ ID NUMBER
- 037GP019 ● ADJACENT SITE DPT SAMPLE
- SME003 ● ADJACENT SITE MONITORING WELL W/ ID NUMBER
- 611SB004 ● ADJACENT SITE SOIL SAMPLE W/ ID NUMBER
- DIRECTION OF FLOW - STORMWATER RUNOFF
- DIRECTION OF FLOW - GROUNDWATER
- FENCE
- WSTO --- WASTE OIL LINE
- SANS --- SANITARY SEWER LINE
- STMS --- STORM SEWER LINE
- STUDY ZONE BOUNDARY
- BUILDING
- GRASS/SOIL OR OTHER POROUS GROUNDCOVER
- GRAVEL OR OTHER POROUS PAVING MATERIAL
- ASPHALT OR OTHER NON-POROUS PAVING MATERIAL
- MARSH OR OTHER WETLANDS
- OPEN WATER
- AOC/SWMU FEATURES



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Rev Number:	Rev Date:	Rev By:
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Rev Number:	Rev Date:	Rev By:

		ZONE F RCRA FACILITY INVESTIGATION WORKPLAN ADDENDUM CHARLESTON NAVAL COMPLEX CHARLESTON, SC	
		FIGURE 5 PROPOSED SAMPLE LOCATION MAP AOC 609	
Dr by: W. FAULK	Tr by: -		
Ck by: C. SMITH	Appr by: T. HAVERKOST	Sheet 1	OF 1
Date: 11/02/99	DWG Name: 2906C015		

Subsurface Soil

Organic analytes exceeding their SSLs (DAF = 1) were 1,1-dichloroethene, acetone, acrolein, trichloroethene, and benzo(a)anthracene. Inorganic analytes exceeding their SSLs (DAF = 1) were antimony, arsenic, barium, cadmium, chromium, iron, manganese, mercury, nickel, and zinc. Additional samples were collected in October 1999 from locations where these exceedances occurred. The samples were analyzed for TOC, bulk metals, cyanide, VOCs, SVOCs, and pesticides/PCBs and according to the SPLP to provide the data necessary for calculating site-specific soil screening levels in accordance with the USEPA soil screening guidance. Soil data will be reevaluated with respect to the calculated site-specific SSLs. Additional data gaps may be identified based on the results of the site-specific SSL evaluations. Results of the site-specific SSL calculations and the subsequent screening for CMCOCs should be complete by mid November 1999.

Groundwater

Concentrations of aluminum and chromium exceeded their respective tap water RBCs and shallow groundwater background concentrations in the additional well 609001. Arsenic exceeded its tap water RBC and shallow groundwater background concentration in the additional well 609002. The groundwater data was reviewed with respect to analyte detections, comparisons to applicable screening levels, data trends, spatial distribution, and groundwater flow direction. Based on that evaluation, the concentrations of aluminum, arsenic, and chromium have not been defined downgradient of 609001 and 609002 for these inorganics. Figure 5 also presents the distribution of analytes detected in groundwater which exceed their respective screening values. The constituents detected at individual well locations are listed in parentheses below the sample identification number at each location. There were either no COPCs detected or the COPC detections were below their respective screening levels at locations where there are no analytes listed.

2.4.3 Sampling and Analysis Plan

To fill the data gaps, the following site-specific sampling and analysis requirements have been proposed. Table 2-4 summarizes the sample matrix to be collected and the analytical parameters proposed.

Six soil borings are proposed to delineate chromium in the area northeast, northwest, west, and southwest of 609SB002. Samples will be collected at two depth intervals for each soil boring, surface (0 to 1 foot bgs) and subsurface (3 to 5 feet bgs), and analyzed for metals at DQO Level III. Additional groundwater sampling is required at 609001 and 609002 to delineate metals and monitor for VOCs at 609001 and 609002. Each proposed sampling location is illustrated on Figure 5. All sampling procedures will adhere to the CNC *Final Comprehensive RFI Work Plan*.

**Table 2-4
 AOC 609
 Sampling Plan**

Proposed Sample Location	Matrix	Quantity	Analysis	Rationale
609SB007 - 609SB012	Soil (0-1' bgs)	6	Metals	Delineate metals northeast, northwest, west, and southwest of 609SB002
609SB007 - 609SB012	Soil (3-5' bgs)	6	Metals	Delineate metals northeast, northwest, west and southwest of 609SB002
609001, 609002	Groundwater (Shallow well)	2	Metals, VOCs	Delineate metals and monitor for VOCs

Note:

All analyses will be performed per SW-846, except where other methods are specified. DQO Level III analyses will be performed as specified in *Final Comprehensive RFI Work Plan*, with a minimum of 10% duplicates. The sample quantities presented do not include QA/QC samples.

