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CORRECTIVE MEASURES STUDY WORK PLAN AREA OF CONCERN 680 (AOC 680) ZONE I CNC CHARLESTON SC

4/30/2003

CH2M HILL

CORRECTIVE MEASURES STUDY WORK PLAN

CMS Work Plan and CMS Report

AOC 680, Zone I

Charleston Naval Complex
North Charleston, South Carolina

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

CH2M·Jones

April 2003

Contract N62467-99-C-0960

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April 30, 2003

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

Re: CMS Work Plan Addendum and CMS Report (Revision 0) – AOC 680, Zone I

Dear Mr. Scaturo:

Enclosed are two copies of the CMS Work Plan Addendum and CMS Report (Revision 0) for AOC 680, Zone I of the Charleston Naval Complex (CNC). This document has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

Please contact me at 352/335-5877, extension 2280, should you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

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

CORRECTIVE MEASURES STUDY WORK PLAN

CMS Work Plan Addendum and CMS Report
AOC 680, Zone I

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
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PREPARED BY
CH2M-Jones

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Revision 0
Contract N62467-99-C-0960
158814.ZI.EX.05

Certification Page for Corrective Measures Study Work Plan Addendum and CMS Report (Revision 0) – AOC 680, 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.

4/25/2023

Date

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Appendices

Acronyms and Abbreviations

AOC	Area of concern
BRAC	Base Realignment and Closure Act
CA	Corrective action
CMS	Corrective Measures Study
CMSWP	Corrective Measures Study Work Plan
CNC	Charleston Naval Complex
COC	Chemical of concern
COPC	Chemical of potential concern
DAF	Dilution attenuation factor
DCA	Dichloroethane
DCE	Dichloroethene
EnSafe	EnSafe, Inc.
EPA	U.S. Environmental Protection Agency
ft bls	Feet below land surface
ft^2	Square feet
HI	Hazard index
ILCR	Incremental Lifetime Cancer Risk
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
LUC	Land use control
LUCIP	Land use control implementation plan
MCL	Maximum contaminant level
MCS	Media cleanup standard
NAVBASE	Naval Base
PCE	Perchloroethene
PPE	Personal protective equipment
RAO	Remedial action objective
RBC	Risk-based concentration
RCRA	Resource Conservation and Recovery Act

Acronyms and Abbreviations

RDA	Redevelopment Authority
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RFIRA	RFI Report Addendum
RGO	Remedial goal option
SAP	Sampling and Analysis Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SSL	Soil screening level
TCE	Trichloroethene
VOC	Volatile organic compound
yd^3	cubic yards

Section 1.0

1.0 Introduction

1.1 Background

Area of Concern (AOC) 680 is an area located within Building NS-26, which was formerly used for brake repair and welding at the Charleston Naval Complex (CNC). Building NS-26 is a single-story, 22,322 square foot (ft^2) building constructed in 1958, and later renovated in 1985. The *Final Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA)* (EnSafe Inc. [EnSafe]/Allen & Hoshall, 1995) identifies AOC 680 as only the area used as a welding shop inside Building NS-26. No previous spills or releases are known to have occurred at this site. At the time that the RCRA Facility Investigation (RFI) was conducted at this site, Building NS-26 housed offices, a carpentry shop, a ship-fitter shop, a welding shop, several smaller shops, and a non-destructive testing lab.

As part of the Zone I RFI, surface soil, subsurface soil and groundwater investigations were conducted at AOC 680 during multiple sampling events in 1998. The *Zone I RFI Report, Revision 0* (EnSafe, 1999) presented the results of the investigations and conclusions regarding contamination and risk.

CH2M-Jones submitted the *Zone I Responses to SCDHEC Comments, Revision 0* and the *Zone I RFI Report Addendum, Revision 0*, in February and November 2001, respectively, which included AOC 680. On November 25, 2001, the South Carolina Department of Health and Environmental Control (SCDHEC) issued a letter accepting these two documents for completion of the RFI process for the sites in Zone I. In accordance with the RCRA site evaluation process, the *Zone I CMS Work Plan, Revision 0* was submitted by CH2M-Jones for review on February 25, 2002. A Revision 1 of this Corrective Measures Study (CMS) Work Plan (CMSWP) was submitted to SCHDEC for approval on May 6, 2002. This CMSWP included a refinement and evaluation of the chemicals of concern (COCs) identified for AOC 680.

As discussed in the *Zone I CMS Work Plan, Revision 1*, perchloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethane (1,1-DCA), and 1,2-dichloroethene (1,2-DCE) were found to be present in a single surface soil sample (I680SB005) at relatively low concentrations, above their respective generic soil screening levels (SSLs) (based on a dilution attenuation factor [DAF]=1). These volatile organic compounds (VOCs) were not detected in any subsurface soil samples, which included the co-located subsurface soil

sample, with the single exception of 1,2-DCE. 1,2-DCE was present in the subsurface sample collected at boring I680SB005 at a concentration of 0.24 milligrams per kilogram (mg/kg), which exceeds its generic SSL of 0.03 mg/kg. None of these constituents were detected in the co-located shallow groundwater monitoring well I680GW004. For these reasons, PCE, TCE, and 1,1-DCA were not considered COCs at AOC 680.

Following agency review of the *Zone I CMS Work Plan, Revision 1*, it was suggested that collection and analysis of additional soil samples for 1,2-DCE should be considered in the immediate vicinity of soil sample location I680SB005, to ensure that the extent of the SSL exceedances was adequately defined. CH2M-Jones agreed to conduct this work and additional field sampling for this purpose was completed in May 2002.

Following review of the analytical data from the May 2002 sample investigation, one of the new sample locations (I680SB007) was found to have surface soil and subsurface soil concentrations of 1,2-DCE, PCE, and TCE at levels higher than their respective generic SSLs. Therefore, the *Sampling and Analysis Plan (SAP) – Addendum 2 for AOC 680, Zone I* was developed and submitted by CH2M-Jones for review on August 21, 2002. This SAP proposed the collection of additional soil samples to further characterize soil in the vicinity of I680SB007, to bound the extent of SSL exceedances.

This CMSWP Addendum for AOC 680 presents the results of the additional sampling conducted in accordance with the SAP - Addendum 2. An evaluation of all VOC soil data is presented. Based on the results as described in this report, two VOCs, PCE and TCE, are identified as soil COCs for AOC 680 for the unpaved land use scenario only. Corrective measure recommendations to address these COCs are also provided in this report.

Figure 1-1 illustrates the location of AOC 680 and Zone I within the Charleston Naval Complex (CNC). Figure 1-2 is an aerial photograph of AOC 680 and presents the historical sampling locations at the site.

1.2 Organization of the Corrective Measures Study Work Plan Addendum and Corrective Measures Study Report

This CMSWP Addendum/CMS Report presents the following:

1.0 Introduction – Presents the purpose of the CMSWP Addendum /CMS Report and background information regarding the site.

2.0 Results of the Phase 2 Sampling and Analysis at AOC 680 – Describes the results of the additional soil sampling and analysis for delineation of chemicals of potential concern (COPCs) in soil at AOC 680. The detected chemicals are compared to generic and site-specific SSLs, and COCs are identified.

3.0 Proposed Medial Cleanup Standards and Candidate Corrective Measures – Presents proposed Media Cleanup Standards (MCSs) and candidate corrective measures for addressing COCs at AOC 680.

4.0 Description of Candidate Corrective Measures - Describes candidate corrective measures for the site, and presents details of their implementation to address the COCs identified for AOC 680.

5.0 Evaluation and Comparison of Corrective Measure Alternatives - Provides a comparative evaluation of the candidate corrective measures for AOC 680.

6.0 Recommended Corrective Measure Alternative - Provides a recommendation for a corrective measure alternative.

7.0 References -Provides a list of references used this report.

Appendix A contains the analytical data summaries for the September 2002 sampling conducted by CH2M-Jones.

Appendix B contains the data validation report for the September 2002 sampling by CH2M-Jones.

Appendix C contains a copy of calculations of SSLs for certain chemicals under the paved and unpaved scenarios at AOC 680.

Appendix D contains cost estimates for the candidate corrective measures proposed for AOC 680.

All tables and figures appear at the end of their respective sections.

