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FINAL ZONE H RESOURCE CONSERVATION AND RECOVERY ACT FACILITY
INVESTIGATION WORK PLAN ADDENDUM SOLID WASTE MANAGEMENT UNIT 196 CNC
CHARLESTON SC
10/22/1999
ENSAFE INC.



DEPARTMENT OF THE NAVY

SOUTHERN DIVISION

NAVAL FACILITIES ENGINEERING COMMAND

P.O. BOX 180010

2155 EAGLE DRIVE

NORTH CHARLESTON, S.C. 29418-9010

8

5090/11
Code 1877
26 October, 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: NOTIFICATION OF SWMU 196

Dear Mr. Litton,

The purpose of this letter is to provide notification of SWMU 196, Public Works Storage Area. The area was identified during the course of the field investigation in Zone H at Naval Base Charleston. Further evaluation concluded that the area should be formally identified as a site. The notification is provided to fulfill the requirements of condition IV.B.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 add this site to the list of sites requiring an RFI, Appendix F-9 of the permit application currently in review. 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

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



DEPARTMENT OF THE NAVY

SOUTHERN DIVISION

NAVAL FACILITIES ENGINEERING COMMAND

P.O. BOX 190010

2155 EAGLE DRIVE

NORTH CHARLESTON, S.C. 29419-9010

5090/11
Code 18B1
23 October, 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 H RCRA FACILITY INVESTIGATION WORKPLAN
ADDENDUM, SWMU 196

Dear Mr. Thompson,

The purpose of this letter is to submit the Final Zone H 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 (803) 743-9985 and (803) 820-5525 respectively.

Sincerely,

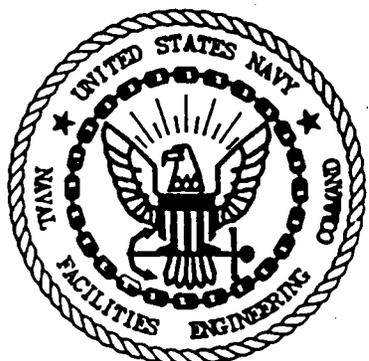
A handwritten signature in black ink that reads "M.A. Hunt".

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

Encl: Final Zone H RFI Workplan Addendum, SWMU 196, 22 October, 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**

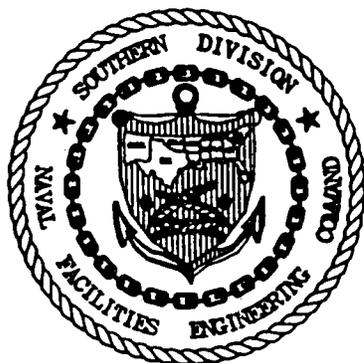


**FINAL ZONE H RFI WORK PLAN ADDENDUM,
SWMU 196**

**SOUTH DIV 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
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**October 22, 1999
Revision No.: 0**

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

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ADDENDUM TO THE FINAL ZONE H RFI WORK PLAN

INTRODUCTION

The area around Building 1838 was previously included as part of the Combined SWMU 9 in the *Final RFI Report for Zone H*, (EnSafe, 1998). Combined SWMU 9 generally includes all of the area contained within the boundary of the closed landfill. However, maps for Combined SWMU 9 do not show the area around Building 1838 as being within the boundary of the closed landfill. Historical aerial photographs indicate that the area around Building 1838 was formerly tidal marsh land and has been filled to its present elevations. Building 1838 was constructed in 1979 and has been used as a materials storage yard by the City of Charleston.

According to the Environmental Baseline Survey for Building 1838, a 1991 Environmental Compliance Evaluation identified full containers (55 gallon drums to quart cans) of unknown or hazardous contents (paints, solvents, battery acid, lube oils) that were stored around the area. Most of these containers were found to be corroded and sitting directly on the ground between the building and the marsh associated with Shipyard Creek. Transformers were also stored in the area and had no indication as to whether they may contain polychlorinated bipheynls (PCBs). These materials were no longer present on the site when the baseline survey was conducted in 1993.

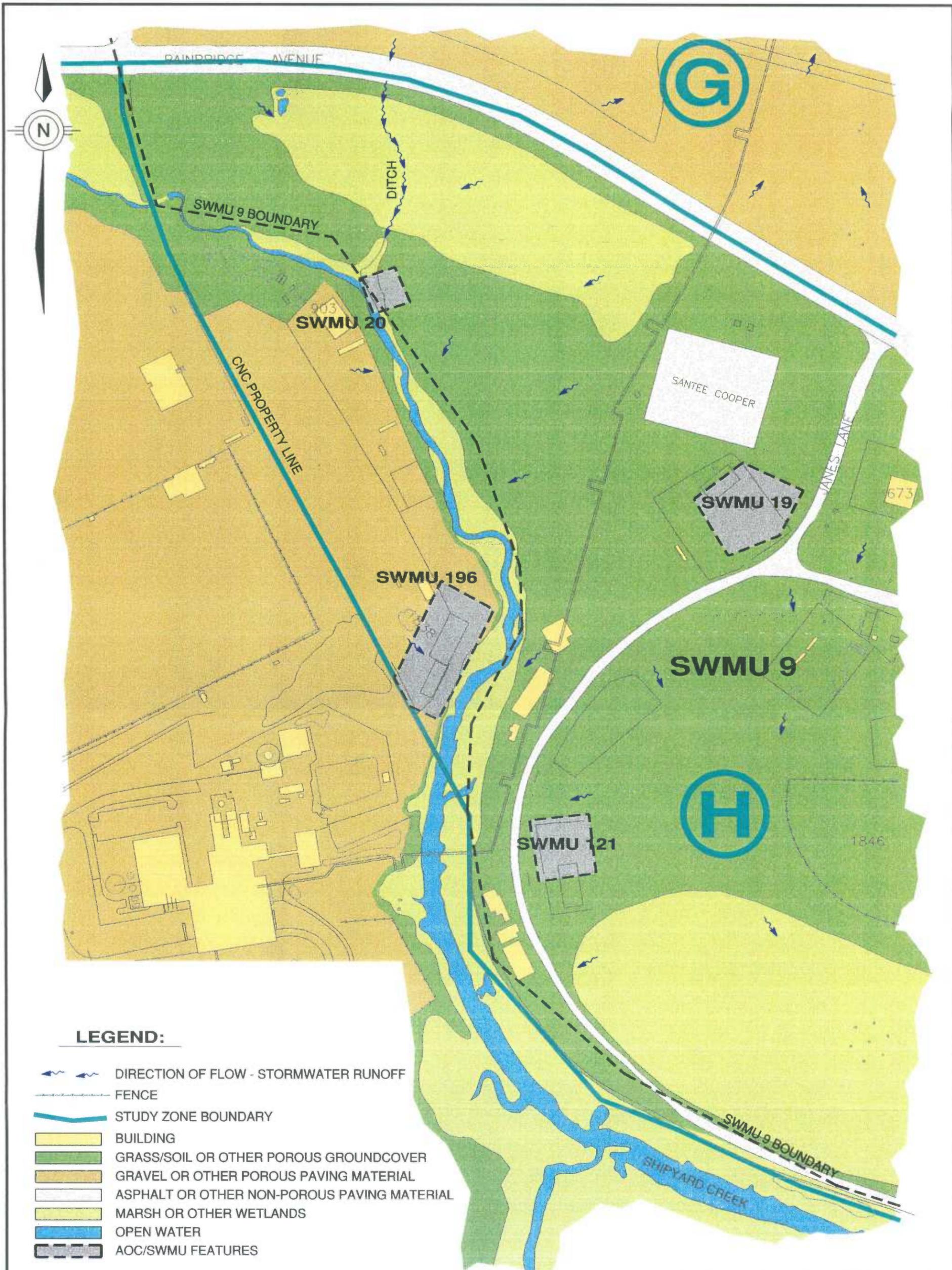
In June of 1996, a monitoring well was installed by the Commissioners of Public Works of the City of Charleston, South Carolina (CPW) in the area behind Building 1838. This well was installed as part of the pre-lease Evaluation of Baseline Environmental Conditions (EBEC) conducted by the CPW. This monitoring well became designated as GEL015. Well GEL015 analytical results indicated levels of contamination that required further investigation.