2.5 AOC 611, Grease Rack and Hobby Shop, Former Building 1264

AOC 611 is the site is the former Building 1264, a small garage size structure which was used as an automotive hobby shop from the late 1950s to the early 1960s, as determined by a review of historical base maps and the building name which appeared in the legend. The building has since been demolished and the site incorporated into a predominantly grass covered area with the exception of a small concrete slab on top of which is a transformer vault. Materials associated with an automotive hobby shop would presumably include things such as petroleum products, antifreeze, solvents, degreasers, enamel paint, paint thinner, battery acid, and lead. The exact nature of the activities that took place at this facility, the hazardous materials which may have been present, and whether or not any releases occurred is not known since the only information that is known about this site is that which can be inferred from the historic map.

As a consequence confirmation sampling was proposed for this site. Because COPCs were detected at AOC 611, the scope of the investigation has been expanded to meet the requirements of a RFI. Please refer to Section 10.6 of the *Draft Zone F RCRA Facility Investigation Report* for additional site information.

2.5.1 Previous Field Work

Soil

Soil borings within the AOC 611 area were advanced to assess the presence of any soil contamination at this site during the initial phase of the RFI. Soil samples were collected from 4 soil borings during the initial phase of the investigation with soil samples collected from the 0-1' 3-5' bgs intervals at each location. The samples were analyzed for metals, SVOCs, and VOCs. The analytical results of these samples indicated the need for additional sampling. Soil samples were collected from the upper and lower intervals at 3 additional soil borings during a second phase of sampling. The analytical parameters for these samples was limited to metals and SVOCs based on the results of the initial samples. In addition, one second-round upper interval duplicate

soil sample was collected for Appendix IX analyses. A summary of the soil data set generated by the sampling and analysis described above can be found in Section 10.6 of the *Draft Zone F RCRA Facility Investigation Report*. The data was reviewed with respect to satisfying the RFI requirement for delineating the nature and extent of contamination. Soil data gaps that were identified are discussed below.

2.5.2 Data Gaps

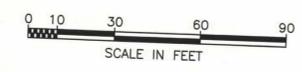
Surface Soil

PAHs, expressed as BEQs, were detected above the residential RBC ($87\mu\text{g}/\text{kg}$) in surface soil at 4 of the 7 locations. Concentrations ranged from $4.9\mu\text{g}/\text{kg}$ to $4317\mu\text{g}/\text{kg}$. The only detection which exceeded both the residential RBC and anthropogenic background values occurred at 611SB006. This location was on the perimeter of the sampling pattern so the extent of BEQs were not defined by the two sampling events. Aroclor-1260 was detected in the one sample analyzed for the Appendix IX parameters. The sample contained $370\mu\text{g}/\text{kg}$ of Aroclor-1260 and was collected from 611SB007 which was also on the edge of the sampling pattern. Chromium was the only other COPC detected along the perimeter of the sampling pattern resulting in the extent not being defined. Chromium was detected at $61\text{ mg}/\text{kg}$ at 611SB005 which exceeds the residential RBC under the assumption that 100 percent of the chromium is in the hexavalent state. Figure 6 presents the distribution of the analytes which exceed their respective screening levels. A summary of the sample results can be found in Section 10.6.3 of the *Draft Zone F RCRA Facility Investigation Report*.

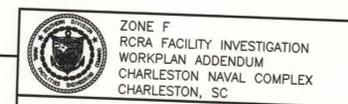
The Project Team decided that AOC 611 was a suitable candidate site to perform an Interim Measure (IM) to mitigate the potential risks posed by the COPCs detected during the initial phases of the RFI. SPORTENVDETHASN excavated the site in January 1998 to address the surface soil exceedances at all of the locations except for the chromium found at 611SB005. Confirmation sampling showed that the remaining COPCs identified in the RFI were



