N61165.AR.003174
CNC CHARLESTON
5090.3a

RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT
ZONE G VOLUME III OF VI SECTIONS 10.8 TO 10.12 CNC CHARLESTON SC
2/20/1998
ENSAFE

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVBASE CHARLESTON

VOLUME III of VI
SECTIONS 10.8 to 10.12

CONTRACT N62467-89-D-0318
CTO-029

Prepared for:

Comprehensive Long-Term Environmental Action Navy (CLEAN)
Charleston Naval Shipyard
Charleston, South Carolina

Prepared by:

EnSafe Inc.
5724 Summer Trees Drive
Memphis, Tennessee 38134
(901)372-7962

February 20, 1998
Revision: 0

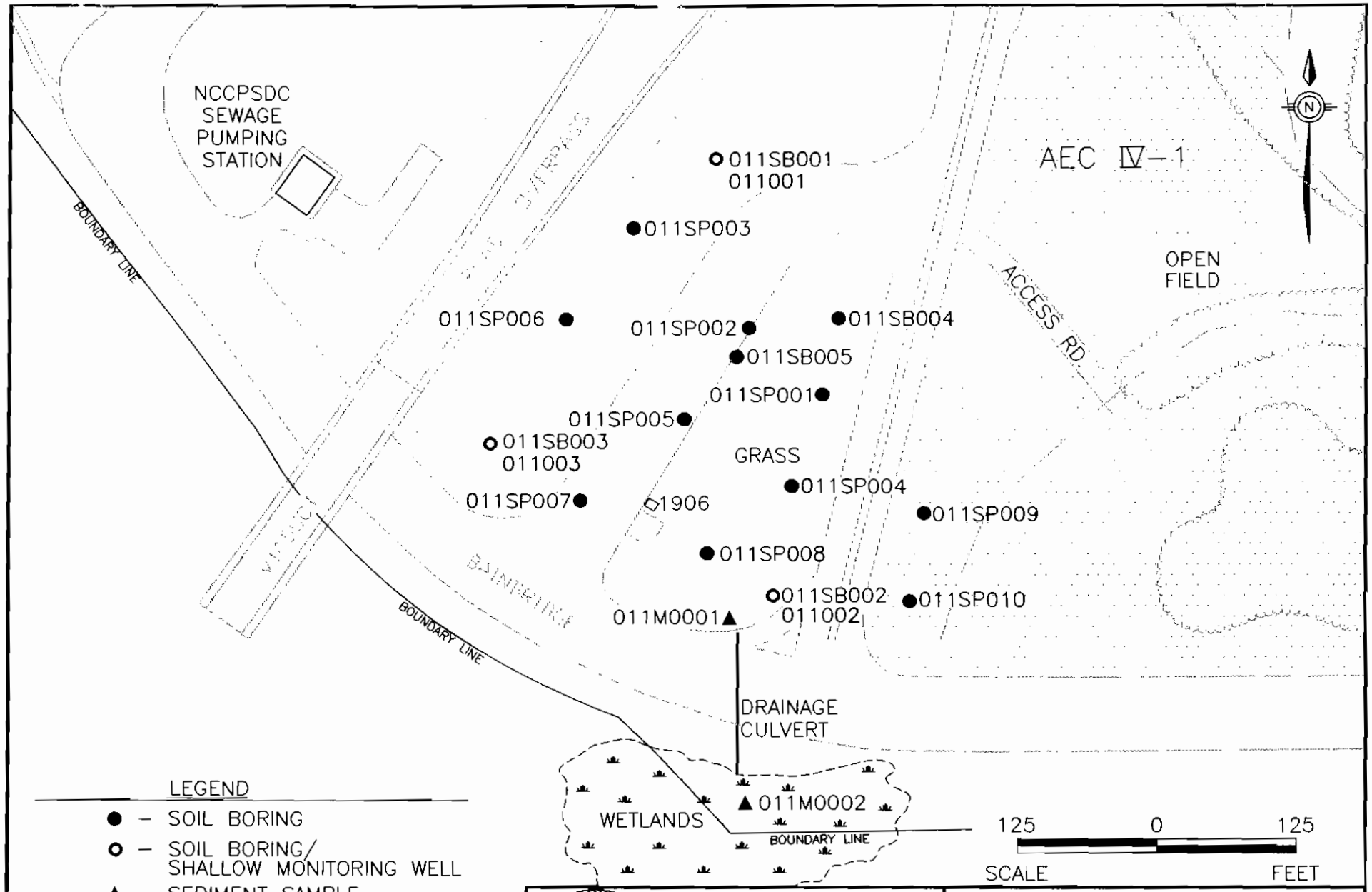
10.8 SWMU 11, Caustic Pond

A RFI site, SWMU 11 is located near the interchange formed by the junction of Bainbridge Avenue and Viaduct Road. It is currently an open space, landscaped with grass. From the early 1940s to the early 1970s, the site was a settling pond used for the disposal of calcium hydroxide generated as a byproduct of the production of acetylene gas. Unknown quantities of water saturated with calcium hydroxide were discharged into the pond, which discharged supernatant into Shipyard Creek. Soil borings taken during initial assessments found sludge depths of one foot. Groundwater samples collected from around the site indicated a neutral pH. A 1982 Confirmation Study (Geraghty and Miller, 1982) indicated that groundwater pH ranged from 6.3 to 7.3, and that calcium and chloride contents and specific conductances were slightly elevated. It was assumed that naturally occurring acidic soils at the site neutralized the relatively high pH of the caustic water infiltrating from the pond. A wetland area south of Bainbridge Avenue currently receives surface runoff from drainage culverts leading from the site.

10.8.1 Site Geology and Hydrogeology

Figure 10.8-1 depicts the soil and groundwater sampling locations within this area. Appendix A contains the boring logs and the monitoring well construction diagrams for the three wells installed at SWMU 11. Based on the three monitoring well boring logs, the stratigraphy at SWMU 11 consists of varying mixtures of alternating silty clay, clayey sand and silt to a depth of approximately 12 ft bgs. The observed clayey sand exhibits an average grain size distribution of 56% sand, 15% silt, and 29% clay.

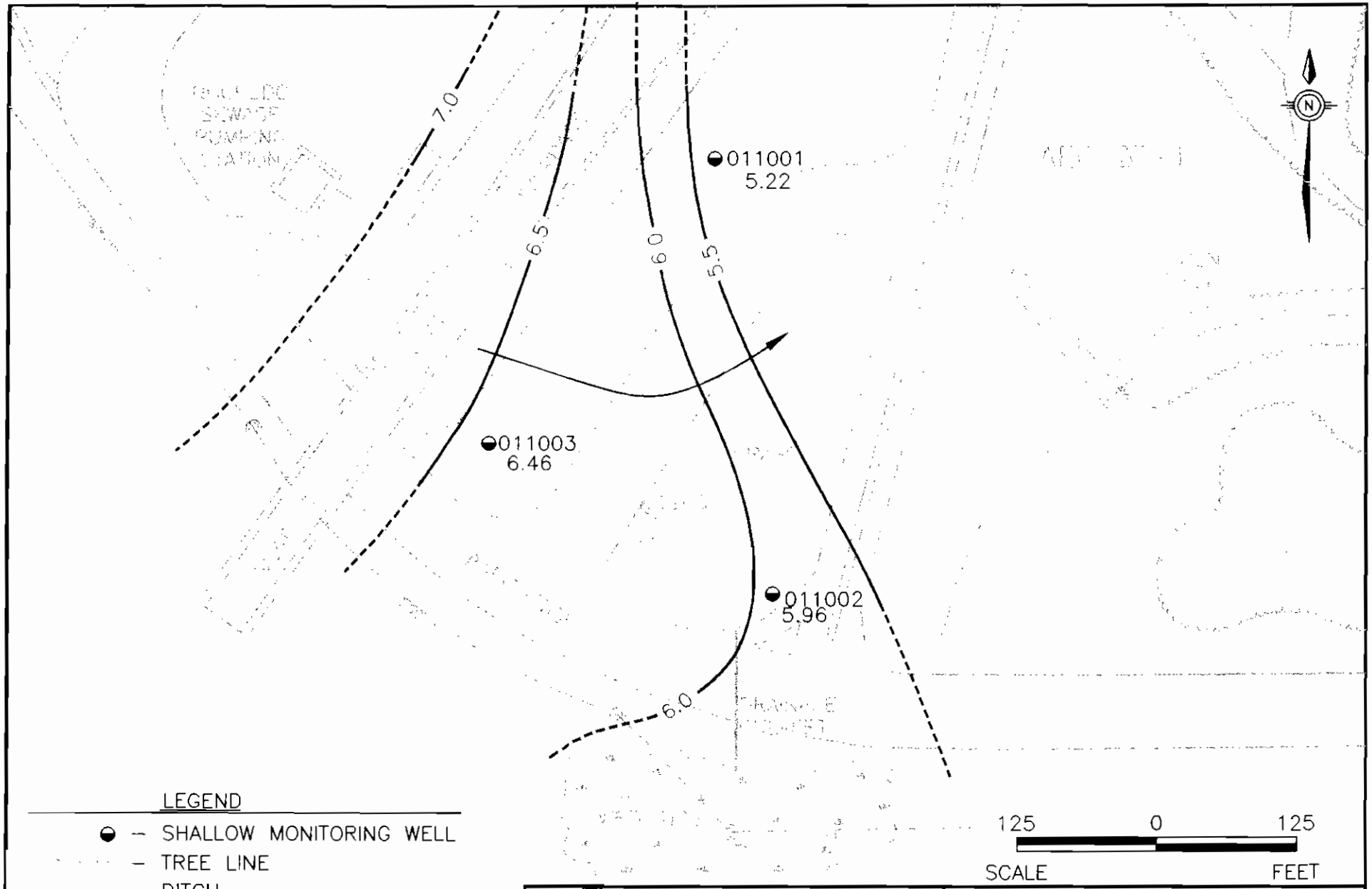
The groundwater elevation at SWMU 11 is approximately 6.0 ft msl. Figures 10.8-2 and 10.8-3 depict the shallow groundwater potentiometric surface and inferred flow direction at low- and high-tide respectively. Minor differences in the static water levels and the overall flow pattern at the SWMU 11 area were observed. Shallow groundwater at SWMU 11 flows generally to the east northeast. The horizontal hydraulic conductivity calculated from slug testing, varied from 3.1 to



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8-1
SAMPLING LOCATIONS
SWMU #11
CAUSTIC POND

DWG DATE: 01/15/98 | DWG NAME: 29CHZG14



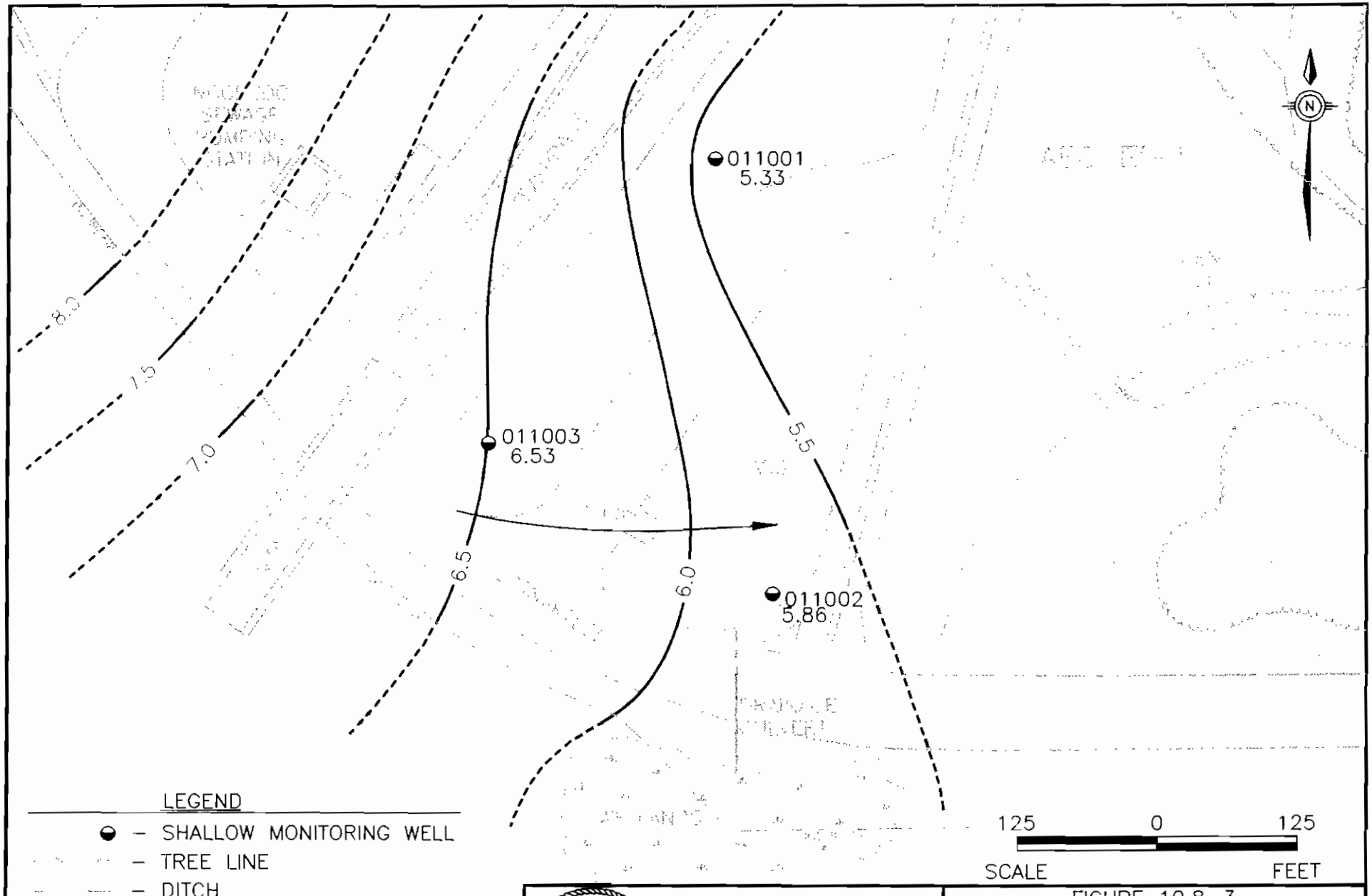
LEGEND

- ◒ – SHALLOW MONITORING WELL
- – TREE LINE
- – DITCH
- – CONTOUR INTERVAL = 0.5 FEET
- ← – ARROW INDICATES FLOW DIRECTION

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8–2
SHALLOW GROUNDWATER
LOW–TIDE POTENTIOMETRIC MAP
SWMU #11
CAUSTIC POND

DWG DATE: 01/22/98 | DWG NAME: 29ZGLTCP



LEGEND

- ◒ – SHALLOW MONITORING WELL
- – TREE LINE
- – DITCH
- – CONTOUR INTERVAL = 0.5 FEET
- – ARROW INDICATES FLOW DIRECTION

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8–3
SHALLOW GROUNDWATER
HIGH–TIDE POTENTIOMETRIC MAP
SWMU #11
CAUSTIC POND

DWG DATE: 01/26/98 | DWG NAME: 29ZGHTCP

4.3 ft/day. The horizontal hydraulic gradient, based on Figure 10.8-2 is 6.3E-03 to the east northeast. The horizontal flow velocity was calculated from SWMU data at 5.7E-02 ft/day.

10.8.2 Field Investigation Approach

The objective of the field investigation at SWMU 11 was to: (1) confirm the presence or absence of contamination in the site area; (2) delineate any contamination found; and (3) provide sufficient data to support a detailed evaluation of treatment alternatives, if required. Media sampled within the investigation area included soil, sediment, and groundwater. Section 3 of this report details the methods used during the field investigation. Included in this section are descriptions of the DPT procedures used for site screening; the hand auger procedures used for soil sampling; the hollow stem auger procedures used for shallow well installation; sediment and groundwater sampling procedures; and miscellaneous procedures used during the field investigation. Also discussed are the analytical protocols for sample analyses. Appendix D contains the analytical data report for samples collected in Zone G.

10.8.3 DPT Sampling and Analysis

A DPT screening effort was conducted to supplement the original soil investigation for this site and to define the areal extent and thickness of residual sludge at the site. It was also conducted to further assess the pH of the unsaturated and saturated zones. Eight push samples were collected at SWMU 11. Of these, six included both upper and lower sampling intervals, while two included the upper interval only. An additional deeper soil sample was collected at two locations. DPT samples were analyzed for metals at DQO Level III, and pH. Table 10.8.1 summarizes the SWMU 11 DPT sampling and analyses.

Table 10.8.1
Zone G
SWMU 11
DPT Samples

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
011SP001	011SP00101 011SP00102 011SP00103	Upper Lower	10/16/96	See note	
011SP002	011SP00201 011SP00202	Upper Lower	10/16/96	See note	
011SP003	011SP00301 011SP00302	Upper Lower	10/16/96	See note	
011SP004	011SP00401	Upper	10/16/96	See note	Lower interval not sampled
011SP005	011SP00501 011SP00502	Upper Lower	10/16/96	See note	
011SP006	011SP00601 011SP00602 011SP00603	Upper Lower	10/17/96	See note	
011SP007	011SP00701 011SP00702	Upper Lower	10/16/96	See note	
011SP008	011SP00801	Upper	10/17/96	See note	Lower interval not sampled

Note:
SW-846 (metals) at DQO Level III; pH

10.8.3.1 DPT Results

Inorganic Elements in DPT Soil Samples

Twenty-three inorganic elements were detected in surface and subsurface DPT soil samples, at SWMU 11. Only one detection of thallium in surface soil exceeded the RBC or SSL and background concentrations. Surface soil sample 011SP002 exhibited a detection of 1.0 mg/kg which only slightly exceeded the RBC of 0.95 mg/kg.

pH in DPT Soil Samples

Surface soil DPT pH sample results ranged from 4.94 to 9.99. Subsurface pH results ranged from 4.63 to 12.6. Two samples were collected from a deeper saturated interval. These samples exhibited pH's of 7.21 and 11.7. Location 011SP006 exhibited the highest pH results in the second (12.6) and third (11.7) intervals. Appendix D contains the SWMU 11 DPT analytical results.

10.8.4 Soil Sampling and Analysis

The approved final RFI work plan proposed advancing five soil borings within the SWMU 11 area to detect the presence of any soil contamination from this site. Upper and lower interval soil samples were proposed from each boring. During the field investigation, five soil borings were advanced within the site area (Figure 10.8-1). Three borings included both upper and lower sampling intervals, while two borings included the upper interval only. Where not collected, the lower interval sample was not collected due to obstructions in the borehole, or because of the shallow water table. In accordance with the approved final RFI work plan, soil samples were analyzed for metals at DQO Level III, and pH. Several SWMU 11 samples were also analyzed for cyanides. Additionally, one upper interval duplicate soil sample was collected at SWMU 11 for Appendix IX analyses at DQO Level IV. Table 10.8.2 summarizes the SWMU 11 soil samples and analyses.

Table 10.8.2
Zone G
SWMU 11
Soil Samples and Analyses

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
011SB001	011SB00101 011SB00102	Upper Lower	8/28/96	Note 1/cyanide	
011SB002	011SB00201	Upper	8/28/96	Note 1/cyanide	Lower interval not sampled
011SB003	011SB00301 011CB00301* 011SB00302	Upper Lower	8/28/96	Note 1/cyanide Note 2	 *Duplicate sample

Table 10.8.2
Zone G
SWMU 11
Soil Samples and Analyses

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
011SB004	011SB00401	Upper	9/20/96	Note 1	Lower interval not sampled due to obstruction
011SB005	011SB00501 011SB00502	Upper Lower	9/20/96	Note 1	

Notes:
1 = SW-846 (metals) at DQO Level III; pH
2 = Appendix IX suite: Appendix IX (pesticides/PCBs, herbicides, SVOCs, VOCs); SW-846 (metals, dioxins, OP-pesticides); cyanide; hex-chrome at DQO Level IV
* = Duplicate sample

10.8.4.1 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.8.3. Inorganic analytical results for soil are summarized in Table 10.8.4. Table 10.8.5 summarizes all analytes detected in soil at SWMU 11. Appendix D contains a complete analytical data report for all Zone G samples collected.

Volatile Organic Compounds in Soil

Two VOCs, trichloroethene, and benzene were detected in the surface soil duplicate sample collected at SWMU 11, at concentrations far below the RBCs for these compounds.

Semivolatile Organic Compounds in Soil

No SVOCs were detected in the surface soil duplicate sample collected at SWMU 11.

Table 10.8.3
Zone G
SWMU 11
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
Volatile Organic Compounds (Upper Interval - 1 Duplicate Sample) (μg/kg)						
Benzene	Upper	1/1	3.00	3.00	22000	0
	Lower	0/0	NA	NA	30	0
Trichloroethene	Upper	1/1	3.00	3.00	58000	0
	Lower	0/0	NA	NA	60	0
Dioxins (Upper Interval - 1 Duplicate Sample) (ng/kg)						
Dioxin(2,3,7,8-TCDD TEQ)[1]	Upper	1/1	0.1004	0.1004	1000	0
	Lower	0/0	NA	NA	1900	0
pH (Upper Interval - 5 Samples plus 1 Duplicate Sample/Lower Interval - 3 Samples) (SU)						
pH	Upper	5/5	7.50 - 8.09	7.85	NA	NA
	Lower	3/3	4.93 - 8.21	6.48	NA	NA

Notes:

1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995b)

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples

ND = Not detected

NA = Not applicable

ng/kg = Nanograms per kilogram

μg/kg = Micrograms per kilogram

SU = Standard units

Table 10.8.4
Zone G
SWMU 11
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Inorganics (Upper Interval - 5 Samples plus 1 Duplicate Sample/Lower Interval - 3 Samples) (mg/kg)						
Aluminum (Al)	Upper	5/5	2050 - 7060	4620	7800	0
	Lower	3/3	2780 -11100	7580	1000000	0
Arsenic (As)	Upper	5/5	1.00 - 5.10	3.44	0.43	5
	Lower	3/3	1.80 - 4.30	3.10	29	0
Barium (Ba)	Upper	5/5	4.60 - 27.9	16.3	550	0
	Lower	3/3	11.1 - 41.8	25.1	1600	0
Beryllium (Be)	Upper	5/5	0.18 - 0.47	0.306	0.15	5
	Lower	3/3	0.19 - 0.53	0.343	63	0
Cadmium (Cd)	Upper	3/5	0.05 - 0.24	0.130	3.90	0
	Lower	3/3	0.13 - 0.24	0.183	8	0
Calcium (Ca)	Upper	5/5	4730 - 50050	16900	NL	NA
	Lower	3/3	1650 - 7180	3670	NL	NA
Chromium (Cr)	Upper	5/5	5.00 - 13.2	8.68	39.0	0
	Lower	3/3	6.20 - 14.0	10.9	1000000	0
Cobalt (Co)	Upper	5/5	1.00 - 1.50	1.18	470	0
	Lower	3/3	0.87 - 1.80	1.29	2000	0
Copper (Cu)	Upper	5/5	0.60 - 16.2	7.53	27000	0
	Lower	3/3	0.57 - 8.30	3.49	920	0

Table 10.8.4
Zone G
SWMU 11
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Cyanide (CN)	Upper	3/3	0.19 - 0.22	0.203	160	0
	Lower	½	0.15	0.150	40	0
Iron (Fe)	Upper	5/5	2660 - 9530	5450	2300	5
	Lower	3/3	3210 - 10800	8170	NL	NA
Lead (Pb)	Upper	5/5	3.00 - 1100	230	400	1
	Lower	3/3	14.2 - 18.0	16.4	400	0
Magnesium (Mg)	Upper	5/5	244 - 614	514	NL	NA
	Lower	3/3	534 - 847	664	NL	NA
Manganese (Mn)	Upper	5/5	9.70 - 46.7	35.9	180	0
	Lower	3/3	42.2 - 60.6	49.7	1100	0
Mercury (Hg)	Upper	3/5	0.05 - 0.20	0.117	2.30	0
	Lower	1/3	0.05	0.05	2.1	0
Nickel (Ni)	Upper	5/5	1.25 - 4.00	2.61	160	0
	Lower	3/3	2.00 - 3.50	2.67	130	0
Potassium (K)	Upper	3/5	77.0 - 221	154	NL	NA
	Lower	2/3	229 - 427	328	NL	NA
Selenium (Se)	Upper	2/5	0.56 - 1.10	0.830	39.0	0
	Lower	1/3	0.45	0.450	5	0
Sodium (Na)	Upper	3/5	164 - 647	356	NL	NA
	Lower	2/3	245 - 246	245.5	NL	NA

Table 10.8.4
Zone G
SWMU 11
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Tin (Sn)	Upper	2/5	6.00 - 6.10	6.05	4700	0
	Lower	1/3	6.80	6.80	11000	0
Vanadium (V)	Upper	5/5	6.05 - 16.3	10.5	55.0	0
	Lower	3/3	11.8 - 22.7	17.8	6000	0
Zinc (Zn)	Upper	5/5	6.70 - 48.6	24.4	2300	0
	Lower	3/3	11.9 - 41.5	22.2	12000	0

Notes:

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples

NL = Not listed

NA = Not applicable

mg/kg = Milligrams per kilogram

Table 10.8.5
Zone G
SWMU 11
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Volatile Organic Compounds (μg/kg)							
Trichloroethene	011SB003	3	58000	NA	NT	60	NA
Benzene	011SB003	3	22000	NA	NT	30	NA
Dioxins (ng/kg)							
Dioxin (2,3,7,8-TCDD TEQs)[1]	011SB003	0.1004	1000	NA	ND	1900	NA
pH (SU)							
pH	011SB001	7.85	NA	NA	6.3	NA	NA
	011SB002	7.87			NT		
	011SB003	7.50			4.93		
	011SB004	7.94			NT		
	011SB005	8.09			8.21		
Inorganics (mg/kg)							
Aluminum (Al)	011SB001	6260	7800.0	18700	11100	1000000	23600
	011SB002	3750			NT		
	011SB003	2050			8860		
	011SB004	7060			NT		
	011SB005	4000			2780		
Arsenic (As)	011SB001	4.3	0.43	17.2[a]	3.2	29	15.5[a]
	011SB002	1			NT		
	011SB003	4.1			4.3		
	011SB004	5.1			NT		
	011SB005	2.7			1.8		

Table 10.8.5
Zone G
SWMU 11
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Barium (Ba)	011SB001	25.1	550.0	109	22.5	1600	64.5
	011SB002	4.6			NT		
	011SB003	7.95			41.8		
	011SB004	27.9			NT		
	011SB005	16			11.1		
Beryllium (Be)	011SB001	0.35	0.15	1.20	0.18	63	1.63
	011SB002	0.18			NT		
	011SB003	0.29			0.53		
	011SB004	0.47			NT		
	011SB005	0.24			0.19		
Cadmium (Cd)	011SB001	0.24	3.9	1.07	0.18	8	0.48
	011SB003	0.05			0.24		
	011SB005	0.1			0.13		
Calcium (Ca)	011SB001	14900	NL	NL	1650	NL	NL
	011SB002	4730			NT		
	011SB003	50050			2190		
	011SB004	5390			NT		
	011SB005	9600			7180		
Chromium (Cr)	011SB001	13.2	39 VI	42.8	14	1000000	43.4[a]
	011SB002	5	7800 III		NT		
	011SB003	5.6			12.5		
	011SB004	10.4			NT		
	011SB005	9.2			6.2		

Table 10.8.5
Zone G
SWMU 11
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Cobalt (Co)	011SB001	1.2	470.0	6.60	1.2	2000	8.14
	011SB002	1			NT		
	011SB003	1			1.8		
	011SB004	1.5			NT		
	011SB005	1.2			0.87		
Copper (Cu)	011SB001	16.2	27000	260	0.57	920	32.6
	011SB002	0.6			NT		
	011SB003	1.34			1.6		
	011SB004	8.6			NT		
	011SB005	10.9			8.3		
Cyanide	011SB001	0.22	160	0.38	0.15	40	0.22
	011SB002	0.19			NT		
	011SB003	0.2			ND		
Iron (Fe)	011SB001	**7100**	2300	NL	10500	NL	NL
	011SB002	**2660**			NT		
	011SB003	**3795**			10800		
	011SB004	**9530**			NT		
	011SB005	**4160**			3210		
Lead (Pb)	011SB001	**1100**	400.0	181	17.1	400	66.3
	011SB002	3			NT		
	011SB003	3.55			14.2		
	011SB004	15.5			NT		
	011SB005	29			18		

Table 10.8.5
Zone G
SWMU 11
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Magnesium (Mg)	011SB001	614	NL	NL	847	NL	NL
	011SB002	244			NT		
	011SB003	593.5			612		
	011SB004	541			NT		
	011SB005	577			534		
Manganese (Mn)	011SB001	39.3	180.0	325	42.2	1100	291
	011SB002	9.7			NT		
	011SB003	42.65			60.6		
	011SB004	46.7			NT		
	011SB005	41.2			46.2		
Mercury (Hg)	011SB001	0.1	2.3	1.03	ND	2.1	0.31
	011SB004	0.05			NT		
	011SB005	0.2			0.05		
Nickel (Ni)	011SB001	4	160.0	20.6	2	130	18.3
	011SB002	1.8			NT		
	011SB003	1.25			2.5		
	011SB004	2.4			NT		
	011SB005	3.6			3.5		
Potassium (K)	011SB001	221	NL	NL	427	NL	NL
	011SB002	77			NT		
	011SB003	163			229		
Selenium (Se)	011SB004	1.1	39.0	1.22	NT	5	1.26
	011SB005	0.56			0.45		
Sodium (Na)	011SB001	258	NL	NL	245	NL	NL
	011SB002	164			NT		
	011SB003	647			246		

Table 10.8.5
Zone G
SWMU 11
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Tin (Sn)	011SB004	6	4700	9.67	NT	11000	2.96
	011SB005	6.1			6.8		
Vanadium (V)	011SB001	14.6	55.0	60.9	22.7	6000	72.4
	011SB002	6.4			NT		
	011SB003	6.05			18.9		
	011SB004	16.3			NT		
	011SB005	9.2			11.8		
Zinc (Zn)	011SB001	48.6	2300.0	519	11.9	12000	145
	011SB002	6.7			NT		
	011SB003	10.25			13.3		
	011SB004	18.6			NT		
	011SB005	37.8			41.5		

Notes:

a = Background value for non-clay samples
* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples
1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c)
ND = Not detected
NT = Not taken
NL = Not listed
NA = Not applicable
SU = Standard units
Bolded concentrations exceed both the reference concentration (RBC or SSL) and the zone background
All background values for Zone G are based on twice the means of the grid sample concentrations

Pesticides and PCBs in Soil

No pesticides or PCBs were detected in the surface soil duplicate sample collected at SWMU 11.

Other Organic Compounds in Soil

Dioxin (2,3,7,8-TCDD TEQ) was detected in the surface soil duplicate sample below the RBC for this parameter.

pH in Soil

The five surface soil samples collected at SWMU 11 had a mean pH of slightly above neutral. The mean pH of the three subsurface soil samples collected at SWMU 11 had a mean pH of slightly below neutral.

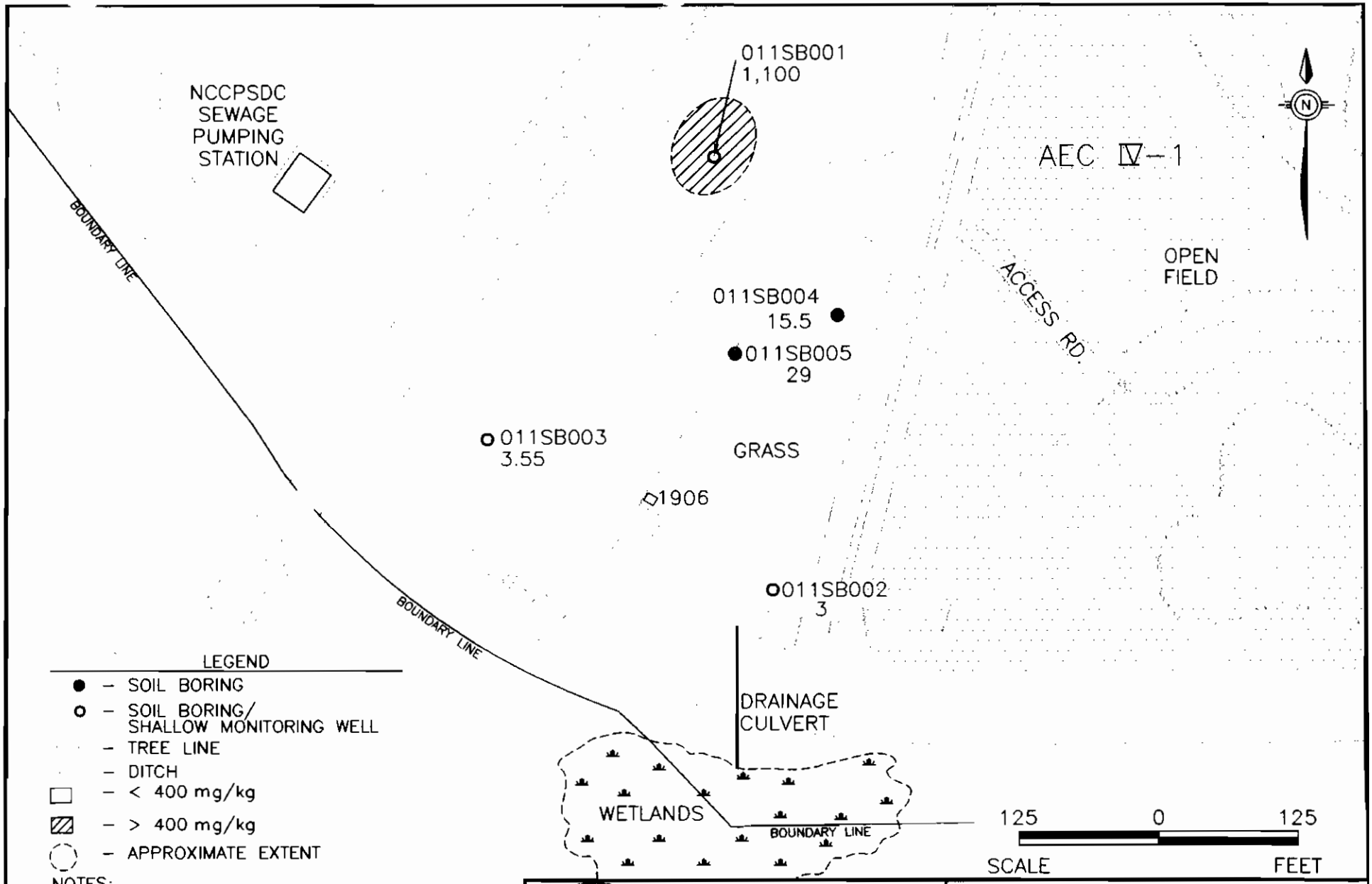
Inorganic Elements in Soil

Twenty-one metals plus cyanide were detected in surface soil samples collected at SWMU 11. Lead was detected at a concentration exceeding its respective RBC and background concentration for Zone G surface soil at one location. Figure 10.8-4 presents the lead concentrations detected in surface soil. Iron was also detected at concentrations which exceeded its RBC. Because iron is considered an essential nutrient, no background was determined.

Twenty-one metals plus cyanide were detected in subsurface soil samples collected at SWMU 11, at concentrations far below their respective SSLs and background concentrations for Zone G subsurface soil.

10.8.5 Sediment Sampling and Analysis

The approved final RFI work plan also proposed collection of two sediment samples at SWMU 11, to assess the impact of surface runoff to nearby wetlands. During the field investigation, two sediment samples were collected, one from the drainage culvert located on the south side of the



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8-4
LEAD IN SURFACE SOIL
SWMU #11
CAUSTIC POND

DWG DATE: 02/10/98 | DWG NAME: 2907M048

site, and another from an adjacent wetland area where the culvert discharges (Figure 10.8-1). In accordance with the approved final RFI work plan, these samples were analyzed for metals at DQO Level III, and pH. Table 10.8.6 summarizes the SWMU 11 sediment sampling and analyses.

Table 10.8.6
Zone G
SWMU 11
Sediment Samples and Analyses

Sample Location	Sample Identifier	Date Collected	Analyses	Remarks
011M0001	011M000101	9/26/96	See note	No deviations from work plan.
011M0002	011M000201	9/26/96	See note	

Note:
SW-846 (metals) at DQO Level III; pH

10.8.5.1 Nature of Contamination in Sediment

Inorganic analytical results for sediment are summarized in Table 10.8.7. Table 10.8.8 summarizes all analytes detected in sediment at SWMU 11. Appendix D contains a complete analytical data report for all Zone G samples collected.

Table 10.8.7
Zone G
SWMU 11
Analytical Results for Sediment

Parameters	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	SSVs (mg/kg)	Number of Samples Exceeding SSVs
Inorganics (2 Samples)					
Aluminum (Al)	2/2	2960 - 3180	3070	NL	NA
Arsenic (As)	2/2	1.40 - 1.60	1.50	7.24	0
Barium (Ba)	2/2	7.30 - 15.7	11.5	NL	NA
Cadmium (Cd)	2/2	0.09 - 0.13	0.11	1.0	0

Table 10.8.7
Zone G
SWMU 11
Analytical Results for Sediment

Parameters	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	SSVs (mg/kg)	Number of Samples Exceeding SSVs
Calcium (Ca)	2/2	7310 - 35000	21200	NL	NA
Chromium (Cr)	2/2	5.60 - 6.70	6.15	52.3	0
Cobalt (Co)	2/2	1.10 - 1.20	1.15	NL	NA
Iron (Fe)	2/2	2940 - 3180	3060	NL	NA
Lead (Pb)	2/2	6.30 - 21.0	13.7	30.2	0
Magnesium (Mg)	2/2	284 - 565	425	NL	NA
Manganese (Mn)	2/2	12.8 - 38.7	25.8	NL	NA
Mercury (Hg)	2/2	0.05 - 2.10	1.08	0.13	1
Silver (Ag)	2/2	0.40 - 0.42	0.41	2.0	0
Vanadium (V)	2/2	5.50 - 6.80	6.15	NL	NA
pH (2 Samples)(SU)					
pH	2/2	7.83 - 12.0	9.92	NL	NA

Notes:
mg/kg = Milligrams per kilogram
NL = Not listed
NA = Not available
SSV = Sediment Screening Value
SSVs from *Supplemental Guidance to RAGs: Region IV Bulletins, Ecological Risk Assessment, Bulletin 2* (USEPA, 1995a)

Table 10.8.8
Zone G
SWMU 11
Analytes Detected in Sediment Samples

Parameters	Location	Concentration	SSVs
Inorganics (mg/kg)			
Aluminum (Al)	011M0001	2960	NL
	011M0002	3180	
Arsenic (As)	011M0001	1.6	7.24
	011M0002	1.4	
Barium (Ba)	011M0001	15.7	NL
	011M0002	7.3	
Cadmium (Cd)	011M0001	0.13	1.0
	011M0002	0.09	
Calcium (Ca)	011M0001	35000	NL
	011M0002	7310	
Chromium (Cr)	011M0001	6.7	52.3
	011M0002	5.6	
Cobalt (Co)	011M0001	1.2	NL
	011M0002	1.1	
Iron (Fe)	011M0001	3180	NL
	011M0002	2940	
Lead (Pb)	011M0001	21	30.2
	011M0002	6.3	
Magnesium (Mg)	011M0001	565	NL
	011M0002	284	
Manganese (Mn)	011M0001	38.7	NL
	011M0002	12.8	
Mercury (Hg)	011M0001	**2.1**	0.13
	011M0002	0.05	
Silver (Ag)	011M0001	0.4	2.0
	011M0002	0.42	
Vanadium (V)	011M0001	6.8	NL
	011M0002	5.5	
pH (SU)			
pH	011M0001	12	NL
	011M0002	7.83	

Notes:
µg/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
NA = Not available
SSV = Sediment Screening Value
Bolded concentrations exceed the SSV
SSVs from *Supplemental Guidance to RAGs: Region IV Bulletins, Ecological Risk Assessment, Bulletin 2* (USEPA, 1995a).

Inorganic Elements in Sediment

Fourteen metals were detected in sediment samples collected at SWMU 11. Mercury was detected at a concentration exceeding the SSV in one sample. Figure 10.8-5 presents the mercury concentrations detected in sediment at SWMU 11.

pH in Sediment

Of the two sediment samples collected at SWMU 11, sample 011M0001 exhibited a pH of 12. The pH of sample 011M0002 was slightly above neutral, at 7.83.

10.8.6 Groundwater Sampling and Analysis

The approved final RFI work plan proposed the installation and sampling of three shallow monitoring wells within the SWMU 11 area to identify contaminants which may be migrating from the site in the shallow aquifer. During the field investigation, three wells were installed at this site (Figure 10.8-1). These wells were installed at approximately 12 ft bgs in the upper sand layer of the Wando Formation. In accordance with the approved final RFI work plan, groundwater samples from this site were analyzed for metals at DQO Level III, and pH. Table 10.8.9 summarizes groundwater sampling and analyses at this site.

Table 10.8.9
Zone G
SWMU 11
Groundwater Samples and Analyses

Well Number	Well Depth	Sample Identifier	Date Sampled	Analyses	Remarks
011001	Shallow	011GW00101	11/11/96	See note	No deviations from work plan.
011002	Shallow	011GW00201	11/11/96	See note	
011003	Shallow	011GW00301	11/11/96	See note	

Note:
SW-846 (metals) at DQO Level III; pH.

10.8.6.1 Nature of Contamination in Groundwater

Inorganic and pH analytical results for groundwater are summarized in Table 10.8.10. Table 10.8.11 summarizes all analytes detected in groundwater at SWMU 11. Appendix D contains a complete analytical data report for all Zone G samples collected.

Inorganic Elements in Groundwater

Fourteen metals were detected in the first-quarter groundwater samples collected at SWMU 11. Iron was the only first-quarter detection which exceeded the respective tap water RBC. Because iron is considered an essential nutrient, no background concentration was generated for this analyte.

pH in Groundwater

pH in the SWMU 11 groundwater samples had a mean detection of slightly below neutral.

10.8.7 Fate and Transport Assessment

A RFI site, SWMU 11 is currently an open space, landscaped with grass. Environmental media sampled as part of the SWMU 11 investigation included surface soil, subsurface soil, sediments, and groundwater. Potential constituent migration pathways investigated for SWMU 11 include soil-to-groundwater, groundwater-to-surface water, surface soil-to-sediment, and emission of volatiles from surface soil to air.

10.8.7.1 Soil-to-Groundwater Cross-Media Transport

Table 10.8.12 compares maximum detected organic compound concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels or (b) background concentrations. To provide a conservative screen generic soil

Table 10.8.10
Zone G
SWMU 11
Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μg/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding RBC
Inorganics (3 Shallow Samples) (μg/L)							
Aluminum (Al)	*Shallow*	3/3	60.2 - 997	625	3700	50	0
Arsenic (As)	Shallow	3/3	3.30 - 9.00	5.57	0.045	50	3
Barium (Ba)	Shallow	3/3	14.9 - 91.0	42.6	260	2000	0
Calcium (Ca)	Shallow	3/3	63400 - 108000	90800	NL	NL	NA
Cobalt (Co)	Shallow	2/3	1.20 - 2.90	2.05	220	NL	0
Iron (Fe)	Shallow	3/3	487 - 26500	9290	1100	300	NA
Magnesium (Mg)	Shallow	3/3	3380 - 34300	15100	NL	NL	NA
Manganese (Mn)	Shallow	3/3	23.1 - 1130	449	84	50	2
Mercury (Hg)	Shallow	1/3	0.19	0.19	1.1	2	0
Nickel (Ni)	*Shallow*	1/3	19.0	19.0	73	100	0
Potassium (K)	Shallow	3/3	1610 - 12100	5730	NL	NL	NA
Sodium (Na)	Shallow	3/3	34200 - 201000	132000	NL	NL	NA
Vanadium (V)	Shallow	3/3	0.89 - 4.20	2.00	26	NL	0
Zinc (Zn)	Shallow	2/3	6.30 - 8.60	7.45	1100	5000	0

Table 10.8.10
Zone G
SWMU 11
Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μg/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding RBC
pH (3 Shallow Samples) (SU)							
pH	Shallow	3/3	6.48 - 7.5	6.97	NL	NL	NA

Notes:
* = Tap Water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996d)
μg/L = Micrograms per liter
NL = Not listed
NA = Not applicable
SU = Standard units

Table 10.8.11
Zone G
SWMU 11
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Inorganics (μg/L)							
Aluminum (Al)	011001	60.2	ND	70.6	3700	50	692
	011002	817	1340	75			
	011003	997	211	197			
Arsenic (As)	011001	4.4	ND	ND	0.045	50	17.8
	011002	3.3	5.0	3.7			
	011003	9	**36.3**	**50.1**			
Barium (Ba)	011001	21.8	18.1	42	260	2000	31
	011002	14.9	12.4	ND			
	011003	91	84.8	109			
Beryllium (Be)	011001	ND	**0.2**	**0.2**	0.016	4	NL
	011002	ND	**0.25**	ND			
	011003	ND	**0.24**	**0.21**			
Cadmium (Cd)	011003	ND	0.42	ND	1.8	5	0.53
Calcium (Ca)	011001	63400	60900	107000	NL	NL	NL
	011002	101000	93500	103000			
	011003	108000	178000	169000			
Chromium (Cr)	011001	ND	ND	1.1	18	100	3.88
Cobalt (Co)	011001	1.2	1.4	ND	220	NL	1.45
	011003	2.9	ND	0.83			
Copper (Cu)	011001	ND	ND	1.5	13000	1300	8.33
	011002	ND	32.6	ND			

Table 10.8.11
Zone G
SWMU 11
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Iron (Fe)	011001	487	**1220**	ND	1100	300	NL
	011002	889	**1940**	525			
	011003	**26500**	**22100**	**17700**			
Magnesium (Mg)	011001	34300	30700	ND	NL	NL	NL
	011002	3380	3140	ND			
	011003	7560	16300	ND			
Manganese (Mn)	011001	194	186	13.3	84	50	2906
	011002	23.1	12.5	16.4			
	011003	1130	1570	1390			
Mercury (Hg)	011002	ND	0.2	ND	1.1	2	NL
	011003	0.19	0.14	ND			
Nickel (Ni)	011001	ND	ND	0.8	73	100	4.08
	011003	19	7.7	7.1			
Potassium (K)	011001	12100	10500	ND	NL	NL	NL
	011002	1610	1350	ND			
	011003	3470	7520	8970			
Selenium (Se)	011001	ND	ND	5.4	18	50	4.3
Sodium (Na)	011001	162000	128000	ND	NL	NL	NL
	011002	34200	17900	ND			
	011003	201000	131000	ND			
Thallium (Tl)	011002	ND	**5.1**	**ND**	0.29	2	NL

Table 10.8.11
Zone G
SWMU 11
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Vanadium (V)	011001	4.2	2.6	3.7	26	NL	15.4
	011002	0.89	2.1	1.3			
	011003	0.92	1.5	1.9			
Zinc (Zn)	011002	8.6	ND	ND	1100	5000	15.6
	011003	6.3	ND	ND			
pH (SU)							
pH	011001	6.48	6.51	6.70	NL	NL	NL
	011002	7.50	7.68	7.31			
	011003	6.94	6.99	6.93			

Notes:
NL = Not listed
ND = Not detected
SU = Standard units
μg/L = Micrograms per liter
* = Tap Water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996d)
Bolded concentrations exceed both the RBC and the zone background
All background values for Zone G are based on twice the means of the grid sample concentrations. Background values for groundwater are based on two sampling rounds in two wells at each depth

Table 10.8.12
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Saltwater Surface Water Chronic Screening Levels, and Background Concentrations
NAVBASE Charleston, Zone G: SWMU 11
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Saltwater Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Benzene	3	NA	NA	NA	30	0.36	109	UG/KG	UG/L	NO	NO	NO
Trichloroethene	3	NA	NA	NA	60	1.6	NA	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	0.1004	NA	NA	NA	1900	0.45	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	7060	11100	997	NA	1000000	37000	NA	MG/KG	UG/L	NO	NO	NO
Arsenic	5.1	4.3	9	NA	29	17.8	36	MG/KG	UG/L	NO	NO	NO
Barium	27.9	41.8	91	NA	1600	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	0.47	0.53	ND	NA	63	0.016	NA	MG/KG	UG/L	NO	NO	NO
Cadmium	0.24	0.24	ND	NA	8	18	9.3	MG/KG	UG/L	NO	NO	NO
Chromium (total)	13.2	14	ND	NA	1000000	180	50	MG/KG	UG/L	NO	NO	NO
Cobalt	1.5	1.8	2.9	NA	2000	2200	NA	MG/KG	UG/L	NO	NO	NO
Copper	16.2	8.3	ND	NA	920	130000	8.33	MG/KG	UG/L	NO	NO	NO
Cyanide	0.22	0.15	NA	NA	40	730	3.8	MG/KG	UG/L	NO	NO	NO
Lead	1100	18	ND	NA	400	15	8.5	MG/KG	UG/L	YES	NO	NO
Manganese	46.7	60.6	1130	NA	1100	2906	NA	MG/KG	UG/L	NO	NO	NO
Mercury	0.2	0.05	0.19	NA	2.1	11	0.025	MG/KG	UG/L	NO	NO	YES
Nickel	4	3.5	19	NA	130	730	21.7	MG/KG	UG/L	NO	NO	NO
Selenium	1.1	0.45	ND	NA	5	180	71	MG/KG	UG/L	NO	NO	NO
Tin	6.1	6.8	ND	NA	11000	22000	NA	MG/KG	UG/L	NO	NO	NO
Vanadium	16.3	22.7	4.2	NA	6000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	48.6	41.5	8.6	NA	12000	11000	86	MG/KG	UG/L	NO	NO	NO

Notes
* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 20, from 1996 Soil Screening Guidance or calculated using values from Table 6.4
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, October 22, 1997
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region IV Bulletins, Ecological Risk Assessment, November, 1995, Table 2
For inorganics, the value shown is the greater of the relevant screening value or the corresponding background value.

NA - Not available/Not applicable
ND - Not detected
RBC - Risk based concentration
SSL - Soil screening level
MG/KG - Milligrams per kilogram
NG/KG - Nanograms per kilogram
PG/L - Picograms per liter
UG/KG - Micrograms per kilogram
UG/L - Micrograms per liter

screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 20:1, with no attenuation of constituents in soil (DAF=20).

No organic compounds were detected in SWMU 11 surface soil at concentrations exceeding groundwater protection SSLs. One inorganic — lead — was detected in SWMU 11 surface soil at location 011SB001 at concentrations exceeding groundwater protection SSLs. The levels detected in subsurface soil, however, did not exceed the applicable SSL. The concentration of the single lead exceedance (1100 mg/kg) is approximately three times the applicable SSL for soil, and should be considered significant in evaluating this pathway. The relationship of lead to the caustic pond operation can not be determined at this time. Historical practices noted do not include metals as potential contaminants. The presence of lead could possibly represent secondary enrichment due to mobilization/reprecipitation as high pH leachate migrated downward through the surface and subsurface soil, but the absence of other inorganics which would be expected to react similarly to lead, some other provenance is suggested. Based on the limited exceedance for lead in the surface soil, the volume of contaminated soil is expected to be small. The lack of exceedance of the applicable SSL in subsurface soil indicates that the migration pathway of soil-to-groundwater for lead is insignificant. It should be noted that leachate exhibiting elevated pH levels could transport lead as it traveled from surface soil to subsurface soil, but the more likely scenario for those conditions is the adsorption/reprecipitation of the lead in the subsurface soil before it reaches groundwater. Specifically, at SWMU 11, the threat to human health from elevated lead in surface soil is greater than the threat to groundwater.

10.8.7.2 Soil-to-Air Cross-Media Transport

Table 10.8.13 lists the VOCs that were detected in surface soil samples collected at SWMU 11, along with the corresponding soil-to-air volatilization screening criteria. No VOCs were detected in surface soil at SWMU 11, consequently, the soil-to-air migration pathway is not considered valid.

Table 10.8.13
Soil-to-Air Volatilization Screening Analysis
NAVBASE Charleston, Zone G: SWMU 11
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Benzene	3	800	UG/KG	NO
Trichloroethene	3	5000	UG/KG	NO

Notes:
* - Soil screening levels for transfers from soil to air were obtained from USEPA Soil Screening Guidance, Technical Background Document Appendix A, May 1996 (first preference) or from Soil Screening Levels - Transfers from Soil to Air, USEPA Region III Risk-Based Concentration Table, June 1996.
NA - Not available

10.8.7.3 Groundwater-to-Surface Water Cross-Media Transport

Table 10.8.12 also compares maximum detected organic compound concentrations in shallow groundwater samples to risk-based concentrations for drinking water and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background concentrations for groundwater, as well as to saltwater surface water chronic values. To provide a conservative screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

No organics exceed either the tap water RBC or the saltwater to surface water chronic screening levels in groundwater at SWMU 11. One inorganic - mercury - exceeded the surface water screening levels. Mercury was detected in 2 wells (011002 and 011003) during the first two quarters of groundwater monitoring, but was not-detect in all wells for the third-quarter. The groundwater-to-surface water migration pathway is considered invalid due to the absence of mercury in the third-quarter sampling event.

10.8.7.4 SWMU 11 Surface Soil-to-Sediment Cross-Media Transport

Table 10.8.8 lists the analytes detected in sediment samples collected as part of the SWMU 11 investigation. Sediments at SWMU 11 are associated with an open drainage ditch which feeds, via the culvert under Bainbridge Avenue, into the adjacent wetland. The inorganics detected were similar at both sediment sampling locations. Aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, manganese, mercury, and vanadium were detected in both surface soil and sediment. Notably, the concentration levels of inorganics decrease from location 011M0001 to 011M0002, indicating either a) 011M0001 is more proximal to the source of these metals, or b) the engineering design effectiveness or the drainage system is more efficient at 011M0001, thus acting as a collection basin and in essence a contaminant sink. The attribution of contaminant input from

SWMU 11 to sediment is unclear as to proportion. The site is currently unpaved, and the inorganic detections in both surface soil and sediment are similar in nature. These two factors suggest that the surface soil-to-sediment migration pathway has some validity.

10.8.7.5 Fate and Transport Summary

No organics and only one inorganic, lead was detected in the surface soil at concentrations that exceeded the applicable SSL. While one exceedance for lead was significant (3 times the SSL), the threat to groundwater is considered insignificant due to the absence of lead exceedances in subsurface soil and its absence in site groundwater. Lead contamination is not consistent with the historical activities at this SWMU, but the concentrations noted could represent a secondary enrichment due to the mobilization/reprecipitation as high pH leachate migrated through the soil. The absence of other metals at elevated levels in these samples however, suggest some other provenance. Only one inorganic in groundwater exceeded the surface water screening levels at this SWMU. Mercury was detected in two of the three monitoring wells sampled at SWMU 11 during the first two quarters, but was not detected during the last quarter in any of the wells. Therefore, the groundwater-to-surface water migration pathway is considered invalid. The majority of inorganic constituents were detected in both surface soil and sediment samples. The concentrations of inorganics at location 011M0001, which is closest to SWMU 11, are consistently higher than those at location 011M0002. However, without additional data, it is conjectural to attribute percentages of the sediment load to SWMU 11. However, the site is unpaved (exposed surface soil); this and the similar nature of contaminants in both surface soil and sediments suggest that the surface soil-to-sediment migration pathway is valid. No VOCs were detected above the soil-to-air volatilization screening levels, thus the soil-to-air pathway is not significant.

10.8.8 Human Health Risk Assessment

10.8.8.1 Site Background and Investigative Approach

SWMU 11 consists of an open, grass-covered area near the junction of Bainbridge Avenue and Viaduct Road. The site was formerly a settling pond used for the disposal of calcium hydroxide generated as a byproduct of the production of acetylene gas.

During the RFI, five soil samples were collected from each of the upper and lower intervals to identify potential impacts resulting from the activities listed above. Surface soil samples from all five boring locations were used to quantitatively assess direct contact soil exposure pathways. Indirect exposure to contaminants associated with subsurface soil is addressed in the previous section, Fate and Transport Assessment for SWMU 11. Three monitoring wells were installed in the shallow aquifer. Data from the first-quarter sampling event were used to quantitatively assess groundwater exposure pathways. Sections 10.8.4 and 10.8.6 provide summaries of the sampling effort for SWMU 11 soil and groundwater.

10.8.8.2 COPC Identification

Soil

Based on the screening comparisons described in Section 7 of this RFI and presented in Table 10.8.14, lead was the only COPC identified in surface soil at SWMU 11.

Groundwater

As shown in Table 10.8.15, no COPCs were identified for shallow groundwater at SWMU 11.

Table 10.8.14
Chemicals Present in Site Samples
SWMU 11 - Surface Soil
Naval Base Charleston, Zone G
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Residential RBC	Screening Concentration Background	Units	Number Exceeding RBC	Number Exceeding Bkgd
TCDD Equivalents												
1234678-HpCDD	1	1	4.46	4.46	4.46	NA	NA	NA	NA	NG/KG		
1234678-HpCDF	1	1	1.53	1.53	1.53	NA	NA	NA	NA	NG/KG		
Dioxin Equiv.	1	1	0.1004	0.1004	0.1004	NA	NA	1000	NA	NG/KG		
OCDD	1	1	38.2	38.2	38.2	NA	NA	NA	NA	NG/KG		
OCDF	1	1	2.27	2.27	2.27	NA	NA	NA	NA	NG/KG		
Inorganics												
Aluminum (Al)	5	5	2050	7060	4624	NA	NA	7800	18700	MG/KG		
Arsenic (As)	5	5	1	5.1	3.44	NA	NA	0.43	17.2	MG/KG	5	
Barium (Ba)	5	5	4.6	27.9	16.31	NA	NA	550	109	MG/KG		
Beryllium (Be)	5	5	0.18	0.47	0.306	NA	NA	0.15	1.2	MG/KG	5	
Cadmium (Cd)	3	5	0.05	0.24	0.13	0.05	0.12	3.9	1.07	MG/KG		
Calcium (Ca)	5	5	4730	50050	16934	NA	NA	NA	NA	MG/KG		
Chromium (Cr)	5	5	5	13.2	8.68	NA	NA	39	42.8	MG/KG		
Cobalt (Co)	5	5	1	1.5	1.18	NA	NA	470	6.6	MG/KG		
Copper (Cu)	5	5	0.6	16.2	7.528	NA	NA	27000	260	MG/KG		
Cyanide (CN)	3	3	0.19	0.22	0.2033	NA	NA	160	0.38	MG/KG		
Iron (Fe)	5	5	2660	9530	5449	NA	NA	NA	NA	MG/KG		
Lead (Pb) *	5	5	3	1100	230.21	NA	NA	400	181	MG/KG	1	1
Magnesium (Mg)	5	5	244	614	513.9	NA	NA	NA	NA	MG/KG		
Manganese (Mn)	5	5	9.7	46.7	35.91	NA	NA	180	325	MG/KG		
Mercury (Hg)	3	5	0.05	0.2	0.1167	0.04	0.04	2.3	1.03	MG/KG		
Nickel (Ni)	5	5	1.25	4	2.61	NA	NA	160	20.6	MG/KG		
Potassium (K)	3	5	77	221	153.6667	231	233	NA	NA	MG/KG		
Selenium (Se)	2	5	0.56	1.1	0.83	0.32	0.37	39	1.22	MG/KG		
Sodium (Na)	3	5	164	647	356.3333	158	305	NA	NA	MG/KG		
Tin (Sn)	2	5	6	6.1	6.05	1	1.9	4700	9.67	MG/KG		
Vanadium (V)	5	5	6.05	16.3	10.51	NA	NA	55	60.9	MG/KG		
Zinc (Zn)	5	5	6.7	48.6	24.39	NA	NA	2300	519	MG/KG		
Volatile Organics												
Benzene	1	1	3	3	3	NA	NA	22000	NA	UG/KG		
Trichloroethene	1	1	3	3	3	NA	NA	58000	NA	UG/KG		

Notes:
* - Indicates chemical was identified as a COPC
SQL - Sample quantitation limit
RBC - Risk-based concentration
UG/KG - micrograms per kilogram
NG/KG - nanograms per kilogram
MG/KG - milligrams per kilogram
NA - Not applicable or not available

Table 10.8.15
Chemicals Present in Site Samples
SWMU 11 - Groundwater
Naval Base Charleston, Zone G
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Tap Water RBC	Screening Concentration Background	Units	Number Exceeding RBC	Number Exceeding Bkgd
Inorganics												
Aluminum (Al)	3	3	60.2	997	625	NA	NA	3700	692	UG/L		2
Arsenic (As)	3	3	3.3	9	5.6	NA	NA	0.045	17.8	UG/L	3	
Barium (Ba)	3	3	14.9	91	43	NA	NA	260	31	UG/L		1
Calcium (Ca)	3	3	63400	108000	90800	NA	NA	NA	NA	UG/L		
Cobalt (Co)	2	3	1.2	2.9	2.1	0.9	0.9	220	1.45	UG/L		1
Iron (Fe)	3	3	487	26500	9292	NA	NA	NA	NA	UG/L		
Magnesium (Mg)	3	3	3380	34300	15080	NA	NA	NA	NA	UG/L		
Manganese (Mn)	3	3	23.1	1130	449	NA	NA	84	2906	UG/L	2	
Mercury (Hg)	1	3	0.19	0.19	0.19	0.1	0.1	1.1	NA	UG/L		
Nickel (Ni)	1	3	19	19	19	2.4	2.5	73	4.08	UG/L		1
Potassium (K)	3	3	1610	12100	5727	NA	NA	NA	NA	UG/L		
Sodium (Na)	3	3	34200	201000	132400	NA	NA	NA	NA	UG/L		
Vanadium (V)	3	3	0.89	4.2	2	NA	NA	26	15.4	UG/L		
Zinc (Zn)	2	3	6.3	8.6	7.5	5.3	5.3	1100	15.6	UG/L		

Notes:
SQL - Sample quantitation limit
RBC - Risk-based concentration
UG/L - micrograms per liter
NA - Not applicable or not available

10.8.8.3 Toxicity Assessment

Lead has been classified as a group B2 carcinogen by USEPA based on animal data. No RfD or SF has been set by USEPA. However, an action level for soil protective of child residents has been proposed by USEPA Region IV: 400 mg/kg. USEPA's Office of Water has established a treatment technique action level of 15 μg/L. As listed in IRIS, the classification is base on sufficient animal evidence. Ten rat bioassays and one mouse assay have shown statistically significant increases in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Animal assays provide reproducible results in several laboratories, in multiple rat strains with some evidence of multiple tumor sites. Short-term studies show that lead affects gene expression. Human evidence is inadequate. An RfD and SF have not been set because of the confounding nature of lead toxicity. Lead can accumulate in bone marrow, and effects have been observed in the CNS, blood, and mental development of children. RfDs are based on the assumption that a threshold must be exceeded to result in toxic effects (other than carcinogenicity). Once lead accumulates in the body, other influences cause the actual levels in the blood to fluctuate – sometimes the lead is attached to binding sites; sometimes lead is free flowing. If an exposed individual has previously been exposed to lead, this individual could lose weight and set fat-bound lead free. This fluctuation and lack of previous lead exposure data are two of the reasons lead effects are difficult to predict (Klaassen et al., 1986).

10.8.8.4 Lead Model

Background

Currently, USEPA has not established an oral SF or reference dose for lead. USEPA believes that the available studies in animals and humans do not provide sufficient quantitative information for their calculation. Although lead is currently classified as a B2 carcinogen, USEPA considers the noncarcinogenic neurotoxic effects in children to be the critical toxic effect with respect to establishing health-based environmental cleanup objectives. The neurotoxic effects of chronic low-level lead exposure in children may occur at blood levels as low as 10 μg/dL.

In the absence of lead health criteria, USEPA Region IV's Office of Health Assessment sanctions the use of the Lead Uptake/Biokinetics Model (Version 0.99d) (Lead Model) to predict mean blood lead levels in children based on exposure to impacted environmental media. The model was used to assess the potential health effects of elevated lead levels reported in surface soil at SWMU 11.

Future Residential Scenario

The Lead Model default concentrations are used for exposure to air (0.1 Pb grams per cubic meter [g/m^3]) and maternal blood lead level (2.5 Pb per μg/dL). In the case of SWMU 11 surface soil, an area of elevated lead concentration was reported for as surface soil sample 011SB001 located at the northern perimeter of the site. There were no sample collected to the north of 011SB001 and so the total area impacted is somewhat uncertain at this time. As a result, the maximum surface soil lead concentration (1,100 mg/kg) was used as the input for soil and house dust. Lead was not detected in first-quarter groundwater samples, and as a result, the Lead Model default concentration (4 μg/L) and was used as the input for drinking water. The Lead Model was run for a child ages 0-7 years using the inputs listed above. Table 10.8.16 summarizes the Lead Model results under these exposure conditions.

