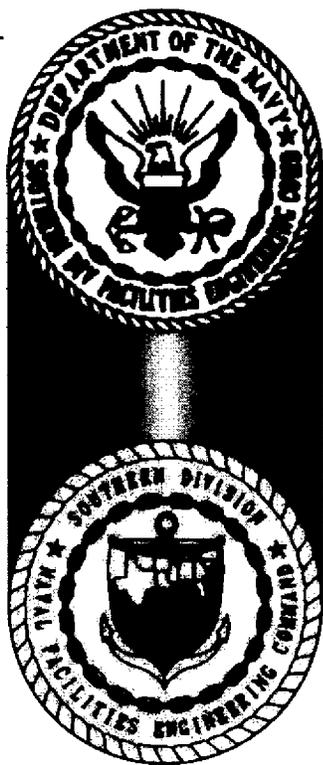


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CORRECTIVE MEASURES STUDY WORK PLAN ZONE 1 CNC CHARLESTON SC  
5/1/2002  
CH2MHILL

# CORRECTIVE MEASURES STUDY WORK PLAN

## Zone I



***Charleston Naval Complex  
North Charleston, South Carolina***

SUBMITTED TO  
***U.S. Navy Southern Division  
Naval Facilities Engineering Command***

*CH2M-Jones*

*May 2002*

*Contract N62467-99-C-0960*

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**CH2MHILL**

May 9, 2002

Mr. David Scaturo  
South Carolina Department of Health and  
Environmental Control  
Bureau of Land and Waste Management  
2600 Bull Street  
Columbia, SC 29201

Re: Response to Comments on the CMS Work Plan – Zone I, Charleston Naval Complex

Dear Mr. Scaturo:

Enclosed we are submitting two copies of the set of pages which will serve as the Revision 1 (in addition to the Responses to Comments) to CMS Work Plan for Zone I of the Charleston Naval Complex (originally submitted in February 2002). Below you will find a list of the items that have been revised, as well as a brief summary characterizing the nature of this revision. This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

- **Revision 1 of cover, spine, and flysheet, dated May 2002.** These items should be replaced in the Revision 0 binder that was provided to you in February.
- **Replacement text and tables, dated May 2002.** These pages should be replaced where indicated in the Revision 0 binder.
- **New Appendix D, CH2M-Jones Responses to EPA Comments regarding the CMS Work Plan, Zone I (Revision 0).** This appendix should be added to the original binder as a new appendix. The material includes the responses by CH2M-Jones to EPA comments on the Revision 0 document.

The principal author of this document is Kris Garcia. Please contact her at 770/604-9182, ext. 476, or me, at 352-335-5877, ext. 2280, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

Tim Frederick/Gannett-Fleming, Inc., w/att  
Rob Harrell/Navy, w/att  
Gary Foster/CH2M HILL, w/att



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February 25, 2002

Mr. David Scaturo  
Division of Hazardous and Infectious Wastes  
South Carolina Department of Health and  
Environmental Control  
Bureau of Land and Waste Management  
2600 Bull Street  
Columbia, SC 29201

Re: CMS Work Plan (Revision 0) – Zone I

Dear Mr. Scaturo:

Enclosed are two copies of the CMS Work Plan (Revision 0) for Zone I of the Charleston Naval Complex (CNC). This CMS work plan has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Kris Garcia. Please contact her at 770/604-9182, extension 476, should you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Tim Frederick/Gannett-Fleming, Inc., w/att  
Rob Harrell/Navy, w/att  
Gary Foster/CH2M HILL, w/att

# CORRECTIVE MEASURES STUDY WORK PLAN

## Zone I



***Charleston Naval Complex  
North Charleston, South Carolina***

SUBMITTED TO  
***U.S. Navy Southern Division  
Naval Facilities Engineering Command***

PREPARED BY  
***CH2M-Jones***

*May 2002*

*Revision 1  
Contract N62467-99-C-0960  
158814.ZI.PR.00*

## Certification Page for Corrective Measures Study Work Plan (Revision 1) – Zone I

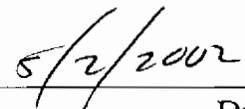
I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428



Dean Williamson, P.E.



Date

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23	2002)	

# 1 Acronyms and Abbreviations

2	AOC	area of concern
3	AST	aboveground storage tank
4	BCT	BRAC Cleanup Team
5	BEQ	benzo(a)pyrene equivalent
6	BRAC	Base Realignment and Closure Act
7	BRC	background reference concentration
8	CA	corrective action
9	CMS	corrective measures study
10	CNC	Charleston Naval Complex
11	COC	chemical of concern
12	COPC	chemical of potential concern
13	DAF	dilution attenuation factor
14	DMA	Dredge Materials Area
15	EnSafe	EnSafe Inc.
16	EPA	U.S. Environmental Protection Agency
17	ILC	incremental lifetime cancer
18	HI	hazard index
19	MCL	maximum contaminant level
20	$\mu\text{g}/\text{kg}$	microgram per kilogram
21	$\mu\text{g}/\text{L}$	microgram per liter
22	$\text{mg}/\text{kg}$	milligram per kilogram
23	NAVBASE	Naval Base
24	NFA	no further action
25	NFI	no further investigation
26	NOAA	National Oceanographic and Atmospheric Administration
27	PCB	polychlorinated biphenyl
28	PCE	tetrachloroethene
29	pg	picogram
30	OWS	oil/water separator

1	RBC	risk-based concentration
2	RCRA	Resource Conservation and Recovery Act
3	RFA	RCRA Facility Assessment
4	RFI	RCRA Facility Investigation
5	RTC	Regional Training Center
6	SCDHEC	South Carolina Department of Health and Environmental Control
7	SIMA	Shore Intermediate Maintenance Activity
8	SQL	sample quantitation limit
9	SSL	soil screening level
10	SVOC	semivolatile organic compound
11	SWMU	solid waste management unit
12	TDS	total dissolved solids
13	TEQ	Dioxin Toxicity Equivalents
14	UST	underground storage tank
15	VOC	volatile organic compound



# 1 1.0 Introduction

2 In 1993, Naval Base (NAVBASE) Charleston was added to the list of bases scheduled for  
3 closure as part of the Defense Base Realignment and Closure Act (BRAC), which regulates  
4 closure and transition of property to the community. The Charleston Naval Complex (CNC)  
5 was formed as a result of the dis-establishment of the Charleston Naval Shipyard and  
6 NAVBASE on April 1, 1996.

7 Corrective Action (CA) activities are being conducted under the Resource Conservation and  
8 Recovery Act (RCRA) with the South Carolina Department of Health and Environmental  
9 Control (SCDHEC) as the lead agency for CA activities at the CNC. Some regulatory review  
10 activities have also been delegated to U.S. Environmental Protection Agency (EPA) Region  
11 4. All RCRA CA activities are performed in accordance with the Final Permit (Permit No.  
12 SC0 170 022 560).

13 The *Zone I RFI Report, Revision 0* (EnSafe Inc. [EnSafe], 1999), was submitted to SCDHEC in  
14 March 1999 to address most of the solid waste management units (SWMUs) and areas of  
15 concern (AOCs) in Zone I, and supplemental *Zone I RFI Report, Revision 0*, was submitted in  
16 May 1999 to address the final four AOCs. Comments generated by SCDHEC on both  
17 submittals were consolidated, and CH2M-Jones provided a combined response to  
18 comments outlining the approach CH2M-Jones would use to finalize the RFI Report.  
19 Following concurrence on the finalization approach, CH2M-Jones submitted the *Zone I RFI*  
20 *Report Addendum, Revision 1* (CH2M-Jones, 2001) to SCDHEC on September 5, 2001. On  
21 November 29, 2001, SCDHEC provided final approval of the RFI Report Addendum, which  
22 was submitted in completion of the RCRA Facility Investigation (RFI) process for the  
23 SWMUs and AOCs in Zone I.

24 This submittal has been prepared by CH2M-Jones to complete the RCRA Corrective  
25 Measures Study (CMS) Work Plan for the RFI units in Zone I of the CNC. The following  
26 Zone I sites are recommended for no further action (NFA):

- 27 • AOC 671
- 28 • AOCs 672/673
- 29 • AOCs 675/676/677
- 30 • AOCs 678/679
- 31 • AOC 680
- 32 • AOC 681

- 1 • AOC 681
- 2 • AOC 685
- 3 • AOC 687/SWMU 16
- 4 • AOC 688
- 5 • AOCs 689/690
- 6 • SWMU 12
- 7 • SWMU 177/ Regional Training Center (RTC)

8 The recommendations presented in this document are based on additional evaluation of  
9 existing data and known site conditions. All SWMUs and AOCs have been reviewed and  
10 rescreened in accordance with the policies and procedures agreed to by the BRAC Cleanup  
11 Team (BCT).

12 Figure 1-1 illustrates the location of Zone I within the CNC and Figure 1-2 shows the  
13 locations of the units being addressed under this CMS Work Plan.

14 AOCs 711, 715, and 718 (shown on Figure 1-2) are oil/water separators (OWSs) that were  
15 identified by SCDHEC in late 2001. Due to their recent identification, they have not yet been  
16 evaluated under the RFI process, but Confirmatory Sampling and Investigation reports are  
17 in progress for each one. The sites are included on Figure 1-2 to indicate their presence. The  
18 AOCs and SWMUs addressed in this CMS Work Plan (other than the OWS AOCs) can be  
19 evaluated separately and closed out independently of the OWS AOCs.

20 The northern portion of Zone I has been zoned for business use (B-2); the lower middle  
21 portion has been zoned for industrial use (M-1); and the southernmost tip has been zoned  
22 for business use (B1-C) (see Figure 1-3.)

## 23 **1.1 Purpose of the CMS Work Plan for Zone I**

24 This report provides information about the Zone I units that documents the conclusions  
25 from the RFI and presents the CMS recommendations for each Zone I unit.

26 SCDHEC comments on both the RFI report and the CH2M-Jones Response to Comments  
27 were presented in the RFI Report Addendum. As a result of the RFI findings, no additional  
28 field investigations are necessary.

29 Also, the RFI report evaluated the potential of constituents present in the soils to impact  
30 groundwater quality by evaluating soil data relative to soil screening level (SSL) values. As  
31 part of the risk evaluations, the RFI compared the maximum detected concentrations of all  
32 constituents to generic SSL values based on a dilution attenuation factor (DAF) of 10. This  
33 approach is appropriate for non-volatile constituents, but given the mobility of volatile

1 organic compounds (VOCs), a comparison to an SSL with a DAF of 1 was agreed by the  
2 BCT to be more appropriate. Therefore, as part of this CMS Work Plan, VOCs detected in  
3 surface and subsurface soils in Zone I were rescreened using a generic SSL with a DAF=1.  
4 SSL values provided in the EPA SSL Guidance Document (May 1996) were used to  
5 complete the screening.

6 Prior to changing the status of any site to NFA in the CNC RCRA CA permit, the BCT  
7 agreed that the following issues should be considered:

- 8 • Status of the RFI
- 9 • Presence of metals (inorganics) in groundwater
- 10 • Potential linkage to SWMU 37, Investigated Sanitary Sewers at the CNC
- 11 • Potential linkage to AOC 699, Investigated Storm Sewers at the CNC
- 12 • Potential linkage of AOC 504, Investigated Railroad Lines at the CNC
- 13 • Potential linkage to surface water bodies (Zone J)
- 14 • Potential contamination associated with oil/water separators (OWSs)
- 15 • Relevance or need for land use controls at the site

16 These issues are addressed for each of the sites included in the RFI report and the results are  
17 provided in this CMS Work Plan to expedite evaluation of each of these sites contained  
18 within Zone I.

19 Provided that the information presented in this report is adequate to address these site  
20 closeout items, it is expected that the BCT will concur that NFA is appropriate for each of  
21 these sites in Zone I. At that time, a Statement of Basis will be prepared that will be  
22 available for public comment in accordance with SCDHEC policy. This will allow for public  
23 participation in the final remedy selection.

## 24 **1.2 Report Organization**

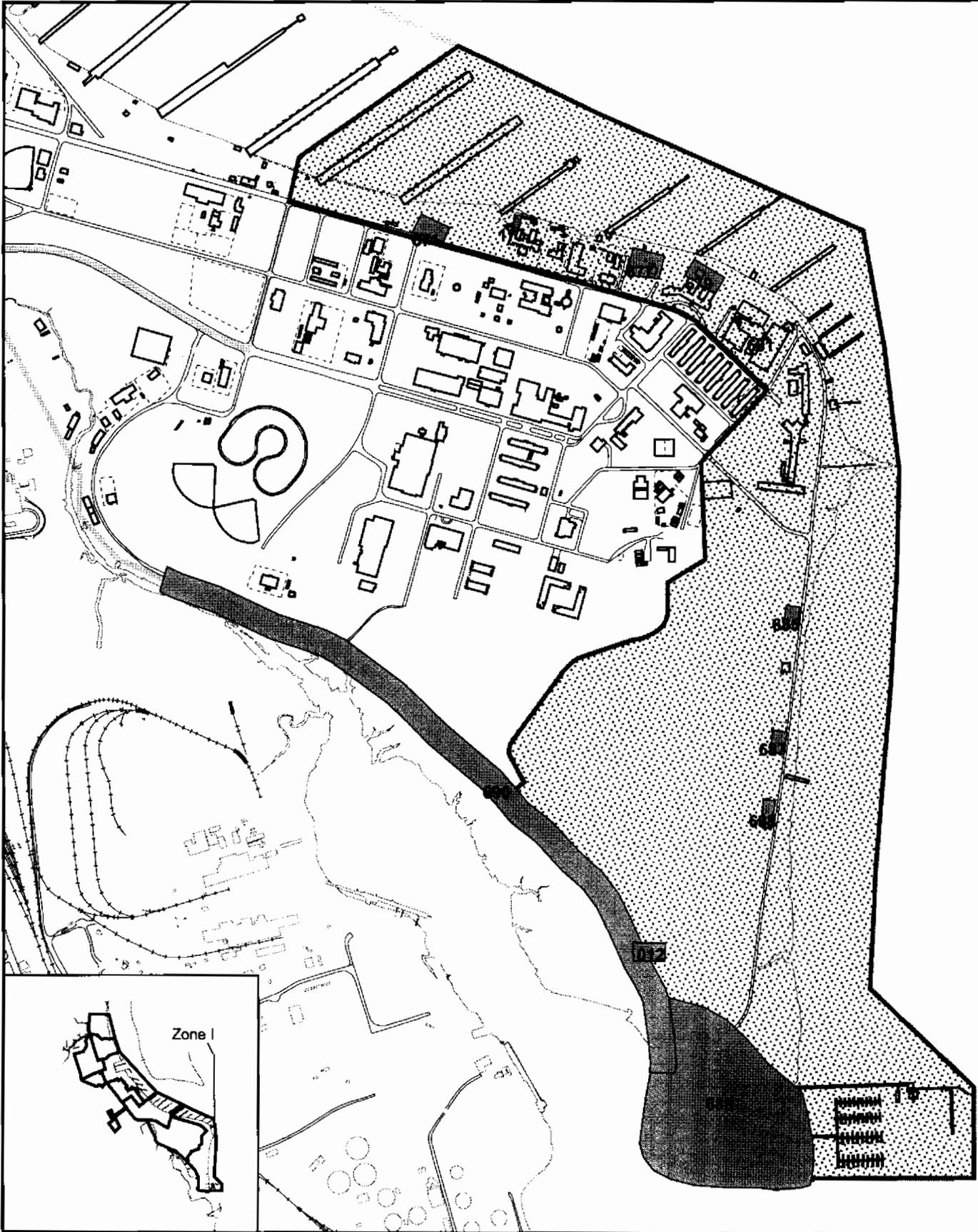
25 This CMS Work Plan consists of the following sections, including this introductory section:

26 **Section 1.0 Introduction** – Presents the purpose of the report and background information  
27 relating to the CMS Work Plan.

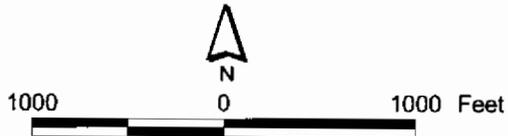
28 **Sections 2.0 through 13.0** - Present unit-specific background, RFI investigation summaries,  
29 RFI risk summaries, and chemical of potential concern (COPC)/chemical of concern (COC)  
30 refinements (if any), closeout discussions, and CH2M-Jones site-specific CMS Work Plan  
31 recommendations.

32 **14.0 Recommendations** – Provides the Zone I CMS Work Plan Summary.

33 **15.0 References** – Lists the references used in this document.



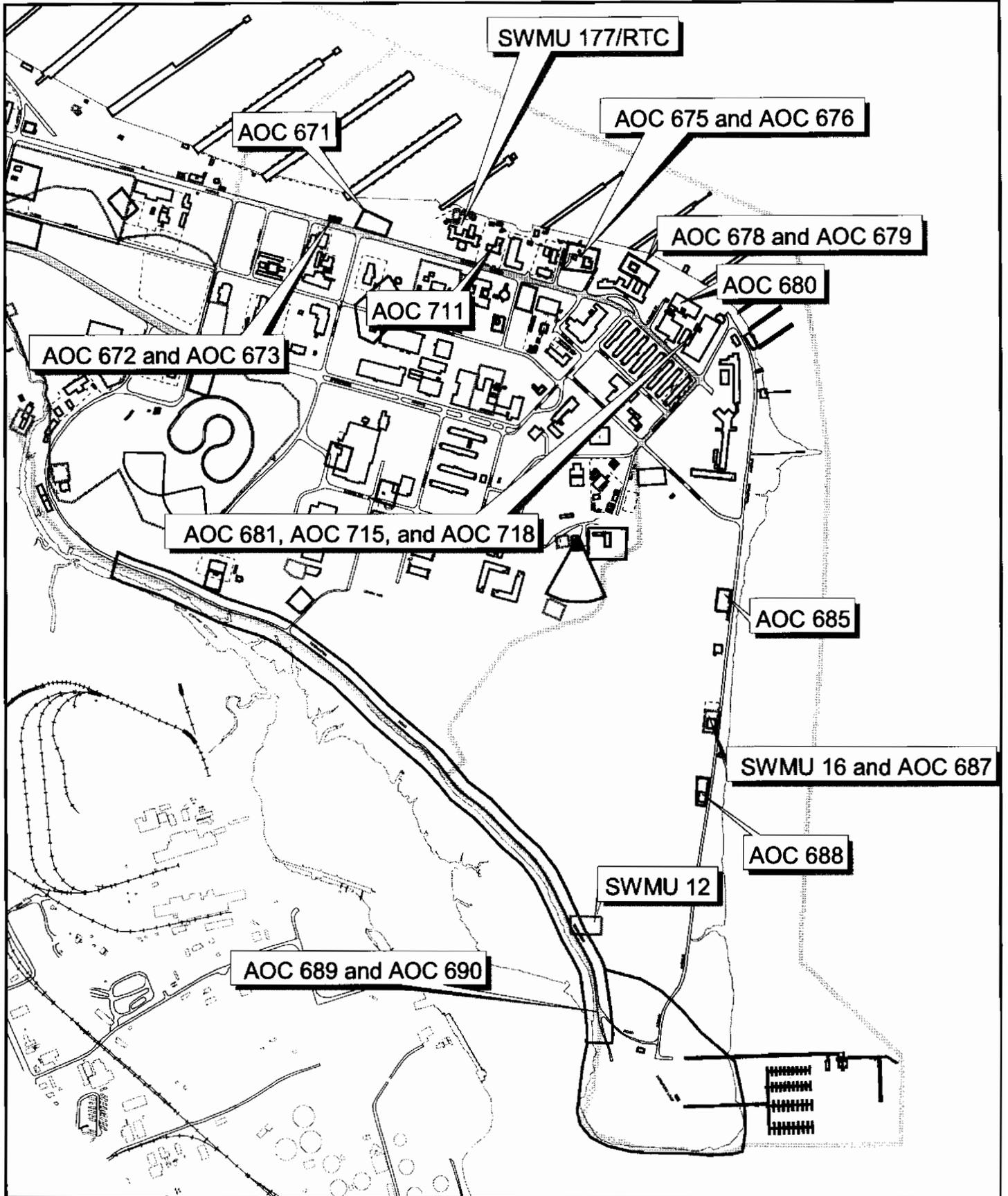
 Zone I  
 SWMU/AOC Within Zone I Boundary



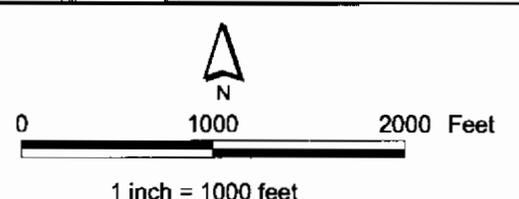
1 inch = 250 feet

**Figure 1-1**  
 Zone I Within CNC  
 Charleston Naval Complex

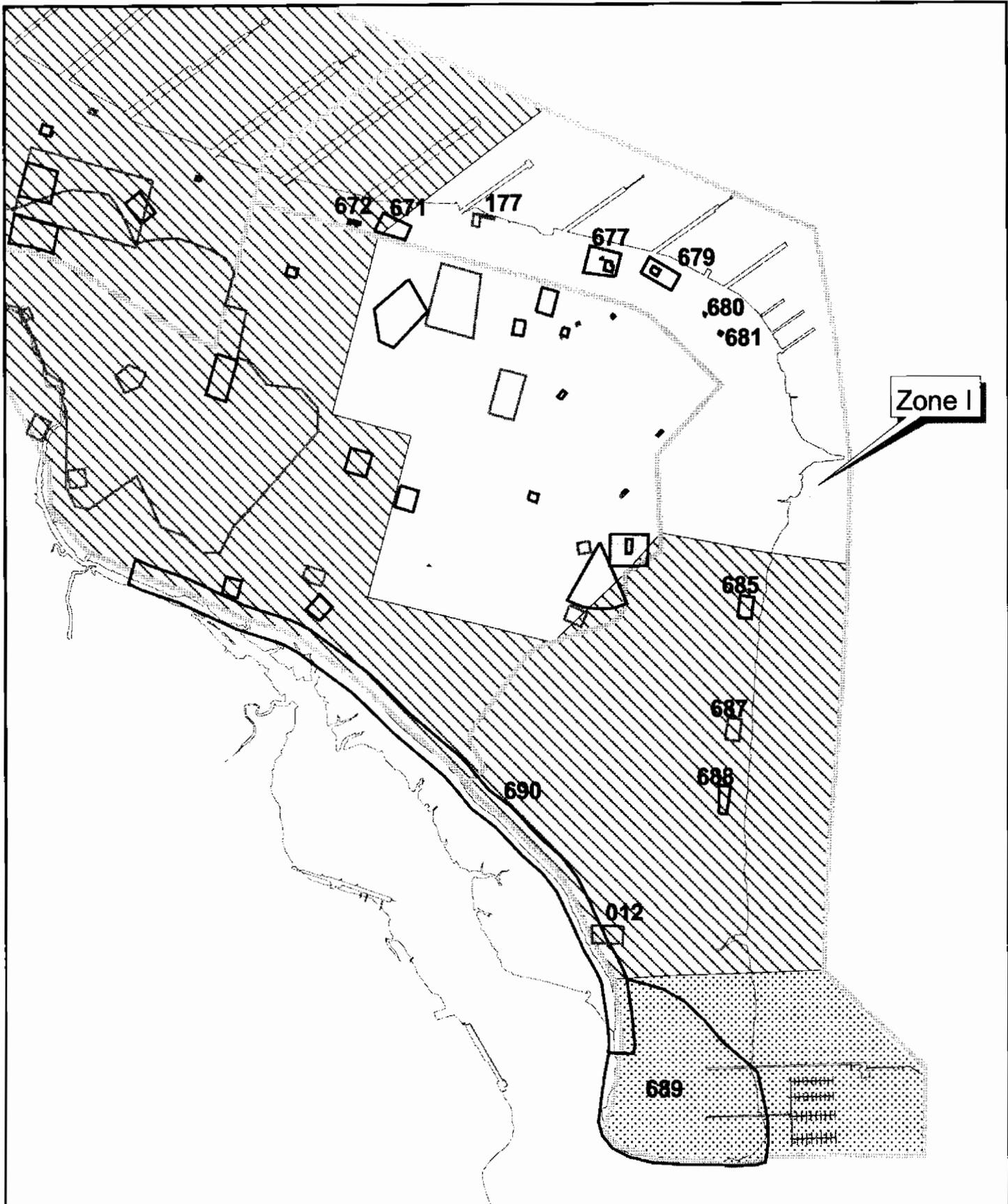
**CH2MHILL**



- Fence
- Railroads
- Roads - Lines
- Shoreline
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary



**Figure 1-2**  
 SWMUs and AOCs  
 Zone I  
 Charleston Naval Complex



Zone I

- Roads
- Shoreline
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary
- B-2
- B1-C
- M-1 (Industrial Zoning)

} Business Zoning



0 1000 2000 Feet

1 inch = 1000 feet

**Figure 1-3**  
 Preliminary Zoning  
 Zone I  
 Charleston Naval Complex



## 2.0 CMS Work Plan for AOC 671

This section summarizes the results and conclusions from the soil and groundwater investigations conducted at AOC 671, which were reported in the *Zone I RFI Report, Revision 0* (EnSafe, 1999), Section 10.1, and as amended by the *Zone I RFI Report Addendum, Revision 1* (CH2M-Jones, 2001). Figure 2-1 presents the site features and RFI sample locations.

As part of the Zone I RFI, surface soil, subsurface soil and groundwater investigations were conducted at AOC 671 during multiple sampling events in 1995 and 1996. The RFI report presented the results of the investigations and conclusions concerning contamination and risk, as summarized in Sections 2.1 and 2.2 of this CMS Work Plan. A further evaluation of COCs is provided in Section 2.3 of this work plan.

### 2.1 Background

AOC 671 consists of a former metering house, Building 3905G, and two associated 25,000-gallon concrete underground storage tanks (USTs). The metering house and the tanks were constructed in 1944 and used to store aviation gasoline until 1966. The area is currently an unused asphalt parking lot between Piers Q and R. Two raised circular areas in the asphalt are thought to represent the locations of the USTs. The lack of information documenting removal of these USTs and the surface expressions suggest that the USTs are still in place. A concrete foundation along Hobson Avenue is all that remains of Building 3905G.

The area is zoned for business and industrial use (B-2 and M-1).

### 2.2 RFI Investigation Results

#### 2.2.1 Soil Investigation Results

As part of the RFI field investigation, surface soil samples and collocated subsurface soil samples were collected (see Table 2-1).

##### 2.2.1.1 Surface Soils

A total of eight surface soil samples were collected in February 1995 and an additional two samples were collected in June 1995 (see Table 2-1 and Figure 2-1) Surface soil sample analytical results were evaluated relative to the EPA Region III risk-based

1 concentrations (RBCs). Based on the analysis presented in the RFI report,  
2 benzo(a)pyrene equivalents (BEQs) and n-Nitroso-di-n-propylamine exceeded their  
3 respective Region III unrestricted land use RBCs of 0.087 and 0.091 milligrams per  
4 kilogram (mg/kg), respectively. As a result of the screening process and subsequent risk  
5 assessment, both constituents in surface soil were identified as COCs under the  
6 unrestricted land use scenario.

### 7 **2.2.1.2 Subsurface Soils**

8 Seven subsurface soil samples, collocated with the surface soil sample locations (see  
9 Figure 2-1) were collected for VOCs, semivolatile organic compounds (SVOCs),  
10 pesticides/polychlorinated biphenyls (PCBs), metals, organotins, and cyanide analyses.

11 Subsurface soil sample analytical results were evaluated relative to EPA Region III  
12 unrestricted and industrial risk-based concentration and SSLs with a DAF=10. Based on  
13 the analysis presented in the RFI report, n-Nitrosodimethylamine (in sample  
14 I671SB00802) exceeded the Region III SSL (DAF=10) of 0.0026 microgram per kilogram  
15 ( $\mu\text{g}/\text{kg}$ ). However, as a result of subsequent risk assessment in the RFI report, no COCs  
16 were identified for subsurface soils under the unrestricted land use scenario.

## 17 **2.2.2 Groundwater**

18 Shallow groundwater at this site flows northward toward the Cooper River, with  
19 contours that essentially duplicate the shoreline (see Figure 2-2).

20 Four shallow monitoring wells were installed as part of the RFI investigation. For  
21 analyses of groundwater samples obtained from the shallow wells, see Table 2-2. The  
22 groundwater samples obtained from an existing shallow/deep grid monitoring well  
23 pair (GDI017/GDI17D) were analyzed for VOCs, SVOCs, pesticides/PCBs, metals,  
24 cyanide, chlorides, sulfates, and total dissolved solids (TDS).

25 Constituents detected in the groundwater samples were evaluated relative to maximum  
26 contaminant levels (MCLs), tap water RBCs, and Zone I groundwater background  
27 reference concentrations (BRCs).

28 The following sections set out the findings as presented in the RFI report.

### 29 **2.2.2.1 Shallow Groundwater**

30 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As  
31 a result of the screening process and subsequent risk assessment, the following  
32 constituents were identified as COCs for shallow groundwater:

- 1 • Arsenic was detected at a concentration exceeding its tap water RBC  
2 (0.045 microgram per liter [ $\mu\text{g}/\text{L}$ ]) in nine groundwater samples. Four samples  
3 exceeded the Zone I BRC for arsenic (23  $\mu\text{g}/\text{L}$ ). Its maximum reported concentration  
4 did not, however, exceed its MCL of 50  $\mu\text{g}/\text{L}$ .
- 5 • Mercury was detected at a concentration exceeding its tap water RBC (1.1  $\mu\text{g}/\text{L}$ ) and  
6 its MCL (2  $\mu\text{g}/\text{L}$ ) in one groundwater sample (I671GW003) collected in the fourth  
7 sampling event.
- 8 • Manganese was detected at a concentration exceeding its tap water RBC (73  $\mu\text{g}/\text{L}$ )  
9 in all 16 groundwater samples. No samples exceeded the BRC (5,430  $\mu\text{g}/\text{L}$ ) for  
10 manganese.
- 11 • Thallium was detected at a concentration exceeding its tap water RBC and MCL in  
12 two groundwater samples collected in the fourth sampling event. In samples  
13 I671GW001 and I671GW003, thallium exceeded its RBC of 0.26  $\mu\text{g}/\text{L}$  and MCL of  
14 2  $\mu\text{g}/\text{L}$ .

#### 15 **2.2.2.2 Deep Groundwater**

16 Analytes detected in deep groundwater samples were evaluated in the RFI report. As a  
17 result of the screening process and subsequent risk assessment, the following  
18 constituent was identified as a COC for deep groundwater:

- 19 • Thallium was detected at a concentration exceeding its tap water RBC and MCL in  
20 one groundwater sample collected in the fourth sampling event. In sample GDI17D,  
21 thallium exceeded its RBC of 0.26  $\mu\text{g}/\text{L}$  and MCL of 2  $\mu\text{g}/\text{L}$ .

#### 22 **2.2.3 RFI Risk Summary**

23 Based on a unrestricted land use scenario, the following COCs were identified in the RFI  
24 report:

25 **Surface Soil:** BEQs, n-Nitroso-di-n-propylamine

26 **Shallow Groundwater:** Arsenic, manganese, mercury, thallium

27 **Deep Groundwater:** Thallium

28 Based on an industrial land use scenario, the following COCs were identified in the RFI  
29 report:

30 **Shallow Groundwater:** Arsenic, manganese, mercury, thallium

31 **Deep Groundwater:** Thallium

## 2.2.4 Recommendations from *Zone I RFI Report, Revision 0*

### 2.2.4.1 Surface Soil

In the RFI report, it was assumed that future land use would be unrestricted. The RFI report recommended a CMS for surface soils, including containment/capping, excavation with offsite disposal, and no action.

### 2.2.4.2 Subsurface Soil

No subsurface COCs were identified; therefore, NFA for subsurface soils was recommended in the RFI report.

### 2.2.4.3 Shallow Groundwater

Groundwater contaminant treatment was recommended in the RFI report.

### 2.2.4.4 Deep Groundwater

Continued monitoring was recommended in the RFI report.

## 2.3 COPC/COC Refinement

Each of the COCs identified in the RFI, which include BEQs in surface soil and arsenic, manganese, mercury and thallium in groundwater, are further evaluated in the following sections. In addition, concentrations of VOCs detected in soils were rescreened using an SSL based on a DAF=1.

### 2.3.1 Surface Soil

#### 2.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)

The VOCs detected in surface soils are presented in Table 2-3. The only SSL exceedance that was identified following the rescreening process was acetonitrile in surface soil. Acetonitrile was detected in one of eight surface soil samples, but not in any of the seven subsurface soil samples or in groundwater at AOC 671. Based on the lack of widespread detection of this chemical at the site and the absence of any detectable concentrations in subsurface soil, acetonitrile is not considered a COC for the soil.

For these reasons, no COCs were identified for the surface soil at AOC 671 using a DAF=1 for VOCs.

#### 2.3.1.2 BEQs in Surface Soil

BEQs were detected in only one of eight surface soil samples at AOC 671 (see Table 2-4). The highest concentration of BEQs detected in the surface soil sample was obtained

1 from sample location 671SB002 at a concentration of 1.088 mg/kg<sup>1</sup>, which is below the  
2 CNC base-wide reference concentration of 1.304 mg/kg for surface soil. Therefore, the  
3 one detected value of BEQ can be attributed to background conditions in the area. In  
4 addition, asphalt materials overlie the location of the detection in sample 671SB002,  
5 indicating that these materials could have served as an anthropogenic source of the  
6 BEQs in the soil sample during boring advancement. Based on these considerations,  
7 BEQs are not considered a COC in surface soil for AOC 671.

### 8 **2.3.1.3 N-Nitroso-di-n-propylamine**

9 N-Nitroso-di-n-propylamine was identified as a COC for AOC 671 in the RFI report.  
10 However, the RFI report also concluded that the incremental lifetime cancer (ILC) risk  
11 associated with this compound is 1.1E-7 for a unrestricted land use scenario and 2.2E-7  
12 for an industrial worker scenario (see Table 10.1.30 in the RFI report). Both of these risk  
13 values are well below the acceptable range of 1E-4 to 1E-6. Based on these  
14 considerations, n-Nitroso-di-n-propylamine is not considered a COC for AOC 671.

## 15 **2.3.2 Subsurface Soils**

16 No subsurface soil COCs were identified in the RFI report.

### 17 **2.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

18 As discussed above, VOCs detected in subsurface soil were rescreened against an SSL  
19 with a DAF=1. The VOCs detected in subsurface soils are presented in Table 2-5. There  
20 were no exceedances in subsurface soils following the rescreening of the VOCs against  
21 an SSL with a DAF=1. Therefore, no VOCs were identified as COCs for subsurface soil  
22 for AOC 671.

## 23 **2.3.3 Groundwater**

24 COCs identified in shallow groundwater for the unrestricted land use exposure scenario  
25 are arsenic, manganese, mercury and thallium, and the only COC identified in deep  
26 groundwater for the unrestricted land use exposure scenario is thallium. These  
27 groundwater constituents are discussed below.

### 28 **2.3.3.1 Arsenic in Shallow and Deep Groundwater**

29 Arsenic was detected in 9 of 16 samples collected (4 sampling events were completed in  
30 4 wells) at AOC 671 as part of the RFI (see Table 2-6). Arsenic was detected in the

---

<sup>1</sup> The values for BEQs presented in Table 2-4 are slightly different than the values presented in the Zone I RFI Report, Revision 0. The BEQ values presented in this CMS Work Plan were calculated using the methodology identified by the BCT.

1 normal/duplicate sample pair collected during the last sampling event at well  
2 671GW003 (1/15/1999), which was collected after the RFI was completed. The  
3 concentrations of arsenic detected in this well during the last sampling event were 14.5  
4 to 17  $\mu\text{g}/\text{L}$  (normal and duplicate samples). A shallow/deep well pair (IGDIGW017/D)  
5 are also located in the vicinity and downgradient of AOC 671. A single exceedance of  
6 the arsenic MCL (50  $\mu\text{g}/\text{L}$ ) occurred during the second sampling event when 66.3  $\mu\text{g}/\text{L}$   
7 of arsenic was detected in the shallow grid well. However, this was a single occurrence  
8 and not duplicated in either of the two subsequent sampling events.

9 The maximum detected concentration of arsenic in wells installed for the RFI was  
10 42  $\mu\text{g}/\text{L}$  and no arsenic concentrations exceeded the MCL of 50  $\mu\text{g}/\text{L}$ , indicating that  
11 further evaluation is not warranted. It should also be noted that the dissolved iron  
12 concentrations in these wells (see Table 2-6) are elevated and are greatest in the well  
13 exhibiting the greatest arsenic concentrations. These data suggest that iron-reducing  
14 conditions are present at the site and influencing the arsenic concentrations. Arsenic  
15 concentrations in groundwater at the CNC have previously been shown to be positively  
16 correlated with iron concentrations at the CNC (see CH2M Jones Technical  
17 Memorandum, *An Overview of Arsenic Geochemistry, Terminal Electron Accepting*  
18 *Processes in GW Systems, and Implications for the CNC Hydrogeologic Environment,*  
19 *August 2001*). These data suggest that the elevated arsenic is due to natural geochemical  
20 processes at this site. For these reasons, arsenic is not considered a COC for shallow  
21 groundwater at AOC 671.

### 22 **2.3.3.2 Manganese in Shallow Groundwater**

23 Manganese is an essential nutrient that is ubiquitous in natural water and commonly  
24 detected in background groundwater at the CNC. It was detected in 16 of 16 samples (4  
25 sampling events were completed in 4 wells), with all of the detected values exceeding  
26 the RBC value (see Table 2-6). All detected values, however, were well below the Zone I  
27 groundwater BRC of 5,430  $\mu\text{g}/\text{L}$ . Consequently, manganese is not considered a COC for  
28 shallow groundwater at AOC 671.

### 29 **2.3.3.3 Mercury in Shallow Groundwater**

30 Mercury was detected in 1 of 16 groundwater samples collected at AOC 671 as part of  
31 the RFI. The detection occurred in the fourth sampling event at a concentration of  
32 37.9  $\mu\text{g}/\text{L}$  (well 671GW003), which exceeded the MCL of 2  $\mu\text{g}/\text{L}$ . Well 671GW003 was  
33 resampled in January 1999 (normal and duplicate samples were collected) and the

1 results were, respectively, nondetect and an estimated value of 0.10  $\mu\text{g}/\text{L}$  (see Table 2-  
2 7). The value of 0.10  $\mu\text{g}/\text{L}$  is well below the MCL of 2  $\mu\text{g}/\text{L}$ .

3 In soil, mercury was detected in only one of eight samples at a concentration below both  
4 the unrestricted soil RBC and BRC, indicating that soils are not a source of elevated  
5 levels of mercury in groundwater.

6 Although the single detection of mercury exceeded its MCL value, it is not considered a  
7 COC at AOC 671 because this single detection appears to be anomalous and was not  
8 confirmed during resampling. Mercury is not considered a COC for shallow  
9 groundwater at AOC 671.

#### 10 **2.3.3.4 Thallium in Shallow Groundwater**

11 Thallium was detected in 3 of 16 shallow groundwater samples collected at AOC 671 as  
12 part of the RFI (see Table 2-8). The three estimated shallow groundwater detections  
13 were 5.5J  $\mu\text{g}/\text{L}$ , 6.6J  $\mu\text{g}/\text{L}$  in wells I671GW001, I671GW003, and IGDIGW017,  
14 respectively. Each well had a single occurrence where the thallium concentrations was  
15 slightly elevated relative to the MCL.

16 There is no background range established for thallium in groundwater in Zone I.  
17 However, the observed concentrations of thallium in shallow groundwater at this site  
18 are consistent with the occurrences of thallium observed in Zone I grid wells. Thallium  
19 was detected intermittently in shallow grid wells at concentrations ranging from  
20 3J  $\mu\text{g}/\text{L}$  to 7.5J  $\mu\text{g}/\text{L}$  (see Appendix A-1). Given that the concentrations of thallium in  
21 shallow groundwater is consistent with grid well background conditions in Zone I, that  
22 there is no source area in soils, and that the occurrences were not consistent between  
23 sampling events, thallium is not considered a COC in groundwater at AOC 671.

#### 24 **2.3.3.5 Thallium in Deep Groundwater**

25 Thallium was detected in two of four deep groundwater samples collected during the  
26 RFI at grid well GDI017D at concentrations of 6.3  $\mu\text{g}/\text{L}$  and 15.4  $\mu\text{g}/\text{L}$  (second and  
27 fourth sampling events, respectively) (see Table 2-8). Thallium was not detected in the  
28 deep well during either the first or third sampling events. In addition, when grid well  
29 GDI017D was resampled in 1999, thallium was not detected.

30 In addition, the sporadic presence of thallium in deep grid well GDI017D is consistent  
31 with occurrences observed in the other 19 deep grid wells located within Zone I. Of the  
32 83 analyses, thallium was detected in 16 samples, with estimated concentrations ranging  
33 from 3.1  $\mu\text{g}/\text{L}$  to 15.4  $\mu\text{g}/\text{L}$  (see Appendix A-1). In nine cases, these exceedances were

1 one time occurrences in wells that were sampled four or more times. The remaining  
2 seven detections were split between three separate wells, all of which were again erratic,  
3 which is consistent with the observed occurrences for thallium in shallow groundwater.  
4 This suggests that the thallium detected in deep groundwater is more likely due to  
5 environmental variability and sampling methodology and is not an actual, reproducible  
6 exceedance. Based on these considerations, thallium is not considered a COC for deep  
7 groundwater at AOC 671.

### 8 **2.3.4 COPC/COC Refinement Summary**

9 There are no COCs requiring further action in surface soils, subsurface soils or  
10 groundwater at AOC 671. This site is recommended for NFA.

## 11 **2.4 Summary of Information Related to Site Closeout Issues**

### 12 **2.4.1 RFI Status**

13 The RFI report, as amended by the RFI Report Addendum, is complete.

### 14 **2.4.2 Presence of Inorganics in Groundwater**

15 For the purpose of site closeout documentation, the inorganics in groundwater issue  
16 refers to the occasional or intermittent detection of several metals (primarily arsenic,  
17 thallium, and antimony) in groundwater at concentrations above the applicable MCL,  
18 preceded or followed by detection of these same metals below the MCL or below the  
19 practicable quantitation limit. This is discussed in Section 2.3.3 of this work plan.

### 20 **2.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

21 Data indicate that AOC 671 was never connected to the sanitary sewer system.  
22 Therefore, there are no concerns regarding connections to the sanitary sewer. Further  
23 evaluation of this issue is not warranted.

### 24 **2.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

25 No direct connection of AOC 671 to the storm sewer is known to exist. No COCs  
26 requiring further evaluation are present at the site. Further evaluation of this issue is not  
27 warranted.

### 28 **2.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

29 The area associated with AOC 671 is located approximately 3,600 feet east-southeast of  
30 the nearest railroad line (located in Zone G). There is no known linkage between AOC

1 671 and the investigated railroad lines of AOC 504, and further evaluation of this issue  
2 is not warranted.

### 3 **2.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

4 The nearest surface water body to AOC 671 is the Cooper River, which lies  
5 approximately 90 feet north from the unit. The only potential migration pathway from  
6 the site to surface water is via overland flow via stormwater runoff. Since the entire site  
7 is covered with pavement, which eliminates contact of surface soil with stormwater, and  
8 no COCs were identified at the site, further evaluation of a potential pathway for  
9 contaminant migration via stormwater runoff is not warranted. Similarly, runoff  
10 directed to the storm sewer system, which discharges to the Cooper River, does not  
11 contact the surface soil.

### 12 **2.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

13 There are no known OWSs associated with AOC 671. Therefore, there are no concerns  
14 regarding connections to the sanitary sewer, and further evaluation of this issue is not  
15 warranted. In addition, there is no reference to an OWS at this facility in the *Oil Water*  
16 *Separator Data* report (Department of the Navy, September 2000).

### 17 **2.4.8 Land Use Control Management Plan**

18 The COC refinement did not identify any COCs at AOC 671. This evaluation was based  
19 on a unrestricted land use classification. Therefore, land use controls are not necessary.

## 20 **2.5 CH2M-Jones Recommendations**

21 Evaluation of the primary media of concern (surface soils, subsurface soils, and  
22 groundwater) indicated that there were no issues associated with the historical  
23 operation of, or releases from, this unit. Based on the review of COPCs/COCs in Section  
24 2.3, no COCs were identified in soil or groundwater.

25 The RFI report concluded that CMS activities were necessary for surface soil and  
26 shallow groundwater. However, CH2M-Jones has re-evaluated the risks posed by the  
27 identified COCs and determined that no COCs exist at AOC 671. Therefore, this site is  
28 recommended for NFA.

**TABLE 2-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	02/20/95 02/21/95 02/27/95	Upper - 8 (8)	Standard Suite Organotins	Organotins were analyzed on four upper-interval samples (671SB00501 through 671SB00801) for site characterization.
		Lower - 7 (8)	Standard Suite, Organotins	One lower-interval sample (671SB00302) was not collected due to a water table less than 5 feet bgs. Organotins were analyzed on four lower-interval samples (671SB00502 through 671SB00802) for site characterization.
		Duplicate - 2	Appendix IX	671CB00201/671CB00501
2	06/21/95 09/19/95	Upper - 2 Upper - 1	Pesticides and PCBs Physical Parameters	Physical parameters collected at boring location 671SB00201.

1  
2  
3  
4  
5  
6  
7  
8

( ) Parentheses indicate number of samples proposed.  
 Standard Suite VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.  
 Appendix IX Standard suite, plus hex-chrome, dioxins, herbicides, and OP pesticides at DQO Level IV.  
 Physical parameters analyses included CEC, chloride, sulfur, ammonia, nitrate/nitrite, phosphorus, TOC and total moisture.

**TABLE 2-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Wells Sampled	Sample Analyses	Comments
1	05/24/95	671001	Standard suite	No deviations from RFI.
	05/25/95	671002	Chloride, TDS, sulfate	
	06/02/95	671003		
	06/02/95	671004		
2	01/16/96	671001	Cyanide, metals, pesticides and PCBs	Second event
	01/16/96	671002		
	01/16/96	671003		
	01/16/96	671004		
	01/16/96	Duplicate - 1	Appendix IX. Cyanide, metals, pesticides and PCBs	Duplicate sample collected from well 671004.
3	06/03/96	671001	Cyanide, metals, pesticides and PCBs	Third event
	06/03/96	671002		
	06/03/96	671003		
	06/04/96	671004		
	06/04/96	Duplicate - 1	Appendix IX. Cyanide, metals, pesticides and PCBs	Duplicate sample collected from 671004.
4	08/30/96	671001	Chloride, cyanide, sulfate, metals, pesticides and PCBs, TDS	Fourth event
	08/30/96	671002		
	08/30/96	671003		
	09/04/96	671004		
	09/04/96	Duplicate - 1	Appendix IX. Chloride, cyanide, sulfate, metals, pesticides and PCBs, TDS	Duplicate sample collected from 671004.

1  
 2  
 3

Standard Suite                    VOCs, SVOCs, metals, cyanide, pesticides and PCBs at DQO Level III.  
 Appendix IX                        Standard suite, plus hex-chrome, dioxins, herbicides, pesticides at DQO Level IV.

**TABLE 2-3**  
 VOCs in Surface Soils  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier	Acetonitrile Result (mg/kg)	Qualifier
			IND RBC		20.000		1,600	
			RES RBC		780.0000		0.6000	
			SSL		0.8		0.6	
			SB BKGD		NA		NA	
I671SB001	671SB00101b	02/21/95	0.0280	J	0.0130	J	0.2400	UJ
I671SB002	671SB00201a	02/20/95	0.0310	U	0.0230	U	0.3100	UJ
I671SB003	671SB00301	02/20/95	0.1200	U	0.0210	U	0.2800	UJ
I671SB004	671SB00401	02/20/95	0.1300	U	0.0210	U	0.2800	UJ
I671SB005	671SB00501b	02/27/95	0.1000	UJ	0.0020	J	0.2200	UJ
I671SB006	671SB00601	02/27/95	0.0310	J	0.0020	J	0.2300	UJ
I671SB007	671SB00701	02/27/95	0.0210	J	0.0020	J	0.2200	UJ
I671SB008	671SB00801	02/27/95	0.1000	UJ	0.0040	J	0.1300	J

NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg milligrams per kilograms

**TABLE 2-4**  
 BEQs Detected in Surface Soils  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ Result	Qualifier
			( $\mu\text{g}/\text{kg}$ )	
		<b>Bkgd</b>	<b>1,304</b>	
I671SB001	671SB00101b	02/21/1995	760	U
I671SB002	671SB00201a	02/20/1995	<b>1,681</b>	=
I671SB003	671SB00301	02/20/1995	898	U
I671SB004	671SB00401	02/20/1995	898	U
I671SB005	671SB00501b	02/27/1995	719	U
I671SB006	671SB00601	02/27/1995	749	U
I671SB007	671SB00701	02/27/1995	714	U
I671SB008	671SB00801	02/27/1995	749	U

= Chemical is detected at concentration shown  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 $\mu\text{g}/\text{kg}$  Micrograms per kilograms

**TABLE 2-5**  
 VOCs in Subsurface Soils  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier
		SSL	0.8000		0.6	
		SB BKGD	NA		NA	
I671SB001	671SB00102	02/21/95	0.1400	UJ	0.0120	J
I671SB002	671SB00202	02/20/95	0.0340	U	0.0250	U
I671SB004	671SB00402	02/20/95	0.1500	U	0.0250	U
I671SB005	671SB00502b	02/27/95	0.1200	UJ	0.0200	U
I671SB006	671SB00602	02/27/95	0.0360	J	0.0020	J
I671SB007	671SB00702	02/27/95	0.1100	U	0.0020	J
I671SB008	671SB00802	02/27/95	0.0330	J	0.0070	J

NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg milligrams per kilograms

**TABLE 2-6**  
 Arsenic, Iron and Manganese in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Arsenic		Iron		Manganese		
			MCL	Result ( $\mu\text{g/L}$ )	Qualifier	Result ( $\mu\text{g/L}$ )	Qualifier	Result ( $\mu\text{g/L}$ )	Qualifier
			MCL	50.0000		300.0		50.0000	
			RBC	0.0450		1100.0		73.0000	
			Shallow	66		31,900		4,850	
			Deep	25		12,200		690	
I671GW001	671GW00102	01/16/96		5.0000	U	1940.0	=	1000.0	=
	671GW00103	06/03/96		10.1000	=	493.0	=	666.0	=
	671GW00104	08/30/96		7.7000	U	533.0	=	640.0	J
	671GW00101	05/24/95		3.2000	U	1580.0	J	908.0	=
I671GW002	671GW00201	05/25/95		3.2000	U	2250.0	J	659.0	=
	671GW00202	01/16/96		5.0000	U	2970.0	=	671.0	=
	671GW00203	06/03/96		5.0000	U	2510.0	=	622.0	=
	671GW00204	08/30/96		5.9000	U	2780.0	=	679.0	J
I671GW003	671GW00304	08/30/96		38.9000	=	4060.0	=	752.0	J
	671GW00301	06/02/95		31.4000	=	3640.0	J	780.0	J
	671GW00302	01/16/96		42.0000	=	4730.0	=	871.0	=
	671GW00303	06/03/96		28.8000	=	4590.0	=	743.0	=
I671GW004	671GW00402	01/16/96		9.9000	J	3780.0	=	627.0	=
	671GW00403	06/04/96		9.9000	J	3610.0	J	600.0	J
	671GW00404	09/04/96		10.0000	U	3430.0	=	583.0	=
	671GW00401	06/02/95		17.2000	=	2810.0	J	668.0	J

**TABLE 2-6**  
 Arsenic, Iron and Manganese in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Arsenic		Iron		Manganese		
			Result (µg/L)	Qualifier	Result (µg/L)	Qualifier	Result (µg/L)	Qualifier	
			<b>MCL</b>	50.0000		300.0		50.0000	
			<b>RBC</b>	0.0450		1100.0		73.0000	
			<b>Shallow</b>	66		31,900		4,850	
			<b>Deep</b>	25		12,200		690	
IGDIGW017	GDIGW01701	05/23/95		20.9000	=	9220.0	J	445.0	=
	GDIGW01702	12/05/95		<b>66.3000</b>	=	9880.0	=	369.0	=
	GDIGW01703	05/28/96		33.5000	=	9750.0	=	372.0	=
	GDIGW01704	08/27/96		46.2000	=	6280.0	=	272.0	=
IGDIGW17D	GDIGW17D04	08/27/96		24.8000	J	160.0	UJ	3.5	U
	GDIGW17D01	05/23/95		3.2000	U	78.2	UJ	14.5	J
	GDIGW17D02	12/05/95		5.0000	U	41.7	J	1.0	U
	GDIGW17D03	05/29/96		5.0000	U	34.4	J	5.0	UJ

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 µg/L Micrograms per liter

**TABLE 2-7**  
 Mercury in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Mercury Result ( $\mu\text{g/L}$ )		Qualifier
			MCL		
			MCL	2	
			RBC	NA	
			Shallow	1.1	
			Deep	2.0	
<b>Shallow Groundwater</b>					
I671GW001	671GW00101	05/24/95		0.2000	U
	671GW00102	01/16/96		0.2000	U
	671GW00103	06/03/96		0.2000	UJ
	671GW00104	08/30/96		0.1000	U
I671GW002	671GW00201	05/25/95		0.2000	U
	671GW00202	01/16/96		0.2000	U
	671GW00203	06/03/96		0.2000	UJ
	671GW00204	08/30/96		0.1000	U
I671GW003	671GW00301	06/02/95		0.2000	U
	671GW00302	01/16/96		0.2000	U
	671GW00303	06/03/96		0.2000	UJ
	671GW00304	08/30/96		<b>37.9000</b>	=
	671GW003F5	01/15/99		0.1000	J
	671GW003U5	01/15/99		0.1000	U
I671GW004	671GW00401	06/02/95		0.2000	U
	671GW00402	01/16/96		0.2000	U
	671GW00403	06/04/96		0.2000	U
	671GW00404	09/04/96		0.2300	U
IGDIGW017	GDIGW01701	05/23/95		0.2000	U
	GDIGW01702	12/05/95		0.2000	U
	GDIGW01703	05/28/96		0.2000	U
	GDIGW01704	08/27/96		0.1200	J

**TABLE 2-7**  
 Mercury in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Mercury Result ( $\mu\text{g/L}$ )	Qualifier
		MCL	2	
		RBC	NA	
		Shallow	1.1	
		Deep	2.0	
<b>Deep Groundwater</b>				
IGDIGW17D	GDIGW17D01	05/23/95	0.2000	U
	GDIGW17D02	12/05/95	0.2000	U
	GDIGW17D03	05/29/96	0.2000	U
	GDIGW17D04	08/27/96	0.1000	U
	GDIGW17DF5	01/18/99	0.1000	U
	GDIGW17DU5	01/18/99	0.1000	U

- = Chemical is detected at concentration shown.
- NA not applicable
- J Chemical is detected at concentration below the method detection limit; the concentration is not known.
- U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).
- UJ Not detected; analytical detection limit is estimated.
- $\mu\text{g/L}$  Micrograms per liter

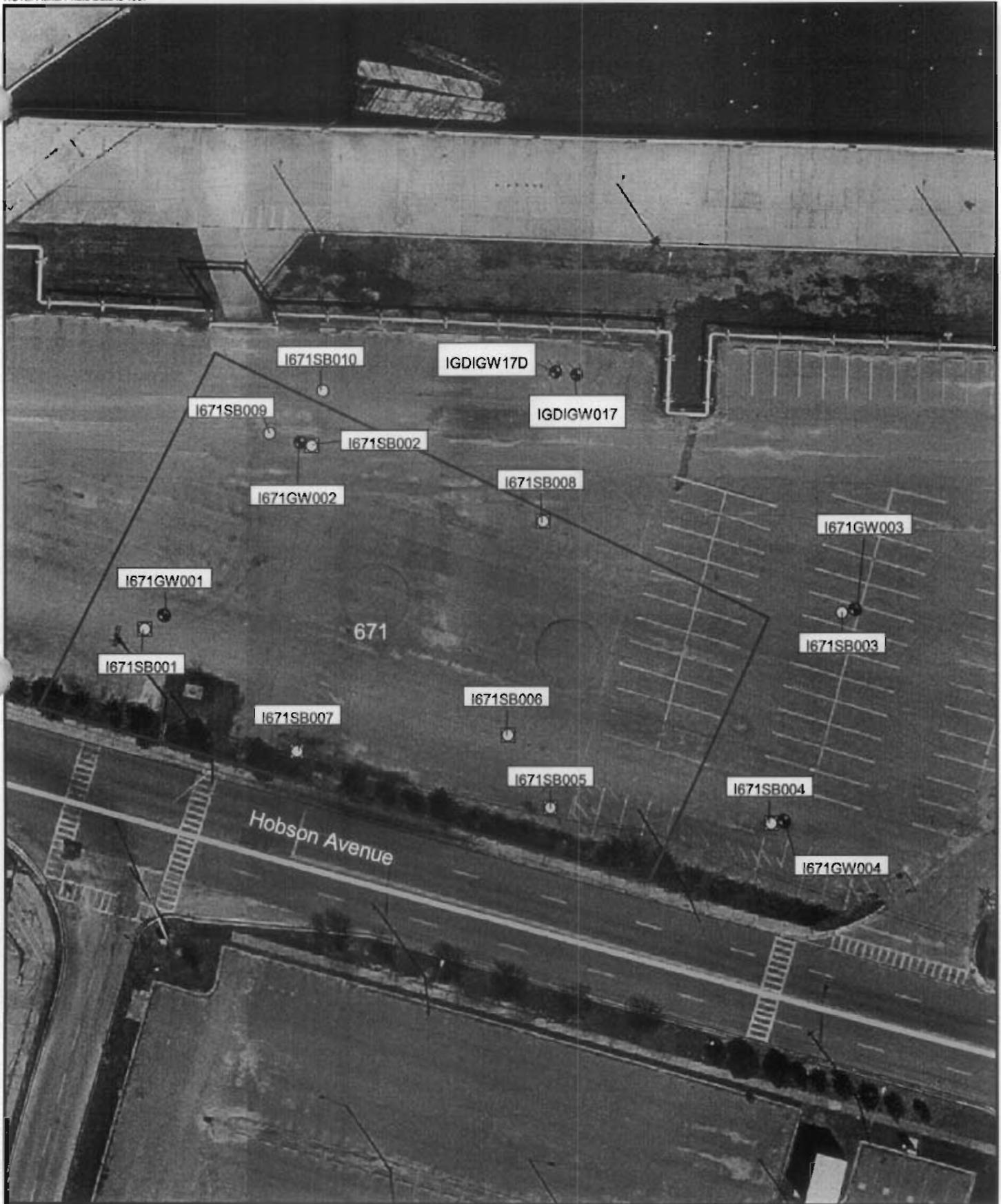
**TABLE 2-8**  
 Thallium in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Thallium Result (µg/L)	Qualifier
			MCL	2
			RBC	0.26
			Shallow	8
			Deep	15
<b>Shallow Groundwater</b>				
I671GW001	671GW00101	05/24/95	4.5000	U
	671GW00102	01/16/96	5.0000	U
	671GW00103	06/03/96	5.0000	U
	671GW00104	08/30/96	5.5000	J
I671GW002	671GW00201	05/25/95	4.5000	U
	671GW00202	01/16/96	5.0000	U
	671GW00203	06/03/96	5.0000	U
	671GW00204	08/30/96	2.7000	U
I671GW003	671GW00301	06/02/95	4.5000	U
	671GW00302	01/16/96	5.0000	U
	671GW00303	06/03/96	5.0000	U
	671GW00304	08/30/96	6.6000	J
	671GW003F5	01/15/99	3.1000	U
I671GW004	671GW003U5	01/15/99	3.1000	U
	671GW00401	06/02/95	4.5000	U
	671GW00402	01/16/96	5.0000	U
	671GW00403	06/04/96	5.0000	U
IGDIGW017	671GW00404	09/04/96	2.7000	UJ
	GDIGW01701	05/23/95	4.5000	U
	GDIGW01702	12/05/95	5.4000	J
	GDIGW01703	05/28/96	5.0000	U
	GDIGW01704	08/27/96	2.7000	UJ

**TABLE 2-8**  
 Thallium in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 671, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Thallium Result (µg/L)	Qualifier
		<b>MCL</b>	2	
		<b>RBC</b>	0.26	
		<b>Shallow</b>	8	
		<b>Deep</b>	15	
<b>Deep Groundwater</b>				
IGDIGW17D	GDIGW17D01	05/23/95	4.5000	U
	GDIGW17D02	12/05/95	<b>6.3000</b>	J
	GDIGW17D03	05/29/96	5.0000	UJ
	GDIGW17D04	08/27/96	<b>15.4000</b>	J
	GDIGW17DF5	01/18/99	3.1000	U
	GDIGW17DU5	01/18/99	3.1000	U

- J Chemical is detected at concentration below the method detection limit; the concentration is not known.
- U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).
- UJ Not detected; analytical detection limit is estimated.
- µg/L Micrograms per liter



- Groundwater Sample
- Surface Soil Sample
- Subsurface Soil Sample
- ▭ AOC Boundary
- ▭ SWMU Boundary
- ▭ Buildings

▭ Zone Boundary

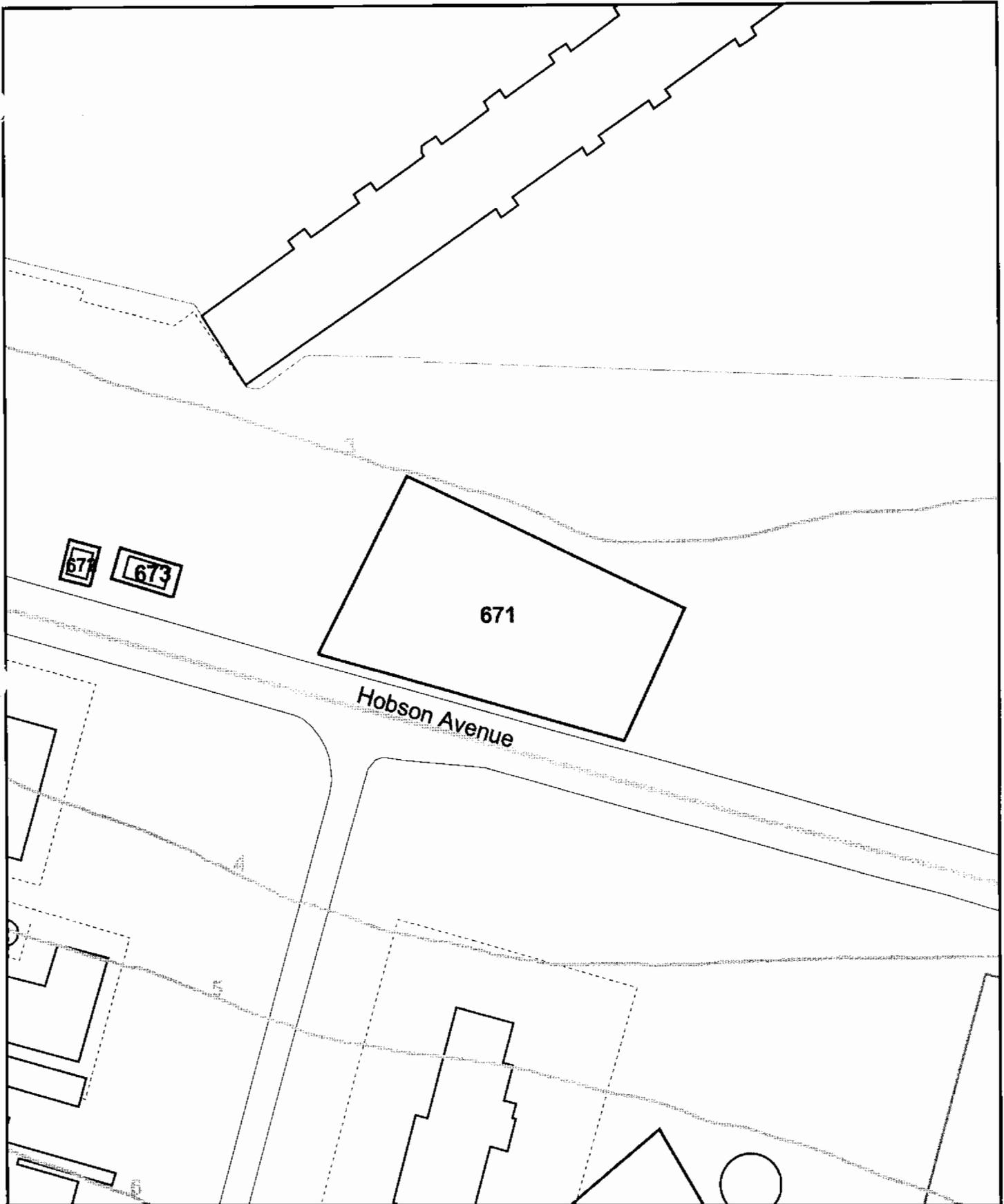


0 50 100 Feet

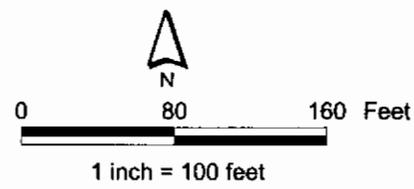


1 inch = 50 feet

**Figure 2-1**  
Sample and Test Location Map  
AOC 671  
Zone I  
Charleston Naval Complex



- Inferred Groundwater Elevation (ft msl)
  - Known Groundwater Elevation (ft msl)
  - Fence
  - Railroads
  - Roads
  - Shoreline
  - AOC Boundary
  - SWMU Boundary
  - Buildings
  - Zone Boundary
- ft msl - feet above mean sea level



**Figure 2-2**  
 Shallow Groundwater Contour Map  
 AOC 671, Zone I  
 Charleston Naval Complex



## 1    **3.0 CMS Work Plan for AOC 672 and AOC 673**

2    This section summarizes the results and conclusions from the soil and groundwater  
3    investigations conducted in the area of AOCs 672 and 673, which were reported in the *Zone*  
4    *I RFI Report, Revision 0* (EnSafe, 1999), Section 10.2, and as amended by the *Zone I RFI Report*  
5    *Addendum, Revision 1* (CH2M-Jones, 2001). Figure 3-1 presents the site features and RFI  
6    sample locations.

7    As part of the Zone I RFI, surface soil, subsurface soil, and groundwater investigations were  
8    conducted at AOCs 672 and 673 during multiple sampling events in 1995, 1996, 1998, and  
9    1999. The RFI report presented the results of the investigations and conclusions concerning  
10   contamination and risk, as summarized in Sections 3.1 and 3.2 of this CMS Work Plan. A  
11   further evaluation of COCs is provided in Section 3.3 of this work plan.

### 12   **3.1 Background**

13   AOC 672 is a high-voltage substation that was constructed in 1947 and modified in 1950.  
14   The structure is a single-story concrete-block building with a concrete floor and roof. A  
15   fenced area at the building's northwest corner enclosed several transformers which were  
16   mounted on a concrete pad, but have been removed. The building contains several high-  
17   voltage switches and breakers. The present equipment does not contain PCBs, but historic  
18   equipment may possibly have contained PCB dielectric fluid or PCB-contaminated fluids.

19   AOC 673 is Building 169, a single-story, concrete-block structure constructed in 1949.  
20   Building 169 was once used to store paints, oils, and solvents associated with painting  
21   operations. In later years, it was used to store fire-fighting equipment.

22   The combined AOC 672/673 area is located in a paved parking area between Piers P and Q.

23   The area is zoned for industrial use (M-1).

### 24   **3.2 RFI Investigation Results**

#### 25   **3.2.1 Soil Investigation Results**

26   As part of the RFI field investigation, surface soil samples and collocated subsurface soil  
27   samples were collected in multiple sampling events (see Table 3-1).

1 **3.2.1.1 Surface Soils**

2 Ten surface soil samples (see Table 3-1 and Figure 3-1), were collected for VOC, SVOC,  
3 pesticide/PCB, metals and cyanide analyses. In addition, four samples and one duplicate  
4 were collected in a second sampling event and analyzed for arsenic.

5 Surface soil sample results were evaluated relative to EPA Region III RBCs. Based on the  
6 analysis presented in the RFI report, arsenic and chromium exceeded the Region III  
7 unrestricted land use RBCs and the Zone I BRC. As a result of the screening process and  
8 subsequent risk assessment, arsenic in surface soil was identified as a COC for unrestricted  
9 land use. Arsenic was detected at concentrations exceeding its Region III unrestricted land  
10 use RBC of 0.43 mg/kg in 14 surface soil samples and the Zone I BRC (21.6 mg/kg) in 5  
11 surface soil samples.

12 **3.2.1.2 Subsurface Soils**

13 Ten subsurface soil samples, collocated with the surface soil sample locations (see  
14 Figure 3-1) were collected for VOC, SVOC, pesticide/PCB, metals and cyanide analyses.

15 Subsurface soil sample results were evaluated relative to EPA Region III unrestricted and  
16 industrial RBCs and SSLs with a DAF=10. Based on the analysis presented in the RFI report,  
17 arsenic exceeded the SSL using a DAF=10. However, as a result of the screening process and  
18 subsequent risk assessment, no COCs were identified for subsurface soils under the  
19 unrestricted land use scenario.