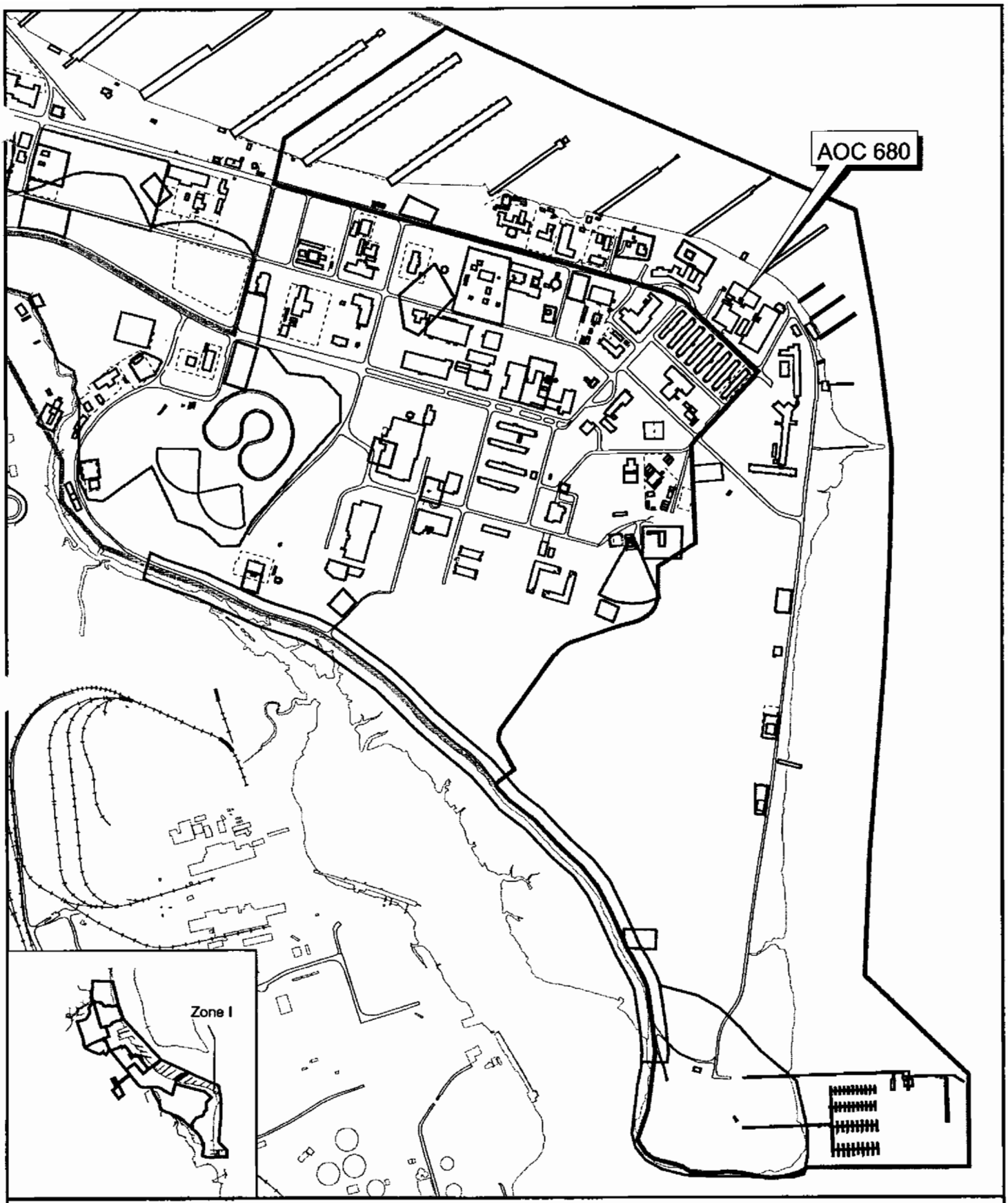

Figure 1-1
AOC 680 within Zone I
Charleston Naval Complex

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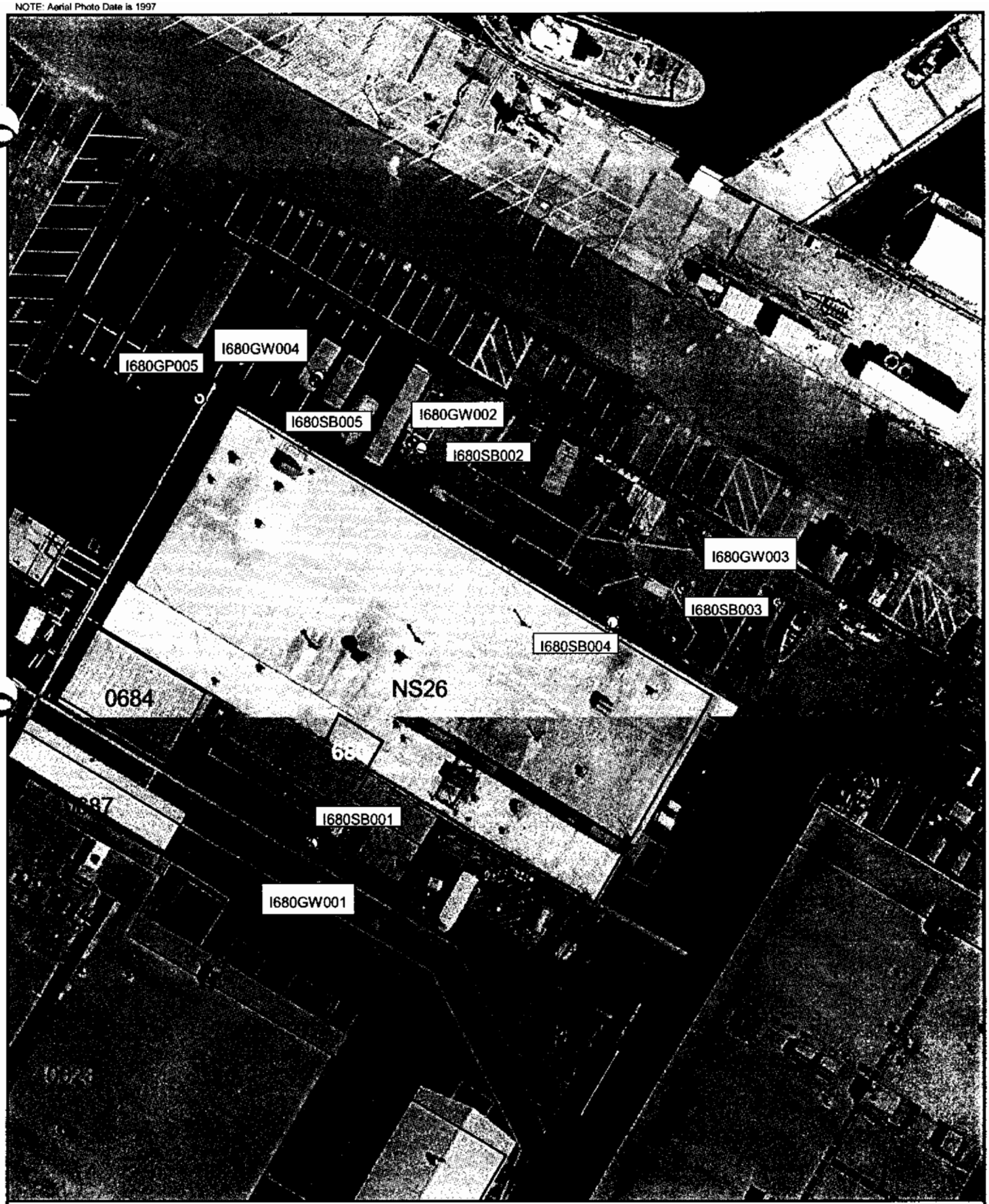
File Path: C:\18gis\Projects\Zone_Nocationfigs.apr, Date: 08 May 2002 9:32, User: NMOUDRY, Figure 1-1 AOC 680

NOTE: Aerial Photo Date is 1997



- Groundwater Sample
- Groundwater Probe
- Surface Soil Sample
- Subsurface Soil Sample
- Fence
- Railroads
- Roads
- Shoreline
- AOC Boundary
- Buildings

N

0 40 80 Feet

1 inch = 50 feet

Figure 1-2
Historical Sampling Locations
AOC 680, Zone I
Charleston Naval Complex

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File Path: C:\18gis\Projects\Zone_I\AOC680\Aprs\aoc680.apr, Date: 08 May 2002 6:39, User: NMOUDRY, Figure 1-2 Historical Sampling Locations

2.0 Results of the Phase 2 Soil Sampling and Analysis at AOC 680

Surface and subsurface soil samples were collected for VOC analysis, as proposed in the *Sampling and Analysis Plan (SAP) – Addendum 2 for AOC 680, Zone I* (CH2M-Jones, 2002). The objective of this sampling was to evaluate the presence of VOCs in soils in the vicinity of sample location I680SB007. The objective of the SAP - Addendum 2 was to confirm the lateral extent of SSL exceedances in soil at AOC 680. All investigative work was performed in accordance with the Comprehensive Sampling and Analysis Plan (CSAP) portion of the *Final Zone I RFI Work Plan, Revision 1* (EnSafe/Allen & Hoshall, 1996).

2.1 September 2002 Soil Sampling Results

The fieldwork proposed in the SAP - Addendum 2 was implemented on September 12, 2002. Two soil borings (I680SB010 and I680SB011) were advanced in the vicinity of sample location I680SB007. Both shallow (0 to 1 foot below land surface [ft bls]) and deep (3 to 5 ft bls) soil samples were collected at each location. All samples were analyzed for VOCs using U.S. Environmental Protection Agency (EPA) Method 8260B. The soil boring locations are shown in Figure 2-1.

Because the entire area at AOC 680 is paved, it was necessary to core through the asphalt prior to collecting the samples. After collection of the soil samples, the boreholes were filled and the pavement was patched.

The detected analytes for these four samples are presented in Table 2-1. A complete set of all analytical results for these samples is presented in Appendix A. The data validation report for these samples is provided in Appendix B. As presented in Table 2-1, no VOCs in any of these samples exceeded their respective SSLs.

2.2 COPC/COC Refinement for Soil at AOC 680

The soil VOC data collected during the September 2002 investigation were combined with previously detected soil VOC data to assess whether soil VOC concentrations represent a potential threat to human health and the environment. Tables 2-2 and 2-3 present a summary of VOC concentrations for surface and subsurface soil samples, respectively, along with the applicable COPC screening criteria. VOC concentrations in several surface

and subsurface soil samples exceed the generic SSLs (DAF=1) for PCE, TCE, and DCE. These VOCs were previously identified as COPCs at the site. Figures 2-1 and 2-2 present the VOC detections in surface and subsurface soils, respectively, as well as the sampling locations.

In order to evaluate whether these VOCs would be considered COCs, site-specific SSLs were calculated for both the paved and unpaved scenarios, as previously agreed to by the BCT. Appendix C presents the calculations for the paved and unpaved SSLs for these VOCs. The site-specific SSLs are also shown in Tables 2-2 and 2-3.

In addition, mean surface and subsurface soil concentrations were calculated for the VOCs that exceeded the generic SSL for comparison to the site-specific SSL. For sample results that were non-detect, half the detection limit for that sample was used as the assumed VOC concentration. The calculated mean concentrations are also presented in Tables 2-2 and 2-3.

Inspection of Tables 2-2 and 2-3 indicates that in both surface and subsurface soil, the mean concentration of all VOCs are below the paved site-specific SSL. Mean concentrations of PCE and TCE exceed the unpaved site-specific SSL in surface and subsurface soil. The mean concentration of DCE is below both the paved and unpaved site-specific SSL in surface and subsurface soil.

Based on this evaluation, PCE and TCE would be considered COCs for the unpaved land use scenario for surface and subsurface soil. It should be noted that no VOC concentrations in surface soil exceeded their respective residential RBCs, thus VOCs are not a concern at the site from a human health exposure pathway.

TABLE 2-1
Detected Volatile Organic Compounds in Surface and Subsurface Soil Samples; September 2002
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)
Surface Soil						
1,2,3-TCB	I680SB010	0.0012	J	NA	NA	NA
Acetone	I680SB010	0.032	=	NA	NA	0.8
Ethylbenzene	I680SB010	0.0024	J	20,000	780	0.7
m+p Xylene	I680SB010	0.01	=	410,000	16,000	10
	I680SB011	0.0046	J			
o-Xylene	I680SB010	0.0019	J	410,000	16,000	9
Toluene	I680SB010	0.01	=	41,000	1,600	0.6
	I680SB011	0.0052	J			
Xylenes, Total	I680SB010	0.012	=	410,000	16,000	9
	I680SB011	0.0046	J			
Subsurface Soil						
Acetone	I680SB010	0.044	=	NA	NA	0.8
	I680SB011	0.055	=			
Carbon Disulfide	I680SB010	0.0039	J	NA	NA	2.0
Ethylbenzene	I680SB010	0.0034	J	NA	NA	0.7
	I680SB011	0.0027	J			
Methyl ethyl ketone (2-Butanone)	I680SB011	0.012	J	NA	NA	0.4
Toluene	I680SB010	0.0058	=	NA	NA	0.6
	I680SB011	0.012	=			
m+p Xylene	I680SB010	0.0068	=	NA	NA	10.0
	I680SB011	0.012	=			
o-Xylene	I680SB010	0.0019	J	NA	NA	9.0
	I680SB011	0.0023	J			
Xylenes, Total	I680SB010	0.0088	=	NA	NA	9.0

TABLE 2-1
Detected Volatile Organic Compounds in Surface and Subsurface Soil Samples; September 2002
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)
Xylenes, Total	I680SB011	0.014	=	NA	NA	9.0

All values are presented in milligrams per kilogram (mg/kg).

Concentration in bold and outlined in the table indicates an exceedance of the screening criteria.