This area is currently being leased by the CPW and is used as a pipe laydown yard northwest of Building 1838 and miscellaneous equipment storage inside of Building 1838. The areas northeast and East of Building 1838 are currently open scrub grass and porous gravel. Since this area appears to have contamination issues that are separate from the Combined SWMU 9, it will be further investigated as a separate waste management area. The area around well GEL015 and Building 1838 will be referred to as SWMU 196 in this Work Plan. A site map for SWMU 196 in relation to the SWMU 9 landfill and offsite areas is shown on Figure 1. Figure 2 shows sampling points from other sites in relation to SWMU 196

RECENT INVESTIGATIONS

Additional wells were installed and sampled in the area of SWMU 196 after the EBEC was conducted. Sampling was performed using the methods presented in the *Supplemental Sampling and Analysis Plan Building 1838 for Zone H Corrective Measures Study* (EnSafe, 1999) or as described below. The following provides a summary of the recent investigations:

- Five new monitoring wells, in addition to well GEL015, were installed in June and July of 1998 to determine the extent of contamination as shown in Figure 3. (Monitoring wells 009020, 009021, 009022, 009023, & 00923D).
- Well GEL015 was sampled in May of 1998 for volatile organic analytes (VOAs). In August of 1998, all six wells were sampled for VOAs, semivolatile organic analytes (SVOAs), pesticides and polychlorinated biphenyls (Pest/PCBs), cyanide, and metals. For the monitored natural attenuation (MNA) sampling event, wells 009020, 021, 022, and 023 were sampled for VOAs. Then, in April of 1999, all six wells were sampled for VOAs, SVOAs, and Pest/PCBs to develop trend data.

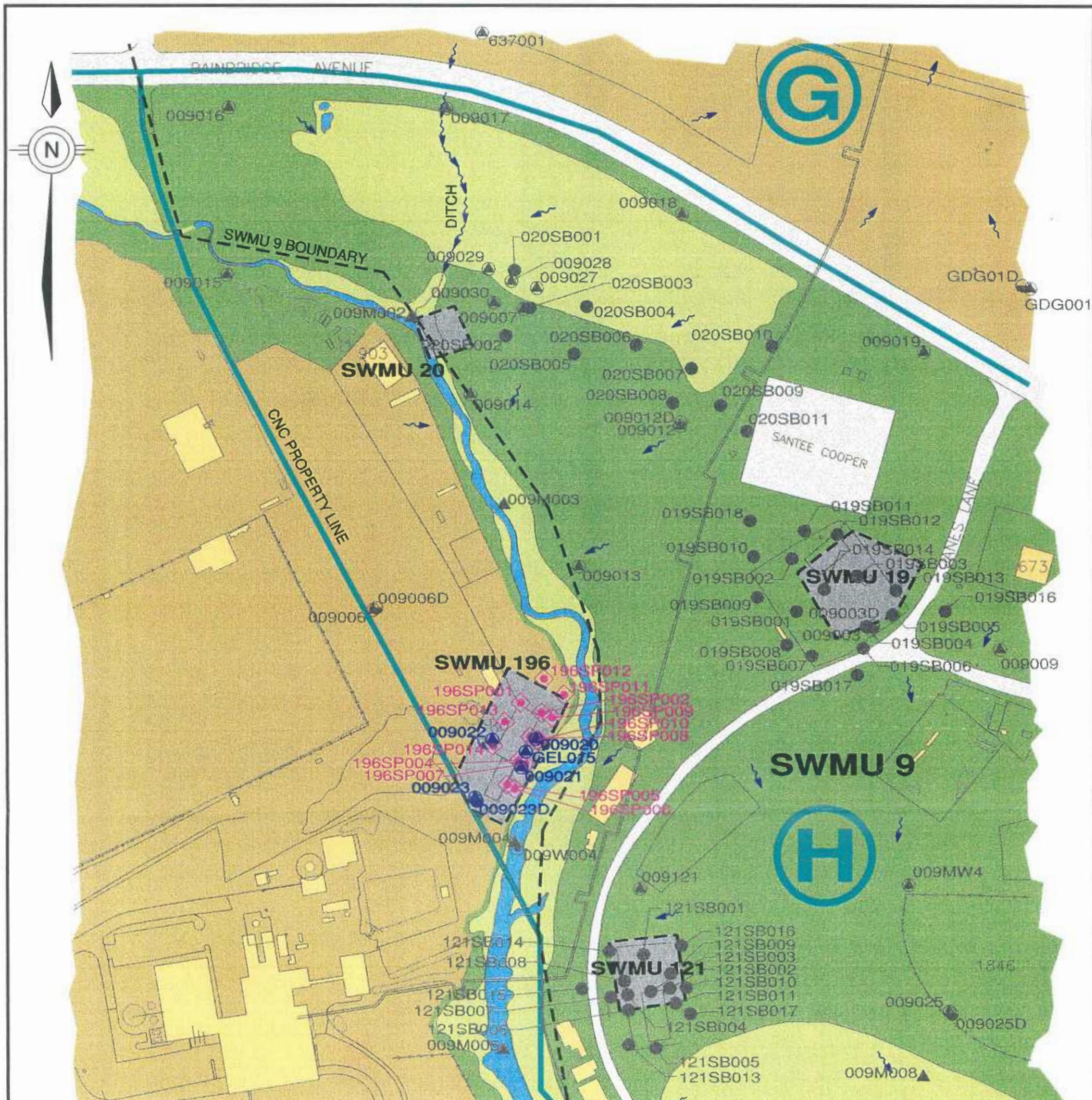



 ZONE H
 RCRA FACILITY INVESTIGATION
 WORKPLAN ADDENDUM
 CHARLESTON NAVAL COMPLEX
 CHARLESTON, SC

FIGURE 1
 SITE MAP
 SWMU 196

Date: 10/22/99 | DWG Name: 2908C027

00295VV B12



LEGEND:

- 196SP001 SWMU196 DPT SAMPLE W/ ID NUMBER
- 009023 SWMU196 MONITORING WELL W/ ID NUMBER
- 009009 ADJACENT SITE MONITORING WELL W/ ID NUMBER
- 121SB008 ADJACENT SITE SOIL SAMPLE W/ ID NUMBER
- 009M005 ADJACENT SITE SEDIMENT SAMPLE W/ ID NUMBER
- 009W001 ADJACENT SITE SURFACE WATER SAMPLE W/ ID NUMBER
- DIRECTION OF FLOW - STORMWATER RUNOFF
- 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