- LEGEND:**
- 611SB004 ● EXISTING AOC 611 SOIL SAMPLE W/ ID NUMBER
 - 611SB008 + PROPOSED AOC 611 SOIL SAMPLE W/ ID NUMBER
 - C2+ PROPOSED CONTINGENCY SAMPLE POINT
 - 037GP019 ○ ADJACENT SITE DPT SAMPLE
 - SME003 ○ ADJACENT SITE MONITORING WELL W/ ID NUMBER
 - 609SB002 ● ADJACENT SITE SOIL SAMPLE W/ ID NUMBER
 - DIRECTION OF FLOW - STORMWATER RUNOFF
 - FENCE
 - WTO --- WASTE OIL LINE
 - SANS --- SANITARY SEWER LINE
 - STMS --- STORM SEWER LINE
 - STUDY ZONE BOUNDARY
 - BUILDING
 - GRASS/SOIL OR OTHER POROUS GROUNDCOVER
 - GRAVEL OR OTHER POROUS PAVING MATERIAL
 - ASPHALT OR OTHER NON-POROUS PAVING MATERIAL
 - MARSH OR OTHER WETLANDS
 - OPEN WATER
 - AOC/SWMU FEATURES



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FIGURE 6
PROPOSED SAMPLE LOCATION MAP
AOC 611

Dr by: W. FAULK Tr by: -

removed to levels below their respective residential RBCs. All surface soil exceedances were removed in the area adjacent to AOC 611. A description of the IM and the confirmation sample results were presented in the *AOC 611 Interim Measures Completion Report* prepared by the DET and submitted to the Project Team. These results of the IM will be briefly discussed in the revised RFI report.

As a result, the only remaining surface soil data gap is the delineation of chromium in the area to the southeast of 611SB005.

Subsurface Soil

Subsurface soil analytes that exceeded their SSLs (DAF = 1) were naphthalene, antimony, arsenic, cadmium, chromium, iron, manganese, mercury, selenium, and thallium. Subsurface soil exceedances were not addressed by the IM. Additional samples were collected in October 1999 from locations where these exceedances occurred. The samples were analyzed for TOC, bulk metals, cyanide, VOCs, SVOCs, and pesticide/PCBs and according to the SPLP to provide the data necessary for calculating site-specific SSLs in accordance with the USEPA soil screening guidance. Soil data will be reevaluated with respect to the calculated SSLs and additional data gaps may be identified based on the outcome of the site-specific SSL evaluations. Results of the site-specific SSL calculation and the subsequent screening of CMCOCs should be complete by mid-November 1999.

2.5.3 Sampling and Analysis Plan

The following site-specific sampling and analysis requirements are proposed. Table 2-5 summarizes the sample matrix to be collected and the analytical parameters proposed.

Five soil borings are proposed to define the extent of chromium in subsurface soil in the area southwest, south, southeast, east, and northeast of 611SB005. Samples will be collected at two depth intervals for each soil boring (0 to 1 foot bgs and 3 to 5 feet bgs) and analyzed for metals at DQO Level III. Each proposed sampling location is illustrated on Figure 6. All sampling procedures will adhere to the CNC *Final Comprehensive RFI Work Plan*.

Table 2-5
 AOC 611
 Sampling Plan

Proposed Sample Location	Matrix	Quantity	Analysis	Rationale
611SB008 - 611SB012	Soil (0-1' bgs)	5	Metals	Delineate chromium southwest, south, southeast, east, and northeast of 611SB005, upgradient and downgradient of the culvert entering the ditchline
611SB008 - 611SB012	Soil (3-5' bgs)	5	Metals	Delineate metals southwest, south, southeast, east, and northeast of 611SB005, upgradient and downgradient of the culvert entering the ditchline

Notes:

All analyses will be performed per SW-846, except where other methods are specified. DQO Level III analyses will be performed as specified in *Final Comprehensive RFI Work Plan*, with a minimum of 10% duplicates. The sample quantities presented do not include QA/QC samples.

xylene, and toluene. Please refer to Section 10.7 of the *Draft Zone F RCRA Facility Investigation Report* for additional site information.

2.6.1 Previous Field Work

DPT Survey

A DPT survey was performed in the combined AOCs 613/615 and SWMU 175 area to identify the extent that soil and shallow groundwater may have been impacted. In all, 65 soil and 58 groundwater screening samples were collected. Push sample points were spaced on 50 foot square grids, dependent on the layout of the site (buildings, obstructions, etc.). The grid density over the site area was increased as necessary to determine the extent of contamination identified through the screening process. Composite samples of unsaturated soil were collected at each grid node from the material below the pavement to the water table. Interval soil sampling during the screening survey was considered unnecessary because the site is mostly paved, thereby reducing the potential for direct exposure and the impact of precipitation leaching contaminants to groundwater from above the saturated zone.