Figure 10.8-6 shows the probability percentage of blood lead levels for a child 0 to 7 years old. Based on this model output using the maximum soil lead concentration and the remaining Lead Model defaults, the geometric mean blood concentration is estimated to be 11.4 μg/dL, and the probability of blood lead concentration exceeding 10 μg/dL is 58.3%. USEPA generally considers that media concentrations resulting in probability percentage estimates of 5% or less sufficiently protect potential child receptors. As a result, surface soil lead would require corrective action under this hypothetical exposure scenario.

Table 10.8.16
Zone G
SWMU 11
Lead Model Results
Future Residential Scenario

AIR CONCENTRATION: **0.100 μg Pb/m3 DEFAULT**
Indoor Air Pb Conc: **30.0 percent of outdoor**
Other Air Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: **DEFAULT**

DRINKING WATER: **4.00 μg Pb/L** **DEFAULT**
WATER Consumption: **DEFAULT**

SOIL AND DUST:
Soil: **Constant conc.**
Dust: **Constant conc.**

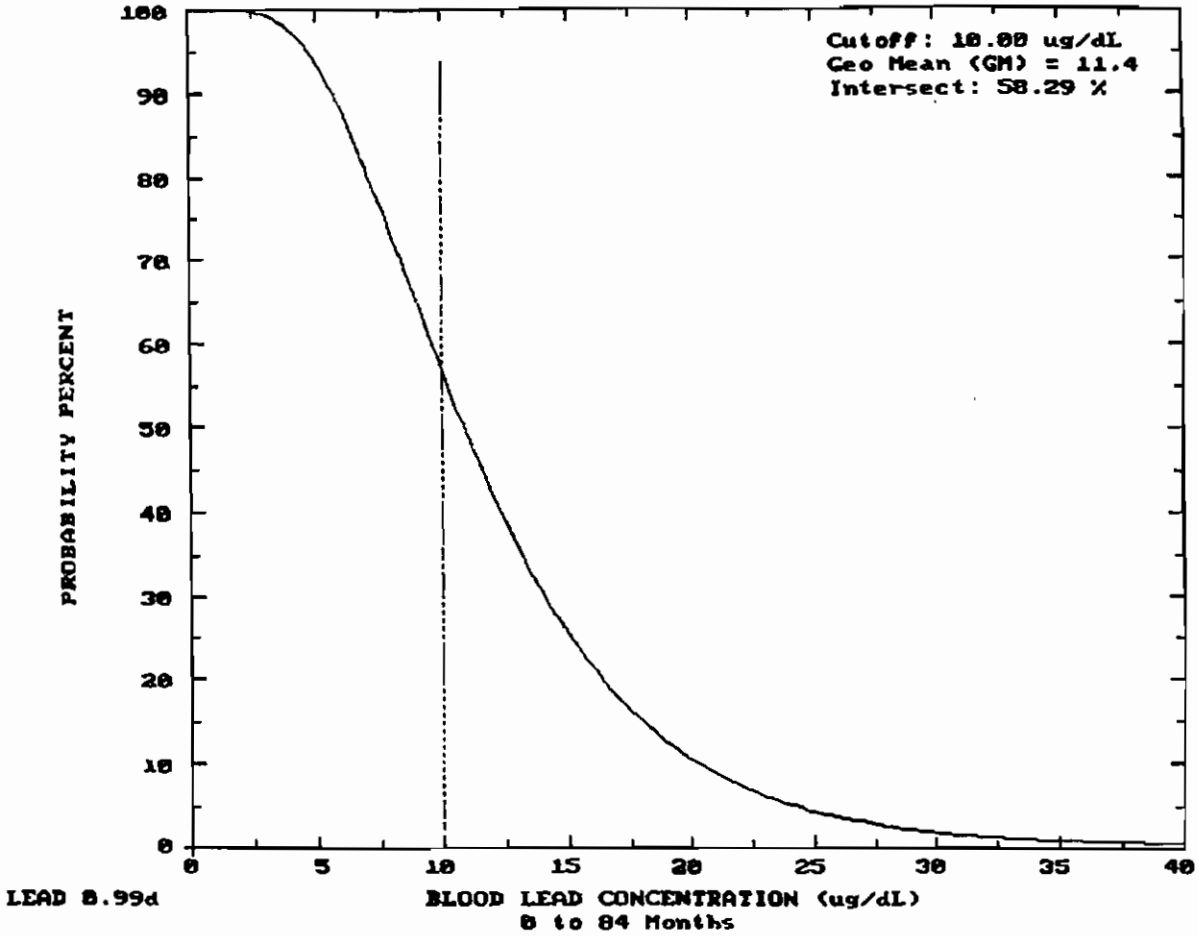
Age	Soil	House Dust (μg Pb/g)
0-1	1100.0	1100.0
1-2	1100.0	1100.0
2-3	1100.0	1100.0
3-4	1100.0	1100.0
4-5	1100.0	1100.0
5-6	1100.0	1100.0
6-7	1100.0	1100.0

Additional Dust Sources: **None** **DEFAULT**
PAINT Intake: **0.00 μg Pb/day** **DEFAULT**

MATERNAL CONTRIBUTION: **Infant Model; Maternal Blood Conc: 2.50 μg Pb/dL**

CALCULATED BLOOD Pb and Pb UPTAKES:

Year	Blood Level (μg/dL)	Total Uptake\ (μg/day)	Soil + Dust Uptake (μg/day)	Diet Uptake (μg/day)	Water Uptake (μg/day)	Paint Uptake (μg/day)	Air Uptake (μg/day)
0.5 - 1	12.3	23.64	21.23	2.09	0.30	0.00	0.02
1-2	14.2	35.18	32.32	2.09	0.30	0.00	0.02
2-3	13.4	36.81	33.53	2.44	0.78	0.00	0.06
3-4	13.0	38.02	34.70	2.43	0.83	0.00	0.07
4-5	10.9	31.21	27.70	2.52	0.92	0.00	0.07
5-6	9.3	29.50	25.67	2.74	1.00	0.00	0.09
6-7	8.2	28.82	24.62	3.07	1.04	0.00	0.09



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8-6
PROBABILITY PERCENTAGE OF BLOOD LEAD
LEVELS FOR CHILD 0-7 YEARS
SWMU 11 - SURFACE SOIL
FUTURE RESIDENTIAL SCENARIO

Date: 02/10/98 | DWG Name: 2907C002

Future Commercial/Industrial Scenario

In coordination with USEPA Region IV's Office of Health Assessment, a conservative exposure scenario was developed to assess the significance of lead concentrations reported in soil samples collected at SWMU 11 under an future industrial scenario. This scenario involves a child (age 5 to 6) who gains access to the most heavily contaminated area for one day and is maximally exposed. The scenario was based on the proposed future use of this area. Base reuse plans indicate that the area will maintain its current use. The exposure frequency was based on the child accompanying a parent to work at a nearby building on a one-time basis and wandering into the area of contaminated soil.

Exposure to site soil and groundwater was addressed as an additional exposure relative to typical exposures encountered at the child's place of residence. This additional exposure was presented as an alternate source within the constructs of the Lead Model. The only modification made to standard default assumptions in the lead model was raising the drinking water lead concentration to the treatment technique action level (TTAL) of 15 μg/L. This change was made to provide a conservative estimate of daily intake from sources unrelated to SWMU 11.

The assumption was made that this child would ingest 0.1 grams of soil from the most heavily contaminated area and one liter of contaminated groundwater. In the case of SWMU 11 surface soil, the lead "hot spot" is represented by surface soil sample 011SB001. The total area of lead contamination is unknown at this time because there are no samples collected to the north of 011SB001. Within the Lead Model, an alternate source was entered to account for exposure to site soil and groundwater as previously discussed. The bioavailability of lead ingested from the alternate source was equal to that of lead ingested through soil consumption from the standard residential default source. The annual alternate source exposure was estimated to be 0.3 μg lead/day. Table 10.8.17 summarizes the Lead Model results under these exposure conditions.

Table 10.8.17
Zone G
SWMU 11
Lead Model Results
Industrial Scenario

AIR CONCENTRATION: **0.100 μg Pb/m3 DEFAULT**
Indoor Air Pb Conc: **30.0 percent of outdoor**
Other Air Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: **DEFAULT**

DRINKING WATER: **15.00 μg Pb/L** **WATER Consumption:** **DEFAULT**

SOIL AND DUST: **Soil:** **Constant conc.** **Dust:** **Constant conc.**

Age	Soil	House Dust (μg Pb/g)
0-1	200.0	200.0
1-2	200.0	200.0
2-3	200.0	200.0
3-4	200.0	200.0
4-5	200.0	200.0
5-6	200.0	200.0
6-7	200.0	200.0

Additional Dust Dust Sources: None **DEFAULT** **PAINT Intake:** **0.00 μg Pb/day** **DEFAULT**

ALTERNATIVE SOURCE Intake: Varied by year as follows:
0-1 0.00 μg Pb/day
1-2 0.00 μg Pb/day
2-3 0.00 μg Pb/day
3-4 0.00 μg Pb/day
4-5 0.00 μg Pb/day
5-6 0.00 μg Pb/day
6-7 0.00 μg Pb/day

MATERNAL CONTRIBUTION: **Infant Model; Maternal Blood Conc: 2.50 μg Pb/dL**
CALCULATED BLOOD Pb and Pb UPTAKES:

Year	Blood Level (μg/dL)	Total Uptake\ (μg/day)	Soil + Dust Uptake (μg/day)	Diet Uptake (μg/day)	Water Uptake (μg/day)	Paint Uptake (μg/day)	Air Uptake (μg/day)
0.5 - 1	4.6	8.52	4.63	2.51	1.36	0.00	0.02
1-2	5.4	13.16	7.21	2.57	3.34	0.00	0.03
2-3	5.1	13.81	7.30	2.93	3.52	0.00	0.06
3-4	4.9	13.97	7.41	2.85	3.64	0.00	0.07
4-5	4.3	12.34	5.61	2.81	3.86	0.00	0.07
5-6	3.8	12.35	5.09	2.99	4.10	0.00	0.09
6-7	3.5	12.42	4.83	3.31	4.19	0.00	0.09

Figure 10.8-7 presents the probability percentage of blood lead levels for a child 5 to 6 years old. Based on this model output, the geometric mean blood level is estimated to be 3.8 μg/dL, and the probability of blood lead levels in excess of 10 μg/dL is 1.99%. USEPA generally considers media concentrations that result in probability percentage estimates of 5% or less sufficiently protective of potential child receptors. As a result, surface soil would require specific action under this hypothetical future exposure scenario.

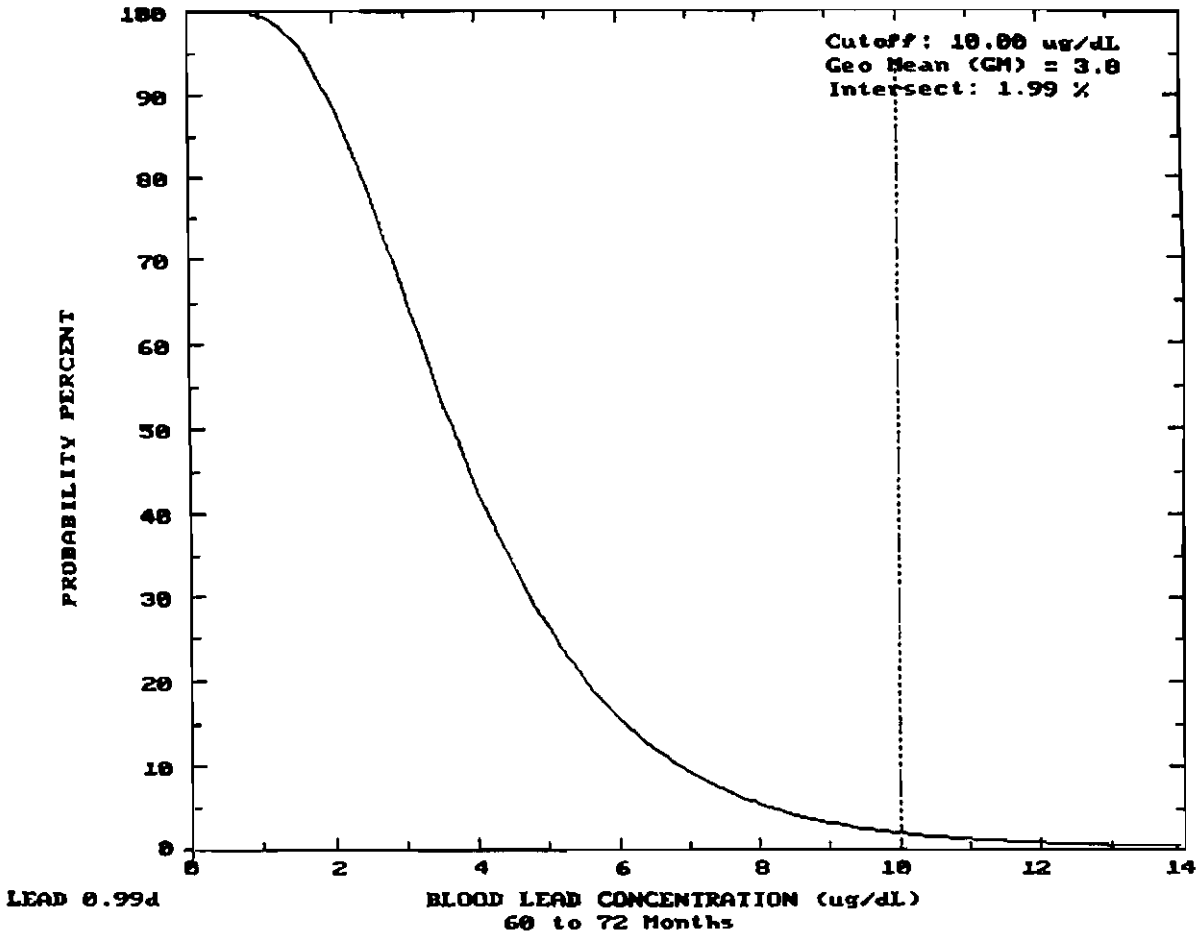
10.8.8.5 Risk Uncertainty

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. If this area were to be used as a residential site, the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, exposure to surface soil conditions as represented by samples collected during the RFI would not be likely under a true future residential scenario. These factors indicate that exposure pathways assessed in this HHRA would generally overestimate the risk and hazard posed to current site workers and future site residents.

Determination of Exposure Point Concentrations

The maximum detected soil lead concentration was used as the exposure point concentrations for this site. Use of maximum detected concentrations represent conservative assumptions when applied as the EPC, such that it is unlikely that the maximum detected concentration would be exceeded by the true mean concentration. Since the maximum lead concentration was reported in a sample collected from the northern perimeter of the site, there is some uncertainty whether the extent of lead contamination was adequately defined.



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8-7
PROBABILITY PERCENTAGE OF BLOOD LEAD LEVELS FOR CHILD 5-6 YEARS
SWMU II - SURFACE SOIL
FUTURE INDUSTRIAL SCENARIO

Date: 02/10/98 | DWG Name: 2907C002

Frequency of Detection and Spatial Distribution

Surface Soil

The maximum surface soil lead concentration was reported in sample 011SB001 (1,100 mg/kg). The remaining four surface soil samples reported lead concentrations ranging from 3 mg/kg (011SB002) to 29 mg/kg (011SB005). As a result, it is likely that setting the soil and house dust equal to the maximum concentration in the Lead Model caused an overestimation of blood lead levels under the future residential scenario.

Surface Soil Screening

A conservative screening process was used to identify COPCs for SWMU 11. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens, the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, none was reported at a concentration near its RBC (e.g. within 10% of its RBC). Arsenic and beryllium were detected at concentrations exceeding their respective RBCs, however, their maximum concentrations did not exceed their corresponding background concentration. As a result, each was eliminated from consideration in the risk assessment.

Groundwater

The same conservative screening process used for soil was also applied to groundwater. Of the CPSSs screened and eliminated from formal assessment, none was reported at a concentration close to its RBCs (e.g. within 10% of its RBC). Arsenic and manganese were detected at concentrations exceeding their respective tap water RBCs, however, their maximum concentrations

did not exceed their corresponding background concentration. As a result, each was eliminated from consideration in the risk assessment.

10.8.8.6 Risk Summary

Soil - Residential Scenario

Lead was identified as a residential soil pathway COC for SWMU 11 based on the results of the Lead Model. Only one surface soil sample reported a concentration above the 400 mg/kg AL for lead in soil (011SB001; 1,100 mg/kg). The remaining four surface soil samples reported lead concentrations well below the AL. There is some uncertainty as to the extent of lead contamination to the north of SWMU 11.

Soil — Site Worker Scenario

No industrial soil pathway COCs were identified for SWMU 11.

Groundwater — Residential Scenario

A conservative screening process, presented in Section 7 of this RFI, was used to identify groundwater COPCs. As a result of this screening process, no COPCs were identified for groundwater.

10.8.9 Corrective Measures Considerations

Based on the analytical results and the human health risk assessment for SMWU 11, COCs requiring further evaluation through the CMS process have been identified for surface soil. The site is currently an open, grass-covered area formerly used for the disposal of calcium hydroxide. SMWU 11 was evaluated under both the residential and industrial (site worker) scenarios. For these scenarios, the incidental ingestion and dermal contact exposure pathways were evaluated. Hazard was evaluated for noncarcinogenic contaminants through incidental ingestion and dermal contact scenarios as well.

As recommended by SCDHEC, a COC is considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual risk exceeds 1E-06 or whose hazard quotient exceeds 0.1.

No COCs were identified based on risk or hazard, however lead was identified as a residential soil pathway COC based on the results of the Lead Model. One surface soil sample indicated lead at concentrations above acceptable levels using the Lead Model criteria.

To determine the leaching potential of contaminants from the subsurface soil media to groundwater, contaminant concentrations in subsurface soil were compared against generic SSLs based on a DAF of 20. This comparison indicated lead at concentrations exceeding the applicable SSL. Lead was detected in one sample at a concentration (1,100 mg/kg) exceeding the SSL of 400 mg/kg. For more information regarding indirect exposure pathways associated with subsurface soil refer to Section 10.8.7, Fate and Transport Assessment for SMWU 11. Potential corrective measures for soil are presented below in Table 10.8.18.

Table 10.8.18
Potential Corrective Measures for SWMU 11

Medium	Compounds	Potential Corrective Measures
Soil	Lead	a) No action b) Excavate, offsite disposal, and monitoring c) Containment/capping

10.9 SWMU 120, Pier M Laydown

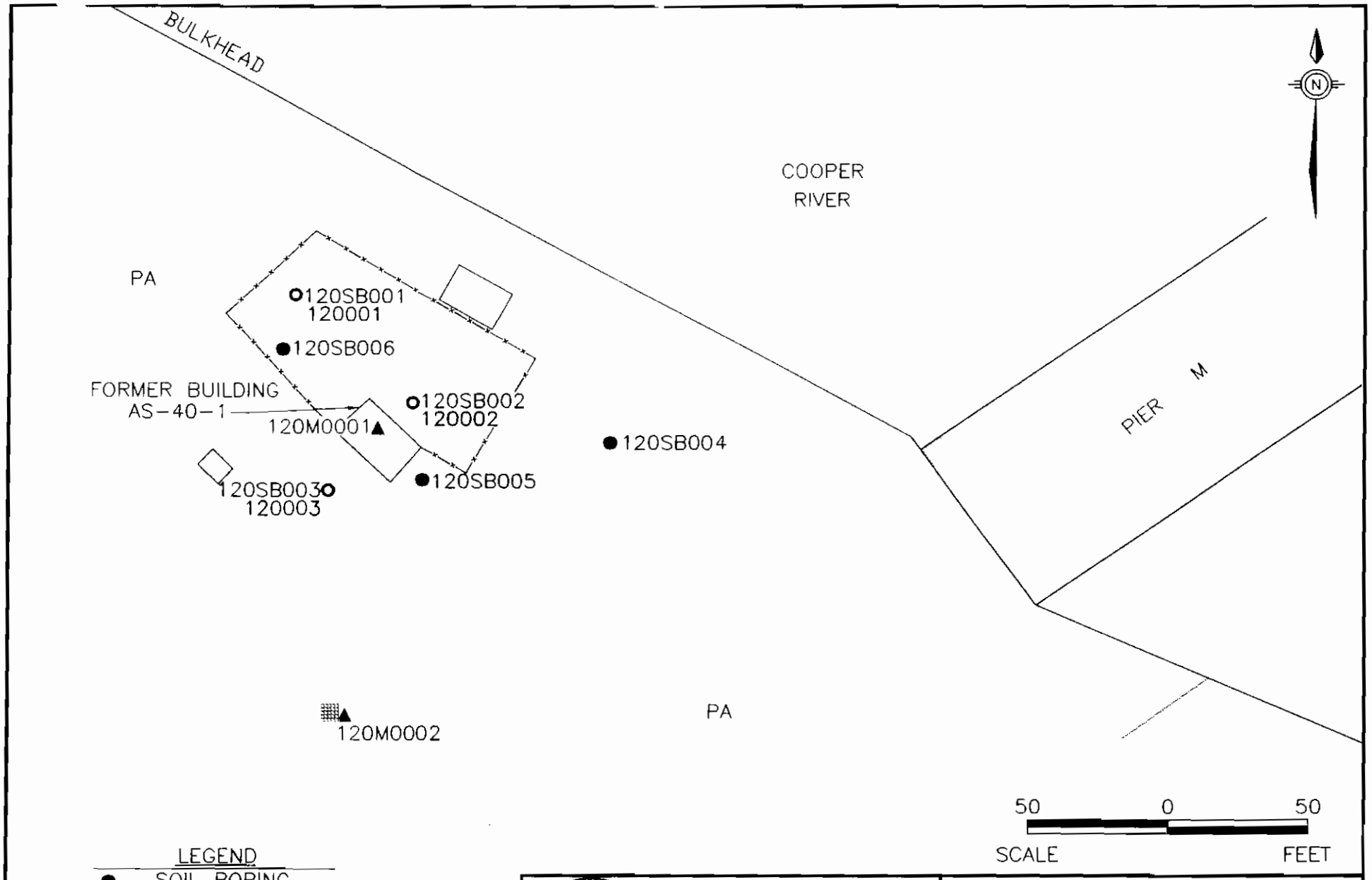
A RFI site, SWMU 120 consists of the laydown area associated with Pier M, included is the former Building AS-40-1, which was adjacent to the area. Palletized lead bricks and shielding were stored at the site, and is suspected that radiologically contaminated tarps may have also been stored there. Severe paint, grease, and solvent staining were noted in the area in the past. Materials released, stored, or disposed of at the site included lead bricks and shielding, paint/thinner wastes, and greases.

10.9.1 Site Geology and Hydrogeology

The soil boring, sediment sampling, and groundwater monitoring well locations associated with the SWMU 120 RFI are shown in Figure 10.9-1. Appendix A contains the boring logs and the monitoring well construction diagrams for the wells installed at SWMU 120.

Based on three monitoring well borings, the general stratigraphy at SWMU 120 consists of alternating clay, salt and silty sand to a depth of approximately 12 ft bgs. The Qc deposits extend to depths ranging from 8 to 11 ft bgs. The Qc in Zone G exhibits a grain size distribution of 56% sand, 15% silt, and 29% clay. The Qs deposits at SWMU 120 exhibit an average grain size distribution of 87% sand, 6% silt, and 7% clay. The porosity in this unit was 56.6%.

The groundwater elevation at SWMU 120 is approximately 4.2 ft msl. Figures 10.9-2 and 10.9-3 depict the shallow groundwater potentiometric surface and inferred flow direction at low- and high-tide respectively. Only very minor differences in the static water levels were observed between high and low-tide. At low-tide the shallow groundwater at SWMU 120 flows generally to the north northwest, at a horizontal flow velocity of approximately 7.1E-02 ft/day. During high-tide, flow is to the east northeast of an approximate velocity of 2.0E-02 ft/day.



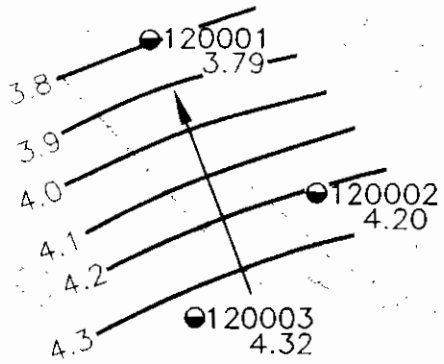
LEGEND

- ● – SOIL BORING
- ▲ – SEDIMENT SAMPLE
- ▦ – STORM DRAIN
- O – SOIL BORING/SHALLOW MONITORING WELL

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-1
SAMPLING LOCATIONS
SWMU #120
PIER M LAYDOWN

DWG DATE: 01/15/98 | DWG NAME: 29CHZG30



50 0 50

SCALE FEET

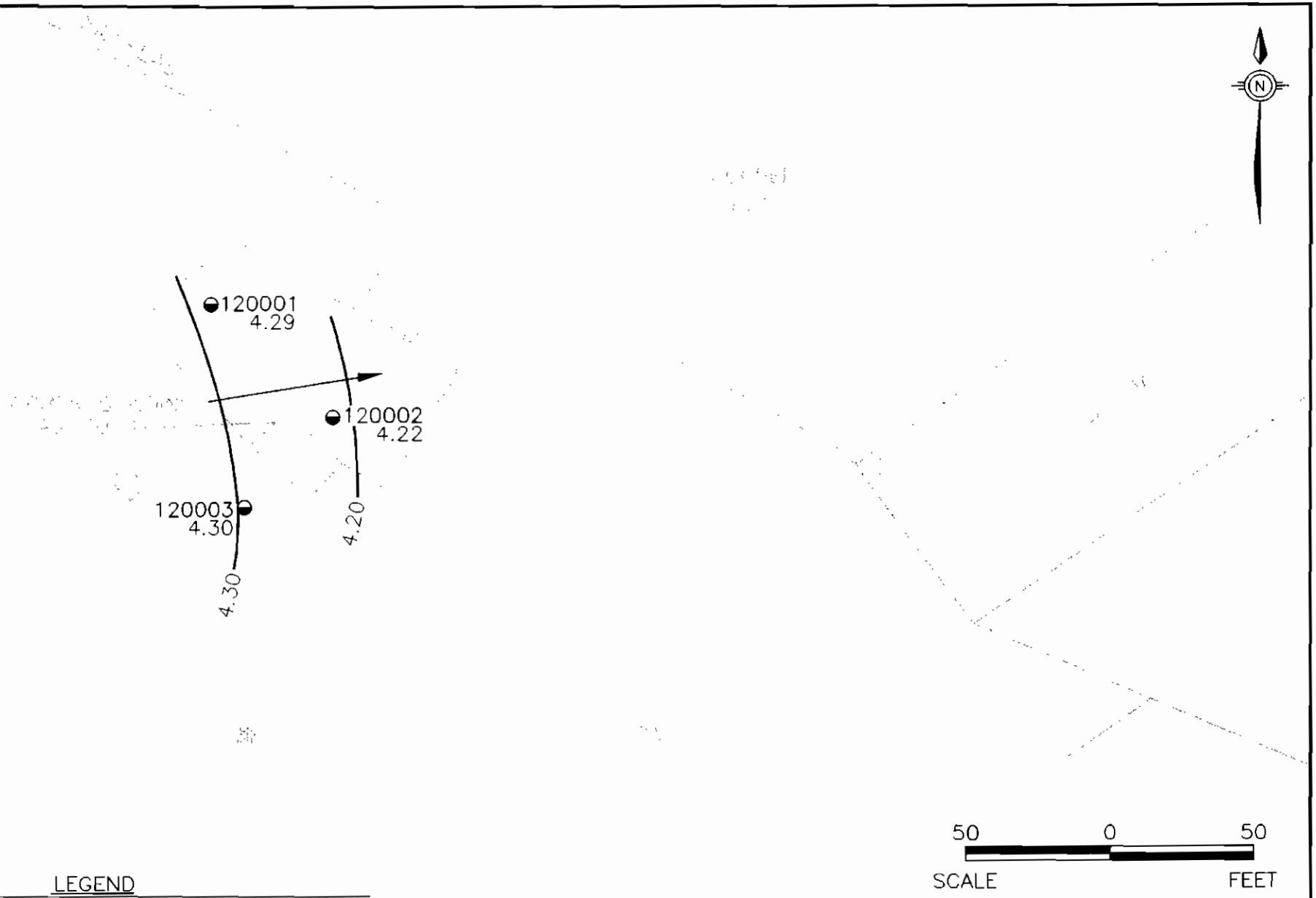
LEGEND

- SHALLOW MONITORING WELL MONITORING WELL
- CONTOUR INTERVAL = 0.1 FEET
- ARROW INDICATES FLOW DIRECTION

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-2
SHALLOW GROUNDWATER
LOW-TIDE POTENTIOMETRIC MAP
SWMU #120
PIER M LAYDOWN

DWG DATE: 01/15/98 | DWG NAME: 29ZGTLPL



LEGEND

- SHALLOW MONITORING WELL MONITORING WELL
- CONTOUR INTERVAL = 0.1 FEET
- ARROW INDICATES FLOW DIRECTION

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-3
SHALLOW GROUNDWATER
HIGH-TIDE POTENTIOMETRIC MAP
SWMU #120
PIER M LAYDOWN

DWG DATE: 01/15/98 | DWG NAME: 29ZGTHPL

10.9.2 Field Investigation Approach

The objective of the field investigation at SWMU 120 was to: (1) confirm the presence or absence of contamination in the site area; (2) delineate any contamination found; and (3) provide sufficient data to support a detailed evaluation of treatment alternatives, if required. Media sampled within the investigation area included soil, sediment, and groundwater. Section 3 of this report details the methods used during the field investigation. Included in this section are descriptions of the hollow stem auger procedures used for shallow well installation; the hand auger procedures used for soil sampling; sediment and groundwater sampling procedures; as well as miscellaneous procedures used during the field investigation Also discussed are the analytical protocols for sample analyses. Appendix D contains the analytical data report for samples collected in Zone G.

10.9.3 Soil Sampling and Analysis

The approved final RFI work plan proposed advancing six soil borings within the SWMU 120 area to detect the presence of any soil contamination from this site. Upper and lower interval soil samples were proposed from each boring. During the field investigation, six soil borings were advanced within the site area (Figure 10.9-2). Two borings included both upper and lower sampling intervals, while four borings included the upper interval only. Where not collected, the lower interval sample was not collected due to a shallow water table. In accordance with the approved final RFI work plan, soil samples were analyzed for metals, pesticides/PCBs, SVOCs and VOCs at DQO Level III. Several SWMU 120 soil samples were also analyzed for cyanide. Table 10.9.1 summarizes the SWMU 120 soil samples and analyses.

10.9.3.1 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.9.2. Inorganic analytical results for soil are summarized in Table 10.9.3. Table 10.9.4 summarizes all analytes detected in soil at SWMU 120. Appendix D contains a complete analytical data report for all Zone G samples.

Table 10.9.1
Zone G
SWMU 120
Soil Samples and Analyses

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
120SB001	120SB00101	Upper	8/29/96	Note 1/cyanide	Lower interval not sampled due to water table
120SB002	120SB00201 120SB00202	Upper Lower	8/29/96	Note 1/cyanide	
120SB003	120SB00301	Upper	8/29/96	Note 1/cyanide	Lower interval not sampled due to water table
120SB004	120SB00401 120SB00402	Upper Lower	9/25/96	Note 1	
120SB005	120SB00501	Upper	9/25/96	Note 1	Lower interval not sampled due to water table
120SB006	120SB00601	Upper	9/24/96	Note	Lower interval not sampled due to water table

Note:
SW-846 (metals, pesticides/PCBs, SVOCs, VOCs) at DQO Level III

Volatile Organic Compounds in Soil

No VOCs were detected in surface or subsurface soil samples at SWMU 120.

Semivolatile Organic Compounds in Soil

Sixteen SVOCs were detected in surface soil samples at SWMU 120. One SVOC, benzo(a)pyrene, exceeded its respective RBC in surface soil samples at this SWMU. Figure 10.9-4 presents total BEQ concentrations detected in surface soil at SWMU 120.

Ten SVOCs were detected in subsurface soil samples at SWMU 120. No SVOCs in subsurface soil exceeded their respective SSL.

Table 10.9.2
Zone G
SWMU 120
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Semivolatile Organic Compounds (Upper Interval - 6 Samples/Lower Interval - 2 Samples) (µg/kg)						
BEQs[1]	Upper	2/6	67.38 - 125.78	96.6	88	1
	Lower	0/0	NA	NA	NA	NA
Benzo(a)anthracene	Upper	2/6	66.0 - 100	83.0	880	0
	Lower	1/2	60.0	60.0	2000	0
Benzo(b)fluoranthene	Upper	2/6	72.0 - 170	121	880	0
	Lower	1/2	250	250	5000	0
Benzo(k)fluoranthene	Upper	2/6	49.0 - 92.0	70.5	8800	0
	Lower	0/2	ND	ND	49000	0
Benzo(a)pyrene	Upper	2/6	53.0 - 92.0	72.5	88	1
	Lower	1/2	140	140	8000	0
Chrysene	Upper	2/6	88.0 - 160	124	88000	0
	Lower	1/2	160	160	160000	0
Indeno(1,2,3-cd)pyrene	Upper	1/6	57	57	880	0
	Lower	1/2	77	77	14000	0
Acenaphthene	Upper	1/6	84.0	84.0	470000	0
	Lower	0/2	ND	ND	570000	0
Benzoic acid	Upper	2/6	58.0 - 87.0	72.5	31000000	0
	Lower	1/2	84.0	84.0	4000000	0
Benzo(g,h,i)perylene	Upper	1/6	57.0	57.0	230000	0
	Lower	1/2	94.0	94.0	4.66E08	0

Table 10.9.2
Zone G
SWMU 120
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Butylbenzylphthalate	Upper	3/6	37.0 - 95.0	61.7	1600000	0
	Lower	0/2	ND	ND	930000	0
Fluoranthene	Upper	2/6	200 - 260	230	310000	0
	Lower	1/2	120	120	4300000	0
Fluorene	Upper	1/6	45.0	45.0	310000	0
	Lower	0/2	ND	ND	560000	0
2-Methylnaphthalene	Upper	2/6	45.0 - 160	103	310000	0
	Lower	0/2	ND	ND	126000	0
Naphthalene	Upper	1/6	86.0	86.0	310000	0
	Lower	0/2	ND	ND	84000	0
Phenanthrene	Upper	2/6	160 - 190	175	230000	0
	Lower	1/2	69.0	69.0	1380000	0
Pyrene	Upper	2/6	160 - 220	190	230000	0
	Lower	1/2	100	100	4200000	0
Pesticides and PCBs (Upper Interval - 6 Samples/Lower Interval - 2 Samples) (µg/kg)						
alpha-Chlordane	Upper	3/6	2.40 - 24.0	10.6	1800	0
	Lower	0/2	ND	ND	10000	0
gamma-Chlordane	Upper	1/6	2.30	2.30	1800	0
	Lower	0/2	ND	ND	10000	0
4,4'DDD	Upper	4/6	12.0 - 560	210	2700	0
	Lower	1/2	7100	7100	16000	0

Table 10.9.2
Zone G
SWMU 120
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
4,4'-DDE	Upper	4/6	5.50 - 130	56.9	1900	0
	Lower	1/2	3100	3100	54000	0
4,4'-DDT	Upper	3/6	35.0 - 470	275	1900	0
	Lower	1/2	380	380	32000	0
Dieldrin	Upper	2/6	3.90 - 7.10	5.50	40	0
	Lower	0/2	ND	ND	4	0
Endrin	Upper	1/6	3.80	3.80	2300	0
	Lower	0/2	ND	ND	1000	0

Notes:

1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c)

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples

ND = Not detected

NL = Not listed

NA = Not applicable

μg/kg = Micrograms per kilogram

Table 10.9.3
Zone G
SWMU 120
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Inorganics (Upper Interval - 6 Samples/Lower Interval - 2 Samples) (mg/kg)						
Aluminum (Al)	Upper	6/6	3030 - 9950	4840	7800	1
	Lower	2/2	1330 - 17300	9320	1000000	0
Antimony (Sb)	Upper	3/6	1.60 - 10.0	5.33	3.10	2
	Lower	1/2	3.30	3.30	5	0
Arsenic (As)	Upper	6/6	0.91 - 16.3	4.64	0.43	6
	Lower	2/2	0.65 - 19.1	9.88	29	0
Barium (Ba)	Upper	6/6	2.90 - 37.0	18.7	550	0
	Lower	2/2	7.90 - 40.1	24.0	1600	0
Beryllium (Be)	Upper	3/6	0.40 - 0.74	0.547	0.15	3
	Lower	2/2	0.22 - 1.00	0.610	63	0
Cadmium (Cd)	Upper	5/6	0.060 - 1.30	0.398	3.90	0
	Lower	1/2	0.50	0.500	8	0
Calcium (Ca)	Upper	6/6	11400 - 67600	34700	NL	NA
	Lower	2/2	42000 - 55000	48500	NL	NA
Chromium (Cr)	Upper	6/6	3.50 - 46.5	14.1	39.0	1
	Lower	2/2	3.30 - 39.4	21.4	1000000	0
Cobalt (Co)	Upper	6/6	0.71 - 3.5	2.02	470	0
	Lower	2/2	0.68 - 4.7	2.69	2000	0

Table 10.9.3
Zone G
SWMU 120
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Copper (Cu)	Upper	5/6	1.80 - 286	108	27000	0
	Lower	1/2	69.3	69.3	920	0
Iron (Fe)	Upper	6/6	954 - 12700	4350	2300	3
	Lower	2/2	2390 - 20900	11660	NL	NA
Lead (Pb)	Upper	6/6	2.20 - 223	76.5	400	0
	Lower	2/2	1.40 - 58.3	29.9	400	0
Magnesium (Mg)	Upper	6/6	287 - 2600	949	NL	NA
	Lower	2/2	254 - 3650	1950	NL	NA
Manganese (Mn)	Upper	6/6	12.7 - 118	61.1	180	0
	Lower	2/2	14.7 - 174	94.4	1100	0
Mercury (Hg)	Upper	2/6	0.23 - 0.35	0.290	2.30	0
	Lower	1/2	0.26	0.260	2.1	0
Nickel (Ni)	Upper	6/6	1.70 - 25.1	12.4	160	0
	Lower	2/2	0.70 - 17.9	9.30	130	0
Potassium (K)	Upper	3/6	253 - 908	485	NL	NA
	Lower	1/2	1370	1370	NL	NA
Selenium (Se)	Upper	4/6	0.35 - 0.64	0.495	39.0	0
	Lower	1/2	0.41	0.410	5	0
Sodium (Na)	Upper	3/6	242 - 723	469	NL	NA
	Lower	1/2	882	882	NL	NA

Table 10.9.3
Zone G
SWMU 120
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Tin (Sn)	Upper	2/6	11.0 - 20.8	15.9	4700	0
	Lower	0/2	ND	ND	11000	0
Vanadium (V)	Upper	6/6	2.50 - 46.9	12.9	55.0	0
	Lower	2/2	4.00 - 51.5	27.8	6000	0
Zinc (Zn)	Upper	6/6	5.80 - 501	182	2300	0
	Lower	1/2	209	209	12000	0

Notes:

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples

ND = Not detected
NL = Not listed
NA = Not applicable
mg/kg = Milligrams per kilogram

Table 10.9.4
Zone G
SWMU 120
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Semivolatile Organic Compounds (μg/kg)							
BEQs[1]	120SB001	125.78	88.0	NA	NA	NL	NA
	120SB002	67.38			NA		
Benzo(a)anthracene	120SB001	100	880	NA	NT	2000	NA
	120SB002	66			60		
Benzo(b)fluoranthene	120SB001	170	880	NA	NT	5000	NA
	120SB002	72			250		
Benzo(k)fluoranthene	120SB001	92	8800	NA	NT	4900	NA
	120SB002	49			ND		
Benzo(a)pyrene	120SB001	92	88	NA	NT	8000	NA
	120SB002	53			140		
Chrysene	120SB001	160	88000	NA	NT	160000	NA
	120SB002	88			160		
Indeno(1,2,3-cd)pyrene	120SB001	57	880	NA	NT	14000	NA
	120SB002	ND			77		
Acenaphthene	120SB002	84	470000	NA	ND	570000	NA
Benzoic acid	120SB001	87	31000000	NA	NT	4000000	NA
	120SB002	ND			84		
	120SB003	58			NT		
Benzo(g,h,i)perylene	120SB001	57	230000	NA	NT	4.66E08	NA
	120SB002	ND			94		

Table 10.9.4
Zone G
SWMU 120
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Butylbenzylphthalate	120SB001	95	1600000	NA	NT	930000	NA
	120SB002	37			ND		
	120SB006	53			NT		
Fluoranthene	120SB001	260	310000	NA	NT	4300000	NA
	120SB002	200			120		
Fluorene	120SB002	45	310000	NA	ND	560000	NA
2-Methylnapthalene	120SB001	160	310000	NA	NT	126000	NA
	120SB002	45			ND		
Naphthalene	120SB001	86	310000	NA	NT	84000	NA
Phenanthrene	120SB001	160	230000	NA	NT	1380000	NA
	120SB002	190			69		
Pyrene	120SB001	220	230000	NA	NT	4200000	NA
	120SB002	160			100		
Pesticides/PCBs (μg/kg)							
4,4'-DDE	120SB001	130	1900.0	NA	NT	54000	NA
	120SB002	36			3100		
	120SB005	5.5			NT		
	120SB006	56			NT		
4.4'-DDD	120SB001	560	2700	NA	NT	16000	NA
	120SB002	200			7100		
	120SB005	12			NT		
	120SB006	68			NT		

Table 10.9.4
Zone G
SWMU 120
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
4,4'-DDT	120SB001	470	1900	NA	NT	32000	NA
	120SB002	35			380		
	120SB005	320			NT		
alpha-Chlordane	120SB001	24	1800	NA	NT	10000	NA
	120SB002	5.4			ND		
	120SB005	2.4			NT		
gamma-Chlordane	120SB006	2.3	1800	NA	NT	10000	NA
Endrin	120SB002	3.8	2300	NA	ND	1000	NA
Dieldrin	120SB004	7.1	40	NA	ND	4	NA
	120SB006	3.9			NT		
Inorganics (mg/kg)							
Aluminum (Al)	120SB001	9950	7800.0	18700	NT	1000000	23600
	120SB002	3980			17300		
	120SB003	3620			NT		
	120SB004	3950			1330		
	120SB005	4490			NT		
	120SB006	3030			NT		
Antimony (Sb)	120SB001	10	3.1	2.89	NT	5	NL
	120SB002	4.4			3.3		
	120SB006	1.6			NT		

Table 10.9.4
Zone G
SWMU 120
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Arsenic (As)	120SB001	16.3	0.43	17.2[a]	NT	29	15.5[a]
	120SB002	5.2			19.1		
	120SB003	0.91			NT		
	120SB004	1.2			0.65		
	120SB005	1.5			NT		
	120SB006	2.7			NT		
Barium (Ba)	120SB001	37	550.0	109	NT	1600	64.5
	120SB002	27			40.1		
	120SB003	2.9			NT		
	120SB004	12.3			7.9		
	120SB005	5.9			NT		
	120SB006	27.1			NT		
Beryllium (Be)	120SB001	0.74	0.15	1.20	NT	63	1.63
	120SB002	0.5			1		
	120SB004	ND			0.22		
	120SB006	0.4			NT		
Cadmium (Cd)	120SB001	1.3	3.9	1.07	NT	8	0.48
	120SB002	0.32			0.5		
	120SB003	0.06			NT		
	120SB005	0.09			NT		
	120SB006	0.22			NT		

Table 10.9.4
Zone G
SWMU 120
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Calcium (Ca)	120SB001	25000	NL	NL	NT	NL	NL
	120SB002	47900			42000		
	120SB003	40400			NT		
	120SB004	15900			55000		
	120SB005	11400			NT		
	120SB006	67600			NT		
Chromium (Cr)	120SB001	46.5	39 VI	42.8	NT	1000000	43.4[a]
	120SB002	13.6	7800 III		39.4		
	120SB003	3.5			NT		
	120SB004	7.4			3.3		
	120SB005	5.5			NT		
	120SB006	7.9			NT		
Cobalt (Co)	120SB001	3.4	470.0	6.60	NT	2000	8.14
	120SB002	3.5			4.7		
	120SB003	0.73			NT		
	120SB004	0.86			0.68		
	120SB005	0.71			NT		
	120SB006	2.9			NT		
Copper (Cu)	120SB001	286	27000	260	NT	920	32.6
	120SB002	160			69.3		
	120SB003	1.8			NT		
	120SB005	10.2			NT		
	120SB006	83.1			NT		

Table 10.9.4
Zone G
SWMU 120
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Iron (Fe)	120SB001	12700	2300	NL	NT	NL	NL
	120SB002	5640			20900		
	120SB003	954			NT		
	120SB004	1880			2390		
	120SB005	1400			NT		
	120SB006	3520			NT		
Lead(Pb)	120SB001	223	400.0	181	NT	400	66.3
	120SB002	155			58.3		
	120SB003	2.2			NT		
	120SB004	11.4			1.4		
	120SB005	7.7			NT		
	120SB006	59.4			NT		
Magnesium (Mg)	120SB001	2600	NL	NL	NT	NL	NL
	120SB002	955			3650		
	120SB003	467			NT		
	120SB004	334			254		
	120SB005	287			NT		
	120SB006	1050			NT		
Manganese (Mn)	120SB001	118	180.0	325	NT	1100	291
	120SB002	81.9			174		
	120SB003	20.5			NT		
	120SB004	23.5			14.7		
	120SB005	12.7			NT		
	120SB006	110			NT		
Mercury (Hg)	120SB001	0.35	2.3	1.03	NT	2.1	0.31
	120SB002	0.23			0.26		

Table 10.9.4
Zone G
SWMU 120
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Nickel (Ni)	120SB001	22.1	160.0	20.6	NT	130	18.3
	120SB002	25.1			17.9		
	120SB003	1.7			NT		
	120SB004	1.9			0.7		
	120SB005	2.5			NT		
	120SB006	21.2			NT		
Potassium (K)	120SB001	908	NL	NL	NT	NL	NL
	120SB002	295			1370		
	120SB006	253			NT		
Selenium (Se)	120SB002	0.64	39.0	1.22	0.41	5	1.26
	120SB003	0.44			NT		
	120SB004	0.35			ND		
	120SB005	0.55			NT		
Sodium (Na)	120SB001	723	NL	NL	NT	NL	NL
	120SB002	441			882		
	120SB003	242			NT		
Tin (Sn)	120SB002	20.8	4700	9.67	ND	11000	2.96
	120SB006	11			NT		
Vanadium (V)	120SB001	46.9	55.0	60.9	NT	6000	72.5
	120SB002	10.9			51.5		
	120SB003	2.5			NT		
	120SB004	4.4			4		
	120SB005	4.8			NT		
	120SB006	7.6			NT		

Table 10.9.4
Zone G
SWMU 120
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Zinc (Zn)	120SB001	501	2300.0	519	NT	12000	145
	120SB002	392			209		
	120SB003	5.8			NT		
	120SB004	14.3			ND		
	120SB005	13.1			NT		
	120SB006	167			NT		

Notes:
a = Background value for non-clay samples
* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples
1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c)
ND = Not detected
NT = Not taken
NL = Not listed
NA = Not applicable
µg/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
Bolded concentrations exceed both the reference concentration (RBC or SSL) and the zone background
All background values for Zone G are based on twice the means of the grid sample concentrations

Pesticides and PCBs in Soil

Seven pesticides were detected in surface soil samples and three pesticides were detected in subsurface soil samples at SWMU 120. All concentrations were far below their respective RBCs or SSLs. No PCBs were detected in SWMU 120 soil samples.

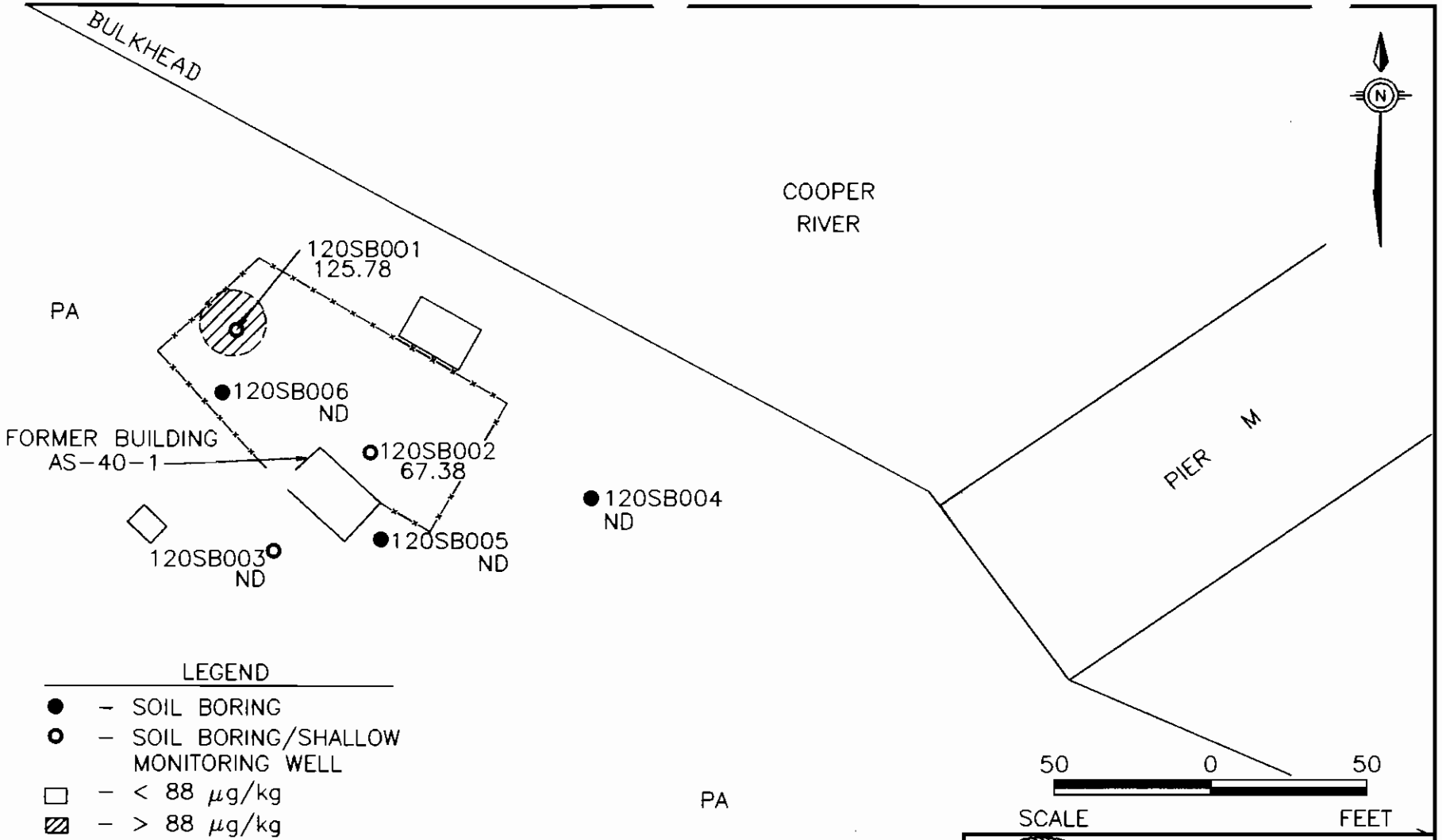
Inorganic Elements in Soil

Twenty-two metals were detected in surface soil samples collected at SWMU 120. Antimony and chromium detected at concentrations exceeding their respective RBCs and background concentrations for Zone G surface soil. Figure 10.10-5 presents antimony concentrations detected in surface soil. Figure 10.10-6 presents chromium concentrations detected in surface soil. Iron concentrations detected in surface soil samples exceed the RBC. No background concentration for iron, the essential nutrient was established.

Twenty-one metals were detected in subsurface soil samples at SWMU 120. No metals in subsurface soil exceeded their respective SSL or subsurface soil background concentrations.

10.9.4 Sediment Sampling and Analysis

The approved final RFI work plan also proposed two sediment samples to assess site impacts on the storm sewer system. One sediment sample (120M0001) was collected during the investigation, as depicted in Figure 10.9-1. The location for the second sediment sample (120M0002) contained insufficient sediment for sample collection. In accordance with the approved final RFI work plan, sediments at SWMU 120 were analyzed for metals, pesticides/PCBs, SVOCs and VOCs at DQO Level III. Table 10.9.5 summarizes the SWMU 120 sediment samples and analyses.



LEGEND

- ● – SOIL BORING
- ○ – SOIL BORING/SHALLOW MONITORING WELL
- □ – < 88 μg/kg
- ▨ – > 88 μg/kg
- ◌ – APPROXIMATE EXTENT

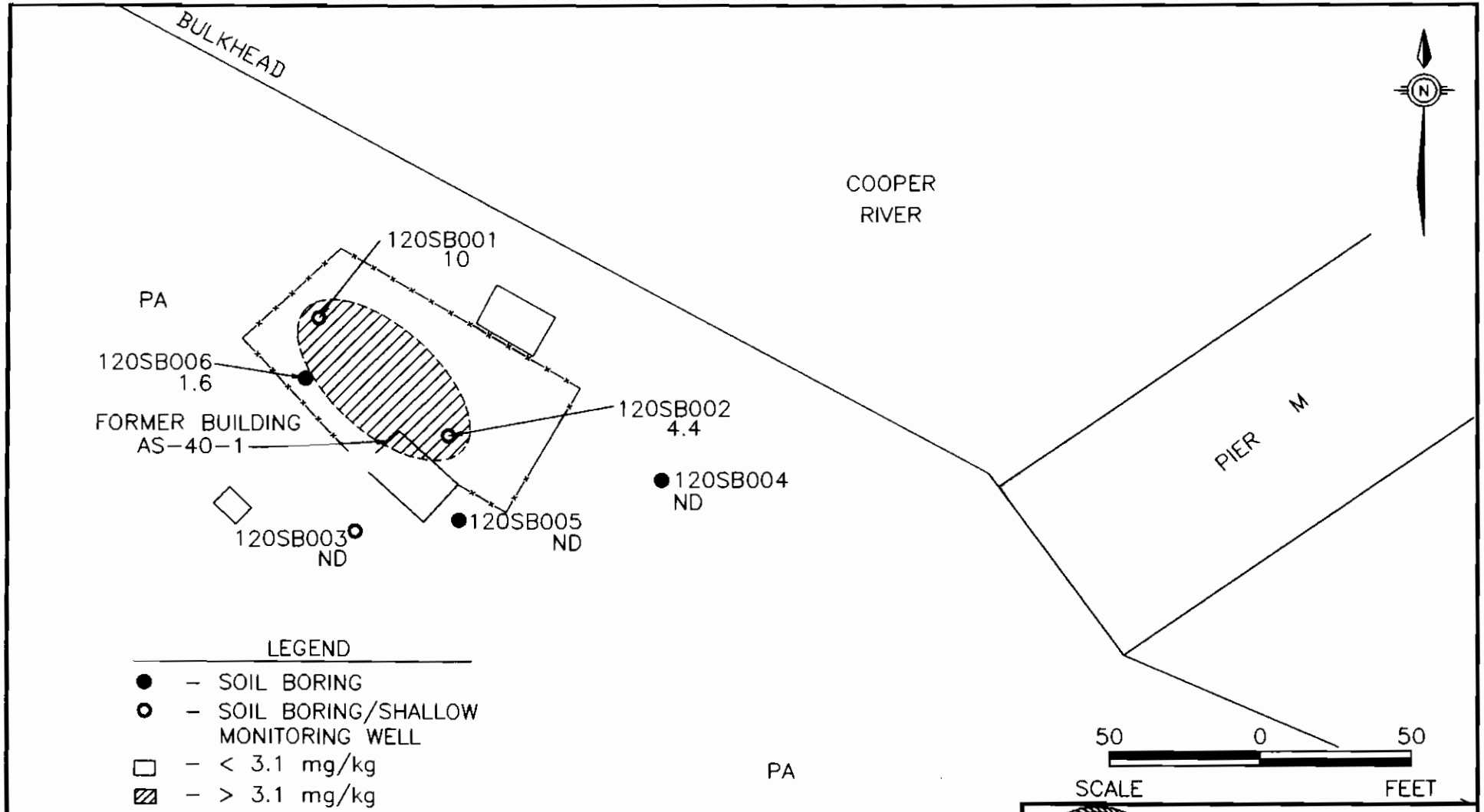
NOTES:

- 88 μg/kg = RBC FOR BEQs IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-4
BEQs IN SUFACE SOIL
SWMU #120
PIER M LAYDOWN

DWG DATE: 02/03/98 | DWG NAME: 2907M059



LEGEND

- ● – SOIL BORING
- ○ – SOIL BORING/SHALLOW MONITORING WELL
- □ – < 3.1 mg/kg
- ▨ – > 3.1 mg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 3.1 mg/kg = RBC FOR ANTIMONY IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN mg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-5
ANTIMONY IN SURFACE SOIL
SWMU #120
PIER M LAYDOWN

DWG DATE: 02/03/98 | DWG NAME: 2907M060

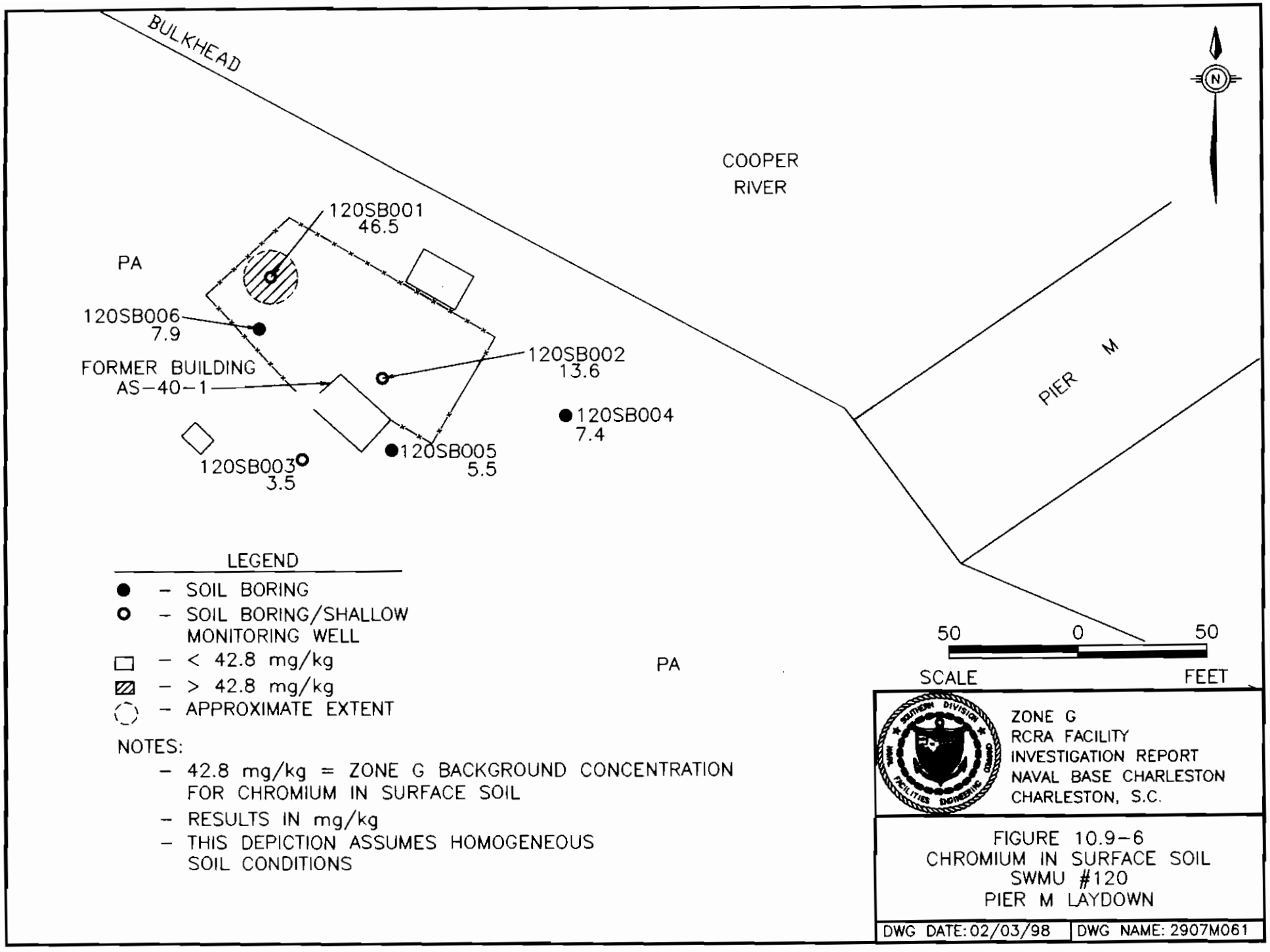

BULKHEAD
COOPER
RIVER
N
PIER M
PA
120SB001
46.5
120SB006
7.9
FORMER BUILDING
AS-40-1
120SB002
13.6
120SB004
7.4
120SB005
5.5
120SB003
3.5
PA
50 0 50
SCALE FEET
LEGEND
● - SOIL BORING
○ - SOIL BORING/SHALLOW MONITORING WELL
□ - < 42.8 mg/kg
▨ - > 42.8 mg/kg
◌ - APPROXIMATE EXTENT
NOTES:
- 42.8 mg/kg = ZONE G BACKGROUND CONCENTRATION FOR CHROMIUM IN SURFACE SOIL
- RESULTS IN mg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 10.9-6
CHROMIUM IN SURFACE SOIL
SWMU #120
PIER M LAYDOWN
DWG DATE: 02/03/98
DWG NAME: 2907M061

Table 10.9.5
Zone G
SWMU 120
Sediment Samples and Analyses

Sample Location	Sample Identifier	Date Collected	Analyses	Remarks
120M0001	120M000101	10/01/96	See Note	
120M0002	NA	NA	NA	Sample not taken.

Notes:
SW-846 (metals, pesticides/PCBs, SVOCs, VOCs) at DQO Level III
NA = Not applicable

10.9.4.1 Nature of Contamination in Sediment

Organic compound analytical results for sediment are summarized in Table 10.9.6. Inorganic analytical results for soil are summarized in Table 10.9.7. Table 10.9.8 summarizes all analytes detected in sediment at SWMU 120. Appendix D contains a complete analytical data report for all Zone G samples.

The following sections discuss sediment sample results in relation to detected soil parameters to offer an indication of potential correlation. However, most SWMU 120 is paved, limiting the potential for surface soil erosion and sediment transport from the immediate site area. Given that sediment samples were collected from engineered structures (storm water catch basins and a floor drain), this material is not true sediment generated in a native setting, and therefore, is not compared to reference concentrations or other criteria.