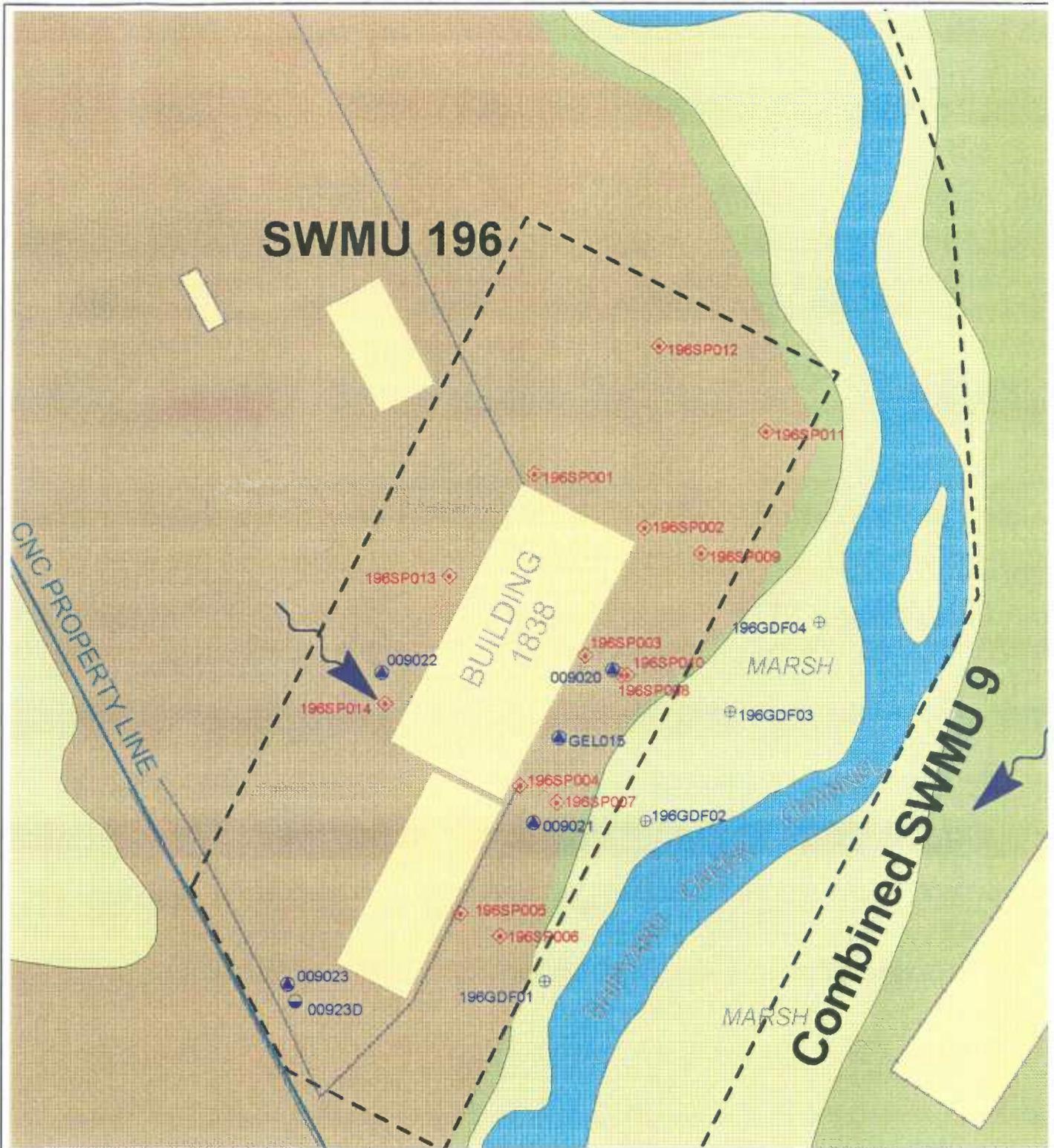


SCALE IN FEET



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FIGURE 2
 EXISTING SAMPLE LOCATION MAP
 SWMU 196



LEGEND

- ▲ SHALLOW MONITORING WELL
- DEEP MONITORING WELL
- ⊕ TEMPORARY WELL (IN MARSH)
- ◆ DPT SOIL SAMPLE



ZONE H
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FIGURE 3
SWMU 196

DPT SOIL SAMPLE AND
TEMPORARY WELL LOCATIONS

50 0 50 100 Feet

- Fourteen subsurface Direct Push Technology (DPT) soil samples were collected in April 1999 from 3 to 5 feet below ground surface in an attempt to delineate a possible source area as shown in Figure 3. Soil samples were evaluated for the VOAs benzene, chlorobenzene, 1,1-dichloroethene, 1,1-dichloroethane, trichloroethene, and tetrachloroethene using a headspace field screening method. Laboratory samples were also collected from each DPT soil core and evaluated for SVOAs and Pest/PCBs.

- Temporary monitoring wells 196GDF01, 196GDF02, 196GDF03, and 196GDF04 were installed in May of 1999 in the marsh area east of Building 1838 as shown on Figure 3. In June of 1999, two samples were collected at each location. Groundwater from these temporary wells was sampled using a diffusion sampler in each well for VOAs, and via conventional purge and sample techniques for VOAs, SVOAs, and Pest/PCBs.

- Four surface water samples were collected from the marsh area using diffusion samplers attached to each temporary well. At high tide, these samplers were submerged in 12-18 inches of water. At low tide, these samplers were sitting on top of the dry marsh surface, exposed to the air and sun. An additional grab surface water sample, including aliquots from near each of the four wells, was collected during high tide and analyzed for VOAs, SVOAs, and Pest/PCBs.

SUMMARY OF RECENT RESULTS

Groundwater

VOAs

Maximum contaminant levels (MCLs) were used as the basis for evaluating if a sample contained constituents at levels of potential concern. Where MCLs have not been established for a constituent, the risk based concentration (RBC) was used. Benzene, chlorobenzene, 1,2-dichloroethene (1,2-DCE), and vinyl chloride (VC) were detected above their respective MCL or RBC value. Benzene was detected in four of ten wells at concentrations above the MCL (5 $\mu\text{g/L}$)

- Fourteen subsurface Direct Push Technology (DPT) soil samples were collected in April 1999 from 3 to 5 feet below ground surface in an attempt to delineate a possible source area as shown in Figure 3. Soil samples were evaluated for the VOAs benzene, chlorobenzene, 1,1-dichloroethene, 1,1-dichloroethane, trichloroethene, and tetrachloroethene using a headspace field screening method. Laboratory samples were also collected from each DPT soil core and evaluated for SVOAs and Pest/PCBs.

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SUMMARY OF RECENT RESULTS

Groundwater

VOAs

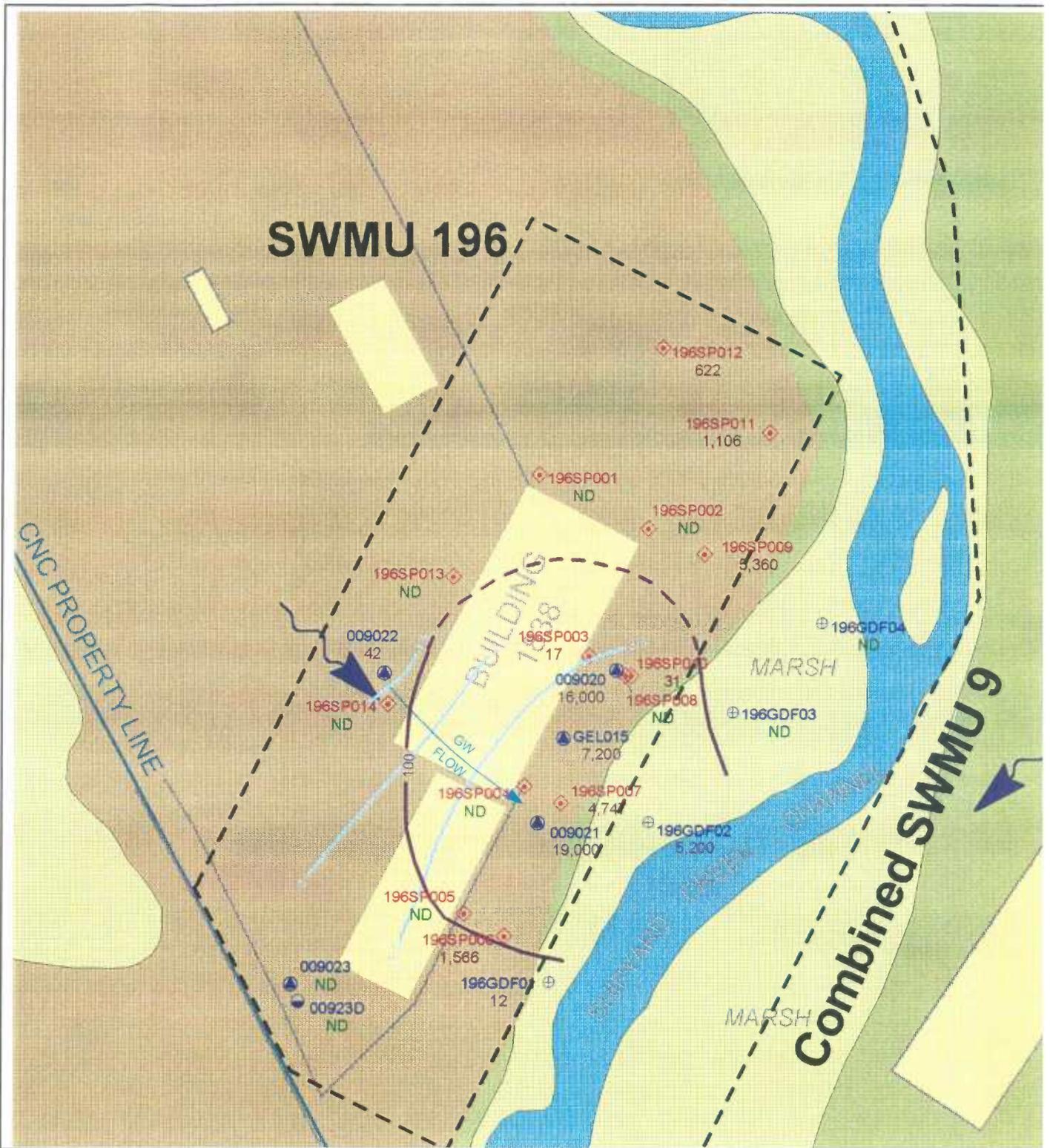
Maximum contaminant levels (MCLs) were used as the basis for evaluating if a sample contained constituents at levels of potential concern. Where MCLs have not been established for a constituent, the risk based concentration (RBC) was used. Benzene, chlorobenzene, 1,2-dichloroethene (1,2-DCE), and vinyl chloride (VC) were detected above their respective MCL or RBC value. Benzene was detected in four of ten wells at concentrations above the MCL (5 µg/L)

ranging from 19 $\mu\text{g/L}$ to 200 $\mu\text{g/L}$. All four of the wells (009020, 009021, GEL015, and 196GDF02) are adjacent to each other, indicating the potential for a plume formation.