Soil samples were analyzed for metals, SVOCs, and VOCs at DQO Level III. Groundwater samples were collected at nodes which yielded water. Groundwater samples were analyzed for similar parameters as the soil samples if sufficient sample volume could be collected. If insufficient groundwater was available for full parameter analysis, priority for analysis was generally given to VOCs. Duplicates were analyzed for Appendix IX parameters at DQO Level IV.

The initial phase of the RFI proposed the screening survey results be used to optimize placement of 10 discrete soil borings and the three shallow and one deep monitoring wells proposed for this investigation. However, the soil screening data was of sufficient quality and site coverage extensive enough for this data to be used in lieu of the proposed discrete soil sampling. Therefore,

no discrete soil samples were collected. Soil and groundwater screening data were used for monitoring well placement as planned. A summary of the DPT soil and groundwater dataset generated by the sampling and analysis described above can be found in Section 10.7.3 of the *Draft Zone F RCRA Facility Investigation Report*.

Groundwater

Groundwater has been extensively investigated under the RFI, the SCDHEC petroleum program, and as part of a due diligence evaluation performed for Charleston County Commissioners of Public Works (CPW) prior to leasing property in this area. The primary COPCs detected in groundwater in this area are petroleum constituents and six separate source areas have been identified which are unrelated to the RFI.

RFI

Five shallow monitoring wells and one deep monitoring well were installed at the combined site during the RFI. Nine existing shallow monitoring wells installed during General Engineering Laboratories' (GEL) investigation of the AOCs 613/615 and SWMU 175 area were also included in the investigation. These wells are identified by the prefix "GEL" preceding the well number. All of the wells were sampled four times. Wells not paved over by the present tenant were sampled five times. Groundwater samples were analyzed at DQO Level III for TOC, bulk metals, SVOCs, VOCs, pesticide/PCBs and according to the SPLP to provide the data necessary for calculating site-specific SSLs in accordance with the USEPA soil screening guidance. Samples taken from two nearby shallow monitoring wells, installed during the investigation of the Fuel Distribution System (FDS), were also included in the investigation. These wells are identified by the prefix "FDS" preceding the well number. A summary of the groundwater dataset generated by the first three sampling events described above can be found in Section 10.7.5 of the *Draft Zone F RCRA Facility Investigation Report*. Data from subsequent sampling events were reviewed for this work plan and will be included in the final RFI report.

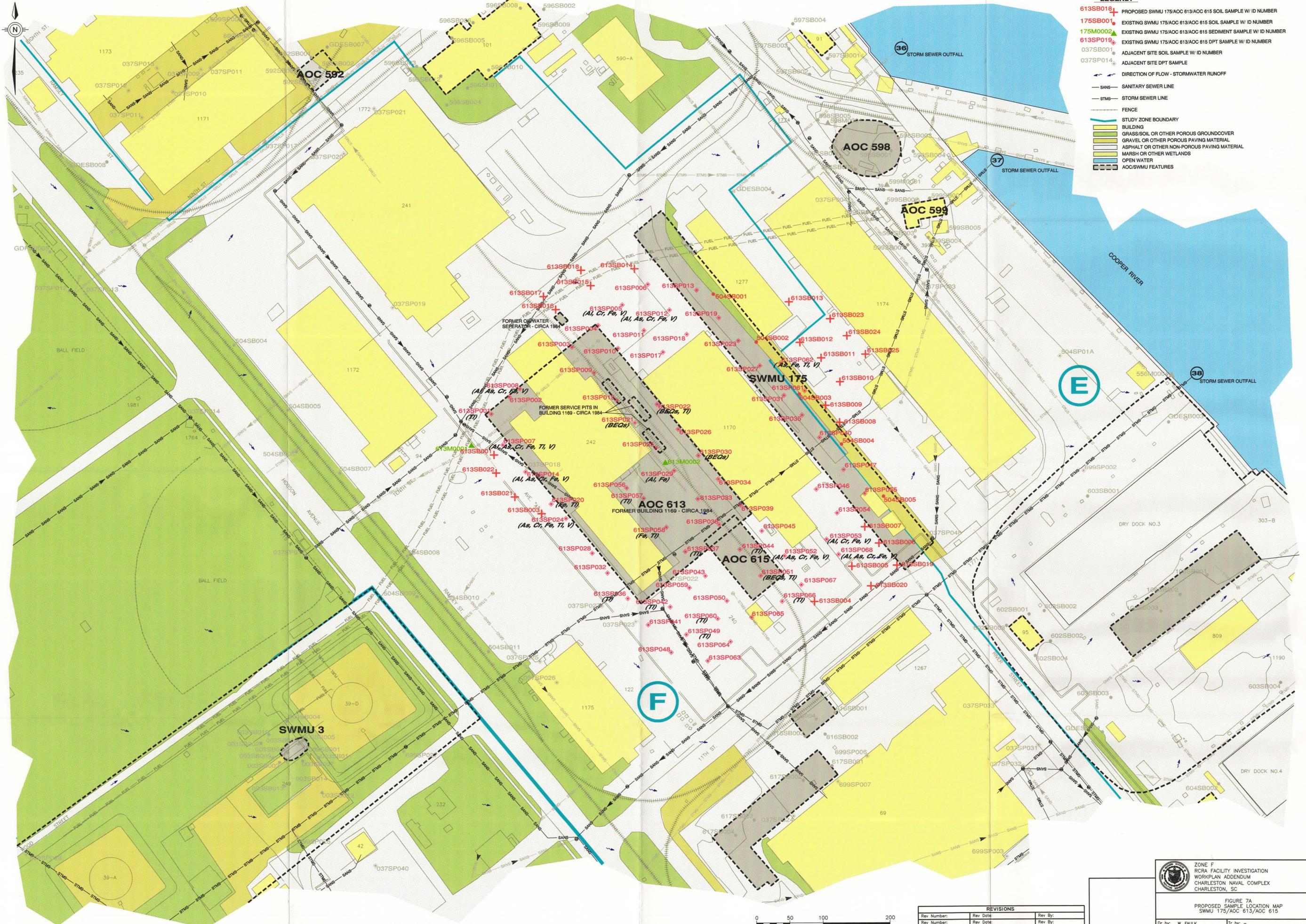
Numerous groundwater samples were collected from temporary wells installed during the Zone L 1
investigation of the sanitary and storm sewer systems located near these sites. The majority of the 2
samples collected from the temporary wells were analyzed for VOCs and metals. 3