20 **3.2.2 Groundwater**

21 Shallow groundwater at this site flows north to northeastward toward the Cooper River,  
22 with contours that essentially duplicate the shoreline (Figure 3-2).

23 One deep and one shallow monitoring well pair (IGDGW018 and IGDGW018D,  
24 respectively) were installed as part of the RFI investigation.<sup>2</sup> The groundwater samples  
25 obtained from both wells were analyzed for VOCs, SVOCs, pesticides/PCBs, metals,  
26 cyanide, chlorides, sulfates, and TDS.

27 Constituents detected in the groundwater samples were evaluated relative to MCLs (or tap  
28 water RBCs in the absence of an MCL) and Zone I groundwater BRCs.

29 The following sections set out the findings as presented in the RFI report.

---

<sup>2</sup> Grid sample data was not included in the unit specific data presented in Section 10.2, but is used to evaluate groundwater conditions at this site. Grid well data is discussed in Section 10.14 – Grid Base of the RFI report.

1 **3.2.2.1 Shallow Groundwater**

2 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
3 result of the screening process and subsequent risk assessment, no constituents were  
4 identified as COCs for shallow groundwater.

5 **3.2.2.2 Deep Groundwater**

6 Analytes detected in deep groundwater samples were evaluated in the RFI report. As a  
7 result of the screening process and subsequent risk assessment, no constituents were  
8 identified as COCs for deep groundwater.

9 **3.2.3 RFI Risk Summary**

10 Based on both a unrestricted land use scenario and an industrial land use scenario, arsenic  
11 was identified as the only COC for surface soils at AOC 672/673.

12 No COCs were identified in the RFI report, for any other media.

13 **3.2.4 Recommendations from *Zone I RFI Report, Revision 0***

14 The RFI recommended a CMS for surface soils, considering no action, excavation and offsite  
15 disposal, and containment/capping.

16 **3.3 COPC/COC Refinement**

17 The only COC identified in the RFI was arsenic in surface soil. This COC is further  
18 evaluated in the following sections. In addition, concentrations of VOCs detected in soils  
19 were rescreened using an SSL based on a DAF=1.

20 **3.3.1 Surface Soil**

21 **3.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

22 The VOCs detected in surface soils are presented in Table 3-2. There were no exceedances of  
23 VOCs in the rescreening process. Therefore, no VOCs were identified as COCs in surface  
24 soil at AOCs 672/673.

25 **3.3.1.2 Arsenic**

26 Arsenic was detected in all 14 surface soil samples collected from AOCs 672/673 with  
27 concentrations ranging from 2.95 mg/kg to 42.9 mg/kg. All samples associated with AOC  
28 673 had arsenic concentrations that exceeded the Zone I background range for arsenic in  
29 surface soil of 0.46 mg/kg to 20 mg/kg (see Table 3-3). Arsenic in soils within the AOC 673  
30 area was further delineated to background in a second sampling event. However, AOC

1 672/673 is located near Zones G (940 feet) and H (<20 feet). A comparison to Zones G and H  
2 is valid because Zone I is similar in character and has had many of the same historical  
3 industrial use land practices. In addition, the surface and subsurface soils in these areas  
4 have been heavily reworked during the CNC's operational history and have been  
5 intermixed. Since both surface and subsurface soils can be sources of leaching to  
6 groundwater, it's valid to look at the concentrations of both surface and subsurface soils for  
7 issues related to inorganics in soils. The concentrations of arsenic values in surface and  
8 subsurface soils for Zones G, H, and I range from 0.46 mg/kg (Zone I surface soils) to  
9 136 mg/kg (Zone H subsurface soils). For these reasons, the presence of arsenic at AOCs  
10 672/673 is likely the result of general pesticide applications across the base or other  
11 anthropogenic use. Pesticide application areas, such as samples from railroad lines,  
12 indicated a concentration range for arsenic between 1.6 mg/kg and 92 mg/kg. Since there  
13 are no site-related operations at AOCs 672/673 that involve arsenic, the detected  
14 concentrations are likely from base maintenance-related arsenical pesticide applications. For  
15 these reasons, arsenic is not considered a COC in surface soil at AOCs 672/673.

### 16 **3.3.2 Subsurface Soils**

17 No subsurface soil COCs were identified in the RFI report.

#### 18 **3.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

19 The VOCs detected in subsurface soils are presented in Table 3-4. There were no  
20 exceedances of VOCs in the rescreening process. For these reasons, no COCs were identified  
21 at AOCs 672 and 673.

### 22 **3.3.3 Groundwater**

23 No COCs were identified for groundwater at AOCs 672 and 673.

#### 24 **3.3.4 COPC/COC Refinement Summary**

25 There are no COCs requiring further action in surface soils, subsurface soils, or  
26 groundwater at AOCs 672 and 673. Therefore this site is recommended for NFA.

## 27 **3.4 Summary of Information Related to Site Closeout Issues**

### 28 **3.4.1 RFI Status**

29 The RFI report, as amended by the RFI Report Addendum, is complete.

### 1 **3.4.2 Presence of Inorganics in Groundwater**

2 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
3 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
4 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
5 followed by detection of these same metals below the MCL or below the practicable  
6 quantitation limit.

7 No groundwater investigation was conducted as part of the RFI for AOCs 672/673.  
8 However, groundwater data from a nearby grid well pair (GDGW018/GDGW018D) was  
9 reviewed and no constituents were found to be present in groundwater at concentrations  
10 exceeding screening criteria. Further evaluation of this issue is not warranted.

### 11 **3.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

12 Data indicate that AOCs 672/673 were never connected to the sanitary sewer system.  
13 Therefore, there are no concerns regarding connections to the sanitary sewer. Further  
14 evaluation of this issue is not warranted.

### 15 **3.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

16 Two stormwater inlets are located adjacent to AOCs 672/673. Considering that the ground  
17 surface within AOCs 672/673 is paved, runoff directed to the storm sewer system does not  
18 contact the surface soil, and no COCs have been identified at these sites. Further evaluation  
19 of this issue is not warranted.

### 20 **3.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

21 The area associated with AOCs 672/673 is approximately 3,400 feet east-southeast from the  
22 closest railroad line. There is no known linkage between AOCs 672/673 and the  
23 investigated railroad lines of AOC 504, and further evaluation of this issue is not warranted.

### 24 **3.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

25 The nearest surface water body to AOCs 672/673 is the Cooper River, which lies  
26 approximately 190 feet north of these sites. The only potential migration pathway from  
27 these sites to surface water is via overland flow via stormwater runoff. Since the entire site  
28 is covered with buildings and pavement, which eliminates contact of surface soil with  
29 stormwater, and no COCs were identified at these sites, further evaluation of a potential  
30 pathway for contaminant migration via stormwater runoff is not warranted. Similarly,  
31 runoff directed to the storm sewer system, which discharges to the Cooper River, does not  
32 contact the surface soil.

1 **3.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

2 There are no known OWSs associated with AOCs 672/673. Therefore, there are no concerns  
3 regarding connections to the sanitary sewer, and further evaluation of this issue is not  
4 warranted.

5 In addition, there is no reference to an OWS at this facility in the *Oil Water Separator Data*  
6 report (Department of the Navy, September 2000).

7 **3.4.8 Land Use Control Management Plan**

8 The COC refinement did not identify any COCs at AOCs 672/673. This evaluation was  
9 based on a unrestricted land use classification. Therefore, land use controls are not  
10 necessary.

11 **3.5 CH2M-Jones Recommendations**

12 Evaluation of the primary media of concern (surface soils and subsurface soils) indicated  
13 that there were no issues associated with the historical operation of, or releases from, this  
14 unit. Based on a review of COPCs/COCs in Section 3.3, no COCs were identified in  
15 groundwater.

16 The RFI report concluded that a CMS was necessary for surface soil. However, CH2M-Jones  
17 has re-evaluated the risks posed by the identified COCs and determined that no COCs exist  
18 at AOCs 672/673. Therefore, these sites are recommended for NFA.

1

**TABLE 3-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, AOCs 672/673, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	02/20/95 02/21/95	Upper - 10 (10)	Standard Suite, Physical Parameters	Four lower samples were not collected due to a water table at less than 5 feet bgs.
		Lower - 6 (10)	Standard Suite	
		Duplicates - 2	Appendix IX	
2	04/07/98	Upper - 4	Arsenic	Borings 673SB007 through 673SB010 were added to delineate arsenic contamination identified during the first sampling event.
		Lower - 4	Arsenic	
		Duplicate - 1	Arsenic	

2  
3  
4  
5  
6  
7  
8

**Notes:**

- ( ) = Parentheses indicate number of samples proposed in the RFI work plan.
- Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.
- Appendix IX = Standard suite, plus hex-Chrome, dioxins, herbicides, and OP pesticides.
- Physical parameters analysis included CEC, chloride, sulfur, ammonia, nitrate/nitrite, phosphorus, TOC, and total moisture.

**TABLE 3-2**  
 VOCs in Surface Soils  
 CMS Work Plan, AOC 672/673, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier
			IND RBC	20,000.00		41,000.00	
			RES RBC	780.00		1,600.00	
			SSL	0.80		0.60	
			SS BKGD	NA		NA	
I672SB001	672SB00101	02/20/95		0.1500	UJ	0.0210	U
I672SB002	672SB00201	02/20/95		0.1400	U	0.0230	U
I672SB003	672SB00301b	02/20/95		0.1000	J	0.0250	U
I672SB004	672SB00401	02/20/95		0.1500	UJ	0.0250	U
I673SB001	673SB00101	02/20/95		0.1400	U	0.0230	U
I673SB002	673SB00201	02/20/95		0.1400	=	0.0230	U
I673SB003	673SB00301	02/21/95		0.1100	UJ	0.0090	J
I673SB004	673SB00401	02/21/95		0.0520	J	0.0040	J
I673SB005	673SB00501	02/21/95		0.1500	J	0.0050	J
I673SB006	673SB00601	02/21/95		0.1200	=	0.0070	J

= Chemical is detected at concentration shown.  
 NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

**TABLE 3-3**  
 Arsenic in Surface Soils  
 CMS Work Plan, AOC 672/673, Zone I, Charleston Naval Complex

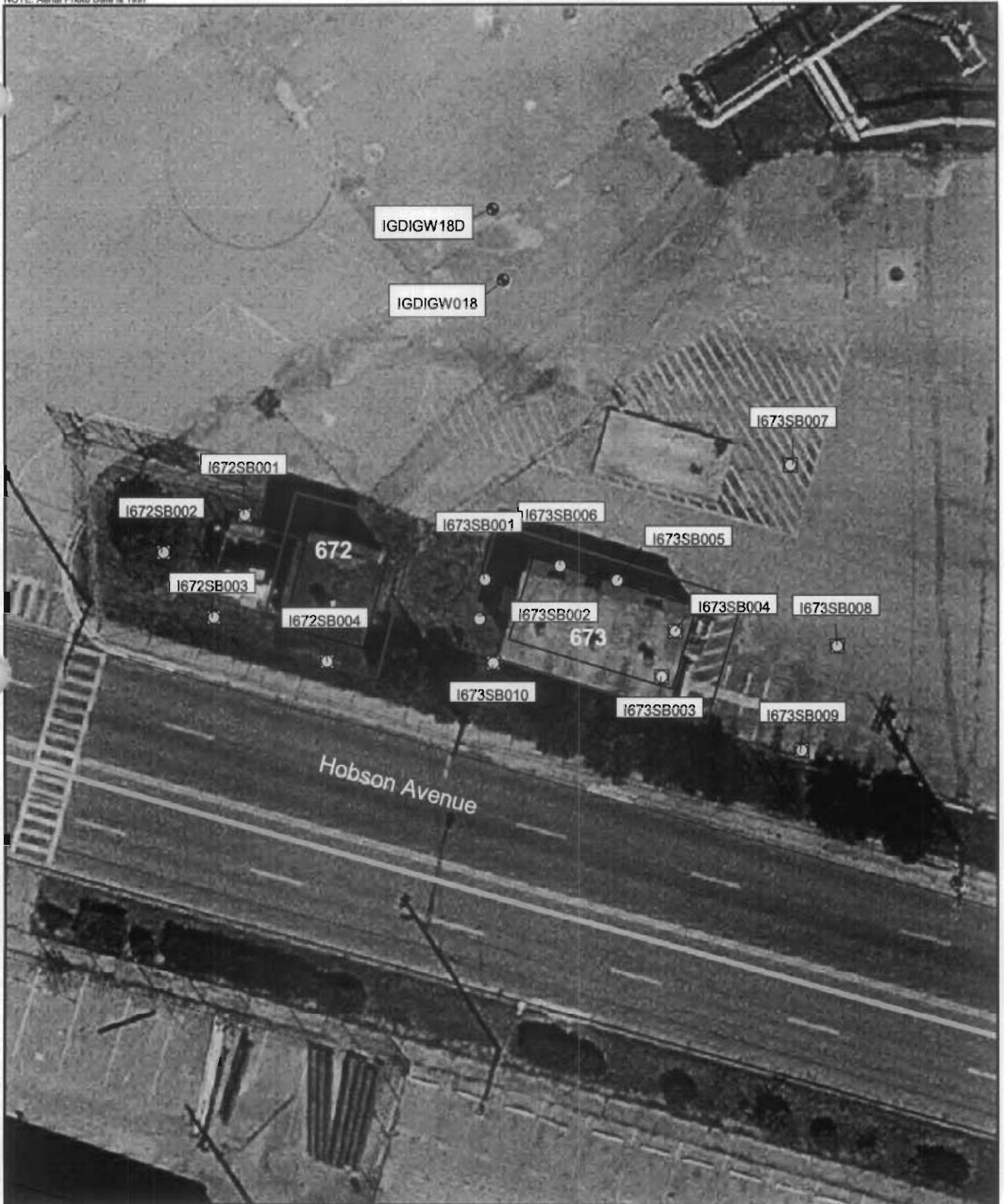
Sample Station	ID	Date	Arsenic Result (mg/kg)	Qualifier
			IND RBC	3.8000
			RES RBC	0.4300
			SSL	14.5000
			SS BKGD	20.0
I672SB001	672SB00101	02/20/95	4.7000	J
I672SB002	672SB00201	02/20/95	13.3000	J
I672SB003	672SB00301b	02/20/95	6.5000	J
I672SB004	672SB00401	02/20/95	8.9000	J
I673SB001	673SB00101	02/20/95	<b>27.0000</b>	J
I673SB002	673SB00201	02/20/95	<b>42.9000</b>	J
I673SB003	673SB00301	02/21/95	<b>34.5000</b>	J
I673SB004	673SB00401	02/21/95	<b>31.4000</b>	J
I673SB005	673SB00501	02/21/95	<b>27.7000</b>	J
I673SB006	673SB00601	02/21/95	3.8000	UJ
I673SB007	673SB00701	04/07/98	8.2000	=
I673SB008	673SB00801	04/07/98	12.5000	=
I673SB009	673SB00901	04/07/98	14.8000	=
I673SB010	673SB01001	04/07/98	3.0000	=

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg milligrams per kilograms

**TABLE 3-4**  
 VOCs in Subsurface Soils  
 CMS Work Plan, AOC 672/673, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier
		SSL	0.8000		0.6000	
		SS BKGD	NA		NA	
I672SB001	672SB00102	02/20/95	0.0270	J	0.0230	U
I672SB002	672SB00202	02/20/95	0.0330	U	0.0250	U
I672SB003	672SB00302	02/20/95	0.0280	J	0.0250	U
I672SB004	672SB00402	02/20/95	0.1600	UJ	0.0270	U
I673SB003	673SB00302	02/21/95	0.1200	UJ	0.0200	U
I673SB004	673SB00402	02/21/95	0.0650	J	0.0030	J

NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram



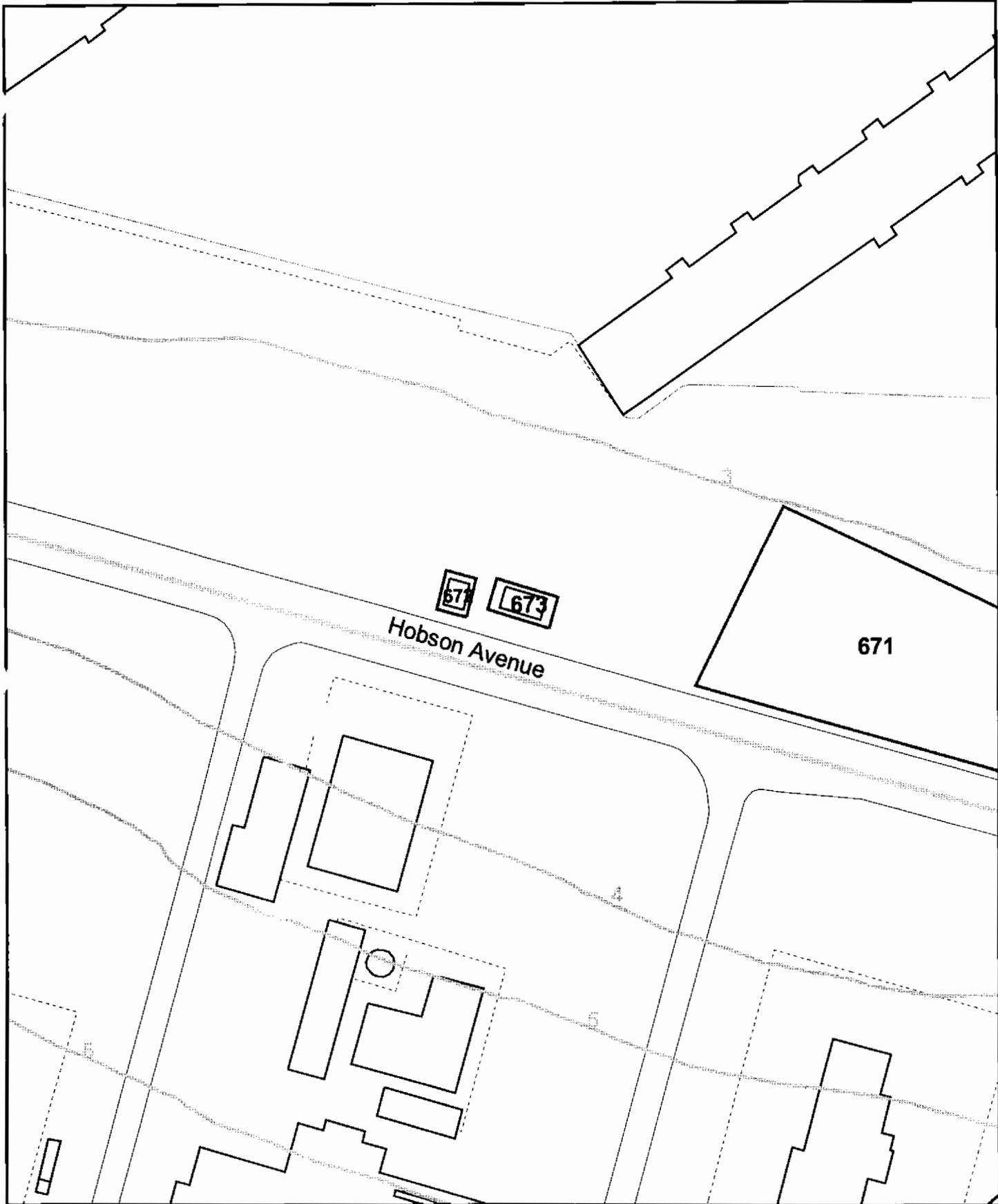
- Surface Soil Sample
- ◻ Subsurface Soil Sample
- ▭ AOC Boundary
- ▭ SWMU Boundary
- ▭ Buildings
- ▭ Zone Boundary



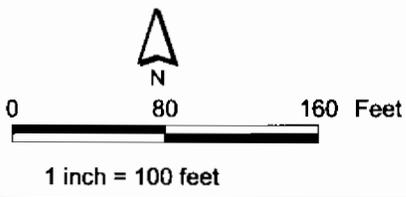
0 30 60 Feet

1 inch = 25 feet

**Figure 3-1**  
Sample and Test Location Map  
AOC 672 and AOC 673  
Zone I  
Charleston Naval Complex



- Inferred Groundwater Elevations (ft msl)
  - Known Groundwater Elevations (ft msl)
  - Fence
  - Railroads
  - Roads
  - Shoreline
  - AOC Boundary
  - SWMU Boundary
  - Buildings
  - Zone Boundary
- ft msl - feet above mean sea level



**Figure 3-2**  
 Shallow Groundwater Contour Map  
 AOC 672 and AOC 673, Zone I  
 Charleston Naval Complex



## 1 4.0 CMS Work Plan for AOC 675, AOC 676 and 2 AOC 677

3 This section summarizes the results and conclusions from the soil and groundwater  
4 investigations conducted in the area of AOCs 675/676/677, which were reported in the  
5 *Zone I RFI Report, Revision 0* (EnSafe, 1999), Section 10.3, as amended by the *Zone I RFI*  
6 *Report Addendum, Revision 1* (CH2M-Jones, 2001). Figure 4-1 presents the site features and  
7 RFI sample locations.

8 As part of the Zone I RFI, surface soil, subsurface soil and groundwater investigations were  
9 conducted at AOCs 675/676/677 in February and September 1995 and February 1999. The  
10 RFI report presented the results of the investigations and conclusions concerning  
11 contamination and risk, as summarized in Sections 4.1 and 4.2 of this CMS Work Plan. A  
12 further evaluation of COCs is provided in Section 4.3 of this work plan.

### 13 4.1 Background

14 AOC 675 is a 25,000-gallon UST (Facility NS-4) installed in 1952. A 495-gallon OWS is  
15 located north of this UST. This UST stored fuel oil for a boiler house (Building NS-2) built in  
16 1958. No. 5 fuel oil was used until 1991. From 1991 until the present, the UST has stored  
17 No. 2 fuel oil. The AOC 675 area was also used to refuel seaplanes, and petroleum  
18 contamination may have resulted from this activity. Actual dates of seaplane operations are  
19 unknown, but this activity was discontinued in the mid-1950s.

20 Former UST NS-2A was an unregulated 560-gallon underground waste oil holding tank for  
21 an OWS. It was located in a grass-covered patch of ground between Buildings NS-2 and  
22 NS-3. This tank was closed by removal in April 1996. During removal it was noted that the  
23 tank was intact with no holes or pitting. The OWS which was associated with the waste oil  
24 UST is currently identified as NS-2A and is located immediately east of the former waste oil  
25 UST. The OWS was left in place and its lines were plugged and capped.

26 Former UST NS-3-1 was a 280-gallon waste oil holding tank and OWS located just north of  
27 Building NS-3. Building NS-3 is a former fuel pumping transfer station located just west of  
28 Facility NS-4. The fuel transfer area was diked and sloped towards a storm drain in the east  
29 corner. The storm drain was connected to the storm sewer by two sets of valves and piping.  
30 The valves directed the stormwater runoff directly to the storm sewer during normal

1 operations or through the OWS to the storm sewer in the event of a spill in the fuel transfer  
2 area.

3 AOC 676 is the location of a former incinerator which operated near the current location of  
4 Building NS-2. The incinerator was used during the 1940s and it is shown on base maps  
5 from 1947 to 1955. No records exist concerning its design, operation, or demolition. The  
6 materials burned in the incinerator are unknown but may have included flammable  
7 hazardous materials (paints, solvents, and waste oils), as well as paper, wood, and general  
8 trash.

9 AOC 677 consists of the grounds surrounding Building NS-2. The facility was built in 1958.  
10 In 1977, the boilers were replaced with newer ones. There is a documented history of fuel  
11 oil spills at this site, ranging in size from 3 to 500 gallons. Fuel for the boilers was stored in  
12 the nearby 25,000-gallon UST at Facility NS-4 (AOC 675) as described above. Prior to 1979,  
13 the sump pump for the boilers discharged to the base storm sewer system. After 1979, the  
14 sump pump discharged to the sanitary sewer system via an OWS. In 1990, the boilers were  
15 connected to the base-wide steam system to provide backup power for the central power  
16 plant.

17 The area is zoned for business use (B-2).

## 18 **4.2 RFI Investigation Results**

### 19 **4.2.1 Soil Investigation Results**

20 As part of the RFI field investigation, surface soil samples and collocated subsurface soil  
21 samples were collected and analyzed for VOCs, SVOCs, pesticides/PCBs, metals,  
22 organotins and cyanide (see Table 4-1).

#### 23 **4.2.1.1 Surface Soils**

24 Fourteen surface soil samples were collected for VOC, SVOC, pesticide/PCB, metals and  
25 cyanide analyses during the first sampling event. One surface soil sample was collected for  
26 physical parameters during the second sampling event, and three surface soil samples for  
27 dioxins were collected during the third sampling event (see Figure 4-1 and Table 4-1).

28 Surface soil sample results were evaluated relative to EPA Region III RBCs. Based on the  
29 analysis presented in the RFI report, five parameters [benzo(a)pyrene, antimony,  
30 chromium, manganese, and vanadium] exceeded the EPA Region III unrestricted land use  
31 RBCs in at least one sample. As a result of the screening process and subsequent risk

1 assessment in the RFI report, no COCs were identified for surface soils under unrestricted  
2 land use.

### 3 **4.2.1.2 Subsurface Soils**

4 Eight subsurface soil samples, collocated with the surface soil sample locations (see  
5 Figure 4-1 and Table 4-1) were collected for VOC, SVOC, pesticide/PCB, metals and  
6 cyanide analyses during the first sampling event. During the third sampling event, one  
7 subsurface soil sample was taken for dioxin analysis.

8 Subsurface soil sample results were evaluated relative to EPA Region III unrestricted and  
9 industrial RBCs and SSLs with a DAF=10. Based on the analysis presented in the RFI report,  
10 no COCs were identified for subsurface soils under the unrestricted land use scenario.

## 11 **4.2.2 Groundwater**

12 A small localized groundwater mound appears to be present in the immediate vicinity of  
13 these units (Figure 3-2). However, shallow groundwater at this site ultimately flows north  
14 to northeastward toward the Cooper River.

15 Four shallow monitoring wells were installed as part of the RFI investigation (see  
16 Figure 4-1). During the first sampling event<sup>3</sup>, the groundwater samples obtained from these  
17 wells, plus samples collected at an existing shallow and deep grid monitoring well pair  
18 (GDI015/GDI15D), were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide,  
19 chlorides, sulfates, and TDS (see Table 4-2). During subsequent sampling events, analytical  
20 criteria were modified based on data needs.

21 Constituents detected in the groundwater samples were evaluated relative to MCLs, tap  
22 water RBCs, and Zone I groundwater BRCs.

23 The following sections set out the findings presented in the RFI report.

### 24 **4.2.2.1 Shallow Groundwater**

25 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
26 result of the screening process and subsequent risk assessment, the following constituents  
27 were identified in the RFI report as COCs for shallow groundwater:

- 28 • **Thallium**, at a concentration of 4.6 µg/L, exceeded its reported tap water RBC  
29 (0.26 µg/L) in one groundwater sample (I677GW002) collected during the fourth

---

<sup>3</sup> Grid sample data were not included in the unit specific data, but are used to investigate the unit and the data are included in the Grid Base section of Section 10 in the Zone I RFI.

1 sampling event. Thallium also exceeded its MCL (2 µg/L) in a sample collected during  
2 the fourth sampling event.

- 3 • **Dimethoate** was detected at a concentration of 2 µg/L which exceeded the tap water  
4 RBC of 0.73 µg/L in one groundwater sample (I675GW002) collected during the first  
5 sampling event.

#### 6 **4.2.2.2 Deep Groundwater**

7 Analytes detected in deep groundwater samples were evaluated in the RFI report. As a  
8 result of the screening process and subsequent risk assessment, no constituents were  
9 identified as COCs for deep groundwater.

#### 10 **4.2.3 RFI Risk Summary**

11 Based on a unrestricted land use scenario, the following COCs were identified:

12 **Shallow Groundwater:** Dimethoate and thallium.

13 No COCs were identified for the industrial receptor.

#### 14 **4.2.4 Recommendations from Zone I RFI Report, Revision 0**

##### 15 **4.2.4.1 Soils**

16 NFA was recommended for soil in the RFI report.

##### 17 **4.2.4.3 Shallow Groundwater**

18 Groundwater contaminant treatment was recommended in the RFI report.

##### 19 **4.2.4.4 Deep Groundwater**

20 Continued monitoring was recommended in the RFI report.

### 21 **4.3 COPC/COC Refinement**

22 The COCs identified in the RFI include dimethoate and thallium in shallow groundwater.  
23 These COCs are further evaluated in the following sections. In addition, concentrations of  
24 VOCs detected in soils were rescreened using an SSL based on a DAF=1.

#### 25 **4.3.1 Surface Soil**

##### 26 **4.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

27 At AOCs 675/676/677, the VOCs detected in the surface soils were rescreened against the  
28 SSL with a DAF=1 (Table 4-3). The only VOC that was detected in surface soil at a  
29 concentration that exceeded its SSL was acetonitrile. Acetonitrile was detected in 1 of 14

1 surface soil samples and in 2 of 8 subsurface soil samples. Acetonitrile was not detected in  
2 groundwater at AOCs 675/676/677. Given the low frequency of detection in both surface  
3 and subsurface soil and the fact that it was not detected in site groundwater, acetonitrile is  
4 not considered a COC for the surface soils.

## 5 **4.3.2 Subsurface Soils**

6 No subsurface soil COCs were identified in the RFI report.

### 7 **4.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

8 As discussed above, VOCs detected in subsurface soil were rescreened against an SSL with  
9 a DAF=1 (Table 4-4). Acetonitrile was detected at concentrations greater than its SSL.

10 Acetonitrile was detected in 2 of 8 subsurface soil samples, but was not detected in  
11 groundwater at AOCs 675/676/677. Given the low frequency of detection in both surface  
12 and subsurface soil and the fact that it was not detected in site groundwater, acetonitrile is  
13 not considered a COC for subsurface soils.

14 Naphthalene was detected in one of the nine subsurface soil samples, which is also the  
15 single exceedance of the SSL (DAF=1) at I677SB009. Naphthalene was not detected in the  
16 surface sample collected from the same location (0.75 U mg/kg in sample I677SB00901).

17 Naphthalene was detected at 1 µg/L in two groundwater samples collected during the first  
18 and third sampling events at shallow monitoring well I675GW002. This well is located  
19 cross-gradient from boring I687SB009 and thus is not likely to have been impacted by this  
20 boring (See Figure 4-1 for sampling locations). Naphthalene was not detected in either  
21 groundwater sample collected during the second or fourth sampling events. No other  
22 naphthalene detections in groundwater were identified at the site, indicating that  
23 naphthalene is not leaching from site soils into groundwater.

24 The average surface soil concentration of naphthalene is 0.47 mg/kg, and its average  
25 subsurface soil concentration is 1.1 mg/kg, which is well below the generic SSL of 4 mg/kg  
26 (DAF=10). Thus, the amount of naphthalene in soils at the site does not present a significant  
27 leaching hazard. Based on these considerations, naphthalene should not be considered a  
28 COC at AOCs 675/676/677.

## 29 **4.3.3 Groundwater**

30 Groundwater samples at AOCs 675/676/677 were collected from four shallow wells in four  
31 sampling events, for a total of 16 samples analyzed. Thallium and dimethoate were  
32 identified in the RFI report as COCs in groundwater for the unrestricted land use scenario  
33 at AOCs 675/676/677. These COCs are discussed below.

#### 1 **4.3.3.1 Thallium in Shallow Groundwater**

2 Of the 16 groundwater analyses, thallium was detected only once in a single well. The  
3 single detection (4.6 µg/L) exceeded the MCL of 2 µg/L (see Table 4-5); there is no  
4 established background range for thallium in Zone I. However, the observed concentrations  
5 of thallium in shallow groundwater at this site are consistent with the occurrences of  
6 thallium observed in Zone I grid wells. Thallium was detected intermittently in shallow  
7 grid wells at concentrations ranging from 3J µg/L to 7.5J µg/L (see Appendix A-1). Given  
8 that the concentrations of thallium in shallow groundwater are consistent with grid well  
9 background conditions in Zone I and that the occurrences were not duplicated in  
10 subsequent sampling events, thallium is not considered a COC in groundwater at AOCs  
11 675/676/677.

#### 12 **4.3.3.2 Dimethoate in Shallow Groundwater**

13 Dimethoate was detected in one of two wells sampled for organophosphorous pesticides. It  
14 was detected at a concentration of 2 µg/L in the first sampling event, but it was not  
15 detected in either well during the second sampling event. Although the RFI report indicates  
16 that this detected concentration exceeded its reported tap water RBC of 0.73 µg/L, this  
17 compound does not appear in the current EPA MCLs or the EPA Region III RBC Table.  
18 Given that it was detected only once in groundwater, that its presence was never  
19 reconfirmed, that it was never detected in surface or subsurface soils, and that it is not  
20 associated with past activities at these sites, dimethoate is not considered a COC in  
21 groundwater.

#### 22 **4.3.4 COPC/COC Refinement Summary**

23 There are no COCs requiring further action in surface soils, subsurface soils, or  
24 groundwater at AOCs 675/676/677. Therefore, these sites are recommended for NFA.

### 25 **4.4 Summary of Information Related to Site Closeout Issues**

#### 26 **4.4.1 RFI Status**

27 The RFI report, as amended by the RFI Report Addendum, is complete.

#### 28 **4.4.2 Presence of Inorganics in Groundwater**

29 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
30 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
31 antimony) in groundwater at concentrations above the applicable MCL, preceded or

1 followed by detection of these same metals below the MCL or below the practicable  
2 quantitation limit. This is discussed in Section 4.3.

### 3 **4.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

4 Data indicate that AOCs 675/676/677 were never connected to the sanitary sewer system.  
5 Therefore, there are no concerns regarding connections to the sanitary sewer. No COCs  
6 requiring further evaluation are present at the site. Further evaluation of this issue is not  
7 warranted.

### 8 **4.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

9 No direct connections of AOCs 675/676/677 to the storm sewer are known to exist. No  
10 COCs requiring further evaluation are present at the site. Further evaluation of this issue is  
11 not warranted.

### 12 **4.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

13 The closest railroad line to AOCs 675/676/677 is located approximately 4,200 feet  
14 southwest. There is no known linkage between these AOCs and the investigated railroad  
15 lines of AOC 504, and further evaluation of this issue is not warranted.

### 16 **4.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

17 The nearest surface water body to AOCs 675/676/677 is the Cooper River, which lies  
18 approximately 65 feet north of the unit. The only potential migration pathway from the site  
19 to surface water is via overland flow via stormwater runoff. Since the entire site is covered  
20 with buildings and pavement, which eliminates contact of surface soil with stormwater,  
21 and no COCs were identified at the site, further evaluation of a potential pathway for  
22 contaminant migration via stormwater runoff is not warranted. Similarly, runoff directed to  
23 the storm sewer system, which discharges to the Cooper River, does not contact the surface  
24 soil.

### 25 **4.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

26 AOC 675 had a 495-gallon OWS associated with it. The OWS was located north of a  
27 25,000-gallon UST. The OWS was removed and the lines were capped.

28 AOC 677 has an OWS associated with it. The OWS was associated with boilers located in  
29 NS-4. Boiler discharge was removed by a sump pump through the OWS into the sanitary  
30 sewer system.

1 Based on the discussion presented in Section 4.3, there are no concerns regarding  
2 environmental releases from these units. In addition, this area was investigated during the  
3 SWMU 37 investigation (Zone L - Sanitary Sewer System) regarding OWS connections to  
4 the sanitary sewer, and no areas of concern were identified in the vicinity of AOCs  
5 675/676/677. Further evaluation of this issue is not warranted.

#### 6 **4.4.8 Land Use Control Management Plan**

7 The COC refinement did not identify any COCs at AOCs 675/676/677. This evaluation was  
8 based on a unrestricted land use classification. Therefore, land use controls are not  
9 necessary.

### 10 **4.5 CH2M-Jones Recommendations**

11 Evaluation of the primary media of concern (surface soils, subsurface soils, and  
12 groundwater) indicated that there were no issues associated with the historical operation of,  
13 or releases from, this unit. Based on a review of COPCs/COCs in Section 4.3, no COCs were  
14 identified in any investigated media.

15 The RFI report concluded that a CMS was necessary for groundwater. However, CH2M-  
16 Jones has re-evaluated the risks posed by the identified COCs and determined that no  
17 COCs exist at AOCs 675/676/677. Therefore, these sites are recommended for NFA.

**TABLE 4-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, AOCs 675/676/677, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	02/21/95 02/27/95 02/28/95	Upper - 14 (13)	Standard Suite, Organotins	Organotins were collected on nine upper-interval samples (677SB00201 through 677SB01001) for site characterization.
		Lower - 8 (13)	Standard Suite, Organotins	Six lower-interval samples were not collected due to a water table at less than 5 feet bgs. Organotins were collected on six lower-interval samples (677SB00202, 677SB00302, 677SB00402, 677SB00602, 677SB00702, and 677SB00902) for site characterization.
		Duplicate - 3	Appendix IX	677CB00101/677CB00201/677CB01001*
2	09/07/95	Upper - 1	Physical Parameters	Sample for physical parameters collected at boring location 677SB01001.
3	02/02/99	Upper - 3	Dioxins	Dioxins were collected on 3 upper-interval samples 677SB011, 677SB012, and 677SB013
		Lower - 1	Dioxins	One low-interval sample (677SB011) was collected for dioxins

1  
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**Notes:**

( ) = Parenthesis indicate number of samples proposed in the RFI work plan.

\* = 677CB01001 was not analyzed for cyanide.

Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.

Appendix IX = Standard Suite, plus hex-chrome, dioxins, herbicides, and OP pesticides at DQO Level IV.

Physical parameters analyses included CEC, chloride, sulfur, ammonia, nitrate/nitrite, phosphorus, TOC and total moisture.

**TABLE 4-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOCs 675/676/677, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Wells Sampled	Sample Analyses	Comments
1	06/01/95	675001	Standard Suite, organotins, chloride, TDS, sulfate	677002 also sampled for herbicides, dioxin, hex-chrome, and OP pesticides
		675002		
	06/05/95	676001		
	06/06/95	677002		
2	01/15/96	675001	Metals, cyanide, pesticides, PCBs, SVOCs	
		675002	Metals, cyanide, pesticides, PCBs, SVOCs, TPH-DRO, TPH-GRO	
		676001	Metals, cyanide, pesticides, PCBs	
		677002	Metals, cyanide, pesticides, PCBs, dioxin	
		675001	Metals, cyanide, pesticides, PCBs, SVOCs	
3	06/03/96	675001	Metals, cyanide, pesticides, PCBs, SVOCs	
		675002	Metals, cyanide, pesticides, PCBs, SVOCs, TPH-DRO, TPH-GRO	
		676001	Metals, cyanide, pesticides, PCBs	
		677002	Metals, cyanide, pesticides, PCBs, dioxin	
		675001	Metals, cyanide, pesticides, PCBs, SVOCs, TPH-DRO, TPH-GRO	
4	09/13/96	675001	Metals, cyanide, pesticides, PCBs, SVOCs, TPH-DRO, TPH-GRO	
		675002	Metals, cyanide, pesticides, PCBs, SVOCs, TPH-DRO, TPH-GRO	
		676002	Metals, cyanide, pesticides, PCBs	
		677002	Metals, cyanide, pesticides, PCBs, dioxin, herbicides, chloride, sulfate, TDS	
		675001	Metals, cyanide, pesticides, PCBs, SVOCs, TPH-DRO, TPH-GRO	

1  
 2 **Note:**  
 3 Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.

**TABLE 4-3**  
 VOCs in Surface Soils  
 CMS Work Plan, AOC 675/676/677, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone Result (mg/kg)	Qualifier	Acetonitrile Result (mg/kg)	Qualifier	Naphthalene Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier
			IND RBC		20,000.00	NA	4,100.00		4,100.00	
			RES RBC		780.00	NA	160.00		1,600.00	
			SSL		0.80	NA	4		0.60	
			SS BKGD		NA	NA	NA		NA	
I675SB001	675SB00101	02/21/95	0.1100	U	0.2400	U	0.7900	U	0.0030	J
I675SB002	675SB00201	02/21/95	0.1100	U	0.2400	U	0.8000	U	0.0180	U
I676SB001	676SB00101	02/21/95	0.1000	U	0.2300	UJ	0.7400	U	0.0010	J
I676SB002	676SB00201	02/28/95	0.1000	UJ	0.0230	UJ	0.7500	U	0.0170	U
I677SB001	677SB00101	02/21/95	0.1100	UJ	0.2400	UJ	0.7700	U	0.0010	J
I677SB002	677SB00201a	02/21/95	0.0320	J	0.2300	UJ	0.7400	U	0.0050	J
I677SB003	677SB00301	02/28/95	0.0990	UJ	0.0220	UJ	0.7200	U	0.0020	J
I677SB004	677SB00401	02/28/95	0.1000	UJ	0.0220	UJ	0.7300	U	0.0170	U
I677SB005	677SB00501	02/28/95	0.1100	U	0.0240	UJ	0.6600	U	0.0180	U
I677SB006	677SB00601	02/27/95	0.0720	J	0.1000	J	0.0520	J	0.0030	J
I677SB007	677SB00701	02/28/95	0.0990	U	0.0220	UJ	0.7300	U	0.0160	U
I677SB008	677SB00801	02/28/95	0.1000	UJ	0.0610	UJ	0.7400	U	0.0020	J
I677SB009	677SB00901	02/28/95	0.0230	UJ	0.0630	UJ	0.7500	U	0.0020	J
I677SB010	677SB01001a	02/28/95	0.1000	UJ	0.0230	UJ	2.1000	=	0.0020	J

= Chemical is detected at concentration shown.  
 NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

**TABLE 4-4**  
 VOCs in Subsurface Soil  
 CMS Work Plan, AOC 675/676/677, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone Result (mg/kg)	Qualifier	Acetonitrile Result (mg/kg)	Qualifier	Naphthalene Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier
			SSL	0.8000	NA		4		0.6000	
			SS BKGD	NA	NA		NA		NA	
I676SB001	676SB00102	02/21/95	0.0170	J	0.2400	U	0.8000	U	0.0190	=
I676SB002	676SB00202	02/28/95	0.1200	UJ	0.0200	UJ	0.6600	U	0.0210	U
I677SB002	677SB00202b	02/21/95	0.0260	J	0.2900	U	0.9300	U	0.0230	=
I677SB003	677SB00302	02/28/95	0.0290	UJ	0.0280	UJ	0.9100	U	0.0210	U
I677SB004	677SB00402b	02/28/95	0.0640	J	0.0810	J	0.8700	U	0.0020	J
I677SB006	677SB00602	02/27/95	0.2000	J	0.1500	J	1.1000	U	0.0060	J
I677SB007	677SB00702	02/28/95	0.0350	UJ	0.1000	UJ	0.8200	U	0.0190	U
I677SB009	677SB00902	02/28/95	0.0230	UJ	0.0400	UJ	5.9000	=	0.0040	J

= Chemical is detected at concentration shown.  
 NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

**Table 4-5**  
 Thallium in Groundwater  
 CMS Work Plan, AOCs 675/676/677, Zone I, Charleston Naval Complex

Sample Station	ID	Date	MCL	Thallium Result (ug/L)	Qualifier
			RBC	2	
			Shallow	0.26	
			Deep	8	
				15	
<b>Shallow Groundwater</b>					
I675GW001	675GW00101	06/01/1995		4.5	U
	675GW00102	01/15/1996		5	U
	675GW00103	06/03/1996		5	U
	675GW00104	09/13/1996		2.7	U
I675GW002	675GW00201	06/01/1995		4.5	U
	675GW00202a	01/15/1996		5	U
	675GW00203	06/03/1996		5	U
	675GW00204	09/13/1996		2.7	U
I676GW001	676GW00101	06/05/1995		4.5	U
	676GW00102	01/15/1996		5	U
	676GW00103	06/04/1996		5	U
	676GW00104	09/12/1996		4	U
I677GW002	677GW00201b	06/06/1995		4.5	U
	677GW00202	01/15/1996		5	U
	677GW00203b	06/06/1996		5	U
	677GW00204	09/10/1996		4.6	J
IGDIGW015	GDIGW01501	05/23/1995		4.5	U
	GDIGW01502	12/15/1995		5	UJ
	GDIGW01503	05/23/1996		5	U
	GDIGW01504	08/23/1996		2.7	UJ
<b>Deep Groundwater</b>					
IGDIGW15D	GDIGW15D01	05/23/1995		4.5	U
	GDIGW15D02	12/15/1995		5	UJ
	GDIGW15D03	05/24/1996		7.1	J
	GDIGW15D04	08/23/1996		2.7	UJ

J Chemical is detected at concentration below the method detection limit; the concentration is not known.

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).

UJ Not detected; analytical detection limit is estimated.

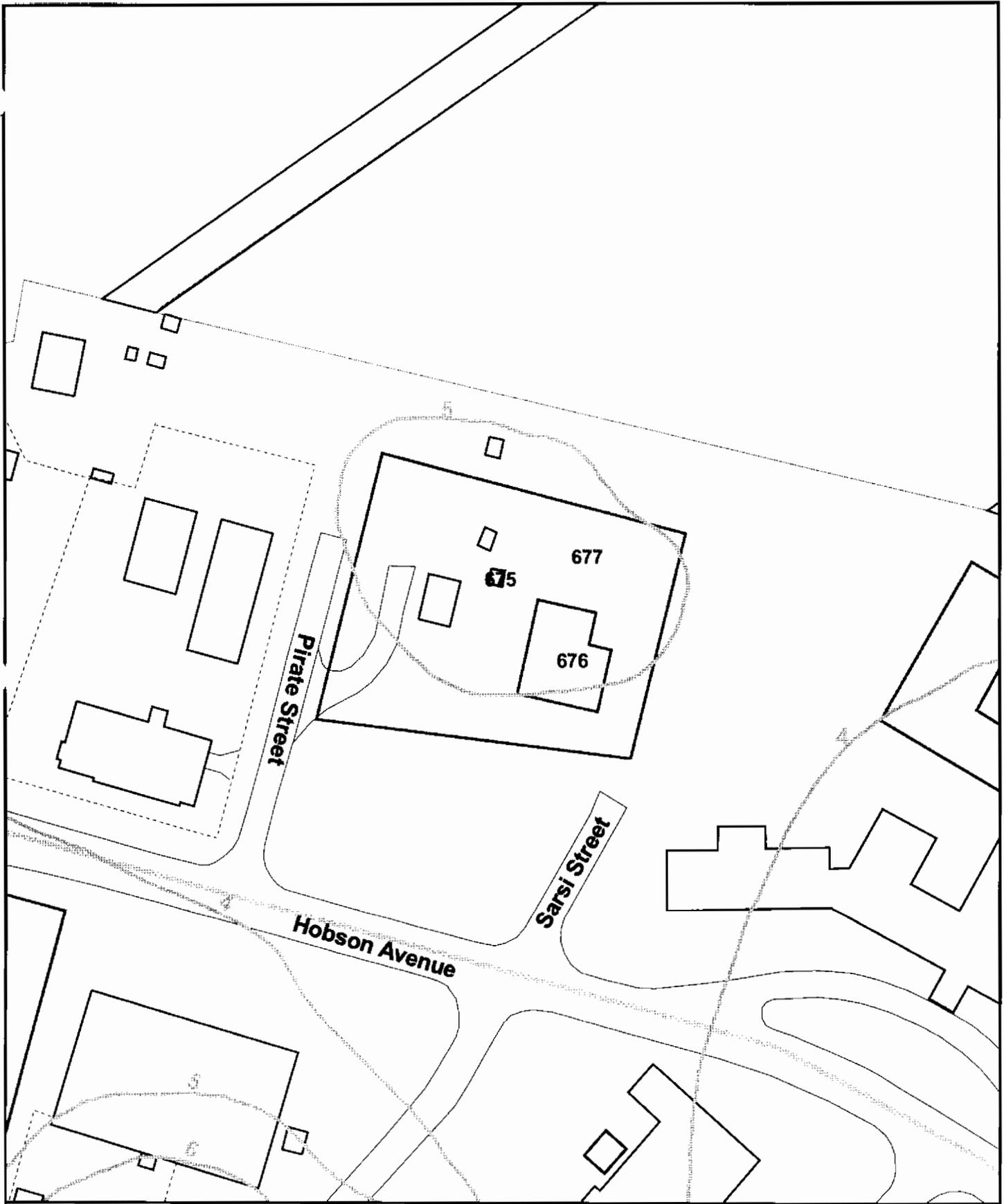
µg/L Micrograms per liter

**TABLE 4-6**  
 Dimethoate in Groundwater  
 CMS Work Plan, AOC 675/676/677, Zone I, Charleston Naval Complex

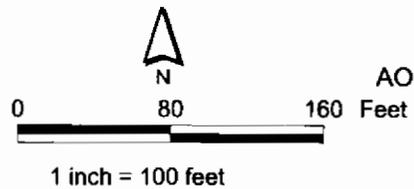
Sample Station	ID	Date	Dimethoate Result ( $\mu\text{g/L}$ )	Qualifier
		<b>MCL</b>	NA	
		<b>RBC</b>	NA	
		<b>Shallow</b>	NA	
<b>Shallow Groundwater</b>				
I675GW001	675GW00101	06/01/95	15.0000	UJ
I675GW002	675GW00201	06/01/95	2.0000	J
I676GW001	676GW00101	06/05/95	15.0000	U
I677GW002	677GW00201b	06/06/95	15.0000	U
	677GW00201b	06/06/95	0.5000	U
IGDIGW015	GDIGW01501	05/23/95	15.0000	U
<b>Deep Groundwater</b>				
IGDIGW15D	GDIGW15D01	05/23/95	15.0000	U

NA Not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 $\mu\text{g/L}$  Micrograms per liter





- Inferred Groundwater Elevations (ft msl)
  - Known Groundwater Elevations (ft msl)
  - Fence
  - Railroads
  - Roads
  - Shoreline
  - AOC Boundary
  - SWMU Boundary
  - Buildings
  - Zone Boundary
- ft msl - feet above mean sea level



**Figure 4-2**  
 Shallow Groundwater Contour Map  
 AOC 675, AOC 676, and AOC 677, Zone I  
 Charleston Naval Complex



## 1 **5.0 CMS Work Plan for AOC 678 and AOC 679**

2 This section summarizes the results and conclusions from the soil and groundwater  
3 investigations conducted in the area of AOCs 678/679, which were reported in the *Zone I*  
4 *RFI Report, Revision 0* (EnSafe, 1999), Section 10.4, and amended by the *Zone I RFI Report*  
5 *Addendum, Revision 1* (CH2M-Jones, 2001). Figure 5-1 presents the site features and RFI  
6 sample locations.

7 As part of the Zone I RFI, surface soil, subsurface soil, and groundwater investigations were  
8 conducted at AOCs 678/679 in multiple sampling events in 1995, 1996, and 1998. The RFI  
9 report presented the results of the investigations and conclusions concerning contamination  
10 and risk, as summarized in Sections 5.1 and 5.2 of this CMS Work Plan. A further  
11 evaluation of COCs is provided in Section 5.3 of this work plan.

### 12 **5.1 Background**

13 AOC 678 is the former site of Building 2-V, the Firefighter School, which is northeast of  
14 Building NS-1 in the northeastern portion of the southern peninsula. The firefighter school  
15 was reportedly constructed in 1947 and demolished circa 1955. Controlled fires may have  
16 been ignited and extinguished onsite for firefighter training. No other details regarding the  
17 design features or operating practices are available. Currently, the area is a paved parking  
18 lot.

19 AOC 679 consists of a former wash rack that is noted on early CNC maps from the 1930s  
20 and 1940s. This former wash rack was located off the west edge of Building NS-1. No  
21 information is available regarding its design features, years of operation, or operating  
22 practices. It is assumed that activities at this unit included washing or cleaning of  
23 equipment in an external wash area.

24 The area is zoned for business use (B-2).

### 25 **5.2 RFI Investigation Results**

#### 26 **5.2.1 Soil Investigation Results**

27 As part of the RFI field investigation, surface soil samples and collocated subsurface soil  
28 samples were collected (see Table 5-1 and Figure 5-1)

1 **5.2.1.1 Surface Soils**

2 A total of 24 surface soil samples (see Figure 5-1) were collected. Twenty one surface soil  
3 samples were collected during the first sampling event for VOC, SVOC, pesticide/PCB,  
4 metals and cyanide analyses. During the second sampling event, two surface soil samples  
5 were taken for metals analysis. During the third sampling event, one surface soil sample  
6 was taken for VOC, SVOC, and metals analysis.

7 Surface soil sample results were evaluated relative to EPA Region III RBCs. Based on the  
8 analytical results presented in the RFI report and the risk assessment screening process,  
9 isodrin (using aldrin as a surrogate since there is no RBC for isodrin) in surface soil was  
10 identified as the only COC under the unrestricted land use scenario. Isodrin was detected in  
11 only 2 of 20 surface soil samples at concentrations of 990  $\mu\text{g}/\text{kg}$  in 679SB006 and  
12 1,000  $\mu\text{g}/\text{kg}$  in 679SB007.

13 **5.2.1.2 Subsurface Soils**

14 Thirteen subsurface soil samples, collocated with the surface soil sample locations (see  
15 Table 5-1 and Figure 5-1), were collected and analyzed for VOCs, SVOCs, pesticides/PCBs,  
16 metals and cyanide during the RFI sampling event. Subsurface soil sample results were  
17 evaluated relative to the EPA Region III unrestricted and industrial RBCs and SSLs with a  
18 DAF=10. Based on the analysis presented in the RFI report, no COCs were identified for  
19 subsurface soils for unrestricted land use.

20 **5.2.2 Groundwater**

21 Shallow groundwater at this site is locally affected by an apparent groundwater high  
22 toward the northwest of the site. However, groundwater patterns locally revert to flow  
23 north-northeast toward the Cooper River (see Figure 5-2).

24 Three shallow and one deep monitoring wells were installed as part of the RFI  
25 investigation. The groundwater was sampled in six separate sampling events at these wells  
26 (see Table 5-2 and Figure 5-1). An additional five shallow and four deep Geoprobe  
27 groundwater samples were collected in March 1998, subsequent to completion of the RFI  
28 field investigation, and are discussed in the RFI report.

29 Constituents detected in the groundwater samples were evaluated relative to MCLs, tap  
30 water RBCs, and Zone I groundwater BRCs.

31 The following sections set out the findings presented in the RFI report.

1 **5.2.2.1 Shallow Groundwater**

2 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
3 result of the screening process and subsequent risk assessment, no constituents were  
4 identified as COCs for shallow groundwater.

5 **5.2.2.2 Deep Groundwater**

6 Analytes detected in deep groundwater samples were evaluated in the RFI report. As a  
7 result of the screening process and subsequent risk assessment, no constituents were  
8 identified as COCs for deep groundwater.

9 **5.2.3 RFI Risk Summary**

10 Based on a unrestricted land use scenario, the following COC was identified:

11 **Surface Soil: Isodrin**

12 No COCs were identified in any media for the industrial land use scenario.

13 **5.2.4 Recommendations from Zone I RFI Report, Revision 0**

14 **5.2.4.1 Surface Soils**

15 The RFI recommended a CMS for surface soils, considering no action, excavation and offsite  
16 disposal, and containment/capping.

17 **5.2.4.2 Subsurface Soil**

18 NFA was recommended in the RFI report for subsurface soils.

19 **5.2.4.3 Groundwater**

20 NFA was recommended in the RFI report for groundwater.

21 **5.3 COPC/COC Refinement**

22 The COC identified in the RFI was isodrin in surface soil for the unrestricted land use  
23 receptor. This COC is further evaluated in the following sections. In addition,  
24 concentrations of VOCs detected in soils were rescreened using an SSL based on a DAF=1.

25 **5.3.1 Surface Soil**

26 **5.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

27 The results following rescreening of the VOCs detected in surface soils using an SSL with a  
28 DAF=1 indicated that there were no VOCs at concentrations exceeding their respective SSL  
29 (see Table 5-3). For these reasons, VOCs at AOCs 678/679 are not considered COCs.

### 1 **5.3.1.2 Isodrin**

2 Isodrin was not detected in any of the 20 normal surface soil samples (see Table 5-4), but  
3 was reportedly present in the two duplicate samples collected during the RFI field  
4 investigations. The two detected concentrations were 0.99 mg/kg (679SB006) and 1 mg/kg  
5 (679SB007), both of which are equal to their respective analytical detection limits. Isodrin,  
6 however, was not detected in any of the subsurface soil samples or groundwater samples.  
7 In addition, there are no SSLs or risk-based concentration for isodrin, so the risk assessment  
8 presented in the RFI report characterized the estimated risk associated with isodrin using  
9 aldrin as a surrogate (residential RBC = 38 µg/kg). This was a very conservative approach  
10 given that aldrin is a known carcinogen. Considering that isodrin is an organo-chlorine  
11 pesticide, it would have been equally appropriate to use another cyclodiene pesticide, such  
12 as endrin or dieldrin (residential RBCs = 2,300 µg/kg [HI=0.1] and 40 µg/kg, respectively)  
13 as the surrogate. Preliminary toxicity studies did not indicate isodrin was a carcinogen,  
14 which suggests that an endrin-based RBC value is more appropriate.

15 Isodrin was detected in 2 of 22 samples (20 normal and 2 duplicate) at concentrations near  
16 1 mg/kg. All other sample results were below detection limits (non-detects). The use of  
17 isodrin has been discontinued, along with other organo-chlorine pesticides, so  
18 concentrations are not likely to increase.

19 Isodrin is not considered a COC for AOCs 678/679 for the following reasons:

- 20 • Isodrin was detected in only 2 of 20 surface soil samples (10 percent) near or at its  
21 detection limit and was not detected in any subsurface soil or groundwater samples.
- 22 • Even when evaluated using aldrin as the surrogate compound, the derived risk reported  
23 in the RFI (2.6E-6) is associated with potential exposure that barely exceeded the  
24 conservative end of the 1E-4 to 1E-6 risk range for residential receptors (it did not  
25 exceed the risk range for industrial receptors).

### 26 **5.3.2 Subsurface Soils**

27 No subsurface soil COCs were identified in the RFI report.

#### 28 **5.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

29 The results following rescreening of the VOCs detected in subsurface soils using an SSL  
30 with a DAF=1 indicated that there were no VOCs detected at concentrations exceeding their  
31 respective SSLs (see Table 5-5). For these reasons, VOCs at AOCs 678/679 are not  
32 considered a COC.

1 **5.3.3 Groundwater**

2 COPCs or COCs were not identified in groundwater at AOCs 678/679.

3 **5.3.4 COPC/COC Refinement Summary**

4 There are no COCs requiring further action in surface soils, subsurface soils or groundwater  
5 at AOCs 678/679. This site is recommended for NFA.

6 **5.4 Summary of Information Related to Site Closeout Issues**

7 **5.4.1 RFI Status**

8 The RFI report, as amended by the RFI Report Addendum, is complete.

9 **5.4.2 Presence of Inorganics in Groundwater**

10 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
11 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
12 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
13 followed by detection of these same metals below the MCL or below the practicable  
14 quantitation limit. No groundwater samples exceeded their respective MCLs.

15 **5.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

16 Data indicate that these AOCs 678/679 were never connected to the sanitary sewer system.  
17 Therefore, there are no concerns regarding connections to the sanitary sewer. Further  
18 evaluation of this issue is not warranted.

19 **5.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

20 Three stormwater inlets are located adjacent to AOCs 678/679. Considering that the ground  
21 surface within AOCs 678/679 is paved, runoff directed to the storm sewer system does not  
22 contact the surface soil, and no COCs have been identified at these sites. Further evaluation  
23 of this issue is not warranted.

24 **5.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

25 The closest railroad line to AOCs 678/679 is located approximately 4,500 feet southwest.  
26 There is no known linkage between these AOCs and the investigated railroad lines of AOC  
27 504, and further evaluation of this issue is not warranted.

#### 1 **5.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

2 The nearest surface water body to AOCs 678/679 is the Cooper River, which lies  
3 approximately 40 feet north of the unit. The only potential migration pathway from the site  
4 to surface water is via overland flow via stormwater runoff. Since the entire site is covered  
5 with pavement, which eliminates contact of surface soil with stormwater, and no COCs  
6 were identified at the site, further evaluation of a potential pathway for contaminant  
7 migration via stormwater runoff is not warranted. Similarly, runoff directed to the storm  
8 sewer system, which discharges to the Cooper River, does not contact the surface soil.

#### 9 **5.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

10 There are no known OWSs associated with AOCs 678/679. Therefore, there are no concerns  
11 regarding connections to the sanitary sewer, and further evaluation of this issue is not  
12 warranted. In addition, there is no reference to an OWS at this facility in the *Oil Water*  
13 *Separator Data* report (Department of the Navy, September 2000).

#### 14 **5.4.8 Land Use Control Management Plan**

15 The COC refinement did not identify any COCs at AOCs 678/679. This evaluation was  
16 based on a unrestricted land use classification. Therefore, land use controls are not  
17 necessary.

### 18 **5.5 CH2M-Jones Recommendations**

19 Evaluation of the primary media of concern (surface soils, subsurface soils, and  
20 groundwater) indicated that there were no issues associated with the historical operation of,  
21 or releases from, this unit. Based on a review of COPCs/COCs in Section 5.3, no COCs were  
22 identified in any investigated media.

23 The RFI report concluded that a CMS was necessary for surface soil. However, CH2M-Jones  
24 has re-evaluated the risks posed by the identified COCs and determined that no COCs exist  
25 at AOCs 678/679. Therefore, these sites are recommended for NFA.

1 **TABLE 5-1**  
 2 RFI Soil Sampling Summary  
 3 *CMS Work Plan, AOCs 678/679, Zone I, Charleston Naval Complex*

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	02/22/95 03/01/95 03/06/95 03/10/95 03/13/95	Upper - 21 (25)  Lower - 12 (25)  Duplicates - 3	Standard Suite, Additional Parameters <sup>a</sup>  Standard Suite  Appendix IX <sup>b</sup>	Four sample locations were inaccessible. 678SB00901 sampled for organotins only. Thirteen lower samples were not collected due to a water table less than 5 feet bgs.
2	06/21/95	Upper - 2	Metals	To delineate the extent of metals detected above their RBCs and background.
3	9/23/98	Upper - 1 Lower - 1	VOCs, SVOCs, metals	

- 4  
 5 Notes:  
 6 ( ) – Parenthesis indicate number of samples proposed  
 7 Standard Suite – VOCs, SVOCs, metals, cyanide, pesticides and PCBs at DQO Level III.  
 8 a – Additional analysis performed on one sample on 09/18/95 included cation, chloride, sulfur, ammonia,  
 9 nitrate/nitrite, phosphorus, TOC and total moisture.  
 10 b – Duplicates were submitted for Appendix IX parameters at DQO Level IV.

1 **TABLE 5-2**  
 2 **RFI Groundwater Sampling Summary**  
 3 *CMS Work Plan, AOCs 678/679, Zone I, Charleston Naval Complex*

Sampling Event	Sampling Date	Number of Wells	Sample Analyses	Comments
1	05/22/95 06/06/95 06/08/95	3	Standard Suite, Organotins, Chlorides, TDS, Sulfates	
2	01/15/96	3	Cyanide, Metals	
		Duplicate - 1	Cyanide, Metals	
3	05/24/96 06/04/96 06/05/96	3	Cyanide, Metals	
		Duplicate - 1	Cyanide, Metals	
4	09/09/96 09/11/96	3	Chloride, Cyanide, Sulfate, Metals, Pesticides, VOCs, TDS	
		Duplicate - 1	Appendix IX	
5	03/16/98 03/17/98 03/19/98	5	VOCs, SVOCs	Five shallow and four deep Geoprobe samples were collected along the boundary between AOC 679 and AOC 680.
		Duplicate - 1	VOCs, SVOCs	
6	10/19/98	1	VOCs	Only Well 679001 was sampled during this event.