Chlorobenze was detected in four of the ten site wells above the MCL (100 $\mu\text{g/L}$) ranging from 4,300 to 16,000 $\mu\text{g/L}$. A site map showing the limits of the chlorobenze plume above the MCL is provided on Figure 4. The detection wells for chlorobenze are the same four mentioned above for benzene. A site map showing the limits of the benzene plume above the MCL is provided on Figure 5. 1,1-DCE was detected in two of the ten site wells (009021 & 009023) above the RBC (5.5 $\mu\text{g/L}$) ranging in concentration from 45 $\mu\text{g/L}$ to 240 $\mu\text{g/L}$. Vinyl chloride was detected in three of the ten site wells (GEL015, 009021 & 009023) above the MCL (2 $\mu\text{g/L}$) ranging in concentration from 3.8 $\mu\text{g/L}$ to 50 $\mu\text{g/L}$. VOA results in the SWMU 196 area wells for the chemicals of potential concern are summarized in Table 1.

SVOAs

The following SVOAs were detected onsite above their respective MCLs/RBC: 2-chlorophenol, 1,2-dichlorobenzene (1,2-DCB), 1,3-dichlorobenzene (1,3-DCB), and 1,4-dichlorobenzene (1,4-DCB). 2-Chlorophenol was detected in only one well (009020) above the MCL (30 $\mu\text{g/L}$) at 52 $\mu\text{g/L}$. 1,2-DCB was detected in three of ten monitoring wells (009020, 009021, and GEL015) above the MCL (600 $\mu\text{g/L}$) ranging in concentration from 1500 $\mu\text{g/L}$ to 13,000 $\mu\text{g/L}$. 1,3-DCB was detected in four of ten monitoring wells (009020, 009021, GEL015, and 196GDF02) above the RBC (5.5 $\mu\text{g/L}$) ranging in concentration from 6 $\mu\text{g/L}$ to 1100 $\mu\text{g/L}$. A site map showing the limits of the 1,3-DCB plume above the MCL is provided on Figure 6. 1,4-DCB was detected in three of ten monitoring wells (009020, 009021, and GEL015) above the MCL (75 $\mu\text{g/L}$) ranging in concentration from 92 $\mu\text{g/L}$ to 1,900 $\mu\text{g/L}$. SVOA results in the SWMU 196 area wells for the chemicals of potential concern are summarized in Table 2.



LEGEND

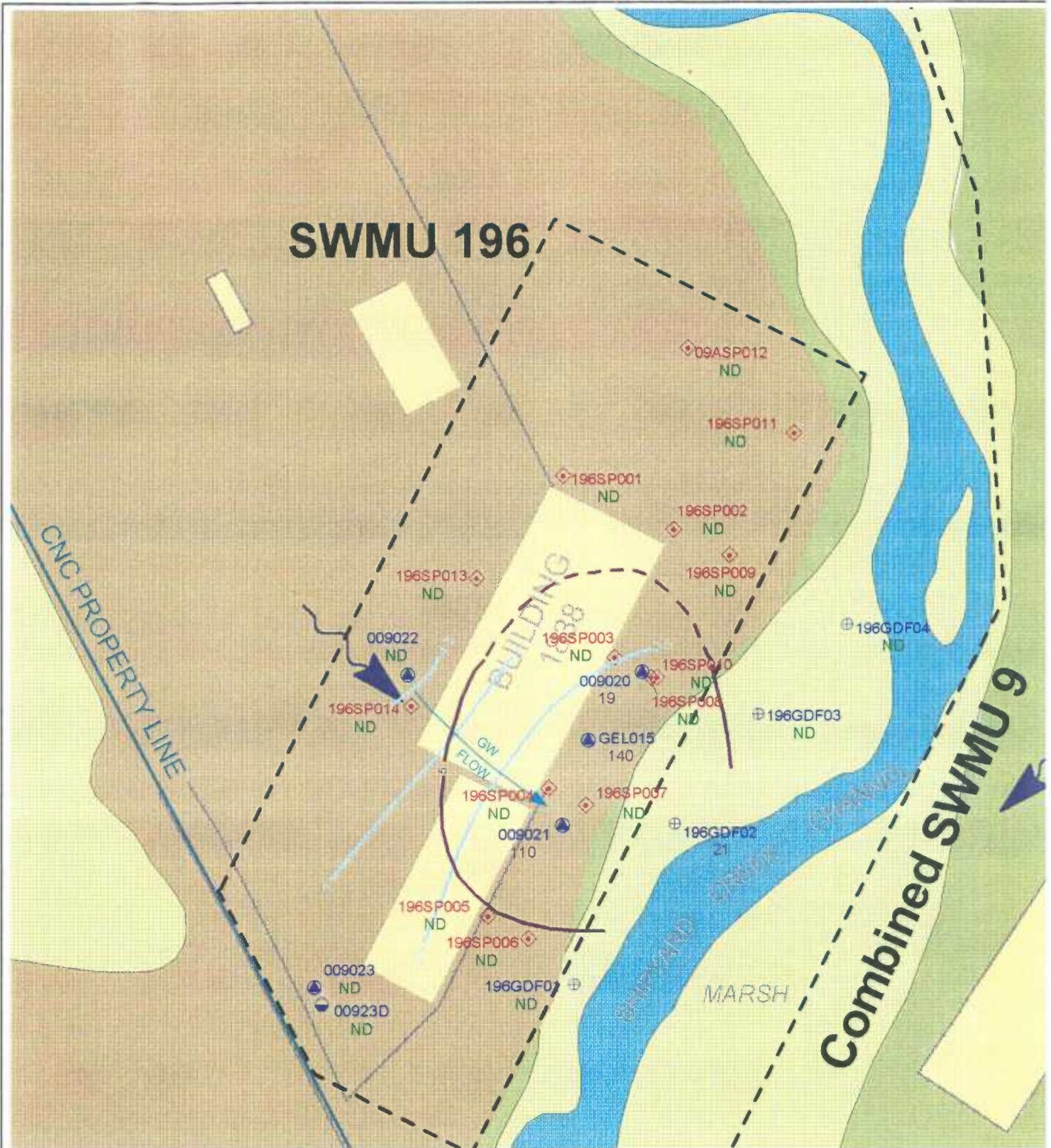
- SHALLOW MONITORING WELL
- DEEP MONITORING WELL
- ⊕ TEMPORARY WELL (IN MARSH)
- ◆ DPT SOIL SAMPLE
- 19,000 GW CHLOROBENZENE CONC. (ug/L)
- 5,360 HEADSPACE CHLOROBENZENE CONC. (ug/L)
- ~100~ APPROXIMATE PLUME BOUNDARY
- ND NOT DETECTED
- GW ELEVATION CONTOUR (INTERVAL = 0.5 ft. MSL)
- GW FLOW DIRECTION