Petroleum Program 4

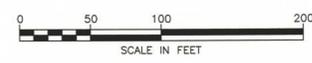
TetraTech NUS is currently in the process of performing Rapid Assessments at 5 tank locations 5
in and around the RFI area of concern. These sites can be distinguished on Figure 7B by locating 6
the areas with monitoring wells that contain the prefix "CNC". The data from these assessments 7
was not available for review at the time this addendum was prepared; therefore, it is not currently 8
known what impact this data may have on decisions regarding the need for additional work in this 9
area. 10

The FDS investigation in this area included the investigation of a portion of underground fuel lines 11
identified as Area 17. Both dissolved phase petroleum constituents and Light Nonaqueous Phase 12
Liquid (LNAPL) have been identified in this area. The Project Team made the decision to keep 13
this area in the RFI rather than investigate it under the petroleum program due to arsenic 14
detections in one of the wells even though the arsenic may not be linked to the petroleum release. 15

The groundwater flow regime is complex in this area with respect to the fact there are a couple 16
of mounds and also two areas that appear to be acting as drains to the system. The mounds occur 17
near wells GEL013 and CNSY240003. The groundwater lows are found near monitoring wells 18
613001 and GEL011. There is a possibility that the low areas may be caused by the groundwater 19
infiltration of the sanitary sewer lines that are in close proximity to these wells. 20



- LEGEND:**
- 613SB018+ PROPOSED SWMU 175/AOC 613/AOC 615 SOIL SAMPLE W/ ID NUMBER
 - 175SB001+ EXISTING SWMU 175/AOC 613/AOC 615 SOIL SAMPLE W/ ID NUMBER
 - 175M0002+ EXISTING SWMU 175/AOC 613/AOC 615 SEDIMENT SAMPLE W/ ID NUMBER
 - 613SP019+ EXISTING SWMU 175/AOC 613/AOC 615 DPT SAMPLE W/ ID NUMBER
 - 037SB001+ ADJACENT SITE SOIL SAMPLE W/ ID NUMBER
 - 037SP014+ ADJACENT SITE DPT SAMPLE
 - Blue arrow DIRECTION OF FLOW - STORMWATER RUNOFF
 - SANS SANITARY SEWER LINE
 - STMS STORM SEWER LINE
 - FENCE
 - STUDY ZONE BOUNDARY
 - BUILDING
 - GRASS/SOIL OR OTHER POROUS GROUND COVER
 - GRAVEL OR OTHER POROUS PAVING MATERIAL
 - ASPHALT OR OTHER NON-POROUS PAVING MATERIAL
 - MARSH OR OTHER WETLANDS
 - OPEN WATER
 - AOC/SWMU FEATURES