4  
 5 **Notes:**  
 6 Standard Suite – VOCs, SVOCs, metals, cyanide, pesticides and PCBs at DQO Level III.  
 7 Appendix IX – Analyses included pesticides and VOCs only, plus chloride, cyanide, sulfate, metals and TDS.  
 8  
 9

**TABLE 5-3**  
VOCs Detected in Surface Soil  
CMS Work Plan, AOC 678/679, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone Result (mg/kg)	Qualifier	Naphthalene Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier	1,1,2-Trichloro-1,2,2-Trifluoroethane Result (mg/kg)	Qualifier	
			<b>IND RBC</b>		20,000.00		4,100.00		41,000.00		6,100,000
			<b>RES RBC</b>		780.00		160.00		1600.00		230,000
			<b>SSL</b>		0.80		4		0.60		NA
			<b>SS BKGD</b>		NA		NA		NA		NA
1678SB001	678SB00101	02/22/95	0.0170	J	0.0680	J	0.0160	U	0.0040	J	
1678SB002	678SB00201	03/01/95	0.1000	U	0.7500	U	0.0170	U	0.0110	U	
1678SB003	678SB00301	03/06/95	0.0280	J	0.7600	U	0.0040	J	0.0120	U	
1678SB005	678SB00501	03/06/95	0.0990	U	0.7200	U	0.0010	J	0.0110	U	
1678SB006	678SB00601	03/06/95	0.1000	U	0.7300	U	0.0170	U	0.0110	U	
1678SB007	678SB00701	03/06/95	0.1000	U	0.6600	U	0.0020	J	0.0110	U	
1678SB008	678SB00801	03/06/95	0.1000	U	0.7600	U	0.0040	J	0.0110	U	
1678SB011	678SB01101	03/06/95	0.0990	U	0.7300	U	0.0020	J	0.0110	U	
1678SB012	678SB01201a	03/06/95	0.1000	U	0.7500	U	0.0170	U	0.0110	U	
1679SB002	679SB00201	03/10/95	0.0150	J	0.7300	U	0.0010	J	0.0110	U	
1679SB003	679SB00301	03/10/95	0.0500	J	0.7500	U	0.0170	U	0.0110	U	
1679SB004	679SB00401	03/10/95	0.0160	J	0.7300	U	0.0010	J	0.0110	U	
1679SB005	679SB00501	03/10/95	0.1000	U	0.7500	U	0.0170	U	0.0110	U	
1679SB006	679SB00601	03/10/95	0.0080	J	0.7100	U	0.0160	U	0.0110	U	
1679SB007	679SB00701	03/10/95	0.0310	J	0.7500	U	0.0170	U	0.0110	U	
1679SB008	679SB00801	03/10/95	0.0380	J	0.0600	J	0.0020	J	0.0110	U	
1679SB009	679SB00901	03/10/95	0.0490	J	0.7300	U	0.0020	J	0.0110	U	
1679SB010	679SB01001	03/10/95	0.0220	U	0.7200	U	0.0160	U	0.0110	U	

**TABLE 5-3**  
VOCs Detected in Surface Soil  
CMS Work Plan, AOC 678/679, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone Result (mg/kg)	Qualifier	Naphthalene Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier	1,1,2-Trichloro-1,2,2-Trifluoroethane Result (mg/kg)	Qualifier
			IND RBC	20,000.00		4,100.00	41,000.00		6,100,000	
			RES RBC	780.00		160.00	1600.00		230,000	
			SSL	0.80		4	0.60		NA	
			SS BKGD	NA		NA	NA		NA	
I679SB011	679SB01101	03/10/95	0.0130	J	0.7200	U	0.0030	J	0.0110	U
I679SB012	679SB01201	03/13/95	0.1000	U	0.7200	U	0.0030	J	0.0110	U

NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

**TABLE 5-4**  
 Isodrin in Surface Soils  
 CMS Work Plan, AOC 678/679, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Isodrin Result (mg/kg)	Qualifier
			IND RBC	NA	
			RES RBC	NA	
			SSL	NA	
			SS BKGD	NA	
678SB00101	678SB00101	02/22/95		0.9900	U
678SB00201	678SB00201	03/01/95		1.0000	U
678SB00301	678SB00301	03/06/95		1.1000	U
678SB00501	678SB00501	03/06/95		1.0000	U
678SB00601	678SB00601	03/06/95		1.0000	U
678SB00701	678SB00701	03/06/95		0.9100	U
678SB00801	678SB00801	03/06/95		1.1000	U
678SB01101	678SB01101	03/06/95		1.0000	U
678SB01201a	678SB01201a	03/06/95		1.0000	U
679SB00201	679SB00201	03/10/95		1.0000	U
679SB00301	679SB00301	03/10/95		1.0000	U
679SB00401	679SB00401	03/10/95		1.0000	U
679SB00501	679SB00501	03/10/95		1.0000	U
679SB00601	679SB00601	03/10/95		0.9900	U
679SB00701	679SB00701	03/10/95		1.0000	U
679SB00801	679SB00801	03/10/95		1.0000	U
679SB00901	679SB00901	03/10/95		1.0000	U
679SB01001	679SB01001	03/10/95		1.0000	U
679SB01101	679SB01101	03/10/95		1.0000	U
679SB01201	679SB01201	03/13/95		1.0000	U

NA not applicable

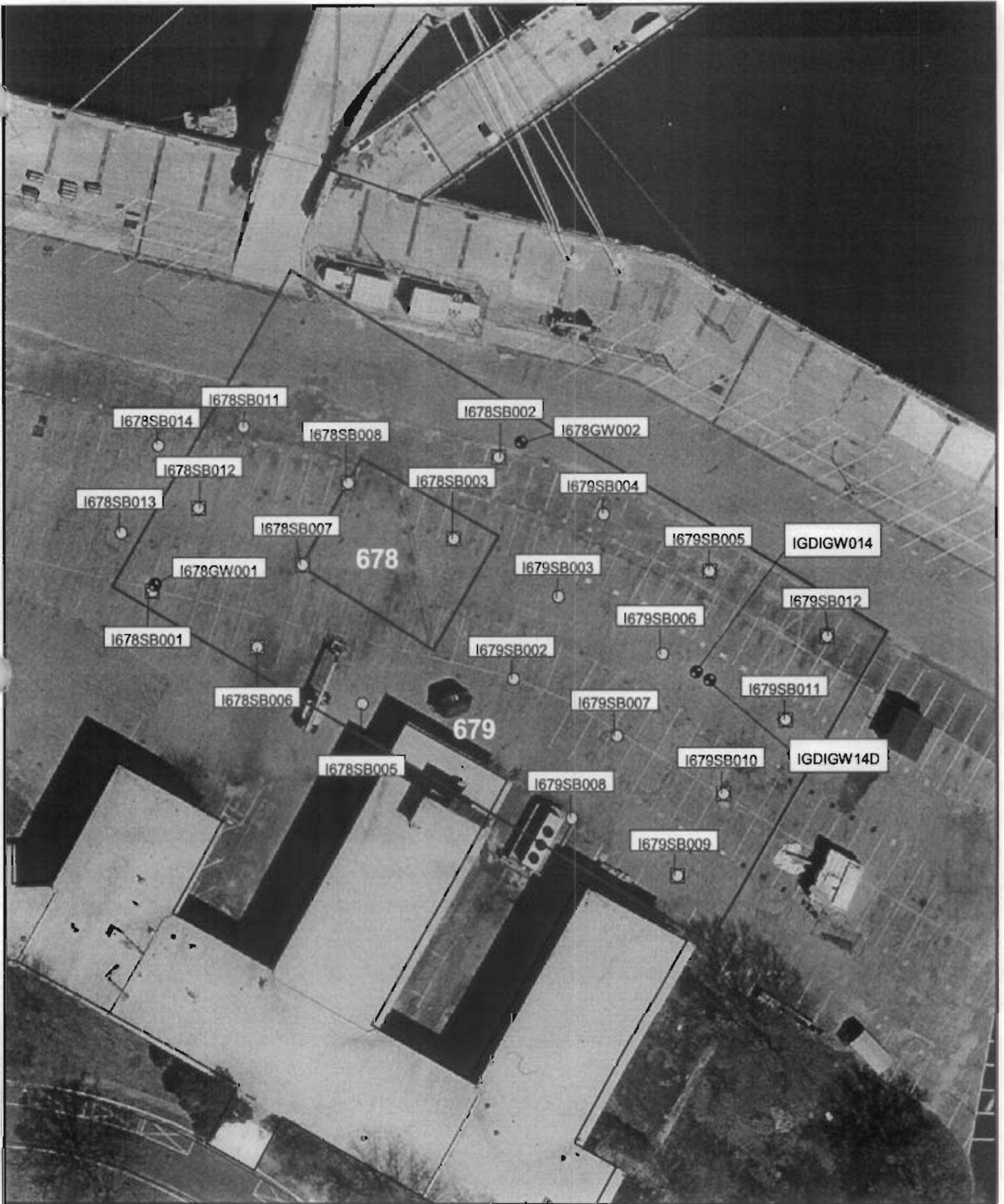
U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).

mg/kg Milligrams per kilogram

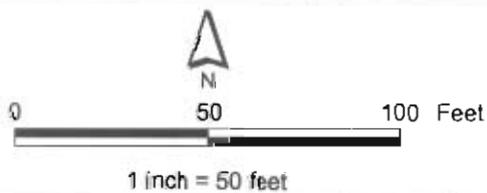
**TABLE 5-5**  
 VOCs in Subsurface Soils  
 CMS Work Plan, AOC 678/679, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier
			<b>IND RBC</b>	20,000.0000		41,000.0000	
			<b>RES RBC</b>	780.0000		1,600.0000	
			<b>SSL</b>	0.8000		0.6000	
			<b>SS BKGD</b>	NA		NA	
I678SB001	678SB00102	02/22/95		0.0170	J	0.0010	J
I678SB002	678SB00202	03/01/95		0.0250	J	0.0190	U
I678SB003	678SB00302	03/06/95		0.0190	J	0.0070	J
I678SB006	678SB00602	03/06/95		0.0110	J	0.0180	U
I678SB007	678SB00702	03/06/95		0.1100	U	0.0180	U
I678SB008	678SB00802	03/06/95		0.1100	U	0.0180	U
I678SB012	678SB01202	03/06/95		0.1100	U	0.0020	J
I679SB005	679SB00502	03/10/95		0.0110	J	0.0230	U
I679SB009	679SB00902	03/10/95		0.0240	U	0.0180	U
I679SB010	679SB01002	03/10/95		0.0290	J	0.0190	U
I679SB011	679SB01102	03/10/95		0.0080	J	0.0180	U
I679SB012	679SB01202	03/13/95		0.0220	U	0.0060	J

NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 mg/kg Milligrams per kilogram

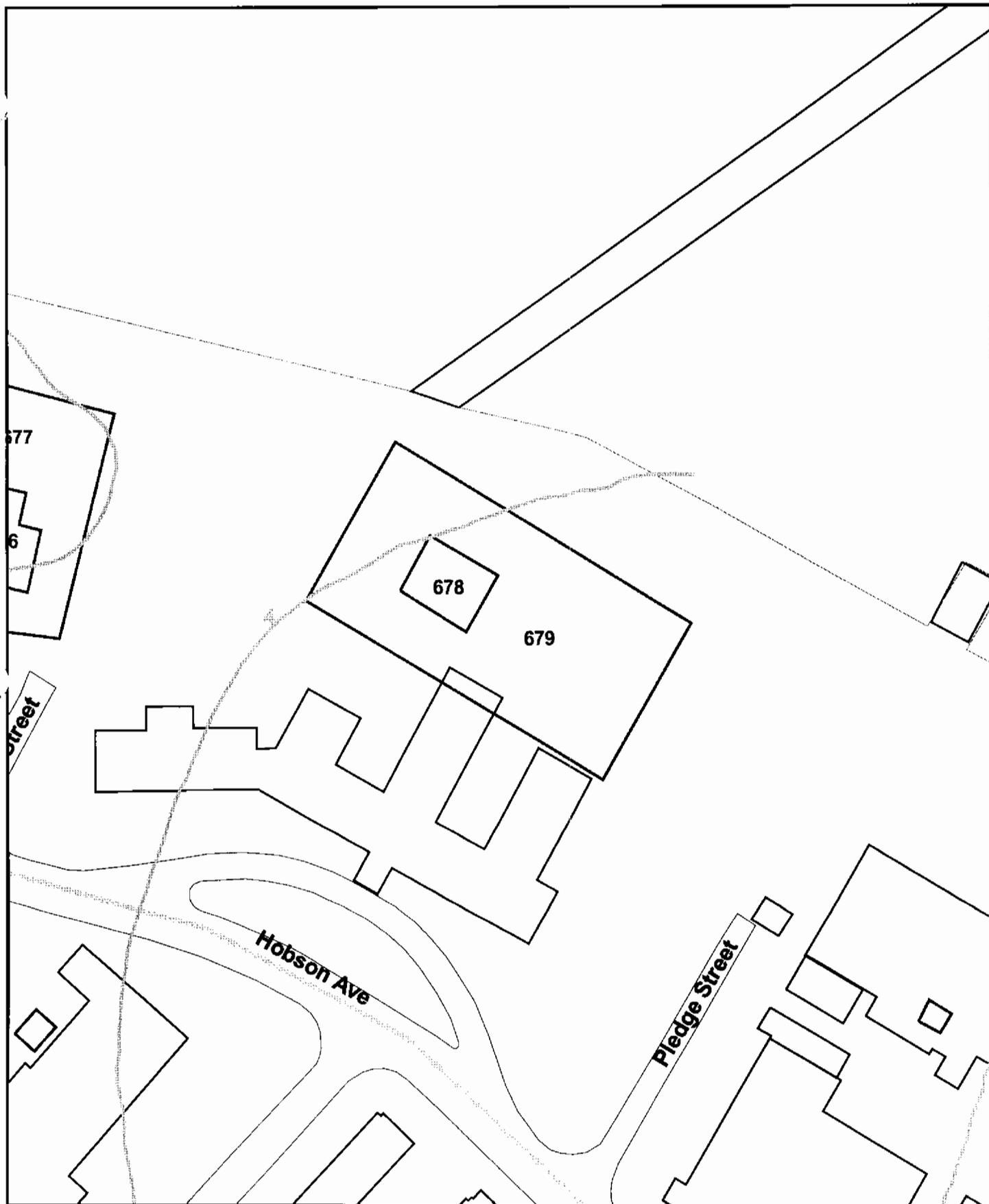


- Surface Soil Sample
- Subsurface Soil Sample
- Groundwater Sample
- ▭ AOC Boundary
- ▭ SWMU Boundary
- ▭ Buildings

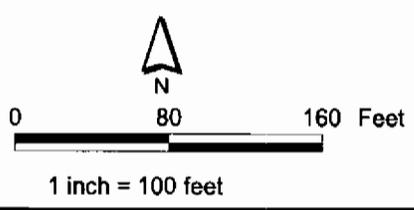


**Figure 5-1**  
 Sample and Test Location Map  
 AOC 678 and AOC 679  
 Zone I  
 Charleston Naval Complex

**CH2MHILL**



- Inferred Groundwater Elevations (ft msl)
  - Known Groundwater Elevations (ft msl)
  - Fence
  - Railroads
  - Roads
  - Shoreline
  - AOC Boundary
  - SWMU Boundary
  - Buildings
  - Zone Boundary
- ft msl - feet above mean sea level



**Figure 5-2**  
 Shallow Groundwater Contour Map  
 AOC 678 and AOC 679, Zone I  
 Charleston Naval Complex

File Path: c:\1801\projects\zone\_1\groundwater\fig\zone1groundwater\_figures.apr Date: 27 Dec 2001 7:31 User: NMOUDRY Elevation 5.2 Shallow Groundwater Contour Map



## 1    **6.0 CMS Work Plan for AOC 680**

2    This section summarizes the results and conclusions from the soil and groundwater  
3    investigations conducted in the area of AOC 680, which were reported in the *Zone I RFI*  
4    *Report, Revision 0* (EnSafe, 1999), Section 10.5, and as amended by the *Zone I RFI Report*  
5    *Addendum, Revision 1* (CH2M-Jones, 2001). Figure 6-1 presents the site features and RFI  
6    sample locations.

7    As part of the Zone I RFI, surface soil, subsurface soil, and groundwater investigations were  
8    conducted at AOC 680 in multiple sampling events in 1998. The RFI report presented the  
9    results of the investigations and conclusions concerning contamination and risk, as  
10   summarized in Sections 6.1 and 6.2 of this CMS Work Plan. A further evaluation of COCs is  
11   provided in Section 6.3 of this work plan.

### 12   **6.1 Background**

13   AOC 680 is an area on the south side of Building NS-26 which was formerly a brake repair  
14   and welding area. Building NS-26 is a single-story, 22,322 square-foot building constructed in  
15   1958 and renovated in 1985. Figure 6-1 presents an aerial photograph of Building NS-26 as it  
16   appeared in 1997. At the time of the RFI, the building housed offices, a carpentry shop, a ship-  
17   fitter shop, a welding shop, several smaller shops, and a non-destructive testing lab. However,  
18   the boundaries of this AOC are restricted to the welding shop.

19   Three dip tanks were located in the west end of the Building NS-26 and were used to clean  
20   ship parts. The contents of the tanks were tri-sodium phosphate, citric acid, and water. The  
21   tanks reportedly were cleaned bi-annually by CNC personnel.

22   An initial assessment study in 1981 noted that the following hazardous wastes were  
23   generated at this facility: boiler cleaning solution (sulfuric acid and nitric acid); cleaning  
24   solvents (chlorinated hydrocarbons); and boiler test chemicals (mercuric nitrate). From 1958  
25   through 1981, disposal practices reportedly included discharging neutralized boiler  
26   solutions, solvents, and mercuric nitrate solutions directly into the Cooper River.

27   Historic information indicates that the area outside Building NS-26 was used as a seaplane  
28   refueling ramp and as an oil storage area in the 1940s.

29   In December 1996, a 200-gallon waste oil UST located on the north side of Building NS-26  
30   was closed by removal. The UST assessment report noted that the tank and associated

1 piping was severely corroded and pitted, but no holes were found. The assessment report  
2 also noted that the OWS associated with this UST and referenced on early building plans  
3 could not be located at the time of UST removal. It is assumed that the OWS has not been  
4 used since the building renovations in 1985. The waste oil tank apparently continued to be  
5 used after 1985 by pouring used oil down the pump-out piping.

6 The area is zoned for business use (B-2).

## 7 **6.2 RFI Investigation Results**

### 8 **6.2.1 Soil Investigation Results**

9 As part of the RFI field investigation, surface soil samples and collocated subsurface soil  
10 samples were collected (see Table 6-1 and Figure 6-1).

#### 11 **6.2.1.1 Surface Soils**

12 Four surface soil samples (see Figure 6-1) were collected for VOC and SVOC analyses  
13 during the first sampling event. One additional sample was analyzed for VOCs, SVOCs,  
14 metals, cyanides, pesticides, and PCBs during the second sampling event.

- 15 • Surface soil sample results were evaluated relative to EPA Region III RBCs. Based on the  
16 analysis presented in the RFI report, the following COC was identified: The calculated  
17 BEQ concentration of 0.26 mg/kg exceeded the Region III unrestricted land use RBC of  
18 0.087 mg/kg in one sample.

#### 19 **6.2.1.2 Subsurface Soils**

20 Three subsurface soil samples collocated with the surface soil sample locations (see Figure  
21 6-1) were collected for VOC and SVOC analyses during the first sampling event. One  
22 additional sample was analyzed for VOCs, SVOCs, pesticides/PCBs, metals and cyanide  
23 during the second sampling event.

24 Subsurface soil sample results were evaluated relative to EPA Region III unrestricted and  
25 industrial RBCs and SSLs with a DAF=10. Based on the analysis presented in the RFI report,  
26 no constituents were identified as COCs for subsurface soil. As a result of the screening  
27 process and subsequent risk assessment, no COCs were identified for subsurface soils for  
28 unrestricted land use.

## 1 **6.2.2 Groundwater**

2 Shallow groundwater at this site is locally affected by an apparent groundwater high  
3 immediately east of AOC 680. However, groundwater patterns ultimately revert locally to  
4 flow north-northeast toward the Cooper River (see Figure 6-2).

5 Four shallow permanent monitoring wells were installed as part of the RFI investigation<sup>4</sup>.  
6 These four shallow monitoring wells, plus one deep monitoring point (I680GP005), were  
7 sampled during the first sampling event for VOCs and SVOCs. During the second sampling  
8 event, three shallow monitoring wells were sampled for VOCs, SVOCs, and metals. During  
9 the third sampling event, one additional shallow groundwater well was installed and  
10 sampled for VOCs and SVOCs. Constituents detected in the groundwater samples were  
11 evaluated relative to MCLs, tap water RBCs, and Zone I groundwater BRCs.

12 The following sections set out the findings as presented in the RFI report.

### 13 **6.2.2.1 Shallow Groundwater**

14 Analytes detected in shallow groundwater samples collected from both a Geoprobe and  
15 permanent monitoring wells were evaluated in the RFI report (see Table 6-2 and Figure 6-1).  
16 As a result of the screening process and subsequent risk assessment, the following  
17 constituents were identified as COCs for shallow groundwater:

- 18 • Arsenic was detected in one groundwater sample collected during the second sampling  
19 event at a concentration of 51.8  $\mu\text{g}/\text{L}$ , which exceeded the Zone I BRC of 23  $\mu\text{g}/\text{L}$  and  
20 the MCL of 50  $\mu\text{g}/\text{L}$ .
- 21 • Tetrachloroethene (PCE) was detected at concentrations which exceeded the tap water  
22 RBC of 1.1  $\mu\text{g}/\text{L}$  in two samples, but neither exceeded the MCL of 5  $\mu\text{g}/\text{L}$ .

### 23 **6.2.2.2 Deep Groundwater**

24 The only deep groundwater sample was collected from a Geoprobe location (I680GP005).  
25 Analytes detected in the deep groundwater sample were evaluated in the RFI report. As a  
26 result of the screening process and subsequent risk assessment, no constituents were  
27 identified as COCs for deep groundwater.

28

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<sup>4</sup> The RFI report for AOC 680 contains conflicting information regarding the number of wells installed and sampled: Figure 10.5.1 shows four shallow wells and no deep wells, the text indicates that three shallow wells were installed, and the data tables and Appendix H all present analytical results for four shallow wells and one deep well. Based on the information provided, it appears that four shallow wells were installed and sampled and one (probably) pre-existing deep well was also sampled.

### 1 **6.2.3 RFI Risk Summary**

2 Based on a unrestricted land use scenario, the following COCs were identified:

3 **Surface soils:** BEQs

4 **Groundwater:** Arsenic and tetrachloroethene

5 Based on an industrial land use scenario, the following COCs were identified:

6 **Groundwater:** Arsenic

### 7 **6.2.4 Recommendations from *Zone I RFI Report, Revision 0***

#### 8 **6.2.4.1 Surface Soils**

9 The RFI report recommended a CMS for soil including no action, excavation and  
10 containment/capping options.

#### 11 **6.2.4.2 Subsurface Soil**

12 No subsurface COCs were identified; therefore, NFA for subsurface soils was  
13 recommended in the RFI report.

#### 14 **6.2.4.3 Shallow Groundwater**

15 The RFI report recommended a CMS for groundwater, including no action, monitoring, ex  
16 situ treatment and in situ treatment options.

#### 17 **6.2.4.4 Deep Groundwater**

18 No deep groundwater COCs were identified; therefore, NFA for deep groundwater was  
19 recommended in the RFI report.

## 20 **6.3 COPC/COC Refinement**

21 The COCs identified in the RFI include BEQs in surface soil, and arsenic and PCE in  
22 groundwater. Each of these COCs are further evaluated in the following sections. In  
23 addition, concentrations of VOCs detected in soils were rescreened using an SSL based on a  
24 DAF=1.

### 25 **6.3.1 Surface Soil**

#### 26 **6.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

27 Several VOCs were reported in the RFI (see Table 6-3). These VOCs include PCE, TCE, 1,1-  
28 dichloroethane (1,1-DCA), 1,2-DCE, 4-methyl-2-pentanone, ethylbenzene, toluene, and

1 xylene.<sup>5</sup> Of these constituents, only ethylbenzene, toluene, and xylene appeared in the  
2 normal samples. The remaining constituents (PCE, TCE, 1,1-DCA, 1,2-DCE, and 4-methyl-2-  
3 pentanone) were detected in a single duplicate sample (I680SB005).<sup>6</sup>

4 Based on the rescreening using generic SSLs (DAF=1), ethylbenzene, toluene, and xylene  
5 were not present in concentrations that exceeded their respective screening criteria.

6 PCE, TCE, 1,1-DCA, and 1,2-DCE were found to be present in surface soil at relatively low  
7 concentrations above their respective SSLs, but they were present in only one of six surface  
8 soil samples (I680SB005) and were not detected in any of the subsurface soil samples,  
9 including the collocated subsurface soil samples, with the single exception of 1,2-DCE. 1,2-  
10 DCE was present in the subsurface sample collected at the same location at a concentration  
11 of 0.24 mg/kg (which exceeds its SSL of 0.03 mg/kg). However, it is also important to note  
12 that none of these constituents were detected in the collocated shallow groundwater  
13 monitoring well I680GW004. For these reasons, PCE, TCE, and 1,1-DCA are not considered  
14 COCs at AOC 680.

15 Based on the results of the rescreening process, only 1,2-DCE was retained as a COPC in  
16 surface soil. Additional soil sampling will be conducted as described in the Responses to  
17 Comments (see Responses to EPA Comments in Appendix D).

### 18 **6.3.1.2 BEQs**

19 BEQs were detected in two of six surface soil samples (see Table 6-4). The detected values  
20 were 0.469 mg/kg and 0.444 mg/kg, both of which are below the BEQ surface soil base-  
21 wide reference concentration of 1.304 mg/kg. Given that the maximum detected  
22 concentration of BEQs was below the base-wide reference concentration of 1.304 mg/kg,  
23 BEQs are not considered a COC in surface soil for AOC 680.

### 24 **6.3.2 Subsurface Soils**

25 No subsurface soil COCs were identified in the RFI report.

#### 26 **6.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

27 VOCs detected in subsurface soil were rescreened against an SSL with a DAF=1 (see Table  
28 6-5). Based on the rescreening, two VOCs were identified in the subsurface soils at  
29 concentrations exceeding their SSLs: benzene and 1,2-dichloroethene. Each of these two  
30 compounds is discussed below.

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<sup>5</sup> Acetone was identified in Table 10.5.2 of the RFI report as a constituent detected in one surface soil sample at a concentration of 0.077 mg/kg. However, review of the analytical results, as presented in Appendix D of the RFI report, does not record any detection of acetone in either surface or subsurface samples collected at AOC 680.

<sup>6</sup> The VOC data associated with the normal sample appears to reflect a limited analytical suite. The duplicate sample, which appears in Appendix D of the RFI report, includes the full analyte list.

1 **Benzene**

2 Benzene was not detected in surface soil at AOC 680, but was detected in three of four  
3 subsurface soil samples. Only the maximum detected concentration of 0.003 mg/kg  
4 exceeded the SSL of 0.002 mg/kg. Although the SSL was exceeded in subsurface soil,  
5 benzene was not detected in the surface soil samples. In addition, benzene was detected in  
6 only one groundwater sample at a concentration of 0.62 µg/L, which is well below the MCL  
7 of 5 µg/L. This one detection was not found in either the preceding or following  
8 groundwater sampling events. Based on these considerations, benzene in subsurface soil is  
9 not considered a COC at AOC 680.

10 **1,2-Dichloroethene**

11 1,2-DCE was present in only one of four subsurface soil samples (0.24J mg/kg at I680SB005)  
12 at an estimated concentration above its SSL of 0.020 mg/kg. It was not detected in any of  
13 the other subsurface soil samples. The collocated surface soil sample also had 1,2-DCE at an  
14 estimated concentration of 0.041J mg/kg, which only slightly exceeded the SSL. 1,2-DCE  
15 was not detected in any other surface soil samples. In addition, 1,2-DCE was not detected in  
16 the groundwater samples collected from the collocated shallow groundwater monitoring  
17 well I680GW004. 1,2-DCE was retained as a COPC, pending the outcome of additional soil  
18 sampling (see Responses to EPA Comments in Appendix D).

19 **6.3.3 Groundwater**

20 COCs identified in groundwater for the unrestricted land use exposure scenario include  
21 arsenic and PCE. For industrial workers, arsenic was identified as a COC in groundwater.

22 These constituents are discussed below.

23 **6.3.3.1 Arsenic in Groundwater**

24 Arsenic was detected in two of three groundwater samples, with the detection ranging from  
25 3.1 µg/L to 51.8 µg/L (see Table 6-6). The Zone I BRC for arsenic in groundwater was  
26 23 µg/L, which was exceeded only by the maximum detected value. Although the  
27 concentration of arsenic in the sample from monitoring well 680MW001 (51.8 µg/L)  
28 exceeded the Zone I BRC of 23 µg/L and the MCL of 50 µg/L, the concentrations of iron  
29 (3,340 µg/L) in this well are also elevated, indicating that the detection of arsenic is likely  
30 due to naturally occurring processes rather than RCRA-related operations. In addition, the  
31 observed concentrations of arsenic in shallow groundwater at this site are consistent with  
32 the occurrences of arsenic observed in Zone I grid wells. Arsenic was detected  
33 intermittently in shallow grid wells at concentrations ranging from 2.9J µg/L to 66.3 µg/L  
34 in 37 of the 87 analyses conducted (see Appendix A-2), and was often not duplicated in  
35 other sampling events from the same well. Given that the concentrations of arsenic coexist

1 with elevated iron levels in shallow groundwater and that the detected concentrations are  
2 consistent with ranges observed for the grid well background conditions in Zone I, arsenic  
3 is not considered a COC in groundwater at AOC 671.

#### 4 **6.3.3.2 PCE in Groundwater**

5 PCE was detected in 3 of 10<sup>7</sup> groundwater samples at a maximum concentration of 2 µg/L  
6 (see Table 6-7). The MCL for PCE is 5 µg/L. Given that the maximum concentration was  
7 below the MCL value, PCE is not considered a COC for AOC 680.

#### 8 **6.3.4 COPC/COC Refinement Summary**

9 There are no COCs requiring further action in surface soils, subsurface soils or groundwater  
10 at AOC 680. This site is recommended for NFA.

## 11 **6.4 Summary of Information Related to Site Closeout Issues**

### 12 **6.4.1 RFI Status**

13 The RFI report, as amended by the RFI Report Addendum, is complete.

### 14 **6.4.2 Presence of Inorganics in Groundwater**

15 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
16 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
17 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
18 followed by detection of these same metals below the MCL or below the practicable  
19 quantitation limit. These constituents are discussed in Section 6.3. Further evaluation of  
20 inorganics in groundwater is not warranted at AOC 680.

### 21 **6.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

22 The nearest investigated sanitary sewers to AOC 680 are located approximately 40 feet  
23 north and 95 feet west of Building NS-26. No data indicate that impacts to the sanitary  
24 sewer system from this unit have occurred from site operations. Further evaluation of this  
25 issue is not warranted.

### 26 **6.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

27 No direct connection of AOC 680 to the storm sewer is known to exist. No COCs requiring  
28 further evaluation are present at the site. Further evaluation of this issue is not warranted.

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<sup>7</sup> The RFI report, for AOC 680 variously reports that either eight or nine groundwater samples were analyzed for PCE. (See Tables 10.5.5 and 10.5.6, respectively.) The analytical data base contains results for 10 Geoprobe and monitoring well samples. Therefore, the number of analytical results rescreened in the database is the basis for this statement.

#### 1 **6.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

2 The nearest investigated railroad line to AOC 680 is approximately 4,700 feet to the west-  
3 southwest. There is no known linkage between AOC 680 and the investigated railroad lines  
4 of AOC 504, and further evaluation of this issue is not warranted.

#### 5 **6.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

6 The nearest surface water body to AOC 680 is the Cooper River, which lies approximately  
7 250 feet northeast of the unit. The only potential migration pathway from the site to surface  
8 water is via overland flow via stormwater runoff. Since the entire site is covered with  
9 buildings and pavement, which eliminates contact of surface soil with stormwater, and no  
10 COCs were identified at the site, further evaluation of a potential pathway for contaminant  
11 migration via stormwater runoff is not warranted. Similarly, runoff directed to the storm  
12 sewer system, which discharges to the Cooper River, does not contact the surface soil.

#### 13 **6.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

14 In December 1996, a 200-gallon waste oil UST located on the north side of Building NS-26  
15 was closed by removal. The assessment report notes that the OWS associated with this UST  
16 and referenced on early building plans could not be located at the time of UST removal. It is  
17 assumed that the OWS has not been used since the building renovations in 1985. Attempts  
18 to locate the OWS in May 2001 were unsuccessful. It is possible that the unit was backfilled  
19 for closure.

#### 20 **6.4.8 Land Use Control Management Plan**

21 The COC refinement did not identify any COCs at AOC 680. This evaluation was based on  
22 a unrestricted land use classification. Therefore, land use controls are not necessary.

### 23 **6.5 CH2M-Jones Recommendations**

24 Evaluation of the primary media of concern (surface soils, subsurface soils, and  
25 groundwater) indicated that there were no issues associated with the historical operation of,  
26 or releases from, this unit. Based on a review of COPCs/COCs in Section 6.3, no COCs were  
27 identified in any investigated media.

28 The RFI report concluded that a CMS was necessary for soil and groundwater. CH2M-Jones  
29 has re-evaluated the risks posed by the identified COCs and determined that one COPC in  
30 soil (1,2-DCE) requires additional sampling and analysis. Once the results of the additional  
31 sampling are received, a final decision about this site can be made.

**TABLE 6-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, AOC 680, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	03/17/98 04/08/98	Geoprobe - 1 (1) Upper - 4 (4) Lower - 3 (4) Duplicates - 2	VOCs, SVOCs VOCs, SVOCs VOCs, SVOCs VOCs, SVOCs	
2	09/24/98	Upper - 1 Lower - 1	Standard Suite	Additional boring installed as result of waste oil UST removal

1  
2  
3  
4  
5  
6

**Notes:**  
 ( ) = Parenthesis indicate numbers of samples proposed  
 Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level IV.

**TABLE 6-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOC 680, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Number of Wells	Sample Analyses	Comments
1	03/17/98 03/18/98 04/15/98	Geoprobe <sup>a</sup> 3	VOCs, SVOCs VOCs, SVOCs	One shallow and one deep sample collected.
2	08/21/98	3	VOCs, SVOCs, metals	
3	10/19/98	1	VOCs, SVOCs	Installed and sampled 680004 only

1  
2  
3  
4  
5

**Notes:**

a = One shallow and one deep Geoprobe sample was collected near the boundary of AOC 680 and AOC 679.

**TABLE 6-3**  
 VOCs in Surface Soils  
 CMS Work Plan, AOC 680, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Ethylbenzene Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier	Xylenes, Total Result (mg/kg)	Qualifier
			IND RBC		41,000		410,000	
			RES RBC		1,600		16,000	
			SSL		0.6		9	
			SS BKGD		NA		NA	
I680SB001	680SB00101	04/08/98	0.0058	U	0.0058	U	0.0058	U
I680SB002	680SB00201	04/08/98	0.0056	U	0.0056	U	0.0020	J
I680SB003	680SB00301	04/08/98	0.0022	J	0.0016	J	0.0100	=
I680SB004	680SB00401	04/08/98	0.0057	U	0.0057	U	0.0014	J

= Chemical is detected at concentration shown.  
 NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 mg/kg Milligrams per kilogram

**TABLE 6-4**  
 BEQs in Surface Soils  
 CMS Work Plan, AOC 680, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ	Qualifier
			Result ( $\mu\text{g}/\text{kg}$ )	
			<b>1,304</b>	
1680SB001	680SB00101	04/08/1998	439	U
1680SB002	680SB00201	04/08/1998	428	U
1680SB003	680SB00301	04/08/1998	469	=
1680SB004	680SB00401	04/08/1998	439	U
1680SB005	680SB00501	09/24/1998	444	=
1680SP005	680SP00501	03/17/1998	474	U

= Chemical is detected at concentration shown.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 $\mu\text{g}/\text{kg}$  Micrograms per kilograms

**TABLE 6-5**  
 VOCs in Subsurface Soils  
 CMS Work Plan, AOC 680, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Benzene Result (mg/kg)	Qualifier	Ethylbenzene Result (mg/kg)	Qualifier	1,2-Dichloroethene (total) Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier	Xylenes, Total Result (mg/kg)	Qualifier
		SSL	0.0020		0.7000		0.020		0.6000		10	
		SS BKGD	NA		NA		NA		NA		NA	
I680SB001	680SB00102	04/08/98	0.0030	J	0.0084	=	0.0074	U	0.0100	=	0.0330	=
I680SB002	680SB00202	04/08/98	0.0010	J	0.0011	J	0.0068	U	0.0022	J	0.0045	J
I680SB004	680SB00402	04/08/98	0.00099	J	0.0034	J	0.0068	U	0.0034	J	0.0140	=
I680SB005	680SB00502	09/24/98	0.4700	U	0.4700	U	0.2400	J	0.4700	U	0.4700	U

= Chemical is detected at concentration shown.

NA not applicable

J Chemical is detected at concentration below the method detection limit; the concentration is not known.

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).

mg/kg Milligrams per kilogram

**TABLE 6-6**  
 Arsenic, Iron, and Manganese in Shallow Groundwater  
 CMS Work Plan, AOC 680, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Arsenic Result (µg/L)	Qualifier	Iron Result (µg/L)	Qualifier	Manganese Result (µg/L)	Qualifier
			<b>MCL</b>		50.0000		300.0000	
			<b>RBC</b>		0.0450		1,100.0000	
			<b>Shallow</b>		66		31,900	
I680GW001	680GW00102	08/21/98	51.8000	=	3340.0000	=	62.8000	=
I680GW002	680GW00202	08/21/98	3.1000	J	106.0000	U	82.3000	=
I680GW003	680GW00302	08/21/98	0.9000	U	125.0000	U	20.5000	=

= Chemical is detected at concentration shown.

J Chemical is detected at concentration below the method detection limit; the concentration is not known.

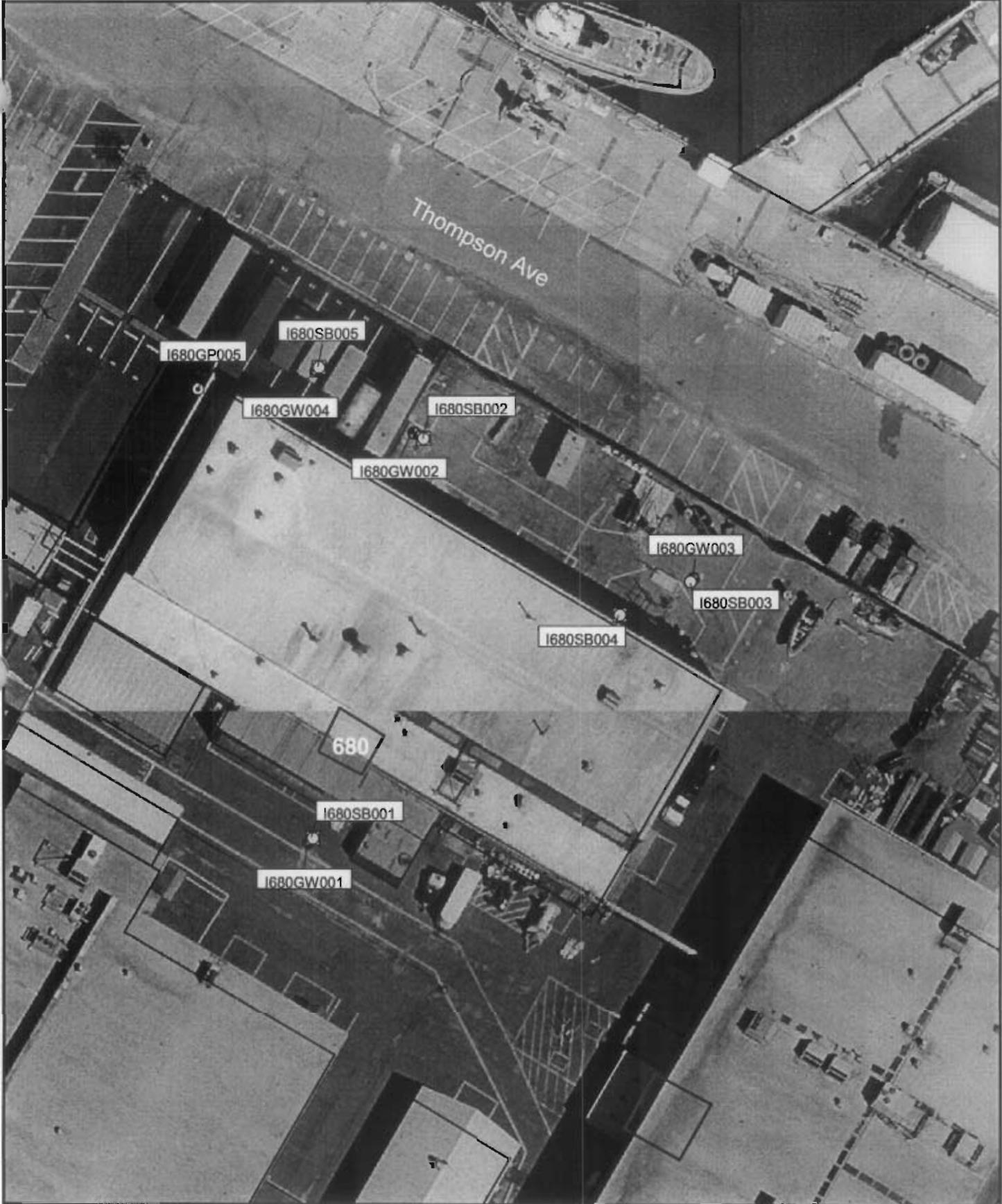
U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).

µg/L Micrograms per liter

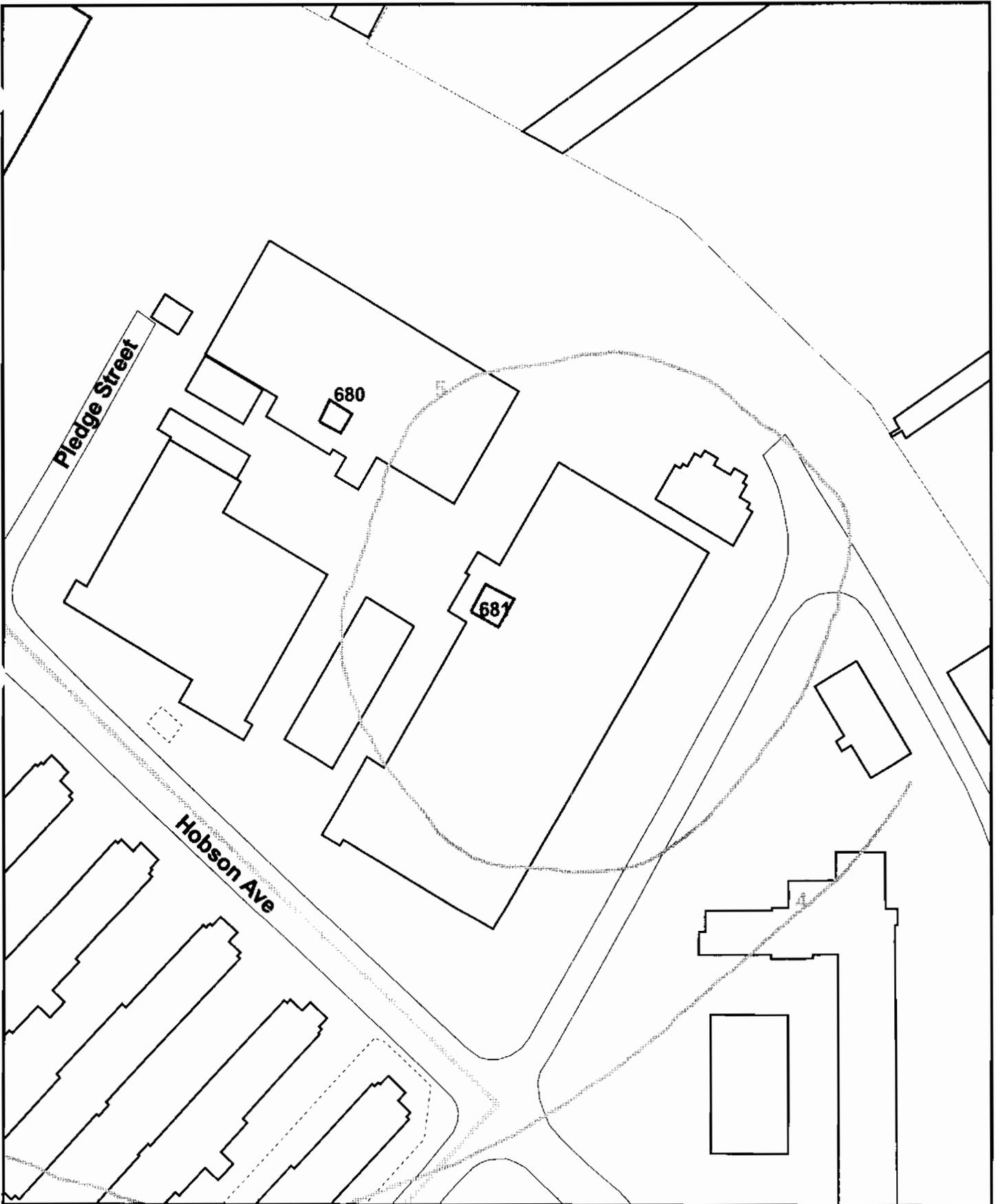
**TABLE 6-7**  
**PCE in Shallow Groundwater**  
*CMS Work Plan, AOC 680, Zone I, Charleston Naval Complex*

Sample Station	ID	Date	Tetrachloroethylene (PCE)		
			MCL	Result ( $\mu\text{g/L}$ )	
			MCL	5	
			RBC	1.1	
			Shallow	NA	
1680GW001	680GW00102	08/21/98		3.0000	U
	680GW00101	04/15/98		1.0000	UJ
1680GW002	680GW00202	08/21/98		02.0000	J
	680GW00201	04/15/98		1.4000	J
1680GW003	680GW00301	04/15/98		1.0000	UJ
	680GW00302	08/21/98		3.0000	U
1680GW004	680GW004A1	10/05/98		5.0000	U
	680GW00401	10/19/98		5.0000	U

NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 $\mu\text{g/L}$  Micrograms per liter

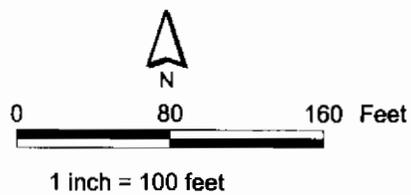


**Figure 6-1**  
 Sample and Test Location Map  
 AOC 680  
 Zone I  
 Charleston Naval Complex



**Figure 6-2**  
 Shallow Groundwater Contour Map  
 AOC 680, Zone I  
 Charleston Naval Complex

- Inferred Groundwater Elevations (ft msl)
  - Known Groundwater Elevations (ft msl)
  - Fence
  - Railroads
  - Roads
  - Shoreline
  - AOC Boundary
  - SWMU Boundary
  - Buildings
  - Zone Boundary
- ft msl - feet above mean sea level





## 1 7.0 CMS Work Plan for AOC 681

2 This section summarizes the results and conclusions from the soil and groundwater  
3 investigations conducted in the area of AOC 681, which were reported in the *Zone I RFI*  
4 *Report, Revision 0* (EnSafe, 1999), Section 10.6, and as amended by the *Zone I RFI Report*  
5 *Addendum, Revision 1* (CH2M-Jones, 2001). Figure 7-1 presents the site features and RFI  
6 sample locations.

7 As part of the Zone I RFI, surface soil, subsurface soil, and groundwater investigations were  
8 conducted at AOC 681 in multiple field events in 1995 and 1998. The RFI report presented  
9 the results of the investigations and conclusions concerning contamination and risk, as  
10 summarized in Sections 7.1 and 7.2 of this CMS Work Plan. A further evaluation of COCs is  
11 provided in Section 7.3 of this work plan.

12 Although the RFI focused on AOC 681, the surface soil, subsurface soil and groundwater  
13 sample locations are adequately placed to address issues related to the OWSs associated  
14 with Building 681.

### 15 7.1 Background

16 AOC 681 consists of the abrasive blast booth on the west side of Building 681 used for  
17 stripping miscellaneous ship and boiler components. The blasting agent (aluminum oxide)  
18 is recycled through a cyclone separator and the generated wastes, primarily paint dust, are  
19 directed into an outdoor hopper and then into 55-gallon drums for disposal.

20 Building 681 was constructed in 1985 to serve as a shop and administration building for  
21 Shore Intermediate Maintenance Activity (SIMA). The facility contained a hose shop; a  
22 canvas shop; a tool storage area; a valve shop; a lagging shop; an air conditioning and  
23 recovery shop; a hydraulics shop; a paint booth; a blasting booth; a pump shop; a machine  
24 shop; an electrical shop; and a varnish dip tank. The facility is currently used as a vessel  
25 support facility for the U.S. Coast Guard.

26 Two USTs (681-1 and 681-2) were associated with this facility. The tanks were installed in  
27 1985, when the facility was constructed. UST 681-1 was an unregulated 100-gallon waste oil  
28 tank located on the southeast side of Building 681. UST 681-2 was an unregulated  
29 20,000-gallon fuel oil tank located on the south side of Building 681. It stored fuel oil for  
30 boilers located in Buildings 681 and 680. Both tanks were closed by removal in early 1997.

1 An OWS is located between Buildings 680 and 681. Operations in both Building 680 and  
2 Building 681 used this unit. According to the January 5, 1994 environmental baseline survey  
3 conducted by Navy personnel, this OWS discharged to the sanitary sewer system.

4 In addition, a sanitary and industrial sewer system site plan map from 1968 indicates that  
5 an OWS and associated UST had been historically located just at the northeast corner of  
6 what is now Building 681.

7 The area is zoned business use (B-2).

## 8 **7.2 RFI Investigation Results**

### 9 **7.2.1 Soil Investigation Results**

10 As part of the RFI field investigation, surface soil samples and collocated subsurface soil  
11 samples were collected (see Table 7-1 and Figure 7-1).

#### 12 **7.2.1.1 Surface Soils**

13 Soils at AOC 681 were investigated in four separate sampling events. Fourteen surface soil  
14 samples, plus one duplicate sample, were collected for analyses during four sampling  
15 events from the locations shown in Figure 7-1. The sampling events and analytes associated  
16 with each event are presented in Table 7-1.

17 Based on the analytical results, BEQs at one surface sample location exceeded its SSL of  
18 1.6 mg/kg (3.445 mg/kg at 681SB00901). Chromium at three surface soil sample locations  
19 exceeded the BRC of 34.5 mg/kg and the RBC of 39 mg/kg (73.5 mg/kg at 681SB001,  
20 79.2 mg/kg at 681SB008, and 44.1 mg/kg at 681SB009). However, following completion of  
21 the risk analysis, only BEQs remained as a COC.

#### 22 **7.2.1.2 Subsurface Soils**

23 Ten subsurface soil samples, collocated with surface soil sample locations (see Figure 7-1),  
24 were collected during four sampling events. The sampling events and analytes associated  
25 with each event are presented in Table 7-1.

26 BEQs for one subsurface sample location exceeded its SSL of 1.6 mg/kg (16.783 mg/kg at  
27 681SB00102)<sup>8</sup>, which was found at a different location than the sole surface soil exceedance.  
28 Acetophenone and dieldrin were found at concentrations exceeding their screening criteria.

---

<sup>8</sup> CH2M-Jones has not been able to establish the source of the 1.6 mg/kg Region III SSL used in the RFI report. However, this criteria was presented for comparative purposes in Table 10.12.2 as a Region III RBC and in Table 10.12.4 as a soil-to-groundwater SSL.

1 However, following completion of the risk assessment, acetophenone and dieldrin were not  
2 retained as COCs.

### 3 **7.2.2 Groundwater**

4 Shallow groundwater at this site is locally affected by an apparent groundwater high  
5 immediately beneath Building 681. However, groundwater patterns ultimately revert  
6 locally to flow north-northeast toward the Cooper River (see Figure 7-2).

7 Groundwater samples were taken from the existing grid-based well pair (GDI013/GDI13D)  
8 in accordance with the work plan (see Figure 7-1 and Table 7-2). Based on the detection of  
9 VOCs and SVOCs in the samples collected from the grid wells, three shallow and three  
10 deep Geoprobe samples were taken and analyzed for VOCs and SVOCs during the first  
11 sampling event. Three shallow monitoring wells were installed and sampled as part of the  
12 RFI investigation in late 1998 to further delineate contamination. The newly installed  
13 permanent monitoring wells were sampled in three events for VOCs, SVOCs, metals, and  
14 cyanides. Groundwater samples collected during the third event were also analyzed for  
15 pesticides. No duplicate samples were collected at AOC 681.

16 Constituents detected in the groundwater samples were evaluated relative to MCLs, tap  
17 water RBCs, and Zone I groundwater BRCs.

18 The following sections set out the findings presented in the RFI report.

#### 19 **7.2.2.1 Shallow Groundwater**

20 Groundwater samples were collected in four sampling events at AOC 681. During the first  
21 sampling event, three shallow Geoprobe samples were collected. Three shallow wells were  
22 later installed and sampled in three subsequent events, for a total of nine shallow  
23 groundwater samples (see Figure 7-1). In addition, an existing grid-based well was sampled  
24 during the second, third, and fourth sampling events. Analytes detected in shallow  
25 groundwater samples were evaluated in the RFI report.

26 As a result of the screening process and subsequent risk assessment, only bis(2-  
27 ethylhexyl)phthalate was identified in the RFI report as a COC for shallow groundwater. It  
28 was detected at a concentration of 22  $\mu\text{g}/\text{L}$  in one groundwater sample (I681GW002) in the  
29 first sampling event, which exceeded its tap water RBC (4.8  $\mu\text{g}/\text{L}$ ). Bis(2-  
30 ethylhexyl)phthalate was only detected at a concentration of 1  $\mu\text{g}/\text{L}$  at I681GW002 in the  
31 second sampling event and was not detected in the third sampling event.

1 **7.2.2.2 Deep Groundwater**

2 Three deep Geoprobe samples were also collected during the first sampling event. In  
3 addition, one deep groundwater grid-based well was sampled during all four RFI sampling  
4 events (see Figure 7-1) and again in 1998 (five times total).

5 Analytes detected in deep groundwater samples were evaluated in the RFI report. As a  
6 result of the screening process and subsequent risk assessment no constituents were  
7 identified as COCs for deep groundwater.

8 **7.2.3 RFI Risk Summary**

9 Based on a unrestricted land use scenario, the following COCs were identified:

10 **Surface soils:** BEQs

11 **Subsurface soils:** None

12 **Shallow groundwater:** Bis(2-ethylhexyl)phthalate

13

14 Based on an industrial land use scenario, the following COC was identified:

15 **Shallow groundwater:** Bis(2-ethylhexyl)phthalate

16 **7.2.4 Recommendations from *Zone I RFI Report, Revision 0***

17 **7.2.4.1 Surface Soils**

18 The RFI report recommended a CMS for surface soil, considering no action, excavation, and  
19 containment/capping options.

20 **7.2.4.2 Subsurface Soil**

21 No subsurface COCs were identified; therefore, NFA for subsurface soils was  
22 recommended in the RFI report.

23 **7.2.4.3 Shallow Groundwater**

24 The RFI report recommended a CMS for shallow groundwater, considering no action,  
25 monitoring, and ex situ treatment options.

26 **7.2.4.4 Deep Groundwater**

27 The RFI report did not include recommendations for deep groundwater.

28 **7.3 COPC/COC Refinement**

29 The COCs identified in the RFI include BEQs in surface and subsurface soil and bis(2-  
30 ethylhexyl)phthalate in groundwater. Each of these COCs are further evaluated in the

1 following sections. In addition, concentrations of VOCs detected in soils were rescreened  
2 using an SSL based on a DAF=1.

### 3 **7.3.1 Surface Soil**

#### 4 **7.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

5 The VOCs detected in surface soils are presented in Table 7-3. Several VOCs were reported  
6 in the RFI as being detected in surface soils that are not included in the database evaluated  
7 by CH2M-Jones. These VOCs include acetone, carbon disulfide, and xylenes in surface soil.  
8 Evaluation of the data by CH2M-Jones uniformly focused on the normal samples. In the  
9 RFI, the duplicate samples were included in the evaluation and, therefore, additional  
10 chemicals were identified as being detected in site soils.

11 No VOCs in surface soil exceeded their respective screening criteria. Therefore, the soil to  
12 groundwater pathway is not complete for VOCs in surface soil at AOC 681.

#### 13 **7.3.1.3 BEQs**

14 BEQs were detected in 4 of 14 surface soil samples (see Table 7-4). The range of detection in  
15 surface soil was 0.0692 mg/kg (681SB002) to 3.445 mg/kg (681SB009). The CNC base-wide  
16 reference concentration for BEQs in surface soil is 1.304 mg/kg. One surface soil sample had  
17 a BEQ concentration that exceeded this value (3.445 mg/kg at 681SB009).

18 In 1999, six surface soil samples (see Figure 7-1) were obtained by the Navy Environmental  
19 Detachment to determine if petroleum hydrocarbon constituents extended under Building  
20 681. BEQs derived for these samples were significantly below the surface soil reference  
21 concentration (maximum of 0.153 mg/kg), and in three of the samples, BEQs were not  
22 detected. This indicates that the extent of BEQ constituents at the site has been delineated.

23 In order to further evaluate the significance of the single BEQ exceedance in surface soils at  
24 AOC 681, CH2M-Jones conducted a limited re-sampling at 681SB009 in September 2001,  
25 which included a visual inspection of the area (see Appendix B for detailed analytical  
26 results). Based on the visual inspection, there was no obvious source for BEQs present at the  
27 point where 681SB009 was located. Since there was no visual indication of a source for  
28 BEQs, both surface and subsurface soil samples were recollected at this location and  
29 analyzed for SVOCs (681SB012). The resulting BEQ values were 0.0177 mg/kg in the surface  
30 soil sample and 0.0148 mg/kg in the subsurface soil sample, both of which are below their  
31 respective CNC BEQ reference concentrations of 1.3 mg/kg and 1.4 mg/kg (see Table 7-4).  
32 Both the surface soil and subsurface soil sample analytical results for 681SB012 confirmed  
33 that BEQs are not considered a COC in the surface soils at 681SB009. The sample location

1 itself is beneath pavement and it is possible that the single exceedance that occurred in  
2 surface soils is due to the presence of the paving material and debris created in cutting the  
3 pavement to obtain the surface soil sample.

4 Appendix B of this CMS Work Plan contains the validation report for the samples collected  
5 for confirmation at sample location 681SB009.

6 Based on the foregoing explanation, BEQs are not considered a COC for surface soils at  
7 AOC 681.

### 8 **7.3.2 Subsurface Soils**

9 BEQs were identified in the RFI report as the only subsurface soil COCs.

#### 10 **7.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

11 The VOCs detected in subsurface soils are presented in Table 7-5. No VOCs exceeded their  
12 respective screening criteria. For these reasons, VOCs in subsurface soil at AOC 681 are not  
13 considered COCs.

#### 14 **7.3.2.2 BEQs**

15 BEQs were detected in 1 of 9 subsurface soil samples (681SB001) at a concentration of  
16 16.8 mg/kg (see Table 7-6). The base-wide reference concentration for BEQs in subsurface  
17 soil is 1.4 mg/kg.

18 In 1999, six surface soil samples (see Figure 7-1) were obtained by the Navy Environmental  
19 Detachment to determine if petroleum hydrocarbon constituents extended under Building  
20 681. BEQs derived for these samples were significantly below the surface soil base-wide  
21 reference concentration (maximum of 0.153 mg/kg), and in three of the samples, BEQs were  
22 not detected. This indicates that the extent of BEQ constituents at the site has been  
23 delineated.

24 In order to further evaluate the significance of the single BEQ exceedance in subsurface soils  
25 at AOC 681, CH2M-Jones conducted a limited re-sampling at 681SB001 in September 2001,  
26 which included a visual inspection of the area. Based on the visual inspection, there was no  
27 obvious source for BEQs present at the point where 681SB001 was located. Since there was  
28 no visual indication of a source for BEQs, both a subsurface soil sample and a duplicate  
29 were recollected at this location and analyzed for SVOCs (681SB013). The resulting BEQ  
30 values were 0.628 mg/kg in the subsurface soil sample and 0.241 in the duplicate  
31 subsurface soil sample, both of which are below the CNC BEQ base-wide reference  
32 concentration of 1.4 mg/kg for subsurface soils (see Table 7-7). The subsurface soil sample

1 (normal and duplicate) analytical results for 681SB013 confirmed that BEQs are not  
2 considered a COC in the subsurface soils at 681SB001. Like the surface soil exceedance  
3 location, the subsurface sample location is beneath pavement and it is possible that the  
4 single historical exceedance occurred as a result of getting paving material debris into the  
5 RFI subsurface soil sample collected at 681SB001.

6 Appendix B of this CMS Work Plan contains the validation report for the samples collected  
7 for confirmation at sample location 681SB001.

8 Based on the foregoing, BEQs are not considered a COC for subsurface soils at AOC 681.

### 9 **7.3.3 Groundwater**

10 Bis(2-ethylhexyl)phthalate was identified as a COC in groundwater for the unrestricted  
11 land use exposure scenario and the industrial scenario.

#### 12 **7.3.3.1 Bis(2-ethylhexyl)phthalate**

13 Bis(2-ethylhexyl)phthalate was the only COPC identified in groundwater from the risk  
14 assessment. Bis(2-ethylhexyl)phthalate is a known laboratory contaminant and is not  
15 known to be associated with past site activities. The derived risks for the industrial worker  
16 equaled  $1.1E-6$ , which is near lower end of the risk range ( $1E-4$  to  $1E-6$ ), and the derived  
17 risks for the unrestricted land use scenario equaled  $4.6E-6$ , which is also near the lower end  
18 of the risk range.

19 Bis(2-ethylhexyl)phthalate was detected in three of the nine samples collected from the  
20 permanent AOC 681 monitoring wells with detections of  $1 \mu\text{g/L}$ ,  $3 \mu\text{g/L}$  and  $22 \mu\text{g/L}$  (see  
21 Table 7-8). Only the maximum detected concentration of  $22 \mu\text{g/L}$  exceeded the RBC of  
22  $4.8 \mu\text{g/L}$ . The concentration of  $22 \mu\text{g/L}$  was detected in the first sampling event at well  
23 681GW002. Bis(2-ethylhexyl)phthalate was detected at  $1 \mu\text{g/L}$  in the second sampling event  
24 at this well and was not detected in the third sampling event. For these reasons, it does not  
25 appear that well 681GW002 is contaminated with bis(2-ethylhexyl)phthalate.

26 Also, of the six groundwater probe samples collected at the beginning of the RFI Field  
27 Investigation (three shallow and three deep), none had detectable concentrations of bis(2-  
28 ethylhexyl)phthalate. Nor did the 12 groundwater samples collected from grid wells  
29 GDIGW013/GDIGW013D have detectable levels of bis(2-ethylhexyl)phthalate. As a result,  
30 only 3 of 27 samples had detectable levels of bis(2-ethylhexyl)phthalate, and only 1 of those  
31 3 exceeded the RBC of  $4.8 \mu\text{g/L}$ .

- 1 Although one sample of groundwater exceeded the MCL for bis(2-ethylhexyl)phthalate,  
2 this constituent is not considered a COC at the site for the following reasons:
- 3 • It is a known laboratory contaminant that is not associated with past site activities.
  - 4 • It was only detected at an elevated concentration in the first sampling event and not  
5 duplicated in any subsequent event.
  - 6 • It was detected in only 3 of 27 samples (11 percent) and exceeded the MCL in only 1 of  
7 27 samples (4 percent).
  - 8 • The risk associated with both the unrestricted land use and industrial worker scenarios  
9 was at the lower end of the risk range, indicating a low probability of excess risk to  
10 potential receptors.

#### 11 **7.3.4 COPC/COC Refinement Summary**

12 In summary, there are no COCs at AOC 681 in surface soil, subsurface soil, or groundwater  
13 at AOC 681. Therefore, the site is recommended for NFA.

## 14 **7.4 Summary of Information Related to Site Closeout Issues**

### 15 **7.4.1 RFI Status**

16 The RFI report, as amended by the RFI Report Addendum, is complete.

### 17 **7.4.2 Presence of Inorganics in Groundwater**

18 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
19 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
20 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
21 followed by detection of these same metals below the MCL or below the practicable  
22 quantitation limit. No inorganic constituents were identified as COPCs or COCs. Further  
23 evaluation of this issue is not warranted.

### 24 **7.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

25 The nearest investigated sanitary sewer to AOC 681 is adjacent to the northeast corner of  
26 Building 681. However, since no contamination exists at AOC 681, further evaluation of this  
27 issue is not warranted.

1 **7.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

2 No direct connections of this site to the storm sewer are known to exist. No COCs requiring  
3 further evaluation are present at the site. Further evaluation of this issue is not warranted.

4 **7.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

5 The closest railroad line to AOC 681 is located approximately 4,700 feet southwest. There is  
6 no known linkage between AOC 681 and the investigated railroad lines of AOC 504, and  
7 further evaluation of this issue is not warranted.

8 **7.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

9 The nearest surface water body to AOC 681 is the Cooper River, which lies approximately  
10 300 feet northeast of the unit. The only potential migration pathway from the site to surface  
11 water is via overland flow via stormwater runoff. Since the entire site is covered with  
12 buildings and pavement, which eliminates contact of surface soil with stormwater, and no  
13 COCs were identified at the site, further evaluation of a potential pathway for contaminant  
14 migration via stormwater runoff is not warranted. Similarly, runoff directed to the storm  
15 sewer system, which discharges to the Cooper River, does not contact the surface soil.

16 **7.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

17 There are two former OWS in close proximity to AOC 681. These two units (AOCs 715 and  
18 718) will be addressed separately from AOC 681 and in accordance with RCRA RFI and  
19 CMS requirements.

20 **7.4.8 Land Use Control Management Plan**

21 The COC refinement did not identify any COCs at AOC 681. This evaluation was based on  
22 a unrestricted land use classification. Therefore, land use controls are not necessary.

23 **7.5 CH2M-Jones Recommendations**

24 Evaluation of the primary media of concern (surface soils, subsurface soils and  
25 groundwater) indicated that there were no issues associated with the historical operation of,  
26 or releases from, this unit. Based on a review of COPCs/COCs in Section 7.3, no COCs were  
27 identified in any investigated media.

28 The RFI report concluded that a CMS was necessary for soil and groundwater. However,  
29 CH2M-Jones has re-evaluated the risks posed by the identified COCs and determined that  
30 no COCs exist at AOC 681. Therefore, this site is recommended for NFA.

1

**TABLE 7-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, AOC 681, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	03/01/95	upper-3 lower-2	Organotins, Standard Suite	
2	06/21/95 06/22/95	upper-2 Duplicate-1	Pesticides, SVOCs, VOCs, TPH-DRO  VOCs, SVOCs, metals, cyanide, pesticides, PCBs, hex-chrome, dioxins, herbicides, and OP pesticides	Boring 681SB004 analyzed for SVOCs only.
3	03/18/98	upper-3  lower-3	VOCs, SVOCs	Samples collected using direct push technology.
4	09/23/98 09/24/98 10/06/98	upper-6  lower-5 Duplicate-1	VOCs, SVOCs, metals, cyanide, pesticides and PCBs	

2

1

**TABLE 7-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOC 681, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Number of Wells	Sample Analyses	Comments
1	03/18/99	Geoprobe-3	VOCs, SVOCs	3 shallow and 3 deep samples collected
2	10/20/98	3	VOCs, SVOCs, Metals, Cyanide	3 shallow wells installed to further delineate the extent of contamination
3	01/25/99 01/26/99	3	VOCs, SVOCs, pesticides, metals, cyanide	
4	06/02/99	3	VOCs, SVOCs, Metals, Cyanide	

2

**TABLE 7-3**  
 VOCs in Surface Soil  
 CMS Work Plan, AOC 681, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Toluene Result (mg/kg)	Qualifier
			<b>IND RBC</b>	41,000.0000
			<b>RES RBC</b>	1,600.0000
			<b>SSL</b>	0.6000
			<b>SS BKGD</b>	NA
I681SB001	681SB00101	03/01/95	0.0170	U
I681SB002	681SB00201	03/01/95	0.0020	J
I681SB003	681SB00301	03/01/95	0.0180	U
I681SB005	681SB00501d	06/23/95	0.0170	U
I681SB007	681SB00701	10/06/98	0.0050	U
I681SB008	681SB00801	09/24/98	0.4100	U
I681SB009	681SB00901	10/06/98	0.0020	J
I681SB010	681SB01001	10/06/98	0.0050	U
I681SB011	681SB01101	10/06/98	0.0020	J

NA not applicable

J Chemical is detected at concentration below the method detection limit; the concentration is not known.