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
Acetone	I680SB001	0.058	U	20,000	780	0.8	NC	NC	NC
	I680SB002	0.056	U						
	I680SB003	0.056	U						
	I680SB004	0.058	U						
	I680SB005	0.023	U						
	I680SB006	0.0052	U						
	I680SB007	0.0023	J						
	I680SB008	0.0054	U						
	I680SB009	0.0056	U						
	I680SB010	0.032	=						
	I680SB011	0.0053	U						
Carbon Disulfide	I680SB001	0.0058	U	20,000	780	2	NC	NC	NC
	I680SB002	0.0056	U						
	I680SB003	0.0057	U						
	I680SB004	0.0057	U						
	I680SB005	0.014	U						
	I680SB006	0.0052	U						
	I680SB007	0.0061	=						

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
Carbon Disulfide	I680SB008	0.0054	U	20,000	780	2	NC	NC	NC
	I680SB009	0.0056	U						
	I680SB010	0.0054	U						
	I680SB011	0.0053	U						
1,1-DCA	I680SB001	0.0058	U	20,000	780	1	NC	NC	NC
	I680SB002	0.0056	U						
	I680SB003	0.0057	U						
	I680SB004	0.0057	U						
	I680SB005	0.006	J						
	I680SB006	0.0052	UJ						
	I680SB007	0.004	J						
	I680SB008	0.0054	UJ						
	I680SB009	0.0056	UJ						
	I680SB010	0.0054	U						
	I680SB011	0.0053	U						
cis-1,2-DCE	I680SB006	0.01	U	2,000	78	0.02	0.96	0.157	0.017
	I680SB007	**0.071**	=						

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
cis-1,2-DCE	I680SB008	0.011	UJ	2,000	78	0.02	0.96	0.157	0.017
	I680SB009	**0.012**	=						
	I680SB010	0.0054	U						
	I680SB011	0.01	U						
trans-1,2-DCE	I680SB006	0.0052	UJ	4,100	160	0.03	0.96	0.157	0.003
	I680SB007	**0.0045**	J						
	I680SB008	0.0054	UJ						
	I680SB009	0.0056	U						
	I680SB010	0.0054	U						
	I680SB011	0.0053	U						
1,2-DCE (total)	I680SB001	0.0058	U	1,800	70	0.02	0.96	0.157	0.011
	I680SB002	0.0056	U						
	I680SB003	0.0057	U						
	I680SB004	0.0057	U						
	I680SB005	**0.041**	J						
	I680SB006	0.0052	U						
	I680SB007	**0.056**	=						

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
1,2-DCE (total)	I680SB008	0.0054	U	1,800	70	0.02	0.96	0.157	0.011
	I680SB009	0.0056	U						
	I680SB010	0.0054	U						
	I680SB011	0.0053	U						
Ethylbenzene	I680SB001	0.0058	U	20,000	780	0.7	42.3	6.9	0.003
	I680SB002	0.0056	U						
	I680SB003	0.0022	J						
	I680SB004	0.0057	U						
	I680SB005	0.014	U						
	I680SB006	0.0052	U						
	I680SB007	0.0021	J						
	I680SB008	0.0054	U						
	I680SB009	0.0056	U						
	I680SB010	0.0024	J						
	I680SB011	0.0053	U						
Methyl isobutyl ketone (4-Methyl-2-pentanone)	I680SB001	0.029	U	16,000	630	0.065[a]	23.5	3.83	0.008

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
Methyl isobutyl ketone (4-Methyl-2-pentanone)	I680SB002	0.028	U	16,000	630	0.065[a]	23.5	3.83	0.008
	I680SB003	0.028	U						
	I680SB004	0.029	U						
	I680SB005	0.003	J						
	I680SB006	0.01	UJ						
	I680SB007	0.01	UJ						
	I680SB008	0.011	UJ						
	I680SB009	0.011	UJ						
	I680SB010	0.011	U						
	I680SB011	0.01	U						
PCE	I680SB001	0.0058	U	110	12	0.003	0.39	0.064	**0.251**
	I680SB002	0.0056	U						
	I680SB003	0.0057	U						
	I680SB004	0.0057	U						
	I680SB005	**0.42**	J						
	I680SB006	**0.017**	=						

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
PCE	I680SB007	**2.3**	J	110	12	0.003	0.39	0.064	**0.251**
	I680SB008	**0.0044**	J						
	I680SB009	**0.0057**	=						
	I680SB010	0.0054	U						
	I680SB011	0.0053	U						
Toluene	I680SB001	0.0058	U	41,000	1,600	0.6	NC	NC	NC
	I680SB002	0.0056	U						
	I680SB003	0.0016	J						
	I680SB004	0.0057	U						
	I680SB005	0.014	U						
	I680SB006	0.0052	U						
	I680SB007	0.005	U						
	I680SB008	0.0054	U						
	I680SB009	0.0056	U						
	I680SB010	0.01	=						
	I680SB011	0.0052	J						
1,2,3-TCB	I680SB006	0.0052	UJ	NA	NA	NA	NC	NC	NC

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
1,2,3-TCB	I680SB007	0.005	UJ	NA	NA	NA	NC	NC	NC
	I680SB008	0.0054	UJ						
	I680SB009	0.0056	UJ						
	I680SB010	0.0012	J						
	I680SB011	0.0053	U						
TCE	I680SB001	0.0058	U	520	58	0.003	0.15	0.025	**0.060**
	I680SB002	0.0056	U						
	I680SB003	0.0057	U						
	I680SB004	0.0057	U						
	I680SB005	0.14	J						
	I680SB006	0.0022	J						
	I680SB007	**0.49**	=						
	I680SB008	0.0031	J						
	I680SB009	0.0056	U						
	I680SB010	0.0054	U						
	I680SB011	0.0053	U						
m+p Xylene	I680SB006	0.0052	U	410,000	16,000	10	NC	NC	NC

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
m+p Xylene	I680SB007	0.0071	=	410,000	16,000	10	NC	NC	NC
	I680SB008	0.0054	U						
	I680SB009	0.0056	U						
	I680SB010	0.01	=						
	I680SB011	0.0046	J						
o-Xylene	I680SB006	0.0052	U	410,000	16,000	9	NC	NC	NC
	I680SB007	0.0027	J						
	I680SB008	0.0054	U						
	I680SB009	0.0056	U						
	I680SB010	0.0019	J						
	I680SB011	0.0053	U						
Xylenes, Total	I680SB001	0.0058	U	410,000	16,000	9	NC	NC	NC
	I680SB002	0.002	J						
	I680SB003	0.01	=						
	I680SB004	0.0014	J						
	I680SB005	0.002	J						
	I680SB006	0.0052	U						

TABLE 2-2
VOCs Detected in Surface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	EPA Region III Industrial RBC	EPA Region III Residential RBC	SSL (DAF=1)	Site Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average (Mean) Concentration
Xylenes, Total	I680SB007	0.0098	=	410,000	16,000	9	NC	NC	NC
	I680SB008	0.0054	U						
	I680SB009	0.0056	U						
	I680SB010	0.012	=						
	I680SB011	0.0046	J						

All values are presented in milligrams per kilogram (mg/kg).

Concentrations in bold and outlined within the table indicate exceedances of the appropriate screening criteria.

[a] Risk-based concentration (RBC) used is from U.S. EPA Region III Tables, based on a dilution attenuation factor (DAF) of 1.

NA Not Applicable

NC Not Calculated

= Indicates that the compound was detected. The reported value is the concentration of the compound.

J Indicates that the compound was detected. The reported value is the estimated concentration of the compound.

U Indicates that the compound was not detected. The reported value is the detection limit.

TABLE 2-3
VOCs Detected in Subsurface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	Date Collected	SSL (DAF=1)	Site-Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average Concentration
Acetone	I680SB001	0.097	U	4/8/98	0.8	NC	NC	NC
	I680SB002	0.068	U	4/8/98				
	I680SB004	0.13	U	4/8/98				
	I680SB006	0.012	U	5/16/02				
	I680SB007	0.041	J	5/16/02				
	I680SB008	0.15	=	5/16/02				
	I680SB009	0.033	J	5/16/02				
	I680SB010	0.044	=	9/12/02				
	I680SB011	0.055	=	9/12/02				
Carbon Disulfide	I680SB001	0.008	U	4/8/98	2	NC	NC	NC
	I680SB002	0.007	U	4/8/98				
	I680SB004	0.007	U	4/8/98				
	I680SB005	0.47	U	9/24/98				
	I680SB006	0.0058	UJ	5/16/02				
	I680SB007	0.0032	J	5/16/02				
	I680SB008	0.0026	J	5/16/02				
	I680SB009	0.0064	UJ	5/16/02				
	I680SB010	0.0039	J	9/12/02				

TABLE 2-3
VOCs Detected in Subsurface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	Date Collected	SSL (DAF=1)	Site-Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average Concentration
Carbon Disulfide	I680SB011	0.0063	U	9/12/02	2	NC	NC	NC
1,1-DCA	I680SB001	0.007	U	4/8/98	1	NC	NC	NC
	I680SB002	0.007	U	4/8/98				
	I680SB004	0.007	U	4/8/98				
	I680SB005	0.47	U	9/24/98				
	I680SB006	0.0058	U	5/16/02				
	I680SB007	0.0052	J	5/16/02				
	I680SB008	0.0051	U	5/16/02				
	I680SB009	0.0064	U	5/16/02				
	I680SB010	0.0051	U	9/12/02				
	I680SB011	0.0063	U	9/12/02				
cis-1,2-DCE	I680SB006	0.0059	=	5/16/02	0.02	0.96	0.157	0.068
	I680SB007	**0.38**	=	5/16/02				
	I680SB008	0.014	=	5/16/02				
	I680SB009	0.0064	U	5/16/02				
	I680SB010	0.0051	U	9/12/02				
	I680SB011	0.0063	U	9/12/02				
trans-1,2-DCE	I680SB006	0.0058	UJ	5/16/02	0.03	0.96	0.157	0.0049

TABLE 2-3
VOCs Detected in Subsurface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	Date Collected	SSL (DAF=1)	Site-Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average Concentration
PCE	I680SB001	0.007	U	4/8/98	0.003	0.39	0.064	**0.225**
	I680SB002	0.007	U	4/8/98				
	I680SB004	0.007	U	4/8/98				
	I680SB005	0.47	U	9/24/98				
	I680SB006	**0.093**	=	5/16/02				
	I680SB007	**1.8**	J	5/16/02				
	I680SB008	**0.089**	=	5/16/02				
	I680SB009	**0.018**	=	5/16/02				
	I680SB010	0.0051	U	9/12/02				
	I680SB011	0.0063	U	9/12/02				
Toluene	I680SB001	0.01	U	4/8/98	0.6	NC	NC	NC
	I680SB002	0.002	J	4/8/98				
	I680SB004	0.003	=	4/8/98				
	I680SB005	0.47	J	9/24/98				
	I680SB006	0.0058	U	5/16/02				
	I680SB007	0.0063	U	5/16/02				
	I680SB008	0.0051	U	5/16/02				
	I680SB009	0.0064	U	5/16/02				

TABLE 2-3
VOCs Detected in Subsurface Soil Screened Against Comparison Criteria
CMS Work Plan Addendum and CMS Report, AOC 680, Zone I, Charleston Naval Complex

Parameter	Station ID	Concentration (mg/kg)	Qualifier	Date Collected	SSL (DAF=1)	Site-Specific SSL (DAF=1), Paved	Site Specific SSL (DAF=1), Unpaved	Average Concentration
Toluene	I680SB010	0.0058	=	9/12/02	0.6	NC	NC	NC
	I680SB011	0.012	=	9/12/02				
TCE	I680SB001	0.007	U	4/8/98	0.003	0.39	0.064	**0.128**
	I680SB002	0.007	U	4/8/98				
	I680SB004	0.007	U	4/8/98				
	I680SB005	0.47	U	9/24/98				
	I680SB006	**0.055**	=	5/16/02				
	I680SB007	**0.91**	=	5/16/02				
	I680SB008	**0.063**	=	5/16/02				
	I680SB009	**0.0045**	J	5/16/02				
	I680SB010	0.0051	U	9/12/02				
	I680SB011	0.0063	U	9/12/02				
m+p Xylene	I680SB006	0.0058	U	5/16/02	10	NC	NC	NC
	I680SB007	0.0063	U	5/16/02				
	I680SB008	0.0051	U	5/16/02				
	I680SB009	0.0064	U	5/16/02				
	I680SB010	0.0068	=	9/12/02				
	I680SB011	0.012	=	9/12/02				