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ZONE F
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 WORKPLAN ADDENDUM
 CHARLESTON NAVAL COMPLEX
 CHARLESTON, SC

FIGURE 7A
 PROPOSED SAMPLE LOCATION MAP
 SWMU 175/AOC 613/AOC 615

Dr. by: W. FAULK	Tr. by: -
Ck. by: C. SMITH	Appr. by: T. HAVERKOST
Date: 11/03/99	DWG Name: 2906C018

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2.6.2 Data Gaps

Soil

PAHs, expressed as BEQs, were detected above the residential RBC ($87\mu\text{g}/\text{kg}$) in soil at 15 of the 65 locations. Concentrations ranged from $5.98\mu\text{g}/\text{kg}$ to $1775\mu\text{g}/\text{kg}$. In addition to the RBC, an anthropogenic background concentration of $289\mu\text{g}/\text{kg}$ has been calculated for BEQs in Zone F. Four locations exhibited concentrations of BEQs which exceeded the background. All of these detections occurred at locations surrounded by data points where the concentrations do not exceed the screening level, therefore, no further delineation is required. Aluminum, arsenic, chromium, iron, thallium, and vanadium exceeded both their respective residential RBCs and background concentrations. Based on a review of the data, these inorganic COPCs are not delineated to the northwest and north of 613SP004 and 613SP005, north and northeast of 613SP062, northeast, east and south of 613SP068, and west of 613SP007 and 613SP014. Other exceedances were observed at perimeter locations 613SP008 and 613SP036 however the concentrations only slightly exceeded the screening values. Figure 7B presents the distribution of analytes which exceed their respective screening levels. The constituents detected at individual locations are listed in parentheses below the sample identification number at each location. There were either no COPCs detected or the COPC detections were below their respective screening levels at those sample locations that have no analyte listed in parentheses.

Organic analytes exceeding their SSLs (DAF = 1) were acetone, benzene, methylene chloride, 1,1,2,2-tetrachloroethane, trichloroethene, vinyl chloride, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, 2-methylnaphthalene, 4-methylphenol, acenaphthene, dibenzofuran, fluorene, naphthalene, and phenanthrene. Inorganic analytes exceeding their SSLs (DAF = 1) were antimony, arsenic, cadmium, chromium, iron, manganese, mercury, nickel, selenium, and thallium. Additional samples were collected in October 1999 from locations where these exceedances occurred. The samples were analyzed for metals, cyanide, VOCs, SVOCs and pesticides/ PCBs according to the SPLP and also for TOC to provide the data

necessary for calculating site-specific SSLs in accordance with the USEPA soil screening guidance. Soil data will be reevaluated with respect to the calculated SSLs. Additional data gaps may be identified based on the outcome of the site-specific SSL evaluations. Results of the site-specific SSL calculations and the subsequent screening for CMCOCs should be complete by mid November 1999.