Table 10.9.6
Zone G
SWMU 120
Organic Analytical Results for Sediment

Parameters	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)
Volatile Organic Compounds (1 Sample) (µg/kg)			
Benzene	1/1	2.00	2.00
Carbon disulfide	1/1	7.00	7.00
Ethylbenzene	1/1	30.0	30.0
Toluene	1/1	10.0	10.0
Xylene (Total)	1/1	270	270
Semivolatile Organic Compounds (1 Sample) (µg/kg)			
BEQs[1]	1/1	7.36	7.36
Benzo(a)anthracene	1/1	72.0	72.0
Chrysene	1/1	160	160
Anthracene	1/1	85.0	85.0
Benzoic acid	1/1	380	380
Benzyl alcohol	1/1	3900	3900
Butylbenzylphthalate	1/1	3000	3000
Di-n-butylphthalate	1/1	370	370
Di-n-octylphthalate	1/1	320	320
Fluoranthene	1/1	700	700
Fluorene	1/1	96.0	96.0
2-Methylnaphthalene	1/1	74.0	74.0
4-Methylphenol(p-Cresol)	1/1	290	290
Naphthalene	1/1	54.0	54.0
Phenanthrene	1/1	520	520
Phenol	1/1	560	560
Pyrene	1/1	410	410
Pesticides and PCBs (1 Sample) (µg/kg)			
4,4'-DDD	1/1	8.60	8.60
4,4'-DDE	1/1	33.0	33.0

Notes:
1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c)
µg/kg = Micrograms per kilogram

Table 10.9.7
Zone G
SWMU 120
Inorganics Analytical Results for Sediment

Parameters	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)
Inorganics (1 Samples) (mg/kg)			
Aluminum (Al)	1/1	2310	2310
Antimony (Sb)	1/1	3.00	3.00
Arsenic (As)	1/1	13.9	13.9
Barium (Ba)	1/1	275	275
Cadmium (Cd)	1/1	5.20	5.20
Calcium (Ca)	1/1	95200	95200
Chromium (Cr)	1/1	57.3	57.3
Cobalt (Co)	1/1	8.30	8.30
Copper (Cu)	1/1	1110	1110
Iron (Fe)	1/1	61200	61200
Lead (Pb)	1/1	241	241
Magnesium (Mg)	1/1	2180	2180
Manganese (Mn)	1/1	481	481
Nickel (Ni)	1/1	65.5	65.5
Potassium (K)	1/1	325	325
Selenium (Se)	1/1	1.30	1.30
Thallium (Tl)	1/1	1.30	1.30
Tin (Sn)	1/1	25.9	25.9
Vanadium (V)	1/1	10.8	10.8
Zinc (Zn)	1/1	1020	1020

Notes:
mg/kg = Milligrams per kilogram

Table 10.9.8
Zone G
SWMU 120
Analytes Detected in Sediment Samples

Parameters	Location	Concentration
Volatile Organic Compounds (μg/kg)		
Benzene	120M0001	2
Carbon disulfide	120M0001	7
Ethylbenzene	120M0001	30
Toluene	120M0001	10
Xylenes	120M0001	270
Semivolatile Organic Compounds (μg/kg)		
BEQs[1]	120M0001	7.36
Benzo(a)anthracene	120M0001	72
Chrysene	120M0001	160
Anthracene	120M0001	85
Benzoic acid	120M0001	380
Benzyl alcohol	120M0001	3900
Butybenzylphthalate	120M0001	3000
Di-n-butylphthalate	120M0001	370
Di-n-octylphthalate	120M0001	320
Fluoranthene	120M0001	700
Fluorene	120M0001	96
2-Methylnaphthalene	120M0001	74
4-Methylphenol	120M0001	290
Naphthalene	120M0001	54
Phenanthrene	120M0001	520
Phenol	120M0001	560
Pyrene	120M0001	410
Pesticides (μg/kg)		
4,4'-DDD	120M0001	8.6
4,4'-DDE	120M0001	33

Table 10.9.8
Zone G
SWMU 120
Analytes Detected in Sediment Samples

Parameters	Location	Concentration
Inorganics (mg/kg)		
Aluminum (Al)	120M0001	2310
Antimony (Sb)	120M0001	3
Arsenic (As)	120M0001	13.9
Barium (Ba)	120M0001	275
Cadmium (Cd)	120M0001	5.2
Calcium (Ca)	120M0001	95200
Chromium (Cr)	120M0001	57.3
Cobalt (Co)	120M0001	8.3
Copper (Cu)	120M0001	1110
Iron (Fe)	120M0001	61200
Lead (Pb)	120M0001	241
Magnesium (Mg)	120M0001	2180
Manganese (Mn)	120M0001	481
Nickel (Ni)	120M0001	65.5
Potassium (K)	120M0001	325
Selenium (Se)	120M0001	1.3
Thallium (Tl)	120M0001	1.3
Tin (Sb)	120M0001	25.9
Vanadium (V)	120M0001	10.8
Zinc (Zn)	120M0001	1020

Notes:
1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c)
µg/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram

Volatile Organic Compounds in Sediment

Five VOCs were detected in SWMU 120 sediment samples. No VOCs were detected in soil at SWMU 120. The highest sediment VOC concentration was 270 μg/kg of xylene.

Semivolatile Organic Compounds in Sediment

Sixteen SVOCs were detected in SWMU 120 sediment samples. Of these SVOCs, ten were also detected in soil samples. The highest sediment SVOC concentration was 3,900 μg/kg of benzyl alcohol.

Pesticides and PCBs in Sediment

Two pesticides, 4,4'-DDD and 4,4'-DDE were detected in SWMU 120 sediment samples. Both of these pesticides were also detected in SWMU 120 soil samples. The highest sediment pesticide concentration in SWMU 120 sediment was 33 μg/kg of 4,4'-DDE.

Inorganic Elements in Sediment

Twenty metals were detected in SWMU 120 sediment samples. Of these metals, all but thallium were also detected in soil. The highest metals concentration detected in sediment samples at SWMU 120 was aluminum at 2310 mg/kg. The concentrations of calcium and iron are not included because they are considered essential nutrients.

10.9.5 Groundwater Sampling and Analysis

The approved final RFI work plan called for the installation and sampling of three shallow monitoring wells within the SWMU 120 area to: (1) assess groundwater quality, and (2) identify contaminants which may be migrating from the site in the shallow aquifer. Three shallow wells were installed during the field investigation (Figure 10.9-1). These wells were installed at approximately 12-ft bgs in the upper sand layer of the Wando Formation. In accordance with the approved final RFI work plan, groundwater samples from this site were analyzed for metals,

pesticides/PCBs, SVOCs and VOCs at DQO Level III. Table 10.9.9 summarizes the SWMU 120 groundwater samples and analyses.

Table 10.9.9
Zone G
SWMU 120
Groundwater Samples and Analyses

Well Number	Well Depth	Sample Identifier	Date Sampled	Analyses	Remarks
120001	Shallow	12000101	11/18/96	See Note	No deviations from work plan.
120002	Shallow	12000201	11/18/96	See Note	
120003	Shallow	12000301	11/18/96	See Note	

Note:
SW-846 (metals, pesticides/PCBs, SVOCs, VOCs) at DQO Level III

10.9.5.1 Nature of Contamination in Groundwater

Inorganic analytical results for groundwater are summarized in Table 10.9.10. Table 10.9.11 summarizes all analytes detected in groundwater at SWMU 120. Appendix D contains a complete analytical data report for all Zone G samples.

Volatile Organic Compounds in Groundwater

No VOCs were detected in SWMU 120 groundwater samples.

Semivolatile Organic Compounds in Groundwater

No SVOCs were detected in SWMU 120 first-quarter groundwater samples.

Pesticides and PCBs in Groundwater

No pesticides or PCBs were detected in SWMU 120 groundwater samples.

Table 10.9.10
Zone G
SWMU 120
Inorganic Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μg/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding RBC
Inorganics (3 Shallow Samples) (μg/L)							
Aluminum (Al)	Shallow	3/3	23.95 - 662	246	3700	50	0
Arsenic (As)	Shallow	2/3	26.5 - 35.3	30.9	0.045	50	2
Barium (Ba)	Shallow	3/3	17.9 - 151	62.3	260	2000	0
Calcium (Ca)	Shallow	3/3	51700 - 101000	80200	NL	NL	NA
Cobalt (Co)	Shallow	1/3	1.45	1.45	220	NL	0
Iron (Fe)	Shallow	3/3	3950 - 7970	6200	NL	300	NA
Lead (Pb)	Shallow	1/3	5.20	5.20	15	15	0
Magnesium (Mg)	Shallow	3/3	26600 - 45500	35200	NL	NL	NA
Manganese (Mn)	Shallow	3/3	213.5 - 627	390	84	50	3
Nickel (Ni)	Shallow	3/3	1.90 - 11.95	6.58	73	100	0
Potassium (K)	Shallow	3/3	15500 - 29300	24000	NL	NL	NA
Selenium (Se)	Shallow	1/3	3.30	3.30	18	50	0
Sodium (Na)	Shallow	3/3	141000 - 319000	214000	NL	NL	NA
Vanadium (V)	Shallow	3/3	0.74 - 4.30	2.05	26	NL	0

Table 10.9.10
Zone G
SWMU 120
Inorganic Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μg/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding RBC
Zinc (Zn)	Shallow	1/3	94.35	94.35	1100	5000	0

Notes:
* = Tap Water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996ce)
μg/L = Micrograms per liter
NL = Not listed
NA = Not applicable

Table 10.9.11
Zone G
SWMU 120
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (µg/L)	MCL/SMCL* (µg/L)	Shallow Background
Semivolatile Organic Compounds (µg/L)							
Benzoic acid	120002	ND	ND	6	15000	NL	NA
	120003	ND	ND	6			
Acenaphthene	120002	ND	ND	2	220	NL	NA
Inorganics (µg/L)							
Aluminum (Al)	120001	662	273	475	3700	50	692
	120002	52.5	57.4	ND			
	120003	23.95	61.1	144			
Arsenic (As)	120001	**26.5**	**41.1**	**60**	0.045	50	17.8
	120002	ND	3.7	5.8			
	120003	**35.3**	**32.7**	**40.1**			
Barium (Ba)	120001	17.9	14.8	ND	260	2000	31
	120002	18.1	18.1	ND			
	120003	151	190	193.5			
Beryllium (Be)	120003	ND	**0.36**	**0.21**	0.016	4	NL
Calcium (Ca)	120001	51700	52400	53100	NL	NL	NL
	120002	101000	98700	76000			
	120003	87950	104500	115500			
Chromium (Cr)	120001	ND	1.5	1.8	18	100	3.88
	120002	ND	1.3	ND			
	120003	ND	ND	2.4			
Cobalt (Co)	120003	1.45	ND	2.21	220	NL	1.45

Table 10.9.11
Zone G
SWMU 120
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (µg/L)	MCL/SMCL* (µg/L)	Shallow Background
Iron (Fe)	120001	7970	8260	8500	NL	300	NL
	120002	3950	2550	4790			
	120003	6665	8100	8470			
Lead (Pb)	120001	ND	2	ND	15	15	4.6
	120003	5.2	3.3	ND			
Magnesium (Mg)	120001	26600	25400	ND	NL	NL	NL
	120002	45500	48300	35500			
	120003	33550	32850	35600			
Manganese (Mn)	120001	330	322	311	84	50	2906
	120002	627	610	636			
	120003	213.5	252	280			
Mercury (Hg)	120001	ND	ND	0.1	1.1	2	NL
Nickel (Ni)	120001	5.9	4.7	4.7	73	100	4.08
	120002	1.9	2.2	1			
	120003	12.0	23.5	15.5			
Potassium (K)	120001	15500	14500	16100	NL	NL	NL
	120002	29300	29800	24300			
	120003	27300	25700	29100			
Selenium (Se)	120003	3.3	ND	ND	18	50	4.3
Silver (Ag)	120003	ND	ND	4	18	100	1.65
Sodium (Na)	120001	182000	150000	ND	NL	NL	NL
	120002	319000	372000	219000			
	120003	141000	212500	219000			

Table 10.9.11
Zone G
SWMU 120
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (µg/L)	MCL/SMCL* (µg/L)	Shallow Background
Vanadium (V)	120001	4.3	1.9	1.72	26	NL	15.4
	120002	1.1	1.5	1.3			
	120003	0.74	ND	ND			
Zinc (Zn)	120003	94.35	195	71.6	1100	5000	15.6

Notes:
NL = Not listed
NA = Not applicable
NT = Not taken
µg/L = Micrograms per liter
* = Tap Water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996e)
Bolded concentrations exceed both the RBC and the zone background
All background values for Zone G are based on twice the means of the grid sample concentrations. Background values for groundwater are based on two sampling rounds in two wells at each depth

Inorganic Elements in Groundwater

Fifteen metals were detected in groundwater samples at SWMU 120. Arsenic was the only metal to exceed its tap water RBC and Zone G background concentration at SWMU 120. Figure 10.9-7 presents the arsenic concentration detected in shallow groundwater at SWMU 120.

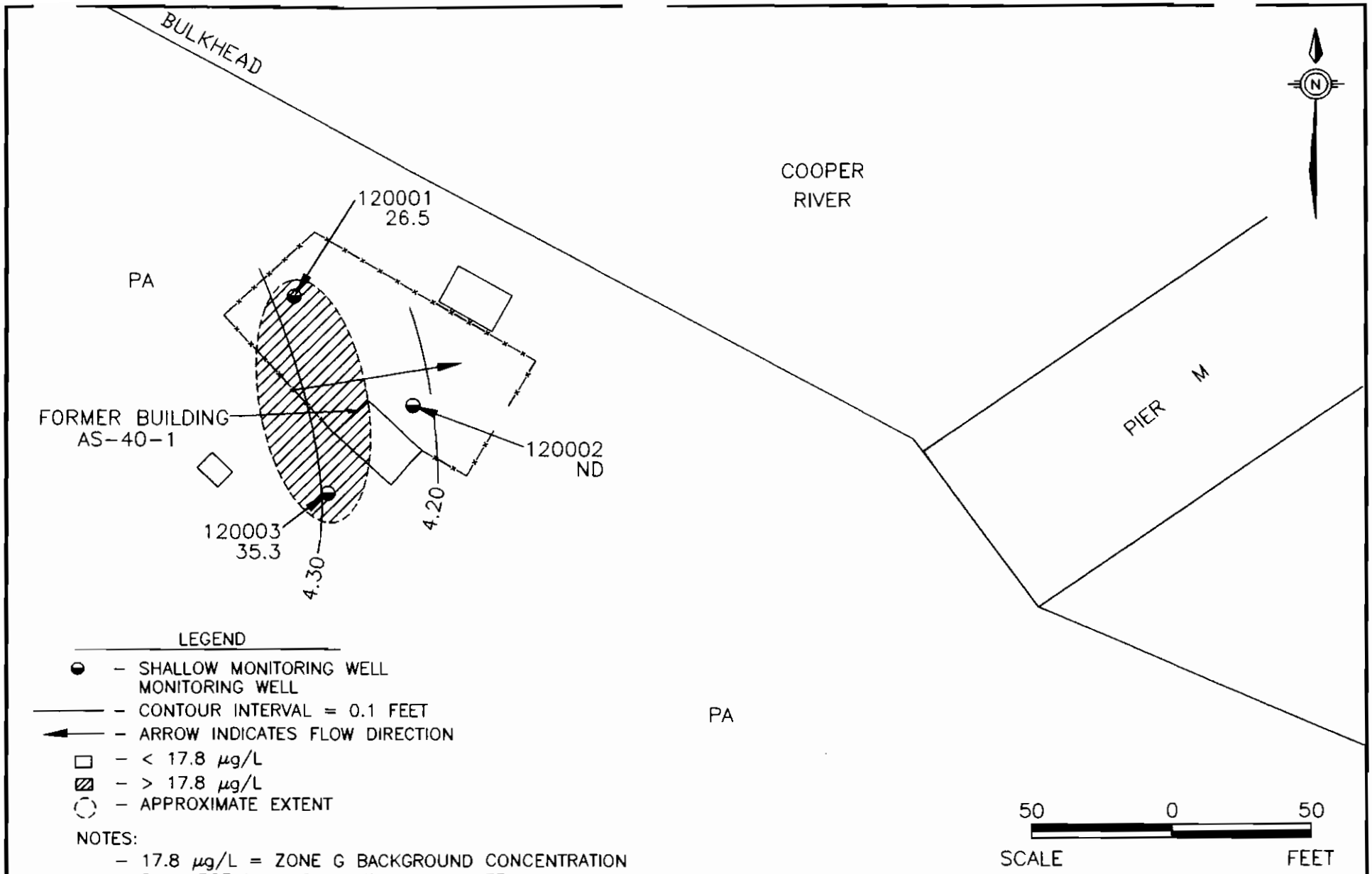
10.9.6 Fate and Transport Assessment

A RFI site, SWMU 120 consists of the lay down area associated with Pier M. Environmental media sampled as part of the SWMU 120 investigation included surface soil, subsurface soil sediments and groundwater. Potential constituent migration pathways investigated for SWMU 120 include soil-to-groundwater, groundwater-to-surface water, surface soil-to-sediment, and emission of volatiles from surface soil to air.

10.9.6.1 Soil-to-Groundwater Cross-Media Transport

Table 10.9.12 compares maximum detected organic constituent concentration in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels or (b) background concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ration of 20:1, with no attenuation of constituents in soil (DAF=20).

Only one organic compound - dieldrin - was detected in SWMU 120 soil at concentrations exceeding groundwater protection SSLs. Dieldrin was detected in 2 of 6 (120SB004 = 7.1 μg/kg, and 120SB006 = 3.9 μg/kg) surface soil samples, but was not present in either of the 2 subsurface soil samples taken. The presence of dieldrin at this SWMU is not consistent with the historical site activities. The vertical distribution of dieldrin, however, is consistent with a surface application of dieldrin. This pesticide has a strong affinity to adsorb to soil media, thereby limiting its mobility and attenuating its concentrations with depth in the soil column. Dieldrin in surface



NOTES:

- 17.8 μg/L = ZONE G BACKGROUND CONCENTRATION FOR ARSENIC IN SHALLOW GROUNDWATER
- RESULTS IN μg/L
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-7
ARSENIC IN SHALLOW GROUNDWATER
SWMU #120
PIER M LAYDOWN

DWG DATE: 02/05/98 | DWG NAME: 2907M062

Table 10.9.12
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Saltwater Surface Water Chronic Screening Levels, and Background Concentrations
NAVBASE Charleston, Zone G: SWMU 120
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Saltwater Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Semivolatile Organic Compounds												
Acenaphthene	84	ND	ND	NA	570000	2200	9.7	G/KG	UG/L	NO	NO	NO
Benzoic acid	87	84	ND	NA	400000	150000	NA	G/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	57	94	ND	NA	4.66E+08	1500	NA	G/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	100	60	ND	NA	2000	0.092	NA	G/KG	UG/L	NO	NO	NO
Benzo(a)pyrene	92	140	ND	NA	8000	0.0092	NA	G/KG	UG/L	NO	NO	NO
Benzo(b)fluoranthene	170	250	ND	NA	5000	0.092	NA	G/KG	UG/L	NO	NO	NO
Benzo(k)fluoranthene	92	ND	ND	NA	49000	0.92	NA	G/KG	UG/L	NO	NO	NO
Chrysene	160	160	ND	NA	160000	9.2	NA	G/KG	UG/L	NO	NO	NO
Indeno(1,2,3-cd)pyrene	57	77	ND	NA	14000	0.092	NA	G/KG	UG/L	NO	NO	NO
Butylbenzylphthalate	95	ND	ND	NA	930000	7300	29.4	G/KG	UG/L	NO	NO	NO
Fluoranthene	260	120	ND	NA	4300000	1500	1.6	G/KG	UG/L	NO	NO	NO
Fluorene	45	ND	ND	NA	560000	1500	NA	G/KG	UG/L	NO	NO	NO
2-Methylnaphthalene	160	ND	ND	NA	126000	1500	NA	G/KG	UG/L	NO	NO	NO
Naphthalene	86	ND	ND	NA	84000	1500	23.5	G/KG	UG/L	NO	NO	NO
Phenanthrene	190	69	ND	NA	1380000	1500	NA	G/KG	UG/L	NO	NO	NO
Pyrene	220	100	ND	NA	4200000	1100	NA	G/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
alpha-Chlordane	24	ND	ND	NA	10000	0.19	0.004	G/KG	UG/L	NO	NO	NO
gamma-Chlordane	2.3	ND	ND	NA	10000	0.19	0.004	G/KG	UG/L	NO	NO	NO
4,4'-DDD	560	7100	ND	NA	16000	0.28	0.025	G/KG	UG/L	NO	NO	NO
4,4'-DDE	130	3100	ND	NA	54000	0.2	0.14	G/KG	UG/L	NO	NO	NO
4,4'-DDT	470	380	ND	NA	32000	0.2	0.001	G/KG	UG/L	NO	NO	NO
Dieldrin	7.1	ND	ND	NA	4	0.0042	0.0019	G/KG	UG/L	YES	NO	NO
Endrin	3.8	ND	ND	NA	1000	11	0.0023	G/KG	UG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	9950	17300	662	NA	1000000	37000	NA	G/KG	UG/L	NO	NO	NO
Antimony	10	3.3	ND	NA	5	15	NA	G/KG	UG/L	YES	NO	NO
Arsenic	16.3	19.1	35.3	NA	29	17.8	36	G/KG	UG/L	NO	YES	NO
Barium	37	40.1	151	NA	1600	2600	NA	G/KG	UG/L	NO	NO	NO
Beryllium	0.74	1	ND	NA	63	0.016	NA	G/KG	UG/L	NO	NO	NO
Cadmium	1.3	0.5	ND	NA	8	18	9.3	G/KG	UG/L	NO	NO	NO
Chromium (total)	46.5	39.4	ND	NA	1000000	180	50	G/KG	UG/L	NO	NO	NO
Cobalt	3.5	4.7	1.5	NA	2000	2200	NA	G/KG	UG/L	NO	NO	NO
Copper	286	69.3	ND	NA	920	130000	8.33	G/KG	UG/L	NO	NO	NO
Lead	223	58.3	5.2	NA	400	15	8.5	G/KG	UG/L	NO	NO	NO
Manganese	118	174	627	NA	1100	2906	NA	G/KG	UG/L	NO	NO	NO
Mercury	0.35	0.26	ND	NA	2.1	11	0.025	G/KG	UG/L	NO	NO	NO
Nickel	25.1	17.9	12	NA	130	730	21.7	G/KG	UG/L	NO	NO	NO
Selenium	0.64	0.41	3.3	NA	5	180	71	G/KG	UG/L	NO	NO	NO
Tin	20.8	ND	ND	NA	11000	22000	NA	G/KG	UG/L	NO	NO	NO
Vanadium	46.9	51.5	4.3	NA	6000	260	NA	G/KG	UG/L	NO	NO	NO
Zinc	501	209	94.4	NA	12000	11000	86	G/KG	UG/L	NO	NO	YES

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 20, from 1996 Soil Screening Guidance or calculated using values from Table 6.4
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, October 22, 1997
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region IV Bulletins, Ecological Risk Assessment, November, 1995; Table 2
For inorganics, the value shown is the greater of the relevant screening value or the corresponding background value.

NA - Not available/Not applicable
ND - Not detected
RBC - Risk based concentration
SSL - Soil screening level
MG/KG - Milligrams per kilogram
NG/KG - Nanograms per kilogram
PG/L - Picograms per liter
UG/KG - Micrograms per kilogram
UG/L - Micrograms per liter

soil is normally temporally persistent as well, exhibiting very slow breakdown over time. Fugitive dust from a nearby area of application could be a potential source associated with the dieldrin in surface soil at this SWMU. Assuming stabilization between soil and groundwater media, the soil-to-groundwater pathway is not expected to be significant for dieldrin, as demonstrated by absence of exceedances in the subsurface soil or groundwater.

One inorganic analyte, antimony, exceeded the groundwater protection criteria in surface soil. It was detected in 3 of 6 locations, but exceeded the SSLs at only one of those locations. Antimony was detected in one subsurface soil at SWMU 120, however, no exceedances were noted. Additionally, shallow groundwater sampling results indicate an absence of antimony in groundwater. The presence of antimony in soil could be consistent with site activities, but its persistent presence noted in this zone, as well as others, would support that it is associated with normal geologic conditions for this area. For example, antimony and arsenic are common impurities in phosphate rock and could account for the consistent presence of these inorganics at most sites in this zone. The levels of antimony in the subsurface soil do not exceed applicable SSLs, nor was antimony detected in groundwater at this site, indicating the soil-to-groundwater migration pathway at SWMU 120 is not expected to be significant for inorganics.

10.9.6.2 Soil-to-Air Cross-Media Transport

No VOCs were detected in surface soil at SWMU 120, consequently, the soil-to-air migration pathway is not considered valid at this site.

10.9.6.3 Groundwater-to-Surface Water Cross-Media Transport

Table 10.9.12 also compares maximum detected organic constituent concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the

greater of (a) risk-based drinking water concentrations, or (b) background concentrations for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

One inorganic — arsenic — was detected in levels in the groundwater that exceeded the applicable drinking water RBC, and a second inorganic - zinc - was detected above surface water screening criteria. Arsenic was detected in two or the three shallow groundwater monitoring wells located at SWMU 120 during first-quarter sampling at concentrations which exceeded the RBC. Arsenic is a common constituent of Zone G soil and groundwater at the concentrations similar to those recorded at SWMU 120, thus making it difficult to assign provenance to this or any other site in Zone G. The concentrations noted are more likely the result of ambient conditions and not attributable to site activities. In consideration of the chemical data presented, the groundwater-to-surface water migration pathway may have merit for this SWMU. However, the groundwater in the surficial aquifer is not currently utilized for consumption, nor is it anticipated to be utilized in the future, thus invalidating the risk-based exposure migration pathway for arsenic.

Zinc was detected in 1 of 3 groundwater samples collected at SWMU 120 (120003=94.35 μg/L). These results were only slightly above the saltwater to surface water chronic screening level. The relationship of zinc to historical uses of this site is unclear; however, zinc is present in both surface and subsurface soil with the highest concentrations recorded in the surface soil. This distribution indicates a potential surface source. The nearest surface water receptor is the Cooper River, located approximately 50 feet northeast of SWMU 120. At this site, groundwater flow is consistent with the discharge to the Cooper River; consequently, this pathway has some merit and should be considered viable. It should be noted, however, that further analysis of transport effects should incorporate attenuation of zinc through the processes of dispersion and retardation to the discharge point, and the effects of dilution upon actual discharge to the Cooper River. Given that

zinc is present in the groundwater at levels that are only slightly elevated above the surface water screening level, the above-cited attenuation effects on concentrations would limit potential impacts to sensitive eco-receptors. As a result, while viable, this pathway is not considered to be significant at this site.

10.9.6.4 Surface Soil-to-Sediment Cross-Media Transport

Table 10.9.8 lists the analytes detected in sediment samples collected as part of the SWMU 120 investigation. Sediment samples were taken at one of two proposed locations. The storm drain catch basin located approximately 100 feet south of SWMU 120 was not sampled due to insufficient sediment to sample. Sediment sample 120M0001 collected from a floor drain in the former Building AS-40-1 contained detectable levels of VOCs, SVOCs, pesticides, and inorganics. The sediment results most likely reflect past disposal procedures at the former building. The effects of this potential discharge to the sewer system will be addressed in the Zone L RFI report.

10.9.6.5 Fate and Transport Summary

One inorganic — dieldrin — was detected in two surface soil locations, and exceeded the SSL of 4.0 μg/kg in one surface soil sample at SWMU 120. Dieldrin was not detected in subsurface soil or in the groundwater. The presence of dieldrin at this SWMU is inconsistent with past practices at the site, but could be attributed to surface soil application in the past as well as fugitive dust from any nearby areas that may have been treated. The analytical results indicate a small residual mass in the soil. Due to the absence of dieldrin in subsurface soil as well as in groundwater, the soil-to-groundwater pathway is not expected to be significant for dieldrin. One inorganic — antimony — exceeds the applicable SSL, but was not shown to be present in the groundwater, thus indicating that the soil-to-groundwater migration pathway for this metal is not significant. One inorganic — arsenic — was detected in the shallow groundwater at levels exceeding the drinking water screening criteria (RBC), and another — zinc — exceeded the surface water screening criteria. Arsenic is commonly detected in the soil and groundwater at many of the sites

of this zone, and may be representative of ambient geologic conditions. Even though it is present above screening levels, the risk-based exposure pathway is invalidated due to non-use of the resource. Zinc is present in a single sample at a concentration only slightly above the surface water screening levels, but was detected in both surface soil and subsurface soil at concentrations below the SSL. The vertical distribution of zinc in soil indicate that a surface source could be present but a relationship to site activities is unknown. Groundwater discharge from this SWMU is to the Cooper River approximately 50 feet to the northeast. However, dispersion, retardation, and dilution upon discharge can be expected to reduce the significance of the surface water migration pathway. Therefore, although viable, this pathway is not considered to be significant at this time. No VOCs were detected in the surface soil, consequently, the soil-to-air pathway is not considered valid at SWMU 120.

10.9.7 Human Health Risk Assessment

10.9.7.1 Site Background and Investigative Approach

SWMU 120 consists of the laydown area associated with Pier M. Materials released, stored, or disposed of at the site included lead bricks and shielding, paint/thinner wastes, and greases.

During the RFI, six soil samples were collected from the upper and two samples were collected form the lower interval to identify potential impacts resulting from the activities listed above. Surface soil samples from all six boring locations were used to quantitatively assess soil exposure pathways. Subsurface soil is addressed in the previous section, Fate and Transport Assessment for SWMU 120. Three monitoring wells were installed in the shallow aquifer. Data from the first- quarter sampling event were used to quantitatively assess groundwater exposure pathways. Sections 10.9.3 and 10.9.5 provide summaries of the sampling effort for SWMU 120 soil and groundwater.

10.9.7.2 COPC Identification

Soil

Based on the screening comparisons described in Section 7 of this RFI and presented in Table 10.9.13, BEQs, antimony, and chromium were identified as COPCs in surface soil.

Groundwater

As shown in Table 10.9.14, arsenic was identified as a COPC for shallow groundwater at SWMU 120.

10.9.7.3 Exposure Assessment

Exposure Setting

SWMU 120 is located near the entrance to Pier M, and is mostly covered by asphalt pavement. Steam pipes traverse the eastern portion of the site, and chain link fencing surrounds the unpaved portion of the site. Access to the site is limited to a gated entry on Hobson Avenue.

Potentially Exposed Populations

Potentially exposed populations are current and future site workers. Additional potentially exposed populations are hypothetical future site residents. Future site resident and worker exposure scenarios were addressed quantitatively in this risk assessment. Current exposure to workers is discussed qualitatively in relation to the future workers and future residents. The hypothetical future site worker scenario assumes continuous exposure to surface soil conditions. Current site workers' exposure would be less than that assumed for the hypothetical future site worker scenario because of their limited soil contact (the pavement would prevent direct contact to a portion of the site). Therefore, future worker assessment is considered to be conservatively representative of current site users. The future site resident scenario was built on the premise that existing features would be removed and replaced with dwellings.

Table 10.9.13
Chemicals Present in Site Samples
SWMU 120 - Surface Soil
Naval Base Charleston, Zone G
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Residential RBC	Background	Units	Number Exceeding RBC	Bkgd
Carcinogenic PAHs													
B(a)P Equiv.	*	2	6	67.378	125.78	96.579	831.96	901.29	88	NA	UG/KG	1	
Benzo(a)anthracene		2	6	66	100	83	360	390	880	NA	UG/KG		
Benzo(a)pyrene	*	2	6	53	92	72.5	360	390	88	NA	UG/KG	1	
Benzo(b)fluoranthene		2	6	72	170	121	360	390	880	NA	UG/KG		
Benzo(k)fluoranthene		2	6	49	92	70.5	360	390	8800	NA	UG/KG		
Chrysene		2	6	88	160	124	360	390	88000	NA	UG/KG		
Indeno(1,2,3-cd)pyrene		1	6	57	57	57	350	390	880	NA	UG/KG		
Inorganics													
Aluminum (Al)		6	6	3030	9950	4836.6667	NA	NA	7800	18700	MG/KG	1	
Antimony (Sb)	*	3	6	1.6	10	5.3333	0.33	0.36	3.1	2.89	MG/KG	2	2
Arsenic (As)		6	6	0.91	16.3	4.635	NA	NA	0.43	17.2	MG/KG	6	
Barium (Ba)		6	6	2.9	37	18.7	NA	NA	550	109	MG/KG		
Beryllium (Be)		3	6	0.4	0.74	0.5467	0.11	0.17	0.15	1.2	MG/KG	3	
Cadmium (Cd)		5	6	0.06	1.3	0.398	0.04	0.04	3.9	1.07	MG/KG		1
Calcium (Ca)		6	6	11400	67800	34700	NA	NA	NA	NA	MG/KG		
Chromium (Cr)	*	6	6	3.5	46.5	14.0667	NA	NA	39	42.8	MG/KG	1	1
Cobalt (Co)		6	6	0.71	3.5	2.0167	NA	NA	470	6.6	MG/KG		
Copper (Cu)		5	6	1.8	288	108.22	3.6	3.6	27000	260	MG/KG		1
Iron (Fe)		6	6	954	12700	4349	NA	NA	NA	NA	MG/KG		
Lead (Pb)		6	6	2.2	223	76.45	NA	NA	400	181	MG/KG		1
Magnesium (Mg)		6	6	287	2800	948.8333	NA	NA	NA	NA	MG/KG		
Manganese (Mn)		6	6	12.7	118	61.1	NA	NA	180	325	MG/KG		
Mercury (Hg)		2	6	0.23	0.35	0.29	0.04	0.04	2.3	1.03	MG/KG		
Nickel (Ni)		6	6	1.7	25.1	12.4167	NA	NA	160	20.6	MG/KG		3
Potassium (K)		3	6	253	908	485.3333	80	224	NA	NA	MG/KG		
Selenium (Se)		4	6	0.35	0.64	0.495	0.33	0.41	39	1.22	MG/KG		
Sodium (Na)		3	6	242	723	468.6667	148	338	NA	NA	MG/KG		
Tin (Sn)		2	6	11	20.8	15.9	0.67	8.2	4700	9.67	MG/KG		2
Vanadium (V)		6	6	2.5	46.9	12.85	NA	NA	55	60.9	MG/KG		
Zinc (Zn)		6	6	5.8	501	182.2	NA	NA	2300	519	MG/KG		
Pesticides													
4,4'-DDD		4	6	12	560	210	2.8	3	2700	NA	UG/KG		
4,4'-DDE		4	6	5.5	130	56.875	2.8	3	1900	NA	UG/KG		
4,4'-DDT		3	6	35	470	275	2.8	3	1900	NA	UG/KG		
alpha-Chlordane		3	6	2.4	24	10.6	1.5	2.8	1800	NA	UG/KG		
Dieldrin		2	6	3.9	7.1	5.5	2.7	34	40	NA	UG/KG		
Endrin		1	6	3.8	3.8	3.8	2.7	34	2300	NA	UG/KG		
gamma-Chlordane		1	6	2.3	2.3	2.3	1.5	20	1800	NA	UG/KG		
Semivolatile Organics													
2-Methylnaphthalene		2	6	45	160	102.5	360	390	310000	NA	UG/KG		
Acenaphthene		1	6	84	84	84	360	440	470000	NA	UG/KG		
Benzo(g,h,i)perylene		1	6	57	57	57	350	390	230000	NA	UG/KG		
Benzoic acid		2	6	58	87	72.5	1700	1800	31000000	NA	UG/KG		
Butylbenzylphthalate		3	6	37	95	61.6667	370	390	1600000	NA	UG/KG		
Fluoranthene		2	6	200	260	230	360	390	310000	NA	UG/KG		
Fluorene		1	6	45	45	45	360	440	310000	NA	UG/KG		
Naphthalene		1	6	86	86	86	350	390	310000	NA	UG/KG		
Phenanthrene		2	6	160	190	175	360	390	230000	NA	UG/KG		
Pyrene		2	6	160	220	190	360	390	230000	NA	UG/KG		

Notes:
* - Indicates chemical was identified as a COPC
SQL - Sample quantitation limit
RBC - Risk-based concentration
UG/KG - micrograms per kilogram
MG/KG - milligrams per kilogram
NA - Not applicable or not available

Table 10.9.14
Chemicals Present in Site Samples
SWMU 120 - Groundwater
Naval Base Charleston, Zone G
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Tap Water RBC	Screening Concentration Background	Units	Number Exceeding RBC	Number Exceeding Bkgd
Inorganics													
Aluminum (Al)		3	3	23.95	662	246	NA	NA	3700	692	UG/L		
Arsenic (As)	*	2	3	26.5	35.3	30.9	2.5	2.5	0.045	17.8	UG/L	2	2
Barium (Ba)		3	3	17.9	151	62.3	NA	NA	260	31	UG/L		1
Calcium (Ca)		3	3	51700	101000	80217	NA	NA	NA	NA	UG/L		
Cobalt (Co)		1	3	1.45	1.45	1.5	0.9	0.9	220	1.45	UG/L		1
Iron (Fe)		3	3	3950	7970	6195	NA	NA	NA	NA	UG/L		
Lead (Pb)		1	3	5.2	5.2	5.2	1.7	1.7	15	4.6	UG/L		1
Magnesium (Mg)		3	3	26600	45500	35217	NA	NA	NA	NA	UG/L		
Manganese (Mn)		3	3	213.5	627	390	NA	NA	84	2906	UG/L	3	
Nickel (Ni)		3	3	1.9	11.95	6.6	NA	NA	73	4.08	UG/L		2
Potassium (K)		3	3	15500	29300	24033	NA	NA	NA	NA	UG/L		
Selenium (Se)		1	3	3.3	3.3	3.3	2.8	2.8	18	4.3	UG/L		
Sodium (Na)		3	3	141000	319000	214000	NA	NA	NA	NA	UG/L		
Vanadium (V)		3	3	0.74	4.3	2.0	NA	NA	26	15.4	UG/L		
Zinc (Zn)		1	3	94.35	94.35	94.4	5.6	20.6	1100	15.6	UG/L		1

Notes:
* - Indicates chemical was identified as a COPC
SQL - Sample quantitation limit
RBC - Risk-based concentration
UG/L - micrograms per liter
NA - Not applicable or not available

Exposure Pathways

Exposure pathways for the hypothetical future site residents are dermal contact and incidental ingestion of surface soils. The exposure pathways for future site workers are the same as those for the future site residents with respect to soil. The groundwater pathway for the hypothetical future site residents is incidental ingestion of groundwater. No VOCs were reported in first-quarter groundwater samples at SWMU 120, therefore the inhalation of volatiles pathway was not addressed for this site. Uniform exposure was assumed for all sample locations. Table 10.9.15 presents the justification for exposure pathways assessed in this HHRA.

Exposure Point Concentrations

Since less than ten surface soil samples were collected, maximum detected concentrations were used as EPCs, as discussed in Section 7 of this RFI. Since only three monitoring wells were established for SWMU 120, maximum reported concentrations in the first-quarter samples were used as EPCs as well.

Quantification of Exposure

Soil

CDIs for ingestion and dermal contact with soils are shown in Tables 10.9.16 and 10.9.17, respectively.

Groundwater

CDIs for the groundwater pathway are shown in Table 10.9.18.

10.9.7.4 Toxicity Assessment

Toxicity assessment terms and methods are discussed in Section 7 of this report. Table 10.9.19 presents toxicological information specific to each COPC identified at SWMU 120. This information was used in the quantification of risk/hazard associated with soil contaminants. Brief toxicological profiles for each COPC are provided in the following paragraphs.

Table 10.9.15
Zone G
SWMU 120
Exposure Pathways Summary

Potentially Exposed Population	Medium and Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Current Land Uses			
Current Users (Site Workers)	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No	This exposure pathway was considered insignificant compared to the other pathways.
	Shallow groundwater, Ingestion of contaminants during potable or general use	No	Shallow groundwater is not currently used as a source of potable or non-residential water at SWMU 120.
	Shallow groundwater, Inhalation of volatilized shallow groundwater contaminants	No	Shallow groundwater is not currently used as a source of potable or non-residential water at SWMU 120.
	Soil, Incidental ingestion	No (Qualified)	Future site use is considered conservatively representative of current site use.
	Soil, Dermal contact	No (Qualified)	Future site use is considered conservatively representative of current site use.
Future Land Uses			
Future Site Residents (Child and Adult), Future Site Worker	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No	This exposure pathway was considered insignificant compared to the other pathways.
	Shallow groundwater, Ingestion of contaminants during potable or general use	Yes	Shallow groundwater is not likely to be used as a source of potable or non-residential water at SWMU 120. This pathway was addressed as a conservative measure.
	Shallow groundwater, Inhalation of volatilized contaminants during domestic use	No	Volatile COPCs were not identified subsequent to risk-based screening comparisons.
	Soil, Incidental ingestion	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Soil, Dermal contact	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Wild game or domestic animals, Ingestion of tissue impacted by media contamination	No	Hunting/taking of game and/or raising livestock is prohibited within the Charleston, South Carolina city limits.

Table 10.9.15
Zone G
SWMU 120
Exposure Pathways Summary

Potentially Exposed Population	Medium and Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
	Fruits and vegetables, Ingestion of plant tissues grown in media	No	The potential for significant exposure via this pathway is low relative to that of other exposure pathways assessed.

Table 10.9.16
Chronic Daily Intakes
Incidental Ingestion of Surface Soil
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Fraction Ingested from Contaminated Source *	Exposure Point Concentration (mg/kg)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Worker adult H-CDI (mg/kg-day)	Future Worker adult C-CDI (mg/kg-day)
Inorganics							
Antimony (Sb)	1	10	1.4E-05	1.3E-04	1.6E-05	4.9E-06	1.7E-06
Chromium (Cr)	1	47	6.4E-05	5.9E-04	7.3E-05	2.3E-05	8.1E-06
Carcinogenic PAHs							
Benzo(a)pyrene Equivalents	1	0.13	1.7E-07	1.6E-06	2.0E-07	6.2E-08	2.2E-08

NOTES:

lwa Lifetime weighted average; used to calculate carcinogenic CDI, RAGS Parts A and B
CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
* Reflects the estimated fraction of the site impacted by the corresponding COPC.

Table 10.9.17
Chronic Daily Intakes
Dermal Contact with Surface Soil
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	FI/FC *	Exposure Point Concentration (mg/kg)	Dermal Absorption Factor (unitless)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Worker adult H-CDI (mg/kg-day)	Future Worker adult C-CDI (mg/kg-day)
Inorganics								
Antimony (Sb)	1	10	0.001	5.6E-07	1.9E-06	3.5E-07	4.0E-07	1.4E-07
Chromium (Cr)	1	47	0.001	2.6E-06	8.6E-06	1.6E-06	1.9E-06	6.7E-07
Carcinogenic PAHs								
Benzo(a)pyrene Equivalents	1	0.13	0.01	7.1E-08	2.3E-07	4.4E-08	5.0E-08	1.8E-08

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
* Reflects the estimated fraction of the site impacted by the corresponding COPC.
\- The dermal absorption factor was applied to the exposure point concentration to reflect the ability for trans-dermal migration of inorganic and organic chemicals

Table 10.9.18
Chronic Daily Intakes
Ingestion of COPCs in Shallow Groundwater
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Exposure Point Concentration (mg/L)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Worker adult H-CDI (mg/kg-day)	Future Worker adult C-CDI (mg/kg-day)
Inorganics						
Arsenic (As)	0.035	9.67E-04	2.26E-03	5.32E-04	3.45E-04	1.70E-04

NOTES:
lwa lifetime weighted average
CDI Chronic Daily Intake
H-CDI Non-carcinogenic hazard based Chronic Daily Intake
C-CDI Carcinogenic risk based Chronic Daily Intake

Ta... .d.9.19

Toxicological Reference Information

for Chemicals of Potential Concern

SWMU 120

Naval Base Charleston, Zone G

Charleston, South Carolina

	Non-Carcinogenic Toxicity Data										*Carcinogenic Toxicity Data*					
hemical	Oral Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Oral	Inhalation Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Inhalation	Oral Slope Factor (kg-day/mg)		Inhalation Slope Factor (kg-day/mg)		Weight of Evidence	Tumor Type
nimony	0.0004	a	L	whole body/blood increased mortality	1,000	NA		NA	NA	NA	NA		NA		D	NA
rsenic	0.0003	a	M	hyperpigmentation	3	NA		NA	NA	NA	1.5	a	15.1	a	A	various
enzo(a)pyrene Equivalents	NA		NA	NA	NA	NA		NA	NA	NA	7.3	a	6.1	b	B2	mutagen
hromium III	1	a	L	NA	100/10	5.71E-07	b	NA	NA	NA	NA		NA	a	D	NA
hromium VI	0.005	a	L	NA	500	NA		NA	NA	NA	NA		42	a	A	lung

otes:

= Integrated Risk Information System (IRIS)

= Withdrawn from IRIS/HEAST

A = Not applicable or not available

= Low confidence

= Medium confidence

Antimony is absorbed slowly through the gastrointestinal tract, which is the target of this element. Another target is the blood, where antimony concentrates. Due to frequent industrial use, the primary exposure route for antimony to the general population is ingestion. Antimony is also a common air pollutant from industrial emissions. USEPA has not classified antimony as a carcinogen, and the oral RfD is 0.0004 mg/kg-day (Klaassen, et al., 1986). The oral RfD is based on a LOAEL of 0.35 mg/kg-day, an uncertainty factor of 1000, and a modifying factor of 1 (IRIS, 1995).

Arsenic exposure via the ingestion route causes darkening and hardening of the skin in chronically exposed humans. Inhalation exposure to arsenic causes neurological deficits, anemia, and cardiovascular effects (Klaassen, et al., 1986). USEPA set 0.3 μg/kg-day as the RfD for arsenic based on a NOAEL of 0.8 μg/kg-day in a human exposure study. Arsenic's effects on the nervous and cardiovascular systems are primarily associated with acute exposure to higher levels. Exposure to arsenic-containing materials has been shown to cause cancer in humans. Inhalation of these materials can lead to increased lung cancer risk, and ingestion of these materials is associated with increased skin cancer rates. Arsenic has been classified as a group A carcinogen by USEPA, who established the 1.5 $(mg/kg\text{-}day)^{-1}$ SF. As listed in IRIS the basis for the classification is sufficient evidence from human data. An increased lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Also, increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in inorganic arsenic. Human milk contains about 3 μg/L arsenic. The tap water RBC for arsenic is 0.045 μg/L. As listed in IRIS the critical effect of this chemical is hyperpigmentation, keratosis, and possible vascular complications. The uncertainty factor was determined to be 3 and the modifying factor was determined to be 1.

Benzo(a)pyrene equivalents include the following list of polynuclear aromatic hydrocarbons (PAHs):

Benzo(a)anthracene	TEF	0.1
Benzo(b)fluoranthene	TEF	0.1
Dibenz(a,h)anthracene	TEF	1.0
Benzo(k)fluoranthene	TEF	0.01
Benzo(a)pyrene	TEF	1.0
Indeno(1,2,3-cd)pyrene	TEF	0.1
Chrysene	TEF	0.001

Some PAHs are toxic to the liver, kidney, and blood. However, the toxic effects of the PAHs above have not been well established. There are no RfDs for the PAHs above due to a lack of data. All PAHs listed above are classified by USEPA as B2 carcinogens, and their carcinogenicity is addressed relative to that of benzo(a)pyrene, having an oral SF 7.3 $(mg/kg\text{-}day)^{-1}$. Toxicity Equivalency Factors, also set by USEPA, are multipliers that are applied to the detected concentrations, which are subsequently used to calculate excess cancer risk. These multipliers are discussed further in the exposure and toxicity assessment sections. Most carcinogenic PAHs have been classified as such due to animal studies using large doses of purified PAHs. There is some doubt as to the validity of these listings, and the SFs listed in USEPA's RBC table are provisional. However, these PAHs are carcinogens when the exposure involves a mixture of other carcinogenic substances (e.g., coal tar, soot, cigarette smoke, etc.). As listed in IRIS, the basis for the benzo(a)pyrene B2 classification is human data specifically linking benzo(a)pyrene to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating benzo(a)pyrene to be carcinogenic by numerous routes.

Benzo(a)pyrene has produced positive results in numerous genotoxicity assays. At the June 1992 CRAVE Work Group meeting, a revised risk estimate for benzo(a)pyrene was verified (see

Additional Comments for Oral Exposure). This section provides information on three aspects of the carcinogenic risk assessment for the agent in question: the USEPA classification and quantitative estimates of exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in application of a low-dose extrapolation procedure and presented as the risk per mg/kg-day. The unit risk is the quantitative estimate in terms of either risk per μg/L drinking water or risk per $\mu g/m^3$ air breathed. The third form in which risk is presented is drinking water or air concentration providing cancer risks of 1 in 10,000 or 1 in 1,000,000. The Carcinogenicity Background Document provides details on the carcinogenicity values found in IRIS. Users are referred to the Oral Reference Dose and Reference Concentration sections for information on long-term toxic effects other than carcinogenicity.

As listed in IRIS, the basis for the dibenz(a,h)anthracene and benzo(b)fluoranthene B2 classification is no human data and sufficient data from animal bioassays. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal or subcutaneous injection, and skin painting. As listed in IRIS, the basis for the benzo(a)anthracene B2 classification is no human data and sufficient data from animal bioassays. Benzo(a)anthracene produced tumors in mice exposed by gavage; intraperitoneal, subcutaneous or intramuscular injection; and topical application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. As listed in IRIS the basis for the benzo(k)fluoranthene B2 classification is no human data and sufficient data from animal bioassays. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in skin-painting studies. Equivocal results have been found in a lung adenoma assay in mice. Benzo(k)fluoranthene is mutagenic in bacteria. (Klaassen, et al., 1986).

Chromium exists in two stable, natural forms: CrIII and CrVI. Acute exposure to chromium can result in kidney damage following oral exposure or damage to the nasal mucosa and septum

following inhalation exposure. Chronic inhalation exposure to CrVI has resulted in kidney and respiratory tract damage, as well as excess lung cancer in both animals and humans following occupational exposure. Only CrVI is believed to be carcinogenic by inhalation (IRIS). Oral RfD values for CrIII and CrVI are 1.0 and 5E-3 (mg/kg-day), respectively. For CrIII, the RfD is based on liver toxicity in the rat. For the CrVI, the RfD is based on unspecified pathological changes observed in rat studies. In addition, CrVI is considered a group A carcinogen for inhalation exposures, and a SF of 42 $(mg/kg\text{-}day)^{-1}$ has been established for the CrVI. Vitamin supplements contain approximately 0.025 mg of chromium. As listed in IRIS, no critical effects were observed for CrIII. The uncertainty factor was 100 and the modifying factor was 10. As listed in IRIS, no critical effects were observed for CrVI. The uncertainty factor for CrVI was 500 and the modifying factor was 1.

10.9.7.5 Risk Characterization

Surface Soil Pathways

Exposure to surface soil onsite was evaluated under residential and industrial (site worker) scenarios. For these scenarios, the incidental ingestion and dermal contact exposure pathways were evaluated. For noncarcinogenic contaminants evaluated for future site residents, hazard was computed separately to address child and adult exposure. Tables 10.9.20 and 10.9.21 present the computed carcinogenic risks and/or HQs associated with the incidental ingestion of and dermal contact with site surface soils, respectively.

Hypothetical Site Residents

The ingestion ILCR (based on the adult and child lifetime weighted average) for SWMU 120 surface soils is 1E-06. The dermal pathway ILCR is 6E-07. Benzo(a)pyrene equivalent compounds were the sole contributors to ILCR projections for the ingestion and dermal pathways.

Table 10.9.20
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Surface Soil Ingestion
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Future Worker Adult Hazard Quotient	Future Worker Adult ILCR
Inorganics							
Antimony (Sb)	0.0004	NA	0.034	0.32	ND	0.012	ND
Chromium (Cr)	0.005	NA	0.013	0.12	ND	0.005	ND
Carcinogenic PAHs							
Benzo(a)pyrene Equivalents	NA	7.3	ND	ND	1.4E-06	ND	1.6E-07
SUM Hazard Index/ILCR			0.05	0.4	1E-06	0.02	2E-07

NOTES:

NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk

Table 10.9.21
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact With Surface Soil
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Dermal Adjustment	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Future Worker Adult Hazard Quotient	Future Worker Adult ILCR
Inorganic								
Antimony (Sb)	0.2	0.00008	NA	0.0070	0.023	ND	0.0050	ND
Chromium (Cr)	0.2	0.001	NA	0.0026	0.009	ND	0.0019	ND
Carcinogenic PAHs								
Benzo(a)pyrene Equivalents	0.5	NA	14.6	ND	ND	6.5E-07	ND	2.6E-07
SUM Hazard Index/ILCR				0.01	0.03	6E-07	0.007	3E-07

NOTES:

NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk
- Dermal to absorbed dose adjustment factor is applied to adjust for Oral SF and RfD (i.e., the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI)

The ingestion HIs projected for the adult and child receptors are 0.05 and 0.4, respectively. The dermal pathway HIs were 0.01 for the adult resident receptor and 0.03 for the child resident receptor.

Hypothetical Site Workers

Site worker ILCRs are 2E-07 for the ingestion pathway and 3E-07 for the dermal contact pathway. Benzo(a)pyrene equivalent compounds were the sole contributors to ILCR projections for the ingestion and dermal pathways.

Site worker HIs were 0.02 for the ingestion pathway and 0.007 for the dermal pathway.

Groundwater Pathways

Exposure to shallow groundwater onsite was evaluated under a residential scenario based on the results of first-quarter sampling event. The ingestion exposure pathway was evaluated assuming the site groundwater will be used for potable and/or domestic purposes and that an unfiltered well, drawing from the corresponding water bearing zone, will be installed. For noncarcinogenic contaminants evaluated relative to future site residents, hazard was computed separately for child and adult receptors. Table 10.9.22 presents the risk and hazard for the ingestion pathway. Since no VOCs were identified as COPCs in groundwater at SWMU 120, the inhalation pathway was not addressed at this site.

Hypothetical Site Residents

Arsenic was the only COPC identified in shallow groundwater, and is the sole contributor to groundwater risk and hazard associated with SWMU 120 groundwater pathways. The ILCR for the future residential scenario is 8E-04. The hazard indices for the adult and child resident are 3 and 8, respectively.

Table 10.9.22
Hazard Quotients and Incremental Lifetime Cancer Risks
Shallow Groundwater Ingestion
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Future Worker Adult Hazard Quotient	Future Worker Adult ILCR
Inorganics							
Arsenic (As)	0.0003	1.5	3.2	7.5	8.0E-04	1.15	2.5E-04
SUM Hazard Index/ILCR			3	8	8E-04	1.2	3E-04

NOTES:

NA Not available
ND Not Determined due to lack of available information
lwa lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime excess Cancer Risk

Hypothetical Site Workers

The groundwater pathway risk for the site worker scenario is 3E-04 and the hazard index is 1.2. Arsenic was the sole contributor to risk and hazard projections associated with the groundwater pathway.

Current Site Workers

Shallow groundwater is not currently used as a potable water source for SWMU 120 or other areas of Zone G. In the absence of a completed exposure pathway, no threat to human health is posed by reported shallow groundwater quality.

COCs Identified

Chemicals of concern were identified based on cumulative (all pathway) risk and hazard projected for this site on a medium-specific basis. USEPA has established a generally acceptable risk range of 1E-04 to 1E-06, and a hazard index threshold of 1.0 (unity). As recommended by SCDHEC, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual ILCR exceeds 1E-06 or whose hazard quotient exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-04 (and individual ILCR of 1E-06) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used in order to provide a more comprehensive evaluation of chemicals contributing to carcinogenic risk or noncarcinogenic hazard during the remedial goal options development process. Table 10.9.23 presents the COCs identified for SWMU 120 surface soil and groundwater.

Table 10.9.23
Summary of Risk and Hazard-based COCs
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident Iwa ILCR	Future Site Worker Hazard Quotient	Future Site Worker ILCR	Identification of COCs
Surface Soil	Incidental Ingestion	**Inorganic**						
		Antimony (Sb)	0.034	0.32	ND	0.012	ND	
		Chromium (Cr)	0.013	0.12	ND	0.005	ND	
		Carcinogenic PAHs						
		Benzo(a)pyrene Equivalents	ND	ND	1.4E-06	ND	1.6E-07	2
	Dermal	**Inorganic**						
		Antimony (Sb)	0.007	0.023	ND	0.0050	ND	
		Chromium (Cr)	0.003	0.009	ND	0.0019	ND	
		Carcinogenic PAHs						
		Benzo(a)pyrene Equivalents	ND	ND	6.5E-07	ND	2.6E-07	2
Surface Soil Pathway Sum			0.06	0.5	2E-06	0.02	4E-07	
Groundwater	Ingestion	**Inorganics**						
		Arsenic (As)	3.2	7.5	8.0E-04	1.2	2.5E-04	1 2 3 4
Groundwater Pathway Sum			3	8	8E-04	1	3E-04	
Sum of All Pathways			3	8	8E-04	1	3E-04	

Notes:
ND indicates not determined due to the lack of available risk information.
ILCR indicates incremental excess lifetime cancer risk
HI indicates hazard index
1- Chemical is a COC by virtue of projected child residence noncarcinogenic hazard.
2- Chemical is a COC by virtue of projected future resident lifetime ILCR.
3- Chemical is a COC by virtue of projected site worker noncarcinogenic hazard.
4- Chemical is a COC by virtue of projected site worker ILCR.

Surface Soils

Future Site Residents

Benzo(a)pyrene equivalent compounds were identified as soil pathway COCs based on their contribution to cumulative residential ILCR projections.

Future Site Workers

No soil pathway COCs were identified for the site worker scenario.

The extent of the COCs identified in surface soil is briefly discussed below. To facilitate this discussion, residential soil RBCs and background concentrations were compared to each reported COC concentration. Benzo(a)pyrene equivalents were detected in only one of six surface soil samples (120SB001) at a concentration above the residential RBC (88 μg/kg) and were not detected in four of five of the remaining surface soil samples. Of the individual carcinogenic PAHs that comprise benzo(a)pyrene equivalents reported for surface soil sample 120SB001, only benzo(a)pyrene exceeded its respective RBC.

First-quarter Groundwater

Arsenic was identified as the only groundwater COC for SWMU 120, based on its contribution risk and hazard projections for the residential and site worker scenarios. Arsenic was detected at a maximum concentration in the first-quarter shallow groundwater sample (120003) at 35.3 μg/L exceeding its tap water RBC (0.045 μg/L), and its background value (17.8 μg/L). The maximum reported concentration of arsenic did not, however, exceed its respective MCL of 50 μg/L.

10.9.7.6 Risk Uncertainty

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure.

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. If this area were to be used as a residential site, the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, exposure to surface soil conditions as represented by samples collected during the RFI would not be likely under a true future residential scenario. These factors indicate that exposure pathways assessed in this HHRA would generally overestimate the risk and hazard posed to current site workers and future site residents.

Groundwater is not currently used at SWMU 120 for potable or industrial purposes. A base-wide system provides drinking and process water to buildings throughout Zone G. This system is slated to remain in operation under the current base reuse plan. As a result, shallow groundwater would not be expected to be used under future site use scenarios, and associated pathways are not expected to be completed in the future.

Determination of Exposure Point Concentrations

The maximum detected soil and groundwater constituent concentrations were used as the exposure point concentrations for this site. Use of maximum detected concentrations represent conservative assumptions when applied as the EPC, such that it is unlikely that the maximum detected concentration would be exceeded by the true mean concentration. Since only three monitoring wells were established on site, it is difficult to conclude whether the first-quarter data is

representative of the average arsenic concentration in the surficial aquifer over time. Subsequent quarterly samples indicated similar results for arsenic, indicating that first-quarter data could be conservatively representative of the surficial aquifer.

Frequency of Detection and Spatial Distribution

Benzo(a)pyrene equivalent compounds were detected in only two of six surface soil samples. Based on available surface soil data, it does not appear that the elevated concentrations of benzo(a)pyrene equivalents are widespread. In consideration of the apparent isolated nature of benzo(a)pyrene equivalent impacts, in conjunction with their marginal exceedance of RBCs it is indicated that the risk and hazard may have been over estimated for these compounds.

Quantification of Risk/Hazard

As indicated by the discussions above, the uncertainty inherent in the risk assessment process is great. In addition, many site-specific factors have affected the uncertainty of this assessment that would upwardly bias the risk and hazard estimates. Exposure pathway-specific sources of uncertainty are discussed below.

Soil

A conservative screening process was used to identify COPCs for SWMU 120. The potential for eliminating CPSSs with the potential for cumulative HI greater than 1 was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens, the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, only aluminum, arsenic, and beryllium were reported at concentrations near their RBCs (e.g. within 10% of their RBCs). Each of these elements was detected at a concentration exceeding its RBC, however, its maximum concentration did not

exceed its background concentration. As a result, each chemical was eliminated from consideration in the risk assessment.

Groundwater

The same conservative screening process used for soil is also used for groundwater. Of the CPSSs screened and eliminated from formal assessment, none was reported at a concentration close to its RBC (e.g. within 10% of its RBC).

Groundwater is not currently used as a potable water source at SWMU 120, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

Background-related Risk

Soil

Aluminum, arsenic, and beryllium were detected in SWMU 120 surface soil at concentrations above their respective RBCs. These elements were eliminated from consideration in the risk assessment based on comparison to corresponding background values. It is not unusual for naturally occurring or background concentrations of some elements to exceed risk-based concentrations. It is the risk assessment's function to identify excess risk and/or hazard, or that which is above background levels. The following is a discussion of the residential scenario risk/hazard associated with background concentrations of aluminum, arsenic, and beryllium.

The maximum surface soil concentration of aluminum (9,950 mg/kg) for SWMU 120 equates with hazard quotients of 0.1 and 0.007 for the residential child and site worker, respectively. The

maximum surface soil concentration of arsenic (16.3 mg/kg) equates with ILCRs of 4E-05 and 6E-06 for the residential and site worker scenarios, respectively. The maximum reported concentration of arsenic also equates with hazard quotients of 0.7 and 0.04 for the residential child and site worker, respectively. The maximum reported concentration of beryllium (.74 mg/kg) yielded ILCRs of 6E-06 and 8E-07 for the residential and site worker scenarios, respectively. Hazard quotients resulting from the maximum reported concentration of beryllium were 0.002 and 0.0001 for the residential child and the site worker, respectively.

10.9.7.7 Risk Summary

The risk and hazard posed by contaminants at SWMU 120 were assessed for future site workers and future site residents under reasonable maximum exposure assumptions. The absence of significant lead concentrations in surface soil indicates that the primary source for potential contamination (palletized lead bricks) at SWMU 120, resulted in minimal impacts. For surface soils, the incidental ingestion and dermal contact pathways were assessed in this HHRA. For groundwater the ingestion pathway was assessed. Table 10.9.24 presents the risk summary for each pathway/receptor group evaluated for SWMU 120.

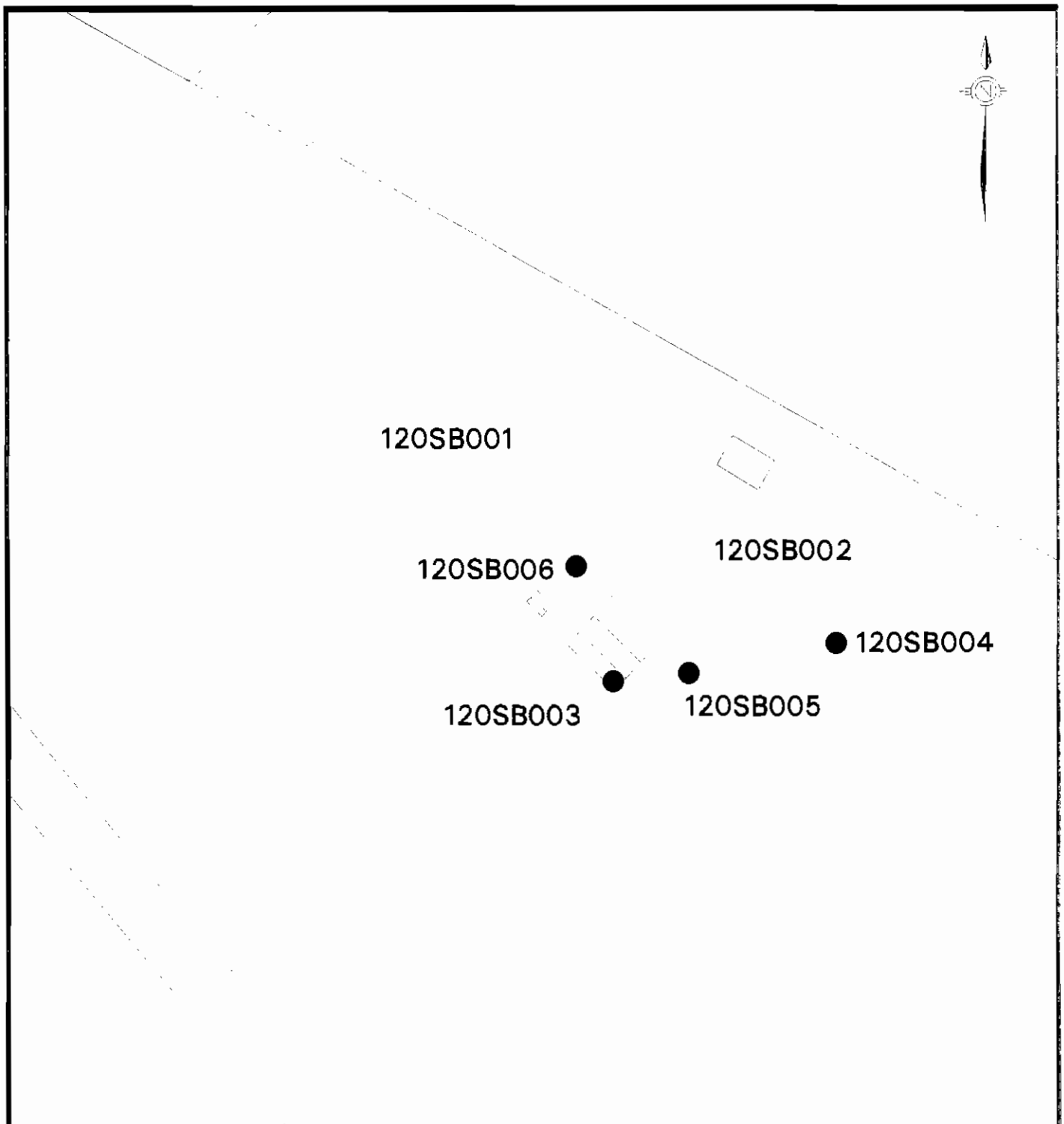
Soil — Residential Scenario

Residential soil pathway COCs identified for SWMU 120 are benzo(a)pyrene equivalents. Figure 10.9-8 illustrates point risk estimates for SWMU 120 based on soil exposure pathways under a future residential scenario. Table 10.9.25 summarizes the risk and hazard contribution of each COPC at each sample location. This point risk map is based on the unlikely assumption that a potential future site resident will be chronically exposed to specific points. Exposure to surface soil conditions is more likely the result of uniform exposure to the soil conditions of the entire site (or exposure unit area) rather than specific points. With this in mind, risk maps supplemented by the tables are useful in that they allow the reader to visualize how chemicals driving risk estimates are spatially distributed across the site.