NOTE: Original figure created in color

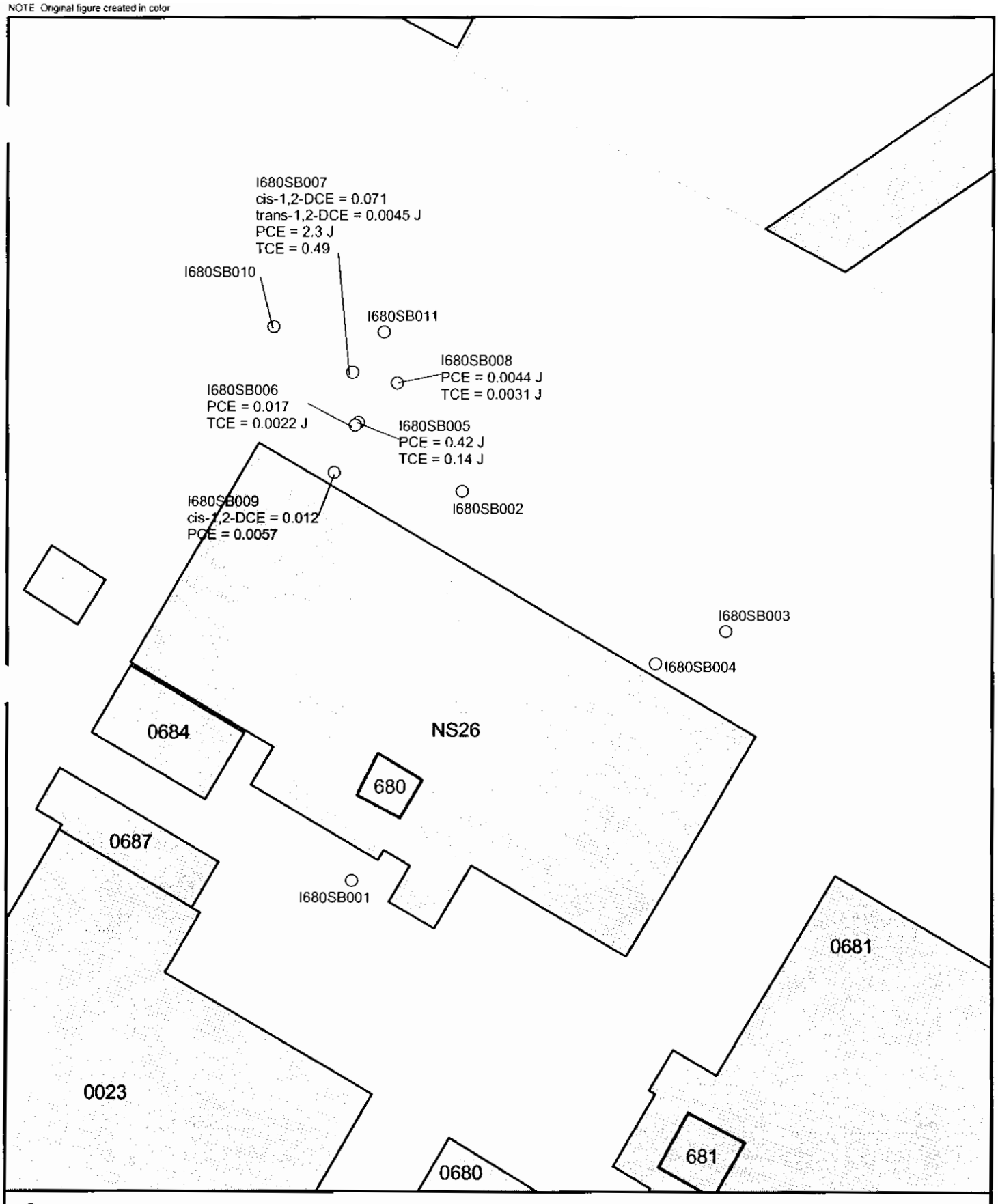

Figure 2-1
VOC Detections in Surface Soil
AOC 680, Zone I
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone I\AOC680\Aprs\aoc680_soil.apr, Date: 07 Apr 2003 11:39, User: ASPOSATO, Figure 2-1 VOC Detections in Surface Soil

NOTE: Original figure created in color

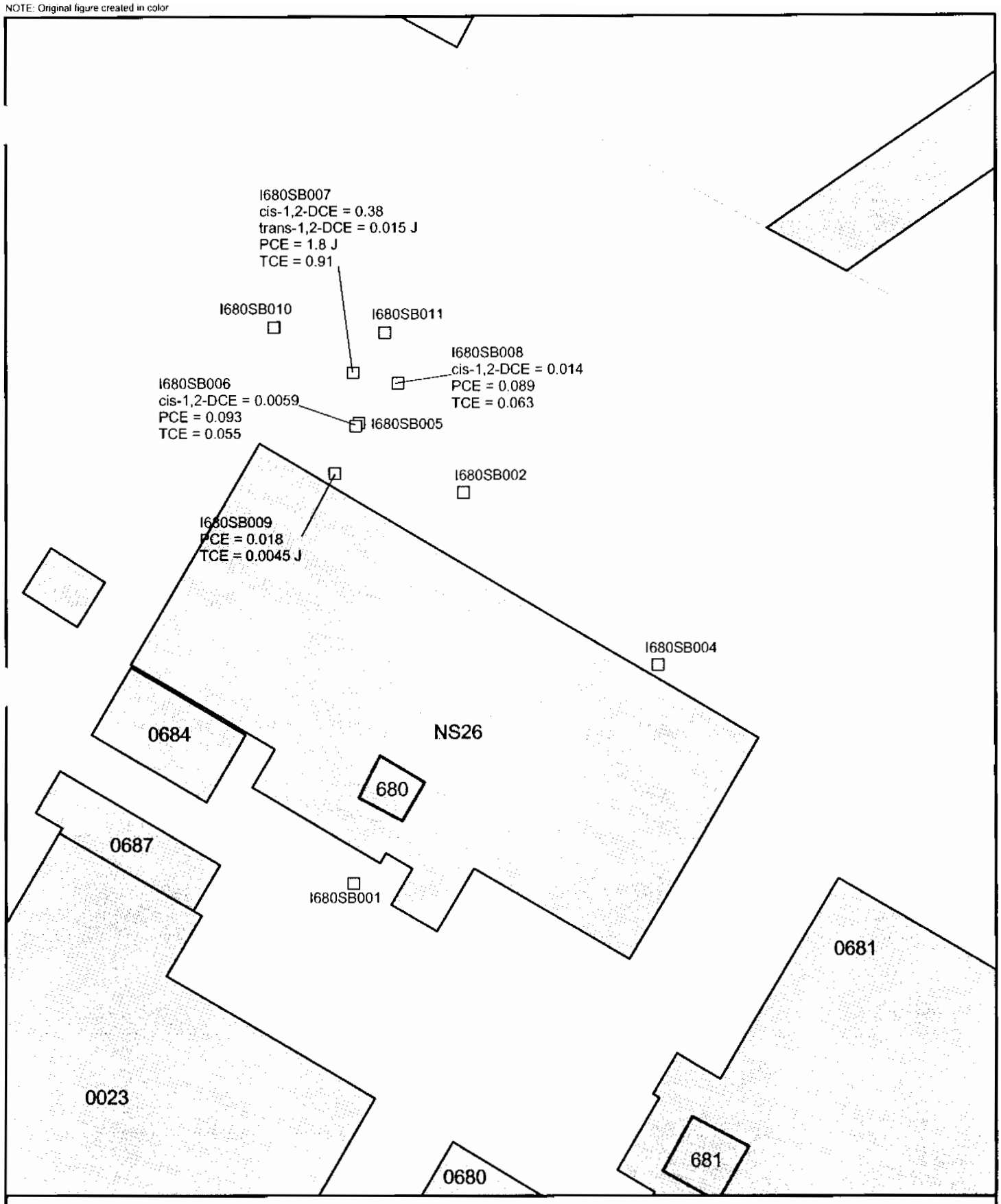

Figure 2-2
VOC Detections in Subsurface Soil
AOC 680, Zone I
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_I\AOC680\Aprs\aoc680_soil.apr, Date: 07 Apr 2003 11:39, User: ASPOSATO, Figure 2-2 VOC Detections in Subsurface Soil

Section 3.0

3.0 Proposed Media Cleanup Standards and Candidate Corrective Measures

This section describes the nature of contamination for the soil COCs at AOC 680, presents proposed MCSs, and identifies potential corrective measure alternatives to address the COCs.

3.1 Nature of Soil Contamination

The COCs at AOC 680 consist of PCE and TCE in surface and subsurface soil. Figures 2-2 and 2-3 identify the location and concentrations of the VOCs in soil at AOC 680.

As described in Section 2.3, average (mean) VOC concentrations in soil are below the respective site-specific paved SSLs. However, mean PCE and TCE concentrations exceed the site-specific unpaved SSLs, thus these VOCs are considered COCs for the unpaved scenario only. The determination of the extent of contamination above the SSLs has been completed.

There is currently no unacceptable threat to groundwater from the VOCs in soil because the entire site is paved. However, in the future, should site conditions change and the site become unpaved, it is feasible that leaching of VOCs in soil to groundwater could be of concern. Thus, a CMS and the implementation of an acceptable remedy is appropriate for this site.

3.2 Remedial Action Objectives

Remedial action objectives (RAOs) are medium-specific goals that the remedial actions will be designed to accomplish in order to protect human health and the environment by preventing or reducing exposures under current and future land use conditions. The RAO identified for surface and subsurface soil at AOC 680 is to prevent leaching of VOCs from soil such that groundwater concentrations of VOCs do not exceed their respective drinking water MCL.

3.3 Remedial Goal Options and Proposed Media Cleanup Standards

Typically after RAOs have been established and the risk assessment is complete, remedial goal options (RGOs) are developed for each RAO. The RGOs are based on assumptions about a particular land use scenario and include different residual risk levels for comparison. For example, to remediate surface soils to protect an onsite maintenance worker, RGOs might include remediating to anthropogenic background levels or to one of a variety of specific risk levels (such as 1E-06 or 1E-04). For each RGO, a specific MCS is determined for specific chemicals. These MCSs are expressed in conventional concentration units, such as milligrams per kilogram (mg/kg) or milligrams per liter (mg/L), for specific chemicals. Remediating the site to those specific MCSs would be suitable to demonstrate that the RAO has been achieved.

The exposure medium of concern for AOC 680 is VOC-impacted surface and subsurface soil. Because AOC 680 is located within a highly developed area of the CNC, the entire site is paved, and there are no surface water bodies in the immediate vicinity of the site, ecological exposures were not considered necessary for evaluation.

Potential MCSs for achieving RGOs protective of groundwater from leaching of VOCs from soil under the anticipated future land use include site-specific SSLs, which are presented in Section 2.0 of this report, or site-specific SSLs developed using other methods, such as SPLP tests. For the purpose of the CMS, the target MCSs are identified as the unpaved site-specific SSLs developed in Section 2.0, and summarized below.

Chemical	Unpaved Site-Specific SSL (mg/kg)
PCE	0.064
TCE	0.025

3.4 Corrective Measure Technology Focused Evaluation

The CMS will evaluate options for preventing leaching of COCs from soil to groundwater. Potential technologies for achieving this objective include active remediation (such as soil excavation or soil vapor extraction) as well as combinations of engineering controls (e.g., capping or pavement) and land use controls (LUCs).

For contaminated sites such as AOC 680 where the extent of contamination is relatively limited in size, only a few of the most feasible remedies need be evaluated. Soil excavation and engineering controls/LUCs are selected as the two candidate technologies to evaluate for the CMS for AOC 680.