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).

mg/kg Milligrams per kilogram

**TABLE 7-4**  
 BEQs in Surface Soils  
 CMS Work Plan, AOC 681, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ Result ( $\mu\text{g}/\text{kg}$ )	Qualifier
		Bkgd	1,304	
I681SB001	681SB00101	03/01/1995	368	=
I681SB002	681SB00201	03/01/1995	335	=
I681SB003	681SB00301	03/01/1995	453	=
I681SB004	681SB00401	06/21/1995	660	U
I681SB005	681SB00501c	06/22/1995	743	U
I681SB006	681SB00601	09/23/1998	428	U
I681SB007	681SB00701	10/06/1998	439	U
I681SB008	681SB00801	09/24/1998	532	U
I681SB009	681SB00901	10/06/1998	3,445	=
I681SB010	681SB01001	10/06/1998	428	U
I681SB011	681SB01101	10/06/1998	451	U
I681SP001	681SP00101	03/18/1998	439	U
I681SP002	681SP00201	03/18/1998	451	U
I681SP003	681SP00301	03/18/1998	451	U
IGDISB013	GDISB01301	02/17/1995	731	U
LI037SB002	037SB00211	06/10/1997	451	U
LI037SB004	037SB00411	06/10/1997	428	U

= Chemical is detected at concentration shown.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 $\mu\text{g}/\text{kg}$  Micrograms per kilograms

**TABLE 7-5**  
 VOCs in Subsurface Soil  
 CMS Work Plan, AOC 681, Zone I, Charleston Naval Complex

Station	ID	Date	Naphthalene Result (mg/kg)	Qualifier	Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier
		SSL	4		0.8000		0.6000	
I681SB001	681SB00102	03/01/1995	1.5000	=	0.1000	U	0.0170	U
I681SB002	681SB00202	03/01/1995	0.9000	U	0.0540	J	0.0210	U
I681SB006	681SB00602	09/23/1998	0.3800	U	ND		ND	
I681SB007	681SB00702	09/24/1998	0.3800	U	ND		0.3300	U
I681SB009	681SB00902	10/06/1998	1.6000	U	0.0070	U	0.0020	J
I681SB011	681SB01102	10/06/1998	0.3900	U	0.0060	UJ	0.0040	UJ

= Chemical is detected at concentration shown.  
 ND No Data  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

**TABLE 7-6**  
 BEQs in Subsurface Soils  
 CMS Work Plan, AOC 681, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ	Qualifier
			Result ( $\mu\text{g}/\text{kg}$ )	
		<b>Bkgd</b>	1,400	
I681SB001	681SB00102	03/01/1995	16,783	=
I681SB002	681SB00202	03/01/1995	881	U
I681SB006	681SB00602	09/23/1998	439	U
I681SB007	681SB00702	09/24/1998	439	U
I681SB009	681SB00902	10/06/1998	1849	U
I681SB011	681SB01102	10/06/1998	451	U
I681SP001	681SP00102	03/18/1998	439	U
I681SP002	681SP00202	03/18/1998	497	U
I681SP003	681SP00302	03/18/1998	451	U
IGDISB013	GDISB01302	02/17/1995	743	U

= Chemical is detected at concentration shown.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 $\mu\text{g}/\text{kg}$  Micrograms per kilograms

**TABLE 7-7**  
 BEQs in Subsurface Soils – 2001 Resampling  
 CMS Work Plan, AOC 681, Zone I, Charleston Naval Complex

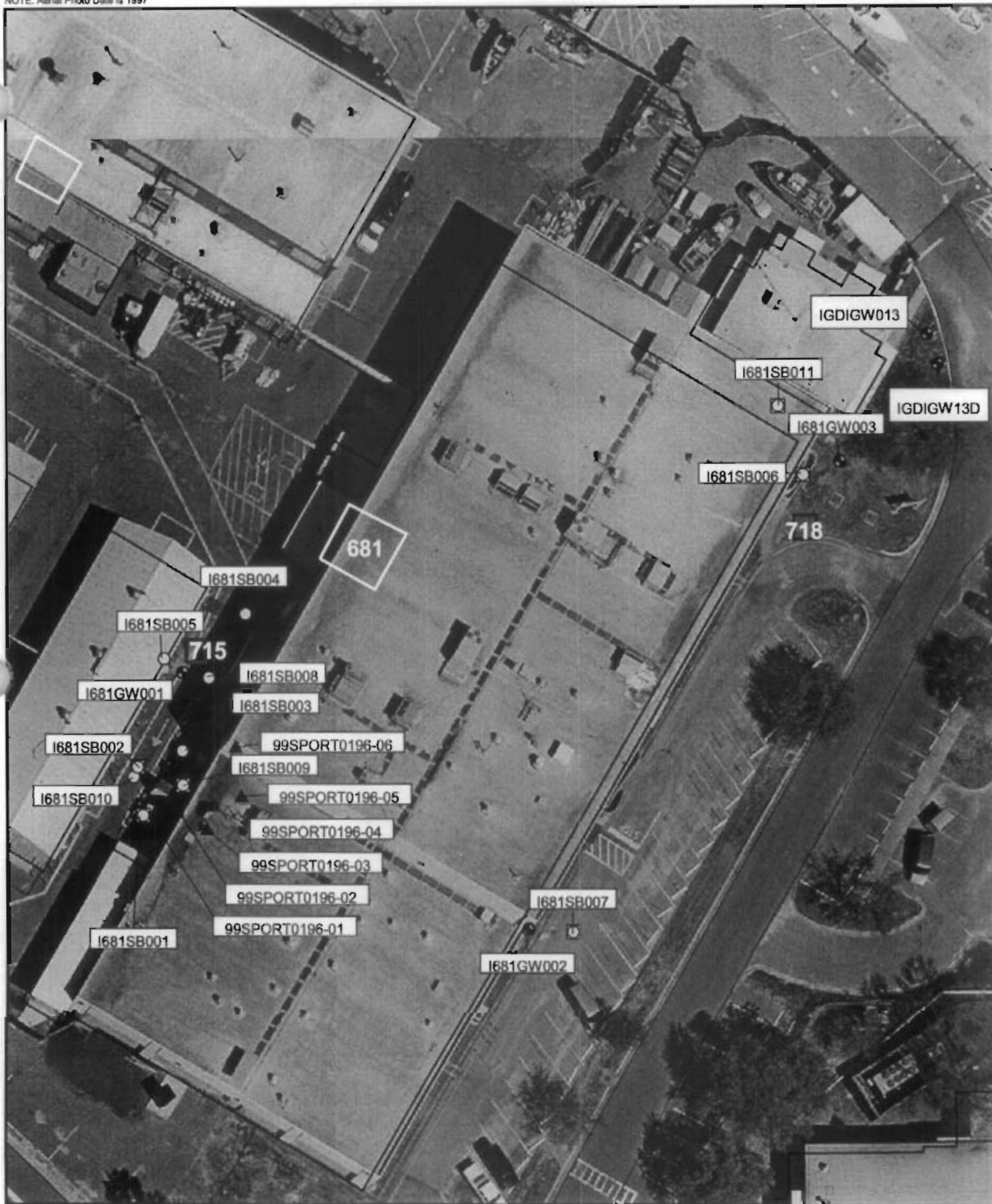
		Station ID	I681SB012		I681SB012		I681SB013		I681SB013	
		Sample ID	681SB01201		681SB01203		681CB01303		681SB01303	
		Date Collected	9/26/2001		9/26/2001		9/26/2001		9/26/2001	
Parameter	Units									
Benzo(a)Anthracene	µg/kg		5.3	J	17	U	100	=	320	=
Benzo(a)Pyrene	µg/kg		7.7	J	4.3	J	140	=	370	=
Benzo(b)Fluoranthene	µg/kg		8.6	J	5.8	J	180	=	490	=
Benzo(k)Fluoranthene	µg/kg		4.9	J	3.9	J	180	=	420	=
Dibenz(a,h)anthracene	µg/kg		7.4	J	17	U	54	J	130	=
Chrysene	µg/kg		15	J	17	U	220	=	500	=
Indeno(1,2,3-c,d)pyrene	µg/kg		11	J	4.8	J	170	=	420	=
<b>BEQs</b>	TEQ									
Benzo(a)Anthracene	0.10		0.86	J	0.58	J	18	=	49	=
Benzo(a)Pyrene	1		4.9	J	3.9	J	180	=	420	=
Benzo(b)Fluoranthene	0.10		0.74	J	0.85	U	5.4	J	13	=
Benzo(k)Fluoranthene	0.01		0.15	J	0.085	U	2.2	=	5	=
Dibenz(a,h)anthracene	1		11	J	4.8	J	170	=	420	=
Chrysene	0.001		0.015	J	0.034	U	0.22	=	0.5	=
Indeno(1,2,3-c,d)pyrene	0.10		1.3	J	0.84	J	16	=	37	=
<b>BEQS</b>			<b>19.0</b>	<b>U</b>	<b>11.1</b>	<b>J</b>	<b>391.8</b>	<b>U</b>	<b>944.5</b>	<b>U</b>

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 µg/kg Micrograms per kilograms  
 BEQs Benzo(a)pyrene equivalents  
 TEQ Technical equivalents

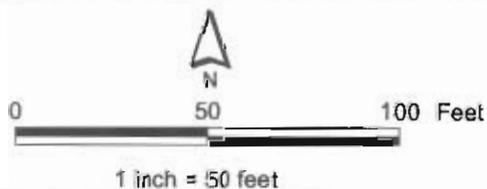
**TABLE 7-8**  
 Bis(2-Ethylhexyl)phthalate in Groundwater  
 CMS Work Plan, AOC 681, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Bis(2-Ethylhexyl) Phthalate		Qualifier
			MCL RBC Shallow	Result ( $\mu\text{g/L}$ )	
				NA 4.8 NA	
<b>Shallow Groundwater</b>					
I681GW001	681GW00102	01/25/99		10.0000	U
	681GW00103	06/02/99		10.0000	U
	681GW00101	10/20/98		5.0000	U
I681GW002	681GW00201	10/20/98		<b>22.0000</b>	J
	681GW00202	01/26/99		1.0000	J
	681GW00203	06/02/99		13.0000	U
I681GW003	681GW00301	10/20/98		5.0000	U
	681GW00302	01/26/99		3.0000	J
	681GW00303	06/02/99		10.0000	U
	GDIGW01303	05/28/96		10.0000	U
IGDIGW013	GDIGW01302	12/06/95		10.0000	UJ
	GDIGW01304	09/04/96		10.0000	U
	GDIGW01305	04/15/98		10.0000	U
	GDIGW01306	08/20/98		5.0000	U
	GDIGW01301	04/26/95		10.0000	U
<b>Deep Groundwater</b>					
IGDIGW13D	GDIGW13D06	08/20/98		5.0000	U
	GDIGW13D01	06/02/95		25.0000	U
	GDIGW13D02	12/06/95		10.0000	U
	GDIGW13D03	05/28/96		10.0000	U
	GDIGW13D04	09/04/96		10.0000	U
	GDIGW13D05	04/15/98		10.0000	U

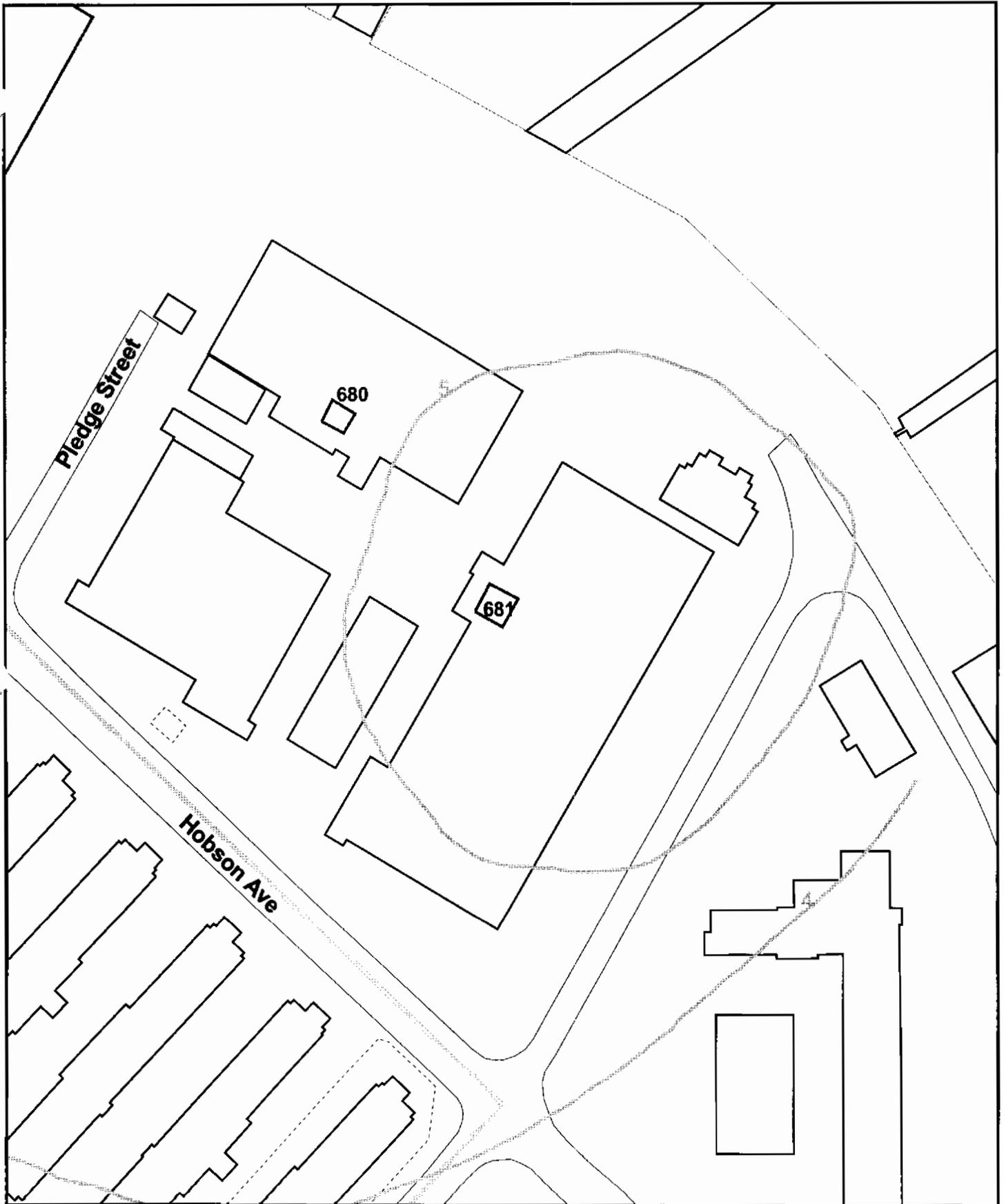
NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 $\mu\text{g/L}$  Micrograms per liter



- ▲ DET Sampling Locations
- Surface Soil Sample
- Subsurface Soil Sample
- ⊕ Groundwater Sample
- ▭ AOC Boundary
- ▭ SWMU Boundary

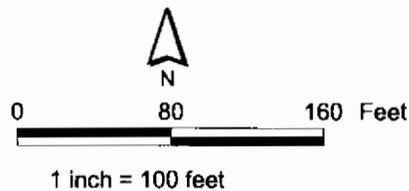


**Figure 7-1**  
Site and Test Location Map  
AOC 681, AOC 715, and AOC 718  
Zone I  
Charleston Naval Complex



**Figure 7-2**  
 Shallow Groundwater Contour Map  
 AOC 681, Zone I  
 Charleston Naval Complex

- Inferred Groundwater Elevations (ft msl)
- Known Groundwater Elevations (ft msl)
- Fence
- Railroads
- Roads
- Shoreline
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary





## 1 **8.0 CMS Work Plan for AOC 685**

2 This section summarizes the results and conclusions from the soil and groundwater  
3 investigations conducted in the area of AOC 685, which were reported in the *Zone I RFI*  
4 *Report, Revision 0* (EnSafe, 1999), Section 10.7, and as amended by the *Zone I RFI Report*  
5 *Addendum, Revision 1* (CH2M-Jones, 2001). Figure 8-1 presents the site features and RFI  
6 sample locations.

7 As part of the Zone I RFI, surface soil, subsurface soil and groundwater investigations were  
8 conducted at AOC 685 in multiple sampling events conducted from February to June 1995.  
9 The RFI report presented the results of the investigations and conclusions concerning  
10 contamination and risk, as summarized in Sections 8.1 and 8.2 of this CMS Work Plan. A  
11 further evaluation of COCs is provided in Section 8.3 of this work plan.

### 12 **8.1 Background**

13 AOC 685 is a former smoke drum site, located on the west side of Juneau Avenue. The  
14 facility was in operation from 1941 until 1953. The smoke drum area was reportedly used to  
15 burn classified documents and other materials, possibly paints, solvents, or waste oil. The  
16 area is now a grassy field with no visible evidence of the former site activities; no activities  
17 are currently associated with the site. Specific design features, dimensions, and operating  
18 practices of the smoke drum are unknown.

19 Products of incomplete combustion are the materials of concern at AOC 685. Potential  
20 receptors include workers who perform invasive activities which bring them in direct  
21 contact with contaminants.

22 The area is zoned for industrial use (M-1).

### 23 **8.2 RFI Investigation Results**

#### 24 **8.2.1 Soil Investigation Results**

25 As part of the RFI field investigation, surface soil samples and collocated subsurface soil  
26 samples were collected during three sampling events (see Table 8-1 and Figure 8-1).

### 1 **8.2.1.1 Surface Soils**

2 A total of 39 surface soil samples (36 normal surface soil samples plus 3 duplicate samples)  
3 were collected from the locations shown in Figure 8-1 and analyzed for the analytes listed in  
4 Table 8-1. Surface soil sample results were evaluated relative to the EPA Region III RBCs,  
5 SSLs, and zone-specific BRCs. Based on the analysis presented in the RFI report, the  
6 following constituents were identified as COCs for surface soil:

- 7 • BEQs were detected at a concentration exceeding its residential RBC (0.087 mg/kg) in 15  
8 surface soil samples
- 9 • Aluminum was detected in three surface soil samples at concentrations exceeding both  
10 the residential RBC (7,800 mg/kg) and the BRC (27,400 mg/kg)
- 11 • Arsenic was detected in one sample at a concentration exceeding both its residential  
12 RBC (0.43 mg/kg) and its BRC (21.6 mg/kg)
- 13 • Chromium was detected in 23 samples at concentrations exceeding both its residential  
14 RBC (39 mg/kg) and its BRC (34.5 mg/kg)

### 15 **8.2.1.2 Subsurface Soils**

16 A total of 20 subsurface soil samples, 18 subsurface soil and 2 duplicates (see Figure 8-1),  
17 were collected and analyzed for the parameters listed in Table 8-1. During the third  
18 sampling event, 18 subsurface soil samples were taken for metals and SVOC analyses.

19 Subsurface soil sample results were evaluated relative to EPA Region III unrestricted and  
20 industrial RBCs and SSLs with a DAF=10. Based on the Zone I RFI Report Table 10.7.3  
21 (pages 10.7.10 and 10.7.11), arsenic, chromium, and manganese exceeded their screening  
22 criteria, but following completion of the risk assessment only arsenic and chromium were  
23 retained as COCs.

### 24 **8.2.2 Groundwater**

25 Shallow groundwater at this site is locally affected by an apparent groundwater high that is  
26 west of AOC 685. There is a slight northward flexure to the contours, likely due to  
27 mounding effects from the Dredge Materials Area (DMA), which is located due west of  
28 AOC 685. Ultimately, groundwater patterns revert locally to flow due east toward the  
29 Cooper River (see Figure 8-2).

30 One shallow and one deep monitoring well pair (IGDIGW10 and IGDIGW010D,  
31 respectively) were used as part of the RFI investigation. The groundwater samples obtained

1 from both wells were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide,  
2 chlorides, sulfates, and TDS (see Table 8-2).

3 Constituents detected in the groundwater samples were evaluated relative to MCLs, tap  
4 water RBCs, and Zone I groundwater BRCs. The following sections present the findings  
5 presented in the RFI report.

#### 6 **8.2.2.1 Shallow Groundwater**

7 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
8 result of the screening process and subsequent risk assessment, no constituents were  
9 identified as COCs for shallow groundwater.

#### 10 **8.2.2.2 Deep Groundwater**

11 Analytes detected in deep groundwater samples were evaluated in the RFI report. As a  
12 result of the screening process and subsequent risk assessment, no constituents were  
13 identified as COCs for deep groundwater.

#### 14 **8.2.3 RFI Risk Summary**

15 Based on a unrestricted land use scenario, the following COCs were identified:

16 **Surface soil:** aluminum, arsenic, chromium and BEQs

17 **Subsurface Soil:** Arsenic and chromium

18

19 Based on an industrial land use scenario, the following COCs were identified:

20 **Arsenic:** surface soil

21 **BEQs:** surface soil

#### 22 **8.2.4 Recommendations from Zone I RFI Report, Revision 0**

##### 23 **8.2.4.1 Surface Soils**

24 The RFI report recommended a CMS for surface soil, considering no action, excavation and  
25 offsite disposal, and containment/capping options.

##### 26 **8.2.4.2 Subsurface Soil**

27 The RFI report recommended a CMS for subsurface soil, considering no action, excavation  
28 and offsite disposal, and containment/capping options.

##### 29 **8.2.4.3 Shallow Groundwater**

30 No shallow groundwater COCs were identified; therefore, NFA for shallow groundwater  
31 was recommended in the RFI report.

1 **8.2.4.4 Deep Groundwater**

2 No deep groundwater COCs were identified; therefore, NFA for deep groundwater was  
3 recommended in the RFI report.

4 **8.3 COPC/COC Refinement**

5 The COCs identified for soils in the RFI include BEQs, aluminum, arsenic, and chromium in  
6 surface soil and arsenic and chromium in subsurface soils. No COCs were identified for  
7 groundwater at AOC 685. Each of the COCs are further evaluated in the following sections.  
8 In addition, the concentrations of VOCs detected in soils were rescreened using an SSL  
9 based on a DAF=1.

10 **8.3.1 Surface Soil**

11 **8.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

12 The VOCs detected in surface soils are presented in Table 8-3. No VOCs exceeded their SSL  
13 screening criteria for DAF=1. For these reasons, VOCs at AOC 685 were not considered  
14 COCs.

15 **8.3.1.2 BEQs**

16 BEQs were detected in 23 of 36 samples of surface soil, with a maximum value of  
17 3.746 mg/kg (685SB025) (see Table 8-4). The base-wide reference concentration for BEQs in  
18 surface soil is 1.304 mg/kg. The maximum detected value of 3.746 mg/kg was the only  
19 sample that exceeded the base-wide reference concentration.

20 Although the maximum concentration of BEQs in surface soil exceeded the base-wide  
21 reference concentration, all other site samples were indicative of background conditions at  
22 the site. In addition, all subsurface soil samples were below both the base-wide reference  
23 concentration and the SSL value. It is not likely that the elevated concentration of BEQs in  
24 surface soil represents site conditions, given the numerous anthropogenic sources of BEQs  
25 at the facility. BEQs are not considered a COC in soil at AOC 685.

26 **8.3.1.3 Aluminum**

27 Aluminum was detected in 36 of 36 surface soil samples. In surface soil, only three samples  
28 exceeded the Zone I BRC of 27,400 mg/kg, with the maximum detected concentration being  
29 29,900 mg/kg (685SB003) (see Table 8-5). The three elevated samples in surface soil  
30 (685SB003, 685SB017, 685SB033) were not located in proximity to each other, indicating that  
31 there is not a localized area of elevated aluminum concentrations at the site. The aluminum

1 in surface soil at the site is likely indicative of natural background conditions. For these  
2 reasons, aluminum is not considered a COC in surface soil at AOC 685.

### 3 **8.3.1.4 Arsenic**

4 In surface soil, arsenic was detected in 36 of 36 surface soil samples, with only 1 sample  
5 exceeding the Zone I background concentration of 21.6 mg/kg base-wide reference  
6 concentration range (30.3 mg/kg at 685SB029) (see Table 8-6). Arsenic is ubiquitous at the  
7 CNC, including this site, as indicated by the detection of arsenic in every surface soil  
8 sample.

9 An exposure point concentration was estimated for the surface soil arsenic data from the  
10 site. A UCL<sub>95</sub> concentration was estimated for the surface soils at the site (see  
11 Appendix C-1). This estimation included all samples collected within the top 1-ft interval of  
12 soil. The resulting UCL<sub>95</sub> estimate was 12.9 mg/kg, which is well below the Zone I BRC for  
13 arsenic in surface soils (20 mg/kg).

14 Because the estimated exposure point concentration is well within the range of arsenic in  
15 surface soil in Zone I, arsenic is not considered a COC in surface soil at AOC 685.

### 16 **8.3.1.5 Chromium**

17 Chromium was detected in 36 of 36 surface soil samples, with detection ranging from  
18 4.9 mg/kg to 210 mg/kg (see Table 8-7). In addition to the total chromium analyses  
19 conducted at this site, six samples were collected for trivalent chromium analyses. Based on  
20 the analytical results, 100 percent of the chromium at AOC 685 is in the less toxic trivalent  
21 form. In accordance with the EPA guidance, there is no generic SSL for trivalent chromium  
22 because its "chemical specific properties are such that this pathway [soil-to-groundwater] is  
23 not of concern at any soil contaminant concentration." (*EPA Soil Screening Guidance:  
24 Technical Background Document* [Table A-1], May 1996.) In addition, the EPA Region III RBC  
25 for trivalent chromium under a unrestricted land use scenario is 12,000 mg/kg, whereas the  
26 highest concentration detected in surface soil at AOC 685 is 210 mg/kg.

27 Given that chromium is a naturally occurring metal consistently found in soils throughout  
28 Zone I, and that 100 percent of the chromium is present in its low toxicity trivalent form,  
29 chromium is not considered a COC in surface soil at AOC 685.

## 1 **8.3.2 Subsurface Soils**

### 2 **8.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

3 VOCs were not detected in subsurface soil at the site, therefore, the rescreening against an  
4 SSL with a DAF of 1 was not necessary.

### 5 **8.3.2.2 Arsenic**

6 Arsenic was detected in all 24 subsurface soil samples at AOC 685 with a concentration  
7 range of 6.2 mg/kg (I685SB032) to 26.0 mg/kg (I685SB029), which exceeded the Zone I  
8 background range for arsenic in subsurface soil of 0.88 mg/kg to 4.4 mg/kg, and 19 of these  
9 samples exceeded the SSL of 14.5 for arsenic (DAF=10) (see Table 8-8). However, the Zone I  
10 background range for arsenic in subsurface soils is based on only four analyses, which is  
11 not statistically representative of zone-specific ranges. However, AOC 685 is located near  
12 Zone H (<700 ft), which has a more representative data set for arsenic (58 subsurface soil  
13 samples).

14 The comparison to Zone H is also valid because Zone I is similar in character and has had  
15 many of the same historical industrial use land practices. Looking at the ranges of arsenic  
16 values in subsurface soils for Zones H and I, the concentrations range from 0.78 mg/kg  
17 (Zone H surface soils) to 136 mg/kg (Zone H subsurface soils). Arsenic detected in  
18 subsurface soil at AOC 673, therefore, is likely the result of general pesticide applications  
19 across the base, as was demonstrated with respect to surface soils at CNC. Since there are  
20 no site-related operations at AOC 685 that involve arsenic, the detected concentrations are  
21 likely from base maintenance-related arsenical pesticide applications. For these reasons,  
22 arsenic is not considered a COC in surface soil at AOC 685.

### 23 **8.3.2.3 Chromium**

24 Chromium was detected in 36 of 36 subsurface soil samples with ranging from 16.8J mg/kg  
25 to 86J mg/kg (see Table 8-7). In addition to the total chromium analyses conducted at this  
26 site, six samples were collected for trivalent chromium analyses. Based on the analytical  
27 results, 100 percent of the chromium at AOC 685 is in the less toxic trivalent form. In  
28 accordance with the EPA guidance, there is no generic SSL for trivalent chromium because  
29 its "chemical specific properties are such that this pathway [soil-to-groundwater] is not of  
30 concern at any soil contaminant concentration." (*EPA Soil Screening Guidance: Technical  
31 Background Document* [Table A-1], May 1996.) In addition, the EPA Region III RBC for  
32 trivalent chromium under a unrestricted land use scenario is 12,000 mg/kg, whereas the  
33 highest concentration detected in subsurface soil at AOC 685 is 86 mg/kg.

1 Given that chromium is a naturally occurring metal consistently found in soils throughout  
2 Zone I, and that 100 percent of the chromium is present in its low toxicity trivalent form,  
3 chromium is not considered a COC in subsurface soil at AOC 685.

#### 4 **8.3.3 Groundwater**

5 No COCs were identified in groundwater at AOC 685.

#### 6 **8.3.4 COPC/COC Refinement Summary**

7 There are no COCs requiring further action in surface soils or subsurface soils at AOC 685.  
8 This site is recommended for NFA.

### 9 **8.4 Summary of Information Related to Site Closeout Issues**

#### 10 **8.4.1 RFI Status**

11 The RFI report, as amended by the RFI Report Addendum, is complete.

#### 12 **8.4.2 Presence of Inorganics in Groundwater**

13 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
14 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
15 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
16 followed by detection of these same metals below the MCL or below the practicable  
17 quantitation limit. Per discussion in Section 8.3, evaluation of inorganics does not warrant  
18 further investigation.

19 Two deep groundwater samples collected from grid wells located within the footprint of  
20 AOC 685 slightly exceeded the 2.0 µg/L MCL for thallium (8.6 in IGDIGW10D02 and  
21 3.1 µg/L in IGDIGW10D04). Only the sample collected during the second sampling event  
22 slightly exceeded the Zone I maximum deep groundwater background value of 8 µg/L, and  
23 was not exceeded in either of the two subsequent sampling events. In addition, thallium  
24 was not identified as a COC for either surface or subsurface soil at AOC 685. Further  
25 evaluation of this issue is not warranted.

#### 26 **8.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

27 Data indicate that AOC 685 was never connected to the sanitary sewer system. Therefore,  
28 there are no concerns regarding connections to the sanitary sewer. Further evaluation of this  
29 issue is not warranted.

1 **8.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

2 No direct connection of AOC 685 to the storm sewer is known to exist. No COCs requiring  
3 further evaluation are present at the site. Further evaluation of this issue is not warranted.

4 **8.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

5 The closest railroad to AOC 685 is located approximately 4,000 feet west. There is no known  
6 linkage between AOC 685 and the investigated railroad lines of AOC 504, and further  
7 evaluation of this issue is not warranted.

8 **8.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

9 The nearest surface water body to AOC 685 is the Cooper River, which lies approximately  
10 60 feet east of the unit. The only potential migration pathway from the site to surface water  
11 is via overland flow via stormwater runoff. Since no COCs were identified at the site,  
12 further evaluation of a potential pathway for contaminant migration via stormwater runoff  
13 is not warranted.

14 **8.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

15 There are no known OWSs associated with AOC 685. Therefore, there are no concerns  
16 regarding connections to the sanitary sewer, and further evaluation of this issue is not  
17 warranted.

18 In addition, there is no reference to an OWS at this facility in the *Oil Water Separator Data*  
19 report (Department of the Navy, September 2000).

20 **8.4.8 Land Use Control Management Plan**

21 The COC refinement did not identify any COCs at AOC 685. This evaluation was based on  
22 a unrestricted land use classification. Therefore, land use controls are not necessary.

23 **8.5 CH2M-Jones Recommendations**

24 Evaluation of the primary media of concern (surface soils, subsurface soils and  
25 groundwater) indicated that there were no issues associated with the historical operation of,  
26 or releases from, this unit. Based on a review of COPCs/COCs in section 8.3, no COCs were  
27 identified in any investigated media.

28 The RFI report concluded that a CMS was necessary for surface soil. However, CH2M-Jones  
29 has re-evaluated the risks posed by the identified COCs and determined that no COCs exist  
30 at AOC 685. Therefore, this site is recommended for NFA.

1

**TABLE 8-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	02/22/95	Upper - 9 (9)	Organotins, Standard Suite, Additional Parameters <sup>a</sup>	
		Lower - 0 (9)		No lower-interval samples were collected due to a water table at less than 5 ft bgs
		Duplicate - 1	Appendix IX	
2	06/20/95	Upper - 6	Metals, SVOCs	Samples collected to delineate the nature and extent of SVOCs and metals detected above RBCs and/or background.
		Duplicate - 1	Appendix IX, TPH GRO/DRO	
3	03/31/98 04/01/98	Upper - 21	Metals, SVOCs	Lower-intervals samples collected below water table for use in assessing groundwater contamination.
		Lower - 18	Metals, SVOCs	
		Duplicate - 3	Metals, SVOCs	

1

**Table 8-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Wells Sampled	Sample Analyses	Comments
1	05/02/95	IGDIGW010/ IGDIGW010D	Standard Suite, Organotins, TDS, Sulfates, Chloride, Dioxins	
2	12/11/95	IGDIGW010/ IGDIGW010D	Standard Suite, TDS, Sulfates, Chloride	
3	5/31/96	IGDIGW010/ IGDIGW010D	Standard Suite, TDS, Sulfates, Chloride	
4	8/26/26	IGDIGW010/ IGDIGW010D	Standard Suite, TDS, Sulfates, Chloride	

2 Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.

**TABLE 8-3**  
 VOCs in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Naphthalene Result (mg/kg)	Qualifier	Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier	1,1,2-Trichloro-1,2,2-Trifluoroethane Result (mg/kg)	Qualifier
			<b>IND RBC</b> 4,100.0000		20,000.0000		41,000.0000		6,100,000	
			<b>RES RBC</b> 160.0000		780.0000		1,600.0000		230,000	
			<b>SSL</b> 4		0.8000		0.6000		NA	
			<b>SS BKGD</b> NA		NA		NA		NA	
I685SB001	685SB00101	02/22/95	0.8400	U	0.0260	J	0.0190	U	0.0130	U
I685SB002	685SB00201	02/22/95	0.8400	U	0.0260	UJ	0.0190	U	0.0040	J
I685SB003	685SB00301	02/22/95	0.9200	U	0.1300	UJ	0.0210	U	0.0140	U
I685SB004	685SB00401	02/22/95	0.8600	U	0.1200	UJ	0.0190	U	0.0130	U
I685SB005	685SB00501	02/22/95	0.7900	U	0.1100	UJ	0.0010	J	0.0120	U
I685SB006	685SB00601	02/22/95	0.8800	U	0.1200	UJ	0.0060	J	0.0130	U
I685SB007	685SB00701	02/22/95	0.8700	U	0.0360	J	0.0030	J	0.0130	U
I685SB008	685SB00801a	02/22/95	0.8200	U	0.1100	U	0.0190	U	0.0120	U
I685SB009	685SB00901	02/22/95	0.0520	J	0.0260	UJ	0.0050	J	0.0150	=
I685SB010	685SB01001	06/20/95	0.0430	J						
I685SB011	685SB01101	06/20/95	0.7500	U						
I685SB012	685SB01201	06/20/95	0.7700	U						
I685SB013	685SB01301	06/20/95	0.7300	U						
I685SB014	685SB01401b	06/20/95	0.8200	U						
I685SB015	685SB01501	06/20/95	0.8900	U						

**TABLE 8-3**  
 VOCs in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Naphthalene Result (mg/kg)	Qualifier	Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier	1,1,2-Trichloro-1,2,2-Trifluoroethane Result (mg/kg)	Qualifier	
			<b>IND RBC</b>		4,100.0000		20,000.0000		41,000.0000		6,100,000
			<b>RES RBC</b>		160.0000		780.0000		1,600.0000		230,000
			<b>SSL</b>		4		0.8000		0.6000		NA
			<b>SS BKGD</b>		NA		NA		NA		NA
1685SB016	685SB01601	03/31/98			0.4800	U					
1685SB017	685SB01701	03/31/98			0.4600	U					
1685SB018	685SB01801	03/31/98			0.4400	U					
1685SB019	685SB01901	03/31/98			0.4600	U					
1685SB020	685SB02001	04/01/98			0.4800	U					
1685SB021	685SB02101	03/31/98			0.4700	U					
1685SB022	685SB02201	04/01/98			0.5000	U					
1685SB023	685SB02301	04/01/98			0.5200	U					
1685SB024	685SB02401	04/01/98			0.5000	U					
1685SB025	685SB02501	03/31/98			0.1000	J					
1685SB026	685SB02601	04/01/98			0.5300	U					
1685SB027	685SB02701	04/01/98			0.4400	U					
1685SB028	685SB02801	03/31/98			0.4500	U					
1685SB029	685SB02901	04/01/98			0.5500	U					
1685SB030	685SB03001	04/01/98			0.0280	J					

**TABLE 8-3**  
 VOCs in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Naphthalene Result (mg/kg)	Qualifier	Acetone Result (mg/kg)	Qualifier	Toluene Result (mg/kg)	Qualifier	1,1,2-Trichloro-1,2,2-Trifluoroethane Result (mg/kg)	Qualifier	
			<b>IND RBC</b>		4,100.0000		20,000.0000		41,000.0000		6,100,000
			<b>RES RBC</b>		160.0000		780.0000		1,600.0000		230,000
			<b>SSL</b>		4		0.8000		0.6000		NA
			<b>SS BKGD</b>		NA		NA		NA		NA
I685SB031	685SB03101	04/01/98			0.4800	U					
I685SB032	685SB03201	04/01/98			0.5300	U					
I685SB033	685SB03301	04/01/98			0.6300	U					
I685SB034	685SB03401	04/01/98			0.4200	U					
I685SB035	685SB03501	04/01/98			0.4700	U					
I685SB036	685SB03601	04/01/98			0.4600	U					

= Chemical is detected at concentration shown.  
 NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

**TABLE 8-4**  
 BEQs in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ	Qualifier
			Result ( $\mu\text{g}/\text{kg}$ )	
			Bkgd	1,304
I685SB001	685SB00101	02/22/1995	814	U
I685SB002	685SB00201	02/22/1995	820	U
I685SB003	685SB00301	02/22/1995	898	U
I685SB004	685SB00401	02/22/1995	837	U
I685SB005	685SB00501	02/22/1995	347	=
I685SB006	685SB00601	02/22/1995	815	=
I685SB007	685SB00701	02/22/1995	608	=
I685SB008	685SB00801a	02/22/1995	442	=
I685SB009	685SB00901	02/22/1995	587	=
I685SB010	685SB01001	06/20/1995	482	=
I685SB011	685SB01101	06/20/1995	361	=
I685SB012	685SB01201	06/20/1995	409	=
I685SB013	685SB01301	06/20/1995	395	=
I685SB014	685SB01401b	06/20/1995	429	=
I685SB015	685SB01501	06/20/1995	405	=
I685SB016	685SB01601	03/31/1998	555	U
I685SB017	685SB01701	03/31/1998	493	=
I685SB018	685SB01801	03/31/1998	284	=
I685SB019	685SB01901	03/31/1998	301	=
I685SB020	685SB02001	04/01/1998	555	U
I685SB021	685SB02101	03/31/1998	437	=
I685SB022	685SB02201	04/01/1998	578	U
I685SB023	685SB02301	04/01/1998	578	=
I685SB024	685SB02401	04/01/1998	578	U
I685SB025	685SB02501	03/31/1998	3,746	=
I685SB026	685SB02601	04/01/1998	612	U
I685SB027	685SB02701	04/01/1998	292	=
I685SB028	685SB02801	03/31/1998	400	=
I685SB029	685SB02901	04/01/1998	636	U
I685SB030	685SB03001	04/01/1998	380	=

**TABLE 8-4**  
 BEQs in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ	Qualifier
			Result ( $\mu\text{g}/\text{kg}$ )	
			<b>Bkgd</b>	<b>1,304</b>
1685SB031	685SB03101	04/01/1998	326	=
1685SB032	685SB03201	04/01/1998	462	=
1685SB033	685SB03301	04/01/1998	728	U
1685SB034	685SB03401	04/01/1998	485	U
1685SB035	685SB03501	04/01/1998	543	U
1685SB036	685SB03601	04/01/1998	374	=
IGDISB010	GDISB01001	02/17/1995	920	U

= Chemical is detected at concentration shown.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 $\mu\text{g}/\text{kg}$  Micrograms per kilograms

**TABLE 8-5**  
 Aluminum in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Aluminum Result (mg/kg)	Qualifier
		IND RBC	200,000	
		RES RBC	7800	
		SSL	NA	
		SS BKGD	27,400	
1685SB001	685SB00101	02/22/95	15,300	J
1685SB002	685SB00201	02/22/95	23,500	J
1685SB003	685SB00301	02/22/95	29,900	J
1685SB004	685SB00401	02/22/95	22,600	J
1685SB005	685SB00501	02/22/95	12,400	J
1685SB006	685SB00601	02/22/95	22,000	J
1685SB007	685SB00701	02/22/95	23,200	J
1685SB008	685SB00801a	02/22/95	14,000	J
1685SB008	685SB00801b	09/07/95	349	U
1685SB009	685SB00901	02/22/95	14,600	J
1685SB010	685SB01001	06/20/95	12,400	J
1685SB011	685SB01101	06/20/95	10,900	J
1685SB012	685SB01201	06/20/95	10,300	J
1685SB013	685SB01301	06/20/95	13,500	J
1685SB014	685SB01401b	06/20/95	13,200	J
1685SB015	685SB01501	06/20/95	18,100	J
1685SB016	685SB01601	03/31/98	16,400	=
1685SB017	685SB01701	03/31/98	28,700	=
1685SB018	685SB01801	03/31/98	22,500	=
1685SB019	685SB01901	03/31/98	8,350	=
1685SB020	685SB02001	04/01/98	24,200	J
1685SB021	685SB02101	03/31/98	25,700	=
1685SB022	685SB02201	04/01/98	23,900	J
1685SB023	685SB02301	04/01/98	15,000	=
1685SB024	685SB02401	04/01/98	19,600	=
1685SB025	685SB02501	03/31/98	17,300	=
1685SB026	685SB02601	04/01/98	25,100	J

Sample Station	ID	Date	Aluminum Result (mg/kg)	Qualifier
			<b>IND RBC</b>	200,000
			<b>RES RBC</b>	7800
			<b>SSL</b>	NA
			<b>SS BKGD</b>	27,400
I685SB027	685SB02701	04/01/98	13,900	=
I685SB028	685SB02801	03/31/98	10,900	=
I685SB029	685SB02901	04/01/98	24,900	J
I685SB030	685SB03001	04/01/98	10,800	J
I685SB031	685SB03101	04/01/98	20,700	=
I685SB032	685SB03201	04/01/98	10,700	J
I685SB033	685SB03301	04/01/98	29,000	J
I685SB034	685SB03401	04/01/98	15,900	J
I685SB035	685SB03501	04/01/98	19,700	J
I685SB036	685SB03601	04/01/98	10,900	J

= Chemical is detected at concentration shown.  
 NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 mg/kg Milligrams per kilogram

**TABLE 8-6**  
 Arsenic in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Arsenic Result (mg/kg)	Qualifier
			IND RBC	3.8000
			RES RBC	0.4300
			SSL	14.5000
			SS BKGD	20
I685SB001	685SB00101	02/22/95	20.7000	J
I685SB002	685SB00201	02/22/95	11.8000	J
I685SB003	685SB00301	02/22/95	15.5000	J
I685SB004	685SB00401	02/22/95	11.2000	J
I685SB005	685SB00501	02/22/95	6.2000	J
I685SB006	685SB00601	02/22/95	14.8000	J
I685SB007	685SB00701	02/22/95	10.0000	=
I685SB008	685SB00801a	02/22/95	9.6000	=
I685SB008	685SB00801b	09/07/95	2.7000	U
I685SB009	685SB00901	02/22/95	7.1000	=
I685SB010	685SB01001	06/20/95	10.9000	J
I685SB011	685SB01101	06/20/95	6.8000	J
I685SB012	685SB01201	06/20/95	5.5000	J
I685SB013	685SB01301	06/20/95	7.8000	J
I685SB014	685SB01401b	06/20/95	5.9000	J
I685SB015	685SB01501	06/20/95	5.8000	J
I685SB016	685SB01601	03/31/98	10.4000	=
I685SB017	685SB01701	03/31/98	14.6000	=
I685SB018	685SB01801	03/31/98	13.1000	=
I685SB019	685SB01901	03/31/98	5.5000	=
I685SB020	685SB02001	04/01/98	10.1000	=
I685SB021	685SB02101	03/31/98	14.0000	=
I685SB022	685SB02201	04/01/98	18.5000	=
I685SB023	685SB02301	04/01/98	12.9000	=
I685SB024	685SB02401	04/01/98	10.4000	=
I685SB025	685SB02501	03/31/98	11.8000	=
I685SB026	685SB02601	04/01/98	20.7000	=

**TABLE 8-6**  
 Arsenic in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Arsenic Result (mg/kg)	Qualifier
			IND RBC	3.8000
			RES RBC	0.4300
			SSL	14.5000
			SS BKGD	20
I685SB027	685SB02701	04/01/98	9.1000	=
I685SB028	685SB02801	03/31/98	10.3000	=
I685SB029	685SB02901	04/01/98	30.3000	=
I685SB030	685SB03001	04/01/98	10.6000	=
I685SB031	685SB03101	04/01/98	15.1000	=
I685SB032	685SB03201	04/01/98	12.1000	=
I685SB033	685SB03301	04/01/98	14.4000	=
I685SB034	685SB03401	04/01/98	14.4000	=
I685SB035	685SB03501	04/01/98	12.4000	=
I685SB036	685SB03601	04/01/98	8.2000	=

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 mg/kg Milligrams per kilogram

**TABLE 8-7**  
 Chromium in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Chromium, Total Result (mg/kg)	Qualifier	Chromium, Trivalent Result (mg/kg)	Qualifier
			IND RBC	310,000	310,000	
			RES RBC	12,000	12,000	
			SSL	19	NA	
			SS BKGD	54	54	
I685SB001	685SB00101	02/22/95	51.6000	=	ND	
I685SB002	685SB00201	02/22/95	47.9000	=	ND	
I685SB003	685SB00301	02/22/95	56.8000	=	ND	
I685SB004	685SB00401	02/22/95	51.0000	=	ND	
I685SB005	685SB00501	02/22/95	34.1000	=	ND	
I685SB006	685SB00601	02/22/95	47.0000	=	ND	
I685SB007	685SB00701	02/22/95	45.0000	=	ND	
I685SB008	685SB00801a	02/22/95	44.4000	=	ND	
I685SB008	685SB00801b	09/07/95	4.9000	J	ND	
I685SB009	685SB00901	02/22/95	78.0000	=	ND	
I685SB010	685SB01001	06/20/95	32.4000	J	ND	
I685SB011	685SB01101	06/20/95	58.4000	J	ND	
I685SB012	685SB01201	06/20/95	83.5000	J	ND	
I685SB013	685SB01301	06/20/95	29.1000	J	ND	
I685SB014	685SB01401b	06/20/95	27.7000	J	ND	
I685SB015	685SB01501	06/20/95	40.0000	J	ND	
I685SB016	685SB01601	03/31/98	39.7000	=	ND	
I685SB016	685SB016A1	08/19/99	46.0000	J	46.00000	=
I685SB017	685SB01701	03/31/98	53.0000	=	ND	
I685SB018	685SB01801	03/31/98	43.2000	=	ND	
I685SB019	685SB01901	03/31/98	16.5000	=	ND	
I685SB020	685SB02001	04/01/98	49.9000	J	ND	
I685SB020	685SB020A1	08/19/99	210.0000	J	210.00000	=
I685SB021	685SB02101	03/31/98	50.0000	=	ND	
I685SB022	685SB02201	04/01/98	46.7000	J	ND	
I685SB023	685SB02301	04/01/98	34.1000	=	44.00000	=

**TABLE 8-7**  
 Chromium in Surface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Chromium, Total Result (mg/kg)	Qualifier	Chromium, Trivalent Result (mg/kg)	Qualifier
			<b>IND RBC</b>		310,000	
			<b>RES RBC</b>		12,000	
			<b>SSL</b>		19	
			<b>SS BKGD</b>		54	
I685SB023	685SB023A1	08/19/99	44.0000	J	ND	
I685SB024	685SB02401	04/01/98	53.5000	=	ND	
I685SB025	685SB02501	03/31/98	42.4000	=	ND	
I685SB026	685SB02601	04/01/98	50.5000	J	ND	
I685SB026	685SB026A1	08/19/99	69.0000	J	69.00000	=
I685SB027	685SB02701	04/01/98	34.9000	=	ND	
I685SB028	685SB02801	03/31/98	30.5000	=	ND	
I685SB029	685SB029A1	08/19/99	64.0000	J	64.00000	=
I685SB029	685SB02901	04/01/98	55.2000	J	ND	
I685SB030	685SB03001	04/01/98	33.6000	J	ND	
I685SB031	685SB03101	04/01/98	49.6000	=	ND	
I685SB032	685SB03201	04/01/98	25.7000	J	ND	
I685SB033	685SB03301	04/01/98	58.2000	J	ND	
I685SB033	685SB033A1	08/19/99	64.0000	J	64.00000	=
I685SB034	685SB03401	04/01/98	35.3000	J	ND	
I685SB035	685SB03501	04/01/98	47.5000	J	ND	
I685SB036	685SB03601	04/01/98	22.7000	J	ND	

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 mg/kg Milligrams per kilogram

**TABLE 8-8**  
 Arsenic in Subsurface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

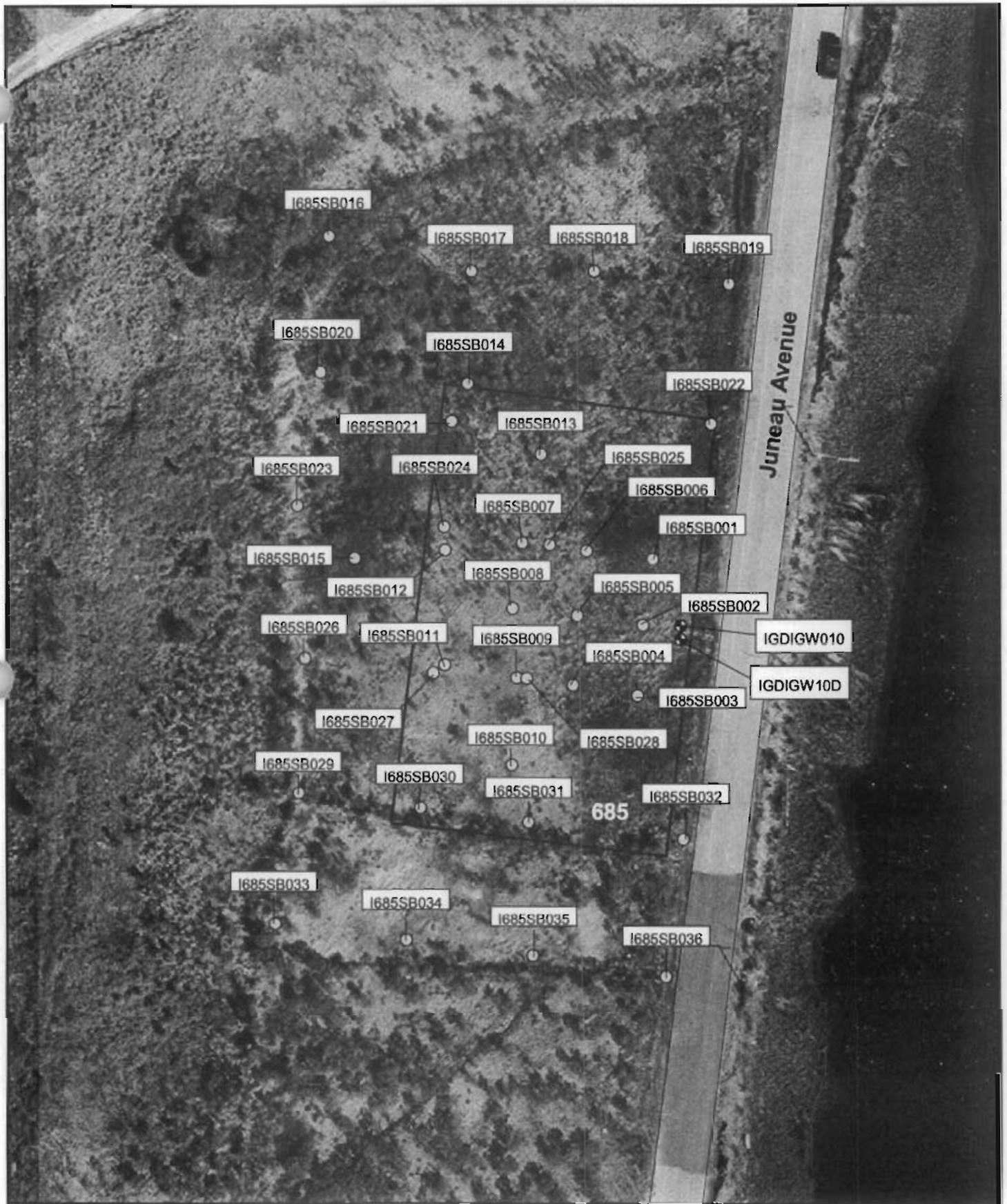
Sample Station	ID	Date	Arsenic Result (mg/kg)	Qualifier
		SSL	14.5000	
		SB BKGD	4.4	
I685SB016	685SB01602	03/31/98	11.3000	=
	685SB016A2	08/19/99	21.0000	=
I685SB017	685SB01702	03/31/98	20.4000	=
I685SB018	685SB01802	03/31/98	8.1000	=
I685SB019	685SB01902	03/31/98	16.1000	=
I685SB020	685SB02002	04/01/98	19.8000	=
	685SB020A2	08/19/99	15.0000	=
I685SB021	685SB02102	03/31/98	16.9000	=
I685SB022	685SB02202	04/01/98	13.2000	=
I685SB023	685SB02302	04/01/98	18.5000	=
	685SB023A2	08/19/99	17.0000	=
I685SB026	685SB02602	04/01/98	17.9000	=
	685SB026A2	08/19/99	15.0000	=
I685SB027	685SB02702	04/01/98	17.0000	=
I685SB029	685SB02902	04/01/98	26.0000	=
	685SB029A2	08/19/99	19.0000	=
I685SB030	685SB03002	04/01/98	17.8000	=
I685SB031	685SB03102	04/01/98	18.8000	=
I685SB032	685SB03202	04/01/98	6.2000	=
I685SB033	685SB03302	04/01/98	30.6000	=
	685SB033A2	08/19/99	24.0000	=
I685SB034	685SB03402	04/01/98	16.2000	=
I685SB035	685SB03502	04/01/98	19.1000	=
I685SB036	685SB03602	04/01/98	6.4000	=

= Chemical is detected at concentration shown.  
 mg/kg Milligrams per kilogram

**TABLE 8-9**  
 Chromium in Subsurface Soils  
 CMS Work Plan, AOC 685, Zone I, Charleston Naval Complex

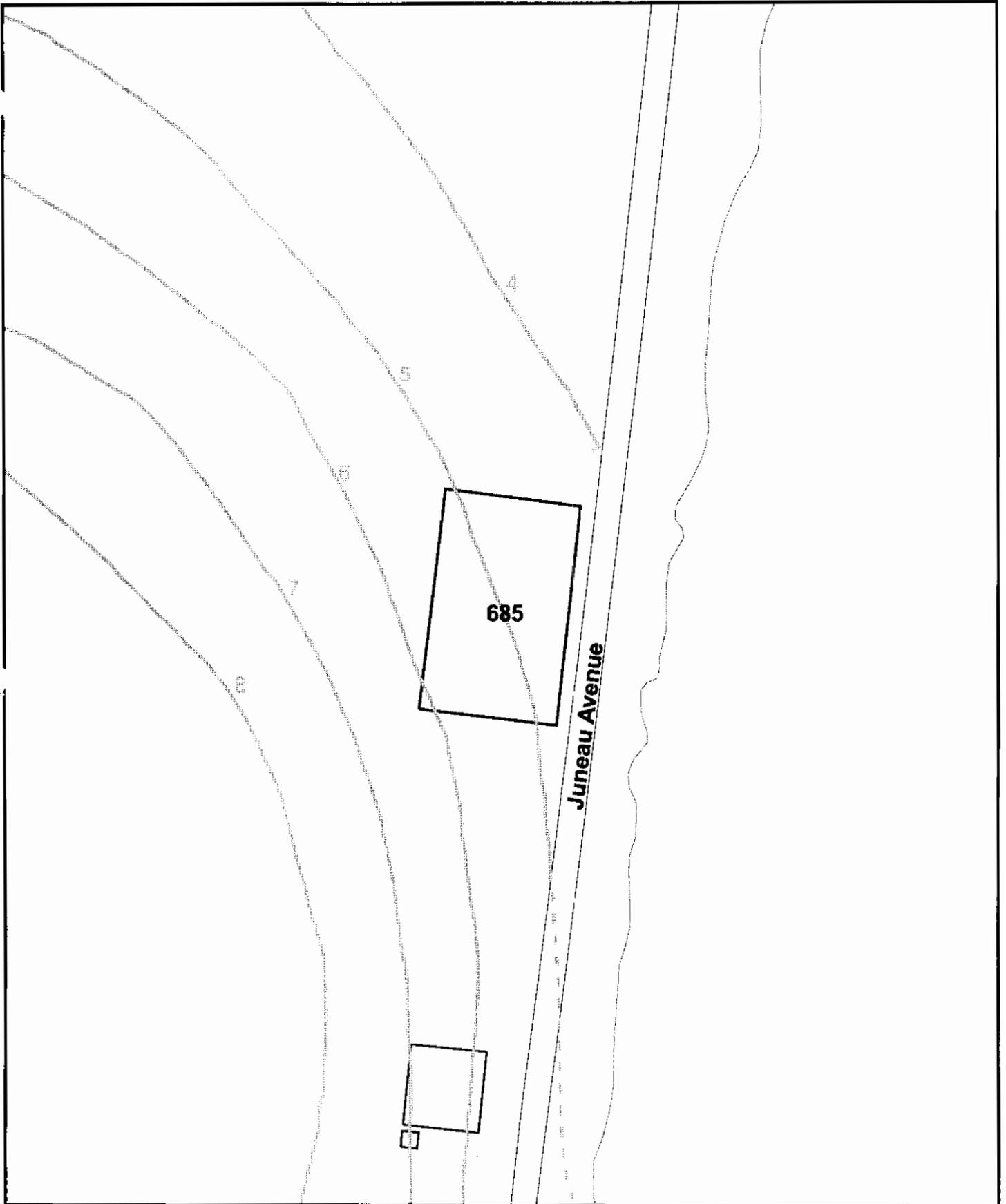
Sample Station	ID	Date	Chromium, Total Result (mg/kg)	Qualifier	Chromium, Trivalent Result (mg/kg)	Qualifier
		SSL	19		NA	
		SB BKGD	41		41	
I685SB016	685SB01602	03/31/98	73.2	=	ND	
	685SB016A2	08/19/99	77	J	77	=
I685SB017	685SB01702	03/31/98	85.7	=	ND	
I685SB018	685SB01802	03/31/98	43.1	=	ND	
I685SB019	685SB01902	03/31/98	33.6	=	ND	
I685SB020	685SB02002	04/01/98	74.1	J	ND	
	685SB020A2	08/19/99	79	J	79	=
I685SB021	685SB02102	03/31/98	57	=	ND	
I685SB022	685SB02202	04/01/98	51.5	J	ND	
I685SB023	685SB02302	04/01/98	56.4	=	ND	
	685SB023A2	08/19/99	73	J	73	=
I685SB026	685SB02602	04/01/98	60.9	J	ND	
	685SB026A2	08/19/99	86	J	86	=
I685SB027	685SB02702	04/01/98	52.2	=	ND	
I685SB029	685SB02902	04/01/98	55.6	J	ND	
	685SB029A2	08/19/99	67	J	67	=
I685SB030	685SB03002	04/01/98	56.9	J	ND	
I685SB031	685SB03102	04/01/98	67.3	=	ND	
I685SB032	685SB03202	04/01/98	16.8	J	ND	
I685SB033	685SB03302	04/01/98	54.7	J	ND	
	685SB033A2	08/19/99	77	J	77	=
I685SB034	685SB03402	04/01/98	64	J	ND	
I685SB035	685SB03502	04/01/98	46.7	J	ND	
I685SB036	685SB03602	04/01/98	21.1	J	ND	

= Chemical is detected at concentration shown.  
 NA not applicable  
 ND no data  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 mg/kg Milligrams per kilogram

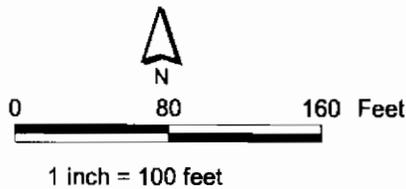


**Figure 8-1**  
 Sample and Test Location Map  
 AOC 685  
 Zone I  
 Charleston Naval Complex

**CH2MHILL**



- Inferred Groundwater Elevations (ft msl)
  - Known Groundwater Elevations (ft msl)
  - Fence
  - Railroads
  - Roads
  - Shoreline
  - AOC Boundary
  - SWMU Boundary
  - Buildings
  - Zone Boundary
- ft msl - feet above mean sea level



**Figure 8-2**  
 Shallow Groundwater Contour Map  
 AOC 685, Zone I  
 Charleston Naval Complex



## 1 9.0 CMS Work Plan for AOC 687 and SMWU 16

2 This section summarizes the results and conclusions from the soil and groundwater  
3 investigations conducted in the area of AOC 687/SWMU 16, which were reported in the  
4 *Zone I RFI Report, Revision 0* (EnSafe, 1999), Section 10.8, and as amended by the *Zone I RFI*  
5 *Report Addendum, Revision 1* (CH2M-Jones, 2001). Figure 9-1 presents the site features and  
6 RFI sample locations.

7 As part of the Zone I RFI, surface soil, subsurface soil and groundwater investigations were  
8 conducted at AOC 687/SWMU 16 in March 1995. The RFI report presented the results of  
9 the investigations and conclusions concerning contamination and risk, as summarized in  
10 Sections 9.1 and 9.2 of this CMS Work Plan. A further evaluation of COCs is provided in  
11 Section 9.3 of this work plan.

### 12 9.1 Background

13 AOC 687 consists of Building X-55, an earth covered ammunition storage bunker  
14 constructed in 1942. The concrete walls and ceiling of the bunker are 4-feet thick. The entire  
15 structure is covered by 2 feet of soil. Surrounding the bunker is a cement and soil  
16 containment berm designed to control the bunker door in the event of an explosion. The  
17 storage bunker is approximately 29-feet wide, 52-feet long, and 12-feet high. The area is  
18 surrounded by a chainlink fence. The AOC is located between Juneau Avenue and the  
19 DMA. The Cooper River and associated wetlands are to the east of the site across Juneau  
20 Avenue.

21 The RFI reported that the bunker appeared to have been used for ammunition storage since  
22 its construction in 1942. No other uses are known. At the time of the RCRA Facility  
23 Assessment (RFA), explosives and small arms ammunition were stored in the bunker.

24 SWMU 16 (the earthen roof of Building X-55) has been associated with AOC 687 due to  
25 prior unauthorized storage of potentially hazardous material (empty paint containers). This  
26 paint container storage was identified as a one-time occurrence and is not thought to  
27 represent a historical problem. Minor spills associated with the storage of the paint  
28 containers were cleaned and the paint containers themselves were removed from the site at  
29 the time of discovery.

1 Materials of concern identified in the final RFI work plan (EnSafe/Allen & Hoshall, 1995)  
2 include explosives, paint wastes, and paint thinner. Potential receptors include workers  
3 involved in invasive and non-invasive activities at these sites. The Cooper River and nearby  
4 wetlands are also potential ecological receptors.

5 The area is zoned industrial use (M-1).

## 6 **9.2 RFI Investigation Results**

### 7 **9.2.1 Soil Investigation Results**

8 As part of the RFI field investigation, surface soil samples and collocated subsurface soil  
9 samples were collected. Samples were analyzed for the constituents listed in Table 9-1.

10 From a risk assessment standpoint, the RFI report evaluated surface soils, subsurface soils,  
11 and sediments as a single media. As a result, it is not possible to separate the three different  
12 media when discussing the COCs identified for soils at SMWU 16/AOC 687. Therefore, the  
13 following discussion is a combined summary of the findings for surface soils, subsurface  
14 soils, and sediments.

15 A total of four surface soil samples, two subsurface samples, and two sediment samples  
16 were collected for analysis during the RFI field investigation (see Figure 9-1). The  
17 parameters for which these samples were analyzed is summarized in Table 9-1. Analytical  
18 results for all three soil media were evaluated relative to the EPA Region III unrestricted  
19 land use and industrial RBCs, Zone I BRCs, and SSLs (DAF=10). Based on the analysis  
20 presented in the RFI report, BEQs, chlordane and chromium were identified as COCs for  
21 soils.

### 22 **9.2.2 Groundwater**

23 Groundwater patterns in the vicinity of AOC 687 show flow east, toward the Cooper River  
24 (see Figure 9-2).

25 Four shallow monitoring wells were installed as part of the RFI investigation (see Figure 9-  
26 1). The groundwater samples obtained from these wells and an existing grid well pair  
27 (GDI008/GDI08D) were analyzed in seven separate sampling events. Samples were  
28 analyzed for the parameters shown in Table 9-2.

29 Constituents detected in the groundwater samples were evaluated relative to MCLs, EPA  
30 Region III tap water RBCs, and Zone I BRCs.

31 The following sections set out the findings presented in the RFI report.

### 1 **9.2.2.1 Shallow Groundwater**

2 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
3 result of the screening process and subsequent risk assessment, the following constituents  
4 were identified as COCs for shallow groundwater:

- 5 • Arsenic exceeded its 50 µg/L MCL in three of six shallow groundwater samples  
6 collected from monitoring well 687GW002, but did not exceed the MCL in any of the  
7 samples collected from the other three wells.
- 8 • Chromium was detected at a concentration exceeding its shallow groundwater BRC  
9 (14.3 µg/L) and tap water RBC (18 µg/L) in three shallow groundwater samples. Its  
10 maximum reported concentration of 26.1 µg/L did not exceed its MCL of 100 µg/L.
- 11 • Methylene chloride was detected at a concentration exceeding its tap water RBC  
12 (4.1 µg/L) in 15 shallow groundwater samples.
- 13 • Thallium was detected at a concentration exceeding its tap water RBC (0.26 µg/L) and  
14 MCL (2 µg/L) in two shallow groundwater samples.

### 15 **9.2.2.2 Deep Groundwater**

16 Analytes detected in deep groundwater samples were evaluated in the RFI report. The  
17 groundwater screening process and subsequent risk assessment did not differentiate  
18 between shallow and deep groundwater. However, the only groundwater constituent  
19 present in deep groundwater that was also identified as a COC in the RFI report was  
20 thallium. Thallium was detected in deep groundwater in the second sampling event at a  
21 concentration of 5.5 µg/L, which exceeded the MCL of 2 µg/L. After completion of the risk  
22 assessment, no COCs were identified in deep groundwater.

### 23 **9.2.3 Sediment Investigation Results**

24 Two sediment samples were collected at AOC 687/SWMU 16 (see Figure 9-1). These  
25 samples were located in a grassy stormwater swale that runs parallel to the western side of  
26 Juneau Avenue. These samples were analyzed for the parameters listed in Table 9-3. The  
27 RFI report combined soils and sediments together for the risk assessment. Sediment was not  
28 evaluated as a separate medium in the RFI.

### 29 **9.2.4 RFI Risk Summary**

30 Based on a unrestricted land use scenario, the following COCs were identified:

31 **Soil and Sediment:** BEQs, chlordane, chromium

32 **Groundwater:** Arsenic, chromium, methylene chloride, and thallium

33 Based on an industrial land use scenario, the following COCs were identified:

1 **Soils and Sediment:** BEQs

2 **Groundwater:** Arsenic, methylene chloride, and thallium

### 3 **9.2.5 Recommendations from Zone I RFI Report, Revision 0**

#### 4 **9.2.5.1 Soils and Sediments**

5 The RFI report recommended a CMS for undifferentiated soils and sediments, considering  
6 no action, excavation and offsite disposal, and containment/ capping options.

#### 7 **9.2.5.2 Groundwater**

8 The RFI report recommended a CMS for groundwater, considering no action, continued  
9 monitoring, and ex situ treatment options.

## 10 **9.3 COPC/COC Refinement**

11 The COCs identified in the RFI include BEQs, chlordane and chromium in soil/sediment  
12 and arsenic, chromium, methylene chloride and thallium in groundwater. Each of these  
13 COCs are further evaluated in the following sections. In addition, concentrations of VOCs  
14 detected in soils were rescreened using an SSL based on a DAF=1.

### 15 **9.3.1 Surface Soil/Sediment**

#### 16 **9.3.1.1 Rescreening of Surface Soil/Sediment VOC Data Based on SSL (DAF=1)**

17 The VOCs detected in surface soils are presented in Table 9-4. Only methylene chloride  
18 exceeded its SSL screening criteria for DAF=1. Methylene chloride was detected at a  
19 concentration just above its detection limit in one of four surface soil samples, but was not  
20 detected in subsurface soil samples. Methylene chloride was detected in groundwater at the  
21 site (2 of 16 samples) at a concentration that exceeded the RBC of 4.1  $\mu\text{g}/\text{L}$  (maximum  
22 detection of 15  $\mu\text{g}/\text{L}$ ). Although the RBC was exceeded, it was only exceeded by the  
23 maximum detected value. Methylene chloride is a common laboratory contaminant and the  
24 concentrations detected in environmental media at AOC 687/SWMU 16 are likely to be the  
25 result of laboratory contamination. Methylene chloride is not considered a COC in surface  
26 soils at AOC 687/SWMU 16 for the following reasons:

- 27 • A single surface soil detection occurred at trace concentrations
- 28 • Methylene chloride was absent in subsurface soil
- 29 • Only one sample in groundwater exceeded the RBC
- 30 • Methylene chloride is a common laboratory contaminant

1 **9.3.1.2 BEQs in Soil**

2 BEQs in the four surface soil samples ranged in concentration from 0.719 mg/kg  
3 (I687SB003) to 0.881 mg/kg (I687SB004) (see Table 9-5). These concentrations are well below  
4 the BEQ reference concentration of 1.3 mg/kg established at CNC for BEQs in surface soils.  
5 This constituent is eliminated as a COC for surface soils at this site.

6 **9.3.1.3 Chlordane in Soil**

7 Chlordane in soils was identified as a COC because the soils and sediments were  
8 considered as a single medium in the RFI report. However, chlordane was not detected in  
9 any of the four surface soil samples collected at AOC 687/SWMU 16. For these reasons,  
10 chlordane is not considered a COC for surface soils at this site.

11 **9.3.1.4 Chromium in Soil**

12 Chromium in soils was also identified as a COC because the soils and sediments were  
13 considered as a single medium in the RFI report. However, the maximum concentration of  
14 chromium detected in any of the four surface soil samples collected at AOC 687/SWMU 16  
15 was 40 mg/kg at sample location I687SB004 (see Table 9-6). All detected concentrations are  
16 well within the background range for chromium in Zone I (7.3 mg/kg to 54 mg/kg). For  
17 these reasons, chromium is not considered a COC for surface soils at this site.

18 **9.3.1.5 BEQs in Sediment**

19 BEQs as reported in the RFI were detected in one of two sediment samples at a  
20 concentration of 1.305 mg/kg (see Table 9-7)<sup>9</sup>. BEQs resulted in a derived cancer risk  
21 greater than  $1 \times 10^{-6}$  for both unrestricted land use and industrial receptors. BEQs, however,  
22 were not detected in surface or subsurface soil and are not known to be associated with past  
23 site use. The reference concentration for BEQs in surface soil is 1.304 mg/kg, which is  
24 equivalent to the detected concentration in sediment. The location of the detected value of  
25 BEQs is a drainage ditch immediately adjacent to Juneau Avenue. The BEQs detected at this  
26 location may have originated from road asphalt and/or roadbase material or runoff from  
27 the streets. Therefore, given that the detected BEQs are not likely to be site-related and that  
28 the detected concentration is likely indicative of background at Zone I, BEQs are not  
29 considered a COC in sediment at AOC 687/SWMU 16.

30 **9.3.1.6 Chlordane in Sediment**

31 Chlordane was detected in one of two sediment samples at a concentration of 5.2 mg/kg,  
32 which exceeded the RBC of 1.8 mg/kg (see Table 9-8). Chlordane was not detected in

1 surface or subsurface soil and is not known to be associated with past site use. The location  
2 of the detected value in sediment is a drainage ditch east of the site, which may have been  
3 influenced by routine pesticide use in the area. Since chlordane is not known to be  
4 associated with past site activities and was detected only in a single sediment sample,  
5 chlordane is not considered a COC at AOC 687/SWMU 16.

### 6 **9.3.1.7 Chromium in Sediment**

7 Chromium was detected in sediment at concentrations of 22.8J mg/kg and 42.3J mg/kg at  
8 sample locations 687M0001 and 687M0002, respectively. The RFI identified chromium in  
9 sediment as a COC. Based on the results of the risk assessment completed as part of the RFI  
10 (Table 10.8.35 of Zone I RFI), however, chromium is not considered a COC for either the  
11 unrestricted land use scenario or industrial scenario. The derived hazards associated with  
12 chromium in sediment were 0.0055 for the industrial receptor and 0.11 for the unrestricted  
13 land use receptor. In addition, all detected concentrations are well within the background  
14 range for chromium in Zone I (7.3 mg/kg to 54 mg/kg). For these reasons, chromium is not  
15 considered a COC at this site.

## 16 **9.3.2 Subsurface Soils**

17 No subsurface soil COCs were identified in the RFI report.

### 18 **9.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

19 The VOCs detected in subsurface soils are presented in Table 9-9. Acetone is the only VOC  
20 detected in the subsurface soils. The maximum detected concentration of acetone was  
21 22 µg/kg and it did not exceed its SSL screening criteria of 800 µg/kg for DAF=1. VOCs  
22 were not identified as COCs at AOC 687/SWMU 16.

## 23 **9.3.3 Groundwater**

24 COCs identified in groundwater for the unrestricted land use exposure scenario are arsenic,  
25 chromium, methylene chloride, and thallium.

### 26 **9.3.3.1 Arsenic in Groundwater**

27 Arsenic was detected in 13 of 24 samples of shallow groundwater at concentrations ranging  
28 from 3.3 to 131 µg/L (see Table 9-10). The highest concentrations of arsenic were detected in  
29 well I687GW002. When this well was resampled in 1999, however, the detected  
30 concentration had decreased to 26.7 µg/L. The pattern of sporadic occurrences and  
31 exceedances was confirmed in the Zone I grid wells (Appendix A-2). For the reasons

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<sup>9</sup> The values for BEQs presented in Table 9-7 are slightly different than the values presented in the RFI report. The BEQ

1 discussed above, arsenic was not considered a COC for groundwater at AOC 687/  
2 SWMU 16. In addition, the iron concentrations in groundwater are elevated (see Table 9-10),  
3 indicating that iron-reducing conditions are present. The groundwater sample with the  
4 greatest arsenic concentration also exhibited the greatest iron concentration, further  
5 suggesting that the elevated arsenic is due to natural geochemical processes. Given that the  
6 concentration of arsenic in site groundwater is indicative of natural background conditions  
7 at the CNC, arsenic is not considered a COC in groundwater at AOC 687/SWMU 16.