Table 10.9.24
Summary of Risk and Hazard
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)
Surface Soil	Incidental Ingestion	0.05	0.4	1E-06	0.02	2E-07
	Dermal Contact	0.01	0.03	6E-07	0.007	3E-07
Sum of Soil Pathways		0.06	0.5	2E-06	0.02	4E-07
Groundwater	Ingestion	3	8	8E-04	1.2	3E-04
Sum of Groundwater Pathways		3	8	8E-04	1	3E-04
Sum of All Pathways		3	8	8E-04	1	3E-04

Notes:
ILCR Indicates incremental lifetime cancer risk
HI Indicates hazard index



LEGEND

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 120

ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-8
POINT RISK ESTIMATES FOR SURFACE SOIL
RESIDENTIAL SCENARIO
SWMU 120

AML: /home3/projects/charleston_dir/zone_g_dir/risk_dir

Table 10.9.25
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
120	001	Antimony (Sb)	10.0	MG/KG	0.3428	72.9	NA	
120	001	B(a)P Equiv.	125.8	UG/KG	NA		2.083	100
120	001	Chromium (Cr)	46.5	MG/KG	0.1275	27.1	NA	
		Total			0.4703		2.083	
120	002	Antimony (Sb)	4.4	MG/KG	0.1508	80.2	NA	
120	002	B(a)P Equiv.	67.4	UG/KG	NA		1.116	100
120	002	Chromium (Cr)	13.6	MG/KG	0.0373	19.8	NA	
		Total			0.1881		1.116	
120	003	Antimony (Sb)	ND	MG/KG	NA		NA	
120	003	B(a)P Equiv.	ND	UG/KG	NA		NA	
120	003	Chromium (Cr)	3.5	MG/KG	0.0096	100	NA	
		Total			0.0096		NA	
120	004	Antimony (Sb)	ND	MG/KG	NA		NA	
120	004	B(a)P Equiv.	ND	UG/KG	NA		NA	
120	004	Chromium (Cr)	7.4	MG/KG	0.0203	100	NA	
		Total			0.0203		NA	
120	005	Antimony (Sb)	ND	MG/KG	NA		NA	
120	005	B(a)P Equiv.	ND	UG/KG	NA		NA	
120	005	Chromium (Cr)	5.5	MG/KG	0.0151	100	NA	
		Total			0.0151		NA	
120	006	Antimony (Sb)	1.6	MG/KG	0.0548	71.7	NA	
120	006	B(a)P Equiv.	ND	UG/KG	NA		NA	
120	006	Chromium (Cr)	7.9	MG/KG	0.0217	28.3	NA	
		Total			0.0765		NA	

Benzo(a)pyrene equivalents are the sole contributors to risk estimates above 1E-06 at two of six surface soil sample locations. Risk estimates ranged from 1E-06 (120SB002) to 2E-06 (120SB001).

Antimony and chromium were the sole contributors to hazard estimates at SWMU 120; however, hazard indices did not exceed unity at any surface soil sample location. Hazard index estimates ranged from 0.01 (120SB003) to 0.5 (120SB001).

Soil — Site Worker Scenario

No soil pathway COCs were identified for the site worker scenario.

Groundwater — Residential Scenario

Arsenic was identified as a groundwater pathway COC. As shown in Table 10.9.26, arsenic was the sole contributor to risk and hazard projections for SWMU 120 groundwater at two of three groundwater sample locations. Risk estimates ranged from 6E-04 (120001) to 8E-04 (120003), with a mean ILCR of 7E-04. Hazard estimates ranged from 6 (120001) to 8 (120003), with a mean hazard index of 7. Figures 10.9-9 and 10.9-10 illustrate point risk and hazard for the groundwater pathway, respectively, under a residential scenario.

10.9.7.8 Remedial Goal Options

Soil

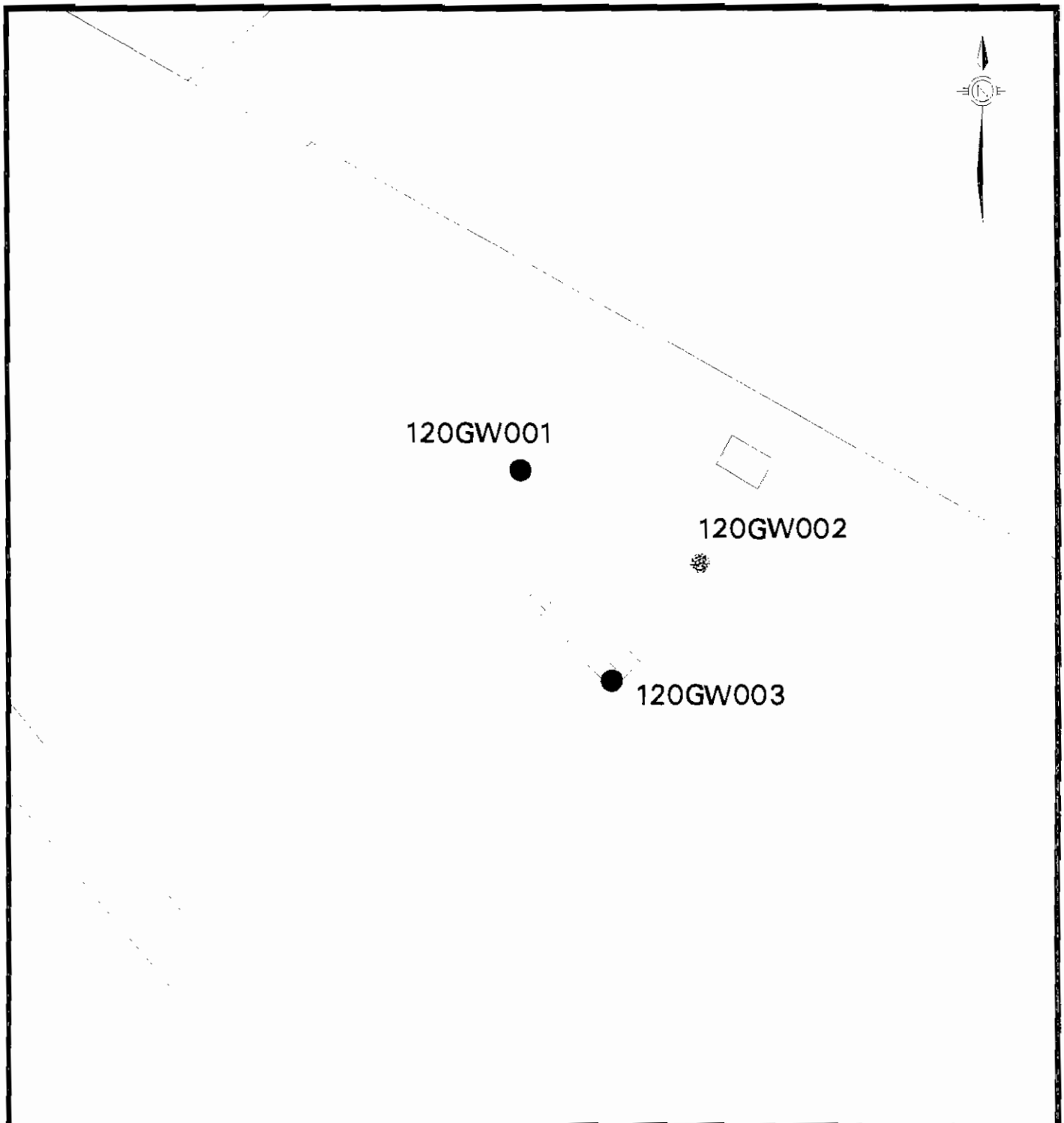
RGOs for carcinogens were based on the lifetime weighted average site resident as presented in Table 10.9.27 for surface soils. Hazard-based RGOs were calculated based on the hypothetical child resident, as noted in the table.

Groundwater

Groundwater RGOs based on the site resident scenario are shown in Table 10.9.28.

Table 10.9.26
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
120	001	Arsenic (As)	26.5	UG/L	5.647	100	591.2	100
		Total			5.647		591.2	
120	002	Arsenic (As)	ND	UG/L	NA		NA	
		Total			NA		NA	
120	003	Arsenic (As)	35.3	UG/L	7.522	100	787.5	100
		Total			7.522		787.5	



LEGEND

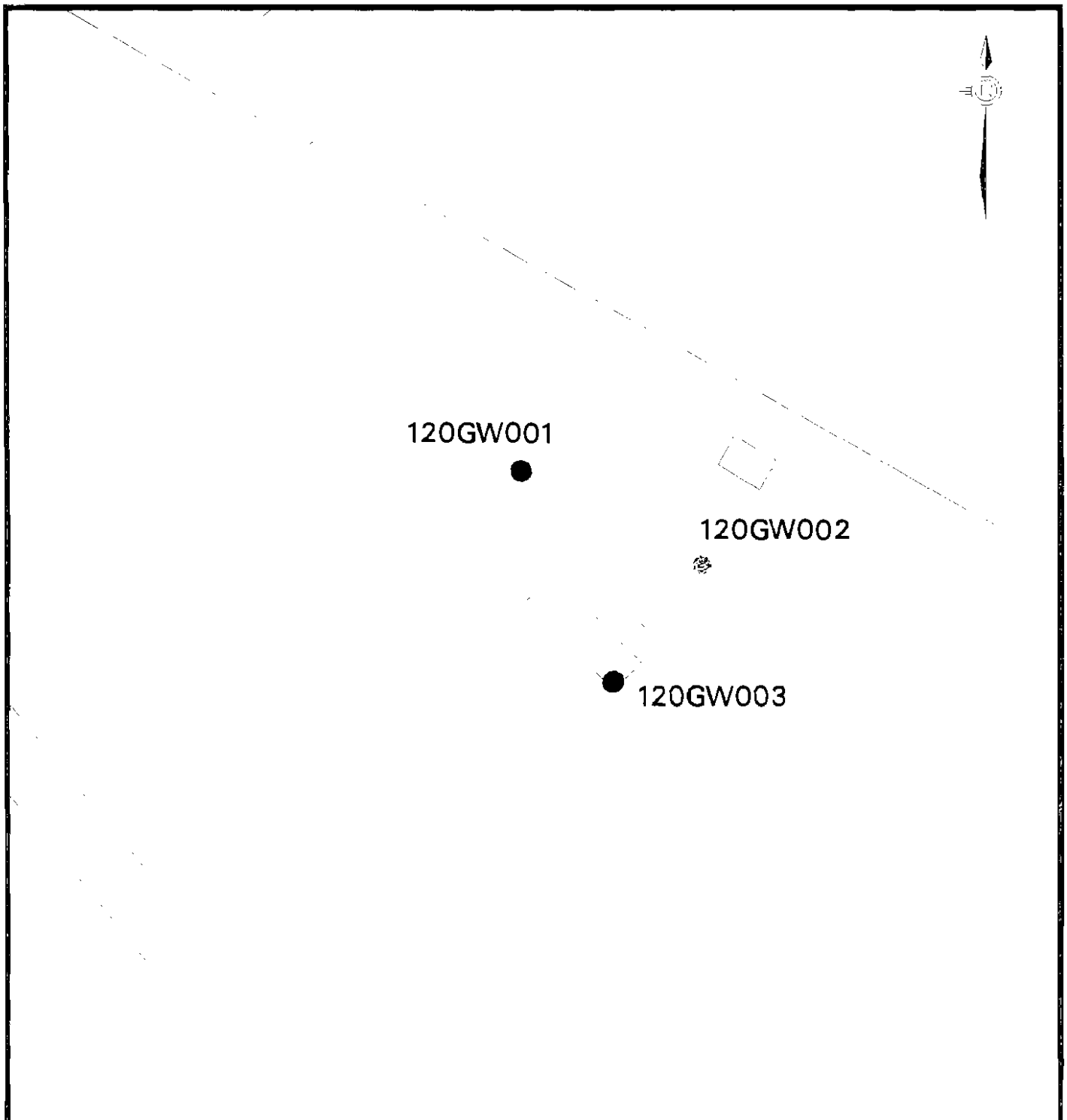
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 120

ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-9
POINT RISK ESTIMATES FOR GROUNDWATER
RESIDENTIAL SCENARIO
SWMU 120

AML: /home3/projects/charleston_dir/zone_g_digital_cir



LEGEND

- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

0 feet 120

ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9-10
POINT HAZARD ESTIMATES FOR GROUNDWATER
RESIDENTIAL SCENARIO
SWMU 120

Table 10.9.27
Remedial Goal Options for Soil
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Residential-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	EPC mg/kg	Hazard-Based Remedial Goal Options **3** mg/kg	**1** mg/kg	**0.1** mg/kg	Risk-Based Remedial Goal Options **1E-06** mg/kg	**1E-05** mg/kg	**1E-04** mg/kg	Background Concentration mg/kg
Carcinogenic PAHs										
Benzo(a)pyrene Equivalents	7.3	NA	0.13	ND	ND	ND	0.06	0.6	6	NA

NOTES:
EPC Exposure point concentration
NA Not applicable
ND Not determined
- Remedial goal options were based on the residential or site worker lifetime weighted average for carcinogens and the child resident or site worker for noncarcinogens

Table 10.9.28
Remedial Goal Options - Shallow Groundwater
SWMU 120
Naval Base Charleston, Zone G
Charleston, South Carolina

Residential-Based Remedial Goal Options

Chemical	Oral SF (mg/kg-day)-1	Oral RfD (mg/kg-day)	EPC mg/l	Hazard-Based Remedial Goal Options 0.1 mg/l	1.0 mg/l	3 mg/l	Risk-Based Remedial Goal Options 1E-06 mg/l	1E-05 mg/l	1E-04 mg/l	MCL mg/l	Background Concentration mg/l
Inorganics											
Arsenic (As)	1.5	0.0003	0.0353	0.0005	0.005	0.014	0.000044	0.00044	0.0044	50	0.0178

NOTES:
EPC exposure point concentration
NA not applicable
ND not determined
- remedial goal options for site residents were based on the residential lifetime weighted average for carcinogens and the child resident for noncarcinogens

10.9.8 Corrective Measures Considerations

Based on the analytical results and the human health risk assessment for SMWU 120, COCs requiring further evaluation through the CMS process have been identified for surface soil and groundwater. The site is currently in an industrial setting, however risk to human health was evaluated under both the residential and industrial (site worker) scenarios for incidental ingestion and dermal contact exposure pathways. Hazard was evaluated for noncarcinogenic contaminants through incidental ingestion and dermal contact scenarios.

As recommended by SCDHEC, a COC is considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual risk exceeds 1E-06 or whose hazard quotient exceeds 0.1.

BEQs were identified as soil pathway COCs for SMWU 120. Arsenic was identified as a groundwater pathway COC for SMWU 120. Table 10.9.29 presents cumulative and COC-specific exposure risks and hazard quotients.

Risk-based remedial goals for the COCs at SMWU 120 for soil and groundwater are presented in Tables 10.9.27 and 10.9.28, respectively. Potential corrective measures are presented in Table 10.9.30.

Table 10.9.29
Zone G
SWMU 120
Cumulative and Chemical-Specific Exposure Risks and Hazard

	Risk		Hazard	
Chemical	**Industrial**	**Residential**	**Industrial**	**Residential**
Soil				
BEQs	4.2E-07	2.1E-06	ND	ND
Cumulative	4.2E-07	2.1E-06	ND	ND
Groundwater				
Arsenic	2.5E-04	8.0E-04	1.2	7.5
Cumulative	2.5E-04	8.0E-04	1.2	7.5

Notes:
ND = Not Determined

Table 10.9.30
Zone G
SWMU 120
Potential Corrective Measures

Medium	Compounds	Potential Corrective Measures
Soil	BEQs	a) No Action b) Excavate, offsite disposal, and monitoring c) Containment/Capping
Groundwater	Arsenic	a) No Action b) Monitoring c) Ex-situ physical/chemical treatment and discharge to POTW d) Ex-situ physical/chemical treatment and discharge through NPDES permitting

10.10 AOC 643, Substation, Building 125

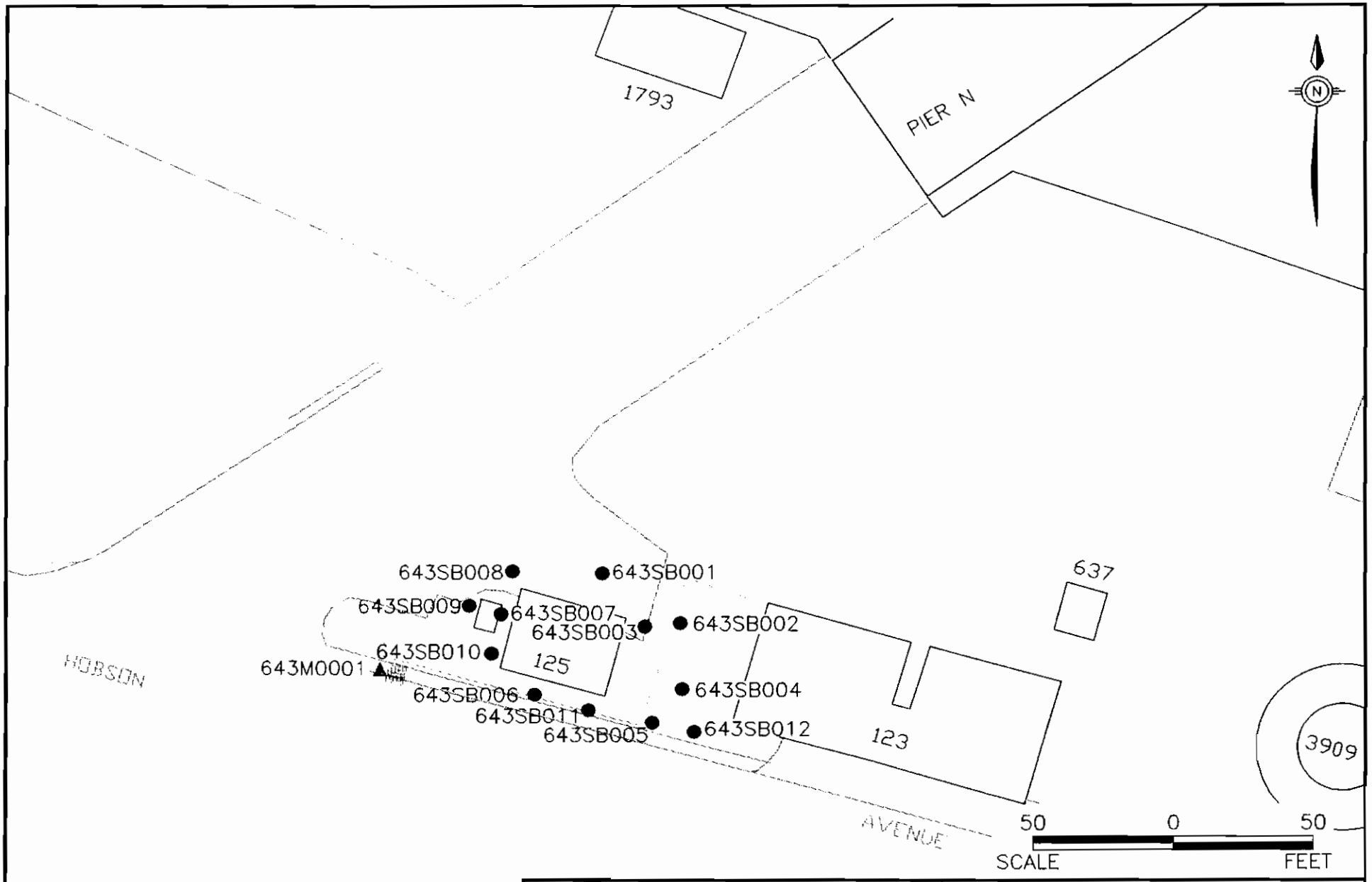
A CSI site, AOC 643 is the electric substation at Building 125 which lies on the north side of Hobson Avenue, near the entrance to Pier N. At one time, PCB transformers, inactive DC generators, switches, and circuit breakers were stored in a wooden shed adjacent to Building 125. A dielectric fluid spill/cleanup was documented, and stains were noted on concrete pavement around this area.

10.10.1 Site Geology

The soil boring and sediment sampling locations for AOC 643 are shown in Figure 10.10-1. Since no monitoring well borings were advanced at this site, the detailed stratigraphy for this AOC could not be determined. Geologic data for monitoring well boring FDS01E (installed during the investigation of the Fuel Distribution System), approximately 63 feet northeast of AOC 643, is therefore presented. The stratigraphy at this location consists of a layer of fill (loose, silty, gravelly, sand) overlying a layer of black silty clay, over a layer of dark gray, silty, clayey, sand, which overlies soft gray silty clay. The silty clay is representative of the Qc unit described in Section 2.2.3.2. The silty clay unit was encountered near the total depth of the borings, occurring about 10 ft bgs. The static groundwater elevation at AOC 643 is approximately 3 ft msl. The shallow groundwater flow at this site is towards the Cooper River.

10.10.2 Field Investigation Approach

The objective of the field investigation at AOC 643 was to: (1) confirm the presence or absence of contamination in the site area; (2) delineate any contamination found; and (3) provide sufficient data to support a detailed evaluation of treatment alternatives, if required. Media sampled within the investigation area included soil and sediment. Section 3 of this report details the methods used during the field investigation. Included in this section are descriptions of the hand-auger procedures used for soil sampling; sediment sampling procedures; and miscellaneous procedures



LEGEND

● – SOIL BORING

▲ – SEDIMENT SAMPLE

▦ – STORM DRAIN

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10–1
SAMPLING LOCATIONS
AOC #643
SUBSTATION,
BUILDING 125

DWG DATE: 01/15/98 | DWG NAME: 29CHZG31

used during the field investigation. Also discussed are the analytical protocols for sample analyses. Appendix D contains the analytical data report for samples collected in Zone G.

10.10.3 Soil Sampling and Analysis

The approved final RFI work plan proposed advancing seven soil borings within the AOC 643 area to detect the presence of any soil contamination from this site. Upper and lower interval soil samples were proposed from each boring. Twelve soil borings were advanced during the field investigation, in two phases (Figure 10.10-1). Seven borings were advanced during the first phase of the field investigation. Upper and lower interval samples were collected from each location. In accordance with the approved final RFI work plan, first phase soil samples were analyzed for pesticide/PCBs, SVOCs and VOCs at DQO Level III. Six first-round samples were also analyzed for metals. Later, five second-round soil borings were advanced to delineate semivolatile and, pesticide/PCB exceedances identified during the first sampling round. Upper and lower interval samples were collected at all five second-round boring locations. Second-round samples from AOC 643 were analyzed for pesticide/PCBs, and SVOAs at DQO Level III. Table 10.10.1 summarizes the AOC 643 soil samples and analyses.

10.10.3.1 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.10.2. Inorganic analytical results for soil are summarized in Table 10.10.3. Table 10.10.4 summarizes all analytes detected in soil at AOC 643. Appendix D contains a complete analytical data report for all Zone G samples collected.

Table 10.10.1
Zone G
AOC 643 Soil Samples

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
643SB001	643SB00101	Upper	9/24/96	Note 1/metals	
	643SB00102	Lower			
643SB002	643SB00201	Upper	9/25/96	Note 1	
	643SB00202	Lower			
643SB003	643SB00301	Upper	10/02/96	Note 1	
	643SB00302	Lower			
643SB004	643SB00401	Upper	9/24/96	Note 1/metals	
	643SB00402	Lower			
643SB005	643SB00501	Upper	9/25/96	Note 1	
	643SB00502	Lower			
643SB006	643SB00601	Upper	9/25/96	Note 1	
	643SB00602	Lower			
643SB007	643SB00701	Upper	9/24/96	Note 1/metals	
	643SB00702	Lower			
643SB008	643SB00801	Upper	1/10/97	Note 2	Second-round sample
	643SB00802	Lower			
643SB009	643SB00901	Upper	1/10/97	Note 2	Second-round sample
	643CB00901*			Note 3	*Duplicate sample
	643SB00902	Lower		Note 2	
643SB010	643SB01001	Upper	1/10/97	Note 2	Second-round sample
	643CB01001*	Lower		Note 3	*Duplicate sample
	643SB01002			Note 2	
642SB011	643SB01101	Upper	1/10/97	Note 2	Second-round sample
	643SB01102	Lower			
643SB012	643SB01201	Upper	1/10/97	Note 2	Second-round sample
	643SB01202	Lower			

Notes:
1 = SW-846 (pesticides/PCBs, SVOCs, VOCs) at DQO Level III
2 = SW-846 (pesticides/PCBs, SVOCs) at DQO Level III
3 = Appendix IX suite: SW-846 (metals, pesticides/PCBs, herbicides, dioxins, SVOCs, VOCs); cyanide; hex-chrome at DQO Level IV
* = Duplicate sample

Table 10.10.2
Zone G
AOC 643
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Volatile Organic Compounds (Upper Interval - 9 Samples plus 2 Duplicate Samples/Lower Interval - 7 Samples) (µg/kg)						
Benzene	Upper	1/9	3.00	3.00	22000	0
	Lower	0/7	ND	ND	30	0
Carbon disulfide	Upper	0/9	ND	ND	780000	0
	Lower	1/7	3.00	3.00	32000	0
Trichloroethene	Upper	1/9	2.00	2.00	58000	0
	Lower	0/7	ND	ND	60	0
Xylene (Total)	Upper	0/9	ND	ND	16000000	0
	Lower	1/7	1.000	1.000	148000	0
Semivolatile Organic Compounds (Upper Interval - 12 Samples plus 2 Duplicate Samples/Lower Interval - 12 Samples) (µg/kg)						
BEQs[1]	Upper	7/12	4.50 - 1446.77	346	88	4
	Lower	0/0	NA	NA	NA	NA
Benzo(a)anthracene	Upper	5/12	81.0 - 1000	326	880	1
	Lower	3/12	91.0 - 180	127	2000	0
Benzo(b)fluoranthene	Upper	7/12	45.0 - 1000	284	880	1
	Lower	4/12	40.0 - 310	168	5000	0
Benzo(k)fluoranthene	Upper	5/12	43.0 - 580	225	8800	0
	Lower	2/12	46.0 - 50.0	48.0	49000	0
Benzo(a)pyrene	Upper	5/12	46.0 - 900	300	88	4
	Lower	2/12	91.0 - 150	121	8000	2

Table 10.10.2
Zone G
AOC 643
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
Chrysene	Upper	5/12	100 - 970	362	88000	0
	Lower	3/12	95.0 - 200	138	160000	0
Dibenz(a,h)anthracene	Upper	3/12	69.0 - 290	153	88	2
	Lower	1/12	70.0	70.0	2000	0
Indeno(1,2,3-cd)pyrene	Upper	5/12	38.0 - 500	174	880	0
	Lower	2/12	60.0 - 140	100	14000	0
Acenaphthene	Upper	1/12	86.0	86.0	470000	0
	Lower	0/12	ND	ND	570000	0
Anthracene	Upper	3/12	48.0 - 200	107	2300000	0
	Lower	1/12	50.0	50.0	12000000	0
Benzo(g,h,i)perylene	Upper	5/12	57.0 - 530	197	230000	0
	Lower	3/12	59.0 - 150	91.3	4.66E08	0
Di-n-butylphthalate	Upper	1/12	40.0	40.0	780000	0
	Lower	0/12	ND	ND	2300000	0
Di-n-octylphthalate	Upper	1/12	69.0	69.0	160000	0
	Lower	0/12	ND	ND	10000000	0
Fluoranthene	Upper	6/12	41.0 - 1900	547	310000	0
	Lower	4/12	44.0 - 390	186	4300000	0
Fluorene	Upper	1/12	66.0	66.0	310000	0
	Lower	0/12	ND	ND	560000	0

Table 10.10.2
Zone G
AOC 643
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Phenanthrene	Upper	5/12	110 - 970	334	230000	0
	Lower	3/12	49.0 - 260	132	1380000	0
Pyrene	Upper	5/12	150 - 1300	490	230000	0
	Lower	3/12	120 - 370	207	4200000	0
Pesticides and PCBs (Upper Interval - 12 Samples plus 2 Duplicate Sample/Lower Interval - 12 Samples) (µg/kg)						
alpha-Chlordane	Upper	4/12	1.70 - 13.0	6.80	1800	0
	Lower	1/12	3.20	3.20	10000	0
gamma-Chlordane	Upper	6/12	5.60 - 24.0	14.0	1800	0
	Lower	0/12	ND	ND	10000	0
4,4'DDD	Upper	2/12	4.00 - 24.0	14.0	2700	0
	Lower	0/12	ND	ND	16000	0
4,4'-DDE	Upper	12/12	3.00 - 380	79.4	1900	0
	Lower	5/12	3.30 - 45.0	14.1	54000	0
4,4'-DDT	Upper	9/12	6.80 - 134	58.3	1900	0
	Lower	3/12	11.0 - 28.0	21.3	32000	0
Dieldrin	Upper	0/12	ND	ND	40	0
	Lower	1/12	22.0	22.0	4	0
Endrin	Upper	2/12	5.70 - 8.50	7.10	2300	0
	Lower	0/12	ND	ND	1000	0
Endrin aldehyde	Upper	1/12	120	120	2300	0
	Lower	1/12	3.80	3.80	1000	0

Table 10.10.2
Zone G
AOC 643
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Aroclor-1260	Upper	6/12	71.0 - 1700	555	320	2
	Lower	3/12	7.00 - 420	199	1000	0
Dioxins (Upper Interval -2 Duplicate Samples) (ng/kg)						
Dioxin(2,3,7,8-TCDD TEQ)[1]	Upper	2/2	0.2886 - 5.4849	2.89	1000	0
	Lower	0/0	NA	NA	1900	0

Notes:

1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995b)
* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples
ND = Not detected
NL = Not listed
NA = Not applicable
µg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram

Table 10.10.3
Zone G
AOC 643
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Inorganics (Upper Interval - 5 Samples plus 2 Duplicate Samples/Lower Interval - 3 Samples) (mg/kg)						
Aluminum (Al)	Upper	5/5	3110 - 6290	4400	7800	0
	Lower	3/3	2160 - 5740	3760	1000000	0
Antimony (Sb)	Upper	2/5	0.86 - 1.00	0.930	3.10	0
	Lower	0/3	ND	ND	5	0
Arsenic (As)	Upper	5/5	1.20 - 52.7	13.8	0.43	5
	Lower	3/3	2.40 - 8.10	5.20	29	0
Barium (Ba)	Upper	5/5	8.20 - 130	34.9	550	0
	Lower	3/3	5.60 - 10.8	8.50	1600	0
Beryllium (Be)	Upper	4/5	0.20 - 0.37	0.313	0.15	4
	Lower	3/3	0.33 - 0.48	0.400	63	0
Cadmium (Cd)	Upper	5/5	0.050 - 0.69	0.322	3.9	0
	Lower	2/3	0.25 - 0.28	0.265	8	0
Calcium (Ca)	Upper	5/5	651 - 106000	35300	NL	NA
	Lower	3/3	4960 - 97200	36600	NL	NA
Chromium (Cr)	Upper	5/5	4.70 - 52.3	18.5	39.0	1
	Lower	3/3	6.10 - 33.7	17.0	1000000	0
Cobalt (Co)	Upper	5/5	0.48 - 24.8	5.84	470	0
	Lower	3/3	0.73 - 1.60	1.28	2000	0

Table 10.10.3
Zone G
AOC 643
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Copper (Cu)	Upper	4/5	5.50 - 36.8	21.3	27000	0
	Lower	2/3	7.40 - 9.80	8.60	920	0
Cyanide (CN)	Upper	½	0.120	0.120	160	0
	Lower	0/3	ND	ND	40	0
Iron (Fe)	Upper	5/5	3400 - 6290	4740	2300	5
	Lower	3/3	2770 - 7150	5420	NL	NA
Lead (Pb)	Upper	5/5	4.70 - 154	53.6	400	0
	Lower	3/3	2.60 - 27.5	11.1	400	0
Magnesium (Mg)	Upper	5/5	162 - 2860	1130	NL	NA
	Lower	3/3	467 - 3980	1790	NL	NA
Manganese (Mn)	Upper	5/5	7.40 - 184	64.9	180	1
	Lower	3/3	18.0 - 103	57.6	1100	0
Mercury (Hg)	Upper	2/5	0.090 - 0.14	0.115	2.30	0
	Lower	0/3	ND	ND	2.1	0
Nickel (Ni)	Upper	3/5	3.60 - 21.5	14.0	160	0
	Lower	0/3	ND	ND	130	0
Potassium (K)	Upper	4/5	260 - 761	412	NL	NA
	Lower	3/3	288 - 827	504	NL	NA
Selenium (Se)	Upper	3/5	0.47 - 0.86	0.620	39.0	0
	Lower	1/3	1.20	1.20	5	0

Table 10.10.3
Zone G
AOC 643
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Silver (Ag)	Upper	1/5	0.65	0.650	39	0
	Lower	0/3	ND	ND	34	0
Sodium (Na)	Upper	2/5	266 - 623	445	NL	NA
	Lower	0/3	ND	ND	NL	NA
Tin (Sn)	Upper	2/5	0.92 - 2.4	1.66	4700	0
	Lower	0/3	ND	ND	11000	0
Vanadium (V)	Upper	5/5	7.90 - 141	44.4	55.0	1
	Lower	3/3	6.10 - 31.3	19.7	6000	0
Zinc (Zn)	Upper	2/5	24.1 - 155	89.6	2300	0
	Lower	0/3	ND	ND	12000	0

Notes:

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples

ND = Not detected

NL = Not listed

NA = Not applicable

mg/kg = Milligrams per kilogram

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Volatile Organic Compounds (μg/kg)							
Benzene	643SB002	3	22000	NA	ND	30	NA
Carbon disulfide	643SB005	ND	780000	NA	3	32000	NA
Trichloroethene	643SB002	2	58000	NA	ND	60	NA
Xylenes	643SB004	ND	16000000	NA	1	148000	NA
Semivolatile Organic Compounds (μg/kg)							
BEQs[1]	643SB002	**112.70**	88	NA	NA	NL	NA
	643SB003	56.63			NA		
	643SB004	37.18			NA		
	643SB005	**1446.80**			NA		
	643SB009	0.45			NA		
	643SB010	**442.03**			NA		
	643SB012	**314.93**			NA		
Benzo(a)anthracene	643SB002	81	880	NA	ND	2000	NA
	643SB003	ND			110		
	643SB004	130			180		
	643SB005	**1000**			91		
	643SB010	240			ND		
	643SB012	180			ND		

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(b)fluoranthene	643SB002	71	880	NA	40	5000	NA
	643SB003	60			310		
	643SB004	240			210		
	643SB005	**1000**			110		
	643SB009	45			ND		
	643SB010	330			ND		
	643SB012	240			ND		
Benzo(k)fluoranthene	643SB002	60	8800	NA	ND	49000	NA
	643SB003	43			ND		
	643SB005	580			46		
	643SB006	ND			50		
	643SB010	270			ND		
	643SB012	170			ND		
Benzo(a)pyrene	643SB002	**93**	88	NA	ND	8000	NA
	643SB003	46			150		
	643SB005	**900**			91		
	643SB010	**270**			ND		
	643SB012	**190**			ND		
Chrysene	643SB002	100	88000	NA	ND	160000	NA
	643SB003	ND			120		
	643SB004	180			200		
	643SB005	970			95		
	643SB010	330			ND		
	643SB012	230			ND		

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Dibenz(a,h)anthracene	643SB003	ND	88	NA	70	2000	NA
	643SB005	**290**			ND		
	643SB010	**100**			ND		
	643SB012	69			ND		
Indeno(1,2,3-cd)pyrene	643SB002	38	880	NA	ND	14000	NA
	643SB003	42			140		
	643SB005	500			60		
	643SB010	170			ND		
	643SB012	120			ND		
Acenaphthene	643SB005	86	470000	NA	ND	570000	NA
Anthracene	643SB004	ND	2300000	NA	50	12000000	NA
	643SB005	200			ND		
	643SB010	72			ND		
	643SB012	48			ND		
Benzo(g,h,i)perylene	643SB002	60	230000	NA	ND	4.66E08	NA
	643SB003	57			150		
	643SB005	530			65		
	643SB006	ND			59		
	643SB010	190			ND		
	643SB012	150			ND		
Di-n-butylphthalate	643SB010	40	780000	NA	ND	2300000	NA
Di-n-octylphthalate	643SB006	69	160000	NA	ND	10000000	NA
Fluorene	643SB005	66	310000	NA	ND	560000	NA

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Fluoranthene	643SB002	220	310000	NA	44	4300000	NA
	643SB003	ND			130		
	643SB004	240			390		
	643SB005	1900			180		
	643SB009	41			ND		
	643SB010	500			ND		
	643SB012	380			ND		
Phenanthrene	643SB002	110	230000	NA	ND	1380000	NA
	643SB003	ND			49		
	643SB004	130			260		
	643SB005	970			88		
	643SB010	270			ND		
	643SB012	190			ND		
Pyrene	643SB002	150	230000	NA	ND	4200000	NA
	643SB003	ND			120		
	643SB004	280			370		
	643SB005	1300			130		
	643SB010	440			ND		
	643SB012	280			ND		
Pesticides/PCBs (μg/kg)							
alpha-Chlordane	643SB002	6	1800	NA	ND	10000	NA
	643SB003	ND			3.2		
	643SB005	1.7			ND		
	643SB010	6.5			ND		
	643SB012	13			ND		

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
gamma-Chlordane	643SB002	24	1800	NA	ND	10000	NA
	643SB004	15			ND		
	643SB005	6.2			ND		
	643SB008	5.6			ND		
	643SB010	17			ND		
	643SB012	18			ND		
4,4'-DDD	643SB001	4	2700	NA	ND	16000	NA
	643SB010	24			ND		
4,4'-DDE	643SB001	8.8	1900.0	NA	ND	54000	NA
	643SB002	210			3.3		
	643SB003	8.2			10		
	643SB004	54			45		
	643SB005	20			ND		
	643SB006	380			ND		
	643SB007	3			ND		
	643SB008	100			ND		
	643SB009	85			4.9		
	643SB010	61.5			ND		
	643SB011	12			ND		
	643SB012	9.8			7.3		

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
4,4'-DDT	643SB002	55	1900	NA	ND	32000	NA
	643SB003	6.8			25		
	643SB004	46			28		
	643SB006	94			ND		
	643SB007	110			ND		
	643SB008	24			ND		
	643SB009	29			11		
	643SB010	134			ND		
	643SB012	26			ND		
Dieldrin	643SB006	ND	40	NA	22	4	NA
Endrin	643SB002	5.7	2300	NA	ND	1000	NA
	643SB006	8.5			ND		
Endrin aldehyde	643SB002	ND	2300	NA	3.8	1000	NA
	643SB010	120			ND		
Aroclor-1260	643SB003	71	320	NA	420	1000	NA
	643SB007	**1700**			ND		
	643SB008	110			ND		
	643SB009	130			170		
	643SB010	**1170**			7		
	643SB012	150			ND		
Dioxins (ng/kg)							
Dioxin (2,3,7,8-TCDD TEQs)[1]	643SB009	0.2888	1000	NA	NA	1900	NA
	643SB010	5.4849					

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Inorganics (mg/kg)							
Aluminum (Al)	643SB001	3220	7800.0	18700	2160	1000000	23600
	643SB004	3110			3380		
	643SB007	4150			5740		
	643SB009	5210			NT		
	643SB010	6290			NT		
Antimony	643SB004	1	3.1	2.89	ND	5	NL
	643SB010	0.86			NT		
Arsenic (As)	643SB001	3.4	0.43	17.2[a]	2.4	29	15.5[a]
	643SB004	5.3			5.1		
	643SB007	1.2			8.1		
	643SB009	52.7			NT		
	643SB010	6.5			NT		
Barium (Ba)	643SB001	8.3	550.0	109	5.6	1600	64.5
	643SB004	16.8			10.8		
	643SB007	8.2			9.1		
	643SB009	11.1			NT		
	643SB010	130			NT		
Beryllium (Be)	643SB001	0.31	0.15	1.20	0.33	63	1.63
	643SB004	0.37			0.39		
	643SB007	ND			0.48		
	643SB009	0.2			NT		
	643SB010	0.37			NT		

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Cadmium (Cd)	643SB001	0.07	3.9	1.07	ND	8	0.48
	643SB004	0.66			0.28		
	643SB007	0.05			0.25		
	643SB009	0.14			NT		
	643SB010	0.69			NT		
Calcium (Ca)	643SB001	32600	NL	NL	4960	NL	NL
	643SB004	24700			7520		
	643SB007	651			97200		
	643SB009	12700			NT		
	643SB010	106000			NT		
Chromium (Cr)	643SB001	9.9	39 VI	42.8	6.1	1000000	43.4*
	643SB004	16.6	7800 III		11.1		
	643SB007	4.7			33.7		
	643SB009	8.8			NT		
	643SB010	52.3			NT		
Cobalt (Co)	643SB001	24.8	470.0	6.60	0.73	2000	8.14
	643SB004	1.7			1.6		
	643SB007	0.48			1.5		
	643SB009	0.73			NT		
	643SB010	1.5			NT		
Copper (Cu)	643SB001	20.3	27000	260	ND	920	32.6
	643SB004	36.8			9.8		
	643SB007	ND			7.4		
	643SB009	5.5			NT		
	643SB010	22.5			NT		

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Cyanide (CN)	643SB010	0.12	160	0.38	NT	40	0.22
Iron (Fe)	643SB001	**4340**	2300	NL	2770	NL	NL
	643SB004	**6290**			6350		
	643SB007	**3400**			7150		
	643SB009	**4140**			NT		
	643SB010	**5530**			NT		
Lead(Pb)	643SB001	5.6	400.0	181	2.6	400	66.3
	643SB004	154			27.5		
	643SB007	4.7			3.3		
	643SB009	9.1			NT		
	643SB010	94.6			NT		
Magnesium (Mg)	643SB001	912	NL	NL	467	NL	NL
	643SB004	1060			912		
	643SB007	162			3980		
	643SB009	664			NT		
	643SB010	2860			NT		
Manganese (Mn)	643SB001	44.1	180.0	325	18	1100	291
	643SB004	58.2			51.9		
	643SB007	7.4			103		
	643SB009	30.9			NT		
	643SB010	184			NT		
Mercury (Hg)	643SB009	0.09	2.3	1.03	NT	2.1	0.31
	643SB010	0.14			NT		

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Nickel (Ni)	643SB004	21.5	160.0	20.6	ND	130	18.3
	643SB009	3.6			NT		
	643SB010	16.8			NT		
Potassium (K)	643SB001	322	NL	NL	288	NL	NL
	643SB004	306			398		
	643SB007	ND			827		
	643SB009	260			NT		
	643SB010	761			NT		
Selenium (Se)	643SB001	0.53	39.0	1.22	ND	5	1.26
	643SB004	0.47			ND		
	643SB007	ND			1.2		
	643SB010	0.86			NT		
Silver (Ag)	643SB001	0.65	39	NL	ND	34	NL
Sodium (Na)	643SB009	266	NL	NL	NT	NL	NL
	643SB010	623			NT		
Tin (Sn)	643SB009	0.92	4700	9.67	NT	11000	2.96
	643SB010	2.4			NT		
Vanadium (V)	643SB001	9.4	55.0	60.9	6.1	6000	72.5
	643SB004	141			31.3		
	643SB007	7.9			21.8		
	643SB009	12.2			NT		
	643SB010	51.5			NT		

Table 10.10.4
Zone G
AOC 643
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Zinc (Zn)	643SB009	24.1	2300.0	519	NT	12000	145
	643SB010	155			NT		

Notes:

a	=	Background value for non-clay samples
*	=	Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples
1	=	Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995b)
ND	=	Not detected
NT	=	Not taken
NL	=	Not listed
NA	=	Not applicable
µg/kg	=	Micrograms per kilogram
mg/kg	=	Milligrams per kilogram
ng/kg	=	Nanograms per kilogram

Bolded concentrations exceed both the reference concentration (RBC or SSL) and the zone background
All background values for Zone G are based on twice the means of the grid sample concentrations.

Volatile Organic Compounds in Soil

Two VOCs were detected in AOC 643 surface soil samples. Two different VOCs were detected in AOC 643 subsurface soil samples. No surface or subsurface soil VOC concentrations exceeded a respective RBC or SSL.

Semivolatile Organic Compounds in Soil

Sixteen SVOCs were detected in surface soil samples at AOC 643. Benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene and dibenz(a,h)anthracene exceeded their respective RBCs in surface soil samples at this AOC. Figure 10.10-2 presents total BEQ concentrations detected in surface soil at AOC 643.

Twelve SVOCs were detected in subsurface soil samples at AOC 643. No SVOCs in subsurface soil exceeded their respective SSL.

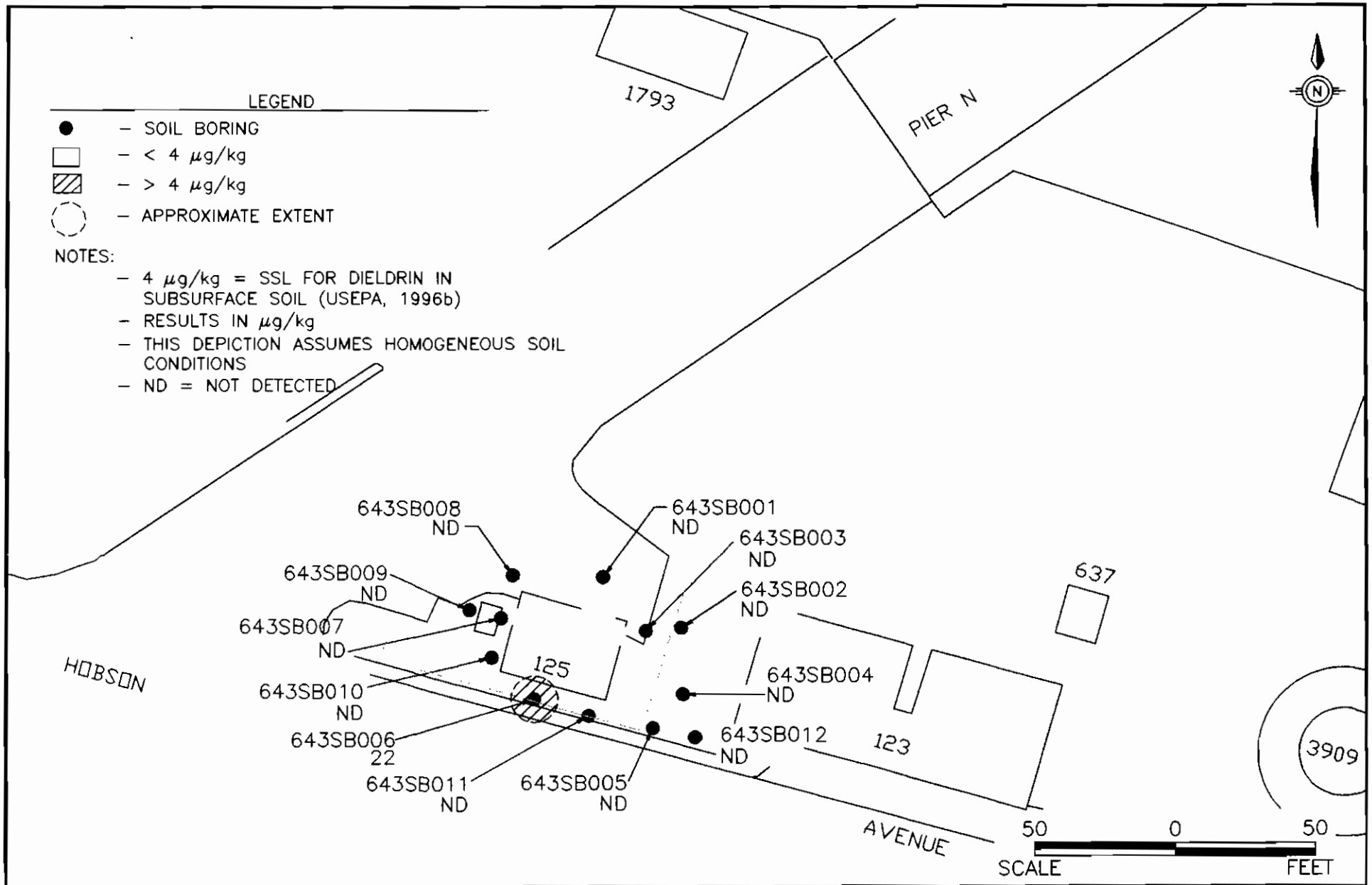
Pesticides and PCBs in Soil

Seven pesticides were detected in surface soil samples at AOC 643. No pesticides in surface soil exceeded their respective RBC. Aroclor-1260 was detected in surface soil above the RBC for this parameter. Figure 10.10-3 presents Aroclor-1260 concentrations detected in surface soil.

Five pesticides were detected in subsurface soil samples at AOC 643. Dieldrin was detected in subsurface soil above the SSL for this parameter. Figure 10.10-4 presents dieldrin detected in subsurface soil.

Other Organic Compounds in Soil

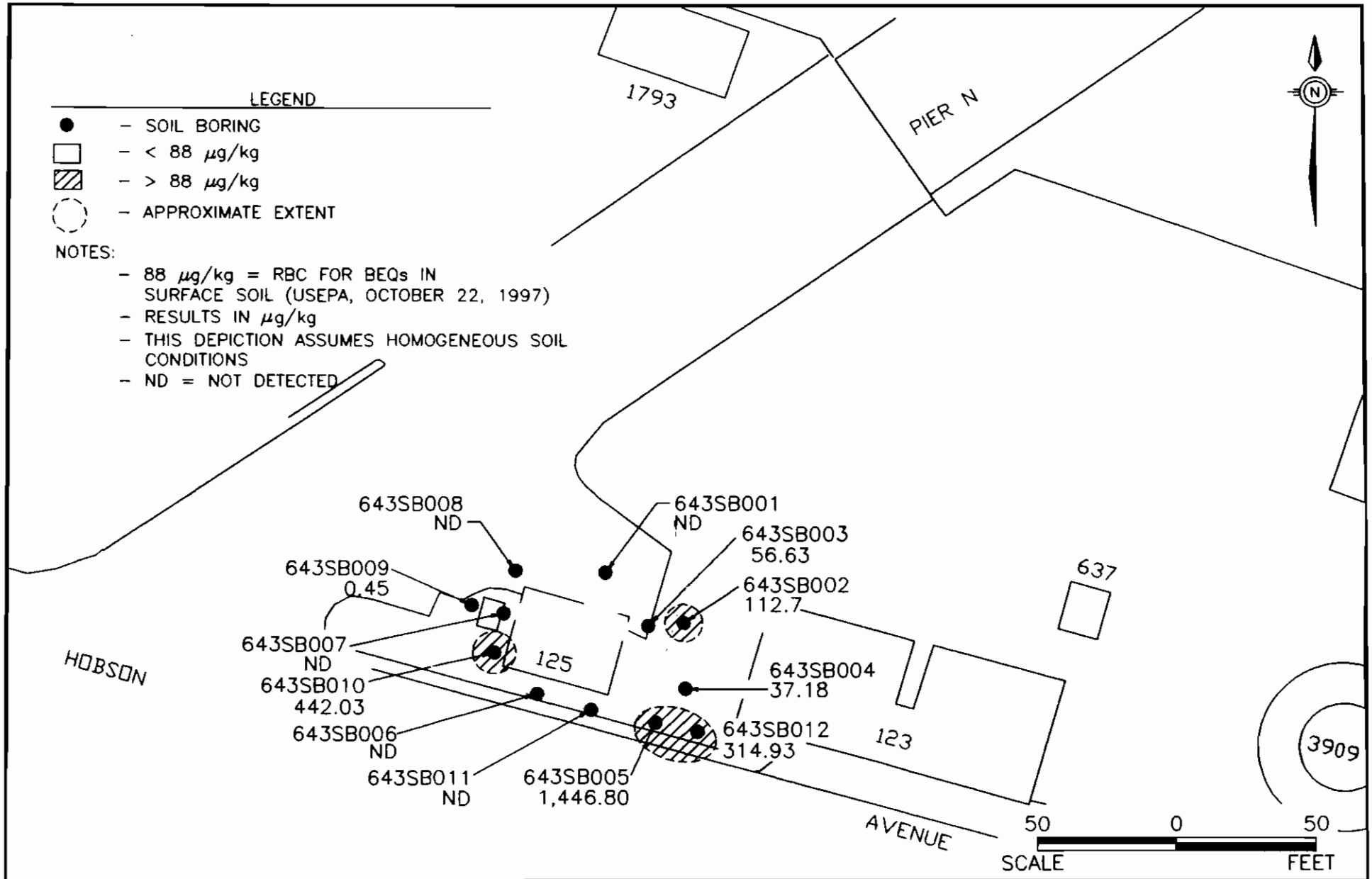
Dioxin (2,3,7,8-TCDD TEQ) was detected in two surface soil duplicate samples below the RBC for this parameter.



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-4
DIELDRIN IN SUBSURFACE SOIL
AOC #643
SUBSTATION,
BUILDING 125

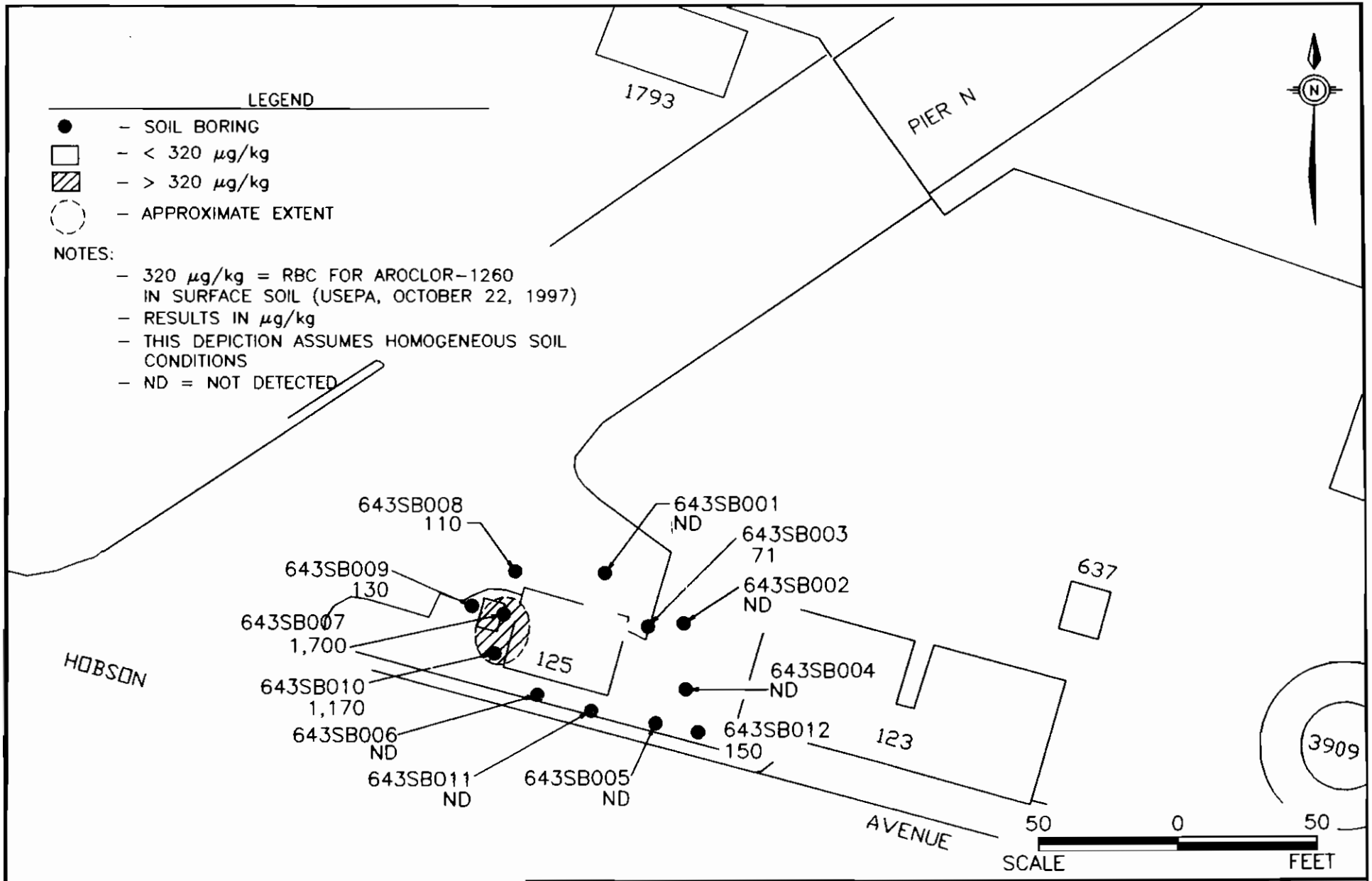
DWG DATE: 01/29/98 | DWG NAME: 2907M016



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-2
BEQs IN SURFACE SOIL
AOC #643
SUBSTATION,
BUILDING 125

DWG DATE: 01/29/98 | DWG NAME: 2907M014



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-3
AROCLOR-1260 IN SURFACE SOIL
AOC #643
SUBSTATION,
BUILDING 125

DWG DATE: 01/29/98 | DWG NAME: 2907M015

Inorganic Elements in Soil

Twenty-three metals plus cyanide were detected in surface soil samples collected at AOC 643. Arsenic, chromium, and vanadium were detected at concentrations exceeding their respective RBCs and background concentrations for Zone G surface soil. Figure 10.10-5 presents arsenic concentrations detected in surface soil. Figure 10.10-6 presents chromium concentrations detected in surface soil. Figure 10.10-7 presents vanadium concentrations in surface soil. Iron was also detected in site soil samples at concentrations exceeding the RBC. Iron is considered an essential nutrient and consequently a background concentration has not been established.

Sixteen metals were detected in subsurface soil samples at AOC 643. No metals detected in subsurface soil exceeded the greater of their respective SSL or subsurface soil background concentrations.

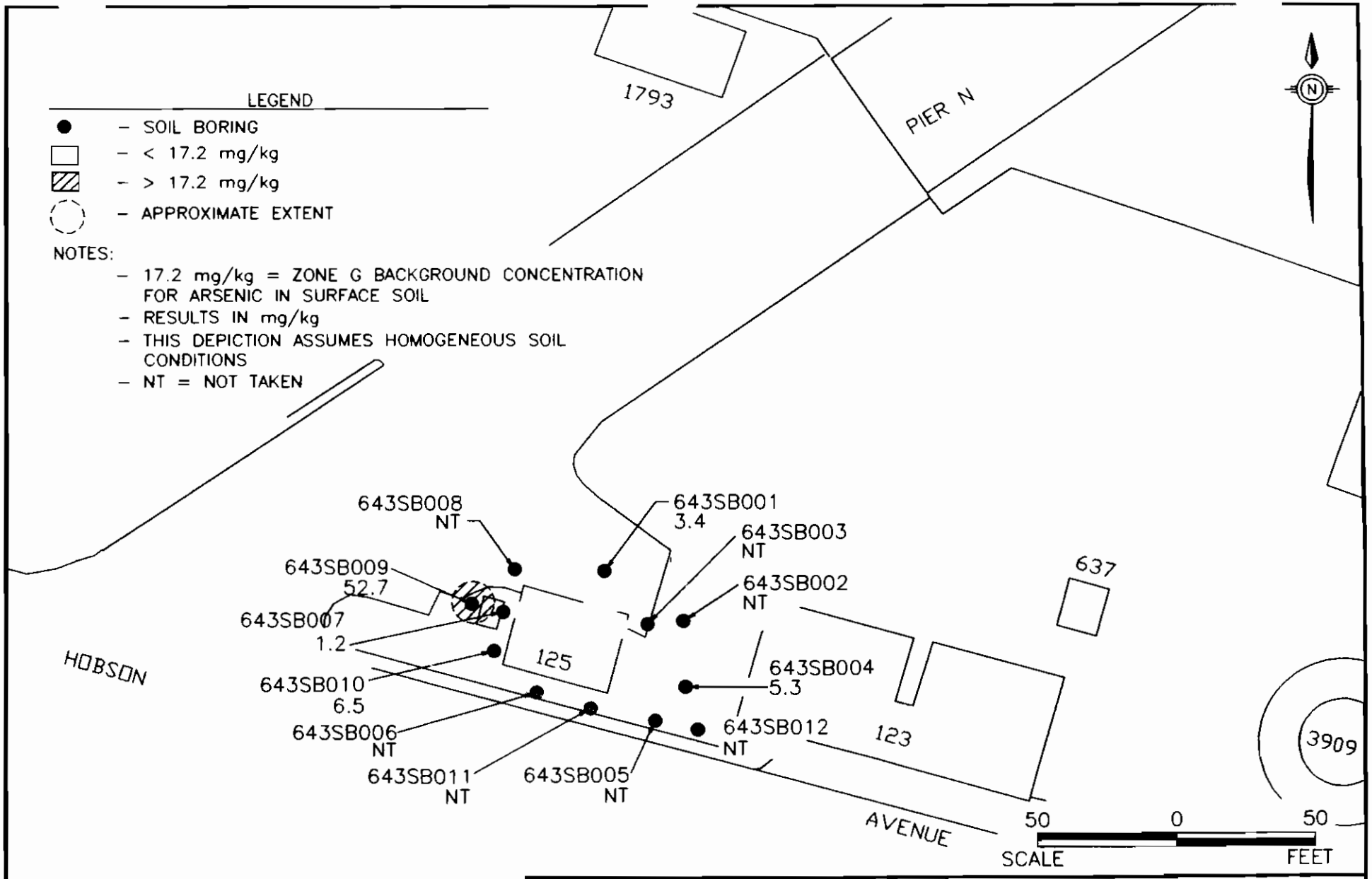
10.10.4 Sediment Sampling and Analysis

The approved final RFI work plan proposed collecting one sediment sample to identify potential contaminants introduced to the storm sewer system from the site. One sediment sample was collected during the field investigation (Figure 10.10-1). In accordance with the approved final RFI work plan, this sample was analyzed for pesticides/PCBs, SVOCs, VOCs at DQO Level III. Table 10.10.5 summarizes the AOC 643 sediment sample and analyses.