3.5 Focused CMS Approach

The focused CMS will consist of the following tasks.

1. The corrective measure alternatives described above will be screened using several criteria and decision factors.
2. A preferred corrective measure alternative will be selected.

Sections 4.0 and 5.0 of this report present the description and evaluation of the candidate corrective measures.

3.6 Approach to Evaluating Corrective Measure Alternatives

According to the RCRA permit issued by SCDHEC (SCDHEC, 1998), the corrective measure alternatives will be evaluated using the following five standards:

1. Protect human health and the environment.
2. Attain MCSs (RGOs).
3. Control the source of releases to minimize future releases that may pose a threat to human health and the environment.
4. Comply with applicable standards for the management of wastes generated by remedial activities.
5. Other factors include (a) long-term reliability and effectiveness; (b) reduction in toxicity, mobility, or volume of wastes; (c) short-term effectiveness; (d) implementability; and (e) cost.

Each of the five standards is defined in more detail below:

1. **Protect human health and the environment.** The alternatives will be evaluated on the basis of their ability to protect human health and the environment. The ability of an alternative to achieve this standard may or may not be independent of its ability to achieve the other standards. For example, an alternative may be protective of human

health, but may not be able to attain the MCSs, if the MCSs are not directly tied to protecting human health.

2. **Attain MCSs (RGOs).** The alternatives will be evaluated on the basis of their ability to achieve the RGOs defined in this CMS Work Plan. Another aspect of this standard is the time frame to achieve the RGOs. Estimates of the time frame for the alternatives to achieve RGOs will be provided.

3. **Control the source of releases.** This standard deals with the control of releases of contamination from the source (the area in which the contamination originated). For example, blast media may be considered a source under the unrestricted land use exposure scenario, but be within RGOs under industrial land use.

4. **Comply with applicable standards for the management of wastes.** This standard deals with the management of wastes derived from implementing the alternatives, e.g., treatment or disposal of excavated material. The removal alternative will be designed to comply with all standards for management of wastes. Consequently, this standard will not be explicitly included in the detailed evaluation presented in the CMS.

5. **Other factors.** Five other factors must be considered if an alternative is found to meet the four standards described above. These other factors are as follows:

   a. Long-term reliability and effectiveness

      These two alternatives will be evaluated on the basis of their reliability and the potential impact should the alternative fail. In other words, a qualitative assessment will be made as to the chance of the alternative's failing and the consequences of that failure.

   b. Reduction in the toxicity, mobility, or volume of wastes

      Alternatives with technologies that reduce the toxicity, mobility, or volume of the contamination will be generally favored over those that do not. Consequently, a qualitative assessment of this factor will be performed for each alternative.

   c. Short-term effectiveness

      Alternatives will be evaluated on the basis of the risk they create during the implementation of the remedy. Factors that may be considered include fire, explosion, and exposure of workers to hazardous substances.

   d. Implementability

The alternatives will be evaluated for their implementability by considering any difficulties associated with conducting the alternatives (such as the construction disturbances they may create), operation of the alternatives, and the availability of equipment and resources to implement the technologies comprising the alternatives.

e. Cost

A net present value of each alternative will be developed. These cost estimates will be used for the relative evaluation of the alternatives, not to bid or budget the work. The estimates will be based on information available at the time of the CMS and on a conceptual design of the alternative. They will be "order of magnitude" estimates with a generally expected accuracy of -50 percent to +50 percent for the scope of action described for each alternative. The estimates will be categorized into capital costs and operations and maintenance costs for each alternative.

4.0 Description of Candidate Corrective Measure Alternatives

4.1 General Description of Alternatives

Two candidate corrective measure alternatives were selected for this site:

- Alternative 1: Soil Excavation and Offsite Disposal
- Alternative 2: Engineering Controls/LUCs

The implementation of Alternative 1 would involve the removal of soil at locations where VOC concentrations exceed the MCS. Based on an evaluation of VOCs in site soil, one area at the site will require soil removal in order for site soils to meet the MCS for VOCs:

- Sample location I680SB007. This location is under asphalt pavement, and removal and replacement of the pavement would be required to complete the soil removal. If buried utilities are encountered during the soil excavation, they will need to be restored if they are affected by the soil removal operations.

The approximate soil area estimated to be necessary for removal to achieve the MCS for Alternative 1 is an approximately 10-ft by 10-ft area centered on soil boring I680SB007. A 20-percent scope contingency is also assumed and included in the cost for this alternative.

For Alternative 2, it is assumed that the Engineering Controls/LUCs will include the following:

- Maintenance of the existing asphalt pavement in the area above the VOC-impacted soil
- Restrictions limiting the VOC impacted area to non-residential uses.
- Restrictions to maintain the paved area, unless a demonstration is made that changing the paved area to unpaved status will not cause RAO to not be met.

The sections below describe each alternative in detail.

4.2 Alternative 1: Soil Excavation and Offsite Disposal

4.2.1 Description of Alternative

This alternative will remove contaminated soil in the area that exceeds the MCS established in Section 3.0. It is assumed that the pavement would be removed to access soil exceeding the MCS and that the area would then be repaved.

Excavated soil would be transported to a permitted landfill facility for long-term disposal, and the excavation would be filled with clean fill from an offsite borrow source. Once the soil is removed, the site would be acceptable for unrestricted land use, with no long-term monitoring required.

The extent of excavation in the paved area is approximately 10-ft by 10-ft, for a total excavated area of 100 square feet (ft^2). The removal and replacement of the asphalt pavement will be required to access all of the soil proposed for removal. For an assumed average depth of soil excavation of 5 ft bls, the total in-place volume of soil to be removed from the two areas is about 18.5 cubic yards (yd^3) plus an approximately 1-ft thick pavement structure with a volume of 3.7 yd^3. Confirmation sampling would involve five samples (four sidewall samples and one floor sample). An equal amount of clean backfill will be required to replace the volume of soil removed from the excavated area and bituminous asphalt to replace the volume of asphalt pavement removed from this area.

4.2.2 Other Considerations

Coordination with the CNC Redevelopment Authority (RDA) would be required for site restrictions during excavation and traffic control for the haul trucks. The potential for expansion of scope during confirmation testing is moderate. Thus, a 20-percent scope contingency is assumed.

4.3 Alternative 2: Engineering Controls/Land Use Controls

4.3.1 Description of Alternative

This alternative involves leaving the contaminated soil and co-located overlying pavement in place and instituting administrative/legal controls to restrict future use of the land. The controls would limit land use to activities that would maintain the paved nature of the site and preclude uncontrolled disturbance to the contaminated soil, thus minimizing the potential for leaching of VOCs to groundwater. The asphalt pavement currently at the site effectively decreases percolation of infiltrating water through the soil and thus provides

protection of groundwater. LUCs may be in the form of deed restrictions and/or easements (property interests retained by the Navy during property transfer to assure protectiveness of the remedy).

Periodic monitoring would be required to assure controls are maintained; periodic site inspections would be required to assure the institutional controls are complied with. Controls may be layered (multiple controls at the same time) to enhance protectiveness. The Navy is negotiating a comprehensive Land Use Control Implementation Plan (LUCIP) for the CNC.

4.3.2 Other Considerations

Currently, the Navy is the property owner. Periodic monitoring of the deed controls and the site would be required. For the purpose of developing a representative cost estimate for this process, an annual evaluation that would include a site inspection, is assumed.

Section 5.0

5.0 Evaluation and Comparison of Corrective Measure Alternatives

The corrective measure alternatives were evaluated relative to the criteria previously described in Section 3.0, and then subjected to a comparative evaluation. A cost estimate for each alternative was also developed; the assumptions and unit costs used for these estimates are included in Appendix D.

5.1 Alternative 1: Soil Excavation and Offsite Disposal

The following assumptions were made for Alternative 1:

- A single area would be targeted for soil excavation.
- A total of 18.3 yd^3 of soil (in-place measurement) would be excavated for offsite disposal at a Subtitle D facility, and replaced with clean backfill.
- Approximately 100 ft^2 of pavement would be removed/replaced with an approximate volume of 3.7 yd^3.
- Excavations would include known exceedances plus extrapolated areas to account for uncertainty.
- Confirmation testing will validate that the extent of contaminated soil is limited to an area no greater than 10 ft around boring I680SB007 plus a contingency of 20 percent.

5.1.1 Protection of Human Health and the Environment

This alternative is effective at protecting groundwater because it removes from the site soil with VOC concentrations that exceed the MCS. The replacement soil will have concentrations of VOCs below the MCS.

5.1.2 Attain MCS

This alternative will permanently remove soil with VOC concentrations that exceed the MCS. The MCS will be achieved at the completion of soil removal actions.

5.1.3 Control the Source of Releases

There are no ongoing sources of releases at AOC 680, therefore this issue is not applicable.

5.1.4 Compliance with Applicable Standards for the Management of Generated Wastes

Excavated soil will be sampled and analyzed for waste characterization prior to disposal. Soil, decontamination waste, and personal protective equipment (PPE) will be disposed of in accordance with applicable regulations and permits. Offsite transportation and disposal will be performed by properly permitted and licensed subcontractors.

5.1.5 Other Factors (a) Long-term Reliability and Effectiveness

This alternative would have long-term reliability and be effective for the site as long as all exceedances are removed. The removal of contamination from the site would be permanent. Uncertainty in the distribution of VOCs in soil is addressed by expanding the excavations beyond the RFI delineation, thus reducing the risk of failure of this alternative. Confirmation sampling would confirm that the excavations have removed soil exceedances. It is much less likely any significant amount of soil with VOC concentrations above the MCS will be left in place; sitewide average concentrations will be below the unpaved (unrestricted) MCS.

5.1.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes

Alternative 1 reduces the mobility of the contaminated soil by transporting it to a regulated containment facility (landfill). Treatment will not be required unless the soil exhibits toxicity characteristics per 40 CFR 261.24. If required, soil will be treated (stabilized/fixated) at the disposal facility to further reduce mobility of the VOCs.

5.1.7 Other Factors (c) Short-term Effectiveness

The excavation and hauling of contaminated soil in this alternative has the potential to create dust containing contaminated soil particles. However, standard engineering controls such as dust suppression during excavation, tarp covers on trucks, and worker PPE to prevent dust inhalation will be implemented. Thus, with controls, the alternative provides short-term effectiveness in preventing ingestion of or contact with the contaminated soil, and minimizes the potential for migration of soil particles. The technologies for dust control and worker protection are well-established and robust. No unmanageable hazards would be created during implementation.

5.1.8 Other Factors (d) Implementability

This alternative will be moderately simple to implement. Most of the required activities have been routinely implemented at other nearby sites using standard equipment and procedures. Utility clearance, subcontracting, waste characterization, and base approval are

customary activities. The field implementation of this remedy is estimated to require 4 to 6 weeks, and the benefits will be immediate. There is ample offsite capacity for disposal (and treatment, if required) of the contaminated soil.

5.1.9 Other Factors (e) Cost

Appendix D presents the overall cost estimate for implementing this remedy. These costs reflect soil removal based on available RFI sample results, plus removal and replacement of pavement. A scope contingency (20 percent) is added to cover minor additional excavation that may be required per results of confirmation testing. In summary, the costs include the following:

- Remove soil in area of MCS exceedance.
- Perform confirmation tests in each area to confirm compliance with MCS.
- Apply 20-percent contingency for additional scope that may be required based on compliance tests.

Using the assumptions listed above, the total present value of Alternative 1 is $42,000.