### 8 **9.3.3.2 Chromium in Groundwater**

9 Chromium was detected in 8 of 24 samples of shallow groundwater at concentrations  
10 ranging from 1.5 to 26.1  $\mu\text{g/L}$  (see Table 9-11). None of these samples exceeded the MCL of  
11 100  $\mu\text{g/L}$ . For these reasons, chromium is not considered a COC in groundwater at AOC  
12 687/SWMU 16.

### 13 **9.3.3.3 Methylene Chloride in Groundwater**

14 The RFI identified methylene chloride in groundwater as a COC in the RFI report.  
15 Methylene chloride was detected in 2 of 22 shallow groundwater samples at concentrations  
16 of 15  $\mu\text{g/L}$  (I687GW002) and 2J  $\mu\text{g/L}$  (I687GW003) (see Table 9-12). There is no MCL for  
17 methylene chloride, but one of the detected values was slightly above the EPA Region III  
18 tap water RBC of 4.1  $\mu\text{g/L}$ . Both detections were single occurrences, which were not  
19 detected in the subsequent three sampling events. In addition, methylene chloride is a  
20 common laboratory contaminant and is not known to be associated with past site activities.  
21 Based on these factors, methylene chloride is not considered a COC for AOC 687 and  
22 SMWU 16.

### 23 **9.3.3.4 Thallium in Groundwater**

24 Thallium was detected in 2 of 24 samples of shallow groundwater samples collected during  
25 the RFI at concentrations of 2.7J and 5.2J  $\mu\text{g/L}$  (see Table 9-13). These two exceedances came  
26 from separate wells in samples collected during the fourth sampling event. However, in  
27 three post-RFI sampling events, thallium was not detected in either well. Both detections  
28 exceeded the MCL of 2  $\mu\text{g/L}$ ; there is no established background range for thallium in Zone  
29 I. However, the observed concentrations of thallium in shallow groundwater at this site are  
30 consistent with the occurrences of thallium observed in Zone I grid wells. Thallium was  
31 detected intermittently in shallow grid wells at concentrations ranging from 3J  $\mu\text{g/L}$  to  
32 7.5J  $\mu\text{g/L}$  (see Appendix A-1). Given that the concentrations of thallium in shallow  
33 groundwater are consistent with grid well background conditions in Zone I and that the

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values presented in this CMS Work Plan were calculated using the methodology identified by the BCT.

1 occurrences were not duplicated in subsequent sampling events, thallium is not considered  
2 a COC in groundwater at AOC 687/SWMU 16.

### 3 **9.3.4 COPC/COC Refinement Summary**

4 There are no COCs requiring further action in surface soils, sediment subsurface soils or  
5 groundwater at AOC 687/SWMU 16. This site is recommended for NFA.

## 6 **9.4 Summary of Information Related to Site Closeout Issues**

### 7 **9.4.1 RFI Status**

8 The RFI report, as amended by the RFI Report Addendum, is complete.

### 9 **9.4.2 Presence of Inorganics in Groundwater**

10 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
11 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
12 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
13 followed by detection of these same metals below the MCL or below the practicable  
14 quantitation limit. Per the discussion presented in Section 9.3, there are no inorganics that  
15 have been identified as COCs at this site.

### 16 **9.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

17 Data indicate that AOC 687/SWMU 16 were never connected to the sanitary sewer system.  
18 Therefore, there are no concerns regarding connections to the sanitary sewer. Further  
19 evaluation of this issue is not warranted.

### 20 **9.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

21 No direct connections of AOC 687/SWMU 16 to the storm sewer are known to exist. No  
22 COCs requiring further evaluation are present at the site. Further evaluation of this issue is  
23 not warranted.

### 24 **9.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

25 The area associated with AOC 687/SWMU 16 is located approximately 3,700 feet east of the  
26 nearest railroad line. There is no known linkage between AOC 687/SWMU 16 and the  
27 investigated railroad lines of AOC 504, and further evaluation of this issue is not warranted.

### 28 **9.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

29 The nearest surface water body to AOC 687/SWMU 16 is the Cooper River, which lies  
30 approximately 90 feet east of the unit. The only potential migration pathway from the site to

1 surface water is via overland flow via stormwater runoff. Since no COCs were identified at  
2 the site, further evaluation of a potential pathway for contaminant migration via  
3 stormwater runoff is not warranted.

#### 4 **9.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

5 There are no known OWSs associated with AOC 687/SWMU 16. Therefore, there are no  
6 concerns regarding connections to the sanitary sewer. Further evaluation of this issue is not  
7 warranted. In addition, there is no reference to an OWS at this facility in the *Oil Water*  
8 *Separator Data* report (Department of the Navy, September 2000).

#### 9 **9.4.8 Land Use Control Management Plan**

10 The COC refinement did not identify any COCs at AOC 687/SWMU 16. This evaluation  
11 was based on a unrestricted land use classification. Therefore, land use controls are not  
12 necessary.

### 13 **9.5 CH2M-Jones Recommendations**

14 Evaluation of the primary media of concern (surface soils, sediments, subsurface soils, and  
15 groundwater) indicated that there were no issues associated with the historical operation of,  
16 or releases from, this unit. Based on a review of COPCs/COCs in Section 9.3, no COCs were  
17 identified in any investigated media.

18 The RFI report concluded that CMS were necessary for surface soil and shallow  
19 groundwater. However, CH2M-Jones has re-evaluated the risks posed by the identified  
20 COCs and determined that no COCs exist at AOC 687/SWMU 16. Therefore, these sites are  
21 recommended for NFA.

1

**TABLE 9-1**  
**RFI Soil Sampling Summary**  
*CMS Work Plan, AOC 687/SWMU 16, Zone I, Charleston Naval Complex*

<b>Sampling Event</b>	<b>Sampling Date</b>	<b>Samples Collected</b>	<b>Sample Analyses</b>	<b>Comments</b>
1	03/30/95 03/31/95	Upper - 4 (11)	Standard Suite, Organotins, Physical Parameters	
		Lower - 2 (11)	Standard Suite, Organotins	
		Duplicate - 1	Standard Suite, Organotins	

**Notes:**

( ) = Parentheses indicate number of samples proposed.

Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.

Physical parameters analysis included CEC, chloride, sulfur, ammonia, nitrate/nitrite, phosphorus, TOC and total moisture.

2

1

**TABLE 9-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOC 687/SWMU 16, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Wells Sampled	Sample Analyses	Comments
1	06/08/95	687001	Standard suite, organotins, chloride, TDS, sulfate	Organotins were collected for site characterization.
	06/09/95	687002		
2	01/16/96	687003	Cyanide, metals	
		687004		
	01/17/96	687001	Cyanide, metals, chloride, sulfate, TDS	
		687002		
3	06/04/96	687003		Cyanide, metals
		687004		
	06/05/96	687001	Cyanide, metals, chloride, sulfate, TDS	
		687002		
4	09/10/96	687003		Chloride, cyanide, sulfate, metals, pesticides, PCBs, VOCs, TDS
		687004		
	09/11/96	687001	Metals, VOCs	
		687002		
5	04/14/98	687003		Metals, VOCs, SVOCs
		687004		
	08/18/98	687001		
		687002		
		687003		
		687004		

2  
 3  
 4  
 5

**Note:**  
 Standard suite = VOCs, SVOCs, metals, cyanide, pesticides and PCBs at DQO Level III.

1

**TABLE 9-3**  
 RFI Sediment Sampling Summary  
 CMS Work Plan, AOC 687/SWMU 16, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	06/22/95	2 (2)	Standard suite, TOC, grain size, organotins	
		Duplicate - 1	Appendix IX, TOC, grain size	

2  
 3  
 4  
 5

**Notes:**  
 ( ) = Parentheses indicate number of samples proposed.  
 Standard suite = VOCs, SVOCs, metals, cyanide, pesticides and PCBs at DQO Level III.

**TABLE 9-4**  
 VOCs in Surface Soils  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone Result (mg/kg)	Qualifier	Methylene Chloride Result (mg/kg)	Qualifier
			<b>IND RBC</b>	20,000	760.0000	
			<b>RES RBC</b>	780.0000	85.0000	
			<b>SSL</b>	0.8000	0.0010	
			<b>SS BKGD</b>	NA	NA	
I687SB001	687SB00101a	03/30/95	0.1100	U	<b>0.0280</b>	J
I687SB002	687SB00201a	03/30/95	0.1100	U	0.0240	UJ
I687SB003	687SB00301b	03/30/95	0.0070	J	0.0220	U
I687SB004	687SB00401a	03/30/95	0.0080	J	0.0270	U

NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

**TABLE 9-5**  
 BEQs in Surface Soils  
 CMS Work Plan, AOC 687w, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ	Qualifier
			Result ( $\mu\text{g}/\text{kg}$ )	
		<b>Bkgd</b>	<b>1,304</b>	
I687SB001	687SB00101a	03/30/1995	760	U
I687SB002	687SB00201a	03/30/1995	767	U
I687SB003	687SB00301b	03/30/1995	719	U
I687SB004	687SB00401a	03/30/1995	881	U
IGDISB008	GDISB00801	02/16/1995	924	=

= Chemical is detected at concentration shown.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 $\mu\text{g}/\text{kg}$  Micrograms per kilograms

**TABLE 9-6**  
 Chromium in Surface Soils  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Chromium, Total Result (mg/kg)	Qualifier
			<b>IND RBC</b>	310,000
			<b>RES RBC</b>	12,000
			<b>SSL</b>	19
			<b>SS BKGD</b>	54
I687SB001	687SB00101a	03/30/95	25.2000	=
I687SB002	687SB00201a	03/30/95	33.5000	=
I687SB003	687SB00301b	03/30/95	9.1000	=
I687SB004	687SB00401a	03/30/95	40.0000	=

= Chemical is detected at concentration shown.  
 mg/kg Milligrams per kilogram

**TABLE 9-7**  
 BEQs in Sediments  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Parameter	Units	Sample Station	687M001		687M00201	
		ID	687M00101		687M00101	
		Date	06/22/95		06/22/95	
Benzo(a)Anthracene	µg/kg		770	U	550	J
Chrysene	µg/kg		630	U	1,500	=
Benzo(b)Fluoranthene	µg/kg		900	U	2,100	J
Benzo(k)Fluoranthene	µg/kg		730	U	2,300	J
Benzo(a)Pyrene	µg/kg		770	U	670	J
Indeno(1,2,3-c,d)pyrene	µg/kg		540	U	530	J
Dibenz(a,h)anthracene	µg/kg		500	U	120	J
<b>BEQs</b>	<b>TEQ</b>					
Benzo(a)Anthracene	0.10		38.5	U	55	J
Chrysene	0.001		0.315	U	1.5	=
Benzo(b)Fluoranthene	0.10		45	U	210	J
Benzo(k)Fluoranthene	0.01		3.65	U	23	J
Benzo(a)Pyrene	1		385	U	670	J
Indeno(1,2,3-c,d)pyrene	0.10		27	U	53	J
Dibenz(a,h)anthracene	1		250	U	120	J
<b>BEQs</b>			<b>749.5</b>	<b>U</b>	<b>1,132.5</b>	

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 µg/kg Micrograms per kilograms  
 BEQ Benzo(a)pyrene Equivients  
 TEQ Technical Equivients

**TABLE 9-8**  
 Chlordane in Sediments  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Chlordane Result (mg/kg)	Qualifier
			IND RBC	16
			RES RBC	1.8
			SSL	5
			SS BKGD	NA
1687M0001	687M000101	06/22/1995	0.00230	U
1687M0002	687M000201	06/22/1995	5.20000	J

NA not applicable

J Chemical is detected at concentration below the method detection limit; the concentration is not known.

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).

mg/kg Milligrams per kilogram

**TABLE 9-9**  
 VOCs in Subsurface Soils  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date	SSL	Acetone Result (mg/kg)	Qualifier
			SS BKGD	0.8000	
I687SB001	687SB00102a	03/30/95		0.0430	U
I687SB003	687SB00302a	03/30/95		0.0220	J

NA not applicable  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 mg/kg Milligrams per kilogram

**TABLE 9-10**  
 Arsenic, Iron, and Manganese in Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Arsenic Result (µg/L)	Qualifier	Iron Result (µg/L)	Qualifier	Manganese Result (µg/L)	Qualifier
			<b>MCL</b>	50.0000		300.0000		50.0000	
			<b>RBC</b>	0.0450		1100.0000		73.0000	
			<b>Shallow</b>	66		31,900		4,850	
			<b>Deep</b>	25		12,200		690	
<b>Shallow Groundwater</b>									
1687GW001	687GW00101b	06/08/95		38.6000	=	3720.0000	=	1330.0000	=
	687GW00102	01/16/96		5.0000	U	879.0000	=	3290.0000	=
	687GW00103	06/04/96		5.0000	U	20.0000	U	5.0000	U
	687GW00104	09/10/96		2.5000	U	112.0000	U	43.5000	=
	687GW00105	04/14/98		3.3000	U	542.0000	=	1270.0000	=
	687GW00106	08/18/98		3.3000	J	795.0000	=	735.0000	=
	687GW00107	05/25/99		3.3000	U	NA		NA	
1687GW002	687GW00201a	06/08/95		33.2000	=	4420.0000	=	165.0000	=
	687GW00202	01/16/96		73.7000	=	8570.0000	=	327.0000	=
	687GW00203	06/04/96		5.0000	U	20.0000	U	8.9000	U
	687GW00204	09/10/96		39.3000	=	3950.0000	=	115.0000	=
	687GW00205	04/14/98		131.0000	=	13700.0000	=	326.0000	=
	687GW00206	08/18/98		58.3000	=	4420.0000	=	223.0000	=
	687GW00207	05/25/99		26.7000	J	NA		NA	
1687GW003	687GW00301	06/08/95		3.2000	U	2480.0000	=	404.0000	=
	687GW00302	01/17/96		5.0000	U	3690.0000	=	796.0000	=
	687GW00303	06/05/96		5.6000	J	3490.0000	J	1750.0000	J

**TABLE 9-10**  
 Arsenic, Iron, and Manganese in Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Arsenic Result (µg/L)	Qualifier	Iron Result (µg/L)	Qualifier	Manganese Result (µg/L)	Qualifier
			<b>MCL</b>	50.0000		300.0000		50.0000	
			<b>RBC</b>	0.0450		1100.0000		73.0000	
			<b>Shallow</b>	66		31,900		4,850	
			<b>Deep</b>	25		12,200		690	
	687GW00304	09/11/96		4.6000	U	1180.0000	=	134.0000	=
	687GW00305	04/14/98		4.1000	J	1790.0000	=	280.0000	=
	687GW00306	08/18/98		4.3000	J	2190.0000	=	404.0000	=
	687GW00307	05/25/99		3.3000	U	NA		NA	
I687GW004	687GW00401	06/08/95		6.3000	J	2950.0000	=	1040.0000	=
	687GW00402	01/17/96		5.0000	U	2210.0000	=	2240.0000	=
	687GW00403	06/05/96		5.0000	U	1740.0000	J	215.0000	J
	687GW00404	09/11/96		2.5000	U	211.0000	=	85.8000	=
	687GW00405	04/14/98		8.2000	J	7300.0000	=	2220.0000	=
	687GW00406	08/18/98		3.3000	J	2310.0000	=	2820.0000	=
IGDIGW008	GDIGW00801a	05/02/95		3.2000	U	6630.0000	J	1630.0000	=
	GDIGW00802	12/12/95		5.0000	U	7220.0000	=	1720.0000	J
	GDIGW00803	05/22/96		5.0000	U	4730.0000	=	1670.0000	=
	GDIGW00804	08/22/96		2.5000	U	379.0000	=	917.0000	=
	GDIGW00805	04/14/98		9.0000	J	5310.0000	=	2550.0000	=
	GDIGW00806	08/20/98		6.5000	J	1010.0000	=	1480.0000	=
	GDIGW00807	05/24/99		3.4000	J	NA		NA	

**TABLE 9-10**  
 Arsenic, Iron, and Manganese in Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Arsenic Result (µg/L)	Qualifier	Iron Result (µg/L)	Qualifier	Manganese Result (µg/L)	Qualifier
			<b>MCL</b>	50.0000		300.0000		50.0000	
			<b>RBC</b>	0.0450		1100.0000		73.0000	
			<b>Shallow</b>	66		31,900		4,850	
			<b>Deep</b>	25		12,200		690	
<b>Deep Groundwater</b>									
IGDIGW08D	GDIGW08D01	05/25/95		3.2000	U	63.1000	U	65.6000	J
	GDIGW08D02	12/12/95		5.0000	U	20.0000	U	11.8000	J
	GDIGW08D03	05/22/96		5.0000	U	20.0000	U	3.3000	J
	GDIGW08D04	08/22/96		3.4000	U	32.0000	UJ	0.9900	J
	GDIGW08D05	04/14/98		3.3000	U	31.0000	U	9.2000	U
	GDIGW08D06	08/20/98		0.9000	U	11.6000	U	24.7000	=
	GDIGW08D07	05/24/99		3.3000	U	NA		NA	

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 µg/L Micrograms per liter  
 NA Not analyzed

**TABLE 9-11**  
 Chromium in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Chromium, Total		Qualifier
			MCL	Result (µg/L)	
			MCL	100	
			RBC	5,500	
			Shallow	24	
			Deep	50	
<b>Shallow Groundwater</b>					
I687GW001	687GW00101b	06/08/95		0.9000	U
	687GW00102	01/16/96		1.0000	U
	687GW00103	06/04/96		1.0000	U
	687GW00104	09/10/96		2.2000	UJ
	687GW00105	04/14/98		0.7000	U
	687GW00106	08/18/98		20.9000	=
I687GW002	687GW00201a	06/08/95		2.1000	J
	687GW00202	01/16/96		1.0000	U
	687GW00203	06/04/96		1.0000	U
	687GW00204	09/10/96		1.3000	UJ
	687GW00205	04/14/98		1.7000	U
	687GW00206	08/18/98		12.7000	=
I687GW003	687GW00301	06/08/95		4.6000	J
	687GW00302	01/17/96		1.0000	U
	687GW00303	06/05/96		1.7000	J
	687GW00304	09/11/96		0.8700	UJ
	687GW00305	04/14/98		2.4000	U

**TABLE 9-11**  
 Chromium in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Chromium, Total		Qualifier
			MCL	Result (µg/L)	
			MCL	100	
			RBC	5,500	
			Shallow	24	
			Deep	50	
	687GW00306	08/18/98		20.7000	=
I687GW004	687GW00401	06/08/95		1.5000	J
	687GW00402	01/17/96		1.0000	U
	687GW00403	06/05/96		1.0000	U
	687GW00404	09/11/96		0.8700	UJ
	687GW00405	04/14/98		1.3000	U
	687GW00406	08/18/98		26.1000	=
IGDIGW008	GDIGW00801a	05/02/95		3.7000	J
	GDIGW00802	12/12/95		1.0000	U
	GDIGW00803	05/22/96		1.0000	U
	GDIGW00804	08/22/96		0.8000	U
	GDIGW00805	04/14/98		1.7000	U
	GDIGW00806	08/20/98		22.7000	=
<b>Deep Groundwater</b>					
IGDIGW08D	GDIGW08D01	05/25/95		1.6000	J
	GDIGW08D02	12/12/95		1.0000	U
	GDIGW08D03	05/22/96		1.0000	U
	GDIGW08D04	08/22/96		0.8000	U

**TABLE 9-11**  
 Chromium in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Chromium, Total Result ( $\mu\text{g/L}$ )	Qualifier
			<b>MCL</b>	100	
			<b>RBC</b>	5,500	
			<b>Shallow</b>	24	
			<b>Deep</b>	50	
	GDIGW08D05	04/14/98		4.0000	U
	GDIGW08D06	08/20/98		6.4000	U

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 $\mu\text{g/L}$  Micrograms per liter

**TABLE 9-12**  
 Thallium in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Thallium Result ( $\mu\text{g/L}$ )		Qualifier
			MCL	RBC	
			MCL	2.0000	
			RBC	0.2600	
			Shallow	7.5	
			Deep	15	
<b>Shallow Groundwater</b>					
I687GW001	687GW00101b	06/08/95		4.5000	U
	687GW00102	01/16/96		5.0000	U
	687GW00103	06/04/96		5.0000	U
	687GW00104	09/10/96		5.2000	J
	687GW00105	04/14/98		5.5000	UJ
	687GW00106	08/18/98		1.8000	UJ
	687GW00107	05/25/99		2.3000	U
I687GW002	687GW00201a	06/08/95		4.5000	U
	687GW00202	01/16/96		5.0000	U
	687GW00203	06/04/96		5.0000	U
	687GW00204	09/10/96		2.7000	J
	687GW00205	04/14/98		5.5000	UJ
	687GW00206	08/18/98		1.8000	UJ
	687GW00207	05/25/99		2.3000	U
I687GW003	687GW00301	06/08/95		4.5000	U
	687GW00302	01/17/96		5.0000	U
	687GW00303	06/05/96		5.0000	U

**TABLE 9-12**  
 Thallium in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

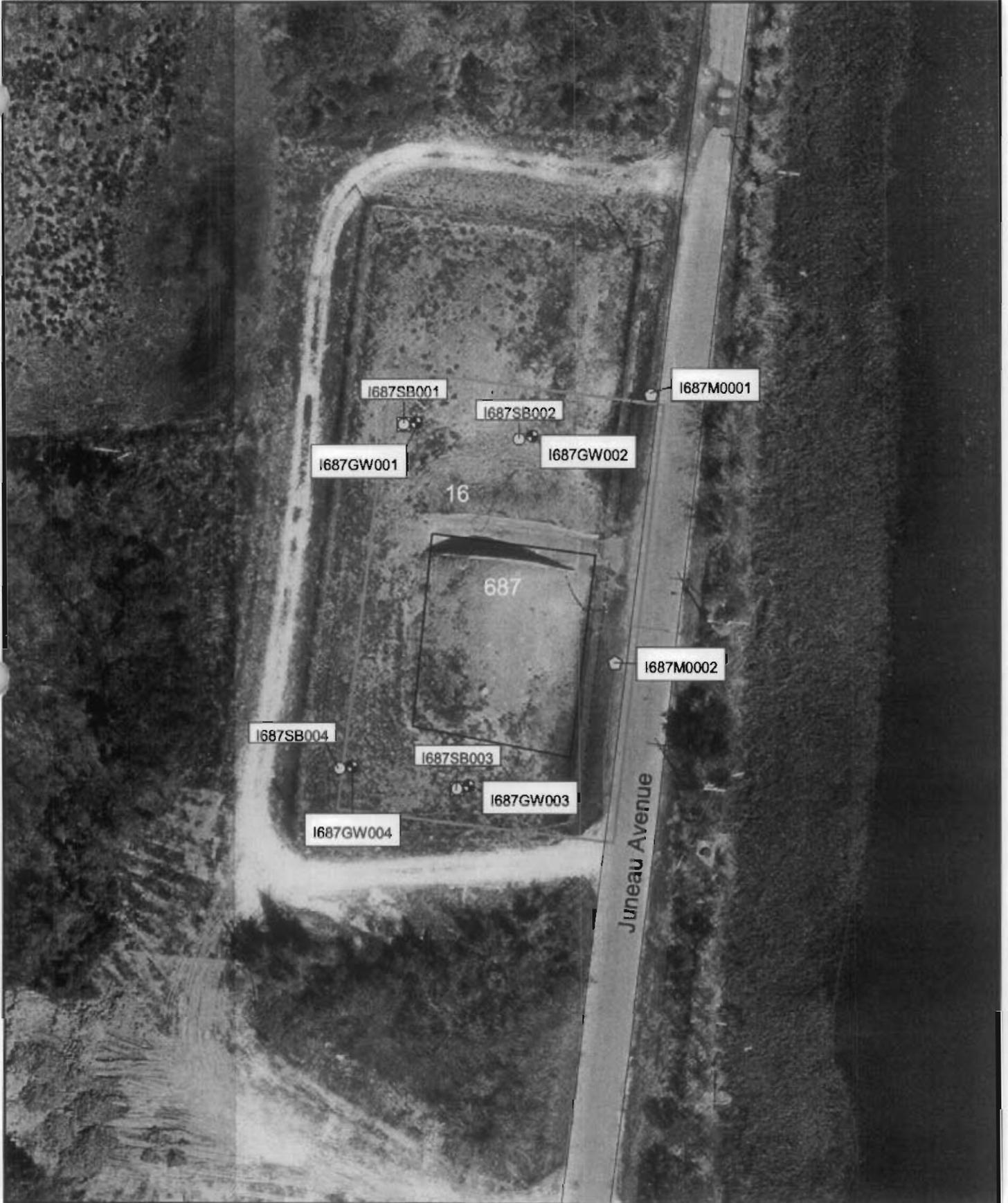
Sample Station	ID	Date	Thallium Result ( $\mu\text{g/L}$ )		Qualifier
			MCL	RBC	
			MCL	2.0000	
			RBC	0.2600	
			Shallow	7.5	
			Deep	15	
I687GW004	687GW00304	09/11/96		2.7000	UJ
	687GW00305	04/14/98		5.5000	UJ
	687GW00306	08/18/98		1.8000	UJ
	687GW00307	05/25/99		2.3000	U
	687GW00401	06/08/95		4.5000	U
	687GW00402	01/17/96		5.0000	U
	687GW00403	06/05/96		5.0000	U
	687GW00404	09/11/96		2.7000	UJ
	687GW00405	04/14/98		5.5000	UJ
	687GW00406	08/18/98		1.8000	UJ
IGDIGW008	687GW00407	05/25/99		2.3000	U
	GDIGW00801a	05/02/95		4.5000	U
	GDIGW00802	12/12/95		5.0000	U
	GDIGW00803	05/22/96		5.0000	U
	GDIGW00804	08/22/96		2.7000	UJ
	GDIGW00805	04/14/98		5.5000	UJ
	GDIGW00806	08/20/98		1.8000	UJ
	GDIGW00807	05/24/99		2.3000	U

**TABLE 9-12**  
 Thallium in Shallow and Deep Groundwater  
 CMS Work Plan, AOC 687 and SWMU 16, Zone I, Charleston Naval Complex

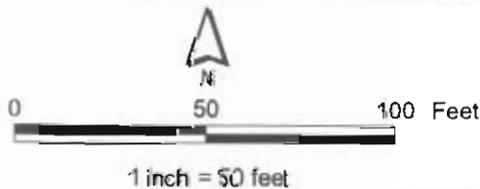
Sample Station	ID	Date	Thallium Result ( $\mu\text{g/L}$ )	Qualifier
		<b>MCL</b>	2.0000	
		<b>RBC</b>	0.2600	
		<b>Shallow</b>	7.5	
		<b>Deep</b>	15	
<b>Deep Groundwater</b>				
IGDIGW08D	GDIGW08D01	05/25/95	4.5000	U
	GDIGW08D02	12/12/95	5.5000	J
	GDIGW08D03	05/22/96	5.0000	UJ
	GDIGW08D04	08/22/96	2.7000	UJ
	GDIGW08D05	04/14/98	5.5000	UJ
	GDIGW08D06	08/20/98	9.0000	UJ
	GDIGW08D07	05/24/99	2.3000	U

J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 $\mu\text{g/L}$  Micrograms per liter

NOTE: Aerial Photo Date is 1997

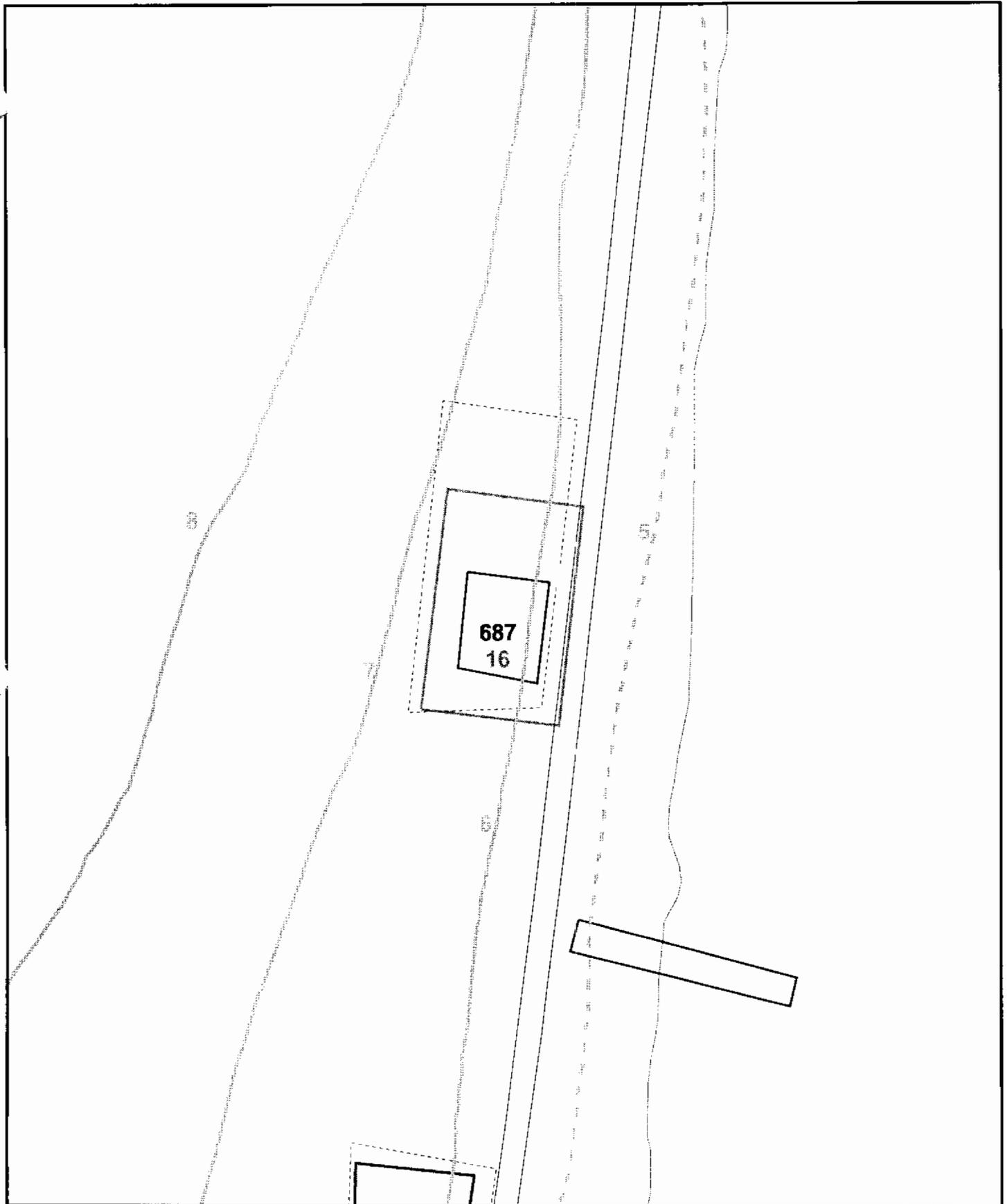


- Surface Soil Sample
- Subsurface Soil Sample
- ⊕ Groundwater Sample
- ⊙ Sediment Sample
- Roads
- ~ Shoreline
- ▭ AOC Boundary
- ▭ SWMU Boundary

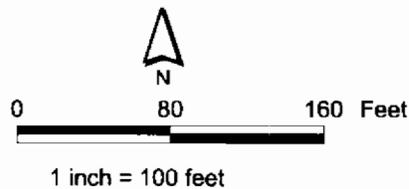


**Figure 9-1**  
Sample and Test Location Map  
AOC 687 and SWMU 16  
Zone I  
Charleston Naval Complex

**CH2MHILL**



- Inferred Groundwater Elevations (ft msl)
  - Known Groundwater Elevations (ft msl)
  - Fence
  - Railroads
  - Roads
  - Shoreline
  - AOC Boundary
  - SWMU Boundary
  - Buildings
  - Zone Boundary
- ft msl - feet above mean sea level



**Figure 9-2**  
 Shallow Groundwater Contour Map  
 AOC 687 and SWMU 16, Zone I  
 Charleston Naval Complex



## 1 **10.0 CMS Work Plan for AOC 688**

2 This section summarizes the results and conclusions from the soil and groundwater  
3 investigations conducted in the area of AOC 688, which were reported in the *Zone I RFI*  
4 *Report, Revision 0* (EnSafe, 1999), Section 10.9, and as amended by the *Zone I RFI Report*  
5 *Addendum, Revision 1* (CH2M-Jones, 2001). Figure 10-1 presents the site features and RFI  
6 sample locations.

7 As part of the Zone I RFI, surface soil, subsurface soil and groundwater investigations were  
8 conducted at AOC 688 in April 1998. The RFI report presented the results of the  
9 investigations and conclusions concerning contamination and risk, as summarized in  
10 Sections 10.1 and 10.2 of this CMS Work Plan. A further evaluation of COCs is provided in  
11 Section 10.3 of this work plan.

### 12 **10.1 Background**

13 AOC 688 consists of Building X-56, an earth-covered ammunition magazine. This unit is  
14 similar to Building X-55. The bunker is a 29 x 52 x 12-foot unit, constructed of thick concrete  
15 and covered with dirt. A 50 x 80-foot chainlink fence surrounds the magazine. A concrete and  
16 earthen containment bunker lies 10 feet north of the explosives storage area to contain the  
17 metal doors in the event of an explosion. The magazine was constructed in 1942, and has been  
18 used for ammunition storage, flammable materials storage, and temporary paint storage. In  
19 the past, this magazine stored nitrogen-based dynamite and as much as 1,000 pounds of black  
20 powder. In 1987, 3,420 gallons of paint were stored at this facility. The DMA lies to the west of  
21 this unit, and the Cooper River is to the east.

22 The area is zoned for industrial use (M-1).

### 23 **10.2 RFI Investigation Results**

#### 24 **10.2.1 Soil Investigation Results**

25 As part of the RFI field investigation, three surface soil samples (two normal samples and  
26 one grid sample) and two collocated subsurface soil samples were collected (see Figure 10-1  
27 and Table 10-1) and analyzed for VOCs, SVOCs, pesticides/PCBs, metals, organotins and  
28 cyanide (see Figure 10-1 and Table 10-1). The grid sample was collected in February 1995  
29 and the two normal samples were collected in April 1998. As a result of the screening

1 process and subsequent risk assessment, no surface soil or subsurface soil constituents were  
2 identified as COCs under the unrestricted land use scenario.

### 3 **10.2.2 Groundwater**

4 Groundwater patterns in the vicinity of AOC 687 show flow eastward, toward the Cooper  
5 River (see Figure 10-2).

6 One deep and one shallow grid-based well pair (IGDIGW07D and IGDIGW007,  
7 respectively) were sampled for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorides,  
8 sulfates, and TDS in multiple sampling events (see Figure 10-1 and Table 10-2). One  
9 duplicate sample was collected from IGDIGW07D during the sixth sampling event.

10 Constituents detected in the groundwater samples were evaluated relative to MCLs, tap  
11 water RBCs, and Zone I groundwater BRCs.

12 The following sections present the findings presented in the RFI report.

#### 13 **10.2.2.1 Shallow Groundwater**

14 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
15 result of the screening process and subsequent risk assessment, the following constituent  
16 was identified as a COC for shallow groundwater:

- 17 • Lead (15.7 µg/L) exceeded its tap water RBC, MCL, and shallow groundwater BRC.

#### 18 **10.2.2.2 Deep Groundwater**

19 Analytes detected in deep groundwater samples were evaluated in the RFI Report. As a  
20 result of the screening process and subsequent risk assessment, no constituents were  
21 identified as COCs for deep groundwater.

### 22 **10.2.3 Sediments**

23 Two sediment samples were collected in July 1995 at AOC 688 (see Figure 10-1 and  
24 Table 10-3) and analyzed for VOCs, SVOCs, pesticides/PCBs, organo-phosphorus  
25 pesticides and cyanide. These samples were located in a grassy stormwater swale that runs  
26 parallel to the western side of Juneau Avenue. The RFI report combined soils and sediments  
27 together for the risk assessment. Although undifferentiated, no COCs were identified for  
28 sediments or soils in the RFI report.

1 **10.2.4 RFI Risk Summary**

2 No COCs were identified in any media for the unrestricted land use scenario or the  
3 industrial land use scenario<sup>10</sup>.

4 **10.2.5 Recommendations from Zone I RFI Report, Revision 0**

5 **10.2.4.1 Soils**

6 NFA was recommended in the RFI for soil.

7 **10.2.4.2 Groundwater**

8 NFA was recommended in the RFI report for shallow groundwater.

9 **10.3 COPC/COC Refinement**

10 No COCs were identified in any media at the site for the unrestricted land use scenario or  
11 the industrial land use scenario. Therefore, no COCs are discussed in this section. The  
12 rescreening of VOCs in soil using an SSL based on a DAF=1, however, is presented in this  
13 section.

14 **10.3.1 Surface Soil**

15 **10.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

16 No VOCs were present for rescreening using an SSL with a DAF of 1 for this site.

17 **10.3.2 Subsurface Soils**

18 No subsurface soil COCs were identified in the RFI report.

19 **10.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

20 No VOCs were present for rescreening using an SSL with a DAF of 1 for this site.

21 **10.3.3 Groundwater**

22 The discussion on the analysis of the grid wells was presented in Section 10.14 of the RFI  
23 report. In this section, lead in shallow groundwater was identified as a COC. However, the  
24 maximum detected concentration of lead in the shallow grid well IGDIGW007 was

---

<sup>10</sup> The Zone I RFI concluded that the data did not indicate any significant levels of risk associated with AOC 688.

As part of the evaluation of AOC 688 in the RFI report, grid well pair IGDIGW007/IGDIGW007D was substituted for a site-specific well pair that was to be installed as part of the RFI. Therefore, the RFI report concluded, based on the site-specific data, that there were no COCs.

1 15.7 µg/L, which occurred in the first of seven sampling events (Table 10-3). This was the  
2 only exceedance of the MCL. Of the six subsequent sampling events, detectable levels of  
3 lead were observed in only the second sampling event and the remainder had non-  
4 detectable levels. For these reasons, lead in groundwater is not considered a COC for AOC  
5 688.

#### 6 **10.3.4 COPC/COC Refinement Summary**

7 There are no COCs requiring further action in surface soils, subsurface soils or groundwater  
8 at AOC 688. This site is recommended for NFA.

### 9 **10.4 Summary of Information Related to Site Closeout Issues**

#### 10 **10.4.1 RFI Status**

11 The RFI report, as amended by the RFI Report Addendum, is complete.

#### 12 **10.4.2 Presence of Inorganics in Groundwater**

13 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
14 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
15 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
16 followed by detection of these same metals below the MCL or below the practicable  
17 quantitation limit. No groundwater samples exceeded the MCL for arsenic, thallium, or  
18 antimony. Further evaluation of this issue is not warranted.

#### 19 **10.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

20 Data indicate that AOC 688 was never connected to the sanitary sewer system. Therefore,  
21 there are no concerns regarding connections to the sanitary sewer. Further evaluation of this  
22 issue is not warranted.

#### 23 **10.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

24 No direct connection of AOC 688 to the storm sewer is known to exist. No COCs requiring  
25 further evaluation are present at the site. Further evaluation of this issue is not warranted.

---

However, a separate evaluation of the data from grid well pair IGDIGW007/ IGDIGW007D was presented in Section 10.14 of the RFI report. In this section, the findings of the RFI included the identification of lead in grid well IGDIGW007 as a COC. This CMS Work Plan considers the findings relative to grid well IGDIGW007 in the following subsections.

1 **10.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

2 The area associated with AOC 688 is located approximately 3,600 feet from the closest  
3 railroad line. There is no known linkage between AOC 688 and the investigated railroad  
4 lines of AOC 504, and further evaluation of this issue is not warranted.

5 **10.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

6 The nearest surface water body to AOC 688 is the Cooper River, which lies approximately  
7 120 feet east of the unit. The only potential migration pathway from the site to surface water  
8 is via overland flow via stormwater runoff. Since no COCs were identified at the site,  
9 further evaluation of a potential pathway for contaminant migration via stormwater runoff  
10 is not warranted.

11 **10.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

12 There are no known OWSs associated with AOC 688. Therefore, there are no concerns  
13 regarding connections to the sanitary sewer, and further evaluation of this issue is not  
14 warranted. In addition, there is no reference to an OWS at this facility in the *Oil Water*  
15 *Separator Data* report (Department of the Navy, September 2000).

16 **10.4.8 Land Use Control Management Plan**

17 The COC refinement did not identify any COCs at AOC 688. This evaluation was based on  
18 a unrestricted land use classification. Therefore, land use controls are not necessary.

19 **10.5 CH2M-Jones Recommendations**

20 Evaluation of the primary media of concern (surface soils, subsurface soils, sediment, and  
21 groundwater) indicated that there were no issues associated with the historical operation of,  
22 or releases from, this unit. Based on a review of COPCs/COCs in Section 10.3, no COCs  
23 were identified in any investigated media.

24 The RFI report concluded that no further investigation (NFI) was necessary. A  
25 recommendation, based on current site conditions, was also made for NFA for AOC 688;  
26 evaluation of COPCs by CH2M-Jones confirmed this assessment. Therefore, this site is  
27 recommended for NFA.

1

**TABLE 10-1**  
 RFI Soil Sampling Summary  
*CMS Work Plan, AOC 688, Zone I, Charleston Naval Complex*

<b>Sampling Event</b>	<b>Sampling Date</b>	<b>Samples Collected</b>	<b>Sample Analyses</b>	<b>Comments</b>
1	04/02/98	Upper - 2 (0) Lower - 2 (0)	Metals, Pesticides and PCBs Metals, Pesticides and PCBs	Not part of the work plan

2

3

4

**Note:**  
 ( ) = Parentheses indicate number of samples proposed.

1

**TABLE 10-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOC 688, Zone I, Charleston Naval Complex

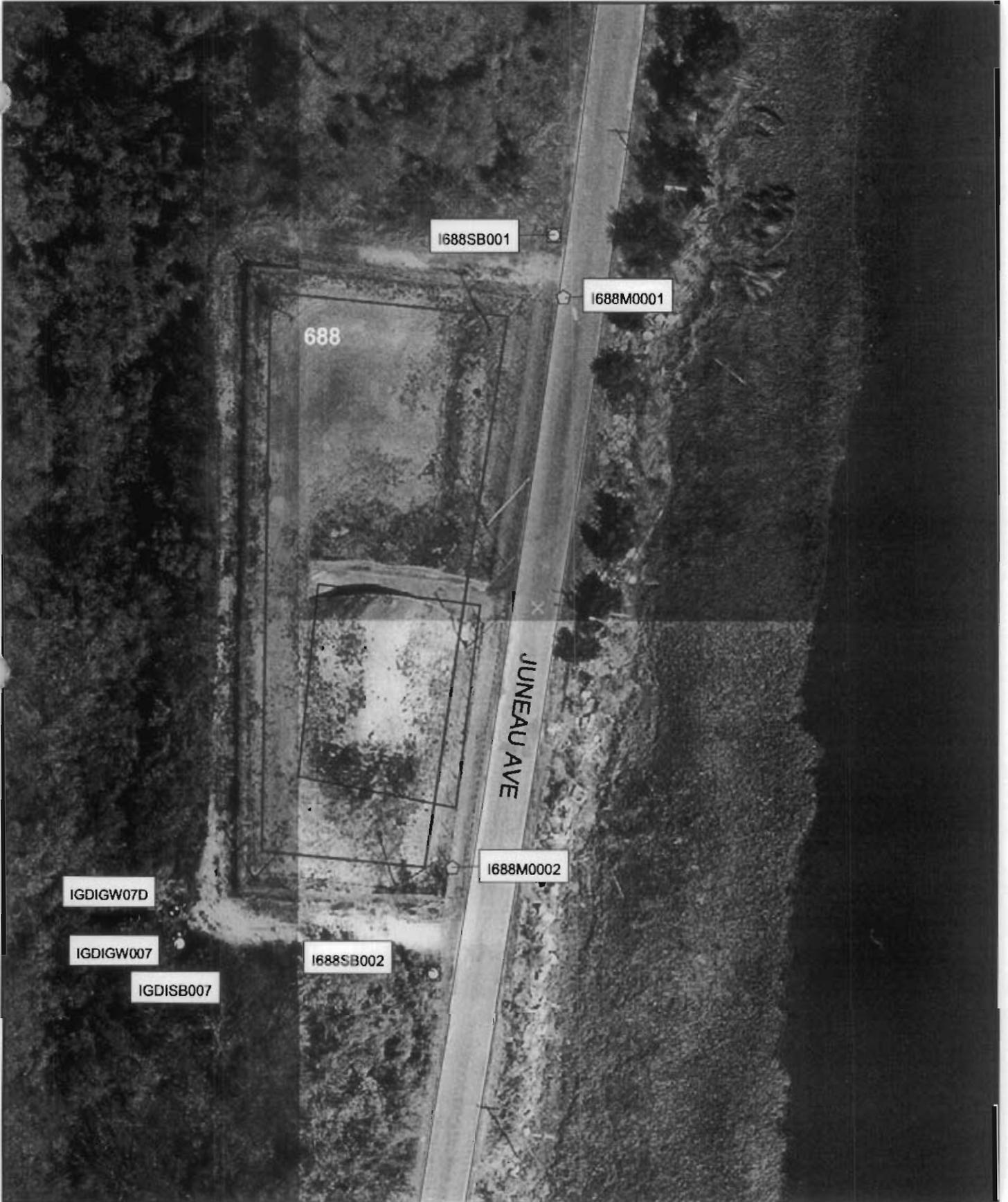
Sampling Event	Sampling Date	Wells Sampled	Sample Analyses	Comments
1	05/02/95	IGDIGW007/ IGDIGW007D	Standard Suite, Organotins, TDS, Sulfates, Chloride, Dioxins	
2	12/11/95	IGDIGW007/ IGDIGW007D	Standard Suite, TDS, Sulfates, Chloride	
3	5/31/96	IGDIGW007/ IGDIGW007D	Standard Suite, TDS, Sulfates, Chloride	
4	8/26/96	IGDIGW007/ IGDIGW007D	Standard Suite, TDS, Sulfates, Chloride	
5	04/14/98	IGDIGW007/ IGDIGW007D	SVOCs, Metals	
6	08/19/98	IGDIGW007/ IGDIGW007D	SVOCs, Metals	

2 Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.

**TABLE 10-3**  
 Lead in Groundwater  
 CMS Work Plan, AOC 688, Zone I, Charleston Naval Complex

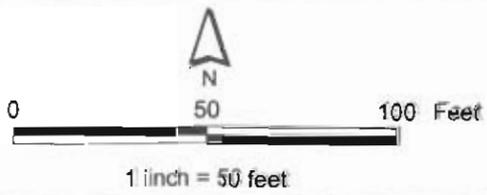
Station	Sample ID	Date	Result ( $\mu\text{g/L}$ )	Qualifier
			<b>MCL</b>	15.00000
			<b>RBC</b>	
			<b>Shallow</b>	4.40000
<b>Shallow Groundwater</b>				
IGDIGW007	GDIGW00701	05/01/1995	12.70000	=
IGDIGW007	GDIGW00702	12/13/1995	15.70000	J
IGDIGW007	GDIGW00703	05/21/1996	3.00000	U
IGDIGW007	GDIGW00704	08/21/1996	1.70000	UJ
IGDIGW007	GDIGW00705	04/15/1998	1.70000	U
IGDIGW007	GDIGW00706	08/19/1998	5.50000	U
<b>Deep Groundwater</b>				
IGDIGW07D	GDIGW07D01b	05/25/1995	1.90000	U
IGDIGW07D	GDIGW07D02	12/13/1995	3.00000	UJ
IGDIGW07D	GDIGW07D03	05/21/1996	3.00000	U
IGDIGW07D	GDIGW07D04	08/21/1996	1.70000	UJ
IGDIGW07D	GDIGW07D05	04/15/1998	3.40000	U
IGDIGW07D	GDIGW07D06	08/19/1998	5.50000	U

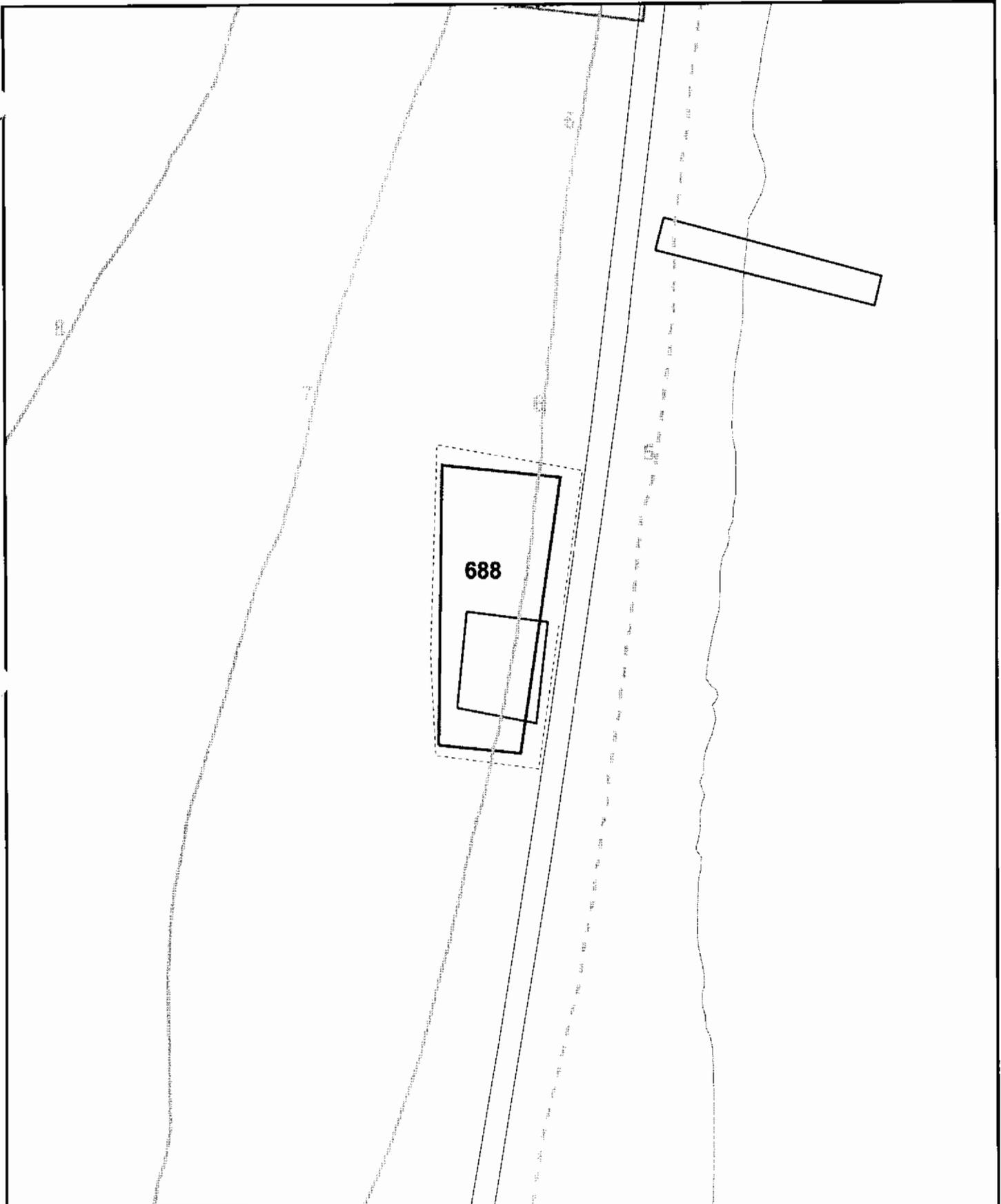
= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 $\mu\text{g/L}$  Micrograms per liter



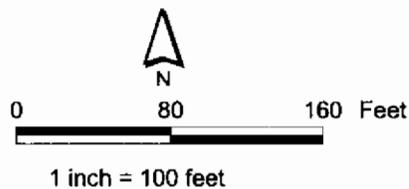
**Figure 10-1**  
 Sample and Test Location Map  
 AOC 688  
 Zone I  
 Charleston Naval Complex

- Sediment Sample
- Surface Soil Sample
- Soil Boring
- Groundwater Sample
- Roads
- Shoreline
- AOC Boundary
- SWMU Boundary





- Inferred Groundwater Elevations (ft msl)
  - Known Groundwater Elevations (ft msl)
  - Fence
  - Railroads
  - Roads
  - Shoreline
  - AOC Boundary
  - SWMU Boundary
  - Buildings
  - Zone Boundary
- ft msl - feet above mean sea level



**Figure 10-2**  
 Shallow Groundwater Contour Map  
 AOC 688, Zone I  
 Charleston Naval Complex



# 1 11.0 CMS Work Plan for AOC 689 and AOC 2 690

3 This section summarizes the results and conclusions from the soil and groundwater  
4 investigations conducted in the area of AOCs 689/690, which were reported in the *Zone I*  
5 *RFI Report, Revision 0* (EnSafe, 1999), Section 10.10, and as amended by the *Zone I RFI Report*  
6 *Addendum, Revision 1* (CH2M-Jones, 2001). Figure 11-1 presents the site features and RFI  
7 sample locations.

8 As part of the Zone I RFI, surface soil, subsurface soil, and groundwater investigations were  
9 conducted at AOCs 689/690 from December 1994 through April 1998. The RFI report  
10 presented the results of the investigations and conclusions concerning contamination and  
11 risk, as summarized in Sections 11.1 and 11.2 of this CMS Work Plan. A further evaluation  
12 of COCs is provided in Section 11.3 of this work plan.

## 13 11.1 Background

14 AOC 689 consists of the marina parking area at the southern tip of CNC, as well as the  
15 surrounding marshlands. This site is bounded to the east by the Cooper River, to the west by  
16 the DMA roads, and to the south by Shipyard Creek. The marina parking area has been  
17 identified as an AOC based on information that the former parking lot was used for  
18 unauthorized disposal of unknown materials during filling activities.

19 AOC 690 consists of the network of roadways at the southern tip of CNC. Roads included in  
20 this AOC are West Road, Lunsford Loop, and a portion of Juneau Avenue. The roadside area  
21 along these dirt roads, totaling approximately 4,500 feet, are reported possible locations of  
22 historic, unauthorized chemical dumping by ship personnel. Shipyard Creek and an  
23 associated salt-marsh are immediately adjacent to this AOC.

24 The area is zoned for industrial (M-1) and business use (B-1C).

## 1 11.2 RFI Investigation Results

### 2 11.2.1 Soil Investigation Results

3 As part of the RFI field investigation, surface soil samples and collocated subsurface soil  
4 samples were collected. All samples were analyzed for VOCs, SVOCs, pesticides/PCBs,  
5 metals, organotins and cyanide. No duplicate samples were collected at AOC 689.

#### 6 11.2.1.1 Surface Soils

7 A total of 42 surface soil samples (see Figure 11-1) were collected at AOCs 689/690. During  
8 the first sampling event, samples were analyzed for VOCs, SVOCs, pesticides/PCBs,  
9 metals, cyanide, and TPH. Sample analytes were modified in future sampling events based  
10 on need (see Table 11-1).

11 Surface soil sample analytical results were evaluated relative to EPA Region III RBCs. Based  
12 on the analysis presented in the RFI report, nine parameters (benzo(a)anthracene,  
13 benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, antimony, arsenic,  
14 chromium, copper, and manganese) exceeded their respective EPA Region III unrestricted  
15 land use RBCs. As a result of the screening process and subsequent risk assessment, the  
16 following constituents were identified as COCs for surface soil:

- 17 • BEQs were detected at a concentration exceeding its residential RBC (87 mg/kg).
- 18 • Arsenic was detected at a concentration exceeding its residential RBC (0.43 mg/kg) in 37  
19 samples. Two samples exceeded its BRC (21.6 mg/kg).
- 20 • Chromium was detected at a concentration exceeding its residential RBC (34.5 mg/kg)  
21 in 13 samples. Eleven samples exceeded its BRC (39 mg/kg).
- 22 • Copper was detected at a concentration exceeding its BRC (240 mg/kg) in two samples.  
23 One sample exceeded its residential RBC (310 mg/kg).
- 24 • 4-Aminobiphenyl was detected at a concentration exceeding its residential RBC  
25 (2.8 µg/kg) in one sample.

#### 26 11.2.1.2 Subsurface Soils

27 Fourteen subsurface soil samples, collocated with the surface soil sample locations (see  
28 Figure 11-1), were collected at AOCs 689/690. During the first sampling event, samples  
29 were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, and TPH. Sample  
30 analytes were modified in future sampling events based on need (see Table 11-1).

1 Subsurface soil sample analytical results were evaluated relative to EPA Region III  
2 unrestricted and industrial RBCs and SSLs with a DAF=10. Based on the analysis presented  
3 in the RFI report, two constituents (chromium and beta-BHC) exceeded the SSL with a  
4 DAF=10. However, no COCs were identified in the RFI report specifically for subsurface  
5 soils.

## 6 **11.2.2 Groundwater**

7 Groundwater patterns in the vicinity of AOCs 689/690 show that flow is predominantly  
8 controlled by the nearest surface water body, either toward the Cooper River or toward  
9 Shipyard Creek (see Figure 10-2). A localized groundwater mound appears in the vicinity of  
10 the DMA, but appears not significantly effect the area of AOCs 689/690.

11 Five grid-based well pairs (IGDIGW001/IGDIGW001D, IGDIGW002/IGDIGW002D,  
12 IGDIGW003/IGDIGW003D, and IGDIGW004/IGDIGW004D) were installed as part of the  
13 RFI investigation. In addition, two Zone H grid well pairs (HGDIGW010/HGDIGW010D)  
14 were already installed in the vicinity of AOCs 689/690 (see Figure 11-1). The groundwater  
15 samples obtained from these wells were analyzed for VOCs, SVOCs, pesticides/PCBs,  
16 metals, cyanide, chlorides, and sulfates, TDS (see Table 11-2).

17 Constituents detected in the groundwater samples were evaluated relative to MCLs, tap  
18 water RBCs, and Zone I groundwater BRCs.

19 The following sections present the findings presented in the RFI report.

### 20 **11.2.2.1 Shallow Groundwater**

21 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
22 result of the screening process and subsequent risk assessment, no constituents were  
23 identified as COCs for shallow groundwater.

### 24 **11.2.2.2 Deep Groundwater**

25 Analytes detected in deep groundwater samples were evaluated in the RFI report. As a  
26 result of the screening process and subsequent risk assessment, no constituents were  
27 identified as COCs for deep groundwater.

## 28 **11.2.3 RFI Risk Summary**

29 Based on a unrestricted land use scenario, the following COCs were identified:

30 **Surface Soil:** Arsenic, BEQs, chromium, copper, and 4-Aminobiphenyl

31 Based on an industrial land use scenario, the following COCs were identified:

1 **Surface Soil: Arsenic**

## 2 **11.2.4 Recommendations from Zone I RFI Report, Revision 0**

### 3 **11.2.4.1 Soils**

4 The RFI recommended a CMS for soils, considering no action, excavation and offsite  
5 disposal, and containment/capping options.

### 6 **11.2.4.2 Groundwater**

7 No groundwater COCs were identified; therefore, NFA for groundwater was recommended  
8 in the RFI report.

## 9 **11.3 COPC/COC Refinement**

10 The COCs identified in the RFI include arsenic, chromium, copper, BEQs and 4-  
11 aminobiphenyl in surface soil. Each of these COCs are further evaluated in the following  
12 sections. In addition, concentrations of VOCs detected in soils were rescreened using an SSL  
13 based on a DAF=1.

### 14 **11.3.1 Surface Soil**

#### 15 **11.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

16 Several VOCs were reported in the RFI as being detected in surface soils that are not  
17 included in the database evaluated by CH2M-Jones. These VOCs include 1,1-  
18 dichloroethene, carbon disulfide, and trichlorofluoromethane. In the RFI report, the  
19 duplicate samples were included in the evaluation and, therefore, additional chemicals  
20 were identified as being detected in site soils. In the re-evaluation of the data by CH2M-  
21 Jones, the database was developed using normal samples only. The results following  
22 rescreening of the VOCs detected in surface soils (see Table 11-3) indicated that acetone,  
23 benzene, chloromethane, methylene chloride, tetrachloroethene were all present in  
24 concentrations above their respective SSLs with a DAF=1. These constituents are discussed  
25 in the following sections.

#### 26 ***Benzene, Tetrachloroethene, Trichloroethene***

27 Benzene, tetrachloroethene, and trichloroethene were rarely detected in surface soil (1 of 39  
28 for benzene, 1 of 39 for tetrachloroethene, 4 of 39 for trichloroethene; see Table 11-3) and  
29 were not detected in subsurface soil or groundwater from grid wells located in the vicinity  
30 of the site. For these reasons, these constituents are not considered COCs at this site.

1 **Acetone**

2 Acetone was detected in 7 of 39 surface soil samples, with only 2 of the samples exceeding  
3 the SSL with a DAF of 1. Acetone was detected in 3 of 14 subsurface soil samples, but none  
4 of the detected values exceeded the SSL. Acetone was detected in groundwater from grid  
5 wells located in the vicinity of the site at AOCs 689/690, but it was found at concentrations  
6 below the RBC. Acetone is a common laboratory contaminant and the concentrations  
7 detected in environmental media at AOCs 689/690 are likely to be the result of laboratory  
8 contamination. Therefore, acetone is not considered a COC at AOCs 689/690.

9 **Chloromethane**

10 Chloromethane was detected in 2 of 39 surface soil samples, but was not detected in any  
11 subsurface soil or groundwater samples located in the vicinity of the site. Given the low  
12 frequency of detection in surface soil and the absence of chloromethane in subsurface soil  
13 and groundwater, chloromethane is not considered a COC at AOCs 689/690.

14 **Methylene Chloride**

15 Methylene chloride was detected in 5 of 39 surface soil samples and 1 of 14 subsurface soil  
16 samples. Methylene chloride was not detected in groundwater from grid wells located in  
17 the vicinity of the site, indicating that significant transport from soil to groundwater has not  
18 occurred. Methylene chloride is a common laboratory contaminant and the concentrations  
19 detected in environmental media at AOCs 689/690 are likely to be the result of laboratory  
20 contamination. Methylene chloride is not considered a COC at AOCs 689/690.

21 **11.3.1.3 Arsenic**

22 Arsenic was detected in 37 of 39 surface soil samples (see Table 11-4). Two of the surface  
23 soil samples exceeded the Zone I background range maximum of 20 mg/kg, with the  
24 maximum onsite detection being 28.7 mg/kg. However, the Zone I background range for  
25 arsenic in surface soils is based on only four analyses, which are not statistically  
26 representative of zone-specific ranges. Arsenic is ubiquitous at the CNC, including this site,  
27 as is indicated by the fact that arsenic was detected in almost every surface soil sample.

28 An exposure point concentration was estimated for the surface soil arsenic data from the  
29 site. A UCL<sub>95</sub> concentration was estimated for the surface soils at the site (see Appendix C-  
30 2a). This estimation included all samples collected within the top 1-ft interval of soil. The  
31 resulting UCL<sub>95</sub> estimate was 7.5 mg/kg, which is well within the range of arsenic in  
32 background samples in Zone I (up to 20 mg/kg).

33 For these reasons, arsenic is not considered a COC in surface soil at AOCs 689/690.

1    **11.3.1.4 Chromium**

2    Chromium was detected in all 50 surface soil samples (see Table 11-5) in concentrations that  
3    ranged from 4.1 mg/kg to 132 mg/kg. Of these, none that were located in Zone I were  
4    higher than the Zone I background range of 7.5 mg/kg to 54 mg/kg. However, two samples  
5    collected from Zone H had concentrations were higher than the Zone H background range  
6    of 2.9 mg/kg to 95 mg/kg. Chromium is ubiquitous at the CNC, including this site, as is  
7    indicated by the fact that chromium was detected in every surface soil sample.

8    An exposure point concentration was estimated for the surface soil chromium data from the  
9    site. A UCL<sub>95</sub> concentration was estimated for the surface soils at the site (see Appendix C-  
10   2b). This estimation included all samples collected within the top 1-ft interval of soil. The  
11   resulting UCL<sub>95</sub> estimate was 43.3 mg/kg, which is well within the range of chromium in  
12   background samples in Zone H and I (up to 95 mg/kg).

13   For these reasons, chromium is not considered a COC in surface soil at AOCs 689/690.

14   **11.3.1.4 BEQs**

15   BEQs were detected in 17 of 42 surface soil samples (see Table 11-6). The maximum detected  
16   concentration in surface soil (1.788 mg/kg) was the only value that exceeded the sitewide  
17   reference concentration of 1.304 mg/kg. This detection was located at well 690SB018. Two  
18   additional samples were subsequently collected in the area to further characterize the BEQs  
19   detected at this location but both samples indicated BEQ levels well below the 1.304 mg/kg  
20   reference concentration (0.987 mg/kg at I690SB031 and 0.608 mg/kg at I690SB032). The one  
21   elevated concentration is likely the result of the numerous anthropogenic sources of BEQs at  
22   the installation. BEQs, are not considered COCs at AOCs 689/690.

23   **11.3.1.5 4-Aminobiphenyl**

24   4-Aminobiphenyl was detected in 1 of 24 surface soil samples (see Table 11-7). 4-  
25   Aminobiphenyl resulted in a derived cancer risk greater than  $1 \times 10^{-6}$  for the unrestricted  
26   land use scenario, but not for the industrial receptor. The one detected value was  
27   0.06 mg/kg, which exceeded the RBC of 0.0028 mg/kg. The range of sample quantitation  
28   limit (SQL) values for 4-Aminobiphenyl, however, was 0.333 to 0.57 mg/kg, indicating that  
29   the detected value of 0.06 mg/kg is estimated and that the RBC of 0.0028 mg/kg could not  
30   be achieved using laboratory methods. In addition, toxicity values are not available for  
31   4-Aminobiphenyl, so benzidine was used as a surrogate in risk assessment presented in the  
32   RFI report. Benzidine has been classified as a Group "A" carcinogen, indicating it is a  
33   human carcinogen. Given the lack of information available on the carcinogenic potential of

1 4-Aminobiphenyl, the use of benzidine as a surrogate is a highly conservative approach.  
2 Given the low frequency of detection and the use of a highly conservative surrogate in the  
3 quantitative evaluation, 4-Aminobiphenyl is not considered a COC in surface soil at AOCs  
4 689/690.

### 5 **11.3.2 Subsurface Soils**

6 No subsurface soil COCs were identified in the RFI report.

#### 7 **11.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

8 As discussed above, VOCs in subsurface soil were rescreened against an SSL with a DAF of  
9 1 (see Table 11-8). The screening process identified an exceedance of the SSL (DAF=1) only  
10 for methylene chloride, which is discussed in further detail below.

#### 11 ***Methylene Chloride***

12 Methylene chloride was detected in 1 of 14 subsurface soil samples, but was not detected in  
13 groundwater from grid wells located in the vicinity of the sites, indicating that significant  
14 transport from soil to groundwater has not occurred. Methylene chloride is a common  
15 laboratory contaminant and the concentrations detected in the single subsurface soil sample  
16 at AOCs 689/690 is likely the result of laboratory contamination. For these reasons,  
17 methylene chloride is not considered a COC at AOCs 689/690.

### 18 **11.3.3 Groundwater**

19 No groundwater COCs were identified at AOCs 689/690.

### 20 **11.3.4 COPC/COC Refinement Summary**

21 There are no known COCs requiring further action in surface soils, subsurface soils or  
22 groundwater at AOCs 689/690. This site is recommended for NFA.

## 23 **11.4 Summary of Information Related to Site Closeout Issues**

### 24 **11.4.1 RFI Status**

25 The RFI report, as amended by the RFI Report Addendum, is complete.

### 26 **11.4.2 Presence of Inorganics in Groundwater**

27 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
28 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
29 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
30 followed by detection of these same metals below the MCL or below the practicable

1 quantitation limit. Per the discussion presented in Section 11.3, there are no inorganics that  
2 have been identified as COCs at this site.

### 3 **11.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

4 Data indicate that AOCs 689/690 were never connected to the sanitary sewer system.  
5 Therefore, there are no concerns regarding connections to the sanitary sewer. Further  
6 evaluation of this issue is not warranted.

### 7 **11.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

8 No direct connections of AOCs 689/690 to the storm sewer are known to exist. No COCs  
9 requiring further evaluation are present at the site. Further evaluation of this issue is not  
10 warranted.

### 11 **11.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

12 The area associated with AOCs 689/690 is located approximately 500 feet northeast of and  
13 across an inlet of the Cooper River from the closest railroad. There is no known linkage  
14 between these sites and the investigated railroad lines of AOC 504, and further evaluation  
15 of this issue is not warranted.

### 16 **11.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

17 The nearest surface water bodies to AOCs 689/690 are Shipyard Creek and the Cooper  
18 River, which border both sites to the south and west. The only potential migration pathway  
19 from the sites to surface water is via overland flow via stormwater runoff. Since no COCs  
20 were identified at the sites, further evaluation of a potential pathway for contaminant  
21 migration via stormwater runoff is not warranted.

### 22 **11.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

23 There are no known OWSs associated with AOCs 689/690. Therefore, there are no concerns  
24 regarding connections to the sanitary sewer, and further evaluation of this issue is not  
25 warranted.

### 26 **11.4.8 Land Use Control Management Plan**

27 The COC refinement did not identify any COCs at AOCs 689/690. This evaluation was  
28 based on a unrestricted land use classification. Therefore, land use controls are not  
29 necessary.