50 0 50 100 Feet



ZONE H
RFI WORKPLAN ADDENDUM
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CHARLESTON, SC

FIGURE 4
SWMU 196
CHLOROBENZENE PLUME IN
GROUNDWATER AND
DPT HEADSPACE ANALYSIS IN SOIL
APRIL/JUNE 1999



LEGEND

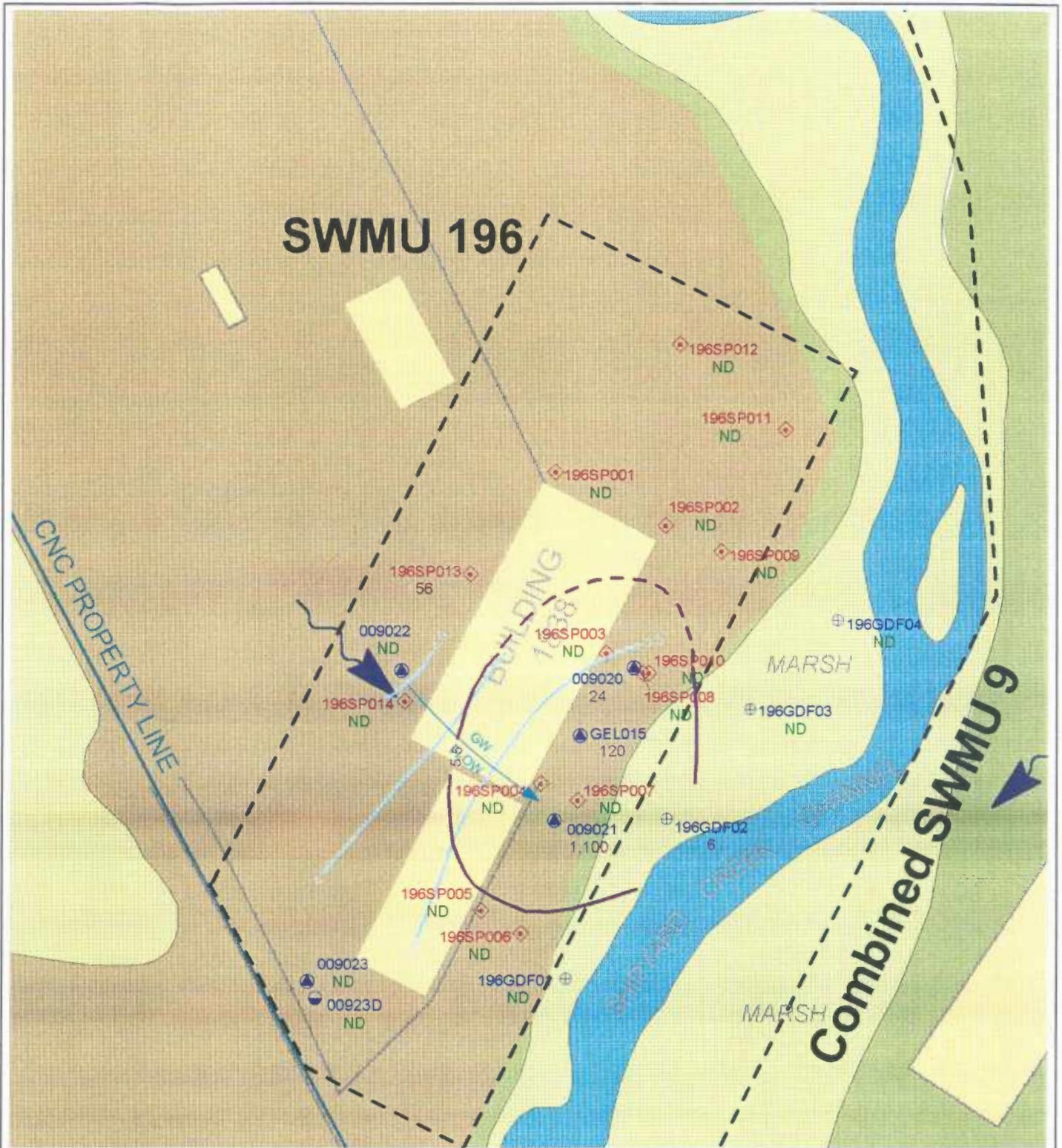
- SHALLOW MONITORING WELL
- DEEP MONITORING WELL
- ⊕ TEMPORARY WELL (IN MARSH)
- ◇ DPT SOIL SAMPLE
- 140 GW BENZENE CONC. (ug/L)
- ND HEADSPACE BENZENE CONC. (ug/L)
- 5- ND APPROXIMATE PLUME BOUNDARY
- ND NOT DETECTED
- GW ELEVATION CONTOUR (INTERVAL = 0.5 ft. MSL)
- GW FLOW DIRECTION

50 0 50 100 Feet



ZONE H
RFI WORKPLAN ADDENDUM
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CHARLESTON, SC

FIGURE 5
SWMU 196
BENZENE PLUME IN
GROUNDWATER AND
DPT HEADSPACE ANALYSIS IN SOIL
APRIL/JUNE 1999



LEGEND

- SHALLOW MONITORING WELL
- DEEP MONITORING WELL
- ⊕ TEMPORARY WELL (IN MARSH)
- ◇ DPT SOIL SAMPLE
- 1,100 GW 1,3-DICHLOROBENZENE CONC. (ug/L)
- 56 DPT SOIL 1,3-DICHLOROBENZENE CONC. (ug/kg)
- 5.5 APPROXIMATE PLUME BOUNDARY
- ND NOT DETECTED
- GW ELEVATION CONTOUR (INTERVAL = 0.5 ft. MSL)
- GW FLOW DIRECTION

50 0 50 100 Feet



ZONE H
RFI WORKPLAN ADDENDUM
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CHARLESTON, SC

FIGURE 6
SWMU 196
1,3-DICHLOROBENZENE PLUME IN
GROUNDWATER AND
DPT SOIL ANALYSIS
APRIL/JUNE 1999

Pesticides and PCBs

No pesticides or PCBs exceeded their respective MCL or RBC value in any of the SWMU 196 well sampling.

Soil

Headspace VOAs

The following VOAs were detected in soil using a field screening headspace analysis: chlorobenzene, 1,1-dichloroethene (1,1-DCE), trichloroethene (TCE), and tetrachloroethene (PCE). Chlorobenzene was detected in seven of fourteen subsurface DPT soil samples (196SP004, 06, 07, 09, 10, 11, and 12). Results ranged from 17 to 5,360 $\mu\text{g/L}$, clearly indicating the presence of this compound in subsurface soils. 1,1-DCE was detected in only one subsurface DPT sample 196SP006 at 5.8 $\mu\text{g/L}$. TCE was detected in 3 of the fourteen samples at 18, 21, and 146 $\mu\text{g/L}$ in locations 196SP013, 196SP014, and 196SP006 respectively. PCE was detected in only one location (196SP004) at a concentration of 0.87 $\mu\text{g/L}$. Results from the headspace analysis are presented in Table 3. Figures 4 and 5 also present the headspace results for chlorobenzene and benzene respectively.

SVOAs

Benzo(a)pyrene and dibenz(a,h)anthracene were detected in two subsurface DPT soil samples above their respective RBC, but below their respective SSLs. The benzo(a)pyrene equivalents (BEQs) value was calculated for all of the subsurface samples. BEQs were detected above the RBC (87 $\mu\text{g/kg}$) but below the SSL (1,600 $\mu\text{g/kg}$) in three of 14 subsurface locations (196SP001, 196SP011, and 196SP014) with concentrations of 265, 147, and 692 $\mu\text{g/kg}$, respectively. SVOAs results in the subsurface soil samples taken at SWMU 196 are presented in Table 4. Figure 6 also presents the DPT soil sampling results for 1,3-DCB.

Pesticides and PCBs

No pesticides or PCBs exceeded any RBC values in the subsurface soil data.

Surface Water

None of the surface water samples exceeded RBCs, MCLs, or surface water screening criteria. As was previously noted, the surface water diffusion samplers were attached to the four temporary wells in the marsh area. At high tide, these samplers were submerged in water, but at low tide these samplers were exposed to the air and sun. We anticipate that significant diffusion of volatile parameters from the samplers occurred during periods of air and sun exposure.

SPATIAL DISTRIBUTION OF RESULTS

Groundwater

Based on site topography, groundwater likely flows from the Building 1838 area generally east towards Shipyard Creek. This was confirmed during the sampling activities that occurred during April/June of 1999. Figures 4, 5 and 6 illustrate the groundwater elevations and groundwater flow direction for this sampling event. Groundwater contamination in this area appears to be generally defined by monitoring wells 009020, 009021, GEL015, and 196GDF02. All of these wells are adjacent to each other. Both chlorobenzene and dichlorobenzene compounds were detected in some of these monitoring wells at concentrations exceeding 1% of their solubility, indicating the possible presence of free product. Dichlorobenzene, in the form of 1,2-DCB, 1,3-DCB, and 1,4-DCB, was detected in groundwater and subsurface DPT soil samples within the plume area.

Contaminated groundwater may be discharging to Shipyard Creek with concentrations of chlorobenzene and 1,2-DCB exceeding saltwater/surface water chronic screening levels; however, surface water samples from the marsh area did not produce detections of any contaminants of potential concern above screening levels. Groundwater at temporary well 196GDF02 exceeds the saltwater/surface water chronic screening level for chlorobenzene and 1,2-DCB of 105 and 19.7 $\mu\text{g/L}$, respectively. Given that the area impacted by this plume is relatively small, the actual surface water concentrations in the creek channel are likely below these screening levels.