Shallow Groundwater

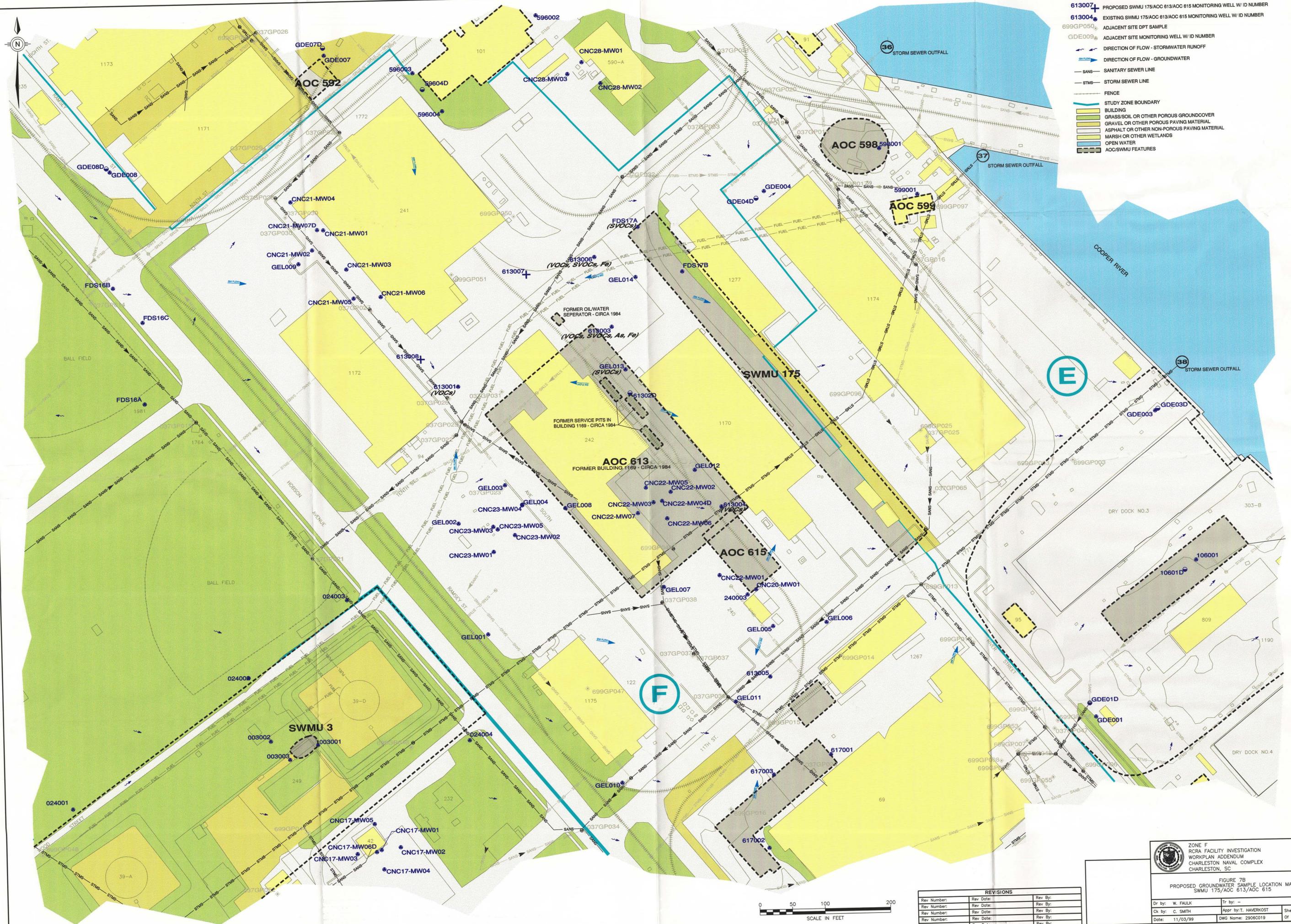
Groundwater analytes exceeding the lower of their tap water RBC or MCL and background throughout sampling events were 1,2-dichloroethene, trichloroethene, 2-methylnaphthalene, bis(2-ethylhexyl)phthalene, naphthalene, dibenzofuran, arsenic, iron, and vanadium. Other analytes detected in earlier events decreased to below the screening values during the most recent sampling event. The groundwater data was reviewed with respect to analyte detections, comparison to applicable screening levels, data trends, special distribution, and groundwater flow direction. Based on that evaluation, the nature and extent of groundwater contamination has not been defined in the areas downgradient of wells 613001 and 613006. Specifically, VOCs downgradient of 613001 and VOCs, SVOCs, and metals downgradient of 613006. Figure 7B also presents the distribution of analytes detected in groundwater which exceed their respective screening levels. The constituents detected at individual locations are listed in parentheses below the sample identification number at each location. There were either no groundwater COPCs detected or the COPC detections were below their respective screening levels at those wells that have no analytes listed in parentheses.

2.6.3 Sampling and Analysis Plan

The following site-specific sampling and analysis requirements are proposed. Table 2-6 summarizes the sample matrix to be collected and the analytical parameters proposed.

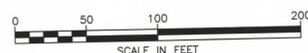
Twenty five soil borings are proposed to delineate SVOCs and metals. Samples will be collected at two depth intervals for each soil boring, surface (0-1 foot bgs) and subsurface (3- 5 feet bgs), and analyzed for SVOCs and metals at DQO Level III. Each proposed sampling location is illustrated on Figure 7A. All sampling procedures will adhere to the CNC *Final Comprehensive RFI Work Plan*.