## 1 **11.5 CH2M-Jones Recommendations**

2 Evaluation of the primary media of concern (surface soils, subsurface soils, and  
3 groundwater) indicated that there were no issues associated with the historical operation of,  
4 or releases from, this unit. Based on a review of COPCs/COCs in Section 11.3, no COCs  
5 were identified in any investigated media.

6 The RFI report concluded that a CMS was necessary for soils. However, CH2M-Jones has  
7 re-evaluated the risks posed by the identified COCs and determined that no COCs exist at  
8 AOCs 689/690. Therefore, these sites are recommended for NFA.

1

**TABLE 11-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, AOCs 689/690, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Samples Collected	Sample Analyses	Comments
1	12/14/94	Upper - 10 (20)	Standard suite, TPH	No lower interval sampling was planned.
	12/16/94	Duplicate - 1	Appendix IX, TPH	
2	02/08/95	Upper - 20	Standard Suite, Organotins, Dioxins, Additional Parameters <sup>a</sup>	Additional samples were collected. Additional parameters were added.
	02/09/95			
	02/13/95			
	02/14/95			
	02/16/95	Lower - 7 (20)	Standard Suite, Organotins, Dioxins	Some lower samples were not collected due to a water table at less than 5 feet bgs.
03/07/95				
	03/08/95			
	03/09/95	Duplicate - 2	Appendix IX	
3	06/20/95	Upper - 3	SVOCs	Samples were collected to delineate the extent of SVOCs detected above their RBCs.
4	04/02/98	Upper - 9	VOCs, SVOCs, Metals	
	04/06/98	Lower - 7	VOCs, SVOCs, Metals	
		Duplicate - 1	VOCs, SVOCs, Metals	

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**Notes:**

( ) = Parenthesis indicate number of samples proposed  
 a = Additional analysis performed on two samples on 09/06/95 included CEC, chloride, sulfur, ammonia, nitrate/nitrite, phosphorus, TOC, and total moisture. These two samples were also extracted using the TPLP and the extract was analyzed for VOCs and SVOCs.  
 Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.  
 Appendix IX = Standard Suite, plus hex-chrome, dioxins, herbicides, and OP pesticides at DQO Level IV.

1

**TABLE 11-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOCs 689/690, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Wells Sampled	Sample Analyses	Comments
<b>Zone H Grid Wells</b>				
1	11/21/94	HGDHGW010/	VOCs, SVOCs, Pesticides/PCBs, Metals, CN	Subsequent event analytical suite based on previous results
	12/16/94	HGDHGW010D		
	11/21/94 12/15/94	HGDHGW011/ HGDHGW011D		
2	4/13/95	HGDHGW010/	Metals	
	4/14/95	HGDHGW010D	Metals, SVOCs	
	4/12/95	HGDHGW011/	Metals, SVOCs	
	4/14/95	HGDHGW011D	Metals	
3	10/10/95	HGDHGW010/	Metals	
	10/11/95	HGDHGW010D	Metals	
	10/11/95	HGDHGW011/	Metals, SVOCs	
	10/12/95	HGDHGW011D	Metals, SVOCs	
4	4/12/95	HGDHGW010/	Metals	
	4/17/95	HGDHGW010D	Metals	
	4/16/96	HGDHGW011/	Metals, SVOCs	
	4/17/96	HGDHGW011D	Metals, SVOCs	
5	6/3/98	HGDHGW011/	VOCs	
	6/23/98	HGDHGW011D	VOCs	
6	1/18/99	HGDHGW011/	VOCs	
	1/19/99	HGDHGW011D	VOCs	
<b>Zone I Grid Wells</b>				
1	05/02/95	IGDIGW001/	Standard Suite, Organotins, TDS, Sulfates, Chloride, Dioxins	
		IGDIGW001D		
		IGDIGW002/		
		IGDIGW002D		
		IGDIGW003/		
IGDIGW003D				
2	12/11/95	IGDIGW004/	Standard Suite, TDS, Sulfates, Chloride	
		IGDIGW004D		
		IGDIGW001/		
		IGDIGW001D		
		IGDIGW002/		
IGDIGW002D				
3		IGDIGW003/		
		IGDIGW003D		
		IGDIGW004/		
IGDIGW004D				

**TABLE 11-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, AOCs 689/690, Zone I, Charleston Naval Complex

Sampling Event	Sampling Date	Wells Sampled	Sample Analyses	Comments
3	5/31/96	IGDIGW001/ IGDIGW001D IGDIGW002/ IGDIGW002D IGDIGW003/ IGDIGW003D IGDIGW004/ IGDIGW004D	Standard Suite, TDS, Sulfates, Chloride	
4	8/26/26	IGDIGW001/ IGDIGW001D IGDIGW002/ IGDIGW002D IGDIGW003/ IGDIGW003D IGDIGW004/ IGDIGW004D	Standard Suite, TDS, Sulfates, Chloride	

1 Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.

TABLE 11-3  
 VOCs in Surface Soil  
 CMS Work Plan, AOC 690, Zone I, Charleston Naval Complex

Sample			Acetone		Ethylbenzene		Methylene Chloride		Tetrachloroethylene (PCE)		Toluene		Xylenes, Total		Trichloro-ethylene (TCE)		Benzene		Chloromethane		Naphthalene		Propionitrile	
Station	ID	Date	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier
	IND RBC		20,000		20,000		760		1100		41,000.0000		410,000		520		100		440		4100		NA	
	RES RBC		760		760		85		120		1600.0000		16,000		58		12		49		160		NA	
	SSL		0.8		0.7		0.001		0.003		0.6000		9		0.03		0.002		NA		4		NA	
	SS BKGD		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
I690SB001	690SB00101	12/14/94	0.031	UJ	0.006	U	0.016	UJ	0.000	U	0.0036	J	0.006	U	0.0037	J	0.006	U	0.013	U	0.45	U	ND	
I690SB002	690SB00201	12/14/94	0.044	UJ	0.006	UJ	0.026	UJ	0.0044	J	0.015	J	0.006	UJ	0.0140	J	0.0029	J	0.012	U	0.14	J	ND	
I690SB003	690SB00301	12/16/94	0.044	J	0.006	U	0.014	J	0.000	U	0.006	U	0.006	U	0.0060	U	0.006	U	0.013	U	0.42	U	ND	
I690SB004	690SB00401	12/16/94	0.04	UJ	0.006	UJ	0.014	J	0.000	UJ	0.0022	J	0.006	UJ	0.006	UJ	0.006	U	0.06	J	0.39	U	ND	
I690SB005	690SB00501	12/16/94	0.87	J	0.03	U	0.067	J	0.00	U	0.03	U	0.03	U	0.0300	U	0.03	U	0.013	UJ	0.42	U	ND	
I690SB006	690SB00601	12/16/94	0.06	J	0.007	UJ	0.015	UJ	0.000	UJ	0.0037	J	0.007	UJ	0.0080	J	0.007	UJ	1.6	UJ	3.6	U	ND	
I690SB007	690SB00701	12/16/94	4	UJ	0.81	U	1.6	UJ	0.81	J	0.81	U	0.81	U	0.8100	U	0.81	U	0.013	UJ	0.47	U	ND	
I690SB008	690SB00801	12/16/94	0.048	UJ	0.007	U	0.013	UJ	0.007	U	0.007	U	0.007	U	0.0070	U	0.007	U	0.013	UJ	0.44	U	ND	
I690SB009	690SB00901	12/16/94	6.8	UJ	0.007	UJ	0.013	UJ	0.007	UJ	0.0026	UJ	0.007	UJ	0.007	UJ	0.007	UJ	0.067	UJ	0.45	U	ND	
I690SB010	690SB01001	12/16/94	1.5	J	0.033	U	0.062	J	0.033	U	0.01	J	0.033	U	0.0330	U	0.033	U	0.044	U	0.47	U	ND	
I690SB011	690SB01101c	02/08/95	0.025	UJ	0.019	U	0.025	U	0.019	U	0.019	U	0.025	U	0.0250	U	0.019	U	0.044	U	0.82	U	0.74	UJ
I690SB012	690SB01201a	02/08/95	0.11	UJ	0.019	U	0.025	U	0.019	U	0.019	U	0.025	U	0.0250	U	0.019	U	0.046	U	0.82	U	0.75	UJ
I690SB013	690SB01301a	02/08/95	0.12	UJ	0.02	U	0.026	U	0.02	J	0.02	U	0.026	U	0.0260	U	0.02	U	0.046	U	0.87	U	0.78	UJ
I690SB014	690SB01401a	02/08/95	0.12	UJ	0.02	U	0.026	U	0.02	J	0.02	U	0.026	U	0.0260	U	0.02	U	0.049	U	0.87	U	ND	
I690SB015	690SB01501a	02/08/95	0.038	J	0.021	U	0.028	U	0.021	J	0.021	U	0.028	U	0.0280	U	0.021	U	0.039	U	0.92	U	0.82	UJ
I690SB016	690SB01601a	02/09/95	0.048	U	0.017	U	0.022	U	0.017	U	0.017	U	0.022	U	0.0220	U	0.017	U	0.047	U	0.73	U	0.66	J
I690SB017	690SB01701b	02/09/95	0.12	UJ	0.02	U	0.027	U	0.02	J	0.027	U	0.027	U	0.0270	U	0.02	U	0.045	U	0.88	U	0.79	UJ
I690SB018	690SB01801a	02/09/95	0.12	UJ	0.019	U	0.026	U	0.019	U	0.019	U	0.026	U	0.0260	U	0.019	U	0.045	U	0.093	J	0.77	UJ
I690SB019	690SB01901a	02/09/95	0.031	U	0.019	U	0.026	U	0.019	U	0.019	U	0.026	U	0.0260	U	0.019	U	0.049	U	0.86	U	0.770	UJ
I690SB020	690SB02001a	02/09/95	0.12	UJ	0.021	U	0.028	U	0.021	U	0.021	U	0.028	U	0.0280	U	0.021	U	0.041	U	0.16	J	0.820	UJ
I690SB021	690SB02101b	02/09/95	0.1	UJ	0.017	U	0.023	U	0.017	U	0.017	U	0.023	U	0.0230	U	0.017	U	0.041	U	0.76	U	0.690	UJ
I690SB022	690SB02201b	02/13/95	0.077	UJ	0.017	U	0.022	UJ	0.017	U	0.017	U	0.022	U	0.0220	U	0.017	U	0.039	U	0.73	U	ND	
I690SB023	690SB02301a	02/13/95	0.03	UJ	0.016	U	0.022	UJ	0.016	U	0.002	J	0.022	U	0.0220	U	0.016	U	0.039	U	0.73	U	ND	
I690SB024	690SB02401a	02/13/95	0.037	UJ	0.019	U	0.025	U	0.019	U	0.019	U	0.025	U	0.0250	U	0.019	U	0.044	U	0.82	U	0.740	UJ
I690SB025	690SB02501a	02/13/95	0.11	UJ	0.019	U	0.025	U	0.019	U	0.019	U	0.025	U	0.0250	U	0.019	U	0.044	U	0.88	U	ND	
I690SB026	690SB02601a	02/13/95	0.045	UJ	0.02	U	0.027	UJ	0.02	U	0.027	U	0.027	U	0.0270	U	0.02	U	0.047	U	0.84	U	ND	
I690SB027	690SB02701a	02/13/95	0.12	UJ	0.019	U	0.026	UJ	0.019	U	0.019	U	0.026	U	0.0260	U	0.019	U	0.045	U	0.84	U	ND	
I690SB028	690SB02801a	02/13/95	0.11	UJ	0.019	U	0.025	U	0.019	U	0.002	J	0.025	U	0.0250	U	0.019	U	0.044	U	0.83	U	0.75	UJ
I690SB029	690SB02901a	02/13/95	0.1	UJ	0.017	U	0.023	U	0.017	U	0.017	U	0.023	U	0.0230	U	0.017	U	0.04	U	0.75	U	ND	
I690SB030	690SB03001a	02/13/95	0.096	J	0.021	U	0.027	U	0.021	J	0.027	U	0.027	U	0.0270	U	0.021	U	0.048	U	0.9	U	0.81	UJ
I690SB031	690SB03101	06/20/95	ND		ND		ND		ND		ND		ND		ND		ND		ND		0.54	J	ND	
I690SB032	690SB03201	06/20/95	ND		ND		ND		ND		ND		ND		ND		ND		ND		0.072	J	ND	
I690SB033	690SB03301	04/06/98	0.062	J	0.0022	J	0.0062	U	0.0062	U	0.0062	U	0.0062	J	0.0062	U	0.0062	U	0.012	U	0.41	U	ND	
I690SB034	690SB03401	04/06/98	0.065	J	0.0065	U	0.0065	U	0.0065	U	0.0065	U	0.0065	U	0.0065	U	0.0065	U	0.013	U	0.43	U	ND	
I690SB035	690SB03501	04/06/98	0.067	J	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.0067	U	0.013	U	0.44	U	ND	
I690SB036	690SB03601	04/02/98	0.056	UJ	0.0056	U	0.0022	J	0.0056	UJ	0.0056	U	0.0056	U	0.0056	U	0.0056	U	0.011	U	0.37	U	ND	
I690SB037	690SB03701	04/02/98	0.057	UJ	0.0057	U	0.002	J	0.0057	UJ	0.0057	U	0.0057	U	0.0057	U	0.0057	U	0.011	U	0.38	U	ND	
I690SB038	690SB03801	04/02/98	0.056	UJ	0.0056	U	0.0056	U	0.0056	UJ	0.0056	U	0.0056	U	0.0056	U	0.0056	U	0.011	U	0.37	U	ND	
I690SB039	690SB03901	04/02/98	0.056	UJ	0.0056	U	0.0056	U	0.0056	UJ	0.0056	U	0.0056	U	0.0056	U	0.0056	U	0.011	U	0.37	U	ND	
I690SB040	690SB04001	04/02/98	0.056	UJ	0.0056	U	0.0056	U	0.0056	UJ	0.0056	U	0.0056	U	0.0056	U	0.0056	U	0.011	U	0.41	U	ND	
I690SB041	690SB04101	04/06/98	0.06	U	0.006	U	0.006	U	0.0060	U	0.006	U	0.006	U	0.0060	U	0.006	U	0.012	U	0.4	U	ND	
I690SB042	690SB04201	04/06/98	0.057	U	0.0057	U	0.0057	U	0.0057	U	0.0057	U	0.0057	U	0.0057	U	0.0057	U	0.011	U	0.38	U	ND	

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 ND no data  
 NA not applicable  
 mg/kg Milligrams per kilogram

**TABLE 11-4**  
 Arsenic in Surface Soils  
 CMS Work Plan, AOC 689/690, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Arsenic Result (mg/kg)	Qualifier
			IND RBC	3.8	
			RES RBC	0.43	
			SSL	14.5	
			SS BKGD	20	
I690SB001	690SB00101	12/14/94		7.5	J
I690SB002	690SB00201	12/14/94		26.3	=
I690SB003	690SB00301	12/16/94		1.7	=
I690SB004	690SB00401	12/16/94		11.2	=
I690SB005	690SB00501	12/16/94		5.8	=
I690SB006	690SB00601	12/16/94		2.1	=
I690SB007	690SB00701	12/16/94		2.2	=
I690SB008	690SB00801	12/16/94		4.7	=
I690SB009	690SB00901	12/16/94		3.6	=
I690SB010	690SB01001	12/16/94		7.4	=
I690SB011	690SB01101c	02/08/95		6.7	J
I690SB012	690SB01201a	02/08/95		9.8	J
I690SB013	690SB01301a	02/08/95		9.2	J
I690SB014	690SB01401a	02/08/95		6.4	J
I690SB015	690SB01501a	02/08/95		8.6	J
I690SB016	690SB01601a	02/09/95		1.9	J
I690SB017	690SB01701b	02/09/95		3.6	J
I690SB018	690SB01801a	02/09/95		10.7	J
I690SB019	690SB01901a	02/09/95		1.3	J
I690SB020	690SB02001a	02/09/95		11.8	J
I690SB021	690SB02101b	02/09/95		6.7	J
I690SB022	690SB02201b	02/13/95		0.37	U
I690SB023	690SB02301a	02/13/95		7.9	=
I690SB024	690SB02401a	02/13/95		0.37	U
I690SB025	690SB02501a	02/13/95		2.6	J
I690SB026	690SB02601a	02/13/95		5.5	=
I690SB027	690SB02701a	02/13/95		8.2	=
I690SB028	690SB02801a	02/13/95		7	J
I690SB029	690SB02901a	02/13/95		28.7	J
I690SB030	690SB03001a	02/13/95		5.3	J
I690SB034	690SB03401	04/06/98		10	=
I690SB035	690SB03501	04/06/98		7.5	=
I690SB036	690SB03601	04/02/98		10.9	=
I690SB037	690SB03701	04/02/98		3.4	=
I690SB038	690SB03801	04/02/98		1.5	=
I690SB039	690SB03901	04/02/98		1.5	=
I690SB040	690SB04001	04/02/98		3.7	=
I690SB041	690SB04101	04/06/98		2.3	=
I690SB042	690SB04201	04/06/98		2.8	=

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 mg/kg Milligrams per kilogram

**TABLE 11-5**  
 Chromium in Surface Soils  
 CMS Work Plan, AOC 689/690, Zone I, Charleston Naval Complex

Sample Station	ID	Date		Chromium, Total Result (mg/kg)	Qualifier
			IND RBC	3,100,000	
			RES RBC	12,000	
			SSL	19	
			SS BKGD	54	
I690SB001	690SB00101	12/14/94		22.5000	=
I690SB002	690SB00201	12/14/94		18.0000	=
I690SB003	690SB00301	12/16/94		7.7000	=
I690SB004	690SB00401	12/16/94		25.7000	=
I690SB005	690SB00501	12/16/94		132.0000	=
I690SB006	690SB00601	12/16/94		21.2000	=
I690SB007	690SB00701	12/16/94		9.5000	=
I690SB008	690SB00801	12/16/94		11.9000	=
I690SB009	690SB00901	12/16/94		66.2000	=
I690SB010	690SB01001	12/16/94		48.0000	=
I690SB011	690SB01101c	02/08/95		36.4000	J
I690SB012	690SB01201a	02/08/95		19.7000	J
I690SB013	690SB01301a	02/08/95		55.9000	J
I690SB014	690SB01401a	02/08/95		31.4000	J
I690SB015	690SB01501a	02/08/95		33.0000	J
I690SB016	690SB01601a	02/09/95		131.0000	J
I690SB017	690SB01701b	02/09/95		33.4000	J
I690SB018	690SB01801a	02/09/95		29.4000	J
I690SB019	690SB01901a	02/09/95		42.7000	J
I690SB020	690SB02001a	02/09/95		26.5000	J
I690SB021	690SB02101b	02/09/95		19.3000	J
I690SB022	690SB02201b	02/13/95		6.5000	=
I690SB023	690SB02301a	02/13/95		21.8000	=
I690SB024	690SB02401a	02/13/95		4.1000	=
I690SB025	690SB02501a	02/13/95		10.3000	J
I690SB026	690SB02601a	02/13/95		57.6000	=
I690SB027	690SB02701a	02/13/95		38.1000	=
I690SB028	690SB02801a	02/13/95		27.6000	J
I690SB029	690SB02901a	02/13/95		19.3000	J
I690SB030	690SB03001a	02/13/95		21.2000	J
I690SB034	690SB03401	04/06/98		58.7000	=
I690SB035	690SB03501	04/06/98		45.4000	=
I690SB036	690SB03601	04/02/98		43.7000	J
I690SB037	690SB03701	04/02/98		10.0000	J
I690SB038	690SB03801	04/02/98		14.3000	J
I690SB039	690SB03901	04/02/98		13.9000	J
I690SB040	690SB04001	04/02/98		28.3000	J
I690SB041	690SB04101	04/06/98		10.4000	=
I690SB042	690SB04201	04/06/98		40.0000	=

= Chemical is detected at concentration shown.

J Chemical is detected at concentration below the method detection limit; the concentration is not known.

mg/kg Milligrams per kilogram

**TABLE 11-6**  
 BEQs in Surface Soils  
 CMS Work Plan, AOC 689/690, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ		Qualifier
			Bkgd	Result (ug/kg) 1,304	
HGDHSB075	GDHSB07501	10/21/1994		449	=
I690SB001	690SB00101	12/14/1994		520	U
I690SB002	690SB00201	12/14/1994		485	U
I690SB003	690SB00301	12/16/1994		485	U
I690SB004	690SB00401	12/16/1994		440	=
I690SB005	690SB00501	12/16/1994		485	U
I690SB006	690SB00601	12/16/1994		4,160	U
I690SB007	690SB00701	12/16/1994		859	=
I690SB008	690SB00801	12/16/1994		508	U
I690SB009	690SB00901	12/16/1994		520	U
I690SB011	690SB01101c	02/08/1995		796	U
I690SB012	690SB01201a	02/08/1995		418	=
I690SB013	690SB01301a	02/08/1995		843	U
I690SB014	690SB01401a	02/08/1995		411	=
I690SB015	690SB01501a	02/08/1995		410	=
I690SB016	690SB01601a	02/09/1995		667	=
I690SB017	690SB01701b	02/09/1995		854	U
I690SB018	690SB01801a	02/09/1995		1,789	=
I690SB019	690SB01901a	02/09/1995		789	=
I690SB020	690SB02001a	02/09/1995		387	=
I690SB021	690SB02101b	02/09/1995		702	=
I690SB022	690SB02201b	02/13/1995		705	=
I690SB023	690SB02301a	02/13/1995		714	U
I690SB024	690SB02401a	02/13/1995		690	U
I690SB025	690SB02501a	02/13/1995		797	U
I690SB026	690SB02601a	02/13/1995		854	U
I690SB027	690SB02701a	02/13/1995		820	U
I690SB028	690SB02801a	02/13/1995		808	U
I690SB029	690SB02901a	02/13/1995		413	=
I690SB030	690SB03001a	02/13/1995		871	U
I690SB031	690SB03101	06/20/1995		987	=
I690SB032	690SB03201	06/20/1995		608	=
I690SB034	690SB03401	04/06/1998		474	U
I690SB035	690SB03501	04/06/1998		497	U
I690SB036	690SB03601	04/02/1998		508	U
I690SB037	690SB03701	04/02/1998		428	U
I690SB038	690SB03801	04/02/1998		439	U
I690SB039	690SB03901	04/02/1998		428	U
I690SB040	690SB04001	04/02/1998		474	U
IGDISB002	GDISB00201	02/16/1995		767	U

- = Chemical is detected at concentration shown.
- J Chemical is detected at concentration below the method detection limit; the concentration is not known.
- U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).
- ug/kg Micrograms per kilogram

**TABLE 11-7**  
 4-Aminobiphenyl in Surface Soils  
 CMS Work Plan, AOC 689/690, Zone I, Charleston Naval Complex

			4-Aminobiphenyl	
Sample			Result	
Station	ID	Date	(mg/kg)	Qualifier
			IND RBC	NA
			RES RBC	NA
			SSL	NA
			SS BKGD	NA
I690SB011	690SB01101c	02/08/95	0.5100	U
I690SB012	690SB01201a	02/08/95	0.5100	U
I690SB013	690SB01301a	02/08/95	0.5400	U
I690SB014	690SB01401a	02/08/95	0.5400	U
I690SB015	690SB01501a	02/08/95	0.5700	U
I690SB016	690SB01601a	02/09/95	0.4500	U
I690SB017	690SB01701b	02/09/95	0.5400	U
I690SB018	690SB01801a	02/09/95	0.5300	U
I690SB019	690SB01901a	02/09/95	0.5300	U
I690SB020	690SB02001a	02/09/95	0.0600	J
I690SB021	690SB02101b	02/09/95	0.4700	U
I690SB022	690SB02201b	02/13/95	0.4500	U
I690SB023	690SB02301a	02/13/95	0.4600	U
I690SB024	690SB02401a	02/13/95	0.4400	U
I690SB025	690SB02501a	02/13/95	0.5100	U
I690SB026	690SB02601a	02/13/95	0.5500	U
I690SB027	690SB02701a	02/13/95	0.5200	U
I690SB028	690SB02801a	02/13/95	0.5100	U
I690SB029	690SB02901a	02/13/95	0.4700	U
I690SB030	690SB03001a	02/13/95	0.5600	U
I690SB031	690SB03101	06/20/95	0.4200	U
I690SB032	690SB03201	06/20/95	0.4200	U

J Chemical is detected at concentration below the method detection limit; the concentration is not known.

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).

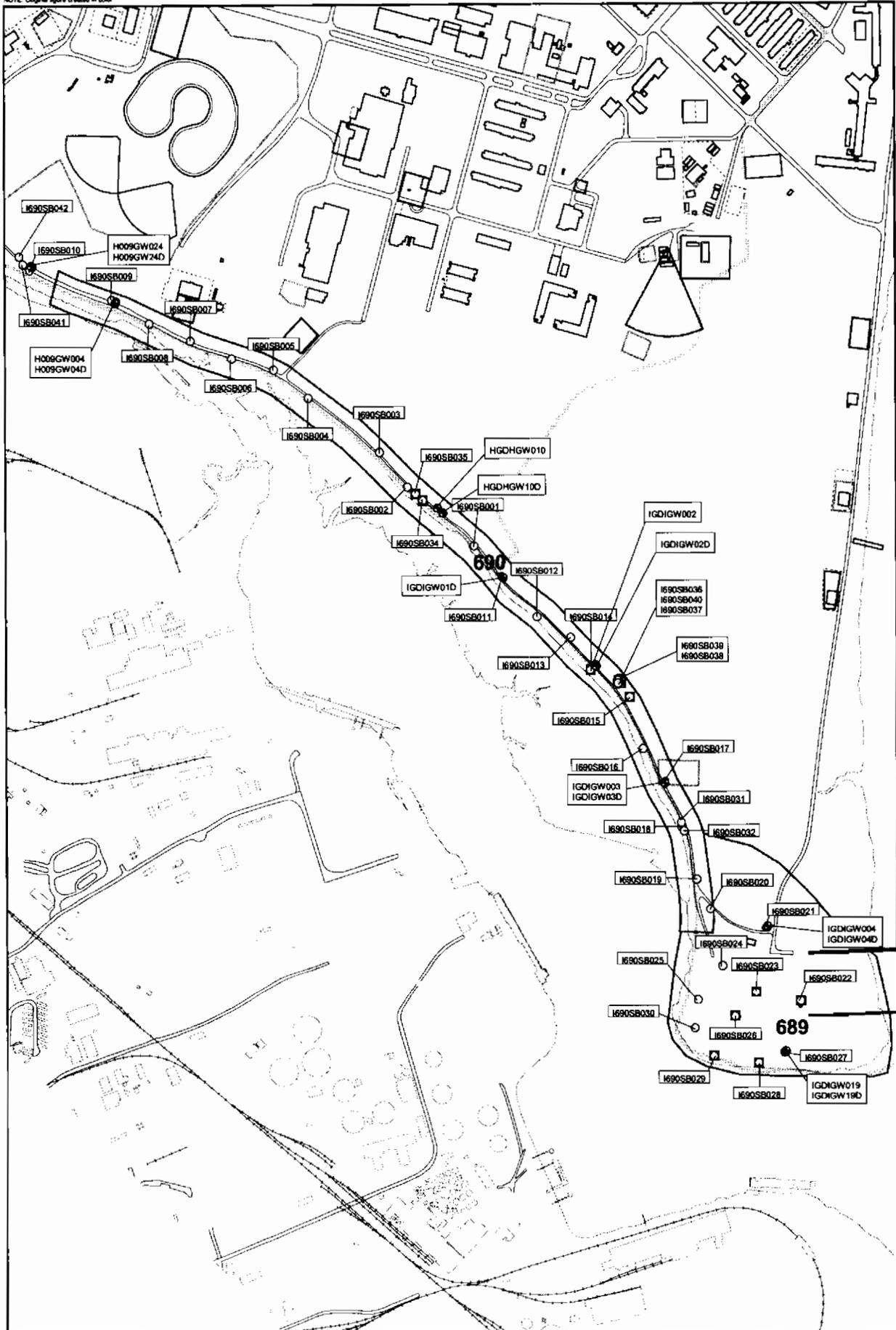
mg/kg Milligrams per kilogram

TABLE 11-8  
 VOCs Detected in Subsurface Soils  
 CMS Work Plan, AOC 689/690, Zone I, Charleston Naval Complex

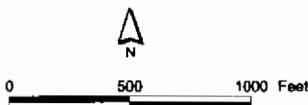
Sample Station	Sample ID	Date	Acetone		Carbon Disulfide		Ethylbenzene		Methylene Chloride		Methyl ethyl ketone (2-Butanone)		Toluene		Xylenes, Total	
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier
			SSL	0.8000	2.0000		0.7000		0.0010		NA		0.6000			
	SB BKGD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
I690SB014	690SB01402a	02/08/95	0.1200	UJ	0.0130	U	0.0190	U	0.0260	U			0.0190	U	0.0280	U
I690SB015	690SB01502	02/08/95	0.0490	U	0.0150	U	0.0230	U	0.0310	U	0.0540	U	0.0230	U	0.0310	U
I690SB022	690SB02202a	02/13/95	0.0450	UJ	0.0140	U	0.0200	U	0.0270	UJ			0.0200	U	0.0270	U
I690SB023	690SB02302a	02/13/95	0.0390	UJ	0.0130	U	0.0200	U	0.0260	UJ			0.0200	U	0.0280	U
I690SB026	690SB02602b	02/13/95	0.0480	UJ	0.0130	U	0.0200	U	0.0260	UJ			0.0200	U	0.0260	U
I690SB028	690SB02802a	02/13/95	0.0380	UJ	0.0140	U	0.0200	U	0.0270	UJ			0.0200	U	0.0270	U
I690SB029	690SB02902a	02/13/95	0.0660	J	0.0140	U	0.0210	U	0.0290	U	0.0500	U	0.0080	J	0.0290	U
I690SB034	690SB03402	04/06/98	0.0690	J	0.0120	=	0.0076	U	0.0076	U	0.0120	J	0.0015	J	0.0029	J
I690SB035	690SB03502	04/06/98	0.0460	J	0.0030	J	0.0023	J	0.0071	U	0.0360	U	0.0020	J	0.0093	=
I690SB036	690SB03602	04/02/98	0.0820	UJ	0.0082	U	0.0082	U	0.0027	J	0.0410	UJ	0.0082	U	0.0082	U
I690SB037	690SB03702	04/02/98	0.0720	U	0.0072	U	0.0072	U	0.0072	U	0.0360	U	0.0072	U	0.0072	U
I690SB038	690SB03802	04/02/98	0.0740	U	0.0074	U	0.0074	U	0.0074	U	0.0370	U	0.0074	U	0.0074	U
I690SB039	690SB03902	04/02/98	0.0740	U	0.0074	U	0.0074	U	0.0074	U	0.0370	U	0.0074	U	0.0074	U
I690SB040	690SB04002	04/02/98	0.0720	U	0.0072	U	0.0072	U	0.0072	U	0.0360	U	0.0072	U	0.0072	U

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

NOTE: Original figure created in color

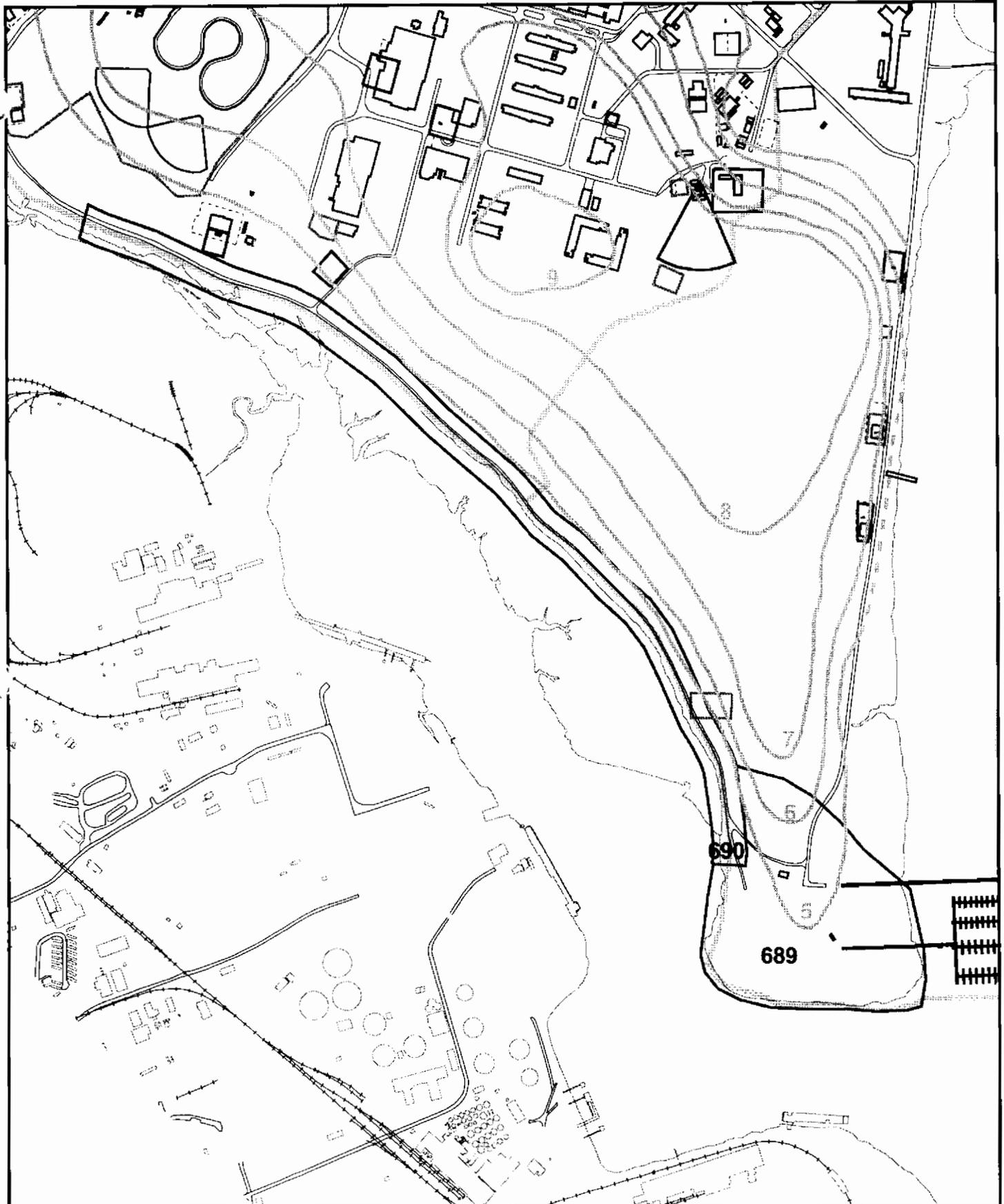


- Groundwater Sample
- Surface Soil Sample
- Subsurface Soil Sample
- ══ Roads
- - - Shoreline
- ▬ AOC Boundary
- - - SWMU Boundary
- ⋯ Zone Boundary

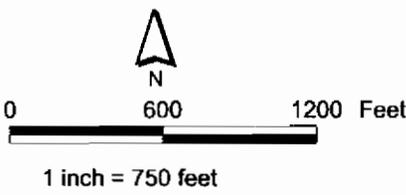


1 inch = 500.333 feet

**Figure 11-1**  
 Sample and Test Location Map  
 AOC 689 and AOC 690  
 Zone I  
 Charleston Naval Complex



- Inferred Groundwater Elevations (ft msl)
- Known Groundwater Elevations (ft msl)
- Fence
- Railroads
- Roads
- Shoreline
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary
- ft msl - feet above mean sea level



**Figure 11-2**  
 Shallow Groundwater Contour Map  
 AOC 689 and AOC 690, Zone I  
 Charleston Naval Complex

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**Section 12.0**

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## 1 12.0 CMS Work Plan for SWMU 12

2 This section summarizes the results and conclusions from the soil and groundwater  
3 investigations conducted at SWMU 12, which were reported in the *Zone I RFI Report,*  
4 *Revision 0* (EnSafe, 1999), Section 10.11, and as amended by the *Zone I RFI Report Addendum,*  
5 *Revision 1* (CH2M-Jones, 2001). Figure 12-1 presents the site features and RFI sample  
6 locations.

7 As part of the Zone I RFI, surface soil and subsurface soil investigations were conducted at  
8 SWMU 12 in March and June 1995 and December 1998. The groundwater investigations  
9 were conducted in June 1995 and January, May, June, and September 1996. The RFI report  
10 presented the results of the investigations and conclusions concerning contamination and  
11 risk, as summarized in Sections 12.1 and 12.2 of this CMS Work Plan. A further evaluation  
12 of COCs is provided in Section 12.3 of this work plan.

### 13 12.1 Background

14 SWMU 12 is the former firefighter training area located in the southwestern portion of the  
15 southern peninsula. At this SWMU, flammable liquids were pumped into a shallow 30- to  
16 50-foot diameter pit, ignited, and then extinguished with water. Training occurred between  
17 1966 and 1971; the frequency of training and types of flammable liquids used are not  
18 documented. A gravel road and clearing at the SWMU, currently used infrequently as a  
19 construction laydown yard, are reportedly near the former training area's location.

20 The area is zoned for industrial use (M-1).

### 21 12.2 RFI Investigation Results

#### 22 12.2.1 Soil Investigation Results

23 As part of the RFI field investigation, surface and subsurface soils were collected (see Figure  
24 12-1) during three sampling events conducted in 1995 and 1998, and analyzed for the  
25 parameters listed in Table 12-1.

1    **12.2.1.1 Surface Soils**

2    A total of 18 surface soil samples were collected during the initial RFI investigation  
3    activities. Surface soil sample analytical results were evaluated relative to EPA Region III  
4    RBC. Based on the analysis presented in the RFI report. As a result of the screening process  
5    and subsequent risk analysis, no COCs were identified for surface soils under the  
6    unrestricted land use scenario.

7    **12.2.1.2 Subsurface Soils**

8    Subsurface soil samples were not collected during the initial RFI investigations due to the  
9    presence of a shallow water table. However, three subsurface soil samples collocated with  
10   the surface soil sample locations were collected in 1998 for dioxin analysis.

11   Subsurface soil sample analytical results were evaluated relative to EPA Region III  
12   unrestricted and industrial risk-based concentration and SSLs with a DAF=10. As a result of  
13   the screening process and subsequent risk analysis, no COCs were identified for subsurface  
14   soils under the unrestricted land use scenario.

15   **12.2.2 Groundwater**

16   SWMU 12 is a geographic subarea of AOCs 689/690 and experiences the same groundwater  
17   flow patterns. In the vicinity of the site, flow is essentially southwestward toward Shipyard  
18   Creek (see Figure 12-2).

19   Three shallow monitoring wells were installed as part of the RFI investigation at the  
20   locations shown in Figure 12-1. The groundwater samples obtained from the shallow wells  
21   were collected for analysis during four sampling events. These samples were analyzed for  
22   the parameters listed in Table 12-2. Constituents detected in the groundwater samples were  
23   evaluated relative to MCLs, tap water RBCs, and Zone I groundwater BRCs.

24   The following sections set out the findings as presented in the RFI report.

25   **12.2.2.1 Shallow Groundwater**

26   Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
27   result of the screening process and subsequent risk analysis, the following constituents were  
28   identified as COCs for shallow groundwater:

- 29   •   Arsenic was detected at a concentration exceeding its tap water RBC, MCL, and shallow  
30       BRC in monitoring well I12GW0002 during all four sampling events.

- 1 • **Bis(2-ethylhexyl)phthalate** was detected at a concentration exceeding its tap water RBC  
2 (4.8  $\mu\text{g}/\text{L}$ ) in the sample collected from monitoring well I012GW003 during the fourth  
3 sampling event.
- 4 • **Cadmium** was detected at a concentration exceeding its screening criteria in monitoring  
5 well I012GW012 in the third sampling event. **Nickel** was detected at concentrations  
6 exceeding its screening criteria in monitoring well I012GW002 in the first three  
7 sampling events.
- 8 • **Thallium** exceeded its tap water RBC and shallow BRC in the sample collected from  
9 grid well IGDIGW003 during the third sampling event.
- 10 • **Dioxin Toxicity Equivalents (TEQ)** was detected at a concentration exceeding its tap  
11 water 4.75 E-7  $\mu\text{g}/\text{L}$  RBC in groundwater samples collected from grid well IGDIGW003  
12 during the third and fourth sampling events.

### 13 **12.2.2.3 Deep Groundwater**

14 Analytes detected in the deep groundwater samples collected from grid well IGDIGW003  
15 were evaluated in the RFI report. As a result of the screening process and subsequent risk  
16 analysis, no constituents were identified as COPCs or COCs for deep groundwater.

### 17 **12.2.3 RFI Risk Summary**

18 Based on a unrestricted land use scenario, the following COCs were identified:

19 **Shallow Groundwater:** Arsenic, cadmium, nickel, thallium, bis(2-ethylhexyl)phthalate,  
20 TEQs

21 Based on an industrial land use scenario, the following COCs were identified:

22 **Shallow Groundwater:** Arsenic, thallium, TEQs

### 23 **12.2.4 Recommendations from Zone I RFI Report, Revision 0**

#### 24 **12.2.4.1 Soils**

25 The RFI report recommended NFA for soils.

#### 26 **12.2.4.2 Groundwater**

27 The RFI report recommended a CMS for groundwater, considering no action, long-term  
28 monitoring, and ex situ treatment options.

## 1 **12.3 COPC/COC Refinement**

2 The COCs identified in the RFI include bis(2-ethylhexyl)phthalate, arsenic, cadmium,  
3 nickel, thallium, and TEQs in groundwater. Each of these COCs are further evaluated in the  
4 following sections.

### 5 **12.3.1 Surface Soil**

6 No surface soil COCs were identified in the RFI report.

#### 7 **12.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

8 The VOCs detected in surface soils are presented in Table 12-3. No exceedances were  
9 identified following the screening process. No VOCs were identified as COCs for surface  
10 soil at SWMU 12 using a DAF=1.

### 11 **12.3.2 Subsurface Soils**

12 No subsurface soil COCs were identified in the RFI report.

#### 13 **12.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

14 No VOCs were detected in the subsurface soil.

### 15 **12.3.3 Groundwater**

16 The COCs identified in the RFI report for groundwater include bis(2-ethylhexyl)phthalate,  
17 TEQ (2,3,7,8-TCED equivalents), arsenic, cadmium, and thallium.

#### 18 **12.3.3.1 Arsenic in Groundwater**

19 Arsenic was detected in 4 of 12 groundwater samples, with all four detections occurring in  
20 samples collected from monitoring well I012GW002 (see Table 12-4). The detected  
21 concentrations ranged from 177  $\mu\text{g/L}$  to 253  $\mu\text{g/L}$ , which exceed the MCL of 50  $\mu\text{g/L}$ . In  
22 1999, monitoring well I012GW002 was resampled and the arsenic concentration was  
23 128  $\mu\text{g/L}$ , indicating that the concentration in the well is decreasing. Arsenic concentrations  
24 in the 13 surface soil samples collected from SWMU 12 ranged in concentration from  
25 3.6J mg/kg to 14.2 mg/kg. All of these values are well within the range of arsenic  
26 background values observed in Zone I (0.46 mg/kg to 20 mg/kg), indicating that soils at the  
27 site are not causing the elevated concentration of arsenic detected in this well.

1 The range of background values for shallow groundwater observed in Zone I is from  
2 3  $\mu\text{g/L}$  to 66  $\mu\text{g/L}$ , and the BRC is 23  $\mu\text{g/L}$ . The arsenic in monitoring well I012GW002  
3 appears to be exceed natural background conditions at the site. However, although the  
4 concentration of arsenic in the samples from the monitoring well appear to be elevated, the  
5 concentrations of iron (104,000  $\mu\text{g/L}$ ) and manganese (4,920  $\mu\text{g/L}$ ) in this well are also  
6 highly elevated (see Table 12-4), indicating that this detection of arsenic is likely due to  
7 naturally occurring processes rather than RCRA-related operations.

8 For these reasons, arsenic is not considered a COC at SWMU 12.

### 9 **12.3.3.2 Bis(2-ethylhexyl)phthalate in Groundwater**

10 Bis(2-ethylhexyl)phthalate was detected in one of six groundwater samples at a  
11 concentration of 20  $\mu\text{g/L}$  (see Table 12-5). The maximum concentration was detected in the  
12 fourth sampling event at monitoring well I012GW003. Bis(2-ethylhexyl)phthalate was not  
13 detected in this well during the first sampling event. Bis(2-ethylhexyl)phthalate is a  
14 common laboratory contaminant. The range of laboratory detection limits (i.e., SQL) was 10  
15 to 25  $\mu\text{g/L}$ , indicating that the detected value is likely indicative of laboratory  
16 contamination and is not site-related. In soil, bis(2-ethylhexyl)phthalate was detected below  
17 the RBC, indicating that soils are not a likely source for the constituent in groundwater.  
18 Given that bis(2-ethylhexyl)phthalate was detected in only one sample at a concentration  
19 within the range of detection limits, that it is a common laboratory contaminant, and that a  
20 significant source was not detected in site soils, bis(2-ethylhexyl)phthalate is not considered  
21 a COC at SWMU 12.

### 22 **12.3.3.3 Dioxins in Groundwater**

23 Dioxins (calculated TEQs) were detected in three of five groundwater samples with  
24 concentrations ranging from 2.6J to 8.9J picogram per liter (pg/L) (see Table 12-6)<sup>11</sup>. Only  
25 the maximum detected concentration, however, exceeded the RBC value of 4.5 E-7  $\mu\text{g/L}$ .  
26 Dioxins resulted in a derived cancer risk greater than  $1 \times 10^{-6}$  for both residential and  
27 industrial receptors. The maximum concentration was detected in the first sampling event  
28 at monitoring well 012001. Dioxins were not detected in this well during the fourth  
29 sampling event. In soil, the TEQs for dioxins were below the RBC value. Given that dioxins  
30 were not detected in follow-up sampling and that a significant source was not detected in  
31 site soils, dioxins are not considered COCs at SWMU 12.

#### 1 **12.3.3.4 Thallium in Shallow Groundwater and Deep Groundwater**

2 Thallium was detected in 4 of 12 groundwater samples with only one detection of thallium  
3 (see Table 12-7). However, the observed concentrations of thallium in shallow groundwater  
4 at this site are consistent with the occurrences of thallium observed in Zone I grid wells.  
5 Thallium was detected intermittently in shallow grid wells at concentrations ranging from  
6 3J  $\mu\text{g}/\text{L}$  to 7.5J  $\mu\text{g}/\text{L}$  (see Appendix A-1). Given that the concentrations of thallium in  
7 shallow groundwater is consistent with grid well background conditions in Zone I and the  
8 occurrences were not duplicated in subsequent sampling events, thallium is not considered  
9 a COC in groundwater at SWMU 12.

#### 10 **12.3.3.5 Cadmium in Groundwater**

11 Cadmium was detected in 2 of 16 groundwater samples, both of which came from  
12 monitoring well I012GW002 at concentrations of 3.1  $\mu\text{g}/\text{L}$  and 1.1  $\mu\text{g}/\text{L}$  in the first and  
13 second sampling events, respectively. However, cadmium was not detected in either of the  
14 two subsequent sampling events (see Table 12-8). Neither detection exceeded the MCL for  
15 cadmium of 5  $\mu\text{g}/\text{L}$ . Given that the maximum detected value of cadmium does not exceed  
16 the MCL, cadmium is not considered a COC at SWMU 12.

#### 17 **12.3.4 COPC/COC Refinement Summary**

18 In summary, there are no COCs at SWMU 12 in soil or groundwater. Therefore, the site is  
19 recommended for NFA.

## 20 **12.4 Summary of Information Related to Site Closeout Issues**

### 21 **12.4.1 RFI Status**

22 The RFI report, as amended by the RFI Report Addendum, is complete.

### 23 **12.4.2 Presence of Inorganics in Groundwater**

24 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
25 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
26 antimony) in groundwater at concentrations above the applicable MCL, preceded or

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<sup>11</sup> The values for TEQs presented in Table 12-6 are slightly different than the values presented in the RFI report. The TEF values presented in this CMS Work Plan were calculated using the methodology identified by the BCT.

1 followed by detection of these same metals below the MCL or below the practicable  
2 quantitation limit. These constituents are addressed in Section 12.3.

### 3 **12.4.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC**

4 Data indicate that SWMU 12 was never connected to the sanitary sewer system. Therefore,  
5 there are no concerns regarding connections to the sanitary sewer. Further evaluation of this  
6 issue is not warranted.

### 7 **12.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

8 No direct connection of SWMU 12 to the storm sewer is known to exist. No COCs requiring  
9 further evaluation are present at the site. Further evaluation of this issue is not warranted.

### 10 **12.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

11 The area associated with SWMU 12 is located approximately 2,400 feet southwest of the  
12 nearest railroad line (located offsite). There is no known linkage between SWMU 12 and the  
13 investigated railroad lines of AOC 504, and further evaluation of this issue is not warranted.

### 14 **12.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

15 The nearest surface water body to SWMU 12 is Shipyard Creek, which lies approximately  
16 150 feet southeast of the unit. No COCs were identified at the site, so further evaluation of a  
17 potential pathway for contaminant migration is not warranted.

### 18 **12.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

19 There are no known OWSs associated with SWMU 12. Therefore, there are no concerns  
20 regarding connections to the sanitary sewer, and further evaluation of this issue is not  
21 warranted.

### 22 **12.4.8 Land Use Control Management Plan**

23 The COC refinement did not identify any COCs at SWMU 12. This evaluation was based on  
24 a unrestricted land use classification. Therefore, land use controls are not necessary.

## 25 **12.5 CH2M-Jones Recommendations**

26 Evaluation of the primary media of concern (surface soils, subsurface soils, and  
27 groundwater) indicated that there were no issues associated with the historical operation of,

- 1 or releases from, this unit. Based on a review of COPCs/COCs in Section 12.3, no COCs
- 2 were identified in soil or groundwater.
- 3 The RFI report concluded that CMS activities were necessary for shallow groundwater.
- 4 However, CH2M-Jones has re-evaluated the risks posed by the identified COCs and
- 5 determined that no COCs exist at SWMU 12. Therefore, this site is recommended for NFA.

1

**TABLE 12-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

Sampling Event	Sampling Dates	Samples Collected	Sample Analyses	Comments
1	03/08/95 03/09/95	Upper - 12 (13)	Standard Suite, Organotins, Physical Parameters	One sample location was inaccessible.
		Lower - 0 (13)	NA	Lower samples were not collected due to a water table at less than 5 feet bgs.
		Duplicate - 2	Appendix IX	
2	06/20/95	Upper - 3	SVOCs	Samples were collected delineate the potential extent of PAHs.
3	12/10/98	Upper - 3	Dioxins	Dioxin samples were collected in Dec. 1998 to further delineate the extent of dioxin at the site.
		Lower - 3	Dioxins	
		Duplicate - 1	Dioxins	

2  
3  
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**Notes:**

- NA = Not Applicable
- () = Parenthesis indicate number of samples proposed in RFI work plan.
- Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.
- Appendix IX = Standard Suite, plus hex-chrome, dioxins, herbicides, pesticides at DQO Level IV.
- Physical parameters analysis included CEC, chloride, sulfur, ammonia, nitrate/nitrite, phosphorus, TOC, and total moisture.

1

**TABLE 12-2**  
 RFI Groundwater Sampling Summary  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

Sampling event	Sampling Date	Number of Wells	Sample Analyses	Comments
1	06/08/95 06/12/95	3	Standard Suite, organotins, chloride, TDS, sulfate, herbicides, hex-chrome, OP pesticides, dioxins	Additional samples were collected for site characterization.
2	01/16/96	3	Chloride, cyanide, sulfate, metals, pesticides, PCBs, TDS	1 well (012001) was analyzed for chloride, sulfate, and TDS.
3	05/31/96 06/03/96	3	Chloride, cyanide, sulfate, metals, pesticides, PCBs, TDS	1 well (012001) was analyzed for chloride, sulfate, and TDS.
4	09/04/96 09/09/96	3	Standard Suite, chloride, TDS, sulfate, dioxins	NA

2

3

4

**Notes:**  
 Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs at DQO Level III.

**TABLE 12-3**  
 VOCs Detected in Surface Soils  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Acetone		Toluene		Methyl ethyl ketone (2-Butanone)		
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	
			IND RBC	20,000	41,000		120,000		
			RES RBC	780	1600		4700		
			SSL	0.8	0.6		NA		
			SS BKGD	NA	NA		NA		
I012SB001	012SB00101a	03/08/95		0.031	J	0.011	J	0.05	UJ
I012SB002	012SB00201	03/08/95		0.06	J	0.021	U	0.048	UJ
I012SB003	012SB00301	03/09/95		0.015	J	0.01	J	0.043	U
I012SB004	012SB00401	03/09/95		0.012	UJ	0.002	J	0.045	UJ
I012SB005	012SB00501	03/09/95		0.13	UJ	0.022	U	0.051	UJ
I012SB006	012SB00601	03/09/95		0.13	UJ	0.022	U	0.051	UJ
I012SB007	012SB00701	03/09/95		0.012	J	0.005	J	0.049	UJ
I012SB008	012SB00801	03/09/95		0.045	J	0.005	J	0.013	J
I012SB009	012SB00901	03/09/95		0.047	J	0.01	J	0.049	UJ
I012SB010	012SB01001	03/09/95		0.01	J	0.009	J	0.046	UJ
I012SB011	012SB01101	03/09/95		0.013	J	0.02	J	0.049	UJ
I012SB012	012SB01201	03/09/95		0.067	J	0.027	=	0.011	J

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 mg/kg Milligrams per kilogram

**TABLE 12-4**  
 Arsenic, Iron and Manganese in Groundwater  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Arsenic Result (µg/L)	Qualifier	Iron Result (µg/L)	Qualifier	Manganese Result (µg/L)	Qualifier
		<b>MCL</b>	50.0000		300.0000		50.0000	
		<b>RBC</b>	0.0450		1,100.0000		73.0000	
		<b>Shallow</b>	66.0000		31,900.0000		4,850.0000	
		<b>Deep</b>	25.0000		12,200.0000		690.0000	
<b>Shallow Groundwater</b>								
I012GW001	012GW00101c	06/12/95	3.2000	U	68.5000	J	129.0000	=
	012GW00102	01/16/96	5.0000	U	119.0000	=	116.0000	=
	012GW00103	05/31/96	5.0000	U	24.6000	J	76.5000	=
	012GW00104	09/09/96	7.8000	U	1,190.0000	=	222.0000	=
	012GW00105	05/20/99	3.3000	U	NA		NA	
I012GW002	012GW00201	06/08/95	177.0000	=	93,700.0000	=	4,870.0000	=
	012GW00202	01/16/96	220.0000	=	93,500.0000	=	4,920.0000	=
	012GW00203	05/31/96	188.0000	=	104,000.0000	=	2,860.0000	=
	012GW00204	09/04/96	253.0000	J	48,000.0000	=	2,770.0000	J
	012GW002F5	01/15/99	40.5000	J	NA		NA	
	012GW002U5	01/15/99	40.7000	J	NA		NA	
	012GW00206	05/20/99	128.000	=	NA		NA	
I012GW003	012GW00301	06/06/95	3.2000	U	2,070.0000	=	93.5000	=
	012GW00302	01/16/96	5.0000	U	1,020.0000	=	66.8000	=
	012GW00303	06/03/96	5.0000	U	471.0000	=	56.5000	=
	012GW00304	09/09/96	4.0000	U	811.0000	=	62.6000	J
	012GW00305	05/20/99	3.3000	U	NA		NA	
GDIGW003	GDIGW00301a	04/24/95	3.2000	U	8,530.0000	=	616.0000	=
	GDIGW00302	12/14/95	5.0000	U	6,430.0000	J	543.0000	J
	GDIGW00303	05/20/96	2.9000	J	7,180.0000	J	509.0000	J
	GDIGW00304	08/21/96	4.9000	J	6,190.0000	J	409.0000	J
	GDIGW00305	05/20/99	3.3000	U	NA		NA	

**TABLE 12-4**  
 Arsenic, Iron and Manganese in Groundwater  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Arsenic Result (µg/L)	Qualifier	Iron Result (µg/L)	Qualifier	Manganese Result (µg/L)	Qualifier
		<b>MCL</b>	50.0000		300.0000		50.0000	
		<b>RBC</b>	0.0450		1,100.0000		73.0000	
		<b>Shallow</b>	66.0000		31,900.0000		4,850.0000	
		<b>Deep</b>	25.0000		12,200.0000		690.0000	
<b>Deep Groundwater</b>								
IGDIGW03D	GDIGW03D01b	06/09/95	3.2000	U	2,290.0000	=	247.0000	=
	GDIGW03D02	12/15/95	5.0000	U	12,200.0000	J	261.0000	J
	GDIGW03D03	05/23/96	5.0000	U	5,970.0000	=	202.0000	=
	GDIGW03D04	08/21/96	3.3000	J	3,180.0000	J	174.0000	J
	GDIGW03D05	05/20/99	3.3000	U	NA		NA	
=	Chemical is detected at concentration shown.							
J	Chemical is detected at concentration below the method detection limit; the concentration is not known.							
U	Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).							
µg/L	Micrograms per liter							
NA	Not analyzed							

**TABLE 12-5**  
 Bis(2-ethylhexyl)phthalate in Groundwater  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

Sample Station	ID	Date	bis(2-Ethylhexyl) Phthalate Result (µg/L)	Qualifier
			<b>MCL</b>	NA
			<b>RBC</b>	4.8
			<b>Shallow</b>	NA
<b>Shallow Groundwater</b>				
I012GW001	012GW00104	09/09/96	10.0000	U
	012GW00101b	06/08/95	25.0000	UJ
I012GW002	012GW00204	09/04/96	10.0000	U
	012GW00201	06/08/95	25.0000	U
I012GW003	012GW00304	09/09/96	<b>20.0000</b>	=
	012GW00301	06/06/95	10.0000	U
	GDIGW00304	08/21/96	10.0000	U
	GDIGW00303	05/20/96	10.0000	U
	GDIGW00302	12/14/95	11.0000	U
	GDIGW00301a	04/24/95	10.0000	U
<b>Deep Groundwater</b>				
IGDIGW03D	GDIGW03D04	08/21/96	10.0000	U
	GDIGW03D03	05/23/96	10.0000	U
	GDIGW03D02	12/15/95	11.0000	U
	GDIGW03D01b	06/09/95	25.0000	U

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 µg/L Micrograms per liter

TABLE 12-6  
 Dioxins in Groundwater  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

Station ID	I012GW001	I012GW001	I012GW002	I012GW003	IGDIGW003	IGDIGW003	IGDIGW003	IGDIGW003	IGDIGW003	IGDIGW003D	IGDIGW003D	
Sample ID	I012GW00104c	I012GW00104	I012GW00204	I012GW00304	IGDIGW00301b	IGDIGW00302	IGDIGW00303	IGDIGW00304	IGDIGW00304	IGDIGW003D01a	IGDIGW003D04	
Date Collected	06/12/95	09/09/96	09/04/96	09/09/96	05/12/95	12/14/95	05/20/96	08/21/96	06/08/95	06/21/96		
Parameter	Units											
1,2,3,7,8-Pentachlorodibenzofuran	1,2,3,7,8-PeCDF	2.671 =	2.85 U	1.53 U	2.02 U	4.189 U	2.35 U	1.26 U	2.88 U	1.183 U	2.72 U	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1,2,3,7,8-PeCDD	1.576 U	3.62 U	2.38 U	2.4 U	7.846 U	2.81 U	2.81 U	3.31 U	1.972 U	3.39 U	
2,3,4,7,8-Pentachlorodibenzofuran	2,3,4,7,8-PeCDF	0.56 U	2.75 U	1.48 U	1.95 U	4.178 U	2.31 U	1.26 U	2.77 U	1.176 U	2.62 U	
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1,2,3,6,7,8-HxCDD	1.938 J	3.18 U	1.89 U	2.07 U	4.84 U	2.25 U	1.77 U	6.34 =	0.919 U	2.6 U	
1,2,3,7,8,9-Hexachlorodibenzofuran	1,2,3,7,8,9-HxCDF	6.766 J	2.83 U	1.42 U	1.8 U	4.078 U	2.11 U	1.52 U	1.3 U	5.6 J	1.46 U	
2,3,4,6,7,8-Hexachlorodibenzofuran	2,3,6,7,8-HxCDF	2.838 =	2.68 U	1.35 U	1.71 U	3.903 U	2.04 U	1.48 U	8.54 =	0.962 U	1.38 U	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	1,2,3,4,6,7,8-HpCDF	111.889 =	3.24 U	2.54 U	2.61 U	5.652 J	3.15 U	41.7 J	80.2 =	9.31 J	2.7 U	
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1,2,3,4,6,7,8-HpCDD	14.857 =	5 U	2.21 U	4.11 U	2.601 U	2.07 U	2.96 U	10 J	3.24 J	3.52 U	
1,2,3,4,7,8,9-Heptachlorodibenzofuran	1,2,3,4,7,8,9-HpCDF	0.768 U	3.73 U	2.93 U	3 U	4.905 U	3.68 U	2.06 U	2.54 U	1.443 U	3.11 U	
1,2,3,4,7,8-Hexachlorodibenzofuran	1,2,3,4,7,8-HxCDF	7.691 J	2.88 U	1.44 U	1.83 U	3.84 U	2.02 U	13.1 J	1.32 U	0.908 U	1.48 U	
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1,2,3,4,7,8-HxCDD	0.922 U	4.38 U	2.6 U	2.85 U	4.798 U	2.79 U	2.82 U	3.38 U	0.999 U	3.58 U	
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1,2,3,7,8,9-HxCDD	0.772 U	3.31 U	1.97 U	2.16 U	4.45 U	2.3 U	2.05 U	2.56 U	0.836 U	2.71 U	
1,2,3,6,7,8-Hexachlorodibenzofuran	1,2,3,6,7,8-HxCDF	7.076 =	2.09 U	1.05 U	1.33 U	3.57 U	1.69 U	0.988 U	8.4 =	0.834 U	1.08 U	
2,3,7,8-Tetrachlorodibenzofuran	2,3,7,8-TCDF	1.127 U	3.53 U	1.39 U	2.74 U	4.094 U	2 U	1.55 U	3.67 U	1.534 U	2.33 U	
2,3,7,8-Tetrachlorodibenzo-p-dioxin	2,3,7,8-TCDD	0.818 U	4.95 U	2.6 U	3.37 U	4.191 U	3.48 U	2.41 U	3.22 U	0.998 U	3.55 U	
Octachlorodibenzofuran	OCDF	359.642 =	3.72 U	1.66 U	2.9 U	10.463 J	2.36 U	34 J	153 =	27.512 J	3.4 U	
Octachlorodibenzo-p-dioxin	OCDD	105.868 =	3.67 U	4.36 J	2.85 U	8.749 J	8.9 =	3.54 U	30.8 =	13.57 U	3.99 U	
<b>TEFs</b>												
1,2,3,7,8-Pentachlorodibenzofuran	1,2,3,7,8-PeCDF	0.05	0.13355 =	0.07125 U	0.03825 U	0.0505 U	0.104725 U	0.05875 U	0.0315 U	0.072 U	0.029575 U	0.068 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1,2,3,7,8-PeCDD	1	0.788 U	1.81 U	1.19 U	1.2 U	3.923 U	1.405 U	1.405 U	1.655 U	0.986 U	1.685 U
2,3,4,7,8-Pentachlorodibenzofuran	2,3,4,7,8-PeCDF	0.5	0.14 U	0.6875 U	0.37 U	0.4875 U	1.0445 U	0.5775 U	0.315 U	0.6925 U	0.294 U	0.655 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1,2,3,6,7,8-HxCDD	0.1	0.1938 J	0.159 U	0.0945 U	0.1035 U	0.242 U	0.1125 U	0.0885 U	0.634 =	0.04595 U	0.13 U
1,2,3,7,8,9-Hexachlorodibenzofuran	1,2,3,7,8,9-HxCDF	0.1	0.6766 J	0.1415 U	0.071 U	0.09 U	0.2039 U	0.1055 U	0.076 U	0.065 U	0.56 J	0.073 U
2,3,4,6,7,8-Hexachlorodibenzofuran	2,3,6,7,8-HxCDF	0.1	0.2838 =	0.134 U	0.0675 U	0.0855 U	0.19515 U	0.102 U	0.074 U	0.854 =	0.0481 U	0.069 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran	1,2,3,4,6,7,8-HpCDF	0.01	1.11889 =	0.0162 U	0.0127 U	0.01305 U	0.05652 J	0.01575 U	0.417 J	0.802 =	0.0331 J	0.0135 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1,2,3,4,6,7,8-HpCDD	0.01	0.14857 =	0.025 U	0.01105 U	0.02055 U	0.013005 U	0.01035 U	0.0148 U	0.1 J	0.0324 J	0.0176 U
1,2,3,4,7,8,9-Heptachlorodibenzofuran	1,2,3,4,7,8,9-HpCDF	0.01	0.00384 U	0.01865 U	0.01465 U	0.015 U	0.024025 U	0.0184 U	0.0103 U	0.0127 U	0.007215 U	0.01555 U
1,2,3,4,7,8-Hexachlorodibenzofuran	1,2,3,4,7,8-HxCDF	0.1	0.7691 J	0.144 U	0.072 U	0.0915 U	0.192 U	0.101 U	1.31 J	0.063 U	0.0454 U	0.074 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1,2,3,4,7,8-HxCDD	0.1	0.0461 U	0.219 U	0.13 U	0.1425 U	0.2399 U	0.1395 U	0.141 U	0.169 U	0.04995 U	0.179 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1,2,3,7,8,9-HxCDD	0.1	0.0386 U	0.1655 U	0.0985 U	0.108 U	0.2225 U	0.115 U	0.1025 U	0.128 U	0.0418 U	0.1355 U
1,2,3,6,7,8-Hexachlorodibenzofuran	1,2,3,6,7,8-HxCDF	0.1	0.7076 =	0.1045 U	0.0525 U	0.0665 U	0.1785 U	0.0845 U	0.0494 U	0.84 =	0.0417 U	0.054 U
2,3,7,8-Tetrachlorodibenzofuran	2,3,7,8-TCDF	0.1	0.05635 U	0.1765 U	0.0695 U	0.137 U	0.2047 U	0.1 U	0.0775 U	0.1835 U	0.0767 U	0.1165 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin	2,3,7,8-TCDD	1	0.409 U	2.475 U	1.3 U	1.685 U	2.955 U	1.74 U	1.205 U	1.61 U	0.499 U	1.775 U
Octachlorodibenzofuran	OCDF	0.0001	0.0359642 =	0.000186 U	0.000084 U	0.000145 U	0.0010463 J	0.000118 U	0.0034 J	0.0153 =	0.002751 J	0.00017 U
Octachlorodibenzo-p-dioxin	OCDD	0.0001	0.0105868 =	0.0001835 U	0.000438 J	0.000143 U	0.0008749 J	0.00089 =	0.000177 U	0.00303 =	0.000679 U	0.0002 U
<b>TEFs</b>			5.6 J	6.3 U	3.6 U	4.3 U	8.9 J	4.7 U	5.3 U	7.9 J	2.9 J	5.1 U

= Chemical is detected at concentration shown.  
 J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 pg/L picograms per liter

**TABLE 12-7**  
 Thallium in Groundwater  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

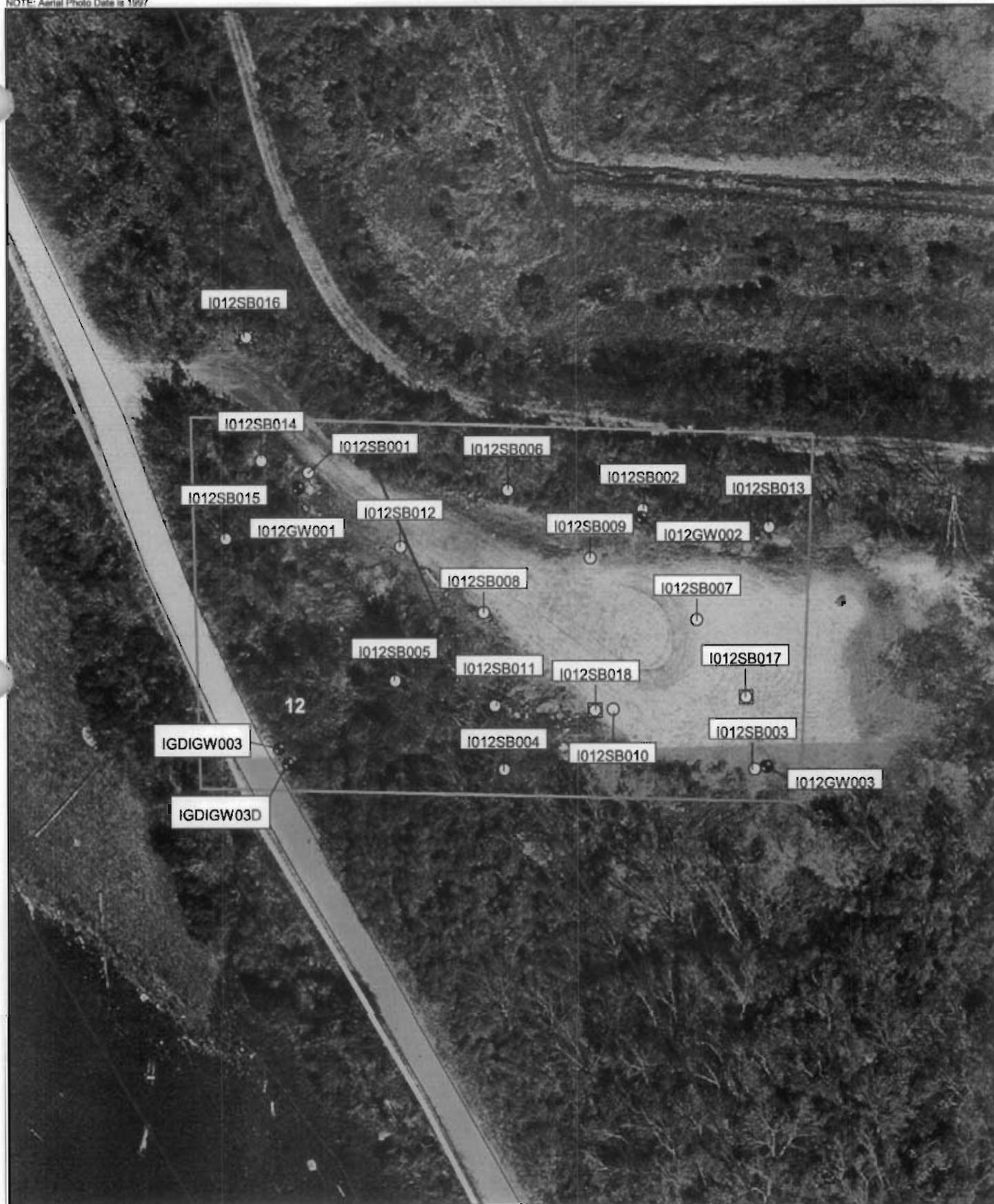
Sample Station	ID	Date	Thallium Result		Qualifier
			MCL	( $\mu\text{g/L}$ )	
			MCL	2.0000	
			RBC	0.2600	
			Shallow	8	
			Deep	15	
<b>Shallow Groundwater</b>					
I012GW001	012GW00101c	06/12/95		4.5000	U
	012GW00102	01/16/96		5.0000	U
	012GW00103	05/31/96		5.0000	U
	012GW00104	09/09/96		2.7000	UJ
	012GW00105	05/20/99		<b>2.4000</b>	J
I012GW002	012GW00201	06/08/95		4.5000	U
	012GW00202	01/16/96		5.0000	U
	012GW00203	05/31/96		5.0000	U
	012GW00204	09/04/96		2.7000	UJ
	012GW00206	05/20/99		<b>2.5000</b>	J
	012GW002F5	01/15/99		3.1000	U
I012GW003	012GW002U5	01/15/99		3.1000	U
	012GW00301	06/06/95		4.5000	U
	012GW00302	01/16/96		5.0000	U
	012GW00303	06/03/96		5.0000	U
	012GW00304	09/09/96		<b>4.3000</b>	J
	012GW00305	05/20/99		2.3000	UJ
	GDIGW00301a	04/24/95		4.5000	UJ
	GDIGW00302	12/14/95		5.0000	UJ
	GDIGW00303	05/20/96		<b>2.8000</b>	J
	GDIGW00304	08/21/96		2.7000	UJ
GDIGW00305	05/20/99		2.3000	UJ	
<b>Deep Groundwater</b>					
IGDIGW03D	GDIGW03D01b	06/09/95		4.5000	U
	GDIGW03D02	12/15/95		5.0000	UJ
	GDIGW03D03	05/23/96		5.0000	UJ

**TABLE 12-7**  
 Thallium in Groundwater  
 CMS Work Plan, SWMU 12, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Thallium Result ( $\mu\text{g/L}$ )	Qualifier
			MCL	2.0000
			RBC	0.2600
			Shallow	8
			Deep	15
	GDIGW03D04	08/21/96	2.7000	UJ
	GDIGW03D05	05/20/99	2.3000	UJ

J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 UJ Not detected; analytical detection limit is estimated.  
 $\mu\text{g/L}$  Micrograms per liter

NOTE: Aerial Photo Date is 1997



- Surface Soil Sample
- Subsurface Soil Sample
- Groundwater Sample
- Roads
- Shoreline
- AOC Boundary
- SWMU Boundary
- Zone Boundary

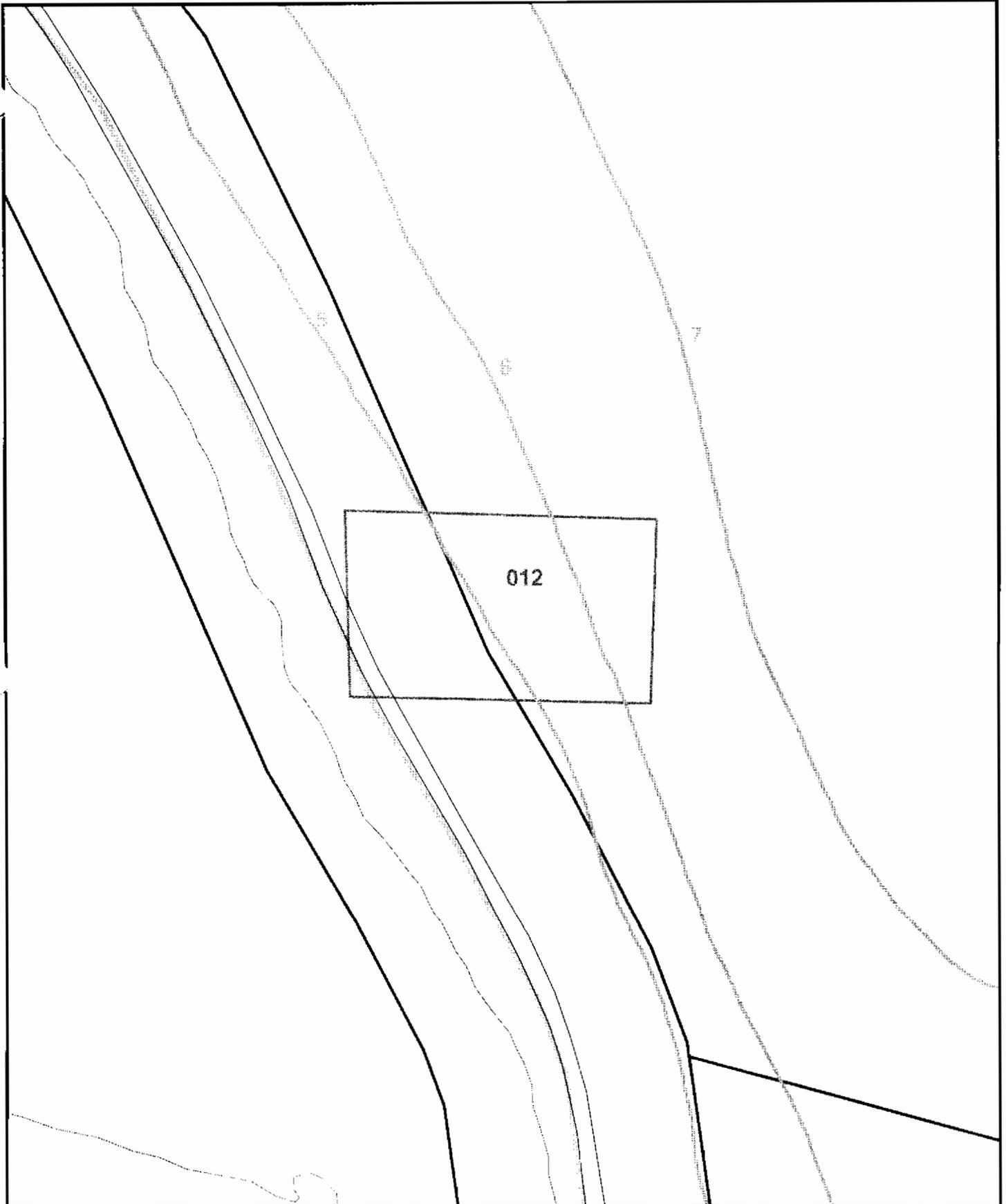


0 50 100 Feet

1 inch = 50 feet

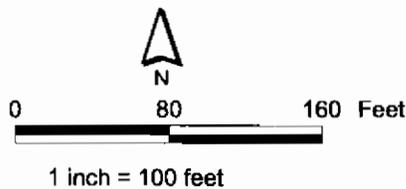
**Figure 12-1**  
Sample and Test Location Map  
SWMU 12  
Zone I  
Charleston Naval Complex

**CH2M HILL**



**Figure 12-2**  
 Shallow Groundwater Contour Map  
 SWMU 12, Zone I  
 Charleston Naval Complex

- Inferred Groundwater Elevations (ft msl)
- Known Groundwater Elevations (ft msl)
- Fence
- Railroads
- Roads
- Shoreline
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary





## 1 13.0 CMS Work Plan for SWMU 177/RTC

2 This section summarizes the results and conclusions from the soil and groundwater  
3 investigations conducted at SWMU 177/RTC, which were reported in the *Zone I RFI Report,*  
4 *Revision 0* (EnSafe, 1999), Section 10.12, and as amended by the *Zone I RFI Report Addendum,*  
5 *Revision 1* (CH2M-Jones, 2001). Figure 13-1 presents the site features and RFI sample  
6 locations.