Soils

The presence of chlorobenzene in the subsurface DPT soil samples was somewhat random, indicating the source area has not been found or is no longer present. (Note that formal VOA samples were not collected from the DPT soil cores and the only VOA data is the headspace analysis). Chlorobenzene was detected in the plume area near the marsh, and may be the result of a fluctuating groundwater table. The headspace samples indicated the presence of chlorobenzene northeast of Building 1838, however, no groundwater monitoring wells are located in this area to confirm the presence or absence of groundwater contamination. Based on the correlation of headspace samples and groundwater chlorobenzene concentrations in the area east of Building 1838, it is likely present in groundwater northeast of the building also. 1,2-Dichlorobenzene was detected in only two subsurface locations, 196SP006 and 196SP013. Only location 196SP013 had significant concentrations of the contaminant, however, they still did not exceed an RBC or SSL. 1,3-DCB and 1,4-DCB were detected in only one location (196SP013).

Relationship to Landfill

SWMU 196 appears to have environmental concerns that are not directly associated with the landfill at SWMU 9. Site maps from the Zone H RFI do not show this area within the boundary of the closed landfill. Building 1838 is located on the opposite site of Shipyard Creek from the southern landfill boundary. The geologic descriptions from the 6 monitoring wells that are in the

SWMU 196 area (GEL015,009020, 009021, 009022, 009023 and 00923D) do not indicate the presence of any fill materials below 2 feet. Also, soil borings, taken during the EBEC (conducted by the CPW), and DPT soil samples do not show fill material below 3 feet. Many of the geologic descriptions from monitoring wells that are in the landfill area (009014, 009016 and 009121) note the presence of plastic, trash, glass, ceramic and other landfill materials at depths up to 15 feet below the ground surface.

The contamination levels for chlorobenzene and dichlorobenzene in the monitoring wells behind Building 1838 are several orders of magnitude greater than wells located within the landfill area. The chlorobenzene and 1,2-dichlorobenzene levels in the 3 wells behind Building 1838 suggest the possible presence of free product in this area. There is no finding similar to this from any of the monitoring wells within the known landfill area. It is for these reasons that SWMU 196 is being investigated for possible remediation separate from combined SWMU 9. Even if SWMU 196 were part of the greater SWMU 9 landfill, monitoring well contaminant levels suggest the existence of a different source in this area at some point in time. The 1991 Environmental Compliance Evaluation identified possible sources for the contamination in the paint, solvent and other containers that were stored at the site at that time.

RECOMMENDATIONS

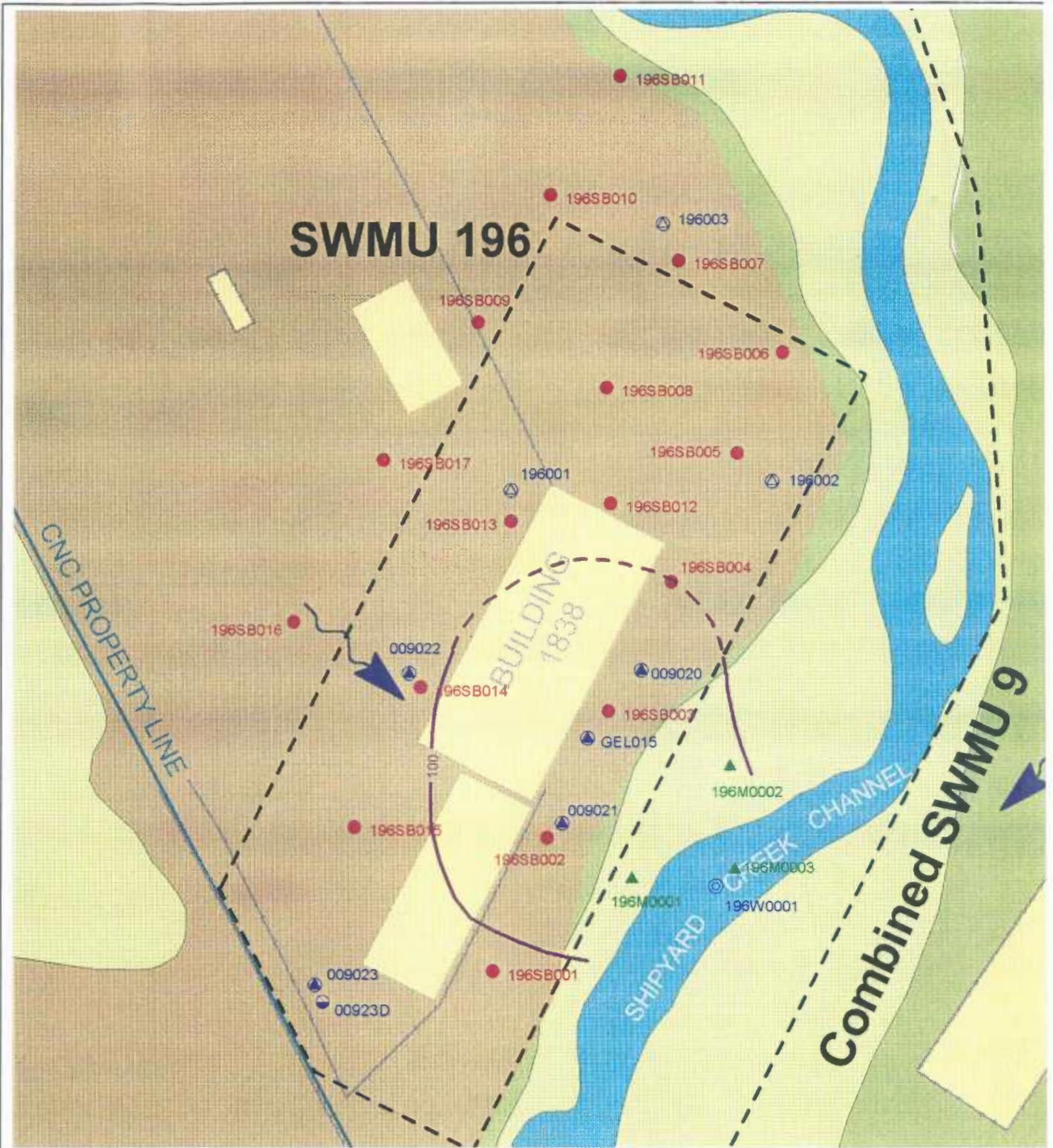
All of the required RFI determinations concerning nature of contamination, contaminant fate and transport, surficial risk, human health risk assessment and ecological risk assessment will be performed for SWMU 196. The following site investigations are recommended in order to further clarify the nature and extent of contamination, and to obtain the necessary data to complete the RFI and CMS for SWMU 196.

Groundwater

Install three additional monitoring wells at SWMU 196 to further define the extent of groundwater contamination. There are currently no monitoring wells in the area north of Building 1838. Chlorobenzene hits were found in the headspace analysis for the soil samples 9, 11 and 12 that were taken north of the building. SVOA hits for BEQs were also noted at sample locations 1, 11 and 12. We propose to install three additional monitoring wells north of the building to determine if the shallow groundwater plume extends into this area. The location for the three proposed shallow monitoring wells is provided on Figure 7. The shallow wells will be permanent and will be installed to approximately 13 feet below the ground surface. All wells will be constructed using threaded PVC screen and casing. Screened intervals for each well will be 10 feet in length. All well installation, development, and sampling will be performed in accordance with Section 5.0 of Revision No. 1 of the *Final Comprehensive Sampling and Analysis Plan (CSAP)* and in compliance with South Carolina Well Standards and Regulations R.61-71. See Table 5 for the rationale used to determine the locations of the proposed wells and Figure 7 for the proposed locations of the wells.

Perform an additional round of groundwater sampling and analysis on all new and existing site wells. The full suite of analytical parameters (VOAs, SVOAs, Pest/PCBs, cyanide, and metals) will be performed on all samples taken.

We do not propose any additional upgradient monitoring wells. Existing wells 009022 and 009023 are upgradient of the contamination that has been found at SWMU 196. Chlorobenzene and dichlorobenzene concentrations at these two wells have been less than MCLs for three rounds of sampling. In addition, we do not propose any deep monitoring wells. Existing well 00923D has not shown any VOA or SVOA contamination. Well 00923D is 36.8 feet deep and is screened between 27 and 36.3 feet below ground surface. There is a layer of clay approximately 11 feet thick that separates the shallow and deep aquifers.