Table 10.10.5
Zone G
AOC 643
Sediment Sample and Analyses

Sample Location	Sample Identifier	Date Collected	Analyses	Remarks
643M0001	643M000101	9/27/96	See note	

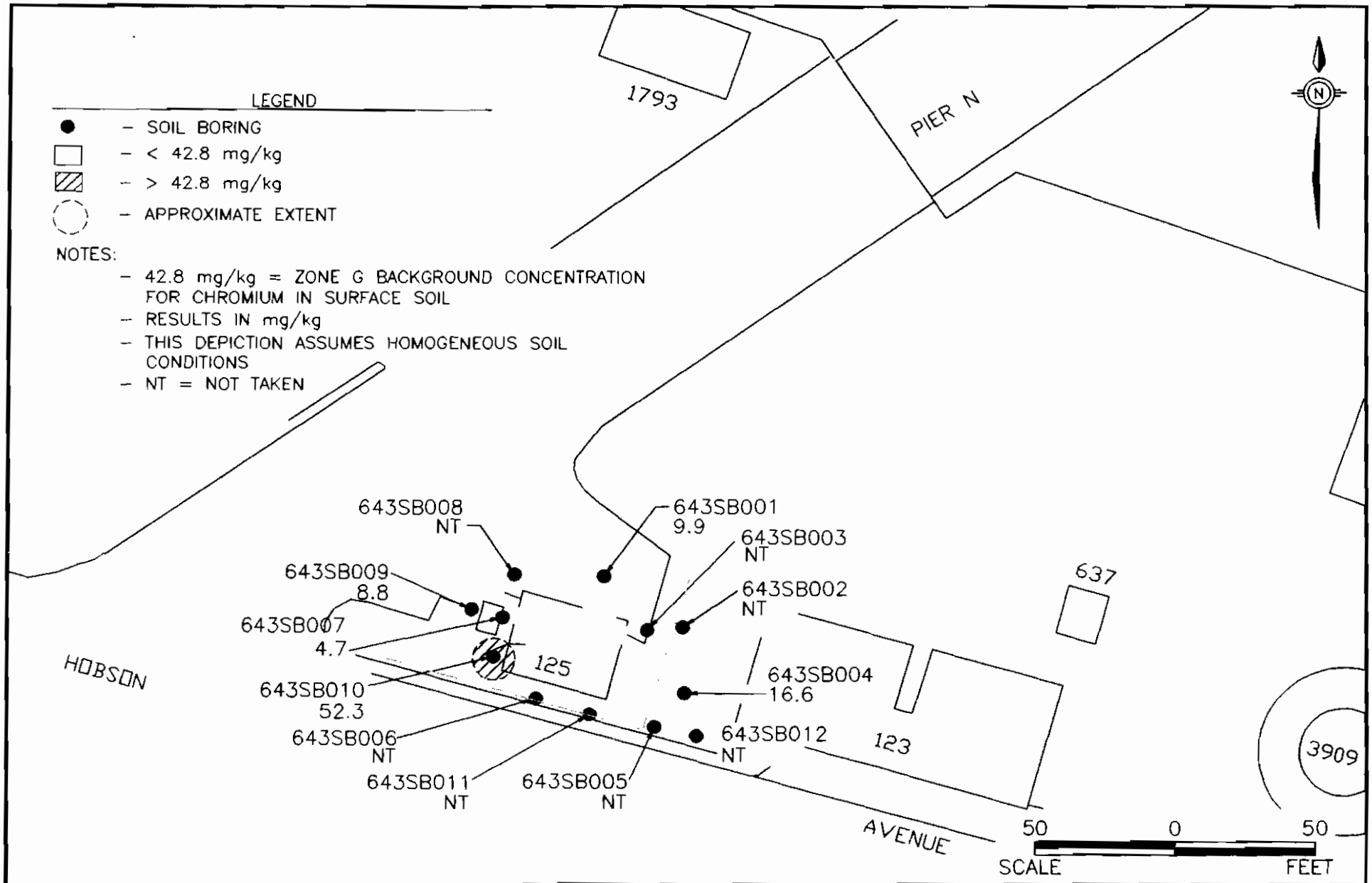
Note:
SW-846 (pesticides/PCBs, SVOCs, VOCs) at DQO Level III



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-5
ARSENIC IN SURFACE SOIL
AOC #643
SUBSTATION,
BUILDING 125

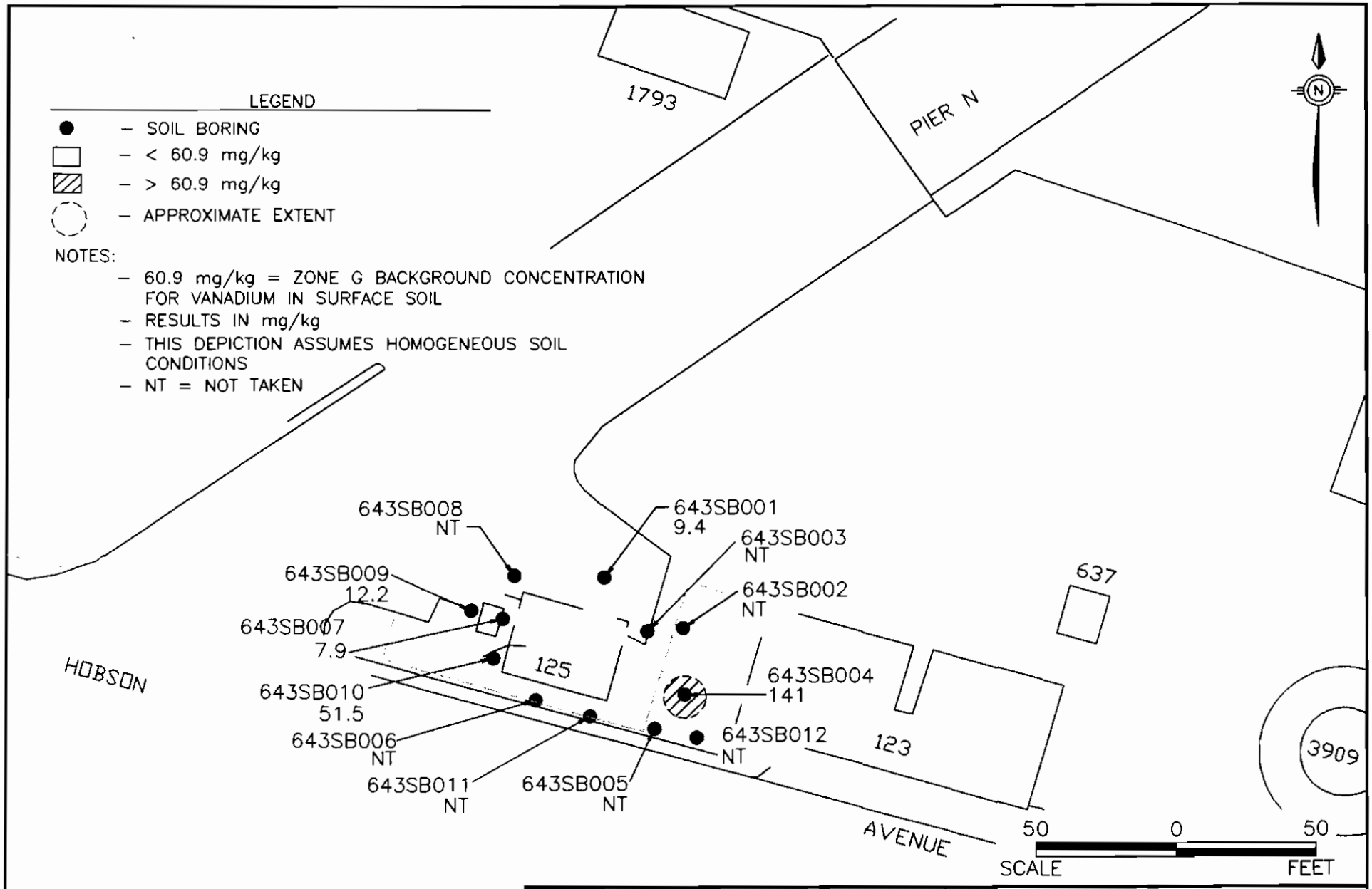
DWG DATE: 02/04/98 | DWG NAME: 2907M017



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-6
CHROMIUM IN SURFACE SOIL
AOC #643
SUBSTATION,
BUILDING 125

DWG DATE: 02/03/97 | DWG NAME: 2907M122



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-7
VANADIUM IN SURFACE SOIL
AOC #643
SUBSTATION,
BUILDING 125

DWG DATE: 02/03/97 | DWG NAME: 2907M018

10.10.4.1 Nature of Contamination in Sediment

Organic compound analytical results for sediment are summarized in Table 10.10.6. Table 10.10.7 presents a summary of all analytes detected in sediment at AOC 643. Appendix D contains the complete analytical data report for all Zone G samples analyzed.

The following sections discuss sediment sample results in relation to detected soil parameters to offer an indication of potential attribution. However, much of AOC 643 is paved, limiting the potential for surface erosion and sediment transport from the immediate site area. Given that the sediment sample was collected from an engineered structure (storm water catch basin), this material is not true sediment generated in a native setting, and therefore, is not compared to reference concentrations or other criteria.

Volatile Organic Compounds in Sediment

One VOC, trichloroethene, was detected in the AOC 643 sediment sample. A single trichloroethene concentration of 3 μg/kg was detected. Trichloroethene was also detected in a site surface soil sample.

Semivolatile Organic Compounds in Sediment

Twenty-two SVOCs were detected in AOC 643 sediment samples. Of these SVOCs, all but acenaphthylene, dibenzofuran, bis(2-ethylhexyl)phthalate, 2-Methylnaphthalene, 4-Methylphenol, and naphthalene were also detected in soil. The highest sediment SVOC concentration was 14,000 μg/kg of bis(2-ethylhexyl)phthalate.

Pesticides and PCBs in Sediment

Eight pesticides were detected in AOC 643 sediment samples. Of these pesticides, all except heptachlor epoxide were also detected in soil. The highest sediment pesticide concentration was 110 μg/kg of endrin aldehyde.

Table 10.10.6
Zone G
AOC 643
Organic Analytical Results for Sediment

Parameters	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)
Volatile Organic Compounds (1 Sample) (μg/kg)			
Trichloroethene	1/1	3.00	3.00
Semivolatile Organic Compounds (1 Sample) (μg/kg)			
BEQs[1]	1/1	2033.7	2033.7
Benzo(a)anthracene	1/1	1300	1300
Benzo(b)fluoranthene	1/1	1200	1200
Benzo(k)fluoranthene	1/1	1300	1300
Benzo(a)pyrene	1/1	1300	1300
Chrysene	1/1	1700	1700
Dibenz(a,h)anthracene	1/1	390	390
Indeno(1,2,3-cd)pyrene	1/1	790	790
Acenaphthene	1/1	230	230
Acenaphthylene	1/1	63.0	63.0
Anthracene	1/1	410	410
Benzo(g,h,i)perylene	1/1	870	870
Di-n-butylphthalate	1/1	520	520
Di-n-octylphthalate	1/1	710	710
Dibenzofuran	1/1	140	140
bis(2-Ethylhexyl)phthalate	1/1	14000	14000
Fluoranthene	1/1	4400	4400
Fluorene	1/1	160	160
2-Methylnaphthalene	1/1	200	200
4-Methylphenol (p-Cresol)	1/1	86.0	86.0
Naphthalene	1/1	160	160
Phenanthrene	1/1	2100	2100
Pyrene	1/1	3000	3000

Table 10.10.6
Zone G
AOC 643
Organic Analytical Results for Sediment

Parameters	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)
Pesticides and PCBs (1 Sample) (μg/kg)			
alpha-Chlordane	1/1	45.0	45.0
gamma-Chlordane	1/1	49.0	49.0
4,4'-DDD	1/1	42	42
4,4'-DDE	1/1	43	43
4,4'-DDT	1/1	9.20	9.20
Dieldrin	1/1	6.60	6.60
Endrin aldehyde	1/1	110	110
Heptachlor epoxide	1/1	2.90	2.90

Notes:
1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995b)
μg/kg = Micrograms per kilogram

Table 10.10.7
Zone G
AOC 643
Analytes Detected in Sediment Samples

Parameters	Location	Concentration
Volatile Organic Compounds (μg/kg)		
Trichloroethene	643M0001	3
Semivolatile Organic Compounds (μg/kg)		
BEQs[1]	643M0001	2033.7
Benzo(a)anthracene	643M0001	1300
Benzo(b)fluoranthene	643M0001	1200
Benzo(k)fluoranthrene	643M0001	1300
Benzo(a)pyrene	643M0001	1300
Chrysene	643M0001	1700
Dibenz(a,h)anthracene	643M0001	390
Indeno(1,2,3-cd)pyrene	643M0001	790
Acenaphthene	643M0001	230
Acenaphthylene	643M0001	63
Anthracene	643M0001	410
Benzo(g,h,i)perylene	643M0001	870
Dibenzofuran	643M0001	140
Di-n-butylphthalate	643M0001	520
Di-n-octylphthalate	643M0001	710
bis(2-Ethylhexyl)phthalate	643M0001	14000
Fluoranthene	643M0001	4400
Fluorene	643M0001	160
2-Methylnaphthalene	643M0001	200
4-Methylphenol	643M0001	86
Naphthalene	643M0001	160
Phenanthrene	643M0001	2100
Pyrene	643M0001	3000

Table 10.10.7
Zone G
AOC 643
Analytes Detected in Sediment Samples

Parameters	Location	Concentration
Pesticides (μg/kg)		
alpha-Chlordane	643M0001	45
gamma-Chlordane	643M0001	49
4,4'-DDD	643M0001	42
4,4'-DDE	643M0001	43
4,4'-DDT	643M0001	9.2
Dieldrin	643M0001	6.6
Endrin aldehyde	643M0001	110
Heptachlor epoxide	643M0001	2.9

Notes:
1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995b)
μg/kg = Micrograms per kilogram

10.10.5 Fate and Transport Assessment

A CSI site, AOC 643 is the electric substation at Building 125 which lies on the north side of Hobson Avenue. Environmental media sampled as part of the AOC 643 investigation include surface soil, subsurface soil, and sediment. Potential constituent migration pathways investigated for AOC 643 include soil-to-groundwater, surface soil-to-sediment, and emission of volatile compounds from surface soil to air.

10.10.5.1 Soil-to-Groundwater Cross-Media Transport

Table 10.10.8 compares maximum detected organic and inorganic constituent concentrations in surface and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganic compounds, maximum concentrations in soil are compared to the

Table 10.10.8
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Saltwater Surface Water Chronic Screening Levels, and Background Concentrations
NAVBASE Charleston, Zone G: AOC 643
Charleston, South Carolina

Parameter	Max Concentration Surface Soil	Max Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Saltwater Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Benzene	3	ND	NA	NA	30	0.36	109	UG/KG	UG/L	NO	NO	NO
Carbon disulfide	ND	3	NA	NA	32000	1000	NA	UG/KG	UG/L	NO	NO	NO
Trichloroethene	2	ND	NA	NA	60	1.6	NA	UG/KG	UG/L	NO	NO	NO
Xylene (total)	ND	1	NA	NA	148000	12000	NA	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Acenaphthene	86	ND	NA	NA	570000	2200	9.7	UG/KG	UG/L	NO	NO	NO
Anthracene	200	50	NA	NA	12000000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	530	150	NA	NA	4.66E+08	1500	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	1000	180	NA	NA	2000	0.092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene	900	150	NA	NA	8000	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(b)fluoranthene	1000	310	NA	NA	5000	0.092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(k)fluoranthene	580	50	NA	NA	49000	0.92	NA	UG/KG	UG/L	NO	NO	NO
Chrysene	970	200	NA	NA	160000	9.2	NA	UG/KG	UG/L	NO	NO	NO
Dibenzo(a,h)anthracene	290	70	NA	NA	2000	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Indeno(1,2,3-cd)pyrene	500	140	NA	NA	14000	0.092	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	40	ND	NA	NA	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
Di-n-octylphthalate	69	ND	NA	NA	10000000	730	NA	UG/KG	UG/L	NO	NO	NO
Fluoranthene	1900	390	NA	NA	4300000	1500	1.6	UG/KG	UG/L	NO	NO	NO
Fluorene	66	ND	NA	NA	560000	1500	NA	UG/KG	UG/L	NO	NO	NO
Phenanthrene	970	260	NA	NA	1380000	1500	NA	UG/KG	UG/L	NO	NO	NO
Pyrene	1300	370	NA	NA	4200000	1100	NA	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
Aroclor-1260	1700	420	NA	NA	1000	0.034	0.03	UG/KG	UG/L	YES	NO	NO
alpha-Chlordane	13	3.2	NA	NA	10000	0.19	0.004	UG/KG	UG/L	NO	NO	NO
gamma-Chlordane	24	ND	NA	NA	10000	0.19	0.004	UG/KG	UG/L	NO	NO	NO
4,4'-DDD	24	ND	NA	NA	16000	0.28	0.025	UG/KG	UG/L	NO	NO	NO
4,4'-DDE	380	45	NA	NA	54000	0.2	0.14	UG/KG	UG/L	NO	NO	NO
4,4'-DDT	134	28	NA	NA	32000	0.2	0.001	UG/KG	UG/L	NO	NO	NO
Dieldrin	ND	22	NA	NA	4	0.0042	0.0019	UG/KG	UG/L	YES	NO	NO
Endrin	8.5	ND	NA	NA	1000	11	0.0023	UG/KG	UG/L	NO	NO	NO
Endrin aldehyde	120	3.8	NA	NA	1000	11	NA	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	5.4849	NA	NA	NA	1900	0.45	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	6290	5740	NA	NA	1000000	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	1	ND	NA	NA	5	15	NA	MG/KG	UG/L	NO	NO	NO
Arsenic	52.7	8.1	NA	NA	29	17.8	36	MG/KG	UG/L	YES	NO	NO
Barium	130	10.8	NA	NA	1600	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	0.37	0.48	NA	NA	63	0.016	NA	MG/KG	UG/L	NO	NO	NO
Cadmium	0.69	0.28	NA	NA	8	18	9.3	MG/KG	UG/L	NO	NO	NO
Chromium (total)	52.3	33.7	NA	NA	1000000	180	50	MG/KG	UG/L	NO	NO	NO
Cobalt	24.8	1.6	NA	NA	2000	2200	NA	MG/KG	UG/L	NO	NO	NO
Copper	36.8	9.8	NA	NA	920	130000	8.33	MG/KG	UG/L	NO	NO	NO
Cyanide	0.12	ND	NA	NA	40	730	3.8	MG/KG	UG/L	NO	NO	NO
Lead	154	27.5	NA	NA	400	15	8.5	MG/KG	UG/L	NO	NO	NO
Manganese	184	103	NA	NA	1100	2906	NA	MG/KG	UG/L	NO	NO	NO
Mercury	0.14	ND	NA	NA	2.1	11	0.025	MG/KG	UG/L	NO	NO	NO
Nickel	21.5	ND	NA	NA	130	730	21.7	MG/KG	UG/L	NO	NO	NO
Selenium	0.86	1.2	NA	NA	5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	0.65	ND	NA	NA	34	180	2.9	MG/KG	UG/L	NO	NO	NO
Tin	2.4	ND	NA	NA	11000	22000	NA	MG/KG	UG/L	NO	NO	NO
Vanadium	141	31.3	NA	NA	6000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	155	ND	NA	NA	12000	11000	86	MG/KG	UG/L	NO	NO	NO

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 20, from 1996 Soil Screening Guidance or calculated using values from Table 6.4
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, October 22, 1997
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region IV Bulletins, Ecological Risk Assessment, November, 1995; Table 2
For inorganics, the value shown is the greater of the relevant screening value or the corresponding background value.

NA - Not available/Not applicable
ND - Not detected
RBC - Risk based concentration
SSL - Soil screening level
MG/KG - Milligrams per kilogram
NG/KG - Nanograms per kilogram
PG/L - Picograms per liter
UG/KG - Micrograms per kilogram
UG/L - Micrograms per liter

greater of either the risk-based soil screening levels or the corresponding background values. To provide a conservative screening, generic soil screening levels are used. Leachate entering the aquifer is assumed to be diluted by a ratio of 20:1, with no attenuation of constituents in soil (DAF = 20).

Two organic constituents - dieldrin and Aroclor-1260 - were detected in AOC 643 soil at concentrations exceeding groundwater protection SSLs. Dieldrin was detected in only 1 of 12 subsurface soil samples (22.0 μg/kg at 643SB006), and was not detected in any of the 12 surface soil samples collected. Since the presence of dieldrin at AOC 643 is not consistent with historical activities at this site, the provenance of dieldrin at this site is unclear. The vertical distribution of dieldrin at location 643SB006 in the grassy area at AOC 643, is consistent with this pesticide is strong affinity to adsorb to soil media, thereby limiting its mobility and attenuating with depth in the soil column. The limited detection in only one subsurface soil sample points toward the presence of a limited residual mass in the subsurface soil. This compound's absence in surface soil and presence in the subsurface soil at concentrations five times the applicable SSL argue that the soil-to-groundwater migration pathway for AOC 643 may have some merit with respect to dieldrin.

One PCB compound - Aroclor-1260 - was detected in two surface soil samples at concentrations exceeding the groundwater protection SSL of 1000 μg/kg. The presence of Aroclor-1260 at this site is consistent with historical site activities. The majority of the detections were in surface soil (6 of 12). Aroclor-1260 was detected in three subsurface soil samples. No concentrations detected in subsurface soil samples exceeded the SSL. The maximum concentrations of Aroclor-1260 present in the surface and subsurface soil samples were 1700 μg/kg and 420 μg/kg respectively. The distribution of Aroclor-1260 is consistent with the typical chemical behavior for PCBs (marked attenuation with depth as constituents adsorb readily to organic carbon sites in soil media). This adsorption tends to effectively immobilize these types of contaminants. The vertical distribution of the Aroclor-1260 supports this, as concentrations decrease significantly

with depth. As for pathway validity, the site surface around AOC 643 is a grassy area, thus allowing precipitation to readily infiltrate and transport these constituents downward into the subsurface soils with no apparent limit to leaching potential. Evidence from the sampling results, however, suggest that this organic constituent has been effectively immobilized with depth (not present above SSL in subsurface soil). The exceedances detected were at locations 643SB007 and 643SB010 in the surface soils, indicating that a limited residual mass may be present in surface soil. Assuming stabilization between soil and groundwater media, the soil-to-groundwater pathway for Aroclor-1260 is not expected to be significant (as demonstrated by absence of exceedances in the subsurface soil).

One inorganic constituent - arsenic - was detected in 5 surface and 3 subsurface soil samples. Arsenic was detected at concentrations exceeding groundwater protection SSLs in only one surface soil sample location 643SB009. Although detected in all subsurface soil samples, no exeedances of the applicable SSLs were reported in the subsurface soil samples. Most inorganic constituents detected at this site exhibit a remarkable attenuation of concentration in the subsurface soil. This depletion in concentration is consistent with a surficial source, and in the absence of a mobilizing agent, inorganics will tend to adsorb onto soil media. The presence of arsenic is not consistent with historical activities at AOC 643, but is a common constituent of Zone G soil, thus making it difficult to assign provenance to this site. Additionally, given the persistent presence of arsenic throughout Zone G soil, consideration should be given that the concentrations of arsenic noted in the surface and subsurface soil at AOC 643 are within the range of ambient conditions and not attributable to site activities. The concentrations of arsenic detected in subsurface soil do not exceed applicable SSLs, thus the soil-to-groundwater migration pathway for arsenic at AOC 643 is considered insignificant.

10.10.5.2 Surface Soil-to-Sediment Cross Media Transport

Table 10.10.7 lists the analytes detected in sediment samples collected as part of the AOC 643 investigation. One sediment sample was taken from the storm catch basin located approximately 50 feet southwest of Building 125. The sediment samples contained detectable levels of all organic constituents from all major parameter groups analyzed for, including VOCs, SVOCs, pesticides, and PCBs. Similarly, parameters from all of these groups were also detected in AOC 643 soil, suggesting that the storm water catch basin that was sampled receives storm water runoff from AOC 643. It also suggests that this catch basin acts as a settling basin for solids and potential contaminants entrained in storm water flowing across the pavement, as well as surface soil media entrained in storm water from AOC 643. Additionally, the contribution to the sediment load from up gradient sources is unknown. The attribution of fractional divisions of contaminants detected in sediment to AOC 643 contaminant sources without additional data is not possible, however the soil-to-sediment migration pathway should be considered viable. The effects of storm water discharge to surface water receptors will be addressed in the Zone J RFI report.

10.10.5.3 Soil-to-Air Cross-Media Transport

Table 10.10.9 lists the VOCs detected in surface soil samples collected at AOC 643, along with the corresponding soil-to-air volatilization screening criteria. Benzene and trichloroethene were detected in surface soil at AOC 643, but did not exceed the soil-to-air screening levels. The soil-to-air migration pathway is therefore considered invalid.

10.10.5.4 Fate and Transport Summary

Two organic constituents - dieldrin and Aroclor-1260 - were detected in soil samples at concentrations exceeding groundwater protection SSLs. Dieldrin was not detected in the surface soil but was detected in one subsurface soil sample. Since the presence of dieldrin at AOC 643 is not consistent with historical activities at this site, the provenance of dieldrin at this site is unclear. Absence in surface soil and presence in the subsurface soil at concentrations five times

Table 10.10.9
Soil to Air Volatilization Screening Analysis
NAVBASE Charleston, Zone G: AOC 643
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Benzene	3	800	UG/KG	NO
Trichloroethene	2	5000	UG/KG	NO

Notes:
* - Soil screening levels for transfers from soil to air were obtained from USEPA Soil Screening Guidance, Technical Background Document Appendix A, May 1996 (first preference) or from Soil Screening Levels - Transfers from Soil to Air, USEPA Region III Risk-Based Concentration Table, June 1996.
NA - Not available

the applicable SSL argue that the soil-to-groundwater migration pathway for AOC 643 may have some merit, with respect to dieldrin, but limited spatial occurrence indicates that the residual mass is small. Aroclor-1260 was detected in surface soil at concentrations exceeding the groundwater protection SSL at AOC 643. It was also detected in three subsurface soil samples, but none exceeded the applicable SSLs. The presence of Aroclor-1260 at this site is consistent with historical site activities. Since the majority of exceedances detected were in two locations (limited residual mass), and the concentrations decrease with depth (no SSL exceedances in subsurface soil), the soil-to-groundwater migration pathway for Aroclor-1260 is not expected to be significant. One inorganic constituent - arsenic - was detected in one surface soil location at concentrations exceeding the groundwater protection SSL. The presence of arsenic is not consistent with past activities at the site; given that it was present in every soil sample collected, consideration should be given that the concentrations are within the range of ambient conditions and not attributable to site activities. The levels of arsenic in subsurface soil do not exceed applicable SSLs, thus the soil-to-groundwater migration pathway for arsenic at AOC 643 is not expected to be significant.

One sediment sample was taken from the storm catch basin located approximately 50 feet southwest of Building 125. The sediment sample contained detectable levels of all organic constituents from all major parameter groups analyzed for including VOCs, SVOCs, pesticides, and PCBs. Similarly, the parameters from these groups were detected in AOC 643 soil, suggesting that the catch basin is accumulating soil particles entrained in storm water from the site; additional input may be coming from the paved areas around AOC 643 as well. The attribution of fractional divisions of contaminants detected in sediment to AOC 643 contaminant sources without additional data is not possible, but the soil-to-sediment migration pathway should be considered viable.

Benzene and trichloroethene were detected in surface soil at AOC 643, but did not exceed soil-to-air volatilization screening criteria; therefore, the soil-to-air migration pathway is considered invalid.

10.10.6 Human Health Risk Assessment

10.10.6.1 Site Background and Investigative Approach

AOC 643 is the electric substation at Building 125 on the north side of Hobson Avenue, near the entrance to Pier N. At one time, PCB transformers, inactive DC generators, switches, and circuit breakers were stored in a wooden shed adjacent to Building 125. A dielectric fluid spill/cleanup was documented, and stains were noted on concrete pavement in the area.

During the CSI, seven first-round soil samples were collected from each the upper and lower intervals to identify potential impacts resulting from the activities listed above. Five second-round soil borings were advanced and samples were collected from each interval to delineate exceedances identified during the first sampling round. Surface soil samples from all 12 boring locations were used to quantitatively assess soil exposure pathways. Subsurface soil is addressed in the previous section, Fate and Transport Assessment for AOC 643. Fate and transport screening did not identify any COPCs for the groundwater pathways. Groundwater is not currently used at Zone G for potable purposes, nor is it expected to be used for drinking water in the future. For these reasons, the groundwater pathway was not included in the risk assessment for AOC 643. Section 10.10.3 provides a summary of the sampling effort for AOC 643 soil.

10.10.6.2 COPC Identification

Based on the screening comparisons described in Section 7 of this report and presented in Table 10.10.10, benzo(a)pyrene equivalents, arsenic, chromium, vanadium, and Aroclor-1260 were identified as COPCs in surface soil.

Table 10.10.10
Chemicals Present in Site Samples
AOC 643 - Surface Soil
Naval Base Charleston, Zone G
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Residential RBC	Background	Units	Number Exceeding RBC	Bkgd
Carcinogenic PAHs													
B(a)P Equiv.	*	7	12	4.5	1446.77	345.6771	808.85	947.51	88	NA	UG/KG	4	
Benzo(a)anthracene	*	5	12	81	1000	326.2	350	410	880	NA	UG/KG	1	
Benzo(a)pyrene	*	5	12	46	900	299.8	350	410	88	NA	UG/KG	4	
Benzo(b)fluoranthene	*	7	12	45	1000	283.7143	350	410	880	NA	UG/KG	1	
Benzo(k)fluoranthene		5	12	43	580	224.6	350	410	8800	NA	UG/KG		
Chrysene		5	12	100	970	362	350	410	88000	NA	UG/KG		
Dibenz(a,h)anthracene	*	3	12	69	290	153	350	410	88	NA	UG/KG	2	
Indeno(1,2,3-cd)pyrene		5	12	38	500	174	350	410	880	NA	UG/KG		
TCDD Equivalents													
1234678-HpCDD		2	2	6.44	152	79.22	NA	NA	NA	NA	NG/KG		
1234789-HpCDF		1	2	1.07	1.07	1.07	0.197	0.197	NA	NA	NG/KG		
123478-HxCDF		2	2	1.1	16.6	8.85	NA	NA	NA	NA	NG/KG		
12378-PeCDF		2	2	0.864	19.4	10.132	NA	NA	NA	NA	NG/KG		
Dioxin Equiv.		2	2	0.2888	5.4849	2.8869	NA	NA	1000	NA	NG/KG		
OCDD		2	2	69.5	1300	684.75	NA	NA	NA	NA	NG/KG		
OCDF		2	2	1.68	24.2	12.94	NA	NA	NA	NA	NG/KG		
Inorganics													
Aluminum (Al)		5	5	3110	6290	4396	NA	NA	7800	18700	MG/KG		
Antimony (Sb)		2	5	0.86	1	0.93	0.32	0.36	3.1	2.89	MG/KG		
Arsenic (As)	*	5	5	1.2	52.7	13.82	NA	NA	0.43	17.2	MG/KG	5	1
Barium (Ba)		5	5	8.2	130	34.88	NA	NA	550	109	MG/KG		1
Beryllium (Be)		4	5	0.2	0.37	0.3125	0.11	0.11	0.15	1.2	MG/KG	4	
Cadmium (Cd)		5	5	0.05	0.69	0.322	NA	NA	3.9	1.07	MG/KG		
Calcium (Ca)		5	5	851	106000	35330.2	NA	NA	NA	NA	MG/KG		
Chromium (Cr)	*	5	5	4.7	52.3	18.46	NA	NA	39	42.8	MG/KG	1	1
Cobalt (Co)		5	5	0.48	24.8	5.842	NA	NA	470	6.6	MG/KG		1
Copper (Cu)		4	5	5.5	36.8	21.275	0.9	0.9	27000	260	MG/KG		
Cyanide (CN)		1	2	0.12	0.12	0.12	0.11	0.11	160	0.38	MG/KG		
Iron (Fe)		5	5	3400	6290	4740	NA	NA	NA	NA	MG/KG		
Lead (Pb)		5	5	4.7	154	53.6	NA	NA	400	181	MG/KG		
Magnesium (Mg)		5	5	162	2860	1131.6	NA	NA	NA	NA	MG/KG		
Manganese (Mn)		5	5	7.4	184	64.92	NA	NA	180	325	MG/KG	1	
Mercury (Hg)		2	5	0.09	0.14	0.115	0.04	0.04	2.3	1.03	MG/KG		
Nickel (Ni)		3	5	3.6	21.5	13.9667	1.4	6.7	160	20.6	MG/KG		1
Potassium (K)		4	5	260	761	412.25	213	213	NA	NA	MG/KG		
Selenium (Se)		3	5	0.47	0.86	0.62	0.32	0.34	39	1.22	MG/KG		
Silver (Ag)		1	5	0.65	0.65	0.65	0.2	0.22	39	NA	MG/KG		
Sodium (Na)		2	5	266	623	444.5	96.1	277	NA	NA	MG/KG		
Tin (Sn)		2	5	0.92	2.4	1.66	0.92	3.1	4700	9.67	MG/KG		
Vanadium (V)	*	5	5	7.9	141	44.4	NA	NA	55	60.9	MG/KG	1	1
Zinc (Zn)		2	5	24.1	155	89.55	6	143	2300	519	MG/KG		
Pesticides/PCBs													
Aroclor-1260	*	6	12	71	1700	555.1667	73	83	320	NA	UG/KG	2	
4,4'-DDD		2	12	4	24	14	2.6	10	2700	NA	UG/KG		
4,4'-DDE		12	12	3	380	79.3583	NA	NA	1900	NA	UG/KG		
4,4'-DDT		9	12	6.8	134	58.3111	2.8	16	1900	NA	UG/KG		
alpha-Chlordane		4	12	1.7	13	6.8	1.4	3.5	470	NA	UG/KG		
Endrin		2	12	5.7	8.5	7.1	2.6	3	2300	NA	UG/KG		
Endrin aldehyde		1	12	120	120	120	2.6	14	2300	NA	UG/KG		
gamma-Chlordane		6	12	5.6	24	14.3	1.4	9.9	470	NA	UG/KG		

Table 10.10.10
Chemicals Present in Site Samples
AOC 643 - Surface Soil
Naval Base Charleston, Zone G
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Residential RBC	Background	Units	Number Exceeding RBC	Bkgd
Semivolatile Organics												
Acenaphthene	1	12	86	86	86	350	410	470000	NA	UG/KG		
Anthracene	3	12	48	200	106.6667	350	410	2300000	NA	UG/KG		
Benzo(g,h,i)perylene	5	12	57	530	197.4	350	410	310000	NA	UG/KG		
Di-n-butylphthalate	1	12	40	40	40	350	410	780000	NA	UG/KG		
Di-n-octyl phthalate	1	12	69	69	69	350	400	160000	NA	UG/KG		
Fluoranthene	6	12	41	1900	546.8333	350	410	310000	NA	UG/KG		
Fluorene	1	12	66	86	66	350	410	310000	NA	UG/KG		
Phenanthrene	5	12	110	970	334	350	410	310000	NA	UG/KG		
Pyrene	5	12	150	1300	490	350	410	230000	NA	UG/KG		
Volatile Organics												
Benzene	1	9	3	3	3	5	6	22000	NA	UG/KG		
Trichloroethene	1	9	2	2	2	5	6	58000	NA	UG/KG		

Notes:
* - Indicates chemical was identified as a COPC
SQL - Sample quantitation limit
RBC - Risk-based concentration
UG/KG - micrograms per kilogram
NG/KG - nanograms per kilogram
MG/KG - milligrams per kilogram
NA - Not applicable or not available

10.10.6.3 Exposure Assessment

Exposure Setting

AOC 643, an electrical substation at Building 125, is surrounded by grass and asphalt pavement. The sidewalk which parallels the north side of Hobson Avenue passes the site.

Potentially Exposed Populations

Potentially exposed populations are current and future site workers. Additional potentially exposed populations are hypothetical future site residents. Future site resident and worker exposure scenarios is addressed quantitatively in this risk assessment. Current exposure to workers is discussed qualitatively in relation to the future workers and future residents. The hypothetical future site worker scenario assumes continuous exposure to surface soil conditions. Current site workers' exposure would be less than that assumed for the hypothetical future site worker scenario because of their limited soil contact. Therefore, future worker assessment is considered to be conservatively representative of current site users. The future site resident scenario is built on the premise that existing features would be removed and replaced with dwellings.

Exposure Pathways

Exposure pathways for the hypothetical future site residents are dermal contact and incidental ingestion of surface soils. The exposure pathways for future site workers are the same as those for the future site residents with respect to soil. Uniform exposure is assumed for all sample locations. Table 10.10.11 presents the justification for exposure pathways assessed in this HHRA.

Table 10.10.11
Zone G
AOC 643
Exposure Pathways Summary

Potentially Exposed Population	Medium and Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Current Land Uses			
Current Users (Site Workers)	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No	This exposure pathway was considered insignificant compared to the other pathways.
	Shallow groundwater, Ingestion of contaminants during potable or general use	No	Shallow groundwater is not currently used as a source of potable or non-residential water at AOC 643.
	Shallow groundwater, Inhalation of volatilized shallow groundwater contaminants	No	Shallow groundwater is not currently used as a source of potable or non-residential water at AOC 643.
	Soil, Incidental ingestion	No (Qualified)	Future site use is considered conservatively representative of current site use.
	Soil, Dermal contact	No (Qualified)	Future site use is considered conservatively representative of current site use.
Futnre Land Uses			
Future Site Residents (Child and Adult), Future Site Worker	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No	This exposure pathway was considered insignificant compared to the other pathways.
	Shallow groundwater, Ingestion of contaminants during potable or general use	No	Fate and transport screening did not identify any COPCs for this exposure pathway.
	Shallow groundwater, Inhalation of volatilized contaminants during domestic use	No	Volatile COPCs were not identified subsequent to risk-based screening comparisons.
	Soil, Incidental ingestion	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Soil, Dermal contact	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Wild game or domestic animals, Ingestion of tissue impacted by media contamination	No	Hunting/taking of game and/or raising livestock is prohibited within the Charleston, South Carolina city limits.
	Fruits and vegetables, Ingestion of plant tissues grown in media	No	The potential for significant exposure via this pathway is low relative to that of other exposure pathways assessed.

Exposure Point Concentrations

Twelve surface soil samples were collected and analyzed for this assessment. Table 10.10.12 presents the EPCs for the COPCs identified in surface soil, by using the 95% UCL as discussed in Section 7 of this RFI. Because less than 10 surface soil samples were analyzed for metals, maximum reported concentrations were used as EPCs for metals.

Quantification of Exposure

CDIs for ingestion and dermal contact with soils are shown in Tables 10.10.13 and 10.10.14, respectively.

10.10.6.4 Toxicity Assessment

Toxicity assessment terms and methods are discussed in Section 7 of this report. Table 10.10.15 presents toxicological information specific to each COPC identified at AOC 643. This information was used in the quantification of risk/hazard associated with soil contaminants. Brief toxicological profiles for each COPC are provided in the following paragraphs:

Arsenic exposure via the ingestion route darkens and hardens the skin in chronically exposed humans. Inhalation exposure to arsenic causes neurological deficits, anemia, and cardiovascular effects (Klaassen et al., 1986). USEPA set 0.3 μg/kg-day as the oral RfD for arsenic based on a NOAEL of 0.8 μg/kg-day in a human exposure study. Arsenic's effects on the nervous and cardiovascular systems are primarily associated with acute exposure to higher concentrations. Exposure to arsenic-containing materials has been shown to cause cancer in humans. Inhaling these materials can lead to increased lung cancer risk, and ingestion is associated with increased skin cancer rates. Arsenic has been classified as a group A carcinogen by USEPA, which set the 1.5 $(mg/kg\text{-}day)^{-1}$ oral SF for arsenic. As listed in IRIS, the classification is based on sufficient evidence from human data. An increased lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Also, increased mortality from multiple internal

Table 10.1.12
Summary of Statistical Analysis
Surface Soil COPCs; AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

COPC	Natural Log Transformed n	mean	SD	H-stat	UCL (mg/kg)	MAX (mg/kg)	EPC (mg/kg)	
Carcinogenic PAHs								
Benzo(a)pyrene Equivalent	12	-0.826	0.418	2.047	0.62	1.45	0.62	UCL
Pesticides/PCBs								
Aroclor-1260	12	-2.305	1.347	3.585	1.06	1.70	1.06	UCL
Inorganics								
Arsenic	5	NA	NA	NA	NA	52.7	52.7	MAX
Chromium	5	NA	NA	NA	NA	52.3	52.3	MAX
Vanadium	5	NA	NA	NA	NA	141	141	MAX

NOTES:

mean Arithmetic mean of the logtransformed data
n Number of samples analyzed
SD Standard deviation for a sample of data
H-stat "H" statistic from Gilbert 1987; cuboidal interpolation was used to determine the value in accordance with USEPA Supplemental Guidance to RAGS, Calculating the Concentration Term
NA Not applicable
EPC Exposure point concentration
UCL 95 percentile upper confidence level mean
MAX Maximum reported concentration

Table 10.1.13
Chronic Daily Intakes
Incidental Ingestion of Surface Soil
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Fraction Ingested from Contaminated Source *	Exposure Point Concentration (mg/kg)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Worker adult H-CDI (mg/kg-day)	Future Worker adult C-CDI (mg/kg-day)
Carcinogenic PAHs							
Benzo(a)pyrene Equivalents	1	0.62	8.5E-07	7.9E-06	9.7E-07	3.0E-07	1.1E-07
Pesticides/PCBs							
Aroclor-1260	1	1.06	1.5E-06	1.4E-05	1.7E-06	5.2E-07	1.9E-07
Inorganics							
Arsenic (As)	1	52.7	7.2E-05	6.7E-04	8.3E-05	2.6E-05	9.2E-06
Chromium (Cr)	1	52.3	7.2E-05	6.7E-04	8.2E-05	2.6E-05	9.1E-06
Vanadium (V)	1	141	1.9E-04	1.8E-03	2.2E-04	6.9E-05	2.5E-05

NOTES:

lwa Lifetime weighted average; used to calculate carcinogenic CDI, RAGS Parts A and B
CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
* Reflects the estimated fraction of the site impacted by the corresponding COPC.

Table 10.1.14
Chronic Daily Intakes
Dermal Contact with Surface Soil
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	FI/FC *	Exposure Point Concentration (mg/kg)	Dermal Absorption Factor (unitless)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Worker adult H-CDI (mg/kg-day)	Future Worker adult C-CDI (mg/kg-day)
Carcinogenic PAHs								
Benzo(a)pyrene Equivalents	1	0.62	0.01	3.5E-07	1.1E-06	2.2E-07	2.5E-07	8.9E-08
Pesticides/PCBs								
Aroclor-1260	1	1.06	0.01	5.9E-07	2.0E-06	3.7E-07	4.2E-07	1.5E-07
Inorganics								
Arsenic (As)	1	52.7	0.001	3.0E-06	9.8E-06	1.9E-06	2.1E-06	7.6E-07
Chromium (Cr)	1	52.3	0.001	2.9E-06	9.7E-06	1.8E-06	2.1E-06	7.5E-07
Vanadium (V)	1	141	0.001	7.9E-06	2.6E-05	5.0E-06	5.7E-06	2.0E-06

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
* Reflects the estimated fraction of the site impacted by the corresponding COPC.
\- The dermal absorption factor was applied to the exposure point concentration to reflect the ability for trans-dermal migration of inorganic and organic chemicals

Table 10.10.15
Toxicological Reference Information
for Chemicals of Potential Concern
AOC 643
Naval Base, Charleston, Zone G
Charleston, South Carolina

	Non-Carcinogenic Toxicity Data										*Carcinogenic Toxicity Data*					
emical	Oral Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Oral	Inhalation Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Inhalation	Oral Slope Factor (kg-day/mg)		Inhalation Slope Factor (kg-day/mg)		Weight of Evidence	Tumor Type
enic	0 0003	a	M	hyperpigmentation	3	NA		NA	NA	NA	1.5	a	15.1	a	A	various
Q	NA		NA	NA	NA	NA		NA	NA	NA	7.3	a	6 1	b	B2	mutagen
omium III	1	a	L	NA	100/10	5 71E-07	b	NA	NA	NA	NA		NA	a	D	NA
omium VI	0 005	a	L	NA	500	NA		NA	NA	NA	NA		42	a	A	lung
B Aroclor-1260 (soil)	NA		NA	NA	NA	NA		NA	NA	NA	2	a	NA		B2	hepatocellular carcinoma
adium	0 007	a	NA	unclear	100	NA		NA	NA	NA	NA		NA		D	NA

rs.

= Integrated Risk Information System (IRIS)
= Withdrawn from IRIS/HEAST
= Not applicable or not available
= High confidence
= Low confidence
= Medium confidence

organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in arsenic. Human milk contains about 3 μg/L arsenic. The RBC for arsenic in tap water is 0.045 μg/L. As listed in IRIS, the critical effect of this chemical is hyperpigmentation, keratosis, and possible vascular complications. The uncertainty factor was 3 and the modifying factor was 1.

Benzo(a)pyrene equivalents include the following list of PAHs:

Benzo(a)anthracene	TEF	0.1
Benzo(b)fluoranthene	TEF	0.1
Dibenz(a,h)anthracene	TEF	1.0
Benzo(k)fluoranthene	TEF	0.01
Benzo(a)pyrene	TEF	1.0
Indeno(1,2,3-cd)pyrene	TEF	0.1
Chrysene	TEF	0.001

Some PAHs are toxic to the liver, kidney, and blood. However, the toxic effects of the PAHs above have not been well established. There are no RfDs for the PAHs listed due to a lack of data. All PAHs listed are classified by USEPA as B2 carcinogens, and their carcinogenicity is addressed relative to that of benzo(a)pyrene, having an oral SF 7.3 $(mg/kg\text{-}day)^{-1}$. Toxicity Equivalency Factors, also set by USEPA, are multipliers that are applied to the detected concentrations, which are subsequently used to calculate excess cancer risk. These multipliers are discussed further in the exposure and toxicity assessment sections. Most carcinogenic PAHs have been classified as such due to animal studies using large doses of purified PAHs. There is some doubt as to the validity of these listings, and the SFs listed in USEPA's RBC table are provisional. However, these PAHs are carcinogens when the exposure involves a mixture of other carcinogenic substances (e.g., coal tar, soot, cigarette smoke, etc.). As listed in IRIS, the basis for the benzo(a)pyrene B2 classification is human data, however data which specifically links

benzo(a)pyrene to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating benzo(a)pyrene to be carcinogenic by numerous routes.

Benzo(a)pyrene has produced positive results in numerous genotoxicity assays. At the June 1992 CRAVE Work Group meeting, a revised risk estimate for benzo(a)pyrene was verified. This section provides information on three aspects of the carcinogenic risk assessment for the agent in question. The USEPA classification and quantitative estimates of exposure, reflect a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in application of a low-dose extrapolation procedure and presented as the risk per mg/kg-day. The unit risk is the quantitative estimate in terms of either risk per μg/L drinking water or risk per $\mu g/m^3$ air breathed. The third form in which risk is presented is drinking water or air concentration providing cancer risks of 1 in 10,000 or 1 in 1,000,000. The Carcinogenicity Background Document provides details on the carcinogenicity values found in IRIS. Users are referred to the Oral Reference Dose and Reference Concentration sections for information on long-term toxic effects other than carcinogenicity.

The basis for the dibenz(a,h)anthracene and benzo(b)fluoranthene B2 classification is listed in IRIS, as no human data and sufficient data from animal bioassays. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal or subcutaneous injection, and skin painting. The basis for the benzo(a)anthracene B2 classification is listed in IRIS, as no human data and sufficient data from animal bioassays. Benzo(a)anthracene produced tumors in mice exposed by gavage; intraperitoneal, subcutaneous or intramuscular injection; and topical application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. The basis for the benzo(k)fluoranthene B2 classification is listed in IRIS as no human data and sufficient data from animal bioassays. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in

skin-painting studies. Equivocal results have been found in a lung adenoma assay in mice. Benzo(k)fluoranthene is mutagenic in bacteria. (Klaassen, et al., 1986).

Chromium exists in two stable, natural forms: CrIII and CrVI. Acute exposure to chromium can result in kidney damage following oral exposure or damage to the nasal mucosa and septum following inhalation exposure. Chronic inhalation exposure to CrVI has resulted in kidney and respiratory tract damage, as well as excess lung cancer in both animals and humans following occupational exposure. Only CrVI is believed to be carcinogenic by inhalation (IRIS). Oral RfD values for CrIII and CrVI are 1.0 and 5E-3 (mg/kg-day), respectively. For CrIII, the RfD is based on liver toxicity in the rat. For the CrVI, the RfD is based on unspecified pathological changes observed in rat studies. In addition, CrVI is considered a group A carcinogen for inhalation exposures, and an inhalation SF of 42 $(mg/kg\text{-}day)^{-1}$ has been established for the CrVI. Vitamin supplements contain approximately 0.025 mg of chromium. As listed in IRIS, no critical effects were observed for CrIII. The uncertainty factor used for CrIII was 100 and the modifying factor was 10. As listed in IRIS, no critical effects were observed for CrVI. The uncertainty factor was 500 and the modifying factor was 1.

PCB Aroclors are a group of chlorinated hydrocarbons (such as Aroclors-1248, 1254, and 1260) that accumulate in fat tissue. Occupational exposure (both inhalation and dermal) to PCBs causes eye and lung irritation, loss of appetite, liver enlargement, increased serum liver enzyme levels, rashes and chloracne, and decreased birth weight of infants in heavily exposed worker/mothers. Of the effects listed above, the liver is the primary target organ (Klaassen, et al., 1986) (Dreisbach, et al., 1987). USEPA classified PCB aroclors as group B2 probable human carcinogens, primarily based on animal data. Oral ingestion of PCBs causes liver and stomach tumors in rat studies. The cancer potency of PCB mixtures is determined using a tiered approach. The high risk and persistence tier uses an upper-bound oral slopefactor of 2.0 $(mg/kg\text{-}day)^{-1}$ and is appropriate for food chain exposures, sediment and soil ingestion, dust or aerosol inhalation,

and dermal exposure. The low risk and persistence tier uses an upper-bound slope factor of 0.4 $(mg/kg\text{-}day)^{-1}$ and is appropriate for ingestion of water soluble congeners and inhalation of evaporated congeners. The lowest risk and persistence tier uses an upper-bound slope factor of 0.07 $(mg/kg\text{-}day)^{-1}$ and is appropriate for PCB congener mixtures with congeners having more than four chlorines comprising less than 1/2% of the mixture.

Vanadium is not readily absorbed through the skin or oral ingestion and is a ubiquitous element. It is also a by-product of petroleum refining. Vanadium is soluble in fats and oils (Klaassen et al., 1986). Municipal water supplies contain 0.001 to 0.006 mg/L of vanadium. The target organ is unclear, and the primary focus of toxicological information is inhalation of vanadium dust. Typical vitamin supplements contain approximately 0.01 mg in a daily dose. The oral RfD set by USEPA is 0.007 mg/kg-day.

10.10.6.5 Risk Characterization

Exposure to surface soil onsite was evaluated under residential and industrial (site worker) scenarios. For these scenarios, the incidental ingestion and dermal contact exposure pathways were evaluated. For noncarcinogenic contaminants evaluated for future site residents, hazard was computed separately to address child and adult exposure. Tables 10.10.16 and 10.10.17 present the computed carcinogenic risks and/or HQs associated with the incidental ingestion of and dermal contact with site surface soils, respectively.

Hypothetical Site Residents

The ingestion ILCR (based on the adult and child lifetime weighted average) for AOC 643 surface soils is 1E-04. The dermal pathway ILCR is 2E-05. Arsenic was the primary contributor to ILCR projections for the ingestion and dermal pathways. Aroclor-1260 and benzo(a)pyrene equivalents were secondary contributors.

Table 10.1.16
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Surface Soil Ingestion
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Future Worker Adult Hazard Quotient	Future Worker Adult ILCR
Carcinogenic PAHs							
Benzo(a)pyrene Equivalents	NA	7.3	ND	ND	7.1E-06	ND	7.9E-07
Pesticides/PCBs							
Aroclor-1260	NA	2	ND	ND	3.3E-06	ND	3.7E-07
Inorganics							
Arsenic (As)	0.0003	1.5	0.241	2.25	1.2E-04	0.086	1.4E-05
Chromium (Cr)	0.005	NA	0.014	0.13	ND	0.005	ND
Vanadium (V)	0.007	NA	0.028	0.26	ND	0.010	ND
SUM Hazard Index/ILCR			0.3	3	1E-04	0.1	1E-05

NOTES:

NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk

Table 10.1.17
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact With Surface Soil
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Dermal Adjustment	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Future Worker Adult Hazard Quotient	Future Worker Adult ILCR
Carcinogenic PAHs								
Benzo(a)pyrene Equivalents	0.5	NA	14.6	ND	ND	3.2E-06	ND	1.3E-06
Pesticides/PCBs								
Aroclor-1260	0.5	NA	4	ND	ND	1.5E-06	ND	6.1E-07
Inorganics								
Arsenic (As)	0.2	0.0001	7.5	0.0493	0.163	1.4E-05	0.0352	5.7E-06
Chromium (Cr)	0.2	0.001	NA	0.0029	0.010	ND	0.0021	ND
Vanadium (V)	0.2	0.001	NA	0.0057	0.019	ND	0.0040	ND
SUM Hazard Index/ILCR				0.06	0.2	2E-05	0.04	8E-06

NOTES:

NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk
- Dermal to absorbed dose adjustment factor is applied to adjust for Oral SF and RfD (i.e., the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI)

The ingestion HIs projected for the adult and child receptors are 0.3 and 3, respectively. The dermal pathway HIs were 0.06 for the adult resident receptor and 0.2 for the child resident receptor. The primary contributor to HI projections for the ingestion and dermal pathways was arsenic. Chromium and vanadium were secondary contributors.

Hypothetical Site Workers

Site worker ILCRs are 1E-05 for the ingestion pathway and 8E-06 for the dermal contact pathway. Arsenic and benzo(a)pyrene equivalents were primary contributors to ILCR projections for the ingestion and dermal pathways. Aroclor-1260 was a secondary contributor.

Site worker HIs were 0.1 for the ingestion pathway and 0.04 for the dermal pathway. The primary contributor to HI projections for the ingestion and dermal pathways was arsenic. Chromium and vanadium were secondary contributors.

COCs Identified

Chemicals of concern were identified based on cumulative (all pathway) risk and hazard projected for this site on a medium-specific basis. USEPA has established a generally acceptable risk range of 1E-04 to 1E-06, and a hazard index threshold of 1.0 (unity). As recommended by SCDHEC, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual ILCR exceeds 1E-06 or whose hazard quotient exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-04 (and individual ILCR of 1E-06) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used in order to provide a more comprehensive evaluation of chemicals contributing to carcinogenic risk or noncarcinogenic hazard during the remedial goal options development process. Table 10.10.18 presents the COCs identified for AOC 643 surface soil.

Table 10.1.18
Summary of Risk and Hazard-based COCs
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident Iwa ILCR	Future Site Worker Hazard Quotient	Future Site Worker ILCR	Identification of COCs		
Surface Soil	Incidental Ingestion	**Carcinogenic PAHs**								
		Benzo(a)pyrene Equivalents	ND	ND	7.1E-06	ND	7.9E-07		2	4
		Pesticides/PCBs								
		Aroclor-1260	ND	ND	3.3E-06	ND	3.7E-07		2	
		Inorganics								
		Arsenic (As)	0.241	2.25	1.2E-04	0.086	1.4E-05	1	2	4
		Chromium (Cr)	0.014	0.13	ND	0.005	ND	1		
		Vanadium (V)	0.028	0.26	ND	0.010	ND	1		
	Dermal	**Carcinogenic PAHs**								
		Benzo(a)pyrene Equivalents	ND	ND	3.2E-06	ND	1.3E-06		2	4
		Pesticides/PCBs								
		Aroclor-1260	ND	ND	1.5E-06	ND	6.1E-07		2	
		Inorganics								
		Arsenic (As)	0.049	0.163	1.4E-05	0.0352	5.7E-06	1	2	4
		Chromium (Cr)	0.003	0.010	ND	0.0021	ND	1		
		Vanadium (V)	0.006	0.019	ND	0.0040	ND	1		
Surface Soil Pathway Sum			0.3	3	2E-04	0.1	2E-05			

Notes:
ND indicates not determined due to the lack of available risk information.
ILCR indicates incremental excess lifetime cancer risk
HI indicates hazard index
1- Chemical is a COC by virtue of projected child residence noncarcinogenic hazard.
2- Chemical is a COC by virtue of projected future resident lifetime ILCR.
3- Chemical is a COC by virtue of projected site worker noncarcinogenic hazard.
4- Chemical is a COC by virtue of projected site worker ILCR.

Future Site Residents

Aroclor-1260, arsenic, and benzo(a)pyrene equivalents were identified as soil pathway COCs based on their contribution to cumulative residential ILCR projections.

Arsenic, chromium, and vanadium were identified as soil pathways COCs based on their contribution to cumulative residential HI projections.

Future Site Workers

Arsenic and benzo(a)pyrene equivalents were identified as soil pathway COCs based on their contribution to cumulative industrial ILCR projections.

No COCs were identified in AOC 643 surface soil based on contribution to cumulative industrial HI projections.

The extent of the COCs identified in surface soil is briefly discussed below. To facilitate this discussion, residential soil RBCs and background concentrations were compared to each reported COC concentration. Arsenic was detected in 5 of 5 surface soil samples analyzed for metals at a concentration above its residential RBC (0.43 mg/kg), but only exceeded its background value (17.2 mg/kg) in 1 surface soil sample (643SB009) with a concentration of 52.7 mg/kg. Chromium was also detected in 5 of 5 surface soil samples, but only exceeded its residential RBC (39 mg/kg) and its background value (42.8 mg/kg) in 1 surface soil sample (643SB010) with a concentration of 52.3 mg/kg. Vanadium was detected in 5 of 5 surface soil samples, but only exceeded its residential RBC (55 mg/kg) and its background value (60.9 mg/kg) in 1 surface soil sample (643SB004) with a concentration of 141 mg/kg. Aroclor-1260 was detected in 6 of 12 surface soil samples, but only exceeded its residential RBC (320 μg/kg) in 2 surface soil samples (643SB007 and 643SB010) with a maximum reported concentration of 1,700 μg/kg. Benzo(a)pyrene equivalent compounds were detected in 7 of 12 surface soil samples, but only exceeded their

corresponding residential RBC (88 μg/kg) in 4 surface soil samples (643SB002, 643SB005, 643SB010, and 643SB012), with a maximum reported concentration of 1,447 μg/kg.

10.10.6.6 Risk Uncertainty

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure.

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. If this area were to be used as a residential site, the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, exposure to surface soil conditions as represented by samples collected during the CSI would not be likely under a true future residential scenario. These factors indicate that exposure pathways assessed in this HHRA would generally overestimate the risk and hazard posed to current site workers and future site residents.

Determination of Exposure Point Concentrations

Exposure point concentrations were set equal to the 95% UCL for benzo(a)pyrene equivalents and Aroclor-1260. Use of the 95% UCL represents a conservative assumption when applied as an EPC, such that it is unlikely that the 95% UCL would be exceeded by the true mean concentration. The maximum concentrations of arsenic, chromium, and vanadium were used as EPCs since less than 10 data points were collected for each of these COPCS. Use of maximum detected concentrations also represent conservative assumptions when applied as EPCs, and tend to overestimate risk and hazard.

Frequency of Detection and Spatial Distribution

Arsenic, chromium, and vanadium each exceeded their respective background value in one surface soil sample. Since their maximum reported concentrations were used as EPCs, it is unlikely that a human receptor would be chronically exposed exclusively to the maximum concentrations. The maximum detected concentrations of both arsenic and chromium were detected in samples collected from the western perimeter of the site. It is unclear whether the extent of contamination has been adequately defined. Therefore, risk and hazard were overestimated with the use of maximum concentrations as EPCs, however, there is uncertainty related to the potential for elevated concentrations of arsenic and chromium in soil located west of the site.

Quantification of Risk/Hazard

As indicated by the discussions above, the uncertainty inherent in the risk assessment process is great. In addition, many site-specific factors have affected the uncertainty of this assessment that would upwardly bias the risk and hazard estimates. Exposure pathway-specific sources of uncertainty are discussed below:

A conservative screening process was used to identify COPCs for AOC 643. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens, the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, only beryllium and manganese were reported at a concentration near their respective RBC (e.g. within 10% of their RBC). Both metals were actually detected at a concentration exceeding their respective RBCs, however, their maximum reported concentrations did not exceed their corresponding background concentrations. As a result, beryllium and manganese were eliminated from consideration in the risk assessment.

The oral RfD used in the quantitative assessment of chromium was based on hexavalent chromium. Hexavalent chromium was analyzed for in duplicate samples collected at 643SB009 and 643SB010, but was not detected. The maximum reported concentration of chromium (52.3 mg/kg) was detected in 643SB010. Since no hexavalent chromium was detected in the same sample, it can be assumed that chromium primarily exists at AOC 643 in the CrIII state. The oral RfD for CrIII is 1. By using the RfD for CrIII, the maximum reported concentration of chromium yielded hazard quotients of 0.0008 and 0.00004 for the child resident and site worker respectively; indicating hazard estimates for chromium are likely overestimated.

Background-related Risk

Beryllium and manganese were detected in AOC 643 surface soil at concentrations above their corresponding RBCs. They were eliminated from consideration in the risk assessment based on comparison to their background values. It is not unusual for naturally occurring or background concentrations of some elements to exceed risk-based concentrations. It is the risk assessment's function to identify excess risk and/or hazard, or that which is above background levels. The following is a discussion of the residential scenario risk/hazard associated with the background concentrations of beryllium and manganese:

The maximum surface soil concentration of beryllium (0.37 mg/kg) at AOC 643 equates with ILCRs of 3E-06 and 4E-07 for the site resident and site worker, respectively. Hazard quotients are 0.001 and 0.00006 for the residential child and site worker, respectively. The background value for beryllium (1.2 mg/kg) results in ILCRs of 9E-06 and 1E-06 for the site resident and site worker, respectively. Hazard quotients are 0.003 and 0.0002 for the residential child and site worker, respectively.

The maximum surface soil concentration of manganese (184 mg/kg) for AOC 643 equates with hazard quotients of 0.1 and 0.006 for the residential child and site worker, respectively. The

background value for manganese (325 mg/kg) results in hazard quotients of 0.2 and 0.01 for the residential child and site worker, respectively.

10.10.6.7 Risk Summary

The risk and hazard posed by contaminants at AOC 643 were assessed for future site workers and future site residents under reasonable maximum exposure assumptions. For surface soils, the incidental ingestion and dermal contact pathways were assessed in this HHRA. Table 10.10.19 presents the risk summary for each pathway/receptor group evaluated for AOC 643.

Residential Scenario

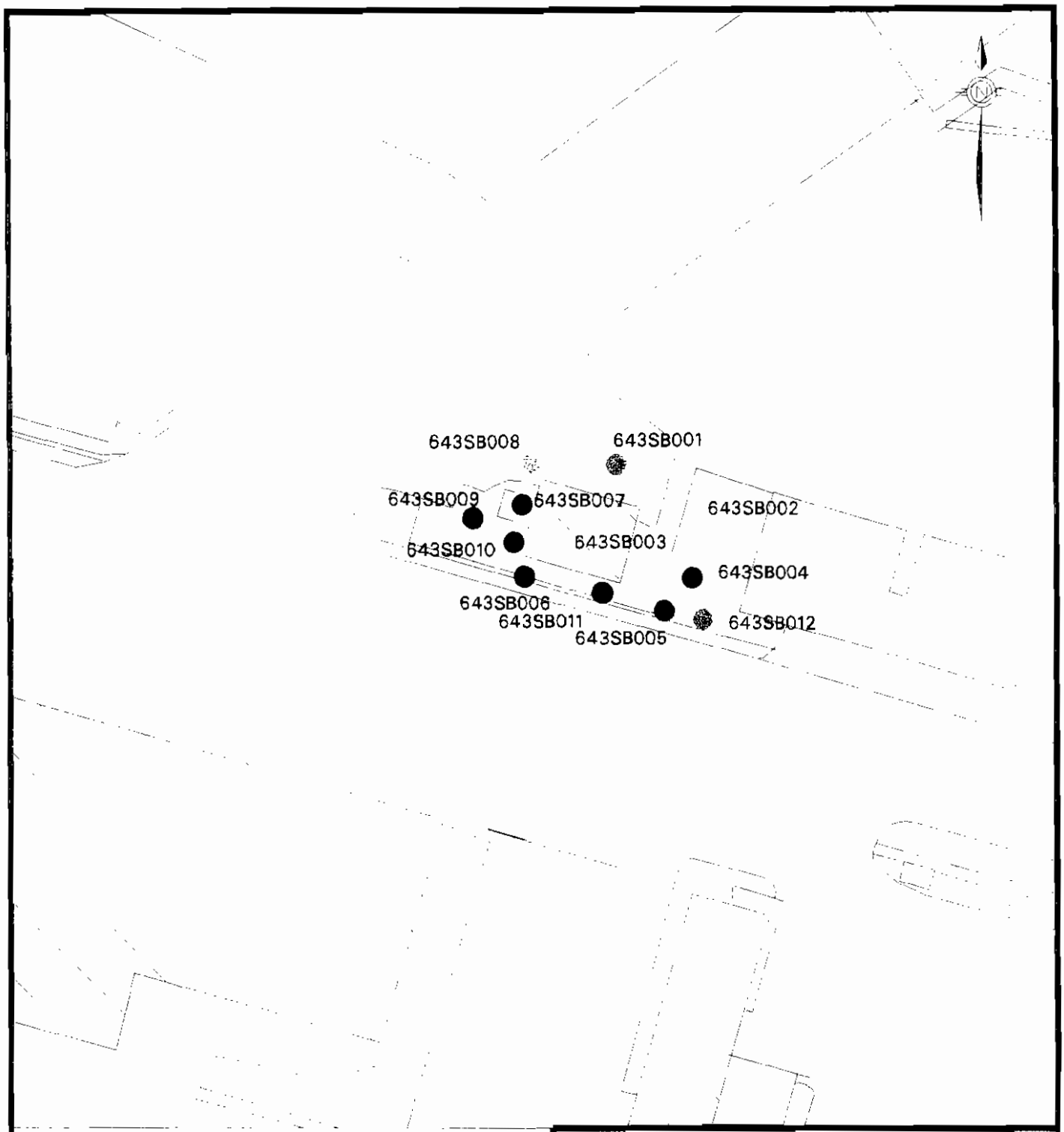
Residential soil pathway COCs identified for AOC 643 are arsenic, chromium, vanadium, Aroclor-1260, and benzo(a)pyrene equivalents. Figures 10.10-8 and 10.10-9 illustrates point risk and point hazard estimates for AOC 643 based on soil exposure pathways under a future residential scenario. Table 10.10.20 summarizes the risk and hazard contribution of each COPC at each sample location. This point risk map is based on the unlikely assumption that a potential future site resident will be chronically exposed to specific points. Exposure to surface soil conditions is more likely the result of uniform exposure to the soil conditions of the entire site (or exposure unit area) rather than specific points. Risk maps supplemented by the tables are useful in that they allow the reader to visualize how chemicals driving risk estimates are spatially distributed across the site.