7 As part of the Zone I RFI, four surface soil and subsurface soil investigations and two  
8 groundwater sampling events were conducted at SWMU177/RTC. The RFI report  
9 presented the results of the investigations and conclusions concerning contamination and  
10 risk, as summarized in Sections 13.1 and 13.2 of this CMS Work Plan. A further evaluation  
11 of COCs is provided in Section 13.3 of this work plan.

### 12 13.1 Background

13 SWMU 177/RTC consisted of two adjacent buildings, both designated as Building RTC-4.  
14 The original RTC-4 was a 24 x 60-foot metal structure used to house heavy equipment,  
15 including backhoes and trackhoes. The designation RTC-4 was also given to the newer  
16 building, which was constructed next to the original RTC-4. The newer RTC-4 was used to  
17 store lawn mowers and other lawn maintenance equipment. This unit was designated as a  
18 SWMU due to oil spillage associated with operations at the two buildings. Visual  
19 inspections during the RFA identified several areas of stained soil and concrete in and  
20 around the two buildings. These buildings were both less than 50 feet from the Cooper  
21 River.

22  
23 This area was included in a lease agreement between the Navy and the National  
24 Oceanographic and Atmospheric Administration (NOAA) in the spring of 1995. Since  
25 taking over this area, NOAA has removed both buildings and installed a diesel fuel  
26 aboveground storage tank (AST) and three generators at the site.

27 The area is zoned for business use (B-2).

## 1 **13.2 RFI Investigation Results**

### 2 **13.2.1 Soil Investigation Results**

3 As part of the RFI field investigation, surface and subsurface soils were collected (see  
4 Figure 13-1) during four sampling events conducted in 1995, 1996 and 1998, and analyzed  
5 for the parameters listed in Table 13-1.

#### 6 **13.2.1.1 Surface Soils**

7 Twenty-nine surface soil samples were collected during the four sampling events (see  
8 Table 13-1). Surface soil sample analytical results were evaluated relative to the EPA Region  
9 III RBC. Based on the analysis presented in the RFI report, BEQs in surface soil were  
10 identified as COCs under the unrestricted land use scenario.

#### 11 **13.2.1.2 Subsurface Soils**

12 Sixteen subsurface soil samples were collected during the four sampling events and  
13 analyzed for various parameters as shown in Table 13-1. Subsurface soil sample analytical  
14 results were evaluated relative to EPA Region III unrestricted and industrial risk-based  
15 concentration and SSLs with a DAF=10. Based on the analysis presented in the RFI report,  
16 Sample I177SB0087 exceeded the reported BEQ Region III SSL of 1.6 mg/kg<sup>12</sup>. As a result of  
17 the screening process and subsequent risk analysis, BEQs were identified as COCs for  
18 subsurface soils under the unrestricted land use scenario.

### 19 **13.2.2 Groundwater**

20 Shallow groundwater at this site flows northward toward the Cooper River, with contours  
21 that essentially duplicate the shoreline (see Figure 13-2).

22 Two shallow monitoring wells were installed as part of the RFI investigation. During two  
23 sampling events, groundwater samples were obtained from both of the new shallow wells,  
24 plus grid well pair IGDIGW016/IGDIGW016D, and analyzed for various parameters (see  
25 Table 13-2). The grid well pair was sampled during four sampling events for VOCs, SVOCs,  
26 pesticides/PCBs, cyanide, metals, chloride, sulfate, and TDS.

---

<sup>12</sup> CH2M-Jones has not been able to establish the source of the 1.6 mg/kg Region III SSL used in the RFI report. However, this criteria was presented for comparative purposes in Table 10.12.2 as a Region III RBC and in Table 10.12.4 as a soil-to-groundwater SSL.

1 Constituents detected in the groundwater samples were evaluated relative to MCLs, tap  
2 water RBCs, and Zone I groundwater BRCs. The following sections set out the findings as  
3 presented in the RFI report.

#### 4 **13.2.2.1 Shallow Groundwater**

5 Analytes detected in shallow groundwater samples were evaluated in the RFI report. As a  
6 result of the screening process and subsequent risk analysis, no COCs for shallow  
7 groundwater were identified at SWMU 177/RTC.

#### 8 **13.2.2.2 Deep Groundwater**

9 Analytes detected in deep groundwater samples from grid well IGDIGW016D were  
10 evaluated in the RFI report. As a result of the screening process and subsequent risk  
11 analysis, no COCs for deep groundwater were identified at SWMU 177/RTC.

### 12 **13.2.3 RFI Risk Summary**

13 Based on unrestricted and industrial land use scenarios, the following COCs were identified  
14 in the RFI report:

15 **Surface Soil:** BEQs

16 **Subsurface Soil:** BEQs

### 17 **13.2.4 Recommendations from *Zone I RFI Report, Revision 0***

#### 18 **13.2.4.1 Soil**

19 EnSafe assumed that future land use would be unrestricted and recommended a CMS for  
20 soils, considering no action, excavation with offsite disposal, and containment/capping  
21 options.

#### 22 **13.2.4.2 Groundwater**

23 No groundwater COCs were identified; therefore, NFA for groundwater was recommended  
24 in the RFI report.

## 25 **13.3 COPC/COC Refinement**

26 The COCs identified in the RFI include BEQs in surface and subsurface soil, which are  
27 further evaluated in the following sections. In addition, concentrations of VOCs detected in  
28 soils were rescreened using an SSL based on a DAF=1.

1 **13.3.1 Surface Soil**

2 **13.3.1.1 Rescreening of Surface Soil VOC Data Based on SSL (DAF=1)**

3 The results following rescreening of the VOCs detected in surface soils using an SSL with a  
4 DAF=1 indicated that there were two VOCs at concentrations exceeding their respective  
5 SSLs: methylene chloride and 1,1,2,2-Tetrachloroethane (see Table 13-3). Each of these  
6 compounds are discussed below.

7 ***Methylene Chloride***

8 Methylene chloride was detected in 2 of 29 surface soil samples and at a maximum  
9 concentration of 12 µg/kg. Methylene chloride is a common laboratory contaminant, so its  
10 presence may be indicative of laboratory contamination. In addition, methylene chloride  
11 was not detected in groundwater at the site, indicating that significant leaching into  
12 groundwater has not occurred. Consequently, methylene chloride is not considered a COC  
13 for soils at SWMU 177 /RTC.

14 ***1,1,2,2-Tetrachloroethane***

15 1,1,2,2-Tetrachloroethane was detected in only 1 of 29 surface soil samples (0.002 mg/kg at  
16 I177SB017), and it was not detected in either subsurface soil or groundwater. Given the  
17 single detection (<5 percent of the samples) and its absence in subsurface soil and  
18 groundwater, 1,1,2,2,-Tetrachloroethane is not considered a COC at SWMU 177/RTC.

19 **13.3.1.2 BEQs in Surface Soil**

20 BEQs were detected in 7 of 27 samples of surface soil, with a maximum detected value of  
21 1.459 mg/kg (I177SB010) (see Table 13-4). The base-wide reference concentration for BEQs  
22 in surface soil is 1.304 mg/kg. The maximum detected value of 1.459 mg/kg was the only  
23 sample that exceeded the base-wide reference concentration.

24 Although the maximum concentration of BEQs in surface soil exceeded the base-wide  
25 reference concentration, the other site samples were indicative of background conditions at  
26 the site. In addition, all but one subsurface soil sample were below both the base-wide  
27 reference concentration and the SSL value. The single subsurface soil exceedance occurred  
28 at sample location I177SB007. In addition, the entire site area is paved with asphalt. It is not  
29 likely that the elevated concentration of BEQs in surface soil represents site constituents,  
30 given the numerous anthropogenic sources of BEQs at the facility. BEQs, are not considered  
31 a COC in surface soil at SMWU 177.

## 1 **13.3.2 Subsurface Soils**

2 BEQs were identified as the only COCs in the RFI report.

### 3 **13.3.2.1 Rescreening of Subsurface Soil VOC Data Based on SSL (DAF=1)**

4 The results following rescreening of the VOCs detected in subsurface soils using an SSL  
5 with a DAF=1 indicated that there was only one VOC at a concentration exceeding its SSL:  
6 methylene chloride (see Table 13-4).

#### 7 ***Methylene Chloride***

8 Methylene chloride was detected in 2 of 16 subsurface soil samples with a maximum  
9 concentration of 15 µg/kg. Methylene chloride is a common laboratory contaminant, so its  
10 presence may be indicative of laboratory contamination. In addition, methylene chloride  
11 was not detected in groundwater at the site, indicating that significant leaching into  
12 groundwater has not occurred. Consequently, methylene chloride is not considered a COC  
13 for soils at SWMU 177/RTC.

### 14 **13.3.2.2 BEQs in Subsurface Soil**

15 BEQs were detected in only 1 of 16 samples of subsurface soil, with a maximum detected  
16 value of 2.899 mg/kg (I177SB007) (see Table 13-6). The base-wide reference concentration  
17 for BEQs in subsurface soil is 1.400 mg/kg. The maximum detected value of 2.899 mg/kg  
18 was the only sample that exceeded the base-wide reference concentration and was the only  
19 detection of BEQs in the subsurface soils. BEQs were not detected in the surface soil sample  
20 collected at the same location (detection limit = 0.439 mg/kg).

21 Although the maximum concentration of BEQs in subsurface soil exceeded the base-wide  
22 reference concentration, all other site samples were non-detects. In addition, the entire site  
23 area is paved with asphalt. It is not likely that the elevated concentration of BEQs in surface  
24 soil represents site constituents, given the numerous anthropogenic sources of BEQs at the  
25 facility. BEQs are not considered a COC in subsurface soil at SMWU 177.

## 26 **13.2.3 Groundwater**

27 No COPCs or COCs were identified in groundwater at SWMU 177/RTC. Therefore, for  
28 future industrial/commercial land use, no further actions are necessary for groundwater.

## 29 **13.3.4 COPC/COC Refinement Summary**

30 In summary, there are no COCs at SWMU 177/RTC in soil or groundwater. Therefore, the  
31 site is recommended for NFA.

## 1 **13.4 Summary of Information Related to Site Closeout Issues**

### 2 **13.4.1 RFI Status**

3 The RFI report, as amended by the RFI Report Addendum, is complete.

### 4 **13.4.2 Presence of Inorganics in Groundwater**

5 For the purpose of site closeout documentation, the inorganics in groundwater issue refers  
6 to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and  
7 antimony) in groundwater at concentrations above the applicable MCL, preceded or  
8 followed by detection of these same metals below the MCL or below the practicable  
9 quantitation limit. These constituents are addressed in Section 13.3 above.

### 10 **13.4.3 Potential Linkage to SWMU 177/RTC, Investigated Sanitary Sewers at the CNC**

11 Data indicate that SWMU 177/RTC was never connected to the sanitary sewer system.  
12 Therefore, there are no concerns regarding connections to the sanitary sewer. Further  
13 evaluation of this issue is not warranted.

### 14 **13.4.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC**

15 No direct connection of SWMU 177/RTC to the storm sewer is known to exist. No COCs  
16 requiring further evaluation are present at the site. Further evaluation of this issue is not  
17 warranted.

### 18 **13.4.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC**

19 The area associated with SWMU 177/RTC is located approximately 4,350 feet west-  
20 northwest of the nearest railroad line (located in Zone E). There is no known linkage  
21 between SWMU 177/RTC and the investigated railroad lines of AOC 504, and further  
22 evaluation of this issue is not warranted.

### 23 **13.4.6 Potential Migration Pathways to Surface Water Bodies at the CNC**

24 The nearest surface water body to SWMU 177/RTC is the Cooper River, which lies  
25 approximately 10 feet northwest of the unit. The only potential migration pathway from the  
26 site to surface water is via overland flow via stormwater runoff. Since the entire site is  
27 covered with pavement, which eliminates contact of surface soil with stormwater, and no  
28 COCs were identified at the site, further evaluation of a potential pathway for contaminant

1 migration via stormwater runoff is not warranted. Similarly, runoff directed to the storm  
2 sewer system, which discharges to the Cooper River, does not contact the surface soil.

### 3 **13.4.7 Potential Contamination in Oil/Water Separators (OWSs)**

4 There are no OWSs associated with SWMU 177/RTC. Therefore, there are no concerns  
5 regarding connections to the sanitary sewer, and further evaluation of this issue is not  
6 warranted. In addition, there is no reference to an OWS at this facility in the *Oil Water*  
7 *Separator Data* report (Department of the Navy, September 2000).

### 8 **13.4.8 Land Use Control Management Plan**

9 The COC refinement did not identify any COCs at SWMU 177/RTC. This evaluation was  
10 based on a unrestricted land use classification. Therefore, land use controls are not  
11 necessary.

## 12 **13.5 CH2M-Jones Recommendations**

13 Evaluation of the primary media of concern (surface soils, subsurface soils, and  
14 groundwater) indicated that there were no issues associated with the historical operation of,  
15 or releases from, this unit. Based on a review of COPCs/COCs in Section 13.3, no COCs  
16 were identified in soil or groundwater.

17 The RFI report concluded that CMS activities were necessary for soil. However, CH2M-  
18 Jones has re-evaluated the risks posed by the identified COCs and determined that no  
19 COCs exist at SWMU 177/RTC. Therefore, this site is recommended for NFA.

1

**TABLE 13-1**  
 RFI Soil Sampling Summary  
 CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex

Sampling event	Sampling Date	Samples Collected	Sample Analyses
1	05/26/95	Upper - 10 (10) Duplicate - 2	Standard Suite Standard Suite, Dioxins
2	06/07/96	Upper - 7 Lower - 6	Standard Suite, DRO, GRO, Dioxins Standard Suite, DRO, GRO, Dioxins
3	04/03/98	Upper - 8 Lower - 6	VOCs, SVOCs VOCs, SVOCs
4	06/17/98	Upper - 4 Lower - 4	VOCs, SVOCs VOCs, SVOCs

2

3

**Notes:**

4

( ) = Parentheses indicate the number of samples proposed.

5

Standard Suite = VOCs, SVOCs, metals, cyanide, pesticides, and PCBs were analyzed at DQO Level III.

1

**TABLE 13-2**  
RFI Groundwater Sampling Summary  
*CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex*

<b>Sampling Round</b>	<b>Sampling Date</b>	<b>Wells Sampled</b>	<b>Sample Analyses</b>
1	04/15/98	177001 177002	VOCs, SVOCs
2	08/17/98	177001 177002	VOCs, SVOCs, metals

2

TABLE 13-3  
 VOCs Detected in Surface Soils  
 CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Benzene		Ethylbenzene		Toluene		Xylenes, Total		Acetone		1,2-Dichloroethene (total)		2-Hexanone	
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier
			IND RBC	100.0000		20000.0000		41000.0000				20000.0000		1,800		8200.0000
			RES RBC	12.0000		780.0000		1600.0000				780.0000		70.0000		310.0000
			SSL	0.0020		0.7000		0.6000				0.8000		0.0190		NA
			SS BKGD	NA		NA		NA				NA		NA		NA
I177SB001	177SB00101	06/07/96	0.0060	U	0.0060	U	0.0060	U	0.0060	U	0.0180	J	0.0060	U	0.0110	UJ
	177SB00124	02/05/01	0.0024	U	0.0007	J	0.0010	J	0.0044	=						
I177SB002	177SB00201	06/07/96	0.0050	U	0.0050	U	0.0050	U	0.0050	U	0.0110	UJ	0.0060	=	0.0110	UJ
I177SB003	177SB00301	06/07/96	0.0060	U	0.0060	U	0.0060	U	0.0060	U	0.0110	UJ	0.0060	U	0.0110	UJ
I177SB004	177SB00401	06/07/96	0.0050	U	0.0050	U	0.0050	U	0.0050	U	0.0080	U	0.0050	U	0.0100	U
I177SB005	177SB00501	06/07/96	0.0060	U	0.0060	U	0.0060	U	0.0060	U	0.1600	=	0.0060	U	0.0110	U
I177SB006	177SB00601	06/10/96	0.0050	U	0.0050	UJ	0.0050	UJ	0.0050	UJ	0.0130	U	0.0050	U	0.0110	UJ
I177SB007	177SB00701	06/07/96	0.0060	U	0.0060	U	0.0060	U	0.0060	U	0.0110	UJ	0.0060	U	0.0110	UJ
I177SB008	177SB00801	04/03/98	0.0054	U	0.0054	U	0.0054	U	0.0054	U	0.0540	UJ	0.0054	U	0.0270	U
I177SB009	177SB00901	04/03/98	0.0054	U	0.0054	U	0.0054	U	0.0054	U	0.0540	UJ	0.0054	U	0.0270	U
I177SB010	177SB01001	04/03/98	0.0008	J	0.0018	J	0.0019	J	0.0079	=	0.0560	U	0.0056	U	0.0280	U
I177SB011	177SB01101	04/03/98	0.0055	U	0.0008	J	0.0055	U	0.0055	U	0.0550	U	0.0055	U	0.0270	U
I177SB012	177SB01201	04/03/98	0.0056	U	0.0012	J	0.0008	J	0.0055	J	0.0560	U	0.0056	U	0.0280	U
I177SB013	177SB01301	04/03/98	0.0056	U	0.0013	J	0.0008	J	0.0068	=	0.0560	U	0.0056	U	0.0280	U
I177SB014	177SB01401	04/03/98	0.0056	U	0.0006	J	0.0056	U	0.0043	J	0.0560	U	0.0056	U	0.0280	U
I177SB015	177SB01501	04/03/98	0.0056	U	0.0056	U	0.0056	U	0.0046	J	0.0560	U	0.0056	U	0.0280	U
I177SB016	177SB01601	06/17/98	0.0050	U	0.0050	U	0.0050	U	0.0050	U	0.0050	U	0.0050	U	0.0050	U
I177SB017	177SB01701	06/17/98	0.0050	UJ	0.0050	UJ	0.0050	UJ	0.0050	UJ	0.0110	U	0.0050	UJ	0.0060	J
I177SB019	177SB01901	06/17/98	0.0060	UJ	0.0060	UJ	0.0060	UJ	0.0060	UJ	0.0080	U	0.0060	UJ	0.0060	UJ
IRTCSB002	RTCSB00201	05/26/95	0.0170	U	0.0170	U	0.0170	U	0.0220	U	0.0130	J	0.0510	U	0.0390	UJ
IRTCSB003	RTCSB00301	05/26/95	0.0170	U	0.0170	U	0.0170	U	0.0220	U	0.1000	UJ	0.0500	U	0.0390	UJ
IRTCSB004	RTCSB00401	05/26/95	0.0160	U	0.0160	U	0.0160	U	0.0220	U	0.0980	J	0.0490	U	0.0380	UJ
IRTCSB005	RTCSB00501	05/26/95	0.0170	U	0.0170	U	0.0170	U	0.0230	UJ	0.0230	UJ	0.0510	U	0.0400	U
IRTCSB006	RTCSB00601	05/26/95	0.0170	U	0.0170	U	0.0170	U	0.0230	U	0.1000	UJ	0.0510	U	0.0400	UJ
IRTCSB007	RTCSB00701	05/26/95	0.0170	U	0.0170	U	0.0170	U	0.0230	U	0.1300	J	0.0520	U	0.0400	UJ
IRTCSB008	RTCSB00801	05/26/95	0.0150	U	0.0150	U	0.0150	U	0.0200	U	0.0120	J	0.0460	U	0.0360	UJ
IRTCSB009	RTCSB00901	05/26/95	0.0170	U	0.0170	U	0.0170	U	0.0220	U	0.0080	J	0.0500	U	0.0390	UJ
IRTCSB010	RTCSB01001	05/26/95	0.0170	U	0.0170	U	0.0170	U	0.0220	UJ	0.0220	UJ	0.0500	U	0.0390	U

TABLE 13-3  
 VOCs Detected in Surface Soils  
 CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex

Sample Station	ID	Date	1,1,2,2-Tetrachloroethane		Methyl ethyl ketone (2-Butanone)		Methyl isobutyl ketone (4-Methyl-2-pentanone)		Methylene Chloride		Trichloroethylene (TCE)		m+p Xylene	
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier
		IND RBC	29.0000		12000.0000		16000.0000		760.0000		520			
		RES RBC	3.2000		4700.0000		630.0000		85.0000		58			
		SSL	0.0002		NA		NA		0.0010		3			
		SS BKGD	NA		NA		NA		NA		NA			
I177SB001	177SB00101	06/07/96	0.0060	U	0.0110	U	0.0110	U	0.0120	J	0.0060	U		
	177SB00124	02/05/01												
I177SB002	177SB00201	06/07/96	0.0050	U	0.0110	U	0.0110	U	0.0060	U	0.0050	U		
I177SB003	177SB00301	06/07/96	0.0060	U	0.0110	U	0.0110	U	0.0070	=	0.0060	U		
I177SB004	177SB00401	06/07/96	0.0050	U	0.0100	U	0.0100	U	0.0050	U	0.0050	U		
I177SB005	177SB00501	06/07/96	0.0060	U	0.0110	U	0.0110	U	0.0130	U	0.0030	J		
I177SB006	177SB00601	06/10/96	0.0050	U	0.0110	U	0.0110	UJ	0.0230	U	0.0030	J		
I177SB007	177SB00701	06/07/96	0.0060	U	0.0110	U	0.0110	U	0.0060	U	0.0020	J		
I177SB008	177SB00801	04/03/98	0.0054	U	0.0270	UJ	0.0270	U	0.0054	U	0.0054	U		
I177SB009	177SB00901	04/03/98	0.0054	U	0.0270	UJ	0.0270	U	0.0054	U	0.0054	U		
I177SB010	177SB01001	04/03/98	0.0056	U	0.0280	U	0.0280	U	0.0056	U	0.0056	U		
I177SB011	177SB01101	04/03/98	0.0055	U	0.0270	U	0.0270	U	0.0055	U	0.0055	U		
I177SB012	177SB01201	04/03/98	0.0056	U	0.0280	U	0.0280	U	0.0056	U	0.0056	U		
I177SB013	177SB01301	04/03/98	0.0056	U	0.0280	U	0.0280	U	0.0056	U	0.0056	U		
I177SB014	177SB01401	04/03/98	0.0056	U	0.0280	U	0.0280	U	0.0056	U	0.0056	U		
I177SB015	177SB01501	04/03/98	0.0056	U	0.0280	U	0.0280	U	0.0056	U	0.0056	U		
I177SB016	177SB01601	06/17/98	0.0050	U	0.0050	U	0.0050	U	0.0080	U	0.0050	U		
I177SB017	177SB01701	06/17/98	0.0020	J	0.0030	J	0.0060	J	0.0140	U	0.0020	J		
I177SB019	177SB01901	06/17/98	0.0060	UJ	0.0060	UJ	0.0060	UJ	0.0240	U	0.0060	UJ		
IRTCSB002	RTCSB00201	05/26/95	0.0110	U	0.0390	UJ	0.0280	U	0.0220	U	0.0220	U		
IRTCSB003	RTCSB00301	05/26/95	0.0110	U	0.0390	UJ	0.0280	U	0.0220	U	0.0220	U		
IRTCSB004	RTCSB00401	05/26/95	0.0110	U	0.0380	UJ	0.0270	U	0.0220	U	0.0220	U		
IRTCSB005	RTCSB00501	05/26/95	0.0110	U	0.0400	U	0.0280	U	0.0230	UJ	0.0230	U		
IRTCSB006	RTCSB00601	05/26/95	0.0110	U	0.0400	UJ	0.0280	U	0.0230	U	0.0230	U		
IRTCSB007	RTCSB00701	05/26/95	0.0110	U	0.0400	UJ	0.0290	U	0.0230	U	0.0230	U		
IRTCSB008	RTCSB00801	05/26/95	0.0100	U	0.0360	UJ	0.0260	U	0.0200	U	0.0200	U		
IRTCSB009	RTCSB00901	05/26/95	0.0110	U	0.0390	UJ	0.0280	U	0.0220	U	0.0220	U		
IRTCSB010	RTCSB01001	05/26/95	0.0110	U	0.0390	U	0.0280	U	0.0220	UJ	0.0220	U		

**TABLE 13-3**  
VOCs Detected in Surface Soils  
*CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex*

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= Chemical is detected at concentration shown.  
J Chemical is detected at concentration below the method detection limit; the concentration is not known.  
U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
UJ Not detected; analytical detection limit is estimated.  
mg/kg Milligrams per kilogram

**TABLE 13-4**  
**BEQs in Surface Soils**  
*CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex*

Station	Sample ID	Sample Date	BEQ Result	
			( $\mu\text{g}/\text{kg}$ )	Qualifier
		BKGD	1,304	
I177SB001	177SB00101	06/07/1996	428	U
I177SB002	177SB00201	06/07/1996	416	U
I177SB003	177SB00301	06/07/1996	428	U
I177SB004	177SB00401	06/07/1996	393	U
I177SB005	177SB00501	06/07/1996	428	U
I177SB006	177SB00601	06/10/1996	404	U
I177SB007	177SB00701	06/07/1996	439	U
I177SB008	177SB00801	04/03/1998	416	U
I177SB009	177SB00901	04/03/1998	4,160	U
I177SB010	177SB01001	04/03/1998	1,459	=
I177SB012	177SB01201	04/03/1998	283	=
I177SB013	177SB01301	04/03/1998	241	=
I177SB014	177SB01401	04/03/1998	411	=
I177SB015	177SB01501	04/03/1998	428	U
I177SB016	177SB01601	06/17/1998	402	=
I177SB017	177SB01701	06/17/1998	404	U
I177SB018	177SB01801	06/17/1998	274	=
I177SB019	177SB01901	06/17/1998	2,195	U
IRTCB002	RTCSB00201	05/26/1995	714	U
IRTCB003	RTCSB00301	05/26/1995	713	U
IRTCB004	RTCSB00401	05/26/1995	702	U
IRTCB005	RTCSB00501	05/26/1995	731	U
IRTCB006	RTCSB00601	05/26/1995	720	U
IRTCB007	RTCSB00701	05/26/1995	643	U
IRTCB008	RTCSB00801	05/26/1995	643	U
IRTCB009	RTCSB00901	05/26/1995	643	U
IRTCB010	RTCSB01001	05/26/1995	422	=

= Chemical is detected at concentration shown.

U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).

$\mu\text{g}/\text{kg}$  Microgram per kilogram

**TABLE 13-5**  
 VOCs Detected in Subsurface Soils  
 CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex

Sample Station	ID	Date	Ethylbenzene		Naphthalene		Toluene		Xylenes, Total	
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier
			SSL SB BKGD	0.7000 NA	4 NA		0.6000 NA		NA NA	
I177SB001	177SB00102	02/05/01		0.0109 =	0.0200 J		0.0122 =		0.9830 =	
I177SB002	177SB00202	06/07/96		0.0020 U	0.4000 U		0.0020 U		0.0030 U	
	177SB00202	06/07/96		0.0060 U	0.0010 U		0.0060 U		0.0060 U	
	177SB00224	02/05/01		0.0022 U	0.0011 U		0.0022 U		0.0033 U	
I177SB003	177SB00302	06/07/96		0.0070 U	0.4400 U		0.0070 U		0.0070 U	
I177SB004	177SB00402	06/07/96		0.0060 U	0.3900 U		0.0060 U		0.0060 U	
I177SB005	177SB00502	06/07/96		0.0060 U	0.4100 U		0.0060 U		0.0060 U	
I177SB006	177SB00602	06/10/96		0.0060 U	0.4200 U		0.0060 U		0.0060 U	
I177SB007	177SB00702	06/07/96		0.0060 U	0.4200 U		0.0060 U		0.0060 U	
I177SB008	177SB00802	04/03/98		0.0061 U	0.4000 U		0.0061 U		0.0061 U	
I177SB009	177SB00902	04/03/98		0.0009 J	0.4000 U		0.0008 J		0.0043 J	
I177SB012	177SB01202	04/03/98		0.0067 U	0.4400 U		0.0067 U		0.0067 U	
I177SB013	177SB01302	04/03/98		0.0011 J	0.4100 U		0.0062 U		0.0047 J	
I177SB014	177SB01402	04/03/98		0.0064 U	0.4200 U		0.0008 J		0.0032 J	
I177SB015	177SB01502	04/03/98		0.0059 U	0.3900 U		0.0059 U		0.0024 J	
I177SB016	177SB01602	06/17/98		0.0060 U	0.4200 U		0.0060 U		0.0060 U	
I177SB017	177SB01702	06/17/98		0.0070 U	0.4700 U		0.0070 U		0.0070 U	
I177SB018	177SB01802	06/17/98		0.0060 UJ	0.4200 U		0.0060 UJ		0.0060 UJ	
I177SB019	177SB01902	06/17/98		0.0070 UJ	0.4600 U		0.0070 UJ		0.0070 UJ	

TABLE 13-5 (CONTINUED)

VOCs Detected in Subsurface Soils

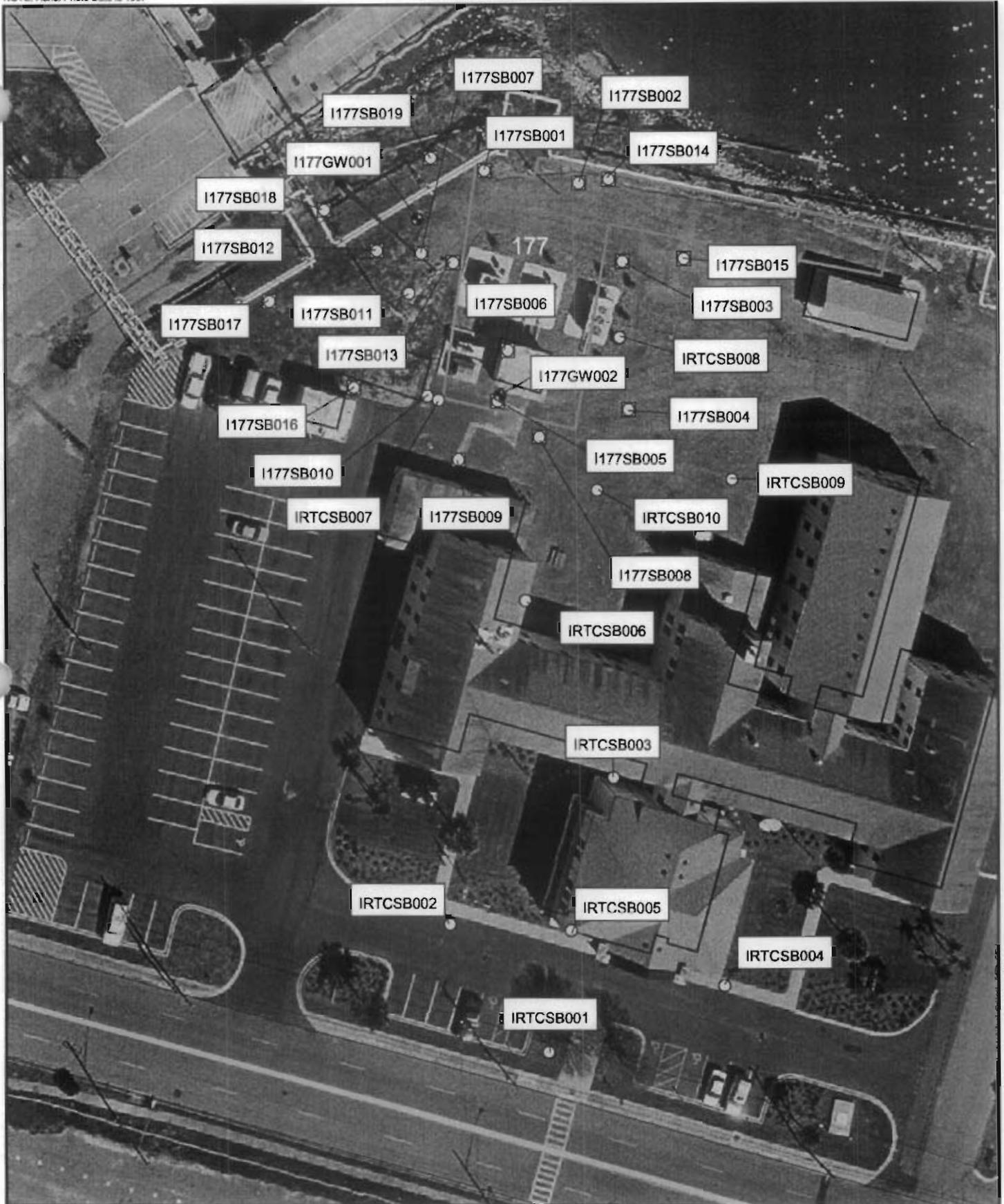
CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex

Sample Station	ID	Date	1,2-Dichloroethene (total)		Carbon Disulfide		Acetone		Methyl ethyl ketone (2-Butanone)	
			Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier	Result (mg/kg)	Qualifier
			SSL SB BKGD	0.02 NA	2.0000 NA		0.8000 NA		NA NA	
I177SB001	177SB00102	02/05/01								
I177SB002	177SB00202	06/07/96		0.0060 U	0.0060 U		0.0200 U		0.0120 U	
	177SB00202	06/07/96								
	177SB00224	02/05/01								
I177SB003	177SB00302	06/07/96		0.0070 U	0.0070 U		0.0280 J		0.0140 U	
I177SB004	177SB00402	06/07/96		0.0060 U	0.0060 U		0.0680 U		0.0120 U	
I177SB005	177SB00502	06/07/96		0.0060 U	0.0020 J		0.0440 U		0.0060 J	
I177SB006	177SB00602	06/10/96		0.0060 U	0.0060 U		0.0390 U		0.0130 U	
I177SB007	177SB00702	06/07/96		0.0060 U	0.0060 U		0.0130 U		0.0130 U	
I177SB008	177SB00802	04/03/98		0.0061 U	0.0061 U		0.0610 U		0.0300 U	
I177SB009	177SB00902	04/03/98		0.0060 U	0.0060 U		0.0370 J		0.0071 J	
I177SB012	177SB01202	04/03/98		0.0067 =	0.0067 U		0.0450 J		0.0094 J	
I177SB013	177SB01302	04/03/98		0.0062 U	0.0062 U		0.0470 J		0.0075 J	
I177SB014	177SB01402	04/03/98		0.0064 U	0.0064 U		0.1300 =		0.0270 J	
I177SB015	177SB01502	04/03/98		0.0059 U	0.0059 U		0.0220 J		0.0290 U	
I177SB016	177SB01602	06/17/98		0.0060 U	0.0060 U		0.0220 U		0.0060 U	
I177SB017	177SB01702	06/17/98		0.0070 U	0.0070 U		0.0210 U		0.0070 U	
I177SB018	177SB01802	06/17/98		0.0060 UJ	0.0030 J		0.0220 UJ		0.0060 UJ	
I177SB019	177SB01902	06/17/98		0.0070 UJ	0.0040 J		0.0310 UJ		0.0030 J	

**TABLE 13-6**  
 BEQs in Subsurface Soils  
 CMS Work Plan, SWMU 177/RTC, Zone I, Charleston Naval Complex

Station	Sample ID	Sample Date	BEQ Result	
			( $\mu\text{g}/\text{kg}$ )	Qualifier
		<b>BKGD</b>	1,400	
I177SB002	177SB00202	06/07/1996	462	U
I177SB003	177SB00302	06/07/1996	508	U
I177SB004	177SB00402	06/07/1996	451	U
I177SB005	177SB00502	06/07/1996	474	U
I177SB006	177SB00602	06/10/1996	485	U
I177SB007	177SB00702	06/07/1996	<b>2,899</b>	=
I177SB008	177SB00802	04/03/1998	462	U
I177SB009	177SB00902	04/03/1998	462	U
I177SB012	177SB01202	04/03/1998	508	U
I177SB013	177SB01302	04/03/1998	474	U
I177SB014	177SB01402	04/03/1998	485	U
I177SB015	177SB01502	04/03/1998	451	U
I177SB016	177SB01602	06/17/1998	485	U
I177SB017	177SB01702	06/17/1998	543	U
I177SB018	177SB01802	06/17/1998	485	U
I177SB019	177SB01902	06/17/1998	532	U

= Chemical is detected at concentration shown.  
 U Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL).  
 $\mu\text{g}/\text{kg}$  Microgram per kilogram



- Groundwater Sample
- Surface Soil Sample
- Subsurface Soil Sample
- ▭ AOC Boundary
- ▭ SWMU Boundary
- ▭ Buildings

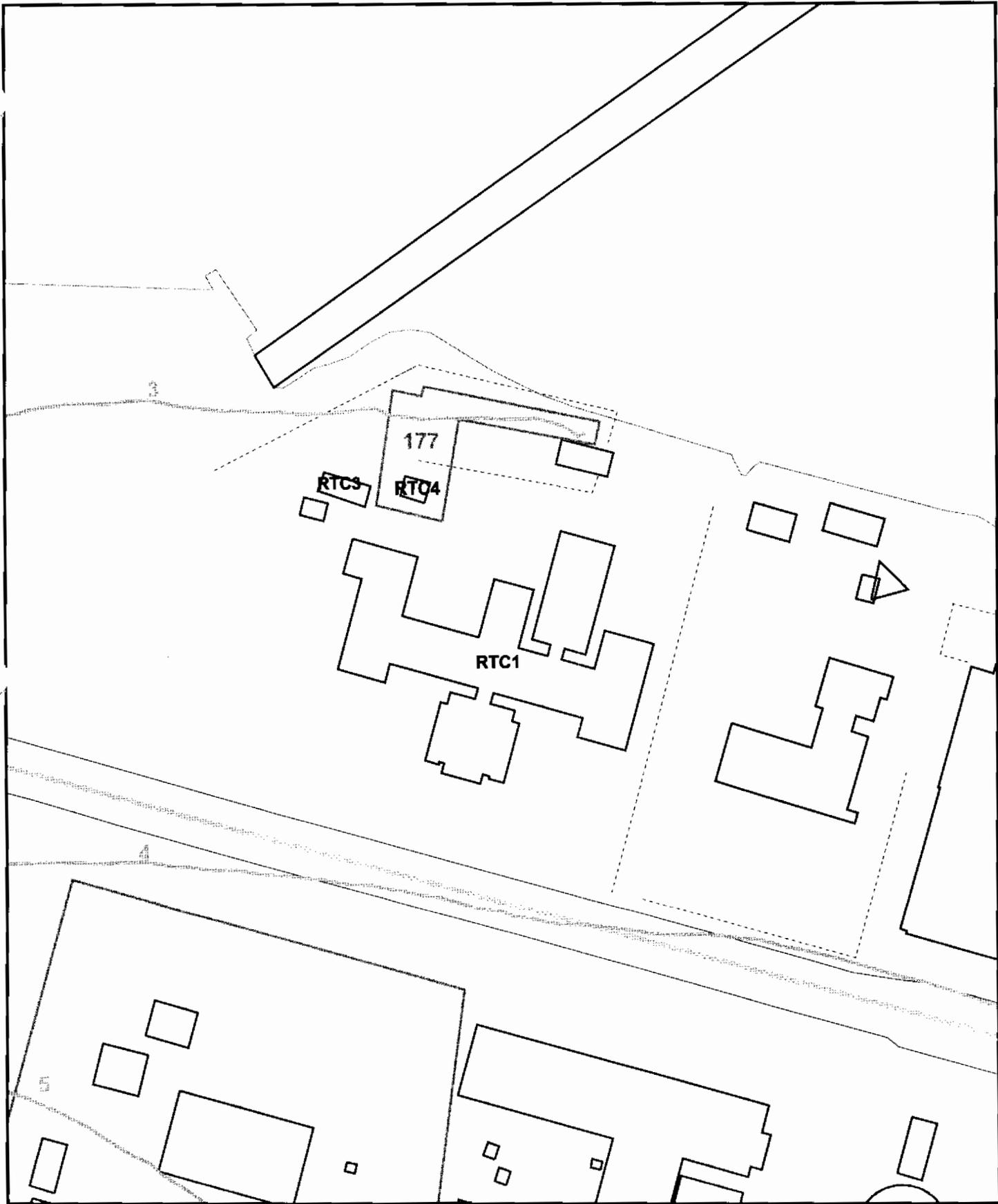
▭ Zone Boundary



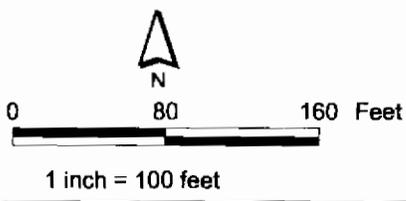
0 50 100 Feet

1 inch = 50 feet

**Figure 13-1**  
 Sample and Test Location Map  
 SWMU 177/RTC  
 Zone I  
 Charleston Naval Complex



- Inferred Groundwater Elevations (ft msl)
- Known Groundwater Elevations (ft msl)
- Fence
- Railroads
- Roads
- Shoreline
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary



**Figure 13-2**  
 Shallow Groundwater Contour Map  
 SMWU 177 and RTC, Zone I  
 Charleston Naval Complex





# 1 14.0 Zone I CMS Work Plan Summary

2 The following SWMUs and AOCs have been recommended for NFA in Zone I at the CNC.

- 3 • AOC 671
  - 4 • AOCs 672/673
  - 5 • AOCs 675/676/677
  - 6 • AOCs 678/679
  - 7 • AOC 680
  - 8 • AOC 681
  - 9 • AOC 685
  - 10 • AOC 687/SWMU 16
  - 11 • AOC 688
  - 12 • AOCs 689/690
  - 13 • SWMU 12
  - 14 • SWMU 177/RTC
  - 15 • SWMU 711
- 
- 



## 1 15.0 References

- 2 CH2M-Jones Inc. *Zone I RFI Report Addendum, Revision 1. NAVBASE Charleston. August*  
3 *2001.*
- 4 CH2M-Jones Inc. Technical Memorandum: An Overview of Arsenic Geochemistry,  
5 Terminal Electron Accepting Processes in GW Systems, and Implications for the CNC  
6 Hydrogeologic Environment. August 2001.
- 7 EnSafe Inc. *Zone I RFI Report, Revision 0. NAVBASE Charleston. November 1999.*
- 8 EnSafe Inc./Allen & Hoshall. *Zone I RFI Report Work Plan. 1995.*
- 9 Department of the Navy. *Oil Water Separator Data. September 2000.*
- 10 U.S. Navy. Various Environmental Baseline Survey Reports. 1994.
- 11 U.S. Environmental Protection Agency (EPA). *EPA Soil Screening Guidance: Technical*  
12 *Background Document (Table A-1), EPA/540/R-95/128. May 1996.*
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**Appendix A-1a****Thallium Concentrations in Zone I Shallow Grid Wells****CNC, Zone I**

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<b>Sample ID</b>	<b>Result</b>	<b>Units</b>	<b>Date Collected</b>
GDIGW00101a	4.50 UJ	ug/L	04/24/1995
GDIGW00102	5.00 U	ug/L	12/12/1995
GDIGW00103	5.50 J	ug/L	05/15/1996
GDIGW00104	6.20 UJ	ug/L	08/19/1996
GDIGW00201b	4.50 UJ	ug/L	04/24/1995
GDIGW00202	6.60 J	ug/L	12/12/1995
GDIGW00203	3.50 J	ug/L	05/16/1996
GDIGW00204	2.70 UJ	ug/L	08/20/1996
GDIGW00301a	4.50 UJ	ug/L	04/24/1995
GDIGW00302	5.00 UJ	ug/L	12/14/1995
GDIGW00303	2.80 J	ug/L	05/20/1996
GDIGW00304	2.70 UJ	ug/L	08/21/1996
GDIGW00305	2.30 UJ	ug/L	05/20/1999
GDIGW00401a	4.50 UJ	ug/L	04/21/1995
GDIGW00402	5.00 UJ	ug/L	12/13/1995
GDIGW00403	5.00 U	ug/L	05/21/1996
GDIGW00404	2.70 UJ	ug/L	08/22/1996
GDIGW00501	4.50 UJ	ug/L	04/25/1995
GDIGW00502	5.00 UJ	ug/L	12/14/1995
GDIGW00503	3.00 J	ug/L	05/20/1996
GDIGW00504	2.70 UJ	ug/L	08/19/1996
GDIGW00601	4.50 UJ	ug/L	04/25/1995
GDIGW00602	5.00 U	ug/L	12/08/1995
GDIGW00603	2.70 UJ	ug/L	05/17/1996
GDIGW00604	2.70 UJ	ug/L	08/20/1996
GDIGW00701	4.50 UJ	ug/L	05/01/1995
GDIGW00702	5.00 UJ	ug/L	12/13/1995
GDIGW00703	5.00 U	ug/L	05/21/1996
GDIGW00704	2.70 UJ	ug/L	08/21/1996
GDIGW00705	5.50 UJ	ug/L	04/15/1998
GDIGW00706	9.00 UJ	ug/L	08/19/1998
GDIGW00801a	4.50 U	ug/L	05/02/1995
GDIGW00802	5.00 U	ug/L	12/12/1995
GDIGW00803	5.00 U	ug/L	05/22/1996
GDIGW00804	2.70 UJ	ug/L	08/22/1996

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**Appendix A-1a****Thallium Concentrations in Zone I Shallow Grid Wells****CNC, Zone I**

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<b>Sample ID</b>	<b>Result</b>	<b>Units</b>	<b>Date Collected</b>
GDIGW00805	5.50 UJ	ug/L	04/14/1998
GDIGW00806	1.80 UJ	ug/L	08/20/1998
GDIGW00807	2.30 U	ug/L	05/24/1999
GDIGW00901	4.50 UJ	ug/L	05/02/1995
GDIGW00902	7.50 J	ug/L	12/11/1995
GDIGW00903	5.00 U	ug/L	05/30/1996
GDIGW00904	2.70 UJ	ug/L	08/23/1996
GDIGW01001a	4.50 U	ug/L	05/02/1995
GDIGW01002	5.00 U	ug/L	12/11/1995
GDIGW01003	5.00 U	ug/L	05/31/1996
GDIGW01004	2.70 UJ	ug/L	08/26/1996
GDIGW01101	4.50 U	ug/L	05/19/1995
GDIGW01102	5.00 UJ	ug/L	12/14/1995
GDIGW01103	5.00 UJ	ug/L	05/23/1996
GDIGW01104	4.10 J	ug/L	08/29/1996
GDIGW01201e	4.50 U	ug/L	05/15/1995
GDIGW01202a	5.90 J	ug/L	12/12/1995
GDIGW01203	5.00 U	ug/L	05/29/1996
GDIGW01204	2.70 U	ug/L	08/30/1996
GDIGW01301	4.50 UJ	ug/L	04/26/1995
GDIGW01302	5.00 U	ug/L	12/06/1995
GDIGW01303	5.00 U	ug/L	05/28/1996
GDIGW01304	2.70 UJ	ug/L	09/04/1996
GDIGW01306	1.80 UJ	ug/L	08/20/1998
GDIGW01401	4.50 U	ug/L	05/22/1995
GDIGW01402	5.00 U	ug/L	01/15/1996
GDIGW01403	5.00 U	ug/L	05/24/1996
GDIGW01404	2.70 UJ	ug/L	09/09/1996
GDIGW01501	4.50 U	ug/L	05/23/1995
GDIGW01502	5.00 UJ	ug/L	12/15/1995
GDIGW01503	5.00 U	ug/L	05/23/1996
GDIGW01504	2.70 UJ	ug/L	08/23/1996
GDIGW01601	4.50 U	ug/L	05/24/1995
GDIGW01602	5.00 U	ug/L	12/06/1995
GDIGW01603	5.00 U	ug/L	05/28/1996

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**Appendix A-1a****Thallium Concentrations in Zone I Shallow Grid Wells****CNC, Zone I**

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<b>Sample ID</b>	<b>Result</b>	<b>Units</b>	<b>Date Collected</b>
GDIGW01604	2.70 UJ	ug/L	08/26/1996
GDIGW01701	4.50 U	ug/L	05/23/1995
GDIGW01702	5.40 J	ug/L	12/05/1995
GDIGW01703	5.00 U	ug/L	05/28/1996
GDIGW01704	2.70 UJ	ug/L	08/27/1996
GDIGW01801	4.50 U	ug/L	05/24/1995
GDIGW01802	5.00 U	ug/L	12/06/1995
GDIGW01803	5.00 U	ug/L	05/29/1996
GDIGW01804	2.70 U	ug/L	08/29/1996
GDIGW01901a	4.50 UJ	ug/L	04/21/1995
GDIGW01902	5.00 UJ	ug/L	12/13/1995
GDIGW01903	5.00 U	ug/L	05/30/1996
GDIGW01904	2.70 U	ug/L	08/28/1996

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**Appendix A-1b****Thallium Concentrations in Zone I Deep Grid Wells  
CNC, Zone I**

<b>Sample ID</b>	<b>Result</b>	<b>Units</b>	<b>Date Collected</b>
GDIGW10D04	3.10 J	ug/L	08/26/1996
GDIGW11D01	4.50 U	ug/L	06/07/1995
GDIGW11D02	5.00 UJ	ug/L	12/15/1995
GDIGW11D03	5.00 UJ	ug/L	05/24/1996
GDIGW11D04	5.70 J	ug/L	08/30/1996
GDIGW12D01	4.50 U	ug/L	06/09/1995
GDIGW12D02b	5.60 J	ug/L	12/12/1995
GDIGW12D03	5.00 UJ	ug/L	05/29/1996
GDIGW12D04	2.70 U	ug/L	08/30/1996
GDIGW13D01	4.50 U	ug/L	06/02/1995
GDIGW13D02	5.00 U	ug/L	12/06/1995
GDIGW13D03	5.00 UJ	ug/L	05/28/1996
GDIGW13D04	2.70 UJ	ug/L	09/04/1996
GDIGW13D06	9.00 UJ	ug/L	08/20/1998
GDIGW14D01	4.50 U	ug/L	06/07/1995
GDIGW14D02	5.00 UJ	ug/L	12/15/1995
GDIGW14D03	5.00 UJ	ug/L	05/29/1996
GDIGW14D04	2.70 UJ	ug/L	09/10/1996
GDIGW15D01	4.50 U	ug/L	05/23/1995
GDIGW15D02	5.00 UJ	ug/L	12/15/1995
GDIGW15D03	7.10 J	ug/L	05/24/1996
GDIGW15D04	2.70 UJ	ug/L	08/23/1996
GDIGW16D01	4.50 U	ug/L	05/24/1995
GDIGW16D02	5.00 U	ug/L	12/06/1995
GDIGW16D03	5.00 UJ	ug/L	05/28/1996
GDIGW16D04	2.70 UJ	ug/L	08/26/1996
GDIGW17D01	4.50 U	ug/L	05/23/1995
GDIGW17D02	6.30 J	ug/L	12/05/1995
GDIGW17D03	5.00 UJ	ug/L	05/29/1996
GDIGW17D04	15.40 J	ug/L	08/27/1996
GDIGW17DF5	3.10 U	ug/L	01/18/1999
GDIGW17DU5	3.10 U	ug/L	01/18/1999
GDIGW18D01a	4.50 U	ug/L	06/09/1995
GDIGW18D02	5.20 J	ug/L	12/06/1995
GDIGW18D03	5.20 J	ug/L	05/29/1996
GDIGW18D04	6.10 J	ug/L	08/29/1996
GDIGW18DF5	3.10 U	ug/L	01/18/1999
GDIGW18DU5	3.10 U	ug/L	01/18/1999
GDIGW19D01	4.50 U	ug/L	06/01/1995
GDIGW19D02	5.00 UJ	ug/L	12/13/1995
GDIGW19D03	5.00 U	ug/L	05/30/1996
GDIGW19D04	2.70 U	ug/L	08/28/1996

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**Appendix A-2a****Arsenic Concentrations in Zone I Shallow Grid Wells****CNC, Zone I**

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<b>Sample ID</b>	<b>Result</b>	<b>Units</b>	<b>Date Collected</b>
GDIGW00101a	3.2 U	ug/L	04/24/1995
GDIGW00102	9.8 J	ug/L	12/12/1995
GDIGW00103	11.7 =	ug/L	05/15/1996
GDIGW00104	6.5 J	ug/L	08/19/1996
GDIGW00201b	6.4 J	ug/L	04/24/1995
GDIGW00202	10.4 =	ug/L	12/12/1995
GDIGW00203	11.9 =	ug/L	05/16/1996
GDIGW00204	5.4 J	ug/L	08/20/1996
GDIGW00301a	3.2 U	ug/L	04/24/1995
GDIGW00302	5.0 U	ug/L	12/14/1995
GDIGW00303	2.9 J	ug/L	05/20/1996
GDIGW00304	4.9 J	ug/L	08/21/1996
GDIGW00305	3.3 U	ug/L	05/20/1999
GDIGW00401a	10.0 =	ug/L	04/21/1995
GDIGW00402	19.2 =	ug/L	12/13/1995
GDIGW00403	22.1 =	ug/L	05/21/1996
GDIGW00404	17.6 U	ug/L	08/22/1996
GDIGW00501	3.2 U	ug/L	04/25/1995
GDIGW00502	5.0 U	ug/L	12/14/1995
GDIGW00503	2.5 U	ug/L	05/20/1996
GDIGW00504	2.5 U	ug/L	08/19/1996
GDIGW00601	3.2 U	ug/L	04/25/1995
GDIGW00602	5.0 U	ug/L	12/08/1995
GDIGW00603	4.8 J	ug/L	05/17/1996
GDIGW00604	5.8 J	ug/L	08/20/1996
GDIGW00701	3.2 U	ug/L	05/01/1995
GDIGW00702	5.0 U	ug/L	12/13/1995
GDIGW00703	5.0 U	ug/L	05/21/1996
GDIGW00704	3.8 J	ug/L	08/21/1996
GDIGW00705	3.3 U	ug/L	04/15/1998
GDIGW00706	1.2 UJ	ug/L	08/19/1998
GDIGW00801a	3.2 U	ug/L	05/02/1995
GDIGW00802	5.0 U	ug/L	12/12/1995
GDIGW00803	5.0 U	ug/L	05/22/1996
GDIGW00804	2.5 U	ug/L	08/22/1996

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**Appendix A-2a****Arsenic Concentrations in Zone I Shallow Grid Wells****CNC, Zone I**

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<b>Sample ID</b>	<b>Result</b>	<b>Units</b>	<b>Date Collected</b>
GDIGW00805	9.0 J	ug/L	04/14/1998
GDIGW00806	6.5 J	ug/L	08/20/1998
GDIGW00807	3.4 J	ug/L	05/24/1999
GDIGW00901	25.9 =	ug/L	05/02/1995
GDIGW00902	31.0 =	ug/L	12/11/1995
GDIGW00903	18.2 =	ug/L	05/30/1996
GDIGW00904	23.0 =	ug/L	08/23/1996
GDIGW01001a	3.2 U	ug/L	05/02/1995
GDIGW01002	5.0 U	ug/L	12/11/1995
GDIGW01003	5.1 J	ug/L	05/31/1996
GDIGW01004	8.5 U	ug/L	08/26/1996
GDIGW01101	16.1 =	ug/L	05/19/1995
GDIGW01102	5.0 U	ug/L	12/14/1995
GDIGW01103	5.0 U	ug/L	05/23/1996
GDIGW01104	3.7 U	ug/L	08/29/1996
GDIGW01201e	3.2 U	ug/L	05/15/1995
GDIGW01202a	5.0 U	ug/L	12/12/1995
GDIGW01203	5.0 U	ug/L	05/29/1996
GDIGW01204	2.5 U	ug/L	08/30/1996
GDIGW01301	9.7 J	ug/L	04/26/1995
GDIGW01302	12.0 =	ug/L	12/06/1995
GDIGW01303	19.0 =	ug/L	05/28/1996
GDIGW01304	23.8 =	ug/L	09/04/1996
GDIGW01306	23.9 =	ug/L	08/20/1998
GDIGW01401	3.2 U	ug/L	05/22/1995
GDIGW01402	12.4 =	ug/L	01/15/1996
GDIGW01403	11.1 =	ug/L	05/24/1996
GDIGW01404	6.1 U	ug/L	09/09/1996
GDIGW01501	3.2 U	ug/L	05/23/1995
GDIGW01502	5.0 U	ug/L	12/15/1995
GDIGW01503	5.0 U	ug/L	05/23/1996
GDIGW01504	2.5 U	ug/L	08/23/1996
GDIGW01601	3.2 U	ug/L	05/24/1995
GDIGW01602	5.0 U	ug/L	12/06/1995
GDIGW01603	5.0 U	ug/L	05/28/1996

**Appendix A-2b**  
**Arsenic Concentrations in Zone I Deep Grid Wells**  
**CNC, Zone I**

Sample ID	Result	Units	Date Collected
GDIGW01D01	3.2 U	ug/L	05/23/1995
GDIGW01D02	5.0 U	ug/L	12/13/1995
GDIGW01D03	5.0 U	ug/L	05/15/1996
GDIGW01D04	2.6 J	ug/L	08/19/1996
GDIGW02D01	3.2 U	ug/L	05/23/1995
GDIGW02D02	5.0 U	ug/L	12/12/1995
GDIGW02D03	2.5 U	ug/L	05/20/1996
GDIGW02D04	2.5 U	ug/L	08/20/1996
GDIGW03D01b	3.2 U	ug/L	06/09/1995
GDIGW03D02	5.0 U	ug/L	12/15/1995
GDIGW03D03	5.0 U	ug/L	05/23/1996
GDIGW03D04	3.3 J	ug/L	08/21/1996
GDIGW03D05	3.3 U	ug/L	05/20/1999
GDIGW04D01	3.2 U	ug/L	06/06/1995
GDIGW04D02	5.0 U	ug/L	12/15/1995
GDIGW04D03	6.0 J	ug/L	05/23/1996
GDIGW04D04	6.3 U	ug/L	08/22/1996
GDIGW05D01	3.2 U	ug/L	05/24/1995
GDIGW05D02	5.0 U	ug/L	12/08/1995
GDIGW05D03	2.5 U	ug/L	05/20/1996
GDIGW05D04	2.5 U	ug/L	08/19/1996
GDIGW06D01	3.2 U	ug/L	05/24/1995
GDIGW06D02	5.0 U	ug/L	12/08/1995
GDIGW06D03	3.5 J	ug/L	05/16/1996
GDIGW06D04	2.5 U	ug/L	08/20/1996
GDIGW07D01b	3.2 U	ug/L	05/25/1995
GDIGW07D02	5.2 J	ug/L	12/13/1995
GDIGW07D03	5.0 U	ug/L	05/21/1996
GDIGW07D04	2.5 U	ug/L	08/21/1996
GDIGW07D05	7.4 J	ug/L	04/15/1998
GDIGW07D06	2.1 J	ug/L	08/19/1998
GDIGW08D01	3.2 U	ug/L	05/25/1995
GDIGW08D02	5.0 U	ug/L	12/12/1995
GDIGW08D03	5.0 U	ug/L	05/22/1996
GDIGW08D04	3.4 U	ug/L	08/22/1996
GDIGW08D05	3.3 U	ug/L	04/14/1998
GDIGW08D06	0.9 U	ug/L	08/20/1998
GDIGW08D07	3.3 U	ug/L	05/24/1999
GDIGW09D01a	3.2 U	ug/L	06/09/1995
GDIGW09D02	5.0 U	ug/L	12/11/1995
GDIGW09D03	5.0 U	ug/L	05/30/1996
GDIGW09D04	2.5 U	ug/L	08/23/1996
GDIGW10D01	3.2 U	ug/L	06/01/1995
GDIGW10D02	7.2 J	ug/L	12/11/1995
GDIGW10D03	5.0 U	ug/L	05/31/1996
GDIGW10D04	5.7 U	ug/L	08/26/1996

**Appendix A-2b**  
**Arsenic Concentrations in Zone I Deep Grid Wells**  
**CNC, Zone I**

Sample ID	Result	Units	Date Collected
GDIGW11D01	3.2 U	ug/L	06/07/1995
GDIGW11D02	5.0 U	ug/L	12/15/1995
GDIGW11D03	5.2 J	ug/L	05/24/1996
GDIGW11D04	5.7 U	ug/L	08/30/1996
GDIGW12D01	3.2 U	ug/L	06/09/1995
GDIGW12D02b	5.0 U	ug/L	12/12/1995
GDIGW12D03	5.0 U	ug/L	05/29/1996
GDIGW12D04	2.5 U	ug/L	08/30/1996
GDIGW13D01	3.2 U	ug/L	06/02/1995
GDIGW13D02	5.0 U	ug/L	12/06/1995
GDIGW13D03	6.5 J	ug/L	05/28/1996
GDIGW13D04	2.5 U	ug/L	09/04/1996
GDIGW13D06	2.4 J	ug/L	08/20/1998
GDIGW14D01	3.2 U	ug/L	06/07/1995
GDIGW14D02	5.0 U	ug/L	12/15/1995
GDIGW14D03	5.0 U	ug/L	05/29/1996
GDIGW14D04	2.5 U	ug/L	09/10/1996
GDIGW15D01	3.2 U	ug/L	05/23/1995
GDIGW15D02	5.0 U	ug/L	12/15/1995
GDIGW15D03	5.0 U	ug/L	05/24/1996
GDIGW15D04	2.5 U	ug/L	08/23/1996
GDIGW16D01	3.2 U	ug/L	05/24/1995
GDIGW16D02	5.0 U	ug/L	12/06/1995
GDIGW16D03	5.0 U	ug/L	05/28/1996
GDIGW16D04	2.5 U	ug/L	08/26/1996
GDIGW17D01	3.2 U	ug/L	05/23/1995
GDIGW17D02	5.0 U	ug/L	12/05/1995
GDIGW17D03	5.0 U	ug/L	05/29/1996
GDIGW17D04	24.8 J	ug/L	08/27/1996
GDIGW17DF5	2.9 U	ug/L	01/18/1999
GDIGW17DU5	2.9 U	ug/L	01/18/1999
GDIGW18D01a	3.2 U	ug/L	06/09/1995
GDIGW18D02	5.0 U	ug/L	12/06/1995
GDIGW18D03	5.0 U	ug/L	05/29/1996
GDIGW18D04	4.7 U	ug/L	08/29/1996
GDIGW18DF5	2.9 U	ug/L	01/18/1999
GDIGW18DU5	2.9 U	ug/L	01/18/1999
GDIGW19D01	14.2 =	ug/L	06/01/1995
GDIGW19D02	13.3 =	ug/L	12/13/1995
GDIGW19D03	11.9 =	ug/L	05/30/1996
GDIGW19D04	8.4 U	ug/L	08/28/1996



## Data Validation Summary - Charleston Naval Complex - Zone I

TO: Kris Garcia/CH2M HILL/ATL  
FROM: Herb Kelly/CH2M HILL/GNA  
DATE: October 16, 2001

The purpose of this memorandum is to present the results of the data validation process for the samples collected at AOC 681 in Zone I, on September 26, 2001.