Two additional shallow monitoring wells are proposed to delineate VOCs, SVOCs, and metals. Prior to installing these wells, the Navy and EnSafe will review the new data from the Rapid Assessments to develop a revised conceptual model of what is happening with respect to groundwater contamination in this area. The data should be available for review by mid-November. If the current understanding of the site remains unchanged a shallow monitoring well (613008) will be installed downgradient of 613001 to delineate VOCs. The new well and 613001 will be resampled for VOCs. An additional shallow monitoring well (613007) will be installed downgradient of 613006 to delineate VOCs, SVOCs, and metals. The new well 613007, 613006, GEL014, FDS17A, and FDS17B will be resampled for VOCs, SVOCs, and metals. Each proposed monitoring well location is illustrated on Figure 7A. The shallow monitoring wells should be advanced no deeper than 15 feet bgs. All wells are to be constructed using threaded Polyvinyl chloride (PVC) screen and casing. Screen intervals for the shallow monitoring wells are to be 10 feet in length. All well installation, development, and sampling will be performed in accordance with Section 5.0 of Revision No. 01 of the *Final Comprehensive Sampling and Analysis Plan* (CSAP) and in compliance with South Carolina Well Standards and Regulations R. 61-71.



- LEGEND:**
- 613007+ PROPOSED SWMU 175/AOC 613/AOC 615 MONITORING WELL W/ ID NUMBER
 - 613004+ EXISTING SWMU 175/AOC 613/AOC 615 MONITORING WELL W/ ID NUMBER
 - 699GP050+ ADJACENT SITE DPT SAMPLE
 - GDE009+ ADJACENT SITE MONITORING WELL W/ ID NUMBER
 - DIRECTION OF FLOW - STORMWATER RUNOFF
 - DIRECTION OF FLOW - GROUNDWATER
 - SANS— SANITARY SEWER LINE
 - STMS— STORM SEWER LINE
 - FENCE
 - STUDY ZONE BOUNDARY
 - BUILDING
 - GRASS/SOIL OR OTHER POROUS GROUND COVER
 - GRAVEL OR OTHER POROUS PAVING MATERIAL
 - ASPHALT OR OTHER NON-POROUS PAVING MATERIAL
 - MARSH OR OTHER WETLANDS
 - OPEN WATER
 - AOC/SWMU FEATURES

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FIGURE 7B
 PROPOSED GROUNDWATER SAMPLE LOCATION MAP
 SWMU 175/AOC 613/AOC 615

Dr by: W. FAULK	Tr by: —
Ck by: C. SMITH	Appr by: T. HAVERKOST
Date: 11/03/99	DWG Name: 2906C019

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**Table 2-6
 AOC 613
 Sampling Plan**

Proposed Sample Location	Matrix	Quantity	Analysis	Rationale
613SB001, 613SB002, 613SB003, 613SB021, and 613SB022	Soil (0-1 ' bgs) Soil (3-5 ' bgs)	5 5	Metals, SVOCs	Delineate metals south and southwest of 613SP007 and 613SP014
613SB004 - 613SB007, 613SB019, and 613SB020	Soil (0-1 ' bgs) Soil (3-5 ' bgs)	6 6	Metals, SVOCs	Delineate metals northeast, east, southeast, and southwest of 613SP068
613SB008 - 613SB013, 613SB023, 613SB024, and 613SB025	Soil (0-1 ' bgs) Soil (3-5 ' bgs)	9 9	Metals, SVOCs	Delineate metals north, northeast, east, and southeast of 613SP062
613SB014 - 613SB018	Soil (0-1 ' bgs) Soil (3-5 ' bgs)	5 5	Metals, SVOCs	Delineate metals north, northeast, and northwest of 613SP004 and 613SP005
613001	Groundwater (shallow well)	1	VOCs	Monitoring
613006		1	VOCs, SVOCs, Metals	Monitoring
GEL014		1	VOCs, SVOCs, Metals	Monitoring
FDS17A		1	VOCs, SVOCs, Metals	Monitoring
FDS17B		1	VOCs, SVOCs, Metals	Monitoring
613007	Groundwater (shallow well)	1	VOCs, SVOCs, Metals	Delineate VOCs, SVOCs and metals downgradient of 613006
613008	Groundwater (shallow well)	1	VOCs	Delineate VOCs downgradient of 613001
613009	Groundwater (shallow well)	1	VOCs, SVOCs, Metals	Contingency well

Note:

All analyses will be performed per SW-846, except where other methods are specified. DQO Level III analyses will be performed as specified in *Final Comprehensive RFI Work Plan*, with a minimum of 10% duplicates. The sample quantities presented do not include QA/QC samples.