Nine of twelve sample locations yielded ILCRs that were greater than 1E-06. Arsenic was the primary contributor to risk at 643SB001, 643SB004, 643SB009, and 643SB010, while it was a secondary contributor at 643SB007. Benzo(a)pyrene equivalents were primary contributors to risk at 643SB002, 643SB003, 643SB005, and 643SB012, while they were secondary contributors at 643SB004, 643SB009, and 643SB010. Aroclor-1260 was a primary contributor to risk at 643SB007, while it was a secondary contributor at 643SB003, 643SB009, 643SB010, and

Table 10.1.19
Summary of Risk and Hazard
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)
Surface Soil	Incidental Ingestion	0.3	3	1E-04	0.10	1E-05
	Dermal Contact	0.06	0.2	2E-05	0.04	8E-06
Sum of Soil Pathways		0.3	3	2E-04	0.1	2E-05

Notes:
ILCR Indicates incremental lifetime cancer risk
HI Indicates hazard index



LEGEND

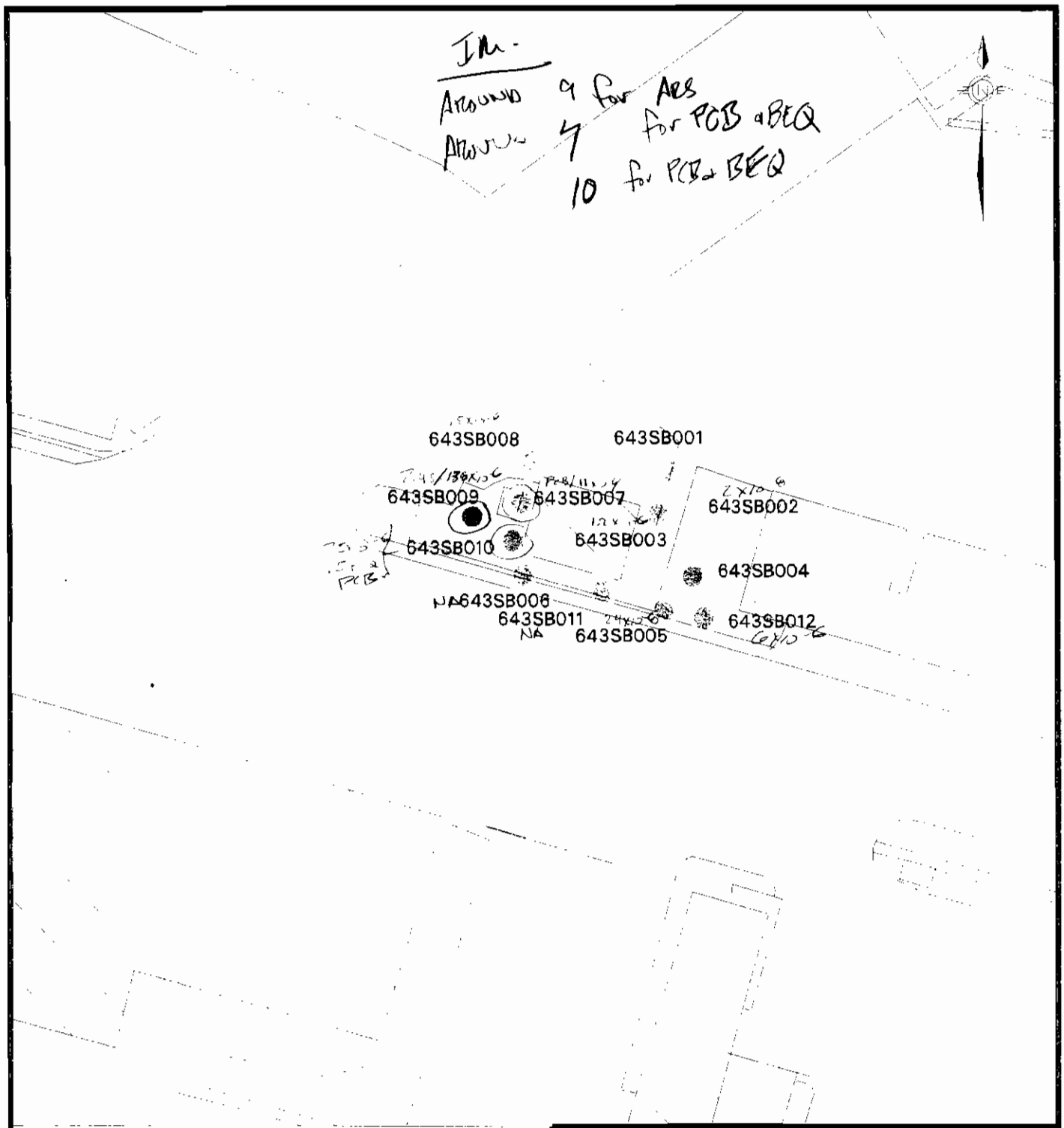
- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 100

ZONE G - RCRA FACILITY INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-8
POINT RISK ESTIMATES FOR SURFACE SOIL
RESIDENTIAL SCENARIO
AOC 643

AMI /home3/projects/charleston_dir/zone_g_dir/net_dir



LEGEND

- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

0 feet 100

ZONE G - RCRA FACILITY INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-9
POINT HAZARD ESTIMATES FOR SURFACE SOIL
RESIDENTIAL SCENARIO
AOC 643

AML /home3/projects/charleston_dir/zone_g_dir/ex_dir

Table 10.10.20
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
643	001	Aroclor-1260	ND	UG/KG	NA		NA	
643	001	Arsenic (As)	3.4	MG/KG	0.1554	77.33	8.8808	100.00
643	001	B(a)P Equiv.	ND	UG/KG	NA		NA	
643	001	Chromium (Cr)	9.9	MG/KG	0.0272	13.51	NA	
643	001	Vanadium (V)	9.4	MG/KG	0.0184	9.16	NA	
		Total			0.2010		8.8808	
643	002	Aroclor-1260	ND	UG/KG	NA		NA	
643	002	B(a)P Equiv.	112.7	UG/KG	NA		1.8663	100.00
		Total			NA		1.8663	
643	003	Aroclor-1260	71	UG/KG	NA		0.3221	25.57
643	003	B(a)P Equiv.	56.63	UG/KG	NA		0.9378	74.43
		Total			NA		1.2599	
643	004	Aroclor-1260	ND	UG/KG	NA		NA	
643	004	Arsenic (As)	5.3	MG/KG	0.2423	42.95	13.8436	95.74
643	004	B(a)P Equiv.	37.18	UG/KG	NA		0.6157	4.26
643	004	Chromium (Cr)	16.6	MG/KG	0.0455	8.07	NA	
643	004	Vanadium (V)	141	MG/KG	0.2762	48.97	NA	
		Total			0.5640		14.4593	
643	005	Aroclor-1260	ND	UG/KG	NA		NA	
643	005	B(a)P Equiv.	1446.77	UG/KG	NA		23.9590	100.00
		Total			NA		23.9590	
643	006	Aroclor-1260	ND	UG/KG	NA		NA	
643	006	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
643	007	Aroclor-1260	1700	UG/KG	NA		7.7130	71.10
643	007	Arsenic (As)	1.2	MG/KG	0.0548	65.91	3.1344	28.90
643	007	B(a)P Equiv.	ND	UG/KG	NA		NA	
643	007	Chromium (Cr)	4.7	MG/KG	0.0129	15.49	NA	
643	007	Vanadium (V)	7.9	MG/KG	0.0155	18.60	NA	
		Total			0.0832		10.8474	
643	008	Aroclor-1260	110	UG/KG	NA		0.4991	100.00
643	008	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		0.4991	
643	009	Aroclor-1260	130	UG/KG	NA		0.5898	0.43
643	009	Arsenic (As)	52.7	MG/KG	2.4088	98.04	137.6525	99.52

Table 10.10.20
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
643	009	B(a)P Equiv.	4.5	UG/KG	NA		0.0745	0.05
643	009	Chromium (Cr)	8.8	MG/KG	0.0241	0.98	NA	
643	009	Vanadium (V)	12.2	MG/KG	0.0239	0.97	NA	
		Total			2.4568		138.3168	
643	010	Aroclor-1260	1170	UG/KG	NA		5.3084	17.88
643	010	Arsenic (As)	6.5	MG/KG	0.2971	54.87	16.9780	57.19
643	010	B(a)P Equiv.	447.03	UG/KG	NA		7.4030	24.93
643	010	Chromium (Cr)	52.3	MG/KG	0.1434	26.49	NA	
643	010	Vanadium (V)	51.5	MG/KG	0.1009	18.63	NA	
		Total			0.5414		29.6893	
643	011	Aroclor-1260	ND	UG/KG	NA		NA	
643	011	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
643	012	Aroclor-1260	150	UG/KG	NA		0.6806	11.54
643	012	B(a)P Equiv.	314.93	UG/KG	NA		5.2153	88.46
		Total			NA		5.8959	

643SB012. Risk estimates at AOC 643 ranged from 5E-07 (643SB008) to 1E-04 (643SB009), with a mean risk estimate of 2E-05.

Arsenic was the primary contributor to the hazard estimate at the only location at AOC 643 that yielded a hazard index above unity (643SB009). Chromium and vanadium were secondary contributors. Hazard index estimates ranged from 0.08 (643SB007) to 2 (643SB009), with a mean hazard estimate of 0.3.

Site Worker Scenario

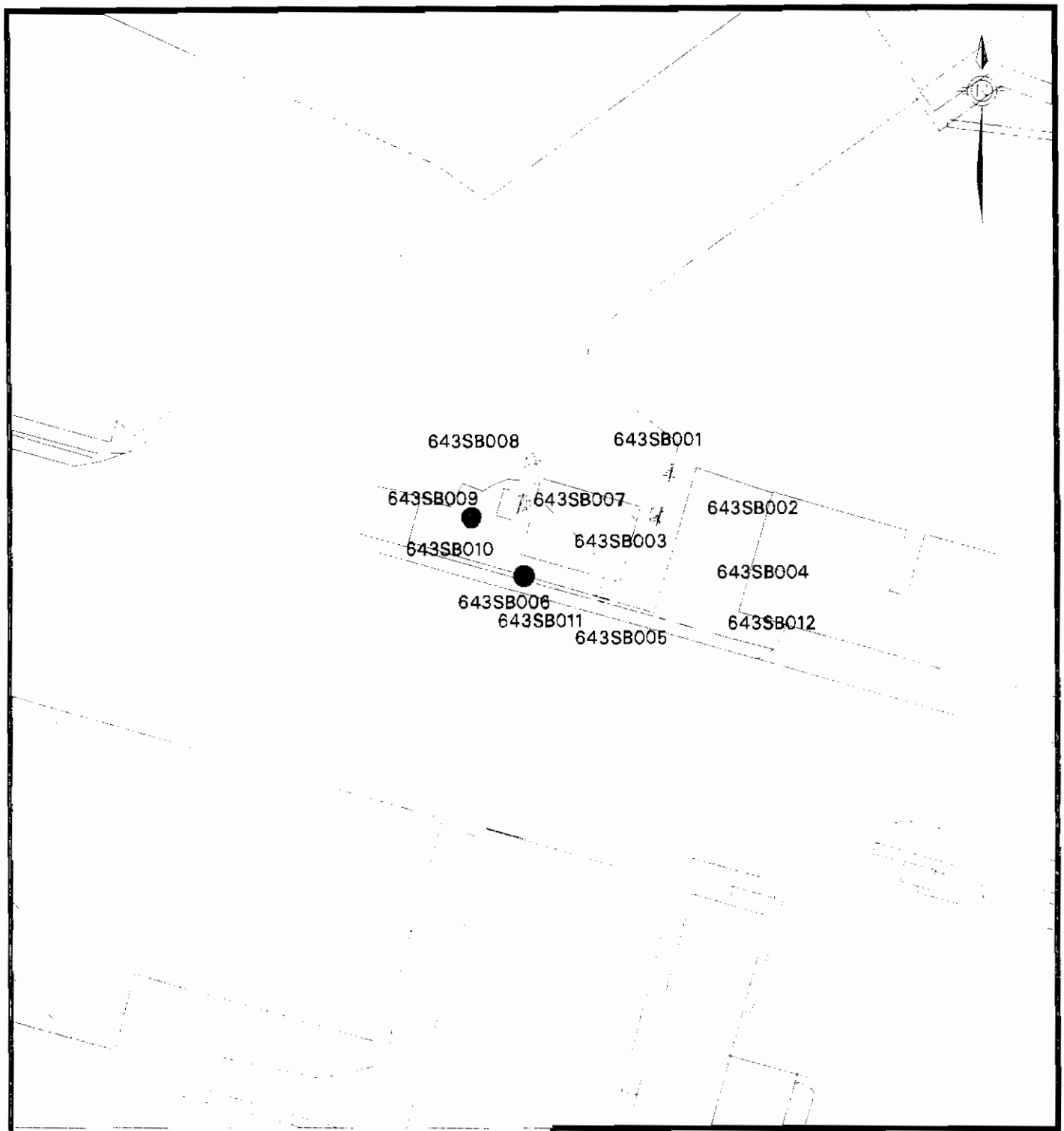
Industrial soil pathway COCs identified for AOC 643 are arsenic and benzo(a)pyrene equivalents. Figure 10.10-10 illustrates point risk estimates for AOC 643 based on soil exposure pathways under a future industrial scenario. Table 10.10.21 summarizes the risk and hazard contribution of each COC at each sample location.

Six of twelve sample locations yielded an ILCR greater than 1E-06 (643SB001, 643SB004, 643SB005, 643SB009, 643SB010, and 643SB012). Arsenic and benzo(a)pyrene equivalents were the sole contributors to ILCR projections for the industrial scenario at AOC 643. Risk estimates ranged from 2E-07 (643SB003) to 2E-05 (643SB009), with a mean risk estimate of 3E-06.

Arsenic was the sole contributor to hazard estimates for the industrial scenario at AOC 643; however, hazard indices did not exceed unity at any location. Hazard index estimates ranged from 0.003 (643SB007) to 0.1 (643SB009), with a mean hazard estimate of 0.01.

10.10.6.8 Remedial Goal Options

RGOs for carcinogens were based on the lifetime weighted average site resident as presented in Table 10.10.22 for surface soils. Hazard-based RGOs were calculated based on the hypothetical child resident, as noted in the table.



LEGEND

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 100

ZONE G - RCRA FACILITY INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.10-10
POINT RISK ESTIMATES FOR SURFACE SOIL
INDUSTRIAL SCENARIO
AOC 643

AML /home3/projects/charleston_dir/zone_g_dir/risk_dir

Table 10.1.21
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
643	001	Arsenic (As)	3.4	MG/KG	0.0078	100	1.2563	100
643	001	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			0.0078		1.2563	
643	002	B(a)P Equiv.	112.7	UG/KG	NA		0.3795	100
		Total			NA		0.3795	
643	003	B(a)P Equiv.	56.63	UG/KG	NA		0.1907	100
		Total			NA		0.1907	
643	004	Arsenic (As)	5.3	MG/KG	0.0122	100	1.9584	93.99
643	004	B(a)P Equiv.	37.18	UG/KG	NA		0.1252	6.01
		Total			0.0122		2.0836	
643	005	B(a)P Equiv.	1446.77	UG/KG	NA		4.8715	100
		Total			NA		4.8715	
643	006	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
643	007	Arsenic (As)	1.2	MG/KG	0.0028	100	0.4434	100
643	007	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			0.0028		0.4434	
643	008	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
643	009	Arsenic (As)	52.7	MG/KG	0.1212	100	19.4730	99.92
643	009	B(a)P Equiv.	4.5	UG/KG	NA		0.0152	0.08
		Total			0.1212		19.4882	
643	010	Arsenic (As)	6.5	MG/KG	0.0149	100	2.4018	61.47
643	010	B(a)P Equiv.	447.03	UG/KG	NA		1.5052	38.53
		Total			0.0149		3.9070	
643	011	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
643	012	B(a)P Equiv.	314.93	UG/KG	NA		1.0604	100
		Total			NA		1.0604	

Table 10.1.22
Remedial Goal Options for Soil
AOC 643
Naval Base Charleston, Zone G
Charleston, South Carolina

Residential-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 1E-06 mg/kg	1E-05 mg/kg	1E-04 mg/kg	Background Concentration mg/kg
Carcinogenic PAHs										
Benzo(a)pyrene Equivalents	7.3	NA	0.62	ND	ND	ND	0.06	0.6	6	NA
Pesticides/PCBs										
Aroclor-1260	2	NA	1.06	ND	ND	ND	0.22	2.2	22	NA
Inorganics										
Arsenic (As)	1.5	0.0003	52.7	66	22	2.2	0.38	3.8	38	17.2
Chromium (Cr)	NA	0.005	52.3	1094	365	36.5	ND	ND	ND	42.8
Vanadium (V)	NA	0.007	141	1531	510	51.0	ND	ND	ND	60.9

Worker-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 1E-06 mg/kg	1E-05 mg/kg	1E-04 mg/kg	Background Concentration mg/kg
Carcinogenic PAHs										
Benzo(a)pyrene Equivalents	7.3	NA	0.62	ND	ND	ND	0.6	6	63	NA
Inorganics										
Arsenic (As)	1.5	0.0003	52.7	1305	435	43	2.7	27	271	17.2

NOTES:

EPC Exposure point concentration
NA Not applicable
ND Not determined
- Remedial goal options were based on the residential or site worker lifetime weighted average for carcinogens and the child resident or site worker for noncarcinogens

10.10.7 Corrective Measures Considerations

Based on the analytical results and the human health risk assessment for AOC 643, COCs requiring further evaluation through the CMS process have been identified for surface soil. The site is currently in an urban area and risk to human health was evaluated under both the residential and industrial (site worker) scenarios. For these scenarios, the incidental ingestion and dermal contact exposure pathways were evaluated. Hazard was evaluated or noncarcinogenic contaminants through incidental ingestion and dermal contact scenarios as well.

As recommended by SCDHEC, a COC is considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual risk exceeds 1E-06 or whose hazard quotient exceeds 0.1.

Aroclor-1260, arsenic, BEQs, chromium, and vanadium were identified as soil pathway COCs for AOC 643. Table 10.10.23 presents cumulative and COC-specific exposure risks and hazard quotients. Risk-based remedial goals for surface soil are presented in Table 10.10.22.

To determine the leaching potential of contaminants from the subsurface soil media to groundwater, contaminant concentrations in subsurface soil were compared against generic SSLs based on a DAF of 20. This comparison indicated three contaminants exceeding SSLs. These contaminants were Aroclor-1260, arsenic, and dieldrin. Aroclor-1260 was detected in two samples at concentrations (1,170 and 1,700 μg/kg) above the SSL of 1,000 μg/kg. Arsenic was detected in one sample at a concentration (52.7 μg/kg) above the SSL of 29 μg/kg. Dieldrin was detected in one sample at a concentration (22 μg/kg) above the SSL of 4 μg/kg. For more information regarding indirect exposure pathways associated with subsurface soil refer to Section 10.10.5, Fate and Transport Assessment for AOC 643. Potential corrective measures for soil are presented in Table 10.10.24.

Table 10.10.23
Zone G
AOC 643
Cumulative and Chemical-Specific Exposure Risks and Hazard

	Risk		Hazard	
Chemical	**Industrial**	**Residential**	**Industrial**	**Residential**
Soil				
Aroclor-1260	9.8E-07	4.8E-06	ND	ND
Arsenic	2.0E-05	1.3E-04	0.121	2.41
BEQs	2.1E-06	1.0E-05	ND	ND
Chromium	ND	ND	0.007	0.14
Vanadium	ND	ND	0.014	0.28
Cumulative	2.3E-05	1.5E-04	0.142	2.83

Note:
ND = Not determined

Table 10.10.24
Zone G
AOC 643
Potential Corrective Measures

Medium	Compounds	Potential Corrective Measures
Soil	Aroclor-1260, Arsenic, BEQs, Chromium, Dieldrin, and Vanadium	a) No action b) Excavate, offsite disposal, and monitoring c) Containment/capping d) Ex-situ physical treatment

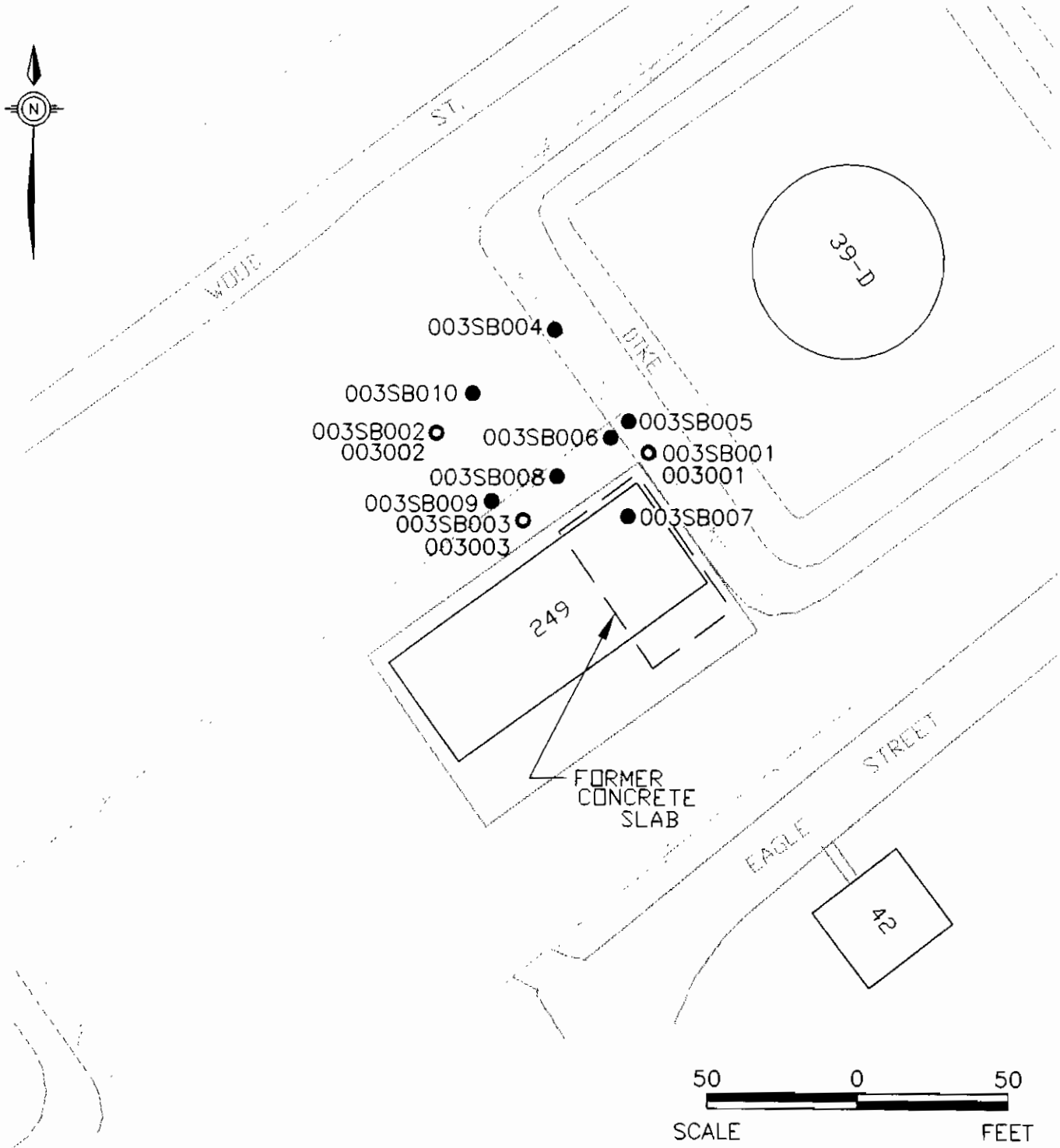
10.11 SWMU 3, Pesticide Mixing Area

A RFI site, SWMU 3 is an approximately 50 by 30 foot area where the former Building 42-A was located. The building was a shed where pesticides were mixed prior to 1971. Equipment for spraying and mixing pesticides was reportedly rinsed on the ground outside, with the rinsate allowed to infiltrate the soil. During the 1982 Confirmation Study (Geraghty and Miller, 1982), a portion of the area surrounding the slab for Building 42-A was also noted to be devoid of vegetation. This once devoid area is now covered with grass. The northwest wall of Building 249 was constructed later over a portion of the area concerned. Soil and groundwater samples collected during the Confirmation Study revealed the presence of low concentrations of various pesticides and associated degradation products, consistent with the types of pesticides documented as being used there. Pesticides detected included DDT and metabolites, heptachlor, and beta/delta BHC. Groundwater sample results were below detection limits for pesticides, herbicides, PCBs and arsenic.

10.11.1 Site Geology and Hydrogeology

Figure 10.11-1 depicts the soil and groundwater sampling locations within this area. Appendix A contains the boring logs and the monitoring well construction diagrams for the three wells installed at SWMU 3. Based on the monitoring well borings advanced at the site, the stratigraphy at SWMU 3 generally consists of alternating silty, sandy clay, and clayey, silty sand, to a depth of 15 ft bgs. SWMU 3 monitoring wells are screened from approximately 4 to 14 ft bgs primarily in silty sand containing trace amounts of clay. The sand in which the wells are completed exhibits a grain size distribution of approximately 85% sand, 5% silt and 10% clay.

The groundwater elevation at SMWU 3 is approximately 5.5 ft msl. Figures 10.11-2 and 10.11-3 depict the shallow groundwater potentiometric surface and inferred flow direction at low and high-tide respectively. Minor differences in the static water levels and the overall flow pattern were



LEGEND

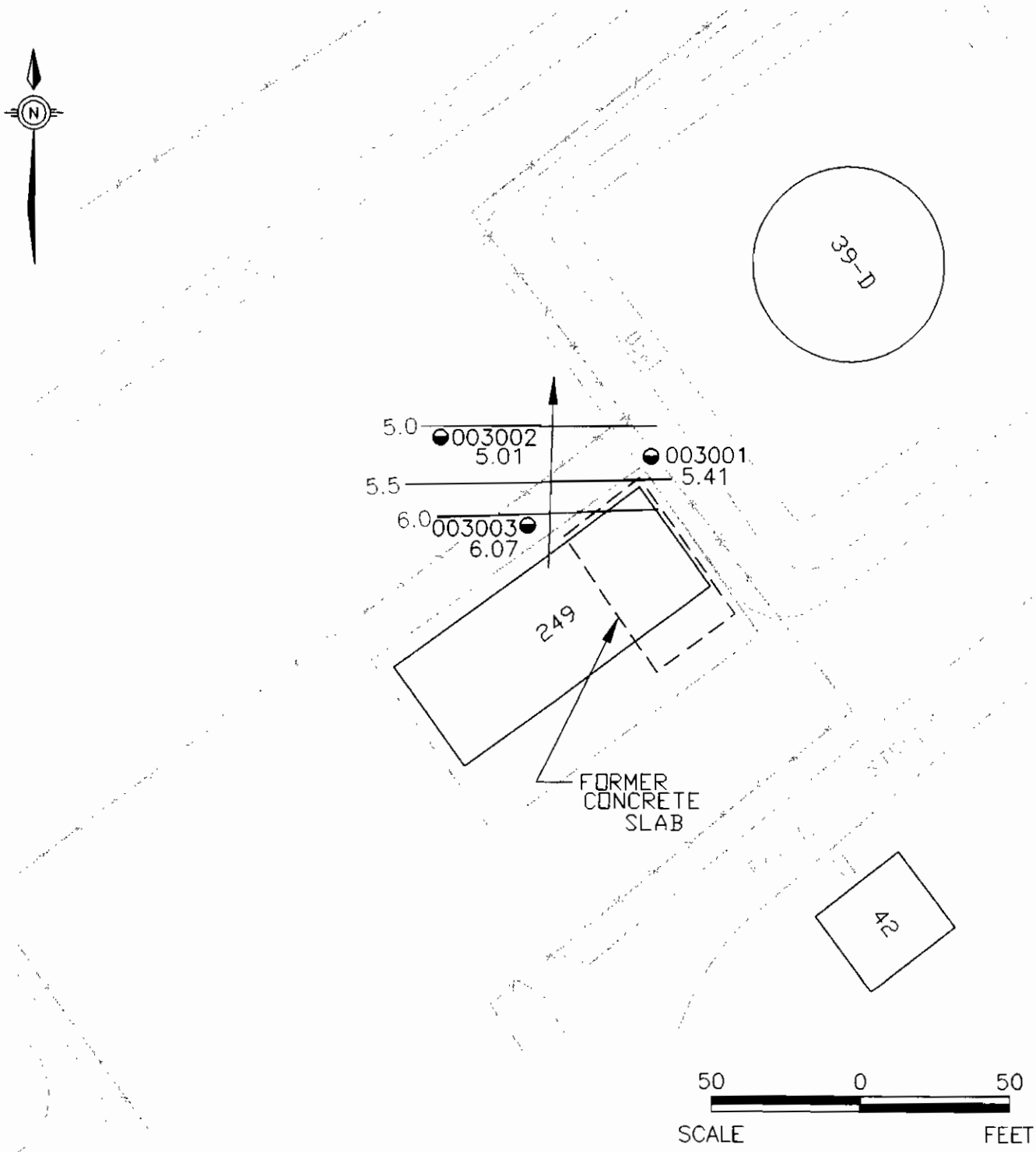
● – SOIL BORING

○ – SOIL BORING/SHALLOW MONITORING WELL

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11–1
SAMPLING LOCATIONS
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 01/15/98 | DWG NAME: 29CHZG19



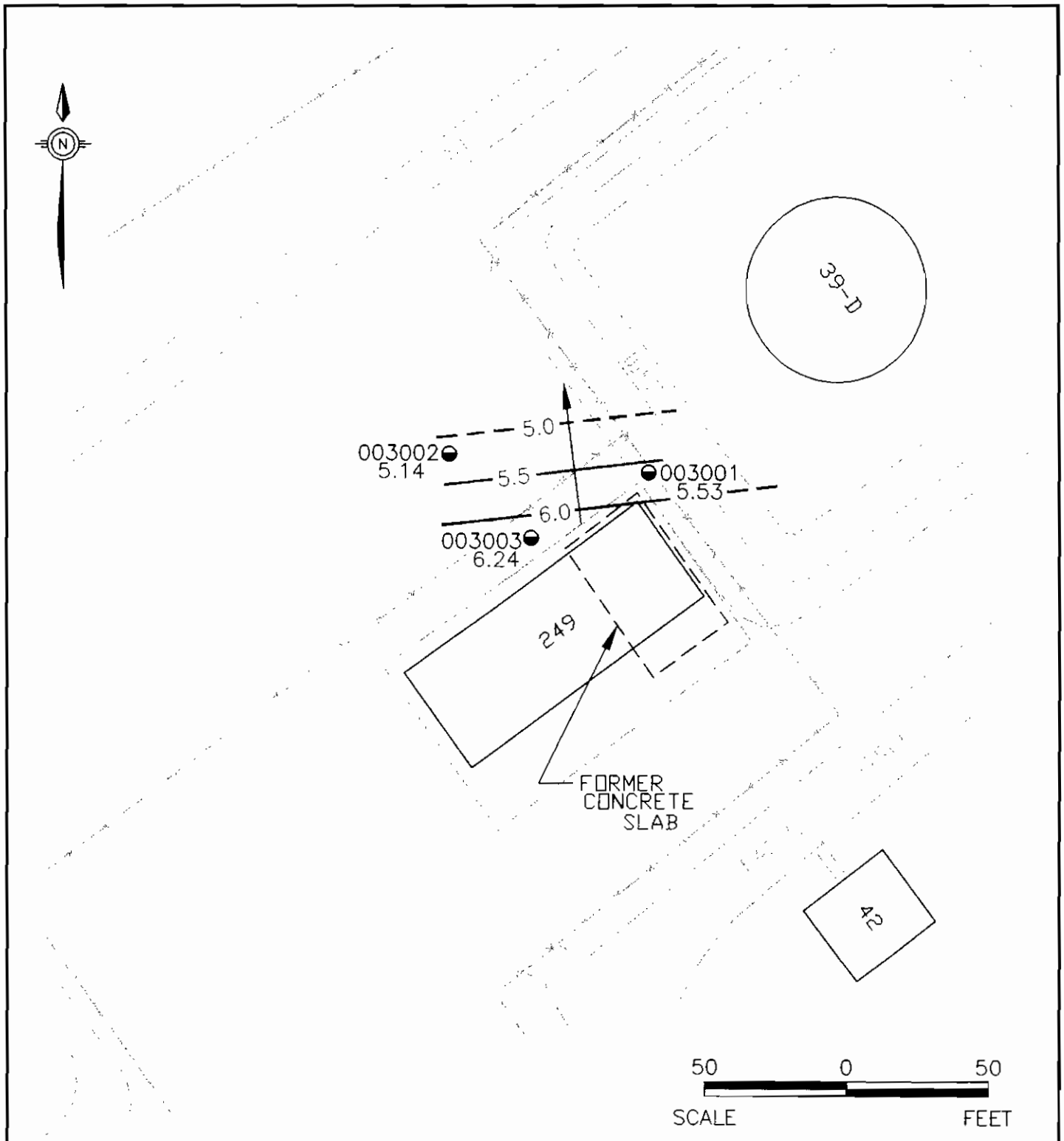
LEGEND

- ◒ – SHALLOW MONITORING WELL
- ——— – CONTOUR INTERVAL = 0.5 FEET
- ←——— – ARROW INDICATES FLOW DIRECTION

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11–2
SHALLOW GROUNDWATER
LOW–TIDE POTENTIOMETRIC MAP
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 01/27/98 | DWG NAME: 29ZGLTPM



LEGEND

- ◒ – SHALLOW MONITORING WELL
- ——— – CONTOUR INTERVAL = 0.5 FOOT
- ←——— – ARROW INDICATES FLOW DIRECTION

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-3
SHALLOW GROUNDWATER
HIGH-TIDE POTENTIOMETRIC MAP
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 01/27/98 | DWG NAME: 29ZGHTPM

observed at the site between high and low-tide. No slug tests were performed on the SWMU 3 wells. However, hydraulic conductivity was measured in nearby shallow well GDG001 at 1.4 ft/day. The mean horizontal hydraulic gradient, based on Figure 10.11-2 is 3.6E-02 to the north, and 3.3E-02 to the north-northwest based on Figure 10.11-3. Shallow groundwater at SWMU 3 flows generally to the north, an approximate horizontal flow velocity of 1.2 ft/day.

10.11.2 Field Investigation Approach

The objective of the field investigation at SWMU 3 was to: (1) confirm the presence or absence of contamination in the site area; (2) delineate any contamination found; and (3) provide sufficient data to support a detailed evaluation of treatment alternatives, if required. Media sampled within the investigation area included soil and groundwater. Section 3 of this report details the methods used during the field investigation. Included in this section are descriptions of the hollow stem auger drilling procedures used for shallow well installation; the hand-auger procedures used for soil sampling; groundwater sampling procedures; and miscellaneous procedures used during the field investigation. Also discussed in this section are the analytical protocols for sample analyses. Appendix D contains the analytical data report for samples collected in Zone G.

10.11.3 Soil Sampling and Analysis

The approved final RFI work plan proposed advancing ten soil borings within the SWMU 3 area to detect the presence of any soil contamination from this site. Upper and lower interval soil samples were proposed from each boring. During the field investigation, ten soil borings were advanced within the site area (Figure 10.11-1). Nine borings included both upper and lower sampling intervals, while one boring included the upper interval only. The lower interval sample was not collected from one boring due to obstructions in the borehole. In accordance with the approved final RFI work plan, the SWMU 3 soil samples were analyzed for metals, and pesticides/PCBs at DQO Level III. All samples were also analyzed for OP-pesticides. Several samples were analyzed for cyanide and pH. Upper and lower interval samples from one boring

were also analyzed for SVOCs. Additionally, one upper interval duplicate soil sample was collected for Appendix IX parameter analyses at DQO Level IV. Table 10.11.1 summarizes the SWMU 3 soil samples and analyses.

Table 10.11.1
Zone G
SWMU 3
Soil Samples and Analyses

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
003SB001	003SB00101 003SB00102	Upper Lower	8/29/96	Note 1/cyanide, SVOCs	Pesticides, OP Pesticides collected 11/12/96
003SB002	003SB00201 003SB00202	Upper Lower	8/28/96	Note 1/cyanide, pH	Pesticides, OP Pesticides collected 11/12/96
003SB003	003SB00301 003SB00302	Upper Lower	8/28/96	Note 1/cyanide, pH	Pesticides, OP Pesticides collected 11/12/96
003SB004	003SB00401 003SB00402	Upper Lower	9/26/96	Note 1	OP Pesticides collected 11/12/96
003SB005	003SB00501 003SB00502	Upper Lower	9/26/96	Note 1	OP Pesticides collected 11/12/96
003SB006	003SB00601 003SB00602	Upper Lower	9/26/96	Note 1	OP Pesticides collected 11/12/96
003SB007	003SB00701 003CB00701*	Upper	10/08/96	Note 1 Note 2	Lower interval not sampled due to obstruction. OP pesticides not collected *Duplicate Sample
003SB008	003SB00801 003SB00802	Upper Lower	9/26/96	Note 1	OP Pesticides collected 11/12/96
003SB009	003SB00901 003SB00902	Upper Lower	9/26/96	Note 1	OP Pesticides collected 11/12/96
003SB010	003SB01001 003SB01002	Upper Lower	9/26/96	Note 1	OP Pesticides collected 11/12/96

Notes:
1 = SW-846 (metals, pesticides/PCBs, OP pesticides) at DQO Level III
2 = Appendix IX suite: SW-846 (metals, pesticides/PCBs, herbicides, OP pesticides, dioxins, SVOCs, VOCs); cyanide; hex-chrome at DQO Level IV
* = Duplicate Sample

10.11.3.1 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.11.2. Inorganic analytical results for soil are summarized in Table 10.11.3. Table 10.11.4 summarizes all analytes detected in soil at SWMU 3. Appendix D contains a complete analytical data report for all Zone G samples collected.

Volatile Organic Compounds in Soil

One VOC, acrolein, was detected in the duplicate sample in SWMU 3 surface soil, at a concentration far below its respective RBC. No subsurface soil samples were analyzed for VOCs.

Semivolatile Organic Compounds in Soil

One SVOC, butylbenzylphthalate, was detected at one location in SWMU 3 surface soil, at a concentration far below its respective RBC. No SVOCs were detected in SWMU 3 subsurface soils.

Pesticides and PCBs in Soil

Nine pesticides were detected in surface soil samples at SWMU 3. Alpha-chlordane, gamma-chlordane, 4,4'-DDE, and heptachlor exceeded their respective RBCs in surface soil samples at this SWMU. Figures 10.11-4 through 10.11-7 present alpha-chlordane, gamma-chlordane, 4,4'-DDE , and heptachlor concentrations detected in surface soil at SWMU 3 respectively. In surface soil sample 003SB003, Aroclor-1248 was detected at a concentration above its RBC. Figure 10.11-8 presents Aroclor-1248 concentrations detected in surface soil at SWMU 3.

Six pesticides were detected in subsurface soil samples at SWMU 3. No pesticide concentrations in subsurface soil exceeded their respective SSL. No PCBs were detected in surface soil samples.

Table 10.11.2
Zone G
SWMU 3
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
Volatile Organic Compounds (Upper Interval - 1 Duplicate Sample) (μg/kg)						
Acrolein	Upper	1/1	2.00	2.00	160000	0
	Lower	0/0	NA	NA	2940	0
Semivolatile Organic Compounds (Upper Interval - 1 Sample plus 1 Duplicate Sample/Lower Interval - 1 Sample) (μg/kg)						
Butylbenzylphthalate	Upper	1/2	930	930	1600000	0
	Lower	0/1	ND	ND	930000	0
Pesticides and PCBs (Upper Interval - 10 Samples plus 1 Duplicate Sample/Lower Interval - 9 Samples) (μg/kg)						
alpha-Chlordane	Upper	5/10	2.40 - 16000	3290	1800	1
	Lower	3/9	5.50 - 85.0	41.8	10000	0
gamma-Chlordane	Upper	6/10	1.70 - 22000	3760	1800	1
	Lower	3/9	6.10 - 110	52.0	10000	0
4,4'DDD	Upper	2/10	9.10 - 420	215	2700	0
	Lower	0/9	ND	ND	16000	0
4,4'-DDE	Upper	9/10	3.50 - 2600	328	1900	1
	Lower	2/9	8.00 - 160	84.0	54000	0
4,4'-DDT	Upper	9/10	3.60 - 570	116	1900	0
	Lower	2/9	12.0 - 250	131	32000	0
Dieldrin	Upper	2/10	3.65 - 12.0	7.83	40	0
	Lower	0/9	ND	ND	4	0

Table 10.11.2
Zone G
SWMU 3
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Endrin	Upper	2/10	8.60 - 540	274	2300	0
	Lower	0/9	ND	ND	1000	0
Heptachlor	Upper	3/10	3.00 - 520	244	140	2
	Lower	1/9	9.00	9.00	23000	0
Heptachlor epoxide	Upper	2/10	3.10 - 5.90	4.50	70.0	0
	Lower	1/9	15.0	15.0	700	0
Aroclor-1248	Upper	1/10	28000	28000	320	1
	Lower	0/9	ND	ND	1000	0
Dioxins (Upper Interval - 1 Duplicate Sample) (ng/kg)						
Dioxin(2,3,7,8-TCDD TEQ)[1]	Upper	1/1	0.211	0.211	1000	0
	Lower	0/0	NA	NA	1900	0
pH (Upper Interval - 2 Samples/Lower Interval - 2 Samples) (SU)						
pH	Upper	2/2	6.89 - 7.86	7.38	NA	NA
	Lower	2/2	7.18 - 7.93	7.56	NA	NA

Notes:

1	=	Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c)
*	=	Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples
ND	=	Not detected
NA	=	Not applicable
NL	=	Not listed
SU	=	Standard units
µg/kg	=	Micrograms per kilogram
ng/kg	=	Nanograms per kilogram

Table 10.11.3
Zone G
SWMU 3
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Inorganics (Upper Interval - 10 Samples plus 1 Duplicate Samples/Lower Interval - 9 Samples) (mg/kg)						
Aluminum (Al)	Upper	10/10	3750 - 8000	5950	7800	1
	Lower	9/9	4990 - 9840	6560	1000000	0
Antimony (Sb)	Upper	1/10	0.34	0.34	3.1	0
	Lower	1/9	0.39	0.39	5	0
Arsenic (As)	Upper	10/10	1.20 - 3.60	2.23	0.43	10
	Lower	9/9	1.50 - 4.40	2.77	29	0
Barium (Ba)	Upper	10/10	13.1 - 65.0	39.8	550	0
	Lower	9/9	14.5 - 40.2	28.7	1600	0
Beryllium (Be)	Upper	8/10	0.35 - 0.67	0.53	0.15	8
	Lower	8/9	0.28 - 0.64	0.43	63	0
Cadmium (Cd)	Upper	4/10	0.06 - 0.38	0.23	3.9	0
	Lower	4/9	0.12 - 0.22	0.16	8	0
Calcium (Ca)	Upper	10/10	567 - 34000	8900	NL	NA
	Lower	9/9	813 - 23200	5460	NL	NA
Chromium (Cr)	Upper	10/10	4.40 - 12.9	7.75	39	0
	Lower	9/9	6.30 - 28.0	14.5	1000000	0
Cobalt (Co)	Upper	10/10	1.70 - 9.20	2.93	470	0
	Lower	9/9	0.89 - 2.50	1.60	2000	0

Table 10.11.3
Zone G
SWMU 3
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Copper (Cu)	Upper	4/10	2.30 - 28.7	13.4	27000	0
	Lower	3/9	0.51 - 41.5	14.3	920	0
Cyanide (CN)	Upper	1/4	0.28	0.28	160	0
	Lower	0/3	ND	ND	40	0
Iron (Fe)	Upper	10/10	2950 - 6860	4570	2300	10
	Lower	9/9	4700 - 20000	17100	NL	NA
Lead (Pb)	Upper	10/10	3.00 - 114	26.1	400	0
	Lower	9/9	3.70 - 36.9	9.13	400	0
Magnesium (Mg)	Upper	10/10	209 - 1290	557	NL	NA
	Lower	9/9	289 - 1260	554	NL	NA
Manganese (Mn)	Upper	10/10	17.65 - 341	169	180	6
	Lower	9/9	26.0 - 196	78.8	1100	0
Mercury (Hg)	Upper	4/10	0.04 - 0.27	0.12	2.30	0
	Lower	1/9	0.04	0.04	2.1	0
Nickel (Ni)	Upper	4/10	2.20 - 7.00	4.68	160	0
	Lower	3/9	1.30 - 2.30	1.63	130	0
Potassium (K)	Upper	3/10	224 - 302	268	NL	NA
	Lower	6/9	169 - 406	281	NL	NA
Selenium (Se)	Upper	3/10	0.36 - 0.555	0.45	39	0
	Lower	1/9	0.43	0.43	5	0

Table 10.11.3
Zone G
SWMU 3
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Sodium (Na)	Upper	3/10	167 - 226	193	NL	NA
	Lower	3/9	119 - 171	148	NL	NA
Vanadium (V)	Upper	10/10	5.40 - 15.8	9.82	55.0	0
	Lower	9/9	7.70 - 32.0	18.0	6000	0
Zinc (Zn)	Upper	5/10	10.3 - 64.3	41.6	2300	0
	Lower	4/9	9.20 - 126	52.4	12000	0

Notes:

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996c) were used as a reference concentration for lower interval samples

ND = Not detected

NL = Not listed

NA = Not applicable

mg/kg = Milligrams per kilogram

Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Volatile Organic Compounds (μg/kg)							
Acrolein	003SB007	2.0	160000	NA	NT	2940	NA
Semivolatile Organic Compounds (μg/kg)							
Butylbenzylphthalate	003SB007	930	1600000	NA	NT	930000	NA
Pesticides/PCBs (μg/kg)							
alpha-Chlordane	003SB002	4.9	1800	NA	ND	10000	NA
	003SB003	**16000**			5.5		
	003SB007	2.4			NT		
	003SB008	420			35		
	003SB009	21			85		
gamma-Chlordane	003SB002	5.9	1800	NA	ND	10000	NA
	003SB003	**22000**			6.1		
	003SB006	1.7			ND		
	003SB007	2.65			NT		
	003SB008	510			40		
	003SB009	21			110		
4.4'-DDD	003SB003	420	2700	NA	ND	16000	NA
	003SB007	9.1			NT		

Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
4,4'-DDE	003SB001	3.5	1900.0	NA	ND	54000	NA
	003SB002	81			ND		
	003SB003	2600			ND		
	003SB004	3.8			ND		
	003SB005	25			ND		
	003SB006	5			ND		
	003SB007	14			NT		
	003SB008	ND			8		
	003SB009	200			160		
	003SB010	21			ND		
4,4'-DDT	003SB002	65	1900	NA	ND	32000	NA
	003SB003	570			ND		
	003SB004	3.6			ND		
	003SB005	19			ND		
	003SB006	5.7			ND		
	003SB007	95.5			NT		
	003SB008	82			12		
	003SB009	180			250		
	003SB010	20			ND		
Dieldrin	003SB007	3.65	40	NA	NT	4	NA
	003SB009	12			ND		
Endrin	003SB002	8.6	2300	NA	ND	1000	NA
	003SB003	540			ND		
Heptachlor	003SB001	520	140	NA	ND	23000	NA
	003SB007	3			NT		
	003SB008	210			9		

Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Heptachlor epoxide	003SB002	3.1	70	NA	ND	700	NA
	003SB009	5.9			15		
Aroclor-1248	003SB003	28000	320	NA	ND	1000	NA
Dioxins (ng/kg)							
Dioxin (2,3,7,8-TCDD TEQs)[1]	003SB007	0.211	1000	NA	NT	1900	NA
pH (SU)							
pH	003SB002	7.86	NA	NA	7.93	NA	NA
	003SB003	6.89			7.18		
Inorganics (mg/kg)							
Aluminum (Al)	003SB001	4200	7800.0	18700	5150	1000000	23600
	003SB002	6330			4990		
	003SB003	8000			6810		
	003SB004	6750			5620		
	003SB005	5960			8080		
	003SB006	5390			9840		
	003SB007	7015			NT		
	003SB008	4920			5520		
	003SB009	3750			6270		
	003SB010	7220			6760		
Antimony (Sb)	003SB004	0.34	3.1	2.89	ND	5	NL
	003SB009	ND			0.39		

Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Arsenic (As)	003SB001	1.6	0.43	17.2[a]	2.6	29	15.5[a]
	003SB002	3.4			1.5		
	003SB003	3.6			4.3		
	003SB004	2.6			2.2		
	003SB005	1.5			4.4		
	003SB006	1.2			3.0		
	003SB007	1.5			NT		
	003SB008	1.6			1.8		
	003SB009	2			2.9		
	003SB010	3.3			2.2		
Barium (Ba)	003SB001	34.8	550.0	109	20.3	1600	64.5
	003SB002	44.6			24.7		
	003SB003	52			14.5		
	003SB004	40.1			39.7		
	003SB005	65			26.8		
	003SB006	45.1			33.3		
	003SB007	13.1			NT		
	003SB008	37.5			22.3		
	003SB009	27.9			40.2		
	003SB010	38.3			36.8		
Beryllium (Be)	003SB002	0.55	0.15	1.20	0.28	63	1.63
	003SB003	0.67			0.29		
	003SB004	0.56			0.53		
	003SB005	0.58			0.37		
	003SB006	0.51			0.5		
	003SB008	0.49			0.37		
	003SB009	0.35			0.64		
	003SB010	0.52			0.43		

Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Cadmium (Cd)	003SB001	ND	3.9	1.07	0.15	8	0.48
	003SB002	0.22			ND		
	003SB003	0.38			0.12		
	003SB008	0.25			ND		
	003SB009	ND			0.22		
	003SB010	0.06			0.14		
Calcium (Ca)	003SB001	3770	NL	NL	1290	NL	NL
	003SB002	12400			813		
	003SB003	34000			5180		
	003SB004	6840			8040		
	003SB005	1360			1270		
	003SB006	1380			1420		
	003SB007	567			NT		
	003SB008	22600			7010		
	003SB009	2830			23200		
	003SB010	3280			929		
Chromium (Cr)	003SB001	4.4	39 VI	42.8	16.4	1000000	43.4[a]
	003SB002	12	7800 III		6.3		
	003SB003	12.9			28		
	003SB004	9.7			6.6		
	003SB005	4.9			23.5		
	003SB006	4.7			17.3		
	003SB007	6.6			NT		
	003SB008	5.6			9		
	003SB009	4.7			14.2		
	003SB010	12			9		

Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Cobalt (Co)	003SB001	2	470.0	6.60	0.89	2000	8.14
	003SB002	2.6			1.6		
	003SB003	2.1			0.9		
	003SB004	2.4			2.3		
	003SB005	2.5			0.9		
	003SB006	2			1.9		
	003SB007	9.2			NT		
	003SB008	2.4			1.2		
	003SB009	1.7			2.5		
	003SB010	2.4			2.2		
Copper (Cu)	003SB001	2.3	27000	260	0.51	920	32.6
	003SB002	11.9			0.83		
	003SB003	28.7			ND		
	003SB009	ND			41.5		
	003SB010	10.7			ND		
Cyanide (CN)	003SB003	0.28	160.0	0.38	ND	40	0.22
Iron (Fe)	003SB001	4670	2300	NL	12700	NL	NL
	003SB002	6860			5750		
	003SB003	4210			20000		
	003SB004	6170			4700		
	003SB005	3510			16200		
	003SB006	3210			12200		
	003SB007	2950			NT		
	003SB008	3320			8520		
	003SB009	4100			5330		
	003SB010	6660			6910		

Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Lead(Pb)	003SB001	3	400.0	181	4.1	400	66.3
	003SB002	114			4.1		
	003SB003	50.6			5.5		
	003SB004	16			8.2		
	003SB005	5.4			6.4		
	003SB006	4.9			7		
	003SB007	5.4			NT		
	003SB008	8.2			3.7		
	003SB009	12.1			36.9		
	003SB010	41.7			6.3		
Magnesium (Mg)	003SB001	278	NL	NL	367	NL	NL
	003SB002	630			289		
	003SB003	1290			575		
	003SB004	519			447		
	003SB005	359			461		
	003SB006	338			670		
	003SB007	209			NT		
	003SB008	1060			498		
	003SB009	280			1260		
	003SB010	602			420		

Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Manganese (Mn)	003SB001	61.8	180.0	325	27.3	1100	291
	003SB002	193			39.1		
	003SB003	183			26		
	003SB004	194			196		
	003SB005	341			29.8		
	003SB006	207			62.1		
	003SB007	17.65			NT		
	003SB008	210			50.9		
	003SB009	118			164		
	003SB010	160			114		
Mercury (Hg)	003SB001	0.27	2.3	1.03	ND	2.1	0.31
	003SB002	0.06			ND		
	003SB003	0.11			ND		
	003SB009	ND			0.04		
	003SB010	0.04			ND		
Nickel (Ni)	003SB001	2.2	160.0	20.6	1.3	130	18.3
	003SB002	7			2.3		
	003SB003	6.3			1.3		
	003SB007	3.2			NT		
Potassium (K)	003SB001	ND	NL	NL	245	NL	NL
	003SB002	224			169		
	003SB003	302			259		
	003SB005	ND			347		
	003SB006	ND			406		
	003SB009	ND			258		
	003SB010	278			ND		

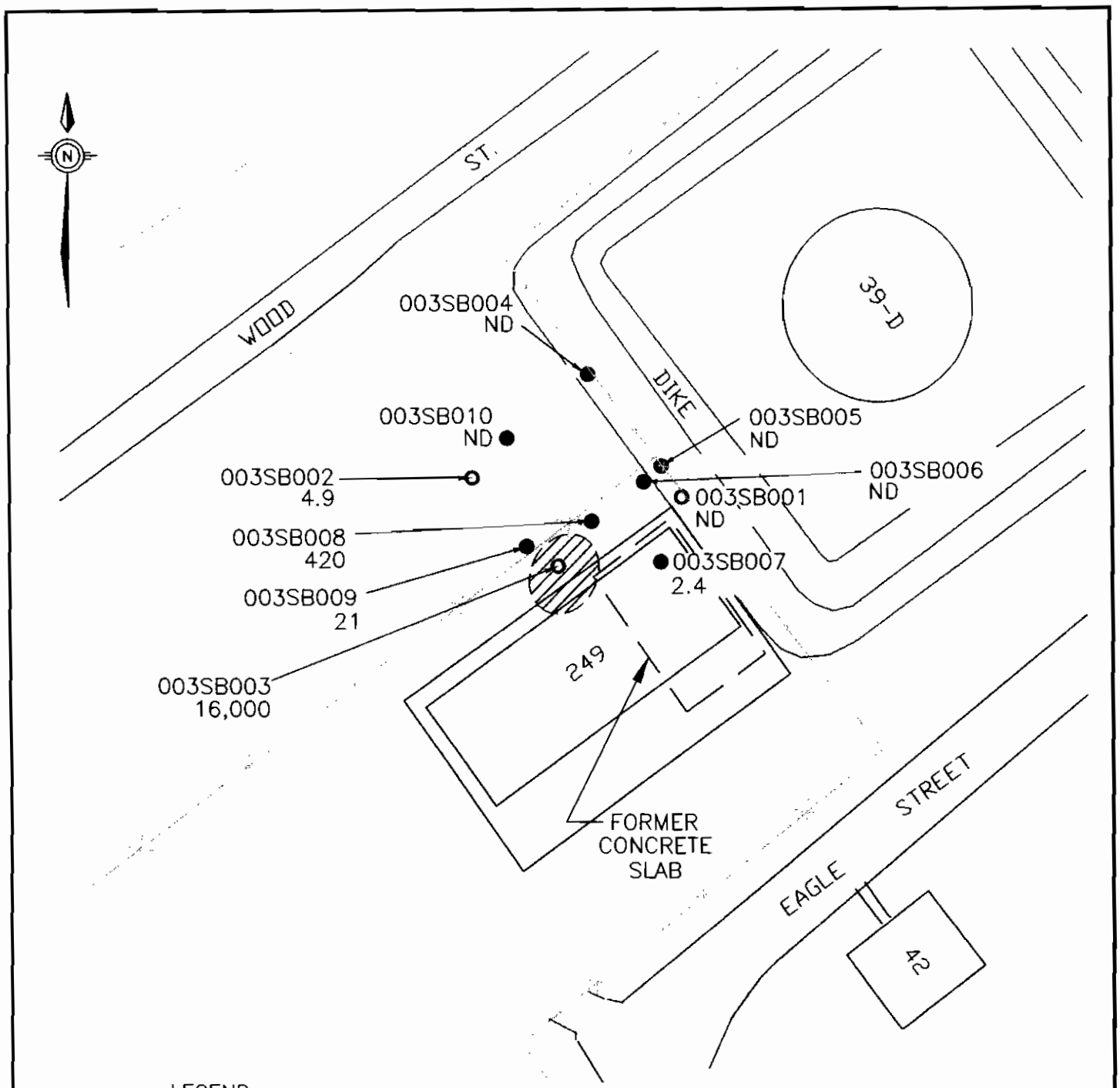
Table 10.11.4
Zone G
SWMU 3
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Selenium (Se)	003SB006	0.36	39.0	1.22	ND	5	1.26
	003SB007	0.555			NT		
	003SB009	ND			0.43		
	003SB010	0.43			ND		
Sodium (Na)	003SB001	167	NL	NL	154	NL	NL
	003SB002	226			171		
	003SB003	185			119		
Vanadium (V)	003SB001	7.7	55.0	60.9	21	6000	72.5
	003SB002	13.1			9.4		
	003SB003	15.6			32		
	003SB004	11.9			7.7		
	003SB005	6			29.2		
	003SB006	5.4			20.3		
	003SB007	8.7			NT		
	003SB008	6.7			14.3		
	003SB009	7.3			17.2		
	003SB010	15.8			11.3		
Zinc (Zn)	003SB001	10.3	2300.0	519	59.8	12000	145
	003SB002	47.1			14.4		
	003SB003	64.3			9.2		
	003SB007	33.6			NT		
	003SB009	ND			126		
	003SB010	52.9			ND		

Notes:

a	=	Background value for non-clay samples
*	=	Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples
1	=	Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c)
ND	=	Not detected
NT	=	Not taken
NL	=	Not liste.
NA	=	Not applicable
SU	=	Standard Units
µg/kg	=	Micrograms per kilogram
mg/kg	=	Milligrams per kilogram
ng/kg	=	Nanograms per kilogram

Bolded concentrations exceed both the reference concentration (RBC or SSL) and the zone background
All background values for Zone G are based on twice the means of the grid sample concentrations



LEGEND

- ● – SOIL BORING
- ○ – SOIL BORING/SHALLOW MONITORING WELL
- □ – < 1,800 μg/kg
- ▨ – > 1,800 μg/kg
- ◯ – APPROXIMATE EXTENT

NOTES:

- 1,800 μg/kg = RBC FOR ALPHA-CHLORDANE IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

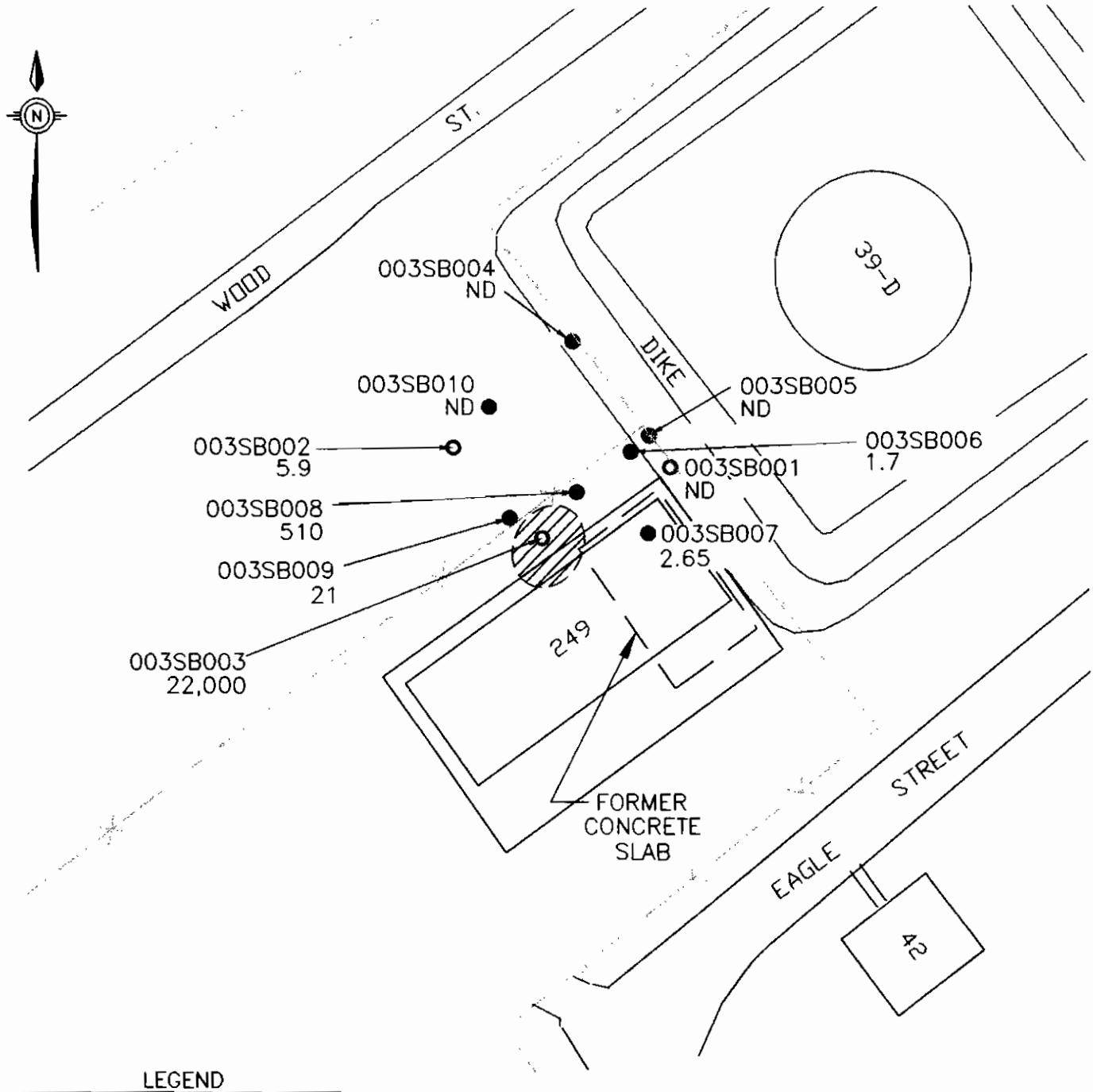
50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-4
ALPHA-CHLORDANE IN SURFACE SOIL
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/10/98 | DWG NAME: 2907M063



LEGEND

- ● – SOIL BORING
- ○ – SOIL BORING/SHALLOW MONITORING WELL
- □ – < 1,800 μg/kg
- ▨ – > 1,800 μg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 1,800 μg/kg = RBC FOR GAMMA-CHLORDANE IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