5.2 Alternative 2: Engineering Controls/Land Use Controls

The assumptions for Alternative 2 include the following:

- Existing pavement will be maintained at the area of MCS exceedances in soil.
- A basewide LUCIP will be developed for the CNC. The plan will allow for restrictions on the use of land at AOC 680 and other areas, and will be developed outside the scope of this CMS.
- Periodic monitoring will be performed for 30 years. While LUCs may be required beyond this timeframe, 30 years is a standard assumption for cost estimating in CMSs. The monitoring will consist of an annual site visit to confirm that site use(s) are consistent with the LUCIP.

5.2.1 Protection of Human Health and the Environment

This alternative is effective at protecting groundwater because it restricts future use of the site that would allow for unpaved conditions to occur and thus prevents a potential leaching scenario to occur.

5.2.2 Attain MCS

This alternative would not immediately achieve the MCSs for VOCs. However, because VOCs are volatile, it is expected that over time, the VOCs would attenuate via diffusion into the vadose zone with subsequent natural attenuation. The duration that it would take for this to occur is difficult to estimate, but this could occur in on the order of 10 years.

5.2.3 Control the Source of Releases

There are no ongoing sources of releases at AOC 680, therefore this issue is not applicable.

5.2.4 Compliance with Applicable Standards for the Management of Generated Wastes

Alternative 2 does not generate any wastes that would require special management.

5.2.5 Other Factors (a) Long-term Reliability and Effectiveness

This alternative provides some level of protection that has long-term reliability and effectiveness. The risk of failure is low, provided the LUCIP is enforced by the responsible entity. If LUCs were not enforced, unpermitted use of the site may result in an unpaved condition at the site with the potential for VOCs to leach into groundwater.

5.2.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes

This alternative involves no treatment and does not reduce the toxicity, mobility, or volume of contaminated soil at AOC 680, other than the natural attenuation of VOCs that would be expected to occur over time.

5.2.7 Other Factors (c) Short-term Effectiveness

The Navy retains ownership and control of the site use until LUCs are implemented. This alternative does not involve any site activities, thus, no short-term risks are created.

5.2.8 Other Factors (d) Implementability

Alternative 2 is relatively easy to implement since it only requires the development of LUCs and an appropriate monitoring program.

5.2.9 Other Factors (e) Cost

Alternative 2 is not costly to implement since it requires no construction of treatment facilities or disposal of wastes. The cost for this alternative is for administrative/legal services and periodic monitoring/review for 30 years. Longer monitoring would likely be required, but its cost impact to present value of this alternative is minimal.

Using the assumptions described earlier, the total present value of Alternative 2 is $20,000.

5.3 Comparative Ranking of Corrective Measure Alternatives

The overall ability of each corrective measure alternative to meet the evaluation criteria is described above. In Table 5-1 below, a comparative evaluation of the degree to which each alternative meets a particular criteria is presented. Alternative 2 (Engineering Controls/LUCs) is the preferred alternative. It provides a protective and reliable remedy at a lower cost.

TABLE 5-1
Qualitative Comparison of Corrective Measure Alternatives
Corrective Measures Study Report, AOC 680, Zone I, Charleston Naval Complex

Criterion	1. Soil Excavation and Offsite Disposal	2. Engineering Controls/ Land Use Controls
Overall Protection of Human Health and the Environment	Protects human health and the environment	Protects human health and the environment
Attainment of MCS	Would achieve MCS immediately	Would not achieve MCS immediately, but is likely to eventually
Control of the source of releases	N/A	N/A
Compliance with applicable standards for the management of wastes	Complies with applicable standards	Complies with applicable standards
Long-term Reliability and Effectiveness	Reliable and effective long term	Reliable and effective long term, provided pavement is maintained
Reduction of Toxicity, Mobility, or Volume through Treatment	Reduces mobility via placement of soil in landfill	Does not reduce toxicity, mobility, or volume
Short-term Effectiveness	Effective in short term	Effective in short term
Implementability	Moderately simple to implement due to need to remove/replace concrete and asphalt pavement and work in busy industrial area.	Easy to implement
Cost Ranking	Comparatively expensive	Inexpensive
Estimated Cost	$42,000	$20,000

6.0 Recommended Corrective Measure Alternative

Two corrective measure alternatives were evaluated using the criteria described in Section 3.0 of this CMS report. These alternatives included: Alternative 1: Soil Excavation and Offsite Disposal; and Alternative 2: Engineering Controls/LUCs.

The preferred corrective measure alternative is Alternative 2: Engineering Controls/LUCs. The remedy would be protective at a moderate cost.

Alternative 2 would provide protection of groundwater by maintaining the current pavement at the site and continued future use of the site as industrial/commercial. Limitations would prevent residential and other unrestricted land use that could create unpaved conditions where the VOCs exceed the MCSs.

Adequate engineering controls releases are already in place. The area is paved or covered by a structure. Planning is already underway to develop and implement administrative controls that would limit future site activities to those that would not involve unrestricted exposures. The expected reliability of this alternative is good.

There are no community safety issues associated with implementation of this remedy, and the controls would be relatively easy to implement. This alternative provides long-term effectiveness for the planned industrial/commercial use, and relies on administrative controls to prevent future residential use.

Section 7.0

7.0 References

CH2M-Jones. *Zone I RFI Responses to SCDHEC Comments*. Charleston Naval Complex. Revision 0. February 28, 2001a.

CH2M-Jones. *Zone I RFI Report Addendum*. Charleston Naval Complex. Revision 0. November 29, 2001b.

CH2M-Jones. *Sampling and Analysis Plan (SAP) – Addendum 2 for AOC 680, Zone I*. Charleston Naval Complex. Revision 0. August 21, 2002.

EnSafe Inc./Allen & Hoshall. *Final Comprehensive RFI Work Plan*. 1994.

EnSafe Inc./Allen & Hoshall. *Final RCRA Facility Assessment Report, NAVBASE Charleston*. June 6, 1995.

EnSafe Inc./Allen & Hoshall. *Final Zone I RFI Work Plan, Revision 1*. 1996.

EnSafe Inc. *Zone I RFI Report, Revision 0. NAVBASE Charleston*. March 1999.

Appendix A

	StationID	I680SB010		I680SB010		I680SB011	
	SampleID	680SB01001 (0-1ft)		680SB01002 (3-5ft)		680CB01102 (3-5ft)	
	DateCollected	09/12/2002		09/12/2002		09/12/2002	
	DateExtracted	09/20/2002		09/20/2002		09/20/2002	
	DateAnalyzed	09/20/2002		09/20/2002		09/20/2002	
	SDGNumber	CNC146		CNC146		CNC146	
Parameter	**Units**						
Chloromethane	ug/kg	11	U	10	U	11	U
Vinyl chloride	ug/kg	11	U	10	U	11	U
Bromomethane	ug/kg	11	U	10	U	11	U
Chloroethane	ug/kg	11	U	10	U	11	U
1,1-Dichloroethene	ug/kg	5.4	U	5.1	U	5.4	U
Acetone	ug/kg	32	=	44	=	40	=
Carbon Disulfide	ug/kg	5.4	U	3.9	J	5.4	U
Methylene Chloride	ug/kg	5.4	U	5.1	U	5.4	U
trans-1,2-Dichloroethene	ug/kg	5.4	U	5.1	U	5.4	U
1,1-Dichloroethane	ug/kg	5.4	U	5.1	U	5.4	U
Vinyl acetate	ug/kg	11	U	10	U	11	U
Methyl ethyl ketone (2-Butanone)	ug/kg	11	U	10	U	9.3	J
cis-1,2-Dichloroethylene	ug/kg	5.4	U	5.1	U	5.4	U
1,2-Dichloroethene (total)	ug/kg	5.4	U	5.1	U	5.4	U
Chloroform	ug/kg	5.4	U	5.1	U	5.4	U
1,1,1-Trichloroethane	ug/kg	5.4	U	5.1	U	5.4	U
Carbon Tetrachloride	ug/kg	5.4	U	5.1	U	5.4	U

	StationID	I680SB011		I680SB011	
	SampleID	680SB01101 (0-1ft)		680SB01102 (3-5ft)	
	DateCollected	09/12/2002		09/12/2002	
	DateExtracted	09/20/2002		09/20/2002	
	DateAnalyzed	09/20/2002		09/20/2002	
	SDGNumber	CNC146		CNC146	
Parameter	**Units**				
Chloromethane	ug/kg	10	U	12	U
Vinyl chloride	ug/kg	10	U	12	U
Bromomethane	ug/kg	10	U	12	U
Chloroethane	ug/kg	10	U	12	U
1,1-Dichloroethene	ug/kg	5.3	U	6.3	U
Acetone	ug/kg	10	U	55	=
Carbon Disulfide	ug/kg	5.3	U	6.3	U
Methylene Chloride	ug/kg	5.3	U	6.3	U
trans-1,2-Dichloroethene	ug/kg	5.3	U	6.3	U
1,1-Dichloroethane	ug/kg	5.3	U	6.3	U
Vinyl acetate	ug/kg	10	U	12	U
Methyl ethyl ketone (2-Butanone)	ug/kg	10	U	12	J
cis-1,2-Dichloroethylene	ug/kg	5.3	U	6.3	U
1,2-Dichloroethene (total)	ug/kg	5.3	U	6.3	U
Chloroform	ug/kg	5.3	U	6.3	U
1,1,1-Trichloroethane	ug/kg	5.3	U	6.3	U
Carbon Tetrachloride	ug/kg	5.3	U	6.3	U

	StationID	I680SB010		I680SB010		I680SB011	
	SampleID	680SB01001 (0-1ft)		680SB01002 (3-5ft)		680CB01102 (3-5ft)	
	DateCollected	09/12/2002		09/12/2002		09/12/2002	
	DateExtracted	09/20/2002		09/20/2002		09/20/2002	
	DateAnalyzed	09/20/2002		09/20/2002		09/20/2002	
	SDGNumber	CNC146		CNC146		CNC146	
Parameter	**Units**						
1,2-Dichloroethane	ug/kg	5.4	U	5.1	U	5.4	U
Benzene	ug/kg	5.4	U	5.1	U	5.4	U
Trichloroethylene (TCE)	ug/kg	5.4	U	5.1	U	5.4	U
1,2-Dichloropropane	ug/kg	5.4	U	5.1	U	5.4	U
Bromodichloromethane	ug/kg	5.4	U	5.1	U	5.4	U
2-Chloroethyl vinyl ether	ug/kg	11	R	10	R	11	R
cis-1,3-Dichloropropene	ug/kg	5.4	U	5.1	U	5.4	U
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/kg	11	U	10	U	11	U
Toluene	ug/kg	10	=	5.8	=	5.7	=
trans-1,3-Dichloropropene	ug/kg	5.4	U	5.1	U	5.4	U
1,1,2-Trichloroethane	ug/kg	5.4	U	5.1	U	5.4	U
2-Hexanone	ug/kg	11	U	10	U	11	U
Tetrachloroethylene (PCE)	ug/kg	5.4	U	5.1	U	5.4	U
Dibromochloromethane	ug/kg	5.4	U	5.1	U	5.4	U
Chlorobenzene	ug/kg	5.4	U	5.1	U	5.4	U
Ethylbenzene	ug/kg	2.4	J	3.4	J	5.4	U
m+p Xylene	ug/kg	10	=	6.8	=	5.5	=
o-Xylene	ug/kg	1.9	J	1.9	J	5.4	U
Xylenes, Total	ug/kg	12	=	8.8	=	5.5	=
Styrene	ug/kg	5.4	U	5.1	U	5.4	U
Bromoform	ug/kg	5.4	U	5.1	U	5.4	U
1,1,2,2-Tetrachloroethane	ug/kg	5.4	U	5.1	U	5.4	U
1,3-Dichlorobenzene	ug/kg	5.4	U	5.1	U	5.4	U
1,4-Dichlorobenzene	ug/kg	5.4	U	5.1	U	5.4	U
1,2-Dichlorobenzene	ug/kg	5.4	U	5.1	U	5.4	U
1,2,4-Trichlorobenzene	ug/kg	5.4	U	5.1	U	5.4	U
1,2,3-Trichlorobenzene	ug/kg	1.2	J	5.1	U	5.4	U