LEGEND

- ⊕ PROPOSED SHALLOW MONITORING WELL
- PROPOSED SOIL BORING
- ▲ PROPOSED CORE SEDIMENT SAMPLE
- ⊙ PROPOSED SURFACE WATER SAMPLE
- ⊕ EXISTING SHALLOW MONITORING WELL
- ⊖ EXISTING DEEP MONITORING WELL
- 100 APPROXIMATE PLUME BOUNDARY

50 0 50 100 Feet



ZONE H
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FIGURE 7
SWMU 196
PROPOSED SHALLOW
MONITORING WELL, SOIL BORING,
SEDIMENT SAMPLE, AND SURFACE WATER
SAMPLE LOCATIONS

Soil

Collect sufficient surface and subsurface soil boring samples from the site to allow soil risk calculations to be performed. Previous DPT soil sampling was performed with the intention of possibly locating a sub-surface source area. Since this was not successful, the proposed sampling is to define the nature and extent of soil contamination and to provide sufficient data for human health risk calculation. Surface samples will be taken from the 0-1 foot depth and sub-surface samples will be taken from the 3-5 feet depth. Where Encore samplers are utilized for soil analysis, bulk samples will also be taken at the same locations to provide a means for determining lab artifacts. The full suite of analytical parameters will be performed on all soil samples taken. The soil sampling work is proceeding concurrently with the submittal of this document. Soil samples will be taken until the extent of surface soil contamination is defined by the residential risk-based concentration (RBC). Chemicals of concern found in the fate and transport analysis will be defined to the soil screening level (SSL) based on a dilution attenuation factor (DAF) = 1 or to a site specific DAF. If a site specific DAF is to be calculated, total organic carbon (TOC) and synthetic precipitation leaching procedure (SPLP) samples will be taken. The DAF used in the fate and transport analysis will be determined upon the receipt of the soil sample data. See Table 6 for the rationale used for the locations of these samples and Figure 7 for the proposed locations of the soil borings.

Sediment

Collect sufficient sediment samples from the site to allow ecological risk calculations to be performed. Three sediment core samples will be taken to determine the vertical extent of sediment contamination. The sediment cores will be made up of samples taken from the 0-6-inch depth, the 15-21-inch depth and the 30-36-inch depth. Plastic shelby tubes with sediment traps will be utilized to take the core samples. Two of the samples will be taken in the marsh adjacent to Shipyard Creek and the other will be taken in the creek. Should sample core recovery be insufficient for analytical requirements, additional samples will be taken at adjacent locations. The full suite of analytical parameters will be performed on all samples taken. The sediment sampling

work is proceeding concurrently with the submittal of this document. See Table 7 for the rationale used for the locations of these samples and Figure 7 for the proposed locations of the sediment samples.

Surface Water

Collect water samples from Shipyard Creek channel to compare surface water quality with screening levels. A diffusion sampler will be utilized for this purpose. The sampler will be placed on the bottom of the channel of Shipyard Creek. See Table 7 for the rationale for the location of this sample and Figure 7 for the proposed location for the diffusion sampler.

Risk Assessments

- Conduct an updated habitat/biota survey for the SWMU 196 area. This work is proceeding concurrently with the submittal of this document.
- Perform human health and ecological risk assessments for the site.

All soil sampling and well installation, development and sampling will be performed in accordance with Section 5.0 of Revision No. 01 of the Charleston Naval Complex (CNC) Final Comprehensive Sampling and Analysis Plan (CSAP) and in compliance with South Carolina Well Standards and Regulations R. 61-71.

Table 1
VOAs in GW at SWMU 196
All concentrations are in µg/L.

Sample Number	Date	Benzene	Chlorobenzene	1,2- Dichloroethene (total)	Vinyl Chloride
		5	100	5.5 ¹	2
		700	5,000	NA	10,000
<i>GEL015-01</i>	<i>5/98</i>	<i>130 JD</i>	<i>14,000 D</i>	<i>2.5</i>	<i>3.8</i>
GEL015-02	8/98	200	5,200 D	5 UJ	5 U
GEL015-03	4/99	140 J	7,200 D	5 UJ	5 U
009020-01	8/98	61	5,100 D	5 UJ	5 U
<i>009020-02</i>	<i>10/98</i>	<i>43</i>	<i>6,800 E</i>	<i>5 U</i>	<i>5 U</i>
009020-03	4/99	19	16,000 D	5 U	5 U
009021-01	8/98	36	4,300 D	49 J	5 U
<i>009021-02</i>	<i>10/98</i>	<i>160</i>	<i>6,400 E</i>	<i>169</i>	<i>26</i>
009021-03	4/99	110	19,000 D	240	44 J
009022-01	8/98	5 U	5 U	5 U	5 U
<i>009022-02</i>	<i>10/98</i>	<i>5 U</i>	<i>5</i>	<i>5 U</i>	<i>5 U</i>
009022-03	4/99	5 U	42	5 U	5 U
009023-01	8/98	5 U	5 U	45 J	50
<i>009023-02</i>	<i>10/98</i>	<i>5 U</i>	<i>2 J</i>	<i>5 U</i>	<i>5 U</i>
009023-03	4/99	5 U	5 U	5 U	5 U
00923D-01	8/98	5 U	5 U	5 UJ	5 U
00923D-03	4/99	5 U	5 U	5 U	5 U
196GDF01-W1	6/99	3 U	12	3 U	3 U
196GDF02-W1	6/99	21	5,200 D	3 U	3 U
196GDF03-W1	6/99	3 U	3 U	3 U	3 U
196GDF04-W1	6/99	3 U	3 U	3 U	3 U

Notes:

1 - Value is an RBC

Outlined concentrations exceed 1% of the compound's solubility.

ITALIC value indicates MNA data that is not validated.

BOLD value indicates a concentration above the applicable MCL/RBC

D - Analysis performed at a secondary dilution factor

E - The concentration of this analyte exceeded the calibration range of the instrument

J - The associated numerical value is an estimated quantity.

U - The material was analyzed but not detected at the listed numerical quantitation limit.

UJ - The material was analyzed but not detected. The sample quantitation limit is estimated.

Table 2
SVOAs in GW at SWMU 196
All concentrations are in µg/L.

Sample Number	Date	2-Chlorophenol	1,2-DCB ¹	1,3-DCB ²	1,4-DCB ³
MCL/RBC		30⁴	600	5.5⁴	75
1 % of Solubility		NA	1000	NA	800
GEL015-02	8/98	28	6000 D	140 J	220 D
GEL015-03	4/99	10 UR	12,000	120 J	310 D
009020-01	8/98	67	1500 D	58	130 D
009020-03	4/99	52	140	24 J	92
009021-01	8/98	3 J	3300 D	270 D	510 D
009021-03	4/99	10 UR	13,000	1,100 D	1,900 D
009022-01	8/98	10 U	10 U	10 U	10 U
009022-03	4/99	10 U	10 U	10 U	15
009023-01	8/98	10 U	10 U	10 U	10 U
009023-03	4/99	10 UJ	4 J	10 U	10 U
00923D-01	8/98	10 UJ	10 U	10 U	10 U
00923D-03	4/99	10 U	10 U	10 U	10 U

Table 2
SVOAs in GW at SWMU 196
All concentrations are in µg/L.

Sample Number	Date	2-Chlorophenol	1,2-DCB ¹	1,3-DCB ²	1,4-DCB ³
MCL/RBC		30⁴	600	5.5⁴	75
196GDF01-01	6/99	6 U	6 U	6 U	6 U
196GDF02-01	6/99	7	6 U	6	23
196GDF03-01	6/99	5 U	5 U	5 U	5 U
196GDF04-01	6/99	5 U	5 U	5 U	5 U

Notes:

1 - 1,2-Dichlorobenzene

2 - 1,3-Dichlorobenzene

3 - 1,4-Dichlorobenzene

4 - Value is an RBC

Outlined concentrations exceed 1% of the compound's solubility.

BOLD value indicates a concentration above the applicable RBC or MCL

D - Analysis performed at a secondary dilution factor.

J - The associated numerical value is an estimated quantity.

U - The material was analyzed but not detected at the listed numerical quantitation limit.

UJ - The material was analyzed but not detected at the estimated numerical quantitation limit.

UR - The material was analyzed but not detected at the unusable quantitation limit.