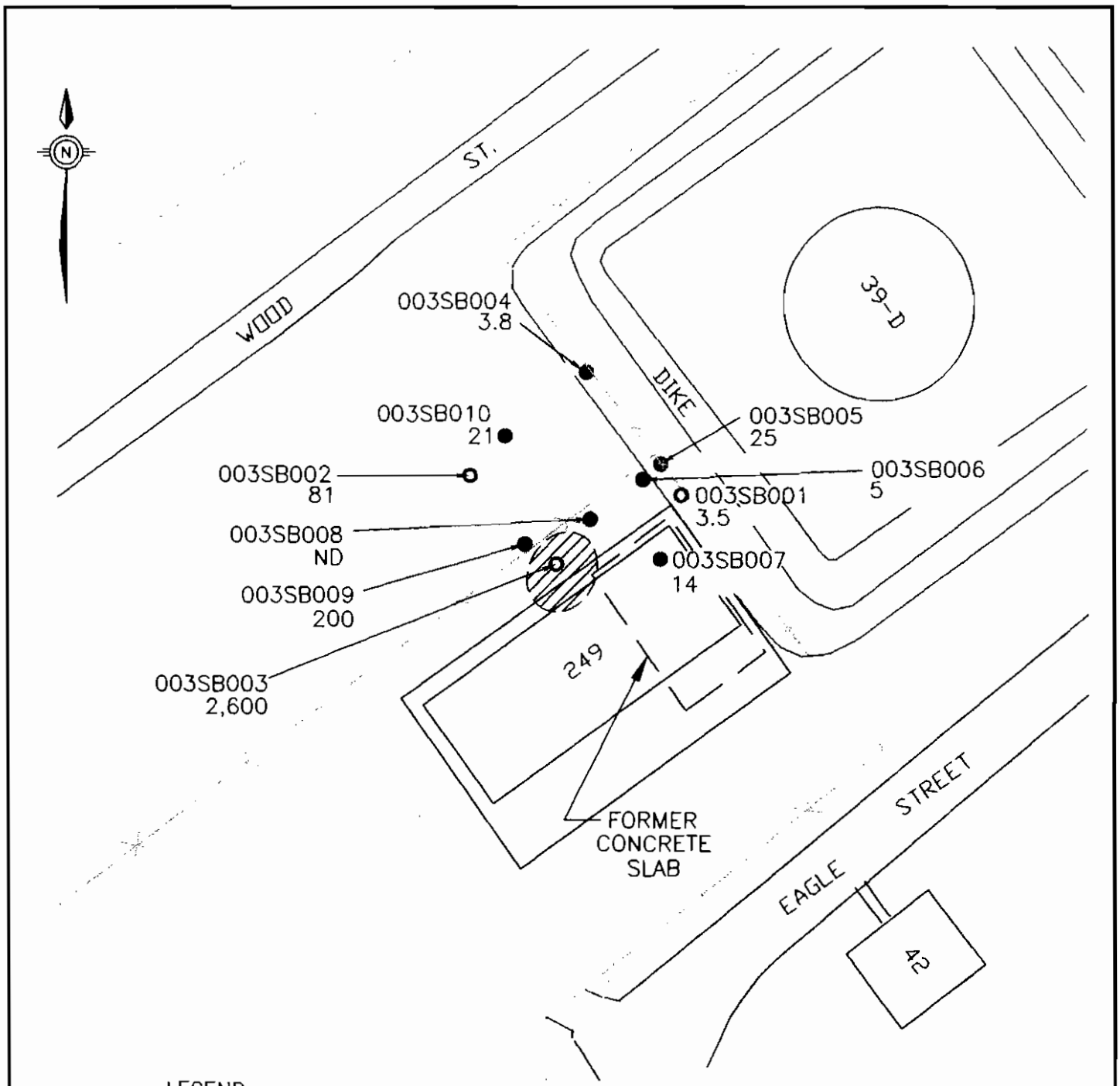
50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-5
GAMMA-CHLORDANE IN SURFACE SOIL
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/10/98 | DWG NAME: 2907M064



LEGEND

- ● – SOIL BORING
- ○ – SOIL BORING/SHALLOW MONITORING WELL
- □ – < 1,900 μg/kg
- ▨ – > 1,900 μg/kg
- ◯ – APPROXIMATE EXTENT

NOTES:

- 1,900 μg/kg = RBC FOR 4,4'-DDE IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

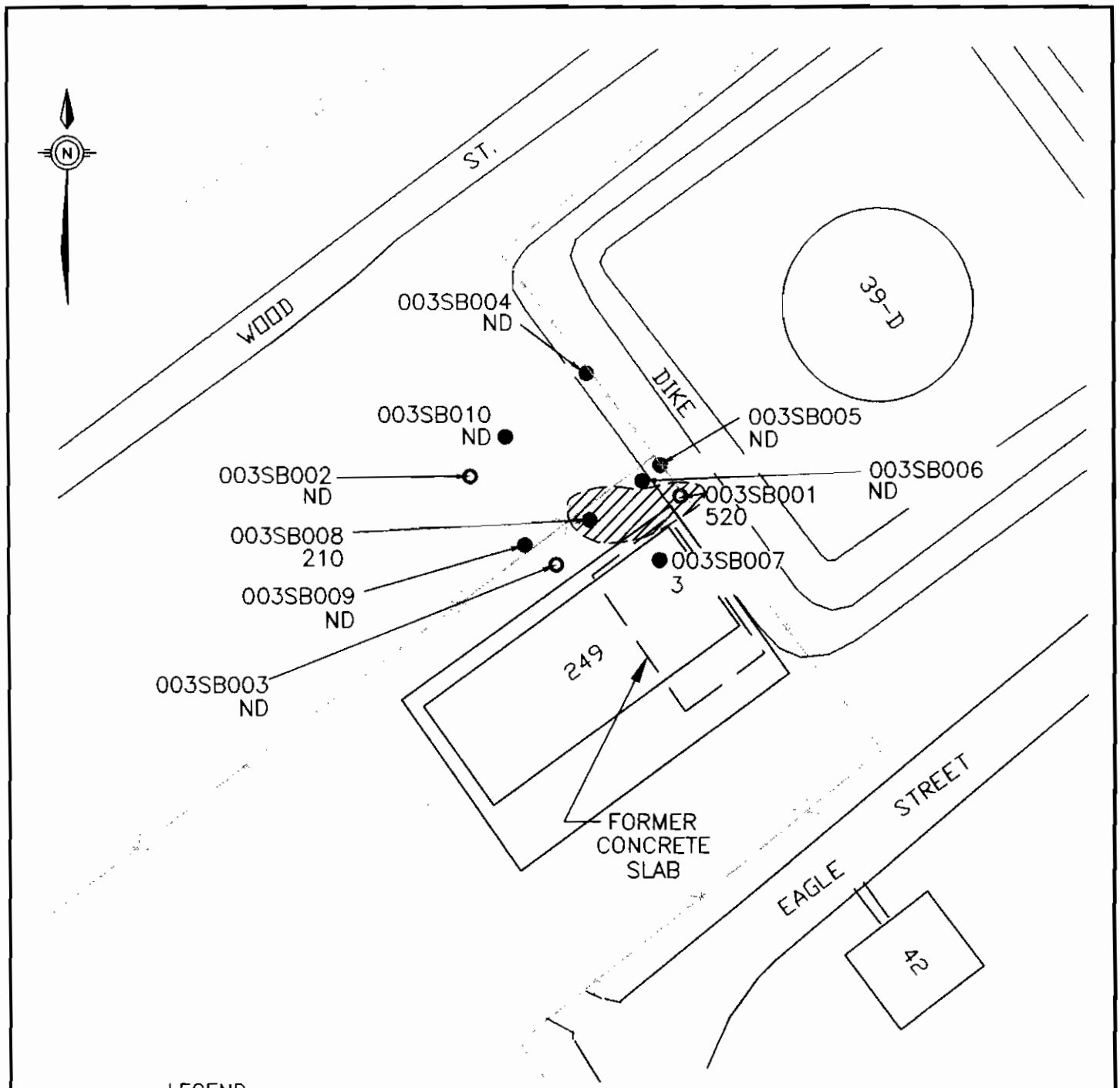
50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-6
4,4'-DDE IN SURFACE SOIL
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/10/98 | DWG NAME: 2907M065



LEGEND

- ● – SOIL BORING
- ○ – SOIL BORING/SHALLOW MONITORING WELL
- □ – < 140 μg/kg
- ▨ – > 140 μg/kg
- ◯ – APPROXIMATE EXTENT

NOTES:

- 140 μg/kg = RBC FOR HEPTACHLOR IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

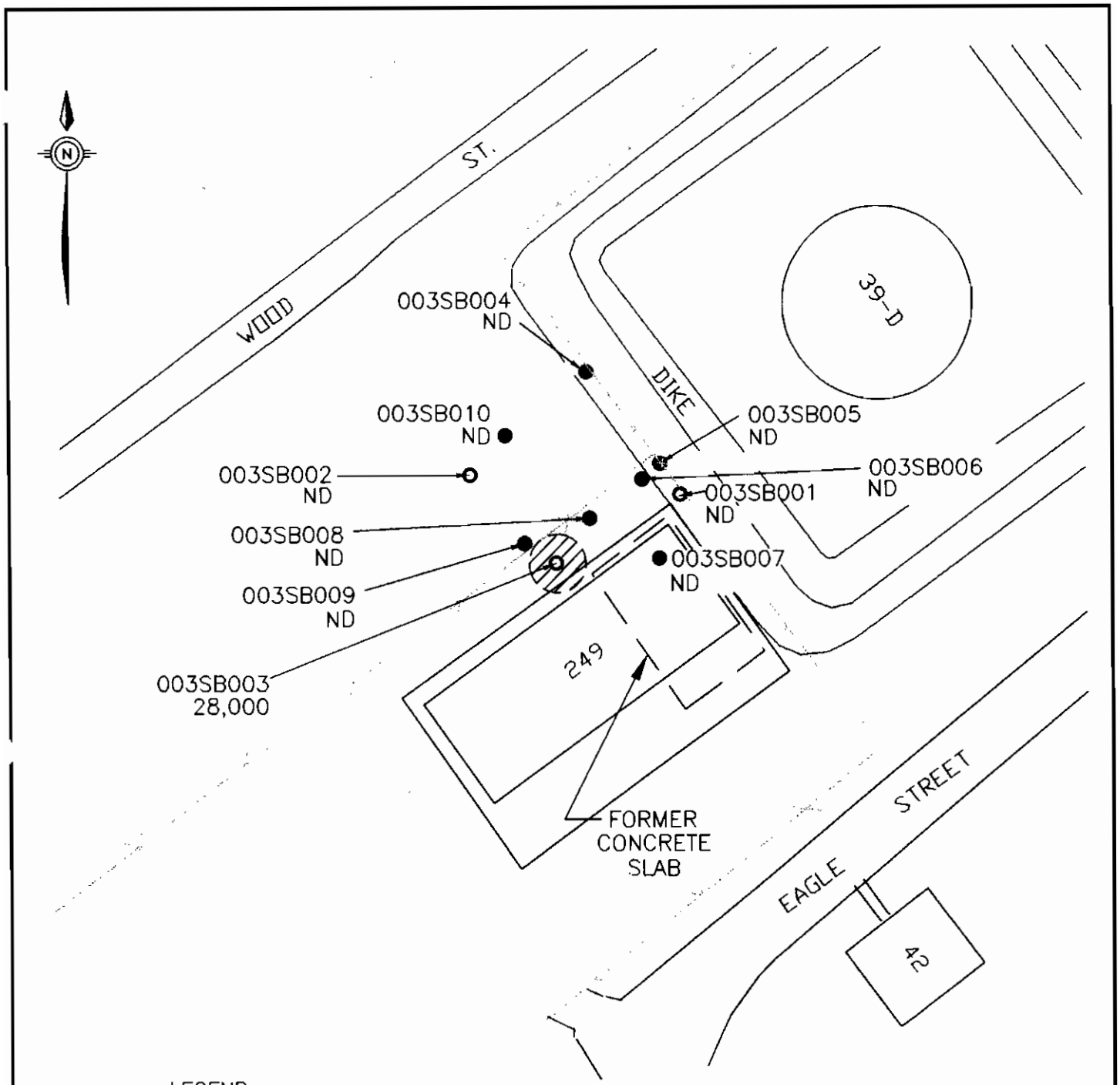
50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-7
HEPTACHLOR IN SURFACE SOIL
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/10/98 | DWG NAME: 2907M066



LEGEND

- ● – SOIL BORING
- ○ – SOIL BORING/SHALLOW MONITORING WELL
- □ – < 320 μg/kg
- ▨ – > 320 μg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 320 μg/kg = RBC FOR AROCLOR–1248 IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11–8
AROCLOR–1248 IN SURFACE SOIL
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/10/98 | DWG NAME: 2907M067

Other Organic Compounds in Soil

Dioxin (2,3,7,8-TCDD TEQ) was detected in one surface soil duplicate sample below the RBC for this parameter.

pH in Soil

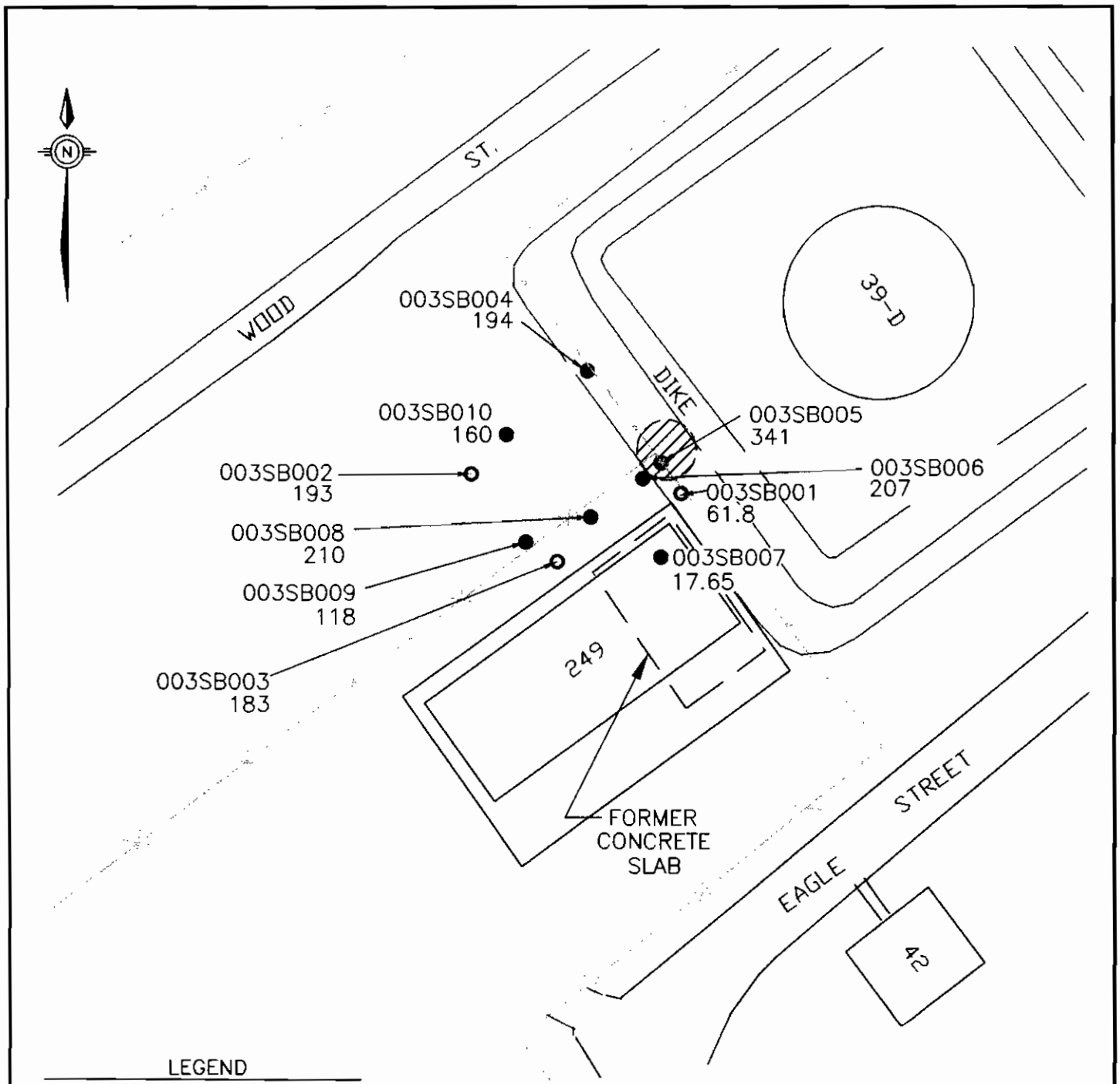
Soil pH was tested in two surface and two subsurface soil samples at SWMU 3. The mean pH for both surface and subsurface soil samples were slightly above neutral.

Inorganic Elements in Soil

Twenty-one metals and cyanide were detected in surface soil. Iron and manganese were detected above their RBCs in surface soil. The concentration of manganese also exceeded its Zone G background concentration. No background was established for iron because it is considered an essential nutrient. Figure 10.11-9 presents manganese surface soil concentrations at SWMU 3. In subsurface soil, 21 metals and cyanide were detected at SWMU 3. None of the subsurface metals concentrations exceeded their respective SSLs and background concentrations for Zone G subsurface soil.

10.11.4 Groundwater Sampling and Analysis

The approved final RFI work plan called for the installation and sampling of three shallow monitoring wells within the SWMU 3 area to: (1) assess groundwater quality, and (2) identify contaminants which may be migrating from the site in the shallow aquifer. Three wells were installed during the field investigation. These wells were installed at approximately 12 ft bgs in the upper sand layer of the Wando Formation. In accordance with the approved final RFI work plan, groundwater samples were analyzed for metals and pesticide/PCBs at DQO Level III. All groundwater samples were also analyzed for OP-pesticides. Additionally, one duplicate groundwater sample was collected for Appendix IX parameter analyses at DQO Level IV. Table 10.11.5 summarizes groundwater sampling and analyses at these sites.



LEGEND

- ● – SOIL BORING
- ○ – SOIL BORING/SHALLOW MONITORING WELL
- □ – < 325 mg/kg
- ▨ – > 325 mg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 325 mg/kg = ZONE G BACKGROUND CONCENTRATION FOR MANGANESE IN SURFACE SOIL
- RESULTS IN mg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11–9
MANGANESE IN SURFACE SOIL
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/10/98 | DWG NAME: 2907M068

Table 10.11.5
Zone G
SWMU 3
Groundwater Samples and Analyses

Well Number	Well Depth	Sample Identifier	Date Sampled	Analyses	Remarks
003001	Shallow	00300101	11/21/96	Note 1	
003002	Shallow	00300201*	11/21/96	Note 1/2*	*Duplicate sample collected
003003	Shallow	00300301	11/21/96	Note 1	

Note:
1 = SW-846 (metals, pesticides/PCBs, OP pesticides) at DQO Level III
2 = Appendix IX suite: SW-846 (metals, pesticides/PCBs, herbicides, OP pesticides, dioxins, SVOCs, VOCs); cyanide; hex-chrome at DQO Level IV
* = Duplicate sample collected

10.11.4.1 Nature of Contamination in Groundwater

Inorganic analytical results for groundwater are summarized in Table 10.11.6. Table 10.11.7 summarizes all analytes detected in groundwater at SWMU 3. Appendix D contains a complete analytical data report for all Zone G samples collected.

Volatile Organic Compounds in Groundwater

No VOCs were detected in the SWMU 3 duplicate groundwater sample.

Semivolatile Organic Compounds in Groundwater

No SVOCs were detected in the SWMU 3 duplicate groundwater sample.

Pesticides and PCBs in Groundwater

No pesticides or PCBs were detected in SWMU 3 groundwater samples.

Table 10.11.6
Zone G
SWMU 3
Inorganic Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μg/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding RBC
Inorganics (3 Shallow Samples) (μg/L)							
Aluminum (Al)	Shallow	3/3	2465 - 15200	9200	3700	50	2
Arsenic (As)	Shallow	3/3	3.10 - 9.70	7.47	0.045	50	3
Barium (Ba)	Shallow	3/3	34.4 - 77.1	62.8	260	2000	0
Beryllium (Be)	Shallow	3/3	0.545 - 1.10	0.915	0.016	4	3
Calcium (Ca)	Shallow	3/3	5500 - 65100	37200	NL	NL	NA
Chromium (Cr)	Shallow	3/3	5.60 - 31.6	19.2	18	100	2
Cobalt (Co)	Shallow	3/3	5.40 - 6.60	5.97	220	NL	0
Copper (Cu)	Shallow	3/3	2.70 - 6.80	5.40	13000	1300	0
Iron (Fe)	Shallow	3/3	3460 - 22800	13800	1100	300	3
Lead (Pb)	Shallow	3/3	2.80 - 12.5	7.63	15	15	0
Magnesium (Mg)	Shallow	3/3	1700 - 9370	6240	NL	NL	NA
Manganese (Mn)	Shallow	3/3	188.5 - 544	311	84	50	3
Nickel (Ni)	Shallow	3/3	4.85 - 10.7	8.52	73	100	0
Potassium (K)	Shallow	2/3	672 - 3300	1990	NL	NL	NA

Table 10.11.6
Zone G
SWMU 3
Inorganic Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μg/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding RBC
Selenium (Se)	Shallow	1/3	6.00	6.00	18	50	0
Sodium (Na)	Shallow	3/3	9605 - 38200	22100	NL	NL	NA
Thallium (Tl)	Shallow	3/3	2.80 - 3.50	3.07	0.29	2	3
Vanadium (V)	Shallow	3/3	7.10 - 46.7	28.4	26	NL	2

Notes:
* = Tap Water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996e)
μg/L = Micrograms per liter
NL = Not listed
NA = Not applicable

Table 10.11.7
Zone G
SWMU 3
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (µg/L)	MCL/SMCL* (µg/L)	Shallow Background (µg/L)
Inorganics (µg/L)							
Aluminum (Al)	003001	9930	202	590	3700	50	692
	003002	2465	108.5	27			
	003003	15200	741	966			
Arsenic (As)	003001	9.6	ND	ND	0.045	50	17.8
	003002	3.1	ND	ND			
	003003	9.7	ND	ND			
Barium (Ba)	003001	76.9	29.1	24.3	260	2000	31
	003002	34.4	17.05	15.85			
	003003	77.1	20.2	19.8			
Beryllium (Be)	003001	1.1	0.2	ND	0.016	4	NL
	003002	0.545	0.36	ND			
	003003	1.1	ND	ND			
Calcium (Ca)	003001	65100	47800	46500	NL	NL	NL
	003002	5500	3275	21900			
	003003	41100	27800	32400			
Chromium (Cr)	003001	20.4	ND	1.2	18	100	3.88
	003002	5.6	ND	ND			
	003003	31.6	ND	2.1			
Cobalt (Co)	003001	5.9	ND	ND	220	NL	1.45
	003002	5.4	2.65	ND			
	003003	6.6	1.1	ND			

Table 10.11.7
Zone G
SWMU 3
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (µg/L)	MCL/SMCL* (µg/L)	Shallow Background (µg/L)
Copper (Cu)	003001	6.8	64.8	ND	13000	1300	8.33
	003002	2.7	ND	ND			
	003003	6.7	1.4	2.0			
Iron (Fe)	003001	**15100**	371	448	1100	300	NL
	003002	**3460**	63.6	47.8			
	003003	**22800**	606	973			
Lead (Pb)	003001	7.6	ND	ND	15	15	4.6
	003002	2.8	ND	ND			
	003003	12.5	ND	ND			
Magnesium (Mg)	003001	9370	8680	3370	NL	NL	NL
	003002	1700	939	1855			
	003003	7640	3770	6710			
Manganese (Mn)	003001	199	80.9	8.7	84	50	2906
	003002	188.5	102.65	33.8			
	003003	544	46.6	24.8			
Mercury (Hg)	003001	ND	ND	0.28	1.1	2	NL
Nickel (Ni)	003001	10	ND	ND	73	100	4.08
	003002	4.85	1.025	64.5			
	003003	10.7	ND	2.2			
Potassium (K)	003001	ND	737	1590	NL	NL	NL
	003002	672	ND	ND			
	003003	3300	1670	1950			
Selenium (Se)	003003	6	ND	ND	18	50	4.3

Table 10.11.7
Zone G
SWMU 3
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (µg/L)	MCL/SMCL* (µg/L)	Shallow Background (µg/L)
Sodium (Na)	003001	18400	19200	9100	NL	NL	NL
	003002	9605	8590	18300			
	003003	38200	17400	36300			
Thallium (Tl)	003001	3.5	ND	ND	0.29	2	NL
	003002	2.9	ND	ND			
	003003	2.8	ND	ND			
Vanadium (V)	003001	**31.4**	1.3	1.2	26	NL	15.4
	003002	7.1	ND	ND			
	003003	**46.7**	2	2.2			
Zinc (Zn)	003002	ND	6.6	ND	1100	5000	15.6
	003003	ND	59.8	22.2			

Notes:
NL = Not listed
ND = Not detected
µg/L = Micrograms per liter
* = Tap Water RBCs (THQ=0.1) (USEPA, October 22, 1997) and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories*, October 1996 (USEPA, 1996e) were used as reference concentrations
Bolded concentrations exceed both the RBC and the zone background
All background values for Zone G are based on twice the means of the grid sample concentrations. Background values for groundwater are based on two sampling rounds in two wells at each depth

Other Organic Compounds in Groundwater

No dioxins were detected in the SWMU 3 duplicate groundwater sample.

Inorganic Elements in Groundwater

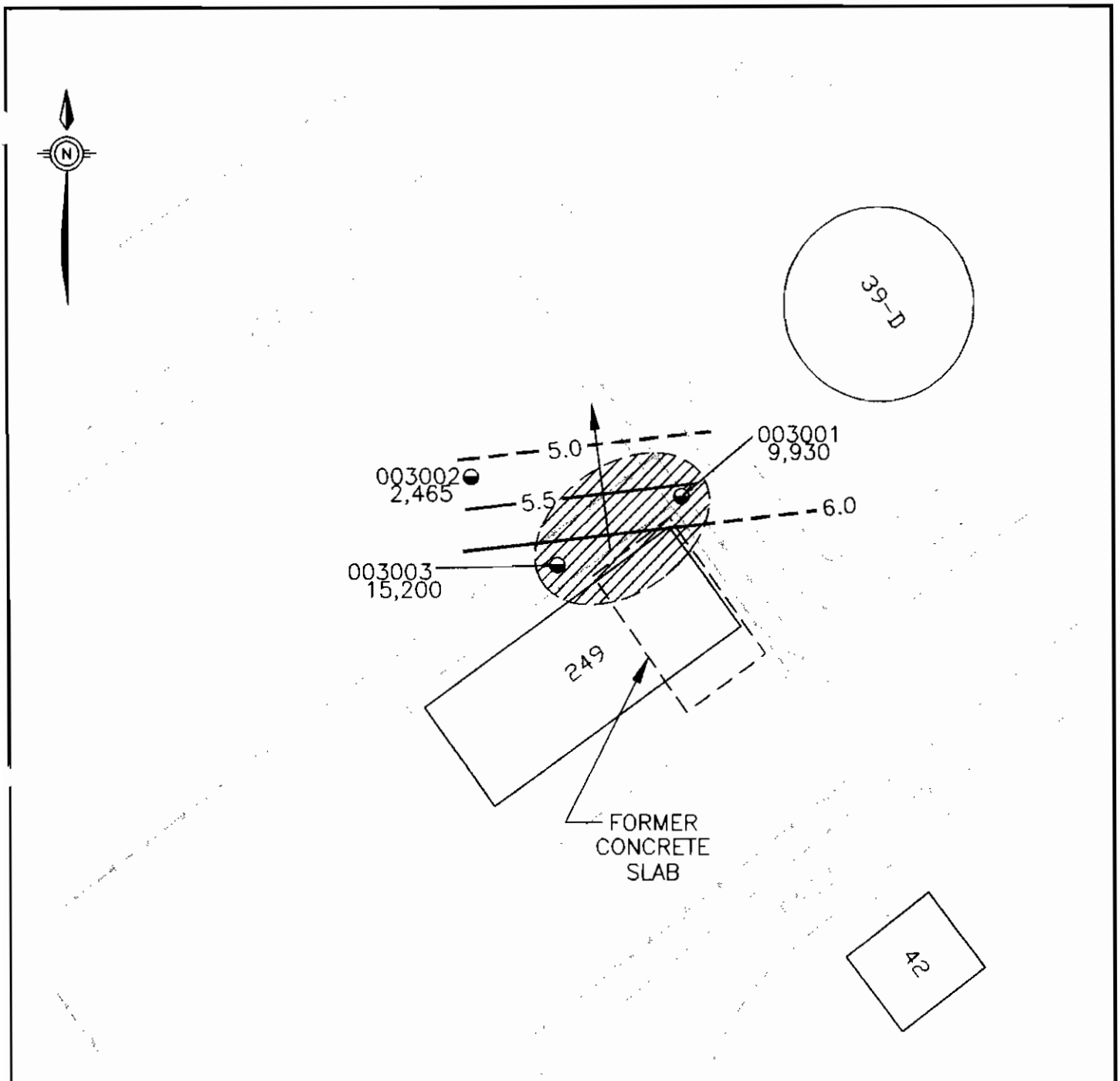
Eighteen metals were detected in SWMU 3 groundwater samples. Aluminum, beryllium, chromium, thallium, and vanadium were detected at concentrations exceeding the greater of their respective tap water RBCs and background concentrations for Zone G shallow groundwater. Iron also exceeded its RBC, however no background was determined for the essential nutrient iron. Figures 10.11-10 through 10.11-14 present aluminum, beryllium, chromium, thallium, and vanadium concentrations detected in shallow groundwater, respectively.

10.11.5 Fate and Transport Assessment

A RFI site, SWMU 3 is and approximately 50- by 20-foot area where the former Building 42-A was located. The building was a shed where pesticides were mixed prior to 1971. Equipment for spraying and mixing pesticides was reportedly rinsed on the ground outside, with the rinsate allowed to infiltrate the soil. Environmental media sampled as part of the SWMU 3 investigation included surface soil, subsurface soil, and shallow groundwater. Potential constituent migration pathways investigated for SWMU 3 include soil-to-groundwater, groundwater-to-surface water, and emission of volatiles from surface soil-to-air.

10.11.5.1 Soil-to-Groundwater Cross-Media Transport

Table 10.11.8 compares maximum detected organic constituent concentration in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels, or (b) background concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 20:1, with no attenuation of constituents in soil (DAF=20).



LEGEND

- SHALLOW MONITORING WELL
- CONTOUR INTERVAL = 0.5 FOOT
- ARROW INDICATES FLOW DIRECTION
- < 3,700 μg/L
- > 3,700 μg/L
- APPROXIMATE EXTENT

NOTES:

- 3,700 μg/L = TAP WATER RBC FOR ALUMINUM (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/L

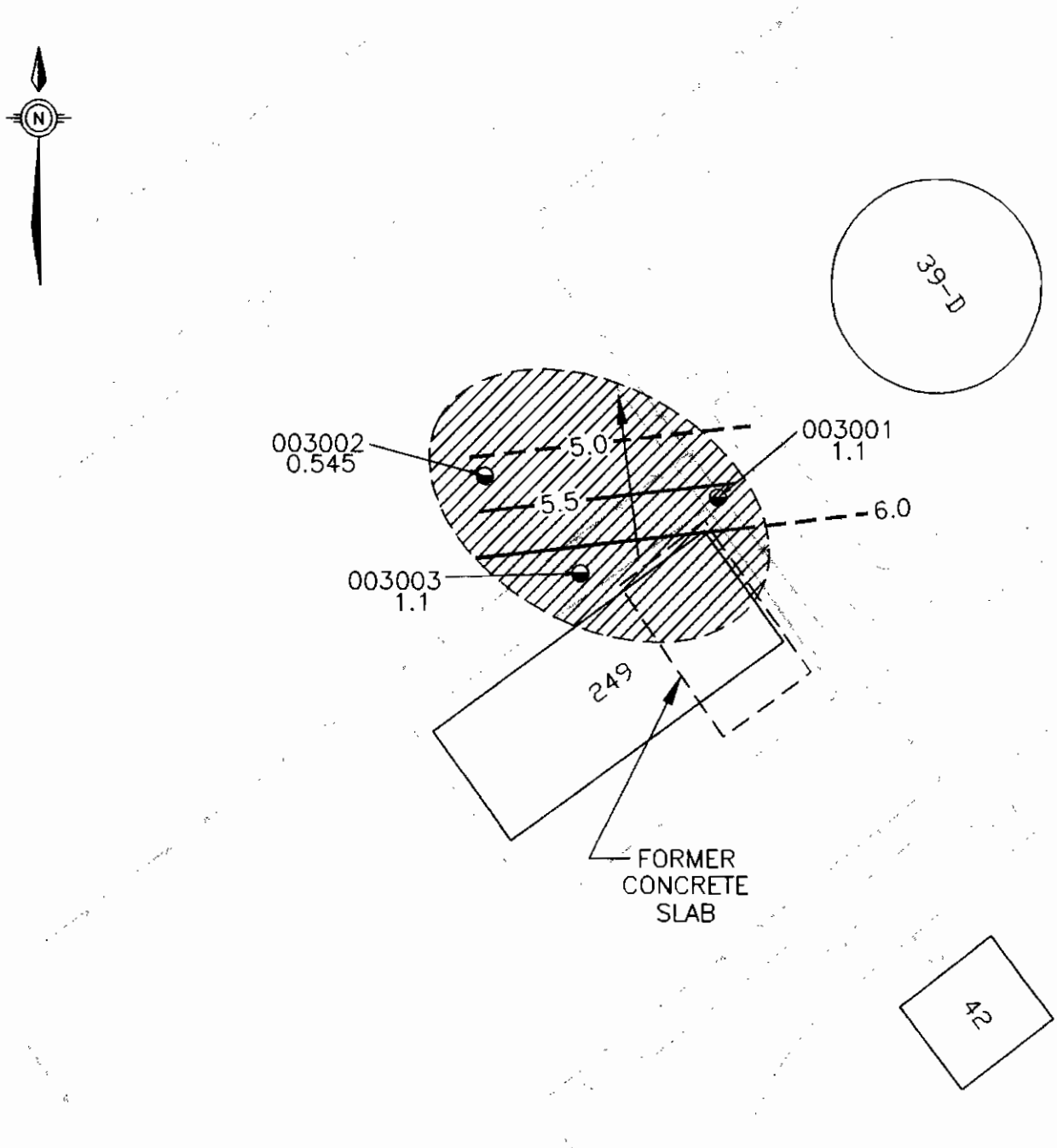
50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-10
ALUMINUM IN
SHALLOW GROUNDWATER
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/11/98 | DWG NAME: 2907M023



LEGEND

- SHALLOW MONITORING WELL
- CONTOUR INTERVAL = 0.5 FOOT
- ARROW INDICATES FLOW DIRECTION
- < 0.016 μg/L
- > 0.016 μg/L
- APPROXIMATE EXTENT

NOTES:

- 0.016 μg/L = TAP WATER RBC FOR BERYLLIUM (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/L

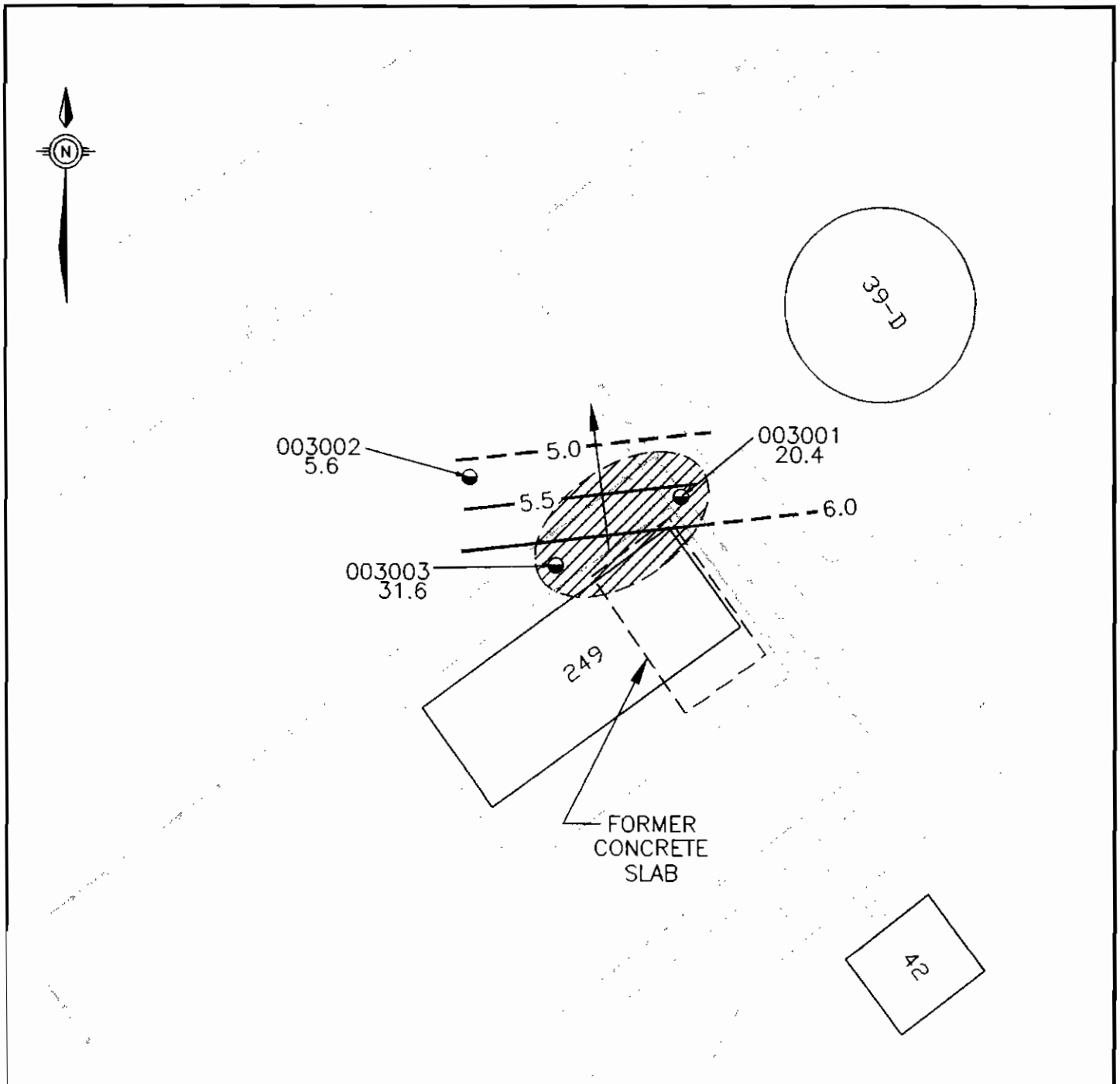
50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-11
BERYLLIUM IN
SHALLOW GROUNDWATER
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/11/98 | DWG NAME: 2907M024



LEGEND

- ● – SHALLOW MONITORING WELL
- ▬ – CONTOUR INTERVAL = 0.5 FOOT
- ← – ARROW INDICATES FLOW DIRECTION
- □ – < 18 μg/L
- ▨ – > 18 μg/L
- ◯ – APPROXIMATE EXTENT

NOTES:

- 18 μg/L = TAP WATER RBC FOR CHROMIUM (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/L

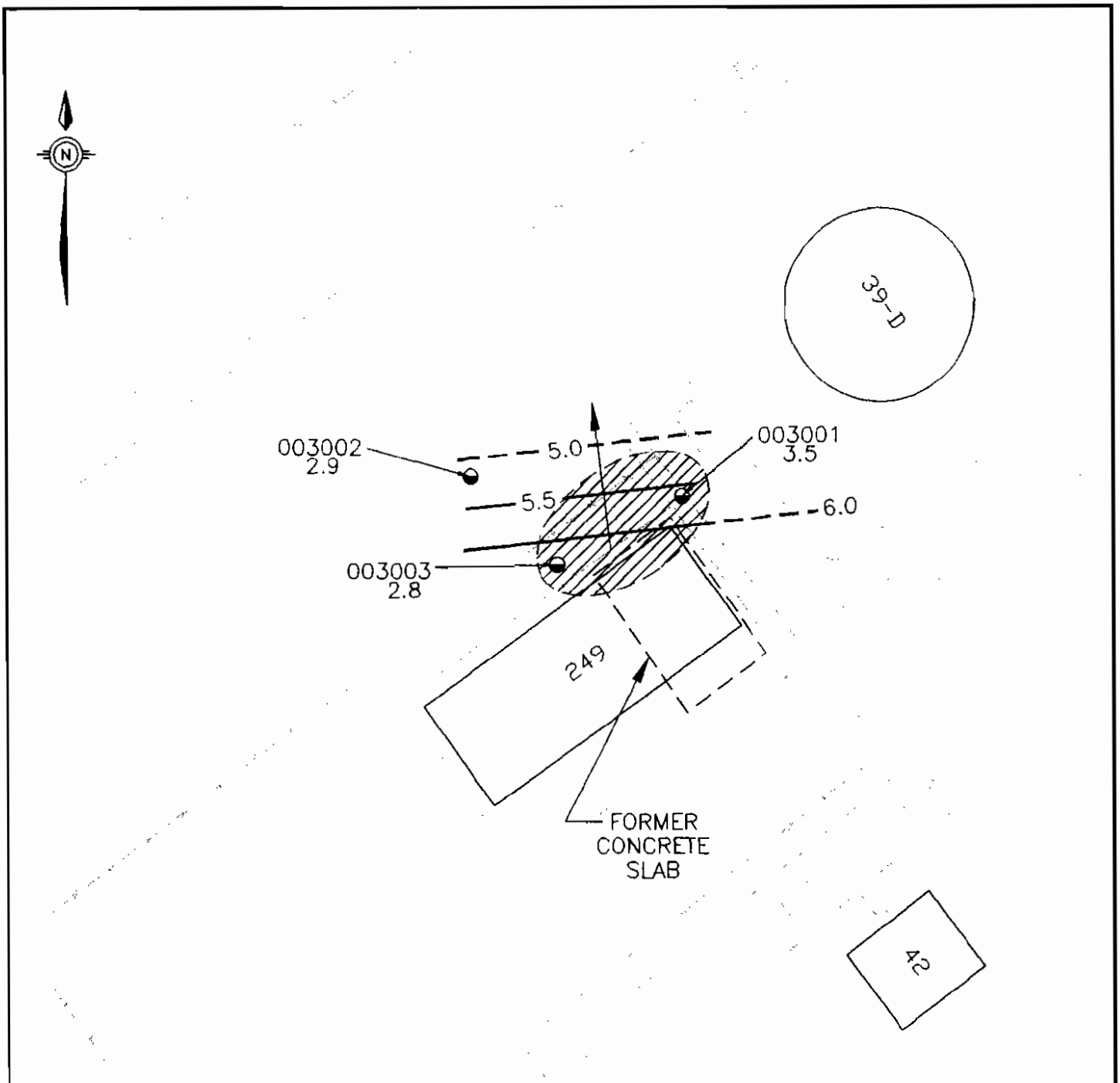
50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-12
CHROMIUM IN
SHALLOW GROUNDWATER
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/11/98 | DWG NAME: 2907M025



LEGEND

- SHALLOW MONITORING WELL
- CONTOUR INTERVAL = 0.5 FOOT
- ARROW INDICATES FLOW DIRECTION
- < 0.29 μg/L
- > 0.29 μg/L
- APPROXIMATE EXTENT

NOTES:

- 0.29 μg/L = TAP WATER RBC FOR THALLIUM (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/L

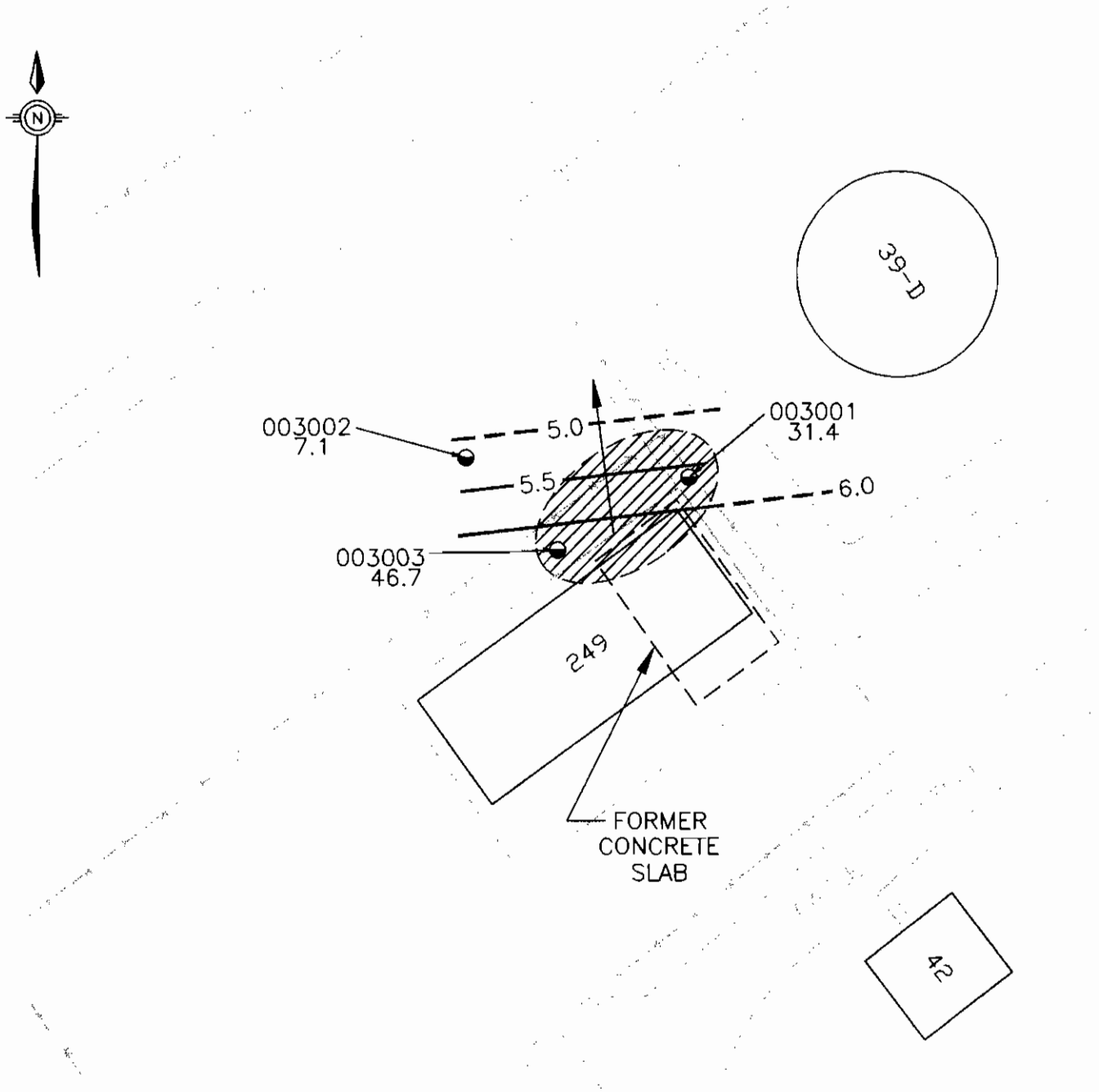
50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-13
THALLIUM IN
SHALLOW GROUNDWATER
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/11/98 | DWG NAME: 2907M026



LEGEND

- SHALLOW MONITORING WELL
- CONTOUR INTERVAL = 0.5 FOOT
- ARROW INDICATES FLOW DIRECTION
- < 26 μg/L
- > 26 μg/L
- APPROXIMATE EXTENT

NOTES:

- 26 μg/L = TAP WATER RBC FOR VANADIUM (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/L

50 0 50

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-14
VANADIUM IN
SHALLOW GROUNDWATER
SWMU #3
PESTICIDE MIXING AREA

DWG DATE: 02/11/98 | DWG NAME: 2907M027

Table 10.11.8
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Saltwater Surface Water Chronic Screening Levels, and Background Concentrations
NAVBASE Charleston, Zone G: SWMU 3
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Saltwater Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Acrolein	2	NA	NA	NA	2940	730	0.55	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Butylbenzylphthalate	930	ND	NA	NA	930000	7300	29.4	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
Aroclor-1248	28000	ND	ND	NA	1000	0.034	0.03	UG/KG	UG/L	YES	NO	NO
alpha-Chlordane	16000	85	ND	NA	10000	0.19	0.004	UG/KG	UG/L	YES	NO	NO
gamma-Chlordane	22000	110	ND	NA	10000	0.19	0.004	UG/KG	UG/L	YES	NO	NO
4,4'-DDD	420	ND	ND	NA	16000	0.28	0.025	UG/KG	UG/L	NO	NO	NO
4,4'-DDE	2600	160	ND	NA	54000	0.2	0.14	UG/KG	UG/L	NO	NO	NO
4,4'-DDT	570	250	ND	NA	32000	0.2	0.001	UG/KG	UG/L	NO	NO	NO
Dieldrin	12	ND	ND	NA	4	0.0042	0.0019	UG/KG	UG/L	YES	NO	NO
Endrin	540	ND	ND	NA	1000	11	0.0023	UG/KG	UG/L	NO	NO	NO
Heptachlor	520	9	ND	NA	23000	0.0023	0.0036	UG/KG	UG/L	NO	NO	NO
Heptachlor epoxide	5.9	15	ND	NA	700	0.0012	0.0036	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	0.2113	NA	NA	NA	1900	0.45	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	8000	9840	15200	NA	1000000	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	0.34	0.39	ND	NA	5	15	NA	MG/KG	UG/L	NO	NO	NO
Arsenic	3.6	4.4	9.7	NA	29	17.8	36	MG/KG	UG/L	NO	NO	NO
Barium	65	40.2	77.1	NA	1600	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	0.67	0.64	1.1	NA	63	0.016	NA	MG/KG	UG/L	NO	YES	NO
Cadmium	0.38	0.22	ND	NA	8	18	9.3	MG/KG	UG/L	NO	NO	NO
Chromium (total)	12.9	28	31.6	NA	1000000	180	50	MG/KG	UG/L	NO	NO	NO
Cobalt	9.2	2.5	6.6	NA	2000	2200	NA	MG/KG	UG/L	NO	NO	NO
Copper	28.7	41.5	6.8	NA	920	130000	8.33	MG/KG	UG/L	NO	NO	NO
Cyanide	0.28	ND	NA	NA	40	730	3.8	MG/KG	UG/L	NO	NO	NO
Lead	114	36.9	12.5	NA	400	15	8.5	MG/KG	UG/L	NO	NO	YES
Manganese	341	196	544	NA	1100	2906	NA	MG/KG	UG/L	NO	NO	NO
Mercury	0.27	0.04	ND	NA	2.1	11	0.025	MG/KG	UG/L	NO	NO	NO
Nickel	7	2.3	10.7	NA	130	730	21.7	MG/KG	UG/L	NO	NO	NO
Selenium	0.56	0.43	6	NA	5	180	71	MG/KG	UG/L	NO	NO	NO
Thallium	ND	ND	3.5	NA	0.95	2.9	21.3	MG/KG	UG/L	NO	YES	NO
Vanadium	15.8	32	46.7	NA	6000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	64.3	126	ND	NA	12000	11000	86	MG/KG	UG/L	NO	NO	NO

Notes:
* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 20, from 1996 Soil Screening Guidance or calculated using values from Table 6.4
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, October 22, 1997
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region IV Bulletins, Ecological Risk Assessment, November, 1995; Table 2
For inorganics, the value shown is the greater of the relevant screening value or the corresponding background value.

NA - Not available/Not applicable
ND - Not detected
RBC - Risk based concentration
SSL - Soil screening level
MG/KG - Milligrams per kilogram
NG/KG - Nanograms per kilogram
PG/L - Picograms per liter
UG/KG - Micrograms per kilogram
UG/L - Micrograms per liter

Four organic constituents were detected in SWMU 3 surface or subsurface soil at concentrations exceeding groundwater protection SSLs. Specifically, Aroclor-1248, alpha-chlordane, gamma-chlordane, and dieldrin were found to exceed these screening levels at this SWMU. None of these four organic compounds exceeded SSLs in the subsurface soil or were detected in shallow groundwater suggesting that the distribution of these organic compounds at SWMU 3 is consistent with typical chemical behavior for pesticides and PCBs in soils. This distribution is demonstrated by a marked attenuation with depth as constituents adsorb readily to organic carbon sites and soil media. It should also be noted that Aroclor-1248, gamma-chlordane, and alpha-chlordane exceeded the SSLs at only one location, 003SB003, which is located northwest and directly adjacent to Building 249 in a gravel area. Aroclor-1248 was detected only at this location where it exceeded its SSL. Dieldrin was detected at two of ten sampling locations, 003SB007 3.65 ug/kg and 003SB009 (12.0 ug/kg) in the surface soil and exceeded the SSLs in both samples. Gamma-chlordane was detected in 6 of the surface soil samples and 3 of the subsurface samples, but exceeded the SSL at only one surface soil location 003SB003. Alpha-chlordane was detected in 5 of the surface soil samples and 3 of the subsurface samples, and exceeded the SSL at 003SB003. All four organic compounds were present at concentrations which significantly exceeded their respective SSLs in surface soil but were not detected or present at significantly reduced concentrations in the subsurface soil.

With the exception of Aroclor-1248, organic compounds exceeding SSLs at SWMU 3 are consistent with the historical use of this site. The site surface around the SWMU is grass and gravel thus allowing precipitation to readily infiltrate and transport these compounds downward into the subsurface soils with no apparent limit to leaching potential. Evidence from the sampling results, however, indicate that these organic constituents have been effectively immobilized with depth as the contaminants adsorb to organic carbon sites and soil media. As a result of the adsorption to the soil media, and as demonstrated in the analytical data, concentrations decrease significantly with depth, and these compounds are not detected in shallow groundwater. The

majority of organic exceedances detected were at location 003SB003 in the surface soils, indicating a limited residual mass present in surface soil. Assuming stabilization between soil and groundwater media, the soil-to-groundwater pathway for organics is not expected to be significant, as evidenced by no exceedances in subsurface soil and no detections in shallow groundwater.

No inorganic constituents were detected in SWMU 3 surface or subsurface soil at concentrations exceeding groundwater protection SSLs. Therefore, even though a number of metals were detected in surface and subsurface soil above analytical detection limits, their leachability to groundwater is expected to be insignificant.

10.11.5.2 Soil-to-Air Cross-Media Transport

Table 10.11.9 lists the VOCs detected in surface soil samples collected at SWMU 3, along with the corresponding soil-to-air volatilization criteria. Acrolein was detected in the surface soil samples collected at SWMU 3. No corresponding soil-to-air volatilization screening level is available for this compound. Because the ground surface is unpaved, this pathway may have merit, however the significance of this pathway is not evaluated due to a lack of soil-to-air screening value.

10.11.5.3 Groundwater-to-Surface Water Cross-Media Transport

Table 10.11.8 compares maximum detected organic constituent concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background concentrations for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

Table 10.11.9
Soil-to-Air Volatilization Screening Analysis
NAVBASE Charleston, Zone G: SWMU 3
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Acrolein	2	NA	UG/KG	NO

Notes:
* - Soil screening levels for transfers from soil to air were obtained from USEPA Soil Screening Guidance, Technical Background Document Appendix A, May 1996 (first preference) or from Soil Screening Levels - Transfers from Soil to Air, USEPA Region III Risk-Based Concentration Table, June 1996.
NA - Not available

Three quarters of sampling data were reviewed for the three shallow groundwater monitoring wells at SWMU 3. Two inorganics, beryllium and thallium, were found to exceed the groundwater risk-based migration screening levels, and lead exceeded the surface water screening criteria. Beryllium was detected at concentrations above the RBC at all three sampling locations but was not detected in the shallow groundwater in any of the three wells during the third quarter. Thallium also was detected above the RBC in all three wells during the first-quarter sampling, but was not detected in the second or third quarter shallow groundwater samples in any of the three wells. Lead was also detected in all three samples in the first-quarter sampling event, but was above the surface water screening level in only one well (003003). Lead was not detected in any of the wells during the second or third quarter sampling events. Well location 003003 consistently exhibited elevated levels of inorganic contaminants in the shallow groundwater during the first-quarter.

The second and third quarter sampling results for the SWMU 3 monitoring wells invalidate the drinking water and surface water migration pathways for this site. The groundwater in the surficial aquifer is not currently utilized for consumption, nor is it anticipated to be utilized in the future, thus invalidating even further the risk-based exposure pathway. The groundwater-to-surface water pathway can also be considered invalid due to the distance and direction of the nearest surface water receptor (Cooper River), approximately 1200 feet to the northeast.

10.11.5.4 Fate and Transport Summary

No inorganic constituents were detected above applicable SSLs in either surface or subsurface soil. Four organic constituents (Aroclor-1248, gamma-chlordane, alpha-chlordane, and dieldrin) were present above respective SSLs in surface soil, but none were above SSLs in subsurface soil or were detected in the shallow groundwater at the site. With the exception of Aroclor-1248, the other organic constituents detected in soil are consistent with the historical use of the site as a pesticide storage and mixing facility. The source of Aroclor-1248 is unknown since PCBs were

not reported to be handled or stored at this facility. The majority of exceedances in the soil are isolated to one location, indicating a limited residual mass present in surface soil. No exceedances of these organics in the subsurface soil, and no detection of any of these constituents in the shallow groundwater indicate that the soil-to-groundwater pathway is invalid for this site. Three inorganic constituents were detected in the shallow groundwater. Beryllium and thallium exceeded the risk-based migration screening, and lead exceeded the surface water screening. The second and third quarter results show no detection of these inorganics in the shallow groundwater, thus invalidating the risk-based migration pathway as well as the surface water migration pathway. Further, even if contaminants continued to be present at concentrations above applicable screening levels, the risk-based pathway is invalid due to non-use of the resource, and the groundwater-to-surface water migration pathway is invalid due to the direction and distance to the nearest surface water receptor, the Cooper River, is 1200 feet to the northeast of SWMU 3.

10.11.6 Human Health Risk Assessment

10.11.6.1 Site Background and Investigative Approach

SWMU 3 consists of the former location of the former Building 42-A, a shed where pesticides were mixed prior to 1971. Building 249 has been used as a maintenance shop, a storage area, and is currently leased to a refrigeration service company.

During the RFI, ten soil samples were collected from each of the upper and nine soil samples were collected from lower intervals to identify potential impacts resulting from the activities listed above. Surface soil samples from all ten boring locations were used to quantitatively assess soil exposure pathways. Subsurface soil is addressed in the previous section, Fate and Transport Assessment for SWMU 3. Three monitoring wells were installed in the shallow aquifer. Data from the first-quarter sampling event were used to quantitatively assess groundwater exposure pathways. Sections 10.11.3 and 10.11.4 provide summaries of the sampling effort for SWMU 3 soil and groundwater, respectively.

10.11.6.2 COPC Identification

Soil

Based on the screening comparisons described in Section 7 of this RFI and presented in Table 10.11.10, manganese, Aroclor-1248, 4,4'-DDE, alpha-chlordane, gamma-chlordane, and heptachlor were identified as COPCs in surface soil.

Groundwater

As shown in Table 10.11.11, aluminum, beryllium, chromium, thallium, and vanadium were identified as COPCs for shallow groundwater at SWMU 3.

10.11.6.3 Exposure Assessment

Exposure Setting

SWMU 3 is bounded by oil tanks and containment berms to the northeast the site is completely fenced. A playground is located to the south/southeast of the site, and athletic fields are located to the northwest. The site itself consists of an approximate 50- by 40-foot area including Building 249, and the surrounding grassy area northwest of the building.

Potentially Exposed Populations

Potentially exposed populations are current and future site workers. Additional potentially exposed populations are hypothetical future site residents. Future site resident and worker exposure scenarios were addressed quantitatively in this risk assessment. Current exposure to workers is discussed qualitatively in relation to the future workers and future residents. The hypothetical future site worker scenario assumes continuous exposure to surface soil conditions. Current site workers' exposure would be less than that assumed for the hypothetical future site worker scenario because of their limited soil contact (Building 249 would prevent direct contact

Table 10.11.10
Chemicals Present in Site Samples
SWMU 3 - Surface Soil
Naval Base Charleston, Zone G
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Residential RBC	Screening Concentration Background	Units	Number Exceeding RBC	Number Exceeding Bkgd
TCDD Equivalents													
1234678-HpCDD		1	1	3.81	3.81	3.81	NA	NA	NA	NA	NG/KG		
234678-HxCDF		1	1	0.472	0.472	0.472	NA	NA	NA	NA	NG/KG		
Dioxin Equiv.		1	1	0.2113	0.2113	0.2113	NA	NA	1000	NA	NG/KG		
OCDD		1	1	126	126	126	NA	NA	NA	NA	NG/KG		
Inorganics													
Aluminum (Al)		10	10	3750	8000	5953.5	NA	NA	7800	18700	MG/KG	1	
Antimony (Sb)		1	10	0.34	0.34	0.34	0.31	0.72	3.1	2.89	MG/KG		
Arsenic (As)		10	10	1.2	3.6	2.23	NA	NA	0.43	17.2	MG/KG	10	
Barium (Ba)		10	10	13.1	65	39.84	NA	NA	550	109	MG/KG		
Beryllium (Ba)		8	10	0.35	0.67	0.5288	0.15	0.34	0.15	1.2	MG/KG	8	
Cadmium (Cd)		4	10	0.06	0.38	0.2275	0.04	0.04	3.9	1.07	MG/KG		
Calcium (Ca)		10	10	567	34000	8902.7	NA	NA	NA	NA	MG/KG		
Chromium (Cr)		10	10	4.4	12.9	7.75	NA	NA	39	42.8	MG/KG		
Cobalt (Co)		10	10	1.7	9.2	2.93	NA	NA	470	6.6	MG/KG		1
Copper (Cu)		4	10	2.3	28.7	13.4	0.58	4.9	27000	260	MG/KG		
Cyanide (CN)		1	4	0.28	0.28	0.28	0.11	0.24	160	0.38	MG/KG		
Iron (Fe)		10	10	2950	6860	4566	NA	NA	NA	NA	MG/KG		
Lead (Pb)		10	10	3	114	26.13	NA	NA	400	181	MG/KG		
Magnesium (Mg)		10	10	209	1290	556.5	NA	NA	NA	NA	MG/KG		
Manganese (Mn)	*	10	10	17.65	341	168.545	NA	NA	180	325	MG/KG	6	1
Mercury (Hg)		4	10	0.04	0.27	0.12	0.033	0.04	2.3	1.03	MG/KG		
Nickel (Ni)		4	10	2.2	7	4.675	2.6	5.6	160	20.6	MG/KG		
Potassium (K)		3	10	224	302	268	128	220	NA	NA	MG/KG		
Selenium (Se)		3	10	0.36	0.555	0.4483	0.31	0.36	39	1.22	MG/KG		
Sodium (Na)		3	10	167	226	192.6667	117	152	NA	NA	MG/KG		
Vanadium (V)		10	10	5.4	15.8	9.82	NA	NA	55	60.9	MG/KG		
Zinc (Zn)		5	10	10.3	64.3	41.64	14.3	37	2300	519	MG/KG		
Pesticides/PCBs													
Aroclor-1248	*	1	10	28000	28000	28000	34	350	320	NA	UG/KG	1	
4,4'-DDD		2	10	9.1	420	214.55	2.7	27	2700	NA	UG/KG		
4,4'-DDE	*	9	10	3.5	2600	328.1444	27	27	1900	NA	UG/KG	1	
4,4'-DDT		9	10	3.6	570	115.6444	2.8	2.8	1900	NA	UG/KG		
alpha-Chlordane	*	5	10	2.4	18000	3289.66	1.4	1.4	1800	NA	UG/KG	1	
Dieldrin		2	10	3.65	12	7.825	2.7	300	40	NA	UG/KG		
Endrin		2	10	8.6	540	274.3	2.7	32	2300	NA	UG/KG		
gamma-Chlordane	*	6	10	1.7	22000	3756.875	1.4	1.4	1800	NA	UG/KG	1	
Heptachlor	*	3	10	3	520	244.3333	1.4	1.5	140	NA	UG/KG	2	
Heptachlor epoxide		2	10	3.1	5.9	4.5	1.4	150	70	NA	UG/KG		
Semivolatile Organics													
Butylbenzylphthalate		1	2	930	930	930	370	370	1600000	NA	UG/KG		
Volatile Organics													
Acrolein		1	1	2	2	2	NA	NA	160000	NA	UG/KG		

Notes:
* - Indicates chemical was identified as a COPC
SQL - Sample quantitation limit
RBC - Risk-based concentration
UG/KG - micrograms per kilogram
NG/KG - nanograms per kilogram
MG/KG - milligrams per kilogram
NA - Not applicable or not available

Table 10.11.11
Chemicals Present in Site Samples
SWMU 3 - Groundwater
Naval Base Charleston, Zone G
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Residential RBC	Screening Concentration Background	Units	Number Exceeding RBC	Number Exceeding Bkgd
Inorganics													
Aluminum (Al)	*	3	3	2465	15200	9198.33	NA	NA	3700	692	UG/L	2	3
Arsenic (As)		3	3	3.1	9.7	7.47	NA	NA	0.045	17.8	UG/L	3	
Barium (Ba)		3	3	34.4	77.1	62.80	NA	NA	260	31	UG/L		3
Beryllium (Be)	*	3	3	0.545	1.1	0.92	NA	NA	0.016	NA	UG/L	3	
Calcium (Ca)		3	3	5500	65100	37233.33	NA	NA	NA	NA	UG/L		
Chromium (Cr)	*	3	3	5.6	31.6	19.20	NA	NA	18	3.88	UG/L	2	3
Cobalt (Co)		3	3	5.4	6.6	5.97	NA	NA	220	1.45	UG/L		3
Copper (Cu)		3	3	2.7	6.8	5.40	NA	NA	13000	8.33	UG/L		
Iron (Fe)		3	3	3460	22800	13786.67	NA	NA	NA	NA	UG/L		
Lead (Pb)		3	3	2.8	12.5	7.63	NA	NA	15	4.6	UG/L		2
Magnesium (Mg)		3	3	1700	9370	6236.67	NA	NA	NA	NA	UG/L		
Manganese (Mn)		3	3	188.5	544	310.50	NA	NA	84	2906	UG/L	3	
Nickel (Ni)		3	3	4.85	10.7	8.52	NA	NA	73	4.08	UG/L		3
Potassium (K)		2	3	672	3300	1986.00	1600	1600	NA	NA	UG/L		
Selenium (Se)		1	3	6	6	6.00	2.8	2.8	18	4.3	UG/L		1
Sodium (Na)		3	3	9605	38200	22068.33	NA	NA	NA	NA	UG/L		
Thallium (Tl)	*	3	3	2.8	3.5	3.07	NA	NA	0.29	NA	UG/L	3	
Vanadium (V)	*	3	3	7.1	46.7	28.40	NA	NA	26	15.4	UG/L	2	2

Notes:
* - Indicates chemical was identified as a COPC
SQL - Sample quantitation limit
RBC - Risk-based concentration
UG/L - micrograms per liter
NA - Not applicable or not available

to a portion of the surface soil on site). Therefore, future worker assessment is considered to be conservatively representative of current site users. The future site resident scenario was built on the premise that existing features would be removed and replaced with dwellings.