	StationID	I680SB011		I680SB011	
	SampleID	680SB01101 (0-1ft)		680SB01102 (3-5ft)	
	DateCollected	09/12/2002		09/12/2002	
	DateExtracted	09/20/2002		09/20/2002	
	DateAnalyzed	09/20/2002		09/20/2002	
	SDGNumber	CNC146		CNC146	
Parameter	**Units**				
1,2-Dichloroethane	ug/kg	5.3	U	6.3	U
Benzene	ug/kg	5.3	U	6.3	U
Trichloroethylene (TCE)	ug/kg	5.3	U	6.3	U
1,2-Dichloropropane	ug/kg	5.3	U	6.3	U
Bromodichloromethane	ug/kg	5.3	U	6.3	U
2-Chloroethyl vinyl ether	ug/kg	10	R	12	R
cis-1,3-Dichloropropene	ug/kg	5.3	U	6.3	U
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/kg	10	U	12	U
Toluene	ug/kg	5.2	J	12	=
trans-1,3-Dichloropropene	ug/kg	5.3	U	6.3	U
1,1,2-Trichloroethane	ug/kg	5.3	U	6.3	U
2-Hexanone	ug/kg	10	U	12	U
Tetrachloroethylene (PCE)	ug/kg	5.3	U	6.3	U
Dibromochloromethane	ug/kg	5.3	U	6.3	U
Chlorobenzene	ug/kg	5.3	U	6.3	U
Ethylbenzene	ug/kg	5.3	U	2.7	J
m+p Xylene	ug/kg	4.6	J	12	=
o-Xylene	ug/kg	5.3	U	2.3	J
Xylenes, Total	ug/kg	4.6	J	14	=
Styrene	ug/kg	5.3	U	6.3	U
Bromoform	ug/kg	5.3	U	6.3	U
1,1,2,2-Tetrachloroethane	ug/kg	5.3	U	6.3	U
1,3-Dichlorobenzene	ug/kg	5.3	U	6.3	U
1,4-Dichlorobenzene	ug/kg	5.3	U	6.3	U
1,2-Dichlorobenzene	ug/kg	5.3	U	6.3	U
1,2,4-Trichlorobenzene	ug/kg	5.3	U	6.3	U
1,2,3-Trichlorobenzene	ug/kg	5.3	U	6.3	U

Appendix B

Data Validation Summary - Charleston Naval Complex - Zone I, AOC 680

TO: William Elliott /CH2M HILL/GNA

FROM: Amy Juchem/CH2M HILL/GNA
Herb Kelly/CH2M HILL/GNA

DATE: April 9, 2003

The purpose of this memorandum is to present the results of the data validation process for the samples collected in Zone I, AOC 680. The samples were collected on September 12, 2002.

The specific samples and analytical fractions reviewed are summarized below in Table 1.

The Quality Control areas that were reviewed 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 2002) 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 following analyses: SW-846 8260 Volatile Organic Compounds (VOC).

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 1 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

Code	Definition
2S	Second Source
2C	Second Column Confirmation
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
TD	Total vs Dissolved
TN	Tune

Table 1 - Chemical Analytical Methods – Field and Quality Control Samples

SDG	Station ID	Sample ID	Lab Sample ID	Matrix	Sample Type	Upper Depth	Lower Depth	Date Collected	VOC Analysis
CNC146	I680SB010	680SB01001	S246559*1	SO	N	0	1	09/12/02	X
CNC146	I680SB010	680SB01002	S246559*2	SO	N	3	5	09/12/02	X
CNC146	I680SB011	680SB01101	S246559*3	SO	N	0	1	09/12/02	X
CNC146	I680SB011	680SB01102	S246559*4	SO	N	3	5	09/12/02	X
CNC146	I680SB011	680CB01102	S246559*5	SO	FD	3	5	09/12/02	X
CNC146	FIELDQC	680EB010M2	S246559*6	WQ	EB			09/12/02	X
CNC146	FIELDQC	680TB010M2	S246559*7	WQ	TB			09/12/02	X
CNC146	LABQC	465598LB	S246559*8	SQ	LB				X
CNC146	LABQC	465599BS	S246559*9	SQ	BS				X
CNC146	LABQC	4655915LB	S246559*15	WQ	LB				X
CNC146	LABQC	4655916BS	S246559*16	WQ	BS				X

MATRIX CODE

Q – Water QC Sample
SO – Soil
SQ – Soil QC Sample

SAMPLE TYPE CODE

BS - Blank Spike
EB - Equipment Blank
TB – Trip Blank
N - Native Sample
FD – Field Duplicate
LB - Laboratory Blank

ANALYSIS CODE

VOC – Volatile Organic Compounds

Organic Parameters

Quality Control Review

The following list represents the QA/QC measures that were 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** – Method blanks, equipment blanks, and trip blanks 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.
- **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.
- **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.
- **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.
- **Confirmation** – If GCMS methodology is not initially used for analysis, SW-846 method 8000 requires confirmation when the composition of samples is not well characterized. Therefore, even when the identification has been confirmed on a dissimilar column or detector, the agreement of the quantitative results on both columns is evaluated. For

Pesticide and PCB analyses covered in this report, confirmation was performed using a dissimilar analytical column. The laboratory analyzed samples with a gas chromatograph (GC) utilizing simultaneous primary and confirmation data acquisition. Per SW-86 method 8000, 40% RPD criteria was used as the acceptance limit.

Volatile Organic Compounds (VOC) Analyses

The QA/QC parameters for VOC analyses for all of the samples were within acceptable control limits, except as noted below:

Blanks

The VOC target parameters detected in blank samples are listed in Table 2.

TABLE 2
Blank Contamination: VOCs
Charleston Naval Complex, Zone I, AOC 680, Charleston, SC

SDG	Sample ID	Lab Sample ID	Sample Type	Parameter	Lab Result	Units	Flag (Concentrations less than the value listed were...
CNC146	465598LB	S246559*8	LB	Methylene chloride	3.7	µg/Kg	37.0 µg/Kg
CNC146	680EB010M2	S246559*6	EB	Methylene chloride	3.5	µg/L	35.0 µg/Kg / 35.0 µg/L
CNC146	680TB010M2	S246559*7	TB	Methylene chloride	3.9	µg/L	39.0 µg/Kg / 39.0 µg/L

If a target parameter determined to be a common contaminant was reported in a field sample, and the concentration was below the level determined to be due to blank contamination, the following actions were taken:

- If the concentration was above the reporting limit, the numeric result was unchanged, but it was flagged "U", as undetected.
- If the concentration was below the reporting limit, the numeric result was changed to the value of the reporting limit, and it was flagged "U", as undetected.

The results qualified due to blank contamination are listed in Attachment 1.

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 in Table 3 below.

TABLE 3
Surrogate, MS/MSD, and LCS/LCSD Recoveries Out of QC Limits: VOC
Charleston Naval Complex, Zone I, AOC 680, Charleston, SC

SDG	Sample	Parameter	Recovery	Recovery Limits	Associated Samples	Flag
CNC146	S246599*9 LCS	2-Chloroethyl vinyl ether	0*	70-130	CNC146 - All	Detects – J, Non-detects - R
* - out of control limits						

Initial and Continuing Calibration Criteria

All initial calibration criteria and continuing calibration criteria were met, except as listed in Table 4.

TABLE 4
Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: VOC
Charleston Naval Complex, Zone I, AOC 680, Charleston, SC

Instrument/calibration date	Analyte	%Relative Standard Deviation or R² (ICAL)/ % Difference (CCAL)	Associated Samples
MSM5972-ICAL-09/20/02, 1343	2-Chloroethyl vinyl ether	0% RSD RRF=0	CNC146 – All

Flags were applied to the compounds in the associated samples in the following manner:

- In extreme cases where the percent Relative Standard Deviation (%RSD) or the RRF was significantly low or there was no response, detected compounds were flagged "J", as estimated, and non-detected compounds were qualified "R", as rejected.

Field Duplicate Samples

All Field Duplicate Samples were within acceptable quality control limits, except as noted in Table 5 below. No flags are applied due to Field Duplicate precision.

TABLE 5
Field Duplicate RPDs Out of QC Limits: VOCs
Charleston Naval Complex, , Zone I, AOC 680, Charleston, SC

Site	Sample	Parameter	Native Concentration	Field Duplicate Concentration	RPD	RPD Limits
CNC146	680SB01102 / 680CB01102	Toluene	12 ug/Kg	5.7 ug/Kg	71.2*	35
		m,p-Xylene	12 ug/Kg	5.5 ug/Kg	74.3*	35
		Xylene (total)	14 ug/Kg	5.5 ug/Kg	87.2*	35
* - out of control limits						

Rejected Data

There were selected results qualified as "R", rejected, due to associated QC parameters out of criteria as discussed in the sections above. The rejected data are summarized in Table 6 below.

TABLE 6
Data Qualification Summary: Rejected Data
Charleston Naval Complex, Zone I, AOC 680, Charleston, SC

Site	Sample ID	Parameter Class	Parameter	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reason
CNC146	680CB01102	VOA	2-Chloroethyl vinyl ether	11	UJ	11	R	ug/kg	IC,BS
CNC146	680SB01001	VOA	2-Chloroethyl vinyl ether	11	UJ	11	R	ug/kg	IC,BS
CNC146	680SB01002	VOA	2-Chloroethyl vinyl ether	10	UJ	10	R	ug/kg	IC,BS
CNC146	680SB01101	VOA	2-Chloroethyl vinyl ether	10	UJ	10	R	ug/kg	IC,BS
CNC146	680SB01102	VOA	2-Chloroethyl vinyl ether	12	UJ	12	R	ug/kg	IC,BS

Conclusion

A review of the analytical data submitted regarding the investigation of Zone I, AOC 680 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.

As discussed above, there were specific results that were rejected, in which the data cannot be used. With the exception of these results, the validation review demonstrated that the analytical systems were generally in control and the data can be used in the decision making process.