Table 3
Head Space Analysis at SWMU 196
All concentrations are in µg/L

Sample Number	Benzene	Chlorobenzene	1,1-DCE ¹	1,1-DCA ²	TCE ³	PCE ⁴
196SP00103	ND	ND	ND	ND	ND	ND
196SP00203	ND	ND	ND	ND	ND	ND
196SP00303	ND	ND	ND	ND	ND	ND

Table 3
Head Space Analysis at SWMU 196
All concentrations are in $\mu\text{g/L}$

Sample Number	Benzene	Chlorobenzene	1,1-DCE ¹	1,1-DCA ²	TCE ³	PCE ⁴
196SP00403	ND	ND	ND	ND	ND	0.87
196SP00503	ND	ND	ND	ND	ND	ND
196SP00603	ND	1,566	5.8	ND	146	ND
196SP00703	ND	4,747	ND	ND	ND	ND
196SP00803	ND	ND	ND	ND	ND	ND
196SP00903	ND	5,360	ND	ND	ND	ND
196SP01003	ND	31	ND	ND	ND	ND
196SP01103	ND	1,106	ND	ND	ND	ND
196SP01203	ND	622	ND	ND	ND	ND
196SP01303	ND	ND	ND	ND	ND	4
196SP01403	ND	ND	ND	ND	21	ND

Notes:

Bold - Detected concentration in headspace sample.

1 - 1,1-Dichloroethene

2 - 1,1-Dichloroethane

3 - Trichloroethene

4 - Tetrachloroethene

Table 4
SVOAs In Soil at SWMU 196
All concentrations are in $\mu\text{g}/\text{kg}$

Sample	B(a)A	Chryse	B(b)F	B(k)F	B(a)P	I(1,2,3-	D(a,h	BEQs	1,2-	1,3-	1,4-
Risk Based Concentration¹	870	87000	870	8700	87	870	87	87	700,000	230,000	27,000
SSL	800	80,000	2,300	24,000	4,000	7,000	800	1,600	8,600	230	1000
196SP00103	260 J	700	210 J	300 J	240 J	380 U	380 U	291	380 U	380 U	39 J
196SP00203	370 U	370 U	370 U	370 U	370 U	370 U	370 U	92 U	370 U	370 U	370 U
196SP00303	380 U	380 U	380 U	380 U	380 U	380 U	380 U	92 U	65 J	380 U	380 U
196SP00403	360 U	360 U	360 U	360 U	360 U	360 U	360 U	92 U	360 U	360 U	360 U
196SP00503	370 U	370 U	370 U	370 U	370 U	370 U	370 U	92 U	370 U	370 U	370 U
196SP00603	400 U	400 U	400 U	400 U	400 U	400 U	400 U	92 U	400 U	400 U	400 U
196SP00703	420 U	420 U	420 U	420 U	420 U	420 U	420 U	92 U	420 U	420 U	420 U
196SP00803	399 U	399 U	399 U	399 U	399 U	399 U	399 U	92 U	399 U	399 U	399 U
196SP00903	360 U	360 U	360 U	360 U	360 U	360 U	360 U	92 U	360 U	360 U	360 U
196SP01003	440 U	440 U	440 U	440 U	440 U	440 U	440 U	92 U	440 U	440 U	440 U
196SP01103	110 J	160 J	140 J	160 J	120 J	370 U	370 U	147	370 U	370 U	370 U
196SP01203	230 J	240 J	350 J	510	490	190 J	120 J	692	390 U	390 U	390 U
196SP01303	390 U	390 U	390 U	390 U	390 U	390 U	390 U	92 U	7,700 E	56 J	420
196SP01404	380 U	380 U	380 U	380 U	380 U	380 U	380 U	92 U	380 U	380 U	380 U

Notes:

All data is unvalidated

1 - RBC's obtained from the October 1998 Region III RBC table, a THQ = 0.1 has been conservatively applied.

BOLD value indicates a concentration above the applicable RBC.

D - Analysis performed at a secondary dilution factor.

E - The concentration of this analyte exceeded the calibration range of the instrument

J - The associated numerical value is an estimated quantity.

U - The material was analyzed but not detected at the listed numerical quantitation limit.

UJ - The material was analyzed but not detected at the estimated numerical quantitation limit.

**Table 5
SWMU 196
Well Installation and Analysis Plan**

Well ID	Rationale
196001	To define the northwest extent of contamination along with well 009022 and to fill the data gap between well 009022 and proposed well 196003
196002	To determine extent of chlorobenzene contamination due to DPT soil samples 196SP009 and 196SP011 which had head space analysis chlorobenzene concentrations of 5,360 µg/L and 1,106 µg/L respectively; It will be located between sample locations 196SP009 and 196SP011
196003	To define the northern extent of contamination; It will be located approximately 50 feet north of DPT soil sample 196SP012 which had a head space analysis chlorobenzene concentration of 622 µg/L

Notes:

All samples will be analyzed for VOAs, SVOAs, Pest/PCBs, metals, and cyanide.
Existing wells will also be sampled for the analytes listed above.

**Table 6
SWMU 196
Soil Sampling and Analysis Plan**

Sample ID	Rationale
196SB001	Located southwest of DPT soil sample 196SP006 which had a head space analysis chlorobenzene and TCE concentrations of 1,566 µg/L and 146 µg/L respectively
196SB002	Located southwest of well 009021 and DPT soil sample 196SP007 which had a head space analysis chlorobenzene concentration of 4,747 µg/L
196SB003	Located between wells GEL015 and 009020
196SB004	Located southwest of DPT soil sample 196SP009 which had a head space analysis chlorobenzene concentration of 5,360 µg/L
196SB005	Located southwest of DPT soil sample 196SP011 which had a head space analysis chlorobenzene concentration of 1,106 µg/L
196SB006	Located north of DPT soil sample 196SP011 and east of 196SP012 which had a head space analysis chlorobenzene concentrations of 1,106 µg/L and 622 µg/L respectively

Table 6
SWMU 196
Soil Sampling and Analysis Plan

Sample ID	Rationale
196SB007	Located north of DPT soil sample 196SP012 which had a head space analysis chlorobenzene concentration of 622 µg/L
196SB008	Located southwest of DPT soil sample 196SP012 which had a head space analysis chlorobenzene concentration of 622 µg/L
196SB009	Located northwest of proposed soil boring 196SB008 to define the extent of soil contamination
196SB010	Located northwest of proposed soil boring 196SB007 to define the extent of soil contamination
196SB011	Located north of proposed soil boring 196SB007 to define the extent of soil contamination
196SB012	Located southeast of DPT soil sample 196SP001 which had a BEQ concentration of 291 µg/kg
196SB013	Located northeast of DPT soil sample 196SP013 which had a head space analysis TCE concentration of 18 µg/L
196SB014	Located near DPT soil sample 196SP014 which had a head space analysis TCE concentration of 21 µg/L
196SB015	Located northwest of proposed soil boring 196SB001 and southwest of proposed soil boring 196SB014 to define the extent of soil contamination
196SB016	Located northwest of proposed soil boring 196SB014 to define the extent of soil contamination
196SB017	Located northwest of proposed soil boring 196SB013 to define the extent of soil contamination

Note:

Surface and subsurface samples will be taken and all samples will be analyzed for VOAs, SVOAs, Pest/PCBs, metals, and cyanide.

Table 7
SWMU 196
Sediment and Surface Water Sampling and Analysis Plan

Sample ID	Rationale
Sediment	
196M0001	Located between temporary wells 196GDF01 and 196GDF02 to determine the vertical extent of sediment contamination due to benzene and chlorobenzene concentrations of 21 µg/L and 5,200 µg/L, respectively, found in groundwater at temporary well 196GDF02
196M0002	Located between temporary wells 196GDF02 and 196GDF03 to determine the vertical extent of sediment contamination due to benzene and chlorobenzene concentrations of 21 µg/L and 5,200 µg/L, respectively, found in groundwater at temporary well 196GDF02
196M0003	Located in Shipyard Creek east of temporary well 196GDF02 to determine the vertical extent of sediment contamination due to benzene and chlorobenzene concentrations of 21 µg/L and 5,200 µg/L, respectively, found in groundwater at temporary well 196GDF02
Surface Water	
196W0001	Located in Shipyard Creek east of temporary well 196GDF02 to determine if contaminated groundwater at temporary well 196GDF02 is impacting surface water in Shipyard Creek

Notes:

All samples will be analyzed for VOAs, SVOAs, Pest/PCBs, metals, and cyanide.

Sediment samples will be taken at the following intervals: 0-6", 15"-21", and 30"-36" below ground surface.