Exposure Pathways

Exposure pathways for the hypothetical future site residents are dermal contact and incidental ingestion of surface soils. The exposure pathways for future site workers are the same as those for the future site residents with respect to soil. The groundwater pathway for the hypothetical future site residents is incidental ingestion of groundwater. No VOCs were reported in SWMU 3 first-quarter groundwater samples at concentrations exceeding residential RBCs; therefore the inhalation of volatiles pathway was not addressed for this site. Uniform exposure was assumed for all sample locations. Table 10.11.12 presents the justification for exposure pathways assessed in this HHRA.

Exposure Point Concentrations

Ten surface soil samples were analyzed for this site. Table 10.11.13 presents the EPCs for the COPCs identified in surface soil, by using the 95% UCL as discussed in Section 7 of this RFI. Maximum reported concentrations of COPCs in surface soil were less than corresponding

Table 10.11.12
Zone G
SWMU 3
Exposure Pathways Summary

Potentially Exposed Population	Medium and Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Current Land Uses			
Current Users (Site Workers)	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No	This exposure pathway was considered insignificant compared to the other pathways.

Table 10.11.12
Zone G
SWMU 3
Exposure Pathways Summary

Potentially Exposed Population	Medium and Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
	Shallow groundwater, Ingestion of contaminants during potable or general use	No	Shallow groundwater is not currently used as a source of potable or non-residential water at SWMU 3.
	Shallow groundwater, Inhalation of volatilized shallow groundwater contaminants	No	Shallow groundwater is not currently used as a source of potable or non-residential water at SWMU 3.
	Soil, Incidental ingestion	No (Qualified)	Future site use is considered conservatively representative of current site use.
	Soil, Dermal contact	No (Qualified)	Future site use is considered conservatively representative of current site use.
Future Land Uses			
Future Site Residents (Child and Adult), Future Site Worker	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No	This exposure pathway was considered insignificant compared to the other pathways.
	Shallow groundwater, Ingestion of contaminants during potable or general use	Yes	Shallow groundwater is not likely to be used as a source of potable or non-residential water at SWMU 3. This pathway was addressed as a conservative measure.
	Shallow groundwater, Inhalation of volatilized contaminants during domestic use	No	Volatile COPCs were not identified subsequent to risk-based screening comparisons.
	Soil, Incidental ingestion	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Soil, Dermal contact	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Wild game or domestic animals, Ingestion of tissue impacted by media contamination	No	Hunting/taking of game and/or raising livestock is prohibited within the Charleston, South Carolina city limits.
	Fruits and vegetables, Ingestion of plant tissues grown in media	No	The potential for significant exposure via this pathway is low relative to that of other exposure pathways assessed.

Table 10.11.13
Summary of Statistical Analysis
Surface Soil COPCs; SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

COPC	Natural Log Transformed n	mean	SD	H-stat	UCL (mg/kg)	MAX (mg/kg)	EPC (mg/kg)	
Inorganics								
Manganese (Mn)	10	4.909	0.842	2.791	423	341	341	MAX
Pesticides/PCBs								
Aroclor-1248	10	-3.058	2.357	6.27	104	28	28	MAX
4,4'-DDE	10	-3.582	2.052	5.525	10	2.6	2.6	MAX
alpha-Chlordane	10	-4.963	3.425	8.93	65985	16	16	MAX
gamma-Chlordane	10	-4.795	3.470	9.042	118479	22	22	MAX
Heptachlor	10	-5.881	2.565	6.782	25	0.52	0.52	MAX

NOTES:

mean Arithmetic mean of the logtransformed data
n Number of samples analyzed
SD Standard deviation for a sample of data
H-stat "H" statistic from Gilbert 1987; cuboidal interpolation was used to determine the value in accordance with USEPA Supplemental Guidance to RAGS, Calculating the Concentration Term
NA Not applicable
EPC Exposure point concentration
UCL 95 percentile upper confidence level mean
MAX Maximum reported concentration

95% UCL values, and were therefore used as EPCs. Since less than 10 monitoring wells were established for SWMU 3, the maximum concentrations reported in the first-quarter samples were used as EPCs for groundwater.

Quantification of Exposure

Soil

CDIs for ingestion and dermal contact with soils are shown in Tables 10.11.14 and 10.11.15, respectively. FI/FC terms were applied to calculate the CDIs for Aroclor-1248, 4,4-DDE, alpha- chlordane, gamma-chlordane, and heptachlor, because their maximum concentrations, which were used as their EPCs, were extremely elevated in comparison to their reported concentrations in the remaining surface soil samples. The "hot spot" for these chemicals was represented by surface soil sample locations 003SB003, 003SB008, and 003SB009. These samples represent an area of approximately 1,750 square feet with is less than one-tenth of one-half acre. As a result, the FI/FC terms for these chemicals was set equal to 0.1.

Groundwater

CDIs for the groundwater pathway are shown in Table 10.11.16.

10.11.6.4 Toxicity Assessment

Toxicity assessment terms and methods are discussed in Section 7 of this report. Table 10.11.17 presents toxicological information specific to each COPC identified at SWMU 3. This information was used in the quantification of risk/hazard associated with soil contaminants. Brief toxicological profiles for each COPC are provided in the following paragraphs.

Aluminum is one of the most abundant metals in the earth's crust (7% aluminum), and it is ubiquitous in air and water, as well as soil. This metal is water-soluble, silvery, and ductile, which suggests its usefulness in many processes. Ingesting aluminum can affect the absorption

Table 10.11.14
Chronic Daily Intakes
Incidental Ingestion of Surface Soil
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Fraction Ingested from Contaminated Source *	Exposure Point Concentration (mg/kg)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Worker adult H-CDI (mg/kg-day)	Future Worker adult C-CDI (mg/kg-day)
Inorganic							
Manganese (Mn)	1	341	4.7E-04	4.4E-03	5.3E-04	1.7E-04	6.0E-05
Pesticides/PCBs							
Aroclor-1248	0.1	28	3.8E-06	3.6E-05	4.4E-06	1.4E-06	4.9E-07
4,4'-DDE	0.1	2.6	3.6E-07	3.3E-06	4.1E-07	1.3E-07	4.5E-08
alpha-Chlordane	0.1	16	2.2E-06	2.0E-05	2.5E-06	7.8E-07	2.8E-07
gamma-Chlordane	0.1	22	3.0E-06	2.8E-05	3.4E-06	1.1E-06	3.8E-07
Heptachlor	0.1	0.52	7.1E-08	6.6E-07	8.1E-08	2.5E-08	9.1E-09

NOTES:

lwa Lifetime weighted average; used to calculate carcinogenic CDI, RAGS Parts A and B
CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
* Reflects the estimated fraction of the site impacted by the corresponding COPC

Table 10.11.15
Chronic Daily Intakes
Dermal Contact with Surface Soil
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	FI/FC *	Exposure Point Concentration (mg/kg)	Dermal Absorption Factor (unitless)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Worker adult H-CDI (mg/kg-day)	Future Worker adult C-CDI (mg/kg-day)
Inorganic								
Manganese (Mn)	1	341	0.001	1.9E-05	6.3E-05	1.2E-05	1.4E-05	4.9E-06
Pesticides/PCBs								
Aroclor-1248	0.1	28	0.01	1.6E-06	5.2E-06	9.8E-07	1.1E-06	4.0E-07
4,4'-DDE	0.1	2.6	0.01	1.5E-07	4.8E-07	9.1E-08	1.0E-07	3.7E-08
alpha-Chlordane	0.1	16	0.01	9.0E-07	3.0E-06	5.6E-07	6.4E-07	2.3E-07
gamma-Chlordane	0.1	22	0.01	1.2E-06	4.1E-06	7.7E-07	8.8E-07	3.2E-07
Heptachlor	0.1	0.52	0.01	2.9E-08	9.6E-08	1.8E-08	2.1E-08	7.5E-09

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
* Reflects the estimated fraction of the site impacted by the corresponding COPC.
\- The dermal absorption factor was applied to the exposure point concentration to reflect the ability for trans-dermal migration of inorganic and organic chemicals

Table 10.11.16
Chronic Daily Intakes
Ingestion of COPCs in Shallow Groundwater
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Exposure Point Concentratio (mg/L)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Worker adult H-CDI (mg/kg-day)	Future Worker adult C-CDI (mg/kg-day)
Inorganics						
Aluminum (Al)	15.2	4.16E-01	9.72E-01	2.29E-01	1.49E-01	7.32E-02
Beryllium (Be)	0.001	3.01E-05	7.03E-05	1.66E-05	1.08E-05	5.29E-06
Chromium (Cr)	0.032	8.66E-04	2.02E-03	4.76E-04	3.09E-04	1.52E-04
Thallium (Tl)	0.004	9.59E-05	2.24E-04	5.27E-05	3.42E-05	1.68E-05
Vanadium (V)	0.047	1.28E-03	2.99E-03	7.04E-04	4.57E-04	2.25E-04

NOTES:
lwa lifetime weighted average
CDI Chronic Daily Intake
H-CDI Non-carcinogenic hazard based Chronic Daily Intake
C-CDI Carcinogenic risk based Chronic Daily Intake

Ta .11.17

Toxicological Reference Information
for Chemicals of Potential Concern
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

	Non-Carcinogenic Toxicity Data										*Carcinogenic Toxicity Data*					
Chemical	Oral Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Oral	Inhalation Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Inhalation	Oral Slope Factor (kg-day/mg)		Inhalation Slope Factor (kg-day/mg)		Weight of Evidence	Tumor Type
,4'-DDE	NA		NA	NA	NA	NA		NA	NA	NA	0.34	a	NA		B2	liver
Aluminum	1	c	NA	NA	NA	NA		NA	NA	NA	NA		NA		NA	NA
Beryllium	0.005	a	L	microscopic organ changes	100	NA		NA	NA	NA	4.3	a	8.4	a	B2	osteosarcoma
Chlordane	0.0005	a	L	liver hypertrophy	NA	NA		NA	NA	NA	0.35	a	0.35	a	B2	liver carcinoma
Chromium III	1	a	L	NA	100/10	5.71E-07	d	NA	NA	NA	NA		NA	a	D	NA
Chromium VI	0.005	a	L	NA	500	NA		NA	NA	NA	NA		42	a	A	lung
Heptachlor	0.0005	a	L	liver weight increase	300	NA		NA	NA	NA	4.5	a	4.55	a	B2	liver tumors
Manganese (food)	0.047	a	NA	neurological effects	1	NA		NA	NA	NA	NA		NA		D	NA
Manganese (water)	0.023	a	NA	neurological effects	1	1.43E-05	a	M	neurological effects	1000	NA		NA		D	NA
PCB Aroclor-1248	NA		NA	NA	NA	NA		NA	NA	NA	2	a	0.4	a	B2	hepatocellular carcinoma
Thallium	8E-05	a	L	increased SGOT (liver) increased serum LDH	3000	NA		NA	NA	NA	NA		NA		D	NA
Vanadium	0.007	b	NA	unclear	100	NA		NA	NA	NA	NA		NA		D	NA

Notes:

= Integrated Risk Information System (IRIS)
= Health Effects Assessment Summary Tables (HEAST)
= EPA NCEA - Cincinnati (provisional)
= Withdrawn from IRIS/HEAST
NA = Not applicable or not available
L = Low confidence
M = Medium confidence

of other elements within the gastrointestinal tract and can alter intestinal function. Aluminum can potentially interfere with the absorption of essential nutrients and cholesterol. Another effect on the gastrointestinal system is the inhibition of acetylcholine-induced contractions, which are part of the neuro-muscular system controlling bowel muscles. The effect could explain why aluminum-containing antacids often produce constipation and indicates aluminum could affect the uptake of other chemicals. Aluminum dust is moderately flammable and explosive in heat. Inhaling this dust can cause fibrosis (aluminosis) (Klaassen, et al., 1986; Dreisbach et al., 1987). No data are available on an applicable SF or the USEPA cancer group. The USEPA Region IV Office of Health Assessment suggested using the provisional oral RfD of 1.0 mg/kg-day. The aesthetic-based SMCL for drinking water is 50 to 200 μg/L.

Beryllium exposure via the inhalation route can inflame the lungs, a condition known as Acute Beryllium Disease, as a result of short-term exposure to high concentrations. Removal from exposure reverses the symptoms. Chronic exposure to much lower concentrations of beryllium or beryllium oxide by inhalation has been reported to cause chronic beryllium disease, with symptoms including shortness of breath, scarring of the lungs, and berylliosis, which is noncancerous growths in the lungs of humans. Both forms of beryllium disease can be fatal, depending on the severity of the exposure. Additionally, a skin allergy may develop when soluble beryllium compounds come into contact with the skin of sensitized individuals (Gradient, 1991). An oral RfD of 0.0054 mg/kg-day has been set for beryllium based on a chronic oral bioassay (rats were the study species) which determined an NOAEL of 0.54 mg/kg-day. Beryllium has been classified by USEPA as a group B2 carcinogen based on animal studies. Human epidemiology studies of beryllium are inadequate. As listed in IRIS, classification is based on beryllium being shown to induce lung cancer via inhalation in rats and monkeys and to induce osteosarcomas in rabbits via intravenous or intramedullary injection. An inhalation SF of 8.4 $(mg/kg\text{-}day)^{-1}$ and an oral SF of 4.3 $(mg/kg\text{-}day)^{-1}$ have been set by USEPA. As listed in IRIS, the critical effect of this

chemical is no adverse effect. The oral uncertainty factor was 100 and the modifying factor was 1. The IRIS RfD in drinking water is 0.005 mg/kg-day.

Chlordane is a polycyclic chlorinated pesticide. Acute exposure to high doses of chlordane causes tremors and convulsions. Chronic exposure can cause emotional and neuromuscular disturbances. Exposed individuals revert to normal approximately one week after the source is removed (Dreisbach et al., 1987). USEPA has established an oral RfD of 0.0005 mg/kg-day and an oral SF and inhalation SF of 0.35 $(mg/kg\text{-}day)^{-1}$.

Chromium exists in two stable, natural forms: CrIII and CrVI. Acute exposure to chromium can result in kidney damage following oral exposure or damage to the nasal mucosa and septum following inhalation exposure. Chronic inhalation exposure to CrVI has resulted in kidney and respiratory tract damage, as well as excess lung cancer in both animals and humans following occupational exposure. Only CrVI is believed to be carcinogenic by inhalation (IRIS). Oral RfD values for CrIII and CrIV are 1.0 and 5E-3 (mg/kg-day), respectively. For CrIII, the RfD is based on liver toxicity in the rat. For the CrVI form, the RfD is based on unspecified pathological changes observed in rat studies. In addition, CrVI is considered a group A carcinogen for inhalation exposures, and an inhalation SF of 42 $(mg/kg\text{-}day)^{-1}$ has been established for the CrVI. Vitamin supplements contain approximately 0.025 mg of chromium. As listed in IRIS, no critical effects were observed for CrIII. The uncertainty factor was 100 and the modifying factor was 10. As listed in IRIS, no critical effects were observed for CrVI. The uncertainty factor was 500 and the modifying factor was 1.

4,4'-DDE, a by-product of the pesticide DDT, is a compound typical of halobenzene derivatives. It is soluble in fat, but not in water, and its target organ is the brain. This analog of DDT is the second-most toxic of the three primary DDT analogues (i.e., the second-most likely to cause cancer). Other DDE effects could include cell death in the liver, fatty change of heart muscles,

and kidney damage. In a study mentioned in Dreisbach, et al., workers historically exposed to DDT had up to 648 ppm DDT in their body fat, yet no adverse health effects were observed. If an individual loses body fat, DDE concentrations are not stored at sufficient concentrations to induce toxic effects. This compound is listed as a B2 carcinogen, and USEPA set the oral SF for DDE to 0.34 $(mg/kg\text{-}day)^{-1}$ (Dreisbach, et al., 1987).

Heptachlor is a man-made chemical that was used in the past for killing insects in homes, buildings, and on food crops. Pure heptachlor is a white powder. Technical-grade heptachlor is a tan powder and has a lower level of purity than pure heptachlor. Heptachlor smells somewhat like camphor, and does not burn easily or explode (ATSDR, 1991).

No studies were located regarding lethal effects in humans after oral exposure to heptachlor. However, since heptachlor is a major component of the insecticide chlordane, chlordane poisoning can be considered when evaluating heptachlor toxicity data. There are no data on chronic oral exposures in humans. There are occupational studies of workers engaged in the manufacture of heptachlor in which the exposures are presumed to be predominantly inhalation with contributions from the dermal route. No adverse health effects have been identified in these cohorts that could be positively associated with heptachlor exposure.

Heptachlor has been issued the USEPA weight of classification of B2, probable human carcinogen (IRIS). Heptachlor has an oral RfD of 5E-04 mg/kg-day, and an oral SF of 4.5 $(mg/kg\text{-}day)^{-1}$, and an inhalation SF of 4.55 $(mg/kg\text{-}day)^{-1}$ (IRIS).

Manganese is an essential nutrient, but chronic exposure (0.8 mg/kg-day) causes mental disturbances. Studies have shown that manganese uptake from water is greater than manganese uptake from food, and the elderly appear to be more sensitive than children (Klaassen et al., 1986; Dreisbach et al., 1987). USEPA determined the RfD to be 0.14 mg/kg-day

based on dietary uptake. USEPA recommended using a modifying factor of 3 when estimating intake from soil and water. In addition, the body is roughly twice as efficient absorbing manganese in water compared to manganese in food. Because of the different uptake rates in water and food, two RfDs were used in this HHRA – one for water and one for food. The RfDs used are 0.047 and 0.023 mg/kg-day, respectively. Inhalation of manganese dust causes neurological effects and increased incidence of pneumonia. An inhalation RfD was set to 1.43E-05 mg/kg-day. According to USEPA, manganese cannot be classified as to its carcinogenicity. Therefore, the cancer class for manganese is group D. As listed in IRIS, the classification is based on studies that are inadequate to assess the carcinogenicity of manganese. Manganese is an element considered essential to human health. The typical vitamin supplement dose of manganese is 2.5 mg/day. As listed in IRIS, the critical effects of this chemical in water in the oral summary are CNS effects. The uncertainty factor was 1 and the recommended modifying factor of 3 was used to estimate soil and groundwater intake. The critical effects of this chemical are CNS effects. As listed in IRIS, the critical effect of this chemical in the inhalation summary is impairment of neuro-behavioral function. For inhalation uptake, the uncertainty factor was 1,000 and the modifying factor was 1. The IRIS RfC is 5E-05 mg/m^3.

PCB Aroclors are a group of chlorinated hydrocarbons (such as Aroclors-1248, 1254, and 1260) that accumulate in fat tissue. Occupational exposure (both inhalation and dermal) to PCBs causes eye and lung irritation, loss of appetite, liver enlargement, increased serum liver enzyme levels, rashes and chloracne, and decreased birth weight of infants in heavily exposed worker/mothers. Of the effects listed above, the liver is the primary target organ (Klaassen, et al., 1986) (Dreisbach, et al., 1987). USEPA classified PCB aroclors as group B2 probable human carcinogens, primarily based on animal data. Oral ingestion of PCBs causes liver and stomach tumors in rat studies. The cancer potency of PCB mixtures is determined using a tiered approach. The high risk and persistence tier uses an upper-bound slope factor of 2.0 (mg/kg-day)$^{-1}$ and is appropriate for food chain exposures, sediment and soil ingestion, dust or aerosol inhalation, and

dermal exposure. The low risk and persistence tier uses an upper-bound slope factor of 0.4 (mg/kg-day)$^{-1}$ and is appropriate for ingestion of water soluble congeners and inhalation of evaporated congeners. The lowest risk and persistence tier uses an upper-bound slope factor of 0.07 (mg/kg-day)$^{-1}$ and is appropriate for PCB congener mixtures with congeners having more than four chlorines comprising less than 1/2% of the mixture.

Thallium is readily absorbed through the gut and skin. Primary effects are stomach and bowel disturbances, kidney and liver damage, and neurological disturbances. Thallium was used in the past as a rodenticide and ant killer, and its use for these purposes is now prohibited. This element remains in the body for a relatively long time, and could accumulate if the chronic dose is large. USEPA's oral RfD for thallium is 8E-05 mg/kg-day (Klaassen, et al., 1986) (Dreisbach, et al., 1987). The uncertainty factor used for thallium is 3000.

Vanadium is not readily absorbed through the skin or oral ingestion and is a ubiquitous element. It is also a by-product of petroleum refining. Vanadium is soluble in fats and oils (Klaassen et al., 1986). Municipal water supplies contain 0.001 to 0.006 mg/L. The target organ is unclear, and the primary focus of toxicological information is inhalation of vanadium dust. Typical vitamin supplements contain approximately 0.010 mg in a daily dose. The oral RfD set by USEPA is 0.007 mg/kg-day. The uncertainty factor used for vanadium is 100.

10.11.6.5 Risk Characterization

Surface Soil Pathways

Exposure to surface soil onsite was evaluated under residential and industrial (site worker) scenarios. For these scenarios, the incidental ingestion and dermal contact exposure pathways were evaluated. For noncarcinogenic contaminants evaluated for future site residents, hazard was computed separately to address child and adult exposure. Tables 10.11.18 and 10.11.19 present

Table 10.11.18
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Surface Soil Ingestion
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Future Worker Adult Hazard Quotient	Future Worker Adult ILCR
Inorganic							
Manganese (Mn)	0.023	NA	0.020	0.19	ND	0.0073	ND
Pesticides/PCBs							
Aroclor-1248	NA	2	ND	ND	8.8E-06	ND	9.8E-07
4,4'-DDE	NA	0.34	ND	ND	1.4E-07	ND	1.5E-08
alpha-Chlordane	0.0005	0.35	0.0044	0.041	8.8E-07	0.0016	9.8E-08
gamma-Chlordane	0.0005	0.35	0.0060	0.056	1.2E-06	0.0022	1.3E-07
Heptachlor	0.0005	4.5	0.00014	0.0013	3.7E-07	0.000051	4.1E-08
SUM Hazard Index/ILCR			0.03	0.3	1E-05	0.01	1E-06

NOTES:
NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk

Table 10.11.19
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact With Surface Soil
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Dermal Adjustment	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Future Worker Adult Hazard Quotient	Future Worker Adult ILCR
Inorganic								
Manganese (Mn)	0.2	0.005	NA	0.0042	0.014	ND	0.0030	ND
Pesticides/PCBs								
Aroclor-1248	0.5	NA	4	ND	ND	3.9E-06	ND	1.6E-06
4,4'-DDE	0.5	NA	0.68	ND	ND	6.2E-08	ND	2.5E-08
alpha-Chlordane	0.5	0.0003	0.7	0.0036	0.012	3.9E-07	0.0026	1.6E-07
gamma-Chlordane	0.5	0.0003	0.7	0.0049	0.016	5.4E-07	0.0035	2.2E-07
Heptachlor	0.5	0.0003	9	0.00012	0.00039	1.6E-07	0.000083	6.7E-08
SUM Hazard Index/ILCR				0.01	0.04	5E-06	0.009	2E-06

NOTES:
NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk
- Dermal to absorbed dose adjustment factor is applied to adjust for Oral SF and RfD (i.e., the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI)

the computed carcinogenic risks and/or HQs associated with the incidental ingestion of and dermal contact with site surface soils, respectively.

Hypothetical Site Residents

The ingestion ILCR (based on the adult and child lifetime weighted average) for SWMU 3 surface soils is 1E-05. The dermal pathway ILCR is 5E-06. Aroclor-1248 and gamma-chlordane were the primary contributors to ILCR projections for the ingestion and dermal pathways, while alpha-chlordane was a secondary contributor.

The ingestion HIs projected for the adult and child receptors are 0.03 and 0.03, respectively. The dermal pathway HIs were 0.01 for the adult resident receptor and 0.04 for the child resident receptor.

Hypothetical Site Workers

Site worker ILCRs are 1E-06 for the ingestion pathway and 2E-06 for the dermal contact pathway. Aroclor-1248 was the primary contributor to ILCR projections for the ingestion and dermal pathways.

Site worker HIs were 0.01 for the ingestion pathway and 0.009 for the dermal pathway.

Groundwater Pathways

Exposure to shallow groundwater onsite was evaluated under a residential scenario based on the results of the first-quarter sampling event. The ingestion exposure pathway was evaluated assuming the site groundwater will be used for potable and/or domestic purposes and that an unfiltered well, drawing from the corresponding water bearing zone, will be installed. For noncarcinogenic contaminants evaluated relative to future site residents, hazard was computed

Table 10.11.20
Hazard Quotients and Incremental Lifetime Cancer Risks
Shallow Groundwater Ingestion
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Future Worker Adult Hazard Quotient	Future Worker Adult ILCR
Inorganics							
Aluminum (Al)	1	NA	0.42	0.97	ND	0.15	ND
Beryllium (Be)	0.005	4.3	0.0060	0.014	7.1E-05	0.0022	2.3E-05
Chromium (Cr)	0.005	NA	0.17	0.40	ND	0.062	ND
Thallium (Tl)	0.00008	NA	1.2	2.8	ND	0.43	ND
Vanadium (V)	0.007	NA	0.18	0.43	ND	0.065	ND
SUM Hazard Index/ILCR			2	5	7E-05	0.7	2E-05

NOTES:

NA Not available
ND Not Determined due to lack of available information
lwa lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime excess Cancer Risk

separately for child and adult receptors. Table 10.11.20 presents the risk and hazard for the ingestion pathway. Since no VOCs were identified as COPCs in SWMU 3 groundwater samples at concentrations exceeding their corresponding RBCs, the inhalation pathway was not addressed at this site.

Hypothetical Site Residents

The ingestion ILCR (based on the adult and child lifetime weighted average) for SWMU 3 groundwater is 7E-05. Beryllium was the sole contributor to ILCR projections for the ingestion pathway.

The ingestion HIs projected for the adult and child receptors are 2 and 5, respectively. Thallium was the primary contributor to HI projections for the ingestion pathway. Aluminum, beryllium, chromium, and vanadium were secondary contributors.

Hypothetical Site Workers

The site worker ILCR is 2E-05 for the ingestion pathway, and beryllium was the sole contributor to ILCR projections.

The site worker HI is 0.7 for the ingestion pathway. Thallium was the primary contributor to HI projections for the ingestion pathway. Aluminum, beryllium, chromium, and vanadium were secondary contributors.

Current Site Workers

Shallow groundwater is not currently used as a potable water source for SWMU 3 or other areas of Zone G. In the absence of a completed exposure pathway, no threat to human health is posed by reported shallow groundwater quality.

COCs Identified

Chemicals of concern were identified based on cumulative (all pathway) risk and hazard projected for this site on a medium-specific basis. USEPA has established a generally acceptable risk range of 1E-04 to 1E-06, and a hazard index threshold of 1.0 (unity). As recommended by SCDHEC, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual ILCR exceeds 1E-06 or whose hazard quotient exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-04 (and individual ILCR of 1E-06) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used in order to provide a more comprehensive evaluation of chemicals contributing to carcinogenic risk or noncarcinogenic hazard during the remedial goal options development process. Table 10.11.21 presents the COCs identified for SWMU 3 surface soil and groundwater.

Surface Soils

Future Site Residents

Aroclor-1248, alpha-chlordane, and gamma-chlordane were identified as soil pathway COCs based on their contribution to cumulative residential ILCR projections.

Future Site Workers

Aroclor-1248 was identified as a soil pathway COC based on its contribution to cumulative industrial ILCR projections.

The extent of the COCs identified in surface soil is briefly discussed below. To facilitate this discussion, residential soil RBCs and background concentrations were compared to each reported COC concentration. Aroclor-1248 was detected in only 1 of 10 surface soil samples (003SB003) at a concentration above the residential RBC (320 μg/kg) and was not detected in any of the remaining surface soil samples. Chlordane (alpha-) was detected in 5 of 10 surface soil samples,

Table 10.11.21
Summary of Risk and Hazard-based COCs
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident Iwa ILCR	Future Site Worker Hazard Quotient	Future Site Worker ILCR	Identifieation of COCs	
Surface Soil	Incidental Ingestion	**Inorganic**							
		Manganese (Mn)	0.020	0.19	ND	0.0073	ND		
		Pesticides/PCBs							
		Aroclor-1248	ND	ND	8.8E-06	ND	9.8E-07	2	4
		4,4'-DDE	ND	ND	1.4E-07	ND	1.5E-08		
		alpha-Chlordane	0.0044	0.041	8.8E-07	0.0016	9.8E-08	2	
		gamma-Chlordane	0.0060	0.056	1.2E-06	0.0022	1.3E-07	2	
		Heptachlor	0.00014	0.0013	3.7E-07	0.000051	4.1E-08		
	Dermal	**Inorganic**							
		Manganese (Mn)	0.0042	0.014	ND	0.0030	ND		
		Pesticides/PCBs							
		Aroclor-1248	ND	ND	3.9E-06	ND	1.6E-06	2	4
		4,4'-DDE	ND	ND	6.2E-08	ND	2.5E-08		
		alpha-Chlordane	0.0036	0.012	3.9E-07	0.0026	1.6E-07	2	
		gamma-Chlordane	0.0049	0.016	5.4E-07	0.0035	2.2E-07	2	
		Heptachlor	0.00012	0.00039	1.6E-07	0.000083	6.7E-08		
Surface Soil Pathway Sum			0.04	0.3	2E-05	0.02	3E-06		
Groundwater	Ingestion	**Inorganics**							
		Aluminum (Al)	0.42	0.97	ND	0.15	ND	1	
		Beryllium (Be)	0.0060	0.014	7.1E-05	0.0022	2.3E-05	2	4
		Chromium (Cr)	0.17	0.40	ND	0.062	ND	1	
		Thallium (Tl)	1.2	2.8	ND	0.43	ND	1	
		Vanadium (V)	0.18	0.43	ND	0.065	ND	1	
Groundwater Pathway Sum			2	5	7E-05	0.7	2E-05		
Sum of All Pathways			2	5	9E-05	0.7	3E-05		

Notes:
ND indicates not determined due to the lack of available risk information.
ILCR indicates incremental excess lifetime cancer risk
HI indicates hazard index
1- Chemical is a COC by virtue of projected child residence noncarcinogenic hazard.
2- Chemical is a COC by virtue of projected future resident lifetime ILCR.
3- Chemical is a COC by virtue of projected site worker noncarcinogenic hazard.
4- Chemical is a COC by virtue of projected site worker ILCR.

yet only exceeded its residential RBC (1,800 μg/kg) at one sample location (16,000 μg/kg at 003SB003). The next highest concentration of alpha-chlordane was reported in sample 003SB008 (420 μg/kg). Chlordane (gamma-) was detected in 6 of 10 surface soil samples, but only exceeded its residential RBC (1,800 μg/kg) at one surface soil sample location (22,000 μg/kg at 003SB003). The next highest concentration of gamma-chlordane was reported in sample 003SB008 (510 μg/kg).

First-quarter Groundwater

Future Site Residents

Beryllium was identified as a groundwater pathway COC based on its contribution to cumulative residential ILCR projections. Aluminum, chromium, thallium, and vanadium were identified as groundwater pathway COCs based on their contribution to cumulative residential HI projections.

Future Site Workers

Beryllium was identified as the only groundwater pathway COC based on its contribution to cumulative industrial ILCR projections.

Beryllium was detected at a concentration exceeding its tap water RBC (0.016 μg/L) in all three first-quarter groundwater samples. A background value has not been established for beryllium in shallow groundwater at Zone G. The maximum reported concentration of beryllium did not, however, exceed its respective MCL of 4 μg/L. Aluminum was detected at a concentration exceeding its tap water RBC (3,700 μg/L) in two first-quarter groundwater samples (003001 and 003003). Aluminum also exceeded its background value (692 μg/L) in all three first-quarter groundwater samples. Chromium was detected at a concentration exceeding its tap water RBC (18 μg/L) in two first-quarter groundwater samples, and its background value (3.88 μg/L) in all three first-quarter groundwater samples. Chromium was not, however, detected at a concentration exceeding its corresponding MCL of 100 μg/L. Thallium was detected at a concentration

exceeding its tap water RBC (0.29 μg/L) in all three first-quarter groundwater samples. A background value has not been determined for thallium in groundwater at Zone G, but thallium did exceed its MCL of 2 μg/L in all three first-quarter groundwater samples. Vanadium was detected at a concentration exceeding its tap water RBC (26 μg/L) and its background value (15.4 μg/L) in two first-quarter groundwater samples.

10.11.6.6 Risk Uncertainty

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure.

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. If this area were to be used as a residential site, the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, exposure to surface soil conditions as represented by samples collected during the RFI would not be likely under a true future residential scenario. These factors indicate that exposure pathways assessed in this HHRA would generally overestimate the risk and hazard posed to current site workers and future site residents.

Groundwater is not currently used at SWMU 3 for potable or industrial purposes. A base-wide system provides drinking and process water to buildings throughout Zone G. This system is slated to remain in operation under the current base reuse plan. As a result, shallow groundwater would not be expected to be used under future site use scenarios, and associated pathways are not expected to be completed in the future.

Determination of Exposure Point Concentrations

The maximum detected soil and groundwater constituent concentrations were used as the exposure point concentrations for this site. Use of maximum detected concentrations represent conservative assumptions when applied as the EPC, such that it is unlikely that the maximum detected concentration would be exceeded by the true mean concentration. Since only three monitoring wells were established on site, it is difficult to conclude whether the first-quarter data is representative of the average COC concentrations in the surficial aquifer over time. Subsequent quarterly samples resulted in significantly lower concentrations of aluminum, beryllium, chromium, thallium, and vanadium, indicating that first-quarter data could overestimate the potential risks and hazards associated with chronic exposure to groundwater from the surficial aquifer.

Frequency of Detection and Spatial Distribution

Surface Soil

Aroclor-1248, 4,4'-DDE, alpha-chlordane, gamma-chlordane, and heptachlor all exceeded their respective RBCs in the same surface soil sample (003SB003), indicating a potential "hotspot". Heptachlor also exceeded its RBC in 003SB008. Since maximum concentration were used as EPCs for these chemicals, FI/FC terms were calculated, based on the approximate area of the "hot spot", to provide a reasonable estimate of CDI for this site. Use of maximum concentrations as EPCs for this site would tend to cause an overestimation of risk. Assuming the extent of these COC has been adequately defined, FI/FC terms would adjust for this uncertainty.

First-quarter Groundwater

All COCs identified in first-quarter groundwater samples were detected in all three samples. Since no background values exist for beryllium and thallium in groundwater at Zone G, it is difficult to determine whether or not concentrations of these elements are indicative of ambient conditions. Aluminum, chromium, and vanadium each exceeded their respective RBC in two first-quarter

groundwater samples. Aluminum and chromium exceeded their background values in all three groundwater samples, and vanadium exceeded its background value in two groundwater samples. Subsequent quarterly sampling however, did not result in any groundwater COCs exceeding their respective RBCs or background values; indicating that risks and hazards posed by these chemicals may be overestimated based on first-quarter results.

Quantification of Risk/Hazard

As indicated by the discussions above, the uncertainty inherent in the risk assessment process is great. In addition, many site-specific factors have affected the uncertainty of this assessment that would upwardly bias the risk and hazard estimates. Exposure pathway-specific sources of uncertainty are discussed below.

Soil

A conservative screening process was used to identify COPCs for SWMU 3. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens, the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, only aluminum, arsenic, and beryllium were reported at concentrations near their RBCs (e.g. within 10% of their RBCs). Each of these elements was detected at a concentration exceeding its RBC, however, its maximum concentration did not exceed its corresponding background concentration. As a result, each chemical was eliminated from consideration in the risk assessment.

Groundwater

The same conservative screening process used for soil is also used for groundwater. Of the CPSSs screened and eliminated from formal assessment, only arsenic and manganese were reported at a concentration close to their corresponding RBCs (e.g. within 10% of their RBCs). Each of these elements was detected at a concentration exceeding its tap water RBC, however, its maximum concentration did not exceed its corresponding background concentration. As a result, each chemical was eliminated from consideration in the risk assessment.

Groundwater is not currently used as a potable water source at SWMU 3, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

Background-related Risk

Soil

Aluminum, arsenic, and beryllium were detected in SWMU 3 surface soil at concentrations above their respective RBCs. These elements were eliminated from consideration in the risk assessment based on comparison to corresponding background values. It is not unusual for naturally occurring or background concentrations of some elements to exceed risk-based concentrations. It is the risk assessment's function to identify excess risk and/or hazard, or that which is above background levels. The following is a discussion of the residential scenario risk/hazard associated with background concentrations of aluminum, arsenic, and beryllium.

The maximum surface soil concentration of aluminum (8,000 mg/kg) for SWMU 3 equates with hazard quotients of 0.1 and 0.006 for the residential child and site worker, respectively. The

background value for aluminum (18,700 mg/kg) results in hazard quotients of 0.3 and 0.01 for the residential child and site worker, respectively. The maximum surface soil concentration of arsenic (3.6 mg/kg) equates with ILCRs of 9E-06 and 2E-06 for the residential and site worker scenarios, respectively. The maximum reported concentration of arsenic also equates with hazard quotients of 0.2 and 0.008 for the residential child and site worker, respectively. The background value for arsenic (17.2 mg/kg) equates with ILCRs of 4E-05 and 6E-06, and hazard quotients of 0.8 and 0.04 for the residential and site worker scenarios, respectively. The maximum reported concentration of beryllium (0.67 mg/kg) yielded ILCRs of 5E-06 and 7E-07 for the residential and site worker scenarios, respectively. Hazard quotients resulting from the maximum reported concentration of beryllium were 0.002 and 0.0001 for the residential child and the site worker, respectively. The background value for beryllium (1.2 mg/kg) yielded ILCRs of 9E-06 and 1E-06, and hazard quotients of 0.0003 and 0.0002 for the residential and site worker scenarios, respectively.

First-quarter Groundwater

Arsenic and manganese were detected in first-quarter groundwater samples at concentrations exceeding their respective RBCs. These inorganics were eliminated from consideration in the risk assessment based on comparison to corresponding background values. The following is a discussion of the residential scenario risk/hazard associated with background concentrations of arsenic and manganese.

The maximum groundwater concentration of arsenic (9.7 μg/L) for SWMU 3 equates with ILCRs of 2E-04 and 7E-05 for the residential child and site worker, respectively. The maximum reported concentration of arsenic also equates with hazard quotients of 2 and 0.3 for the residential child and site worker, respectively. The background value for arsenic (17.8 μg/L) equates with ILCRs of 4E-04 and 1E-04, respectively, for the residential child and site worker; it also equates with hazard quotients of 4 and 0.6 for the residential child and site worker, respectively. The

maximum reported concentration of manganese (544 μg/L) yielded hazard quotients of 2 and 0.2 for the residential and site worker scenarios, respectively. Hazard quotients resulting from the background value for manganese (2,906 μg/L) were 8 and 1 for the residential child and the site worker, respectively.

10.11.6.7 Risk Summary

The risk and hazard posed by contaminants at SWMU 3 were assessed for future site workers and future site residents under reasonable maximum exposure assumptions. For surface soils, the incidental ingestion and dermal contact pathways were assessed in this HHRA. The ingestion pathway was assessed for groundwater. Table 10.11.22 presents the risk summary for each pathway/receptor group evaluated for SWMU 3.

Soil - Residential Scenario

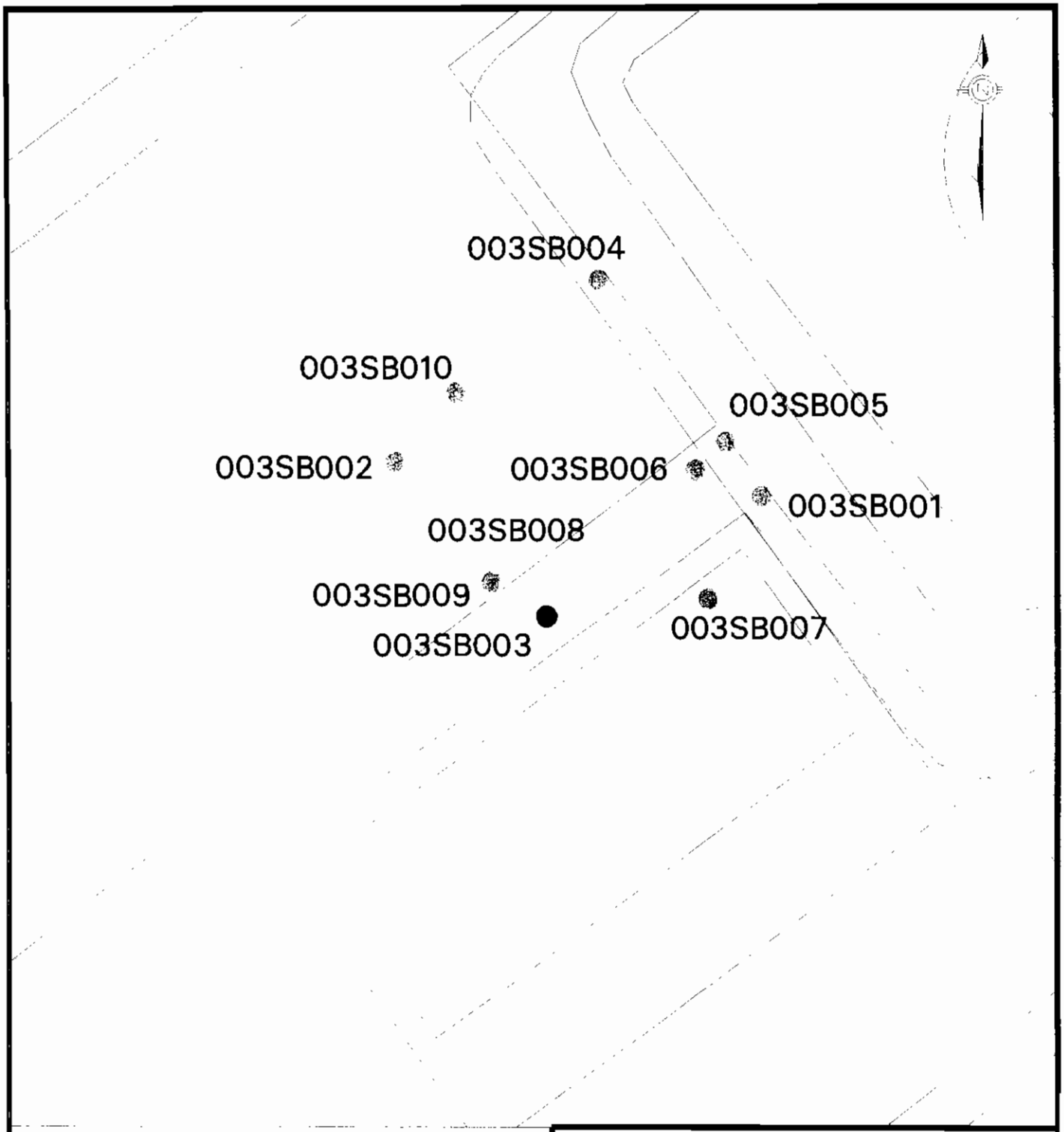
Residential soil pathway COCs identified for SWMU 3 are manganese, Aroclor-1248, 4,4'-DDE, alpha-chlordane, gamma-chlordane, and heptachlor. Figures 10.11-15 and 10.11-16 illustrate point risk and hazard estimates for SWMU 3 based on soil exposure pathways under a future residential scenario. Table 10.11.23 summarizes the risk and hazard contribution of each COPC at each sample location. This point risk map is based on the unlikely assumption that a potential future site resident will be chronically exposed to specific points. Exposure to surface soil conditions is more likely the result of uniform exposure to the soil conditions of the entire site (or exposure unit area) rather than specific points. With this in mind, risk maps supplemented by the tables are useful in that they allow the reader to visualize how chemicals driving risk estimates are spatially distributed across the site.

Only two sample locations yielded ILCRs that were greater than 1E-06 (003SB003 and 003SB008). Aroclor-1248 was the primary contributor to risk at 003SB003, while 4,4'-DDE , heptachlor, alpha-chlordane, and gamma-chlordane were secondary contributors. Heptachlor was

Table 10.11.22
Summary of Risk and Hazard
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)
Surface Soil	Incidental Ingestion	0.03	0.3	1E-05	0.01	1E-06
	Dermal Contact	0.01	0.04	5E-06	0.009	2E-06
Sum of Soil Pathways		0.04	0.3	2E-05	0.02	3E-06
Groundwater	Ingestion	2	5	7E-05	0.7	2E-05
Sum of Groundwater Pathways		2	5	7E-05	0.7	2E-05
Sum of All Pathways		2	5	9E-05	0.7	3E-05

Notes:
ILCR Indicates incremental lifetime cancer risk
HI Indicates hazard index



LEGEND

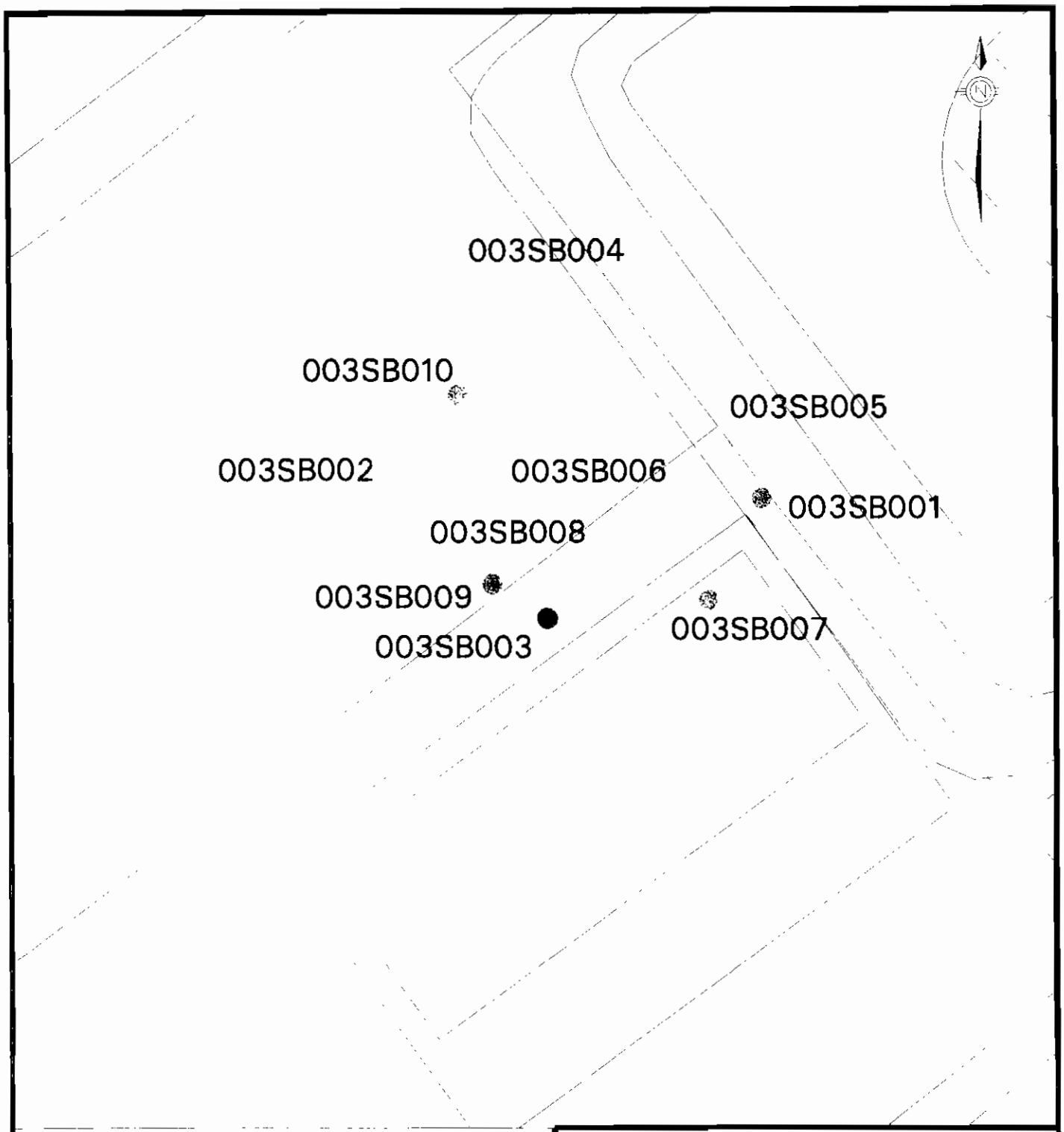
- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 50

ZONE G - RCRA FACILITY INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-15
POINT RISK ESTIMATES FOR SURFACE SOIL
RESIDENTIAL SCENARIO
SWMU 3

ANL: /home3/projects/charleston_dir/zone_g_dir/risk_dir



LEGEND

- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

0 feet 50

ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-16
POINT HAZARD ESTIMATES FOR SURFACE SOIL
RESIDENTIAL SCENARIO
SWMU 3

ANL: /home3/projects/charleston_dir/zone_g_district_dir

Table 10.11.23
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
003	001	4,4'-DDE	3.5	UG/KG	NA		0.0027	100
003	001	Aroclor-1248	ND	UG/KG	NA		NA	
003	001	Heptachlor	ND	UG/KG	NA		NA	
003	001	Manganese (Mn)	61.8	MG/KG	0.0368	100	NA	
003	001	alpha-Chlordane	ND	UG/KG	NA		NA	
003	001	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.0368		0.0027	
003	002	4,4'-DDE	81	UG/KG	NA		0.0625	87.93
003	002	Aroclor-1248	ND	UG/KG	NA		NA	
003	002	Heptachlor	ND	UG/KG	NA		NA	
003	002	Manganese (Mn)	193	MG/KG	0.1151	99.69	NA	
003	002	alpha-Chlordane	4.9	UG/KG	0.0002	0.14	0.0039	5.48
003	002	gamma-Chlordane	5.9	UG/KG	0.0002	0.17	0.0047	6.59
		Total			0.1154		0.0711	
003	003	4,4'-DDE	2600	UG/KG	NA		2.0054	1.22
003	003	Aroclor-1248	28000	UG/KG	NA		127.0380	77.22
003	003	Heptachlor	520	UG/KG	0.0172	1.24	5.3084	3.23
003	003	Manganese (Mn)	183	MG/KG	0.1091	7.91	NA	
003	003	alpha-Chlordane	16000	UG/KG	0.5278	38.25	12.7038	7.72
003	003	gamma-Chlordane	22000	UG/KG	0.7257	52.60	17.4677	10.62
		Total			1.3797		164.5233	
003	004	4,4'-DDE	3.8	UG/KG	NA		0.0029	100
003	004	Aroclor-1248	ND	UG/KG	NA		NA	
003	004	Heptachlor	ND	UG/KG	NA		NA	
003	004	Manganese (Mn)	194	MG/KG	0.1157	100	NA	
003	004	alpha-Chlordane	ND	UG/KG	NA		NA	
003	004	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.1157		0.0029	
003	005	4,4'-DDE	25	UG/KG	NA		0.0193	100
003	005	Aroclor-1248	ND	UG/KG	NA		NA	
003	005	Heptachlor	ND	UG/KG	NA		NA	
003	005	Manganese (Mn)	341	MG/KG	0.2033	100	NA	
003	005	alpha-Chlordane	ND	UG/KG	NA		NA	
003	005	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.2033		0.0193	

Table 10.11.23
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
003	006	4,4'-DDE	5	UG/KG	NA		0.0039	74.07
003	006	Aroclor-1248	ND	UG/KG	NA		NA	
003	006	Heptachlor	ND	UG/KG	NA		NA	
003	006	Manganese (Mn)	207	MG/KG	0.1234	99.95	NA	
003	006	alpha-Chlordane	ND	UG/KG	NA		NA	
003	006	gamma-Chlordane	1.7	UG/KG	0.0001	0.05	0.0013	25.93
		Total			0.1235		0.0052	
003	007	4,4'-DDE	14	UG/KG	NA		0.0108	23.77
003	007	Aroclor-1248	ND	UG/KG	NA		NA	
003	007	Heptachlor	3	UG/KG	0.0001	0.92	0.0306	67.41
003	007	Manganese (Mn)	17.65	MG/KG	0.0105	97.54	NA	
003	007	alpha-Chlordane	2.4	UG/KG	0.0001	0.73	0.0019	4.19
003	007	gamma-Chlordane	2.65	UG/KG	0.0001	0.81	0.0021	4.63
		Total			0.0108		0.0454	
003	008	4,4'-DDE	ND	UG/KG	NA		NA	
003	008	Aroclor-1248	ND	UG/KG	NA		NA	
003	008	Heptachlor	210	UG/KG	0.0069	4.25	2.1438	74.38
003	008	Manganese (Mn)	210	MG/KG	0.1252	76.90	NA	
003	008	alpha-Chlordane	420	UG/KG	0.0139	8.51	0.3335	11.57
003	008	gamma-Chlordane	510	UG/KG	0.0168	10.33	0.4049	14.05
		Total			0.1628		2.8822	
003	009	4,4'-DDE	200	UG/KG	NA		0.1543	82.22
003	009	Aroclor-1248	ND	UG/KG	NA		NA	
003	009	Heptachlor	ND	UG/KG	NA		NA	
003	009	Manganese (Mn)	118	MG/KG	0.0704	98.07	NA	
003	009	alpha-Chlordane	21	UG/KG	0.0007	0.97	0.0167	8.89
003	009	gamma-Chlordane	21	UG/KG	0.0007	0.97	0.0167	8.89
		Total			0.0717		0.1876	
003	010	4,4'-DDE	21	UG/KG	NA		0.0162	100
003	010	Aroclor-1248	ND	UG/KG	NA		NA	
003	010	Heptachlor	ND	UG/KG	NA		NA	
003	010	Manganese (Mn)	160	MG/KG	0.0954	100	NA	
003	010	alpha-Chlordane	ND	UG/KG	NA		NA	
003	010	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.0954		0.0162	

the primary contributor to risk at 003SB008, while alpha-chlordane and gamma-chlordane were secondary contributors. Risk estimates at SWMU 3 ranged from 3E-09 (003SB001) to 2E-04 (003SB003), with a mean risk estimate of 2E-05.

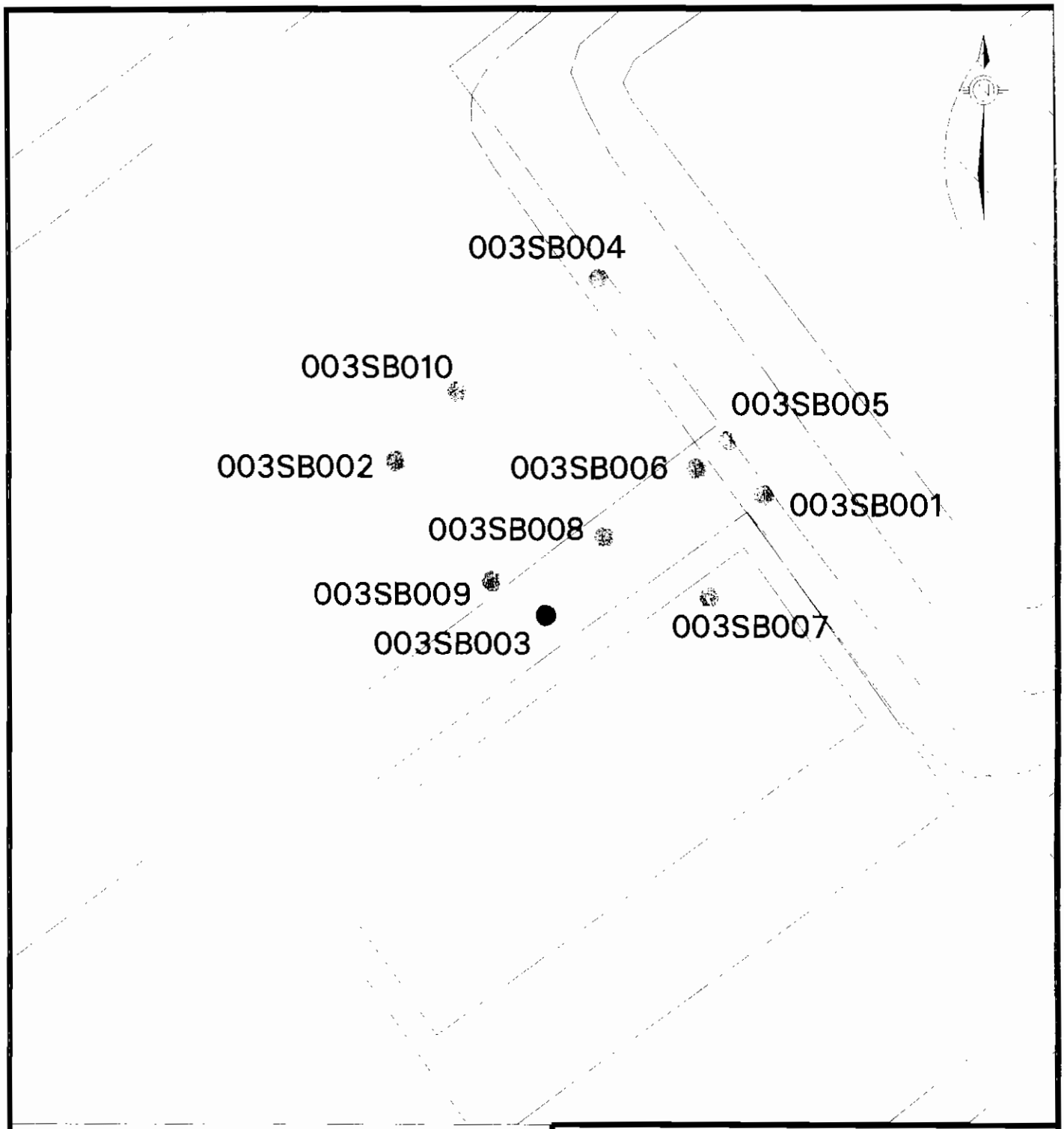
Chlordane (alpha-) and gamma-chlordane were primary contributors to hazard estimates at the only location at SWMU 3 that yielded a hazard index above unity (003SB003). Heptachlor and manganese were secondary contributors. Hazard index estimates ranged from 0.01 (003SB007) to 1.4 (003SB003), with a mean hazard estimate of 0.2.

Soil — Site Worker Scenario

Industrial soil pathway COCs identified for SWMU 3 are Aroclor-1248, alpha-chlordane, gamma-chlordane, and heptachlor. Figure 10.11-17 illustrates point risk estimates for SWMU 3 based on soil exposure pathways under a future site worker/industrial scenario. Table 10.11.24 summarizes the risk and hazard contribution of each COPC at each sample location. Heptachlor was not detected at a concentration exceeding its industrial RBC (1,300 μg/kg), and was therefore, not included in the point risk estimate table or figure.

Only one sample location yielded an ILCR greater than 1E-06 (003SB003). Aroclor-1248 was the primary contributor to risk at 003SB003, while alpha-chlordane and gamma-chlordane were secondary contributors. Risk estimates ranged from 3E-10 (003SB006) to 3E-05 (003SB003), with a mean risk estimate of 3E-06. None of these COCs were detected in 003SB001, 003SB004, 003SB005, or 003SB010.

Chlordane (alpha-) and gamma-chlordane were the sole contributors to hazard estimates at SWMU 3; however, hazard indices did not exceed unity at any location for the industrial scenario. Hazard index estimates ranged from 0.000004 (003SB007) to 0.1 (003SB003), with a mean hazard



LEGEND

- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 50

ZONE G - RCRA FACILITY INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-17
POINT RISK ESTIMATES FOR SURFACE SOIL
INDUSTRIAL SCENARIO
SWMU 3

AML: /home3/projects/charleston_dir/zone_g_dir/risk_di-

Table 10.11.24
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
003	001	Aroclor-1248	ND	UG/KG	NA		NA	
003	001	alpha-Chlordane	ND	UG/KG	NA		NA	
003	001	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			NA		NA	
003	002	Aroclor-1248	ND	UG/KG	NA		NA	
003	002	alpha-Chlordane	4.9	UG/KG	0.00001	45.4	0.0008	45.4
003	002	gamma-Chlordane	5.9	UG/KG	0.00002	54.6	0.0010	54.6
		Total			0.00003		0.0017	
003	003	Aroclor-1248	28000	UG/KG	NA		25.8301	80.8
003	003	alpha-Chlordane	16000	UG/KG	0.04133	42.1	2.5830	8.1
003	003	gamma-Chlordane	22000	UG/KG	0.05683	57.9	3.5516	11.1
		Total			0.09816		31.9648	
003	004	Aroclor-1248	ND	UG/KG	NA		NA	
003	004	alpha-Chlordane	ND	UG/KG	NA		NA	
003	004	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			NA		NA	
003	005	Aroclor-1248	ND	UG/KG	NA		NA	
003	005	alpha-Chlordane	ND	UG/KG	NA		NA	
003	005	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			NA		NA	
003	006	Aroclor-1248	ND	UG/KG	NA		NA	
003	006	alpha-Chlordane	ND	UG/KG	NA		NA	
003	006	gamma-Chlordane	1.7	UG/KG	0.000004	100	0.0003	100
		Total			0.000004		0.0003	
003	007	Aroclor-1248	ND	UG/KG	NA		NA	
003	007	alpha-Chlordane	2.4	UG/KG	0.000006	47.5	0.0004	47.5
003	007	gamma-Chlordane	2.65	UG/KG	0.000007	52.5	0.0004	52.5
		Total			0.00001		0.0008	
003	008	Aroclor-1248	ND	UG/KG	NA		NA	
003	008	alpha-Chlordane	420	UG/KG	0.00108	45.2	0.0678	45.2
003	008	gamma-Chlordane	510	UG/KG	0.00132	54.8	0.0823	54.8
		Total			0.00240		0.1501	

Table 10.11.24
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
003	009	Aroclor-1248	ND	UG/KG	NA		NA	
003	009	alpha-Chlordane	21	UG/KG	0.00005	50.0	0.0034	50.0
003	009	gamma-Chlordane	21	UG/KG	0.00005	50.0	0.0034	50.0
		Total			0.00011		0.0068	
003	010	Aroclor-1248	ND	UG/KG	NA		NA	
003	010	alpha-Chlordane	ND	UG/KG	NA		NA	
003	010	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			NA		NA	

estimate of 0.01. Neither of these COCs were detected in 003SB001, 003SB004, 003SB005, or 003SB010.

Groundwater — Residential Scenario

Aluminum, beryllium, chromium, thallium and vanadium were identified as groundwater pathway COCs. As shown in Table 10.11.25 and Figure 10.11-18, beryllium was the sole contributor to risk projections for SWMU 3 groundwater. Risk estimates ranged from 3E-05 (003002) to 7E-05 (003001 and 003003), with a mean ILCR of 6E-05. Thallium was the primary contributor to hazard estimates, while aluminum, beryllium, chromium, and vanadium were secondary contributors. Figure 10.11-19 illustrates point hazard estimates for groundwater for the residential scenario. Hazard estimates ranged from 3 (003002) to 4 (003003), with a mean hazard index of 4.

10.11.6.8 Remedial Goal Options

Soil

RGOs for carcinogens were based on the lifetime weighted average site resident as presented in Table 10.11.26 for surface soils. Hazard-based RGOs were calculated based on the hypothetical child resident, as noted in the table.

Groundwater