The specific samples and analytical fractions reviewed are summarized below in Table 1.

The Quality Control areas that were review and the resulting findings are documented within each subsection that follows. This data was validated for compliance with the analytical method requirements. This process also included a review of the data to assess the accuracy, precision, and completeness based upon procedures described in the guidance documents such as the Environmental Protection Agency (EPA) *National Functional Guidelines for Inorganic Data Review (EPA 1994)* and *National Functional Guidelines for Organic Data Review (EPA 1999)*. Quality assurance/quality control (QA/QC) summary forms and data reports were reviewed.

Samples were submitted to Severn Trent Services, STL Savannah Laboratories, Inc., in Savannah, Georgia for the analysis of Polyaromatic Hydrocarbons following SW-846 8270 methodology.

Sample results that were not within the acceptance limits were appended with a qualifying flag, which consisted of a single- or double-letter code that indicated a possible problem with the data. The qualifying flags originated during the data review and validation processes. These also include the secondary, or the two-digit "sub-qualifier" flags. The secondary qualifiers provide the reasoning behind the assignment of a qualifier flag to the data. The secondary qualifiers are presented and defined below.

Attachment A lists the changes in data qualifiers, due to the validation process.

The following primary flags were used to qualify the data:

- [=] Detected. The analyte was analyzed for and detected at the concentration shown.
- [J] Estimated. The analyte was present but the reported value may not be accurate or precise.
- [U] Undetected. The analyte was analyzed for but not detected above the method detection limit.
- [UJ] Detection limit estimated. The analyte was analyzed for but qualified as not detected; the result is estimated.
- [R] Rejected. The data is not useable.

### Secondary Data Validation Qualifiers

<u>Code</u>	<u>Definition</u>
2S	Second Source
BL	Blank
BD	Blank Spike/Blank Spike Duplicate or (LCS/LCSD) Precision
BS	Blank Spike/LCS
CC	Continuing Calibration Verification
DL	Dilution
FD	Field Duplicate
HT	Holding Time
IB	In-Between (metals - B's → J's)
IC	Initial Calibration
IS	Internal Standard
LD	Lab Duplicate
LR	Concentration exceeded Linear Range
MD	MS/MSD or LCS/LCSD Precision
MS	Matrix Spike/Matrix Spike Duplicate
OT	Other (see DV worksheet)
PD	Pesticide Degradation
PS	Post Spike
RE	Re-extraction/Re-analysis
SD	Serial Dilution
SS	Spiked Surrogate
TN	Tune

**Table 1 - Chemical Analytical Methods – Field and Quality Control Samples**

**TABLE 1**  
 Chemical Analytical Methods - Field and Quality Control Samples  
 Charleston Naval Complex, Zone I, AOC 681, Charleston, SC

CNC32	I681SB012	681SB01201	16342-1	9/26/01	SO	N		0	1	X
CNC32	I681SB012	681SB01201RE	16342-1RE	9/26/01	SO	LR	RE	0	1	X
CNC32	I681SB012	681SB01203	16342-2	9/26/01	SO	N		2	3	X
CNC32	I681SB012	681SB01203RE	16342-2RE	9/26/01	SO	LR	RE	2	3	X
CNC32	I681SB013	681SB01303	16342-3	9/26/01	SO	N		2	3	X
CNC32	I681SB013	681CB01303	16342-4	9/26/01	SO	FD		2	3	X
CNC32	FIELD QC	681EB01201	16342-1	9/26/01	WQ	EB				X
<b>MATRIX CODE</b>										
SO - Soil										
WQ - Soil QC Samples										
<b>SAMPLE TYPE CODE</b>										
EB - Equipment Blank										
FD - Field Duplicate										
N - Native Sample										
LR - Laboratory Replicate										
<b>LR TYPE CODE</b>										
RE - Re-analysis										
<b>ANALYSIS CODE</b>										
PAHs - Polyaromatic Hydrocarbons										

## Organic Parameters

### Quality Control Review

The following list represents the QA/QC measures that are typically reviewed during the data quality evaluation procedure for organic data.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – A laboratory method blank and one equipment blank sample were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Surrogate Recoveries** – Surrogate Compounds are added to each sample and the recoveries are used to monitor lab performance and possible matrix interference.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", either laboratory reagent water or Ottawa sand, in which target compounds have been added prior to extraction/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and its duplicate. This information can only be determined when target compounds are detected.
- **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples** – Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. Precision information is also determined by calculating the reproducibility between the recoveries of each spiked parameter.
- **GC/MS Tuning** – The mass spectrum of the tuning compound is evaluated for method compliance. The criteria are established to verify the proper mass assignment and mass resolution.
- **Initial Calibration** – The initial calibration ensures that the instrument is capable of producing acceptable qualitative and quantitative data for the compounds of interest.
- **Continuing Calibration** – The continuing calibration checks satisfactory performance of the instrument and its predicted response to the target compounds.
- **Internal Standards** – The internal standards (retention time and response) are evaluated for method compliance. The internal standards are used in quantitation of the target parameters and monitor the instrument sensitivity and response for stability during each analysis.

## Polyaromatic Hydrocarbons (PAHs) Analyses

The QA/QC parameters for the PAH analyses for all of the samples were within acceptable control limits, except as noted below.

### Blanks

All equipment and method blanks were free of contamination, except as noted below.

- Naphthalene was detected in the equipment blank at a concentration of 0.25 ug/L. However, it was not detected in any field samples, therefore no flags were applied.

### Recoveries - Surrogate, MS/MSD and LCS/LCSD

All Surrogate, Matrix Spike (MS), Matrix Spike Duplicate (MSD), Laboratory Control Sample (LCS) and Laboratory Control Duplicate Sample (LCSD) recoveries were within acceptable quality control limits, except as noted below.

- The recoveries for the surrogate Terphenyl-d14 in the original analysis and re-analysis of 16342-2 were slightly below QC limits of 30 percent, at 28 and 26 percent respectively. This sample was analyzed at a dilution, therefore no flags were applied due to the low recoveries.
- The MS and MSD samples reflected poor recoveries due to the concentration of the spiked compounds in the native sample. Due to the high concentration in the native sample, and because the recoveries in the LCS were acceptable, no flags were applied.

### Internal Standard Area

All internal standard areas were within QC limits except as noted below.

- Internal standard Perylene-d12 was above QC limits in samples 16342-1 and 16342-2. The samples were re-analyzed with similar results, therefore the results from the original analyses were used and the results from the re-analyses were rejected. The detected compounds associated with Perylene-d12 were qualified "J" as estimated. Since the internal standards were high, the non-detected compounds were not qualified.

### Field Duplicate Samples

The Relative Percent Differences (RPDs) for some of the compounds in the Native/Field Duplicate Sample set 16342-3/16342-4, were outside acceptable QC limits. Flags are not typically applied to results based upon Duplicate RPD values only, but in conjunction with other QC parameters such as surrogate recoveries, internal standard areas, etc. In addition, non-homogeneity in soil matrices is often the reason for poor precision between the native sample and its field duplicate. No flags were applied to the results based upon the Field Duplicate RPD results.

## Conclusion

A review of the analytical data submitted regarding the investigation of site AOC 681 in Zone I at the Charleston Naval Complex, Charleston, South Carolina by CH2M HILL has been completed. An overall evaluation of the data indicates that the sample handling, shipment, and analytical procedures have been adequately completed, and that the analytical results should be considered usable as qualified.

The analytical data had minor QC concerns as discussed above. However, the validation review demonstrated that the analytical systems were generally in control and the data results can be used in the decision making process.



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## FACSIMILE MESSAGE

---

<b>To:</b>	Herb Kelly/Kris Garcia	<b>From:</b>	Michelle Owens
<b>Company:</b>	CH2M	<b>Date:</b>	October 3, 2001
<b>Fax #:</b>	352-271-4811/770-604-9163	<b># of Pages:</b>	12

---

**Message:**

Herb/Kris,

Here are the results for the Low-Level PAHs from Zone I AOC 681. Samples S116342-1 and -2 were reanalyzed due to failing internal standards (IS were high). Re-analysis confirmed the original results. Both analysis have been reported. Call if you have any questions.

Thank you,

Michelle



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LOG NO: S1-16342  
 Received: 28 SEP 01  
 Reported: 03 OCT 01

Mr. Herb Kelly  
 CH2M Hill  
 3011 SW Williston Road  
 Gainesville, FL 32608-3928

Client PO. No.: 159161.PM.2A/(2211)

Project: Charleston/CNC32/ZONE I, AOC 681  
 Sampled By: Client  
 Code: 16471103

REPORT OF RESULTS

Page 1

LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
16342-1	681SB01201	09-26-01/14:30	CNC32
16342-1-RE	681SB01201	09-26-01/14:30	CNC32
16342-2	681SB01203	09-26-01/14:35	CNC32
16342-2-RE	681SB01203	09-26-01/14:35	CNC32
16342-3	681SB01303	09-26-01/15:00	CNC32

12-1

12-3

12-3

PARAMETER	16342-1	16342-1-RE	16342-2	16342-2-RE	16342-3
Low Level PAH (8270)					
Naphthalene, ug/kg dw	17U	17U	17U	17U	77U
Acenaphthylene, ug/kg dw	17U	17U	17U	17U	77U
Acenaphthene, ug/kg dw	17U	17U	17U	17U	77U
Fluorene, ug/kg dw	17U	17U	17U	17U	77U
Phenanthrene, ug/kg dw	5.9J	5.9J	17U	17U	150
Anthracene, ug/kg dw	17U	17U	17U	17U	20J
Fluoranthene, ug/kg dw	8.8J	8.5J	17U	17U	760
Pyrene, ug/kg dw	11J	11J	17U	17U	620
Chrysene, ug/kg dw	15J	14J	17U	17U	500
Benzo(a)anthracene, ug/kg dw	5.3J	17U	17U	17U	320
Benzo(b)fluoranthene, ug/kg dw	8.6J	8.4J	5.8J	5.8J	490
Benzo(k)fluoranthene, ug/kg dw	4.9J	17U	3.9J	17U	420
Benzo(a)pyrene, ug/kg dw	7.7J	6.0J	4.3J	4.1J	370
Indeno(1,2,3-cd)pyrene, ug/kg dw	11J	6.6J	4.8J	3.5J	420
Dibenzo(a,h)anthracene, ug/kg dw	7.4J	17U	17U	17U	130
Benzo(g,h,i)perylene, ug/kg dw	13J	8.4J	8.4J	8.3J	370
Surrogate - o-Terphenyl	38 ‡	33 ‡	28 ‡	26 ‡	52 ‡
Dilution Factor	2	2	2	2	10



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REPORT OF RESULTS

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LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
16342-1	681SB01201	09-26-01/14:30	CNC32
16342-1-RE	681SB01201	09-26-01/14:30	CNC32
16342-2	681SB01203	09-26-01/14:35	CNC32
16342-2-RE	681SB01203	09-26-01/14:35	CNC32
16342-3	681SB01303	09-26-01/15:00	CNC32

PARAMETER	16342-1	16342-1-RE	16342-2	16342-2-RE	16342-3
Prep Date	09.28.01	09.28.01	09.28.01	09.28.01	09.28.01
Prep Time	13:30	13:30	13:30	13:30	13:30
Analysis Date	10.03.01	10.03.01	10.03.01	10.03.01	10.01.01
Analysis Time	09:19	10:35	09:44	11:51	14:38
Batch ID	0928E	928E	0928E	0928E	0928E
Clock ID	1D1003	1D1003	1D1003	1D1003	1D1001
Quantitation Factor	1	1	1	1	1
Percent Solids	78	---	79	---	87



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REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
16342-4	681CB01303	09-26-01	CNC32
PARAMETER		16342-4	
Low Level PAH (8270)			
	Naphthalene, ug/kg dw	75U	
	Acenaphthylene, ug/kg dw	75U	
	Acenaphthene, ug/kg dw	75U	
	Fluorene, ug/kg dw	75U	
	Phenanthrene, ug/kg dw	50J	
	Anthracene, ug/kg dw	75U	
	Fluoranthene, ug/kg dw	280	
	Pyrene, ug/kg dw	220	
	Chrysene, ug/kg dw	220	
	Benzo(a)anthracene, ug/kg dw	100	
	Benzo(b)fluoranthene, ug/kg dw	180	
	Benzo(k)fluoranthene, ug/kg dw	180	
	Benzo(a)pyrene, ug/kg dw	140	
	Indeno(1,2,3-cd)pyrene, ug/kg dw	170	
	Dibenzo(a,h)anthracene, ug/kg dw	54J	
	Benzo(g,h,i)perylene, ug/kg dw	160	
	Surrogate - o-Terphenyl	48 %	
	Dilution Factor	10	
	Prep Date	09-28-01	
	Prep Time	13:30	
	Analysis Date	10-01-01	
	Analysis Time	15:55	
	Batch ID	0928E	
	Clock ID	1D1001	
	Quantitation Factor	1	



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REPORT OF RESULTS

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LOG NO	SAMPLE DESCRIPTION , SOLID OR SEMISOLID SAMPLES	DATE/ TIME SAMPLED	SDG#
16342-4	681CB01303	09-26-01	CNC32
PARAMETER		16342-4	
Percent Solids		89	



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REPORT OF RESULTS

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LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
16342-5	681EB012L1	09-26-01/15:30	CNC32
PARAMETER	16342-5		
Low Level PAH (8270)			
Naphthalene, ug/l		0.25	
Acenaphthylene, ug/l		0.20U	
Acenaphthene, ug/l		0.20U	
Fluorene, ug/l		0.20U	
Phenanthrene, ug/l		0.20U	
Anthracene, ug/l		0.20U	
Fluoranthene, ug/l		0.20U	
Pyrene, ug/l		0.20U	
Chrysene, ug/l		0.20U	
Benzo(a)anthracene, ug/l		0.20U	
Benzo(b)fluoranthene, ug/l		0.20U	
Benzo(k)fluoranthene, ug/l		0.20U	
Benzo(a)pyrene, ug/l		0.20U	
Indeno(1,2,3-cd)pyrene, ug/l		0.20U	
Dibenzo(a,h)anthracene, ug/l		0.20U	
Benzo(g,h,i)perylene, ug/l		0.20U	
Surrogate - o-Terphenyl		70 %	
Dilution Factor		1	
Prep Date		10.01.01	
Prep Time		15:30	
Analysis Date		10.03.01	
Analysis Time		13:07	
Batch ID		1001F	
Clock ID		1D1003	
Quantitation Factor		1	



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REPORT OF RESULTS

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LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR SOLID/SEMISOLID	DATE/ TIME SAMPLED	SDG#
16342-6	Method Blank		CNC32
16342-7	Lab Control Standard Result		CNC32
16342-8	Lab Control Standard % Recovery		CNC32
16342-9	LCS Accuracy Control Limit (%R)		CNC32
16342-10	Spike Amount Added, LCS		CNC32

PARAMETER	16342-6	16342-7	16342-8	16342-9	16342-10
<b>Low Level PAH (8270)</b>					
Naphthalene, ug/kg dw	6.70	31	46 %	25-131 %	67
Acenaphthylene, ug/kg dw	6.70	---	---	---	---
Acenaphthene, ug/kg dw	6.70	31	46 %	18-123 %	67
Fluorene, ug/kg dw	6.70	30	45 %	27-151 %	67
Phenanthrene, ug/kg dw	6.70	---	---	---	---
Anthracene, ug/kg dw	6.70	---	---	---	---
Fluoranthene, ug/kg dw	6.70	---	---	---	---
Pyrene, ug/kg dw	6.70	37	55 %	10-133 %	67
Chrysene, ug/kg dw	6.70	---	---	---	---
Benzo(a)anthracene, ug/kg dw	6.70	---	---	---	---
Benzo(b)fluoranthene, ug/kg dw	6.70	---	---	---	---
Benzo(k)fluoranthene, ug/kg dw	6.70	---	---	---	---
Benzo(a)pyrene, ug/kg dw	6.70	34	51 %	41-142 %	67
Indeno(1,2,3-cd)pyrene, ug/kg dw	6.70	---	---	---	---
Dibenzo(a,h)anthracene, ug/kg dw	6.70	---	---	---	---
Benzo(g,h,i)perylene, ug/kg dw	6.70	---	---	---	---
Surrogate - o-Terphenyl	61 %	36	54 %	30-130 %	---
Dilution Factor	1	1	1	---	1



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REPORT OF RESULTS

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LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR SOLID/SEMISOLID	DATE/ TIME SAMPLED	SDG#
16342-6	Method Blank		CNC32
16342-7	Lab Control Standard Result		CNC32
16342-8	Lab Control Standard & Recovery		CNC32
16342-9	LCS Accuracy Control Limit (%R)		CNC32
16342-10	Spike Amount Added, LCS		CNC32

PARAMETER	16342-6	16342-7	16342-8	16342-9	16342-10
Prep Date	09.28.01	09.28.01	09.28.01	---	09.28.01
Prep Time	13:30	13:30	13:30	---	13:30
Analysis Date	10.01.01	10.01.01	10.01.01	---	10.01.01
Analysis Time	12:55	13:21	13:21	---	13:21
Batch ID	0928E	0928E	0928E	---	0928E
Clock ID	1D1001	1D1001	1D1001	---	1D1001
Quantitation Factor	1	1	1	---	1

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CH2M Hill  
3011 SW Williston Road  
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Project: Charleston/CNC32/ZONE I, AOC 681

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## REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR SOLID/SEMISOLID	DATE/ TIME SAMPLED		SDG#
		16342-11	16342-12	
16342-11	Reporting Limit (RL)			CNC32
16342-12	Method Detection Limit (MDL)			CNC32
-----				
PARAMETER		16342-11	16342-12	
-----				
Low Level PAH (8270)				
Naphthalene, ug/kg		6.7	1.0	
Acenaphthylene, ug/kg		6.7	1.2	
Acenaphthene, ug/kg		6.7	1.5	
Fluorene, ug/kg		6.7	1.1	
Phenanthrene, ug/kg		6.7	1.2	
Anthracene, ug/kg		6.7	1.2	
Fluoranthene, ug/kg		6.7	1.5	
Pyrene, ug/kg		6.7	1.7	
Chrysene, ug/kg		6.7	2.1	
Benzo(a)anthracene, ug/kg		6.7	1.5	
Benzo(b)fluoranthene, ug/kg		6.7	1.5	
Benzo(k)fluoranthene, ug/kg		6.7	1.5	
Benzo(a)pyrene, ug/kg		6.7	1.2	
Indeno(1,2,3-cd)pyrene, ug/kg		6.7	1.0	
Dibenzo(a,h)anthracene, ug/kg		6.7	1.4	
Benzo(g,h,i)perylene, ug/kg		6.7	1.3	
Quantitation Factor		1	---	



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REPORT OF RESULTS

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LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
16342-13	Method Blank		CNC32
16342-14	Lab Control Standard Result		CNC32
16342-15	Lab Control Standard % Recovery		CNC32
16342-16	LCS Accuracy Control Limit (%R)		CNC32
16342-17	Spike Amount Added, LCS/LCSD		CNC32

PARAMETER	16342-13	16342-14	16342-15	16342-16	16342-17
<b>Low Level PAH (8270)</b>					
Naphthalene, ug/l	0.20U	1.4	70 %	41-130 %	2.0
Acenaphthylene, ug/l	0.20U	---	---	---	---
Acenaphthene, ug/l	0.20U	1.5	75 %	36-121 %	2.0
Fluorene, ug/l	0.20U	1.5	75 %	50-124 %	2.0
Phenanthrene, ug/l	0.20U	---	---	---	---
Anthracene, ug/l	0.20U	---	---	---	---
Fluoranthene, ug/l	0.20U	---	---	---	---
Pyrene, ug/l	0.20U	1.5	75 %	31-139 %	2.0
Chrysene, ug/l	0.20U	---	---	---	---
Benzo(a)anthracene, ug/l	0.20U	---	---	---	---
Benzo(b)fluoranthene, ug/l	0.20U	---	---	---	---
Benzo(k)fluoranthene, ug/l	0.20U	---	---	---	---
Benzo(a)pyrene, ug/l	0.20U	1.5	75 %	45-120 %	2.0
Indeno(1,2,3-cd)pyrene, ug/l	0.20U	---	---	---	---
Dibenzo(a,h)anthracene, ug/l	0.20U	---	---	---	---
Benzo(g,h,i)perylene, ug/l	0.20U	---	---	---	---
Surrogate - o-Terphenyl	70 %	1.3	65 %	30-130 %	---
Dilution Factor	1	1	1	---	1



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REPORT OF RESULTS

Page 10

LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#		
16342-13	Method Blank		CNC32		
16342-14	Lab Control Standard Result		CNC32		
16342-15	Lab Control Standard % Recovery		CNC32		
16342-16	LCS Accuracy Control Limit (%R)		CNC32		
16342-17	Spike Amount Added, LCS/LCSD		CNC32		
PARAMETER	16342-13	16342-14	16342-15	16342-16	16342-17
Prep Date	10.01.01	10.01.01	10.01.01	---	10.01.01
Prep Time	15:30	15:30	15:30	---	15:30
Analysis Date	10.03.01	10.03.01	10.03.01	---	10.03.01
Analysis Time	10:10	12:16	12:16	---	12:16
Batch ID	1001F	1001F	1001F	---	1001F
Clock ID	1D1003	1D1003	1D1003	---	1D1003
Quantitation Factor	1	1	1	---	1

These test results meet all the requirements of NELAC. All questions regarding this test report should be directed to the STL Project Manager who signed this test report.

SW-846, Test Methods for Evaluating Solid Waste, Third Edition, September 1986, and Updates I, II, IIA, IIB, and III.



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 Gainesville, FL 32608-3928

Client PO. No.: 159161.PM.2A/(2211)

Project: Charleston/CNC32/ZONE I, AOC 681

Sampled By: Client

Code: 16471103

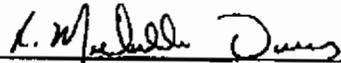
Page 11

## REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES	DATE/ TIME SAMPLED	SDG#
16342-18	Reporting Limit (RL)		CNC32
16342-19	Method Detection Limit (MDL)		CNC32
PARAMETER		16342-18	16342-19
Low Level PAH (8270)			
Naphthalene, ug/l		0.20	0.071
Acenaphthylene, ug/l		0.20	0.074
Acenaphthene, ug/l		0.20	0.088
Fluorene, ug/l		0.20	0.087
Phenanthrene, ug/l		0.20	0.089
Anthracene, ug/l		0.20	0.076
Fluoranthene, ug/l		0.20	0.054
Pyrene, ug/l		0.20	0.089
Chrysene, ug/l		0.20	0.069
Benzo(a)anthracene, ug/l		0.20	0.042
Benzo(b)fluoranthene, ug/l		0.20	0.057
Benzo(k)fluoranthene, ug/l		0.20	0.057
Benzo(a)pyrene, ug/l		0.20	0.057
Indeno(1,2,3-cd)pyrene, ug/l		0.20	0.064
Dibenzo(a,h)anthracene, ug/l		0.20	0.054
Benzo(g,h,i)perylene, ug/l		0.20	0.056

These test results meet all the requirements of NELAC. All questions regarding this test report should be directed to the STL Project Manager who signed this test report.

SW-846, Test Methods for Evaluating Solid Waste, Third Edition, September 1986, and Updates I, II, IIA, IIB, and III.

  
 Michelle Owens, Project Manager



**Table C-1**  
 UCL 95% Calculation for Arsenic in Surface Soil  
 CMS Work Plan, AOC 685, Zone I

Sample ID	Arsenic Result (mg/kg)	Qualifier	Statistics	
I685SB001	20.7	J		
I685SB002	11.8	J	N	37
I685SB003	15.5	J	Detects	36
I685SB004	11.2	J	FOD	97%
I685SB005	6.2	J	Mean of Detect	11.9
I685SB006	14.8	J	Min of Detect	5.50
I685SB007	10	=	Max of Detect	30
I685SB008	9.6	=		
I685SB008	2.7	U	Mean (arithmetic)	11.7
I685SB009	7.1	=	Mean (geometric)	10.4
I685SB010	10.9	J		
I685SB011	6.8	J	UCL95 Normal	13.1
I685SB012	5.5	J	UCL95 Lognormal	14.1
I685SB013	7.8	J	<b>UCL95 Nonparametric</b>	<b>12.9</b>
I685SB014	5.9	J		
I685SB015	5.8	J		
I685SB016	10.4	=	Population is best described as: Non-parametric	
I685SB017	14.6	=	DOES NOT FIT NORMAL OR LOGNORMAL	
I685SB018	13.1	=	DISTRIBUTION	
I685SB019	5.5	=	Industrial RBC	3.8
I685SB020	10.1	=	Residential RBC	0.43
I685SB021	14	=	SSL	14.5
I685SB022	18.5	=	Zone I Surface Soil Bkg	21.6
I685SB023	12.9	=	Nonparametric UCL95% =	<b>12.9</b>
I685SB024	10.4	=		
I685SB025	11.8	=		
I685SB026	20.7	=		
I685SB027	9.1	=		
I685SB028	10.3	=		
I685SB029	30.3	=		
I685SB030	10.6	=		
I685SB031	15.1	=		
I685SB032	12.1	=		
I685SB033	14.4	=		
I685SB034	14.4	=		
I685SB035	12.4	=		
I685SB036	8.2	=		

**Table C-2a**

UCL95% Calculation for Arsenic in Surface Soil  
 CMS Work Plan, AOCs 689/690, Zone I

Sample	Arsenic Result (mg/kg)	Qualifier	Statistics	
I690SB001	7.5	J	Samples	39
I690SB002	26.3	=	Detects	37
I690SB003	1.7	=	FOD	1
I690SB004	11.2	=	Mean of Detect	7.0
I690SB005	5.8	=	Min of Detect	1.3
I690SB006	2.1	=	Max of Detect	28.7
I690SB007	2.2	=		
I690SB008	4.7	=	Mean (arithmetic)	6.6
I690SB009	3.6	=	Mean (geometric)	4.43
I690SB010	7.4	=		
I690SB011	6.7	J	UCL95 Normal	8.2
I690SB012	9.8	J	UCL95 Lognormal	11.6
I690SB013	9.2	J	UCL95 Nonparametric	7.5
I690SB014	6.4	J		
I690SB015	8.6	J	Population is best described as: Nonparametric	
I690SB016	1.9	J		
I690SB017	3.6	J	Industrial RBC	3.8
I690SB018	10.7	J	Residential RBC	0.43
I690SB019	1.3	J	SSL	14.5
I690SB020	11.8	J	Zone I Surface Soil Bkg	21.6
I690SB021	6.7	J	Nonparametric UCL95% =	7.5
I690SB022	0.37	U		
I690SB023	7.9	=		
I690SB024	0.37	U		
I690SB025	2.6	J		
I690SB026	5.5	=		
I690SB027	8.2	=		
I690SB028	7	J		
I690SB029	28.7	J		
I690SB030	5.3	J		
I690SB034	10	=		
I690SB035	7.5	=		
I690SB036	10.9	=		
I690SB037	3.4	=		
I690SB038	1.5	=		
I690SB039	1.5	=		
I690SB040	3.7	=		
I690SB041	2.3	=		
I690SB042	2.8	=		

**Table C-2b**

UCL95% Calculation for Chromium in Surface Soil  
 CMS Work Plan, AOCs 689/690, Zone I

Sample	Chromium		Statistical Summary	
	Result (mg/kg)	Qualifier		
I690SB001	22.5	=	Samples	39
I690SB002	18	=	Detects	39
I690SB003	7.7	=	FOD	1
I690SB004	25.7	=	Mean of Detect	33.1
I690SB005	132	=	Min of Detect	4.1
I690SB006	21.2	=	Max of Detect	132.0
I690SB007	9.5	=		
I690SB008	11.9	=	Mean (arithmetic)	33.1
I690SB009	66.2	=	Mean (geometric)	25.09
I690SB010	48	=		
I690SB011	36.4	J	UCL95 Normal	40.8
I690SB012	19.7	J	UCL95 Lognormal	43.3
I690SB013	55.9	J	UCL95 Nonparametric	33.4
I690SB014	31.4	J		
I690SB015	33	J	Population is best described as: LOGNORMAL	
I690SB016	131	J		
I690SB017	33.4	J		
I690SB018	29.4	J	Industrial RBC	310,000
I690SB019	42.7	J	Residential RBC	12,000
I690SB020	26.5	J	SSL	NA
I690SB021	19.3	J	Zone I Surface Soil Bkg	41
I690SB022	6.5	=	Nonparametric UCL95% =	43.3
I690SB023	21.8	=		
I690SB024	4.1	=		
I690SB025	10.3	J		
I690SB026	57.6	=		
I690SB027	38.1	=		
I690SB028	27.6	J		
I690SB029	19.3	J		
I690SB030	21.2	J		
I690SB034	58.7	=		
I690SB035	45.4	=		
I690SB036	43.7	J		
I690SB037	10	J		
I690SB038	14.3	J		
I690SB039	13.9	J		
I690SB040	28.3	J		
I690SB041	10.4	=		
I690SB042	40	=		



**Response to EPA Comments on the  
Corrective Measures Study Work Plan – Zone I  
Charleston Naval Complex  
North Charleston, South Carolina  
Dated February 2002**

**General Comments**

The recommendations of the CMS Work Plan appear to be appropriate based upon the data presented. The CMS Work Plan appears to be complete with the exceptions noted in the Specific Comments below.

**CH2M-Jones Response:** *Thank you, we concur.*

**Specific Comments**

1. **Section 1, Figure 1-2.** The figure shows the locations of several Areas of Concern (AOC) that are not mentioned in the CMS Work Plan (AOC 711, AOC 715, and AOC 718). Please provide information about these AOC or why they are not included in the report.

**CH2M-Jones Response:**

*AOCs 711, 715, and 718 are oil/water separators (OWSs) that were identified by SCDHEC in late 2001. Due to their recent identification, they have not yet been evaluated under the RFI process, but Confirmatory Sampling and Investigation reports are in progress for each one. The sites were included on the figure to indicate their presence. The text in Section 1.0 of the CMS Work Plan will be revised to reflect the current status of these three AOCs. The AOCs and SWMUs addressed in the Zone I CMS Work Plan (other than the OWSs AOCs) can be evaluated separately and closed out independently of these OWS AOCs.*

2. **Section 4, Table 4-4.** The naphthalene concentration at Sample Station I677SB009 is listed as 5.9 milligrams per kilogram (mg/Kg) which exceeds the Soil Screening Level (SSL) of 4 mg/Kg. This constituent is not addressed in the chemicals of concern (COC) discussions for AOC 677. Please address why naphthalene was not considered a COC.

**CH2M-Jones Response:**

*The SSL value for naphthalene reported in Table 4-4 (and Table 4-3) was listed as 4 mg/kg, which is the SSL for a DAF=1. This compound should have been included in the discussion of COPCs presented in Section 4.3.2.1 of the CMS Work Plan. Based on review of the naphthalene data at AOCs 675/676/677 (Tables 4-3 and 4-4), it appears that naphthalene was detected in only one of the nine subsurface soil samples, which is also the single exceedence of the SSL (DAF=1) at I677SB009. Naphthalene was not detected in the surface sample collected from the same location (0.75U mg/kg in sample I677SB00901.)*

*Naphthalene was detected at 1 ug/L in two groundwater samples collected during the first and third sampling events at shallow monitoring well I675GW002. This well is*

located cross-gradient from boring I687SB009 and thus is not likely to have been impacted by this boring (See Figure 4-1 for sampling locations). Naphthalene was not detected in either groundwater sample collected during the second or fourth sampling events.

No other naphthalene detections in groundwater were identified at the site, indicating that naphthalene is not leaching from site soils into groundwater.

The average surface soil concentration of naphthalene is 0.47 mg/kg and its average subsurface soil concentration is 1.1 mg/kg, well below the generic SSL of 4 mg/kg (DAF = 10). Thus the amount of naphthalene in soils at the site does not present a significant leaching hazard. Based on these considerations, naphthalene should not be considered a COC at AOCs 676/676/677. The text in Section 4.3.2.1 of the CMS Work Plan will be revised to include this information.

3. **Section 5.3.1.2, Page 5-4.** There is a typographic error in the endrin RBC that should be corrected prior to finalizing the document.

**CH2M-Jones Response:**

*The text will be corrected accordingly. The correct value for the endrin residential RBC is 2,300 ug/kg (HI = 0.1) or 23,000 (HI = 1).*

4. **Section 6.3.2.1, Page 6-6.** The report states that 1,2-dichloroethene was detected in surface and subsurface soil in the same boring at concentrations greater than the SSL. Since 1,2-dichloroethene was not detected in groundwater at a co-located well and the concentrations are only slightly above the SSL, the report concludes that 1,2-dichloroethene is not a COC. However, the nearest soil sample is approximately 50 feet from the detection location. Additional soil sampling may be required to adequately determine that 1,2-dichloroethene is not present at concentrations of concern.

**CH2M-Jones Response:**

*CH2M-Jones proposes to resample surface (0 – 1 ft bls) and subsurface (3 – 5 ft bls) soil at the location adjacent to well I680GW004 and analyze the samples for VOCs to assess current soil conditions. In addition, surface and subsurface soil samples will be collected at three locations approximately 20 feet from I680GW004. One soil sampling location will be upgradient of the well and two will be downgradient. Attachment 1 is a figure that shows the specific proposed sampling locations.*

*After collection and analysis of these samples, a CMS Work Plan addendum for AOC 680 will be prepared. The results will be evaluated to assess whether VOCs in surface or subsurface soil should be considered COCs. If VOCs are determined to be COCs at the site, a pathway forward for additional activities, which may include more soil or groundwater sampling, will be developed, after consultation with EPA.*

5. **Section 7.2, Page 7-4.** On Line 11, BEQs are listed as a COC for subsurface soil. However, on lines 21 and 22 it is indicated that no COCs were identified in subsurface soil. Please correct this discrepancy.

**CH2M-Jones Response:**

*BEQs were identified as COCs for soils in the RFI Report (Ensafe, 1999), not specific to interval. The text in Section 7.2.4.2 will be revised to include BEQs in subsurface soil as a COC at AOC 681.*

6. **Section 9.3.3.1, Page 9-6.** The report indicates that when well I687GW002 was re-sampled in 1999, the concentration of arsenic had decreased to 26.7 micrograms per liter (ug/L). However, this result could not be located on the tables provided. Please provide this data, since it is used to conclude that arsenic in groundwater at AOC 687 is not a COC. Please provide a description of the sampling technique, since this can significantly impact inorganic compound results. For example were low flow purging/sampling techniques used in more recent sampling events?

**CH2M-Jones Response:**

*The arsenic data for 1999 were inadvertently omitted from Table 9-10. The table will be revised to include the 1999 arsenic results.*

*Regarding the low flow purge and sampling techniques, we have enclosed copies of several groundwater sampling forms for the sampling performed dates of 1/16/96, 6/4/96, and 9/10/96 (see Attachment 2). These forms show that the groundwater purge flow rates ranged from about 0.1 to 0.23 gallons per minute. This flow rate is generally within the range considered to be low flow purging. Based on conversations with Ensafe, low flow purge methods were used for all groundwater sampling.*

*Also, Attachment 3 to this Response to Comments is a figure that plots arsenic versus iron concentrations in groundwater samples from well I687GW002 (except for the 1999 data point, for which iron was not measured). The figure shows a linear regression for the data, with an R-squared value of 0.957, a remarkably good coefficient for groundwater data of this type. The regression shows a significant relationship between arsenic and iron, strongly confirming the probability that the arsenic is present due to natural geochemical processes.*

*Based on these considerations, we believe that arsenic is not site related and should not be considered a COC for this site.*

7. **Section 11, Table 11-8.** The title of this table is "VOCs Detected in Surface Soil"; Table 11-3 is also entitled "VOCs in Surface Soil." It appears that this table should be labeled VOCs Detected in Subsurface Soil. Please correct this discrepancy.

**CH2M-Jones Response:**

*The correct title for Table 11-8 should be "VOCs detected in Subsurface Soil." This correction will be made.*

8. **Section 12.3.3.1, Page 12-4.** The report concludes that elevated arsenic concentrations detected in well I012GW002 (128 to 253 ug/L) are from natural background sources based on the presence of arsenic in background grid wells and elevated iron and manganese concentrations in groundwater at well I012GW002. The 1999 data could not be located on the tables provided. Please provide this data, since it is used to conclude that arsenic in groundwater is not a COC. Also, the concentration of arsenic in groundwater at this well is 2 to 4 times the maximum concentration detected in grid wells (66 ug/L). While iron and manganese concentrations are also many times higher than the concentrations detected at other wells, re-sampling of the well using low flow purging/sampling is recommended to confirm the results.

***CH2M-Jones Response:***

*The arsenic data for 1999 were inadvertently omitted from Table 9-10. The table will be revised to include the 1999 arsenic results. Also, Attachment 4 to this Response to Comments is a figure that plots arsenic versus iron concentrations in groundwater samples collected at SMWU 12. The figure shows a linear regression for the data, with an R-squared value of 0.8159, which is a remarkably good coefficient for groundwater data of this type.*

*There is one outlier in the data set. When the outlier is removed from the regression analysis, the arsenic versus iron concentrations have an even stronger relationship with an R-squared value of 0.9707, which is an exceptionally strong correlation coefficient (See Attachment 5).*

*These regression analyses show a strongly significant relationship between arsenic and iron, strongly confirming the probability that the arsenic is present due to natural geochemical processes.*

*Based on these considerations, we believe that arsenic is not site related and should not be considered a COC for this site.*

9. ~~**Section 12.3.3.3, Page 12-5.** The report states that dioxins (calculated TEQs) are not a COC because (1) only the highest detected value exceeds the RBC, (2) dioxins resulted in a cancer risk greater than  $1 \times 10^{-6}$  for both residential and industrial receptors, and (3) dioxins were not detected in the most recent sampling event at well 012001. This designation appears to be a typo, since no well with this designation was found on the tables. Dioxins were detected in wells I012GW001 and IGDIGW003 (5.6J to 8.9J picograms per liter — pg/L). These concentrations exceed the RBC. The maximum detected value was recorded at well IGDIGW003, according to Table 12-6. This table also indicates that dioxins were detected at this well in the most recent sampling event (8/21/96) at a concentration of 7.9J pg/L (which exceeds the RBC). If the calculated cancer risk is greater than  $1 \times 10^{-6}$ , then dioxin should be a COC under the residential scenario. Please provide more information regarding dioxins.~~

[Note: Disregard comment 9; I leave it in for your information only. Dioxins >RBC but < 1 ppb need not be considered COCs. However, these facts should be pointed out in the uncertainties section. -ds]

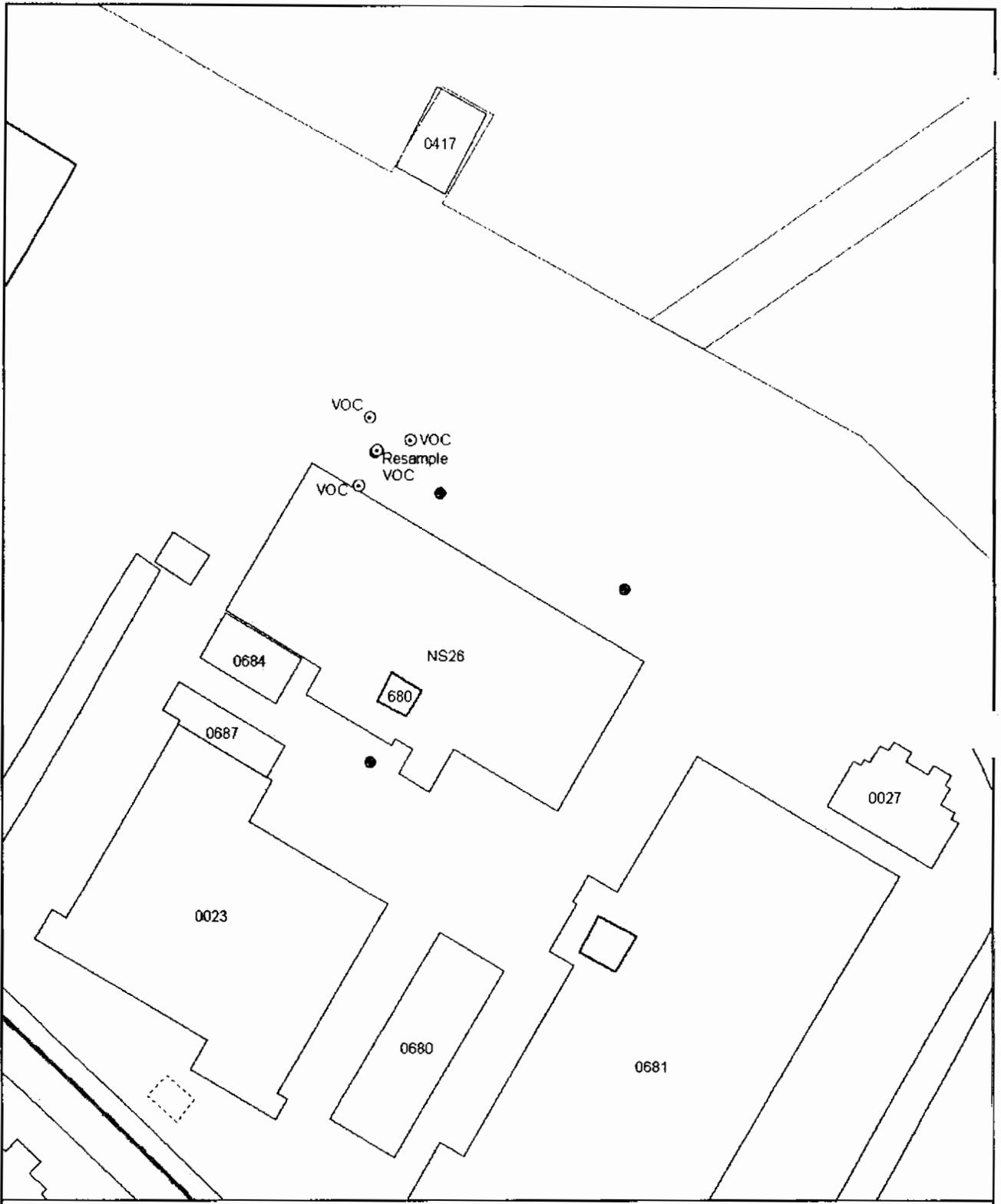
**CH2M-Jones Response:**

*Although this comment was included for informational purposes only, CH2M-Jones feels that some clarification is warranted.*

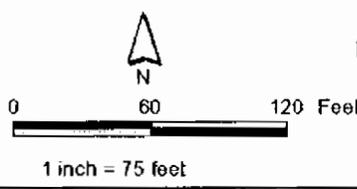
*The primary criterion for SCDHEC for determining whether a chemical in groundwater is a COC is whether the concentrations of the chemical are above or below the drinking water MCL. The MCL for dioxin in drinking water is 30 pg/L. None of the dioxin concentrations in groundwater samples at this site, including the nearby grid well, exceeded the MCL. Therefore, dioxin is not considered a COC in groundwater at this site.*

*The tables included as Attachment 6 present the grid well concentration ranges for dioxins measured in Zone 1, for shallow and deep groundwater (see Table 1 below). As can be noted in Table 1, background concentration ranges are 1.3 pg/L to 5.2 pg/L, with a mean of 3 pg/L for shallow groundwater. Similar values for deep groundwater are 0.9 pg/L to 9.9 pg/L, with a mean of 2.7 pg/L. In most cases, much of the concentrations in these estimated values result simply from summing up the values represented by half the detection limit. The TEF values calculated based on actual detected concentrations (= or j flagged) are much lower than those shown in the attached tables.*

*The estimated TEQ values in site wells at SWMU 12 ranged (Table 2) between 1.5 pg/L to 4.7 pg/L, with a mean value of 2.1 pg/L. The last round of samples for two of the three wells are non-detects and the one detect is at 2 pg/L. The average background concentration is at 3 pg/L. These values are all well below the MCL.*



- ⊗ Proposed Sample Location
- Groundwater Sample
- - - Fence
- ~ Roads
- ~ Shoreline
- Buildings
- ▭ Zone Boundary
- ▭ AOC Boundary
- ▭ SWMU Boundary



**Attachment 1**  
**Proposed Confirmation Surface Soil and**  
**Subsurface Soil Sampling Locations**  
**AOC 680, Zone I**  
**Charleston Naval Complex**  
**CH2MHILL**

**Attachment 2**  
(1 of 3)

Final Comprehensive Sampling and Analysis Plan  
Naval Base Charleston  
August 30, 1994

**Figure 6-1**  
**Groundwater Sampling Form**

Groundwater Sampling		Sample ID: _____					
PROJECT NAME: <u>NAVAL BASE CHARLESTON</u>		JOB NO: <u>2908-08440</u> DATE: <u>1/16/96</u>					
WELL NO.: <u>NBCI/ 687 GW 002 02</u>		LOCATION: <u>ZONE I</u>					
WEATHER CONDITIONS: <u>Cloudy</u>		AMBIENT TEMP: <u>55°</u>					
REVIEWED BY: _____		PERSONNEL: <u>LESTER/BASHA/WARD</u>					
<b>PURGING DEVICE</b> Type device? <u>PERISTALTIC PUMP/TEFLON TUBING</u> How was the device decontaminated? <u>N/A</u> How was the line decontaminated? <u>5 STEP D-CON</u> Which well was previously purged? <u>NBCI/</u>	<b>SAMPLING DEVICE</b> Type device? _____ <u>S</u> How was the device decontaminated? _____ <u>A</u> How was the line decontaminated? _____ <u>M</u> Which well was previously sampled? _____ <u>E</u>						
<b>INITIAL WELL VOLUME</b> Well diameter (in.) <u>2</u> Stickup (ft.) _____ Depth to bottom of well from TOC (ft.) <u>15.51</u> Depth to water surface from TOC (ft.) <u>5.80</u> Length of water (ft.) <u>9.71</u> Volume of water (ft. <sup>3</sup> ) _____ (gal.) <u>1.6</u> Amount of sediment at bottom of well (ft.) _____ 3 Volumes of water (gal.) <u>4.8</u>	<b>PURGING</b> Time started <u>1533</u> Finished <u>1608</u> Volume purged <u>4.8 gal</u> Comments on Well Recovery _____ Depth to water (ft.) <u>5.80</u> Completion <u>N/A 9.11</u> Additional Comments _____ Sample Collected: Start <u>1615</u> Finish <u>1628</u>						
<b>IN-SITU TESTING</b>	Time:	<u>1533</u>	<u>1546</u>	<u>1559</u>	<u>1601</u>	_____	_____
Well Volume Purged (gal.)		<u>0</u>	<u>1.6</u>	<u>3.2</u>	<u>4.8</u>	_____	_____
Turbidity		<u>266</u>	<u>4.88</u>	<u>2.44</u>	<u>1.49</u>	_____	_____
Oder		_____	_____	_____	_____	_____	_____
pH (urvis)		<u>7.23</u>	<u>7.13</u>	<u>7.12</u>	<u>7.15</u>	_____	_____
Conductivity (umhos)		<u>4570</u>	<u>4070</u>	<u>4090</u>	<u>4140</u>	_____	_____
Water Temperature (°C)		<u>67</u>	<u>67</u>	<u>68</u>	<u>67</u>	_____	_____
Depth to water (ft.)		<u>5.80</u>	<u>8.10</u>	<u>8.85</u>	<u>9.11</u>	_____	_____
NOTES: 1 ft. length of 4" = 0.087 ft <sup>3</sup> or 0.85 gal.      1 ft. length 2" = 0.022 ft <sup>3</sup> or 0.18 gal. Turbidity choices: clear, turbid, opaque      Revision Date: 8/5/82							

**Attachment 2**  
(2 of 3)

Final Comprehensive Sampling and Analysis Plan  
Naval Base Charleston  
August 30,

FIGURE 6-1

**Groundwater Sampling Form**

Groundwater Sampling	Sample ID: NBCI 687 CW 00203
PROJECT NAME: <u>NAVAL BASE CHARLESTON (clean)</u>	JOB NO: _____ DATE: <u>6-4-96</u>
WELL NO: <u>NBCI 687-002</u>	LOCATION: <u>ZONE I</u>
WEATHER CONDITIONS: <u>partly cloudy</u>	AMBIENT TEMP: <u>85°</u>
REVIEWED BY: <u>AK [signature]</u>	PERSONNEL: <u>B. Herrick M. Zitzke [signature]</u>

<b>PURGING DEVICE</b> Type device? <u>Peristaltic Pump</u> How was the device decontaminated? <u>Per CSAP</u> How was the line decontaminated? <u>Per CSAP</u> Which well was previously purged? <u>NBCI 687-001</u>	<b>SAMPLING DEVICE</b> Type device? <u>Peristaltic Pump</u> How was the device decontaminated? <u>Per CSAP</u> How was the line decontaminated? <u>Per CSAP</u> Which well was previously sampled? <u>NBCI 687-001</u>
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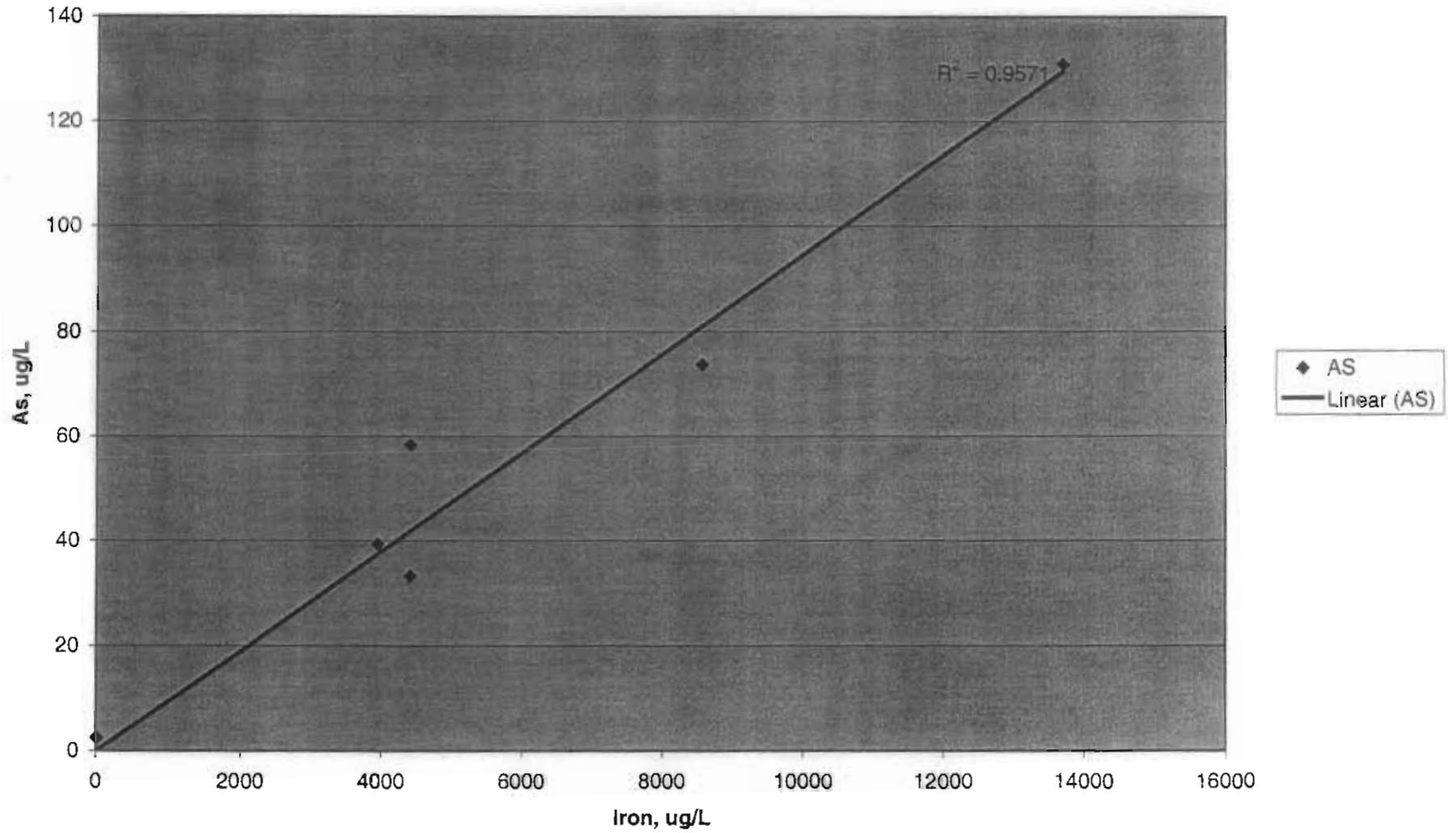
<b>INITIAL WELL VOLUME</b> Well diameter (in.) <u>2</u> Stickup (ft.) <u>3'</u> Depth to bottom of well from TOC (ft.) <u>15.51</u> Depth to water surface from TOC (ft.) <u>7.67</u> Length of water (ft.) <u>7.84</u> Volume of water (ft.) <u>—</u> (gal.) <u>1.3</u> Amount of sediment at bottom of well (ft.) <u>None</u> 3 volumes of water (gal.) <u>4</u>	<b>PURGING</b> Time started <u>1150</u> Finished <u>1258</u> Volume purged <u>6.75 gal</u> Comments on Well Recovery <u>Pool</u> Depth to water (ft.) <u>11.19</u> Completion <u>—</u> Additional Comments <u>—</u> Sample Collected: Start <u>1305</u> Finish <u>1312</u>
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<b>IN-SITU TESTING</b>	Time: <u>1258</u>	<u>—</u>	<u>1157</u>	<u>1203</u>	<u>1210</u>	<u>1216</u>	<u>1222</u>	<u>1229</u>	<u>1238</u>	<u>1249</u>
		<u>9</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
Well Volume Purged (gal.)	<u>6.75</u>	<u>7.5</u>	<u>1.5</u>	<u>2.25</u>	<u>3</u>	<u>3.75</u>	<u>4.5</u>	<u>5.25</u>	<u>6</u>	<u>6</u>
Turbidity	<u>6</u>	<u>3/1</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>5</u>	<u>85</u>	<u>3</u>	<u>8</u>	<u>8</u>
Odor	<u>None</u>	<u>None</u>	<u>None</u>	<u>None</u>	<u>None</u>	<u>None</u>	<u>None</u>	<u>None</u>	<u>None</u>	<u>None</u>
pH (units)	<u>6.58</u>	<u>6.64</u>	<u>6.58</u>	<u>6.59</u>	<u>6.57</u>	<u>6.61</u>	<u>6.57</u>	<u>6.61</u>	<u>6.59</u>	<u>6.59</u>
Conductivity (umho)	<u>3.90</u>	<u>3.84</u>	<u>3.58</u>	<u>3.69</u>	<u>3.67</u>	<u>3.79</u>	<u>6.62</u>	<u>4.02</u>	<u>3.85</u>	<u>3.85</u>
Water Temperature (deg. C)	<u>21.5</u>	<u>21.4</u>	<u>21.5</u>	<u>21.3</u>	<u>21.3</u>	<u>21.0</u>	<u>21.4</u>	<u>22.0</u>	<u>22.1</u>	<u>22.1</u>
Depth to water (ft.)	<u>11.19</u>	<u>8.64</u>	<u>9.22</u>	<u>9.68</u>	<u>10.1</u>	<u>10.71</u>	<u>11.01</u>	<u>10.99</u>	<u>11</u>	<u>11</u>

**NOTES:** 1 FT. LENGTH OF 4" equals 0.087 ft or 0.65 gal. 1 ft. length 2" equals 0.0228 or 0.18 gal.  
 Turbidity choices: clear, turbid, opaque  
 Revision Date: 8/5/92

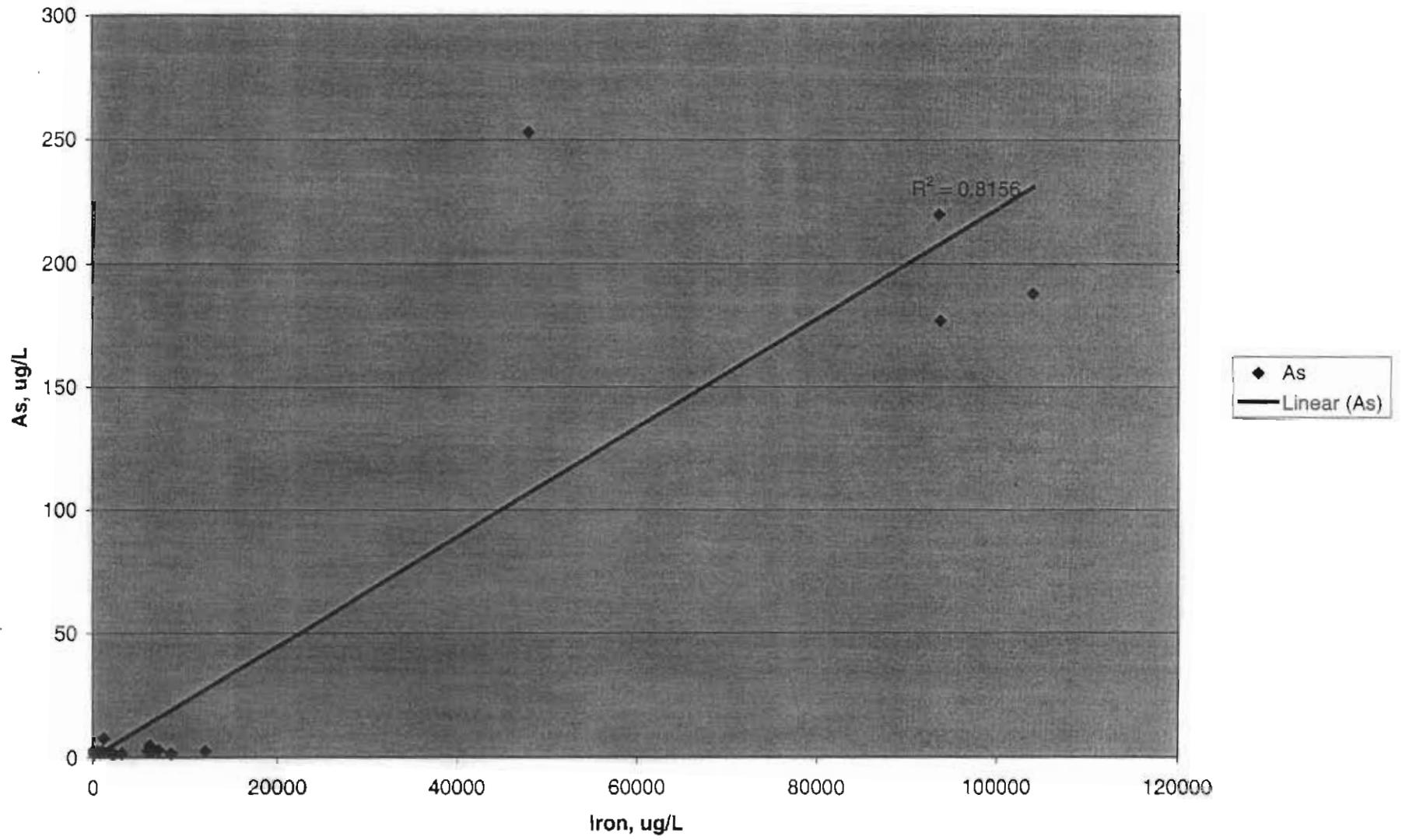
### Attachment 3

Arsenic as a function of Iron Concentration (ug/L)  
At Well I687GW002



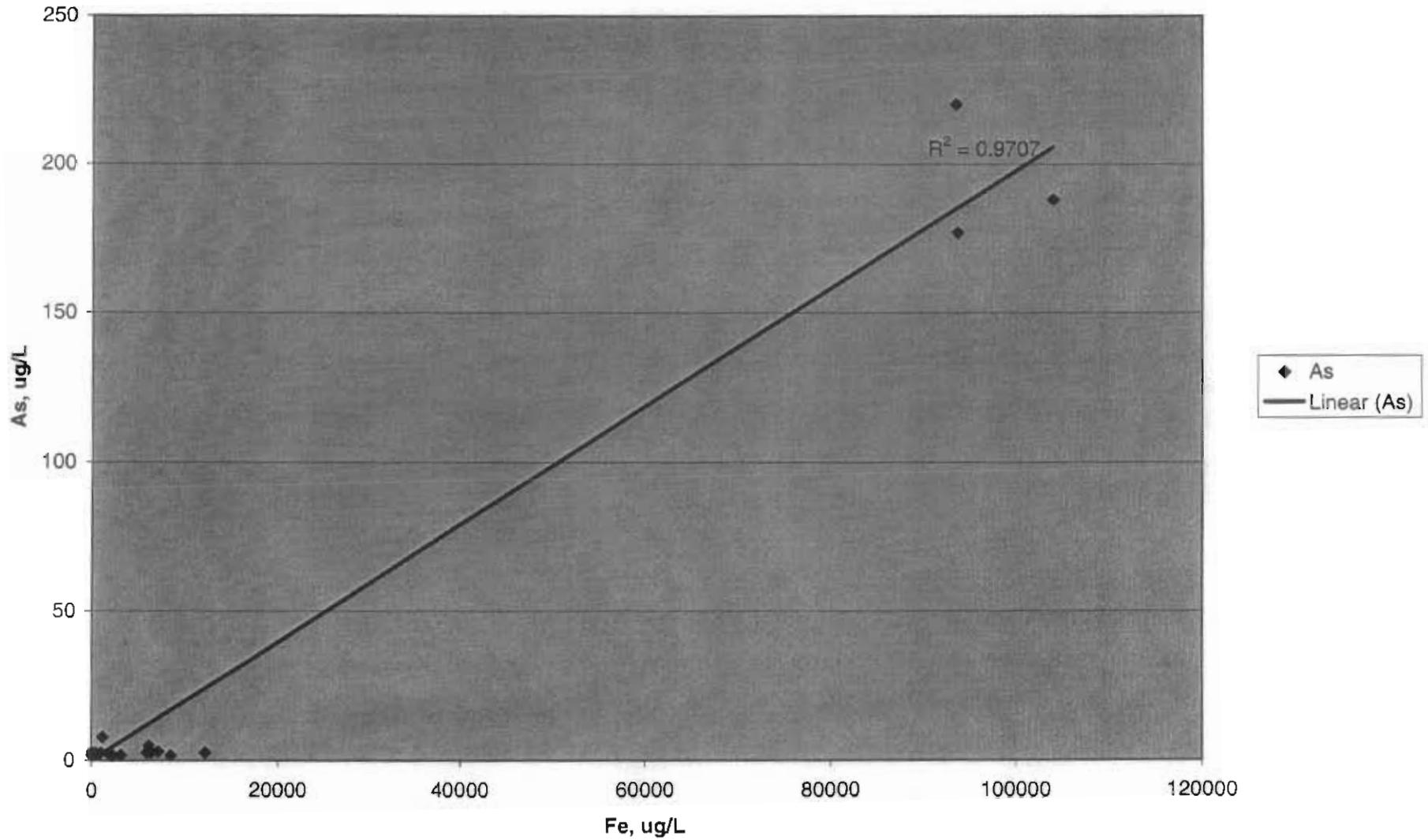
# Attachment 4

## Arsenic Versus Iron in Groundwater at SWMU 12



# Attachment 5

## As vs FE SWMU 12, 1 point removed



Attachment 6

Table 1: TEQs in Background Wells in Zone I – Shallow and Deep

STATION ID	SAMPLE ID	SAMPLE DATE	TEQ	QUAL	UNITS	SAMPLE TYPE
IGDIGW002	GDIGW00201a	12-May-95	4.0	=	pg/L	N
IGDIGW002	GDIGW00202	12-Dec-95	1.5	=	pg/L	N
IGDIGW003	GDIGW00301b	12-May-95	3.5	=	pg/L	N
IGDIGW003	GDIGW00302	14-Dec-95	2.0	=	pg/L	N
IGDIGW003	GDIGW00303	20-May-96	3.1	=	pg/L	N
IGDIGW003	GDIGW00304	21-Aug-96	5.2	=	pg/L	N
IGDIGW004	GDIGW00401b	12-May-95	3.0	=	pg/L	N
IGDIGW004	GDIGW00402	13-Dec-95	1.9	=	pg/L	N
IGDIGW004	GDIGW00403	21-May-96	3.2	=	pg/L	N
IGDIGW004	GDIGW00404	22-Aug-96	2.8	=	pg/L	N
IGDIGW008	GDIHW00801a	02-May-95	4.0	=	pg/L	FD
IGDIGW009	GDIHW00901	05-May-95	5.1	=	pg/L	FD
IGDIGW010	GDIGW01002	11-Dec-95	3.7	=	pg/L	N
IGDIGW010	GDIGW01003	31-May-96	2.4	=	pg/L	N
IGDIGW012	GDIHW01201a	15-May-95	3.4	=	pg/L	FD
IGDIGW015	GDIGW01504	23-Aug-96	2.8	=	pg/L	N
IGDIGW015	GDIHW01501a	23-May-95	1.5	=	pg/L	FD
IGDIGW019	GDIGW01901b	15-May-95	1.8	=	pg/L	N
IGDIGW019	GDIGW01904	28-Aug-96	1.3	=	pg/L	N
<b>Mean of background</b>			<b>3.0</b>			
<b>Max of Background</b>			<b>5.2</b>			
<b>Minimum of Background</b>			<b>1.3</b>			
<b>Deep Background Groundwater</b>						
IGDIGW01D	GDIGW01D01	23-May-95	1.6	=	pg/L	N
IGDIGW01D	GDIGW01D03	15-May-96	9.9	=	pg/L	N
IGDIGW02D	GDIGW02D01	23-May-95	1.0	=	pg/L	N
IGDIGW03D	GDIGW03D01a	08-Jun-95	1.5	=	pg/L	N
IGDIGW04D	GDIGW04D01	06-Jun-95	0.9	=	pg/L	N
IGDIGW04D	GDIGW04D02	15-Dec-95	2.1	=	pg/L	N
IGDIGW04D	GDIGW04D03	23-May-96	3.3	=	pg/L	N
IGDIGW06D	GDIHW06D01a	24-May-95	3.0	=	pg/L	FD
IGDIGW12D	GDIHW12D01a	08-Jun-95	2.3	=	pg/L	FD
IGDIGW16D	GDIGW16D03	28-May-96	2.6	=	pg/L	N
IGDIGW19D	GDIGW19D01	01-Jun-95	1.1	=	pg/L	N
<b>Mean of background</b>			<b>2.7</b>			
<b>Max of Background</b>			<b>9.9</b>			
<b>Minimum of Background</b>			<b>0.9</b>			

<b>Attachment 6</b>						
<b>Table 2: TEQs in Groundwater at SWMU 12 – Zone I</b>						
<b>STATION ID</b>	<b>SAMPLE ID</b>	<b>SAMPLE DATE</b>	<b>TEQ</b>	<b>QUAL</b>	<b>UNITS</b>	<b>SAMPLE TYPE</b>
I012GW001	012GW00101 c	12-Jun-95	4.7	=	pg/L	N
I012GW001	012GW00104	09-Sep-96	2.7	U	pg/L	N
I012GW002	012GW00204	04-Sep-96	1.5	=	pg/L	N
I012GW003	012GW00304	09-Sep-96	1.8	U	pg/L	N
I012GW003	012HW00301	06-Jun-95	2.0	=	pg/L	FD
<b>Mean of detects + non-detects at ½-value</b>			<b>2.1</b>			
<b>Max of detects</b>			<b>4.7</b>			
<b>Minimum of detects</b>			<b>1.5</b>			