Attachment 1 - Chai Qualifiers and Results
Zone I, AOC 680 - Data Validation

Parameter Class	Analytical Method	Parameter	SDG	Sample ID	Lab Sample ID	Matrix	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
VOA	SW8260B	2-Chloroethyl vinyl ether	CNC146	680SB01001	S246559*1	SO	11	UJ	11	R	ug/kg	IC,BS
VOA	SW8260B	2-Chloroethyl vinyl ether	CNC146	680SB01002	S246559*2	SO	10	UJ	10	R	ug/kg	IC,BS
VOA	SW8260B	2-Chloroethyl vinyl ether	CNC146	680SB01101	S246559*3	SO	10	UJ	10	R	ug/kg	IC,BS
VOA	SW8260B	2-Chloroethyl vinyl ether	CNC146	680SB01102	S246559*4	SO	12	UJ	12	R	ug/kg	IC,BS
VOA	SW8260B	2-Chloroethyl vinyl ether	CNC146	680CB01102	S246559*5	SO	11	UJ	11	R	ug/kg	IC,BS
VOA	SW8260B	METHYLENE CHLORIDE	CNC146	680SB01001	S246559*1	SO	5.3	JB	5.4	U	ug/kg	BL
VOA	SW8260B	METHYLENE CHLORIDE	CNC146	680SB01002	S246559*2	SO	4.1	JB	5.1	U	ug/kg	BL
VOA	SW8260B	METHYLENE CHLORIDE	CNC146	680SB01101	S246559*3	SO	4.2	JB	5.3	U	ug/kg	BL
VOA	SW8260B	METHYLENE CHLORIDE	CNC146	680SB01102	S246559*4	SO	5.8	JB	6.3	U	ug/kg	BL
VOA	SW8260B	METHYLENE CHLORIDE	CNC146	680CB01102	S246559*5	SO	4.4	JB	5.4	U	ug/kg	BL

Laboratory: STL

Project Name: Charleston Navy Complex

Site Name: Zone I, AOC 680

Project Number: 158814.PM.04

TAT: 7 day results

Project Manager: Tom Beisel

QA Level: level 3

Address: GNV: 3011 SW Williston Rd., Gainesville, FL 32605

ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278

Send Report To: see last page of COC

EDD: CNC format

Lab Batch/SDG:

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Sample ID	Station ID	Sample Description	Depth Begin	Depth End	Date & Time Collected	Matrix	# of containers	3 - 5g Encore & 1 - 2oz jar: VOCs (SW8260B)	3 - 40mL vial, HCl: VOCs (SW8260B)		Comments
680SB01001	I680SB010	1	0	1	9.12.02 / 1045	SO	4	X			
680SB01002	I680SB010	2	3	5	9.12.02 / 1055	SO	4	X		*	RCRA
680SB01101	I680SB011	3	0	1	9.12.02 / 0955	SO	4	X			
680SB01102	I680SB011	4	3	5	9.12.02 / 1000	SO	4	X		*	SAMPLES
680CB01102	I680SB011	5	3	5	9.12.02 / 1002	SO	4	X			complete
680EB010M2	I680EB010	6			9.12.02 / 1100	SQ	3		X		soil EB
680TB010M2	I680TB010	7			LAB SUPPLIED	SQ	3		X		TB

Sampled By: ANDREW O'CONNOR Date/Time: 9.12.02 /

Relinquished by: Date/Time: 9.12.02 / 1600

Additional Samplers:

Received By Lab: Date/Time: 091302 0932

Relinquished by: Date/Time:

Received By: Date/Time:

Shipped Via: UPS FedEx Hand Other Tracking#:

Remarks: Temperature:

Receipt Exceptions: 5246559

Appendix C

Soil Screening Level (SSL) Calculations
AOC 680, Zone I, Charleston Naval Complex

						Parameter	Ethylbenzene	2-Butanone	cis-1,2-Dichloroethene	Trichloroethene	Tetrachloroethene
Chemical Specific Input Parameters											
Cw	=	Target groundwater concentration MCL (mg/L)					**7.00E-01**	**1.90E+00**	**7.00E-02**	**5.00E-03**	**5.00E-03**
H	=	Henry's Law Constant, dimensionless					**3.23E-01**	**1.93E-03**	**1.67E-01**	**4.22E-01**	**7.54E-01**
ks	=	Soil-water sorption coefficient (cm3 water / g soil = L/kg) = Koc x foc where					3.06E+00	4.73E-01	5.33E-01	1.41E+00	3.98E+00
		koc = organic carbon-water sorption coefficient, (cm3 (ml) water) / (g soluble organic carbon)					**2.04E+02**	**3.15E+01**	**3.55E+01**	**9.43E+01**	**2.65E+02**
		foc = Fraction of organic content, dimensionless				**0.015**					
Site Specific Input Parameters											
Sw	=	Width of Source Parallel to Groundwater Flow Direction	(impacted soil zone)	**7.8** m	25.5 ft						
da	=	Aquifer Thickness		**10.7** m	35 ft						
d	=	Groundwater Mixing Zone thickness	(paved)	**0.87** m	2.9 ft						
			(unpaved)	**1.59** m	5.2 ft						
i	=	Groundwater Gradient		**2.0E-03**	(unitless)						
Ks	=	Saturated Hydraulic Conductivity		**667.5** m/yr	2190.0 ft/yr						
θw	=	Volumetric Water Content of Soil Pore Space		**0.3** cm^3_{vapor}/cm^3_{soil}	0.3 in^3_{vapor}/in^3_{soil}						
θv	=	Volumetric Vapor Content of Soil Pore Space		**0.15** cm^3_{vapor}/cm^3_{soil}	0.15 in^3_{vapor}/in^3_{soil}						
ρs	=	Soil Bulk Density		1.5 g/cm^3	93.64 lb_m/ft^3						
qi	=	Water Infiltration Rate	(paved)	**0.0086** m/yr	0.0283 ft/yr						
			(unpaved)	**0.1372** m/yr	0.4500 ft/yr						
		Partition Term, Cw/Csoil, (L/kg)		$\frac{C_{soil}}{C_w} = \left(\frac{\theta_w + K_s\rho_s + H\theta_v}{\rho_s}\right)\left(\frac{K_s i d + q_i S_w}{q_i S_w}\right)$			3.29E+00	6.73E-01	7.49E-01	1.66E+00	4.25E+00
		Dilution Term, dimensionless	(paved)				1.84E+01	1.84E+01	1.84E+01	1.84E+01	1.84E+01
			(unpaved)				2.99E+00	2.99E+00	2.99E+00	2.99E+00	2.99E+00
		Csoil/Cw =Partition term * Dilution term (mg/kg / mg/L) = L/kg	(paved)				6.04E+01	1.23E+01	1.38E+01	3.04E+01	7.80E+01
			(unpaved)				9.86E+00	2.01E+00	2.24E+00	4.96E+00	1.27E+01
		Calculated Site Specific Target Level for Soil									
		C_{soil} calculated source soil concentration (SSL, mg/kg) Cw*(partion term)*(dilution term)				(paved)	**42.3**	**23.5**	**0.96**	**0.15**	**0.39**
						(unpaved)	**6.90**	**3.83**	**0.157**	**0.025**	**0.064**

Cwt is the MCL from EPA National Drinking Water Standards (March 2001) or the RBC from the EPA Region III RBC Table (10/2000).
H from Table 36 of the Soil Screening Guidance; Technical Background Document (EPA, 1996) or the Hasdardous Substances Data Base (electronic, 2002).
ks = koc x foc.
koc from Table 39 of the Soil Screening Guidance; Technical Background Document (EPA, 1996) or the Hasdardous Substances Data Base (electronic, 2002)..
foc was calculated from Zone I total organic carbon (TOC) data. Nine surface soil samples were analyzed for TOC.
Sw Estimated as longest dimension of AOC 680 ($[18^2+18^2]^{1/2}$=25.5).
d is calculated as $d = (0.0112\ Sw^2)^{0.5} + da\{1 - e^{[-0.0112\ Sw\ qi/Ks\ da]}\}$ or da, whichever is less.
da is based on the water elevation from the shallow groundwater contours (5 ft msl, GIS) - the top of Ashley (-30 ft msl, GIS).
I Calculated from data in the Groundwater Monitoring Report ([5-4]/500~0.002, CH2MHill, 2001)
Ks Based on CH2MHill's hydraulic conductivity theme in the GIS (6 ft/d).
θw is the default value presented in the Soil Screening Guidance: User's Guide (EPA, 1996)
θv is calculated as total porosity (0.45, assumed) - θw (0.3) = 0.15.
ρs is the default value presented in the Soil Screening Guidance: User's Guide (EPA, 1996)
qi Is a derived value (5.4 in/yr, unpaved and 0.34 in/yr, paved) based on annual precipitation, evapo-transportation, and runoff coefficient values

Appendix D

COMPARISON OF TOTAL COST OF REMEDIAL SOLUTIONS

Site: Charleston Naval Complex
Location: AOC 680
Phase: Corrective Measures Study
Base Year: 2003
Date: 04/04/03

	Alternative Number 1	Alternative Number 2
Total Project Duration (Years)	<1	30
Capital Cost	$22,000	$6,000
Annual O&M Cost	$0	$1,100
Total Present Value of Solution	$42,000	$20,000

Disclaimer: The information in this cost estimate is based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude cost estimate that is expected to be within -50 to +100 percent of the actual project costs.

Alternative: Number 1 — **COST ESTIMATE SUMMARY**

Elements: Soil Excavation and Offsite Disposal

Site: Charleston Naval Complex

Location: AOC 680
Phase: Corrective Measures Study
Base Year: 2003
Date: 04/04/03

Description: Excavation of contaminated soil, disposal offsite at permitted landfill, backfill with clean soil. Extent includes RFI sample points plus 20% scope contingency.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Confirmation Sampling	1	EA	$1,800	$1,800	See Confirmation Worksheet
Removal, Disposal and Backfill	1	EA	$12,000	$12,000	See Excavation 1 Worksheet
				$0	
SUBTOTAL				$13,800	
Contingency	20%		$13,800	$2,760	
SUBTOTAL				**$16,560**	
Project Management	8%		$16,560	$1,325	USEPA 2000, p. 5-13, $100K-$500K
Remedial Design	15%		$16,560	$2,484	USEPA 2000, p. 5-13, $100K-$500K
Construction Management	10%		$16,560	$1,656	USEPA 2000, p. 5-13, $100K-$500K
SUBTOTAL				**$5,465**	
TOTAL CAPITAL COST				**$22,000**	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SUBTOTAL				$0	
Allowance for Misc. Items	20%		$0	$0	
SUBTOTAL				$0	
TOTAL ANNUAL O&M COST				**$0**	

PRESENT VALUE ANALYSIS

Discount Rate = 7%

End Year	COST TYPE	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
0	CAPITAL COST	$22,000	$22,000	1.000	$22,000	
	ANNUAL O&M COST	$0	$0	0.000	$0	
		$22,000			$22,000	
	PRESENT VALUE OF LUC				$20,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE				**$42,000**	

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

Alternative: Number 2
Elements: Land Use Controls

COST ESTIMATE SUMMARY

Site: Charleston Naval Complex
Location: AOC 680
Phase: Corrective Measures Study
Base Year: 2003
Date: 04/04/03

Description: Implementation of base-wide land use management plan to put instituional controls in place to restrict site use to commercial/industrial.

Assumes this site is part of a multi-site implementation, and costs are shared among all the sites.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Deed Restrictions - Attorney	4	hour	$200	$800	
Record Deed	4	each	$500	$2,000	
LUC Implementation	24	hours	$75	$1,800	
SUBTOTAL				$4,600	
Contingency	20%		$4,600	$920	
SUBTOTAL				**$5,520**	
Project Management	10%		$5,520	$552	USEPA 2000, p. 5-13, <$100K
Remedial Design	0%		$5,520	$0	Not applicable.
Construction Management	0%		$5,520	$0	Not applicable.
SUBTOTAL				**$552**	
TOTAL CAPITAL COST				**$6,000**	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Annual Evaluation	12	hour	$75	$900	
SUBTOTAL				$900	
Allowance for Misc. Items	20%		$900	$180	
SUBTOTAL				$1,080	
TOTAL ANNUAL O&M COST				**$1,100**	

PRESENT VALUE ANALYSIS - 20 years

Discount Rate = 7%

End Year	COST TYPE	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
0	CAPITAL COST	$6,000	$6,000	1.000	$6,000	
30	ANNUAL O&M COST	$33,000	$1,100	12.409	$13,650	
		$39,000			$19,650	
	TOTAL PRESENT VALUE OF ALTERNATIVE				**$20,000**	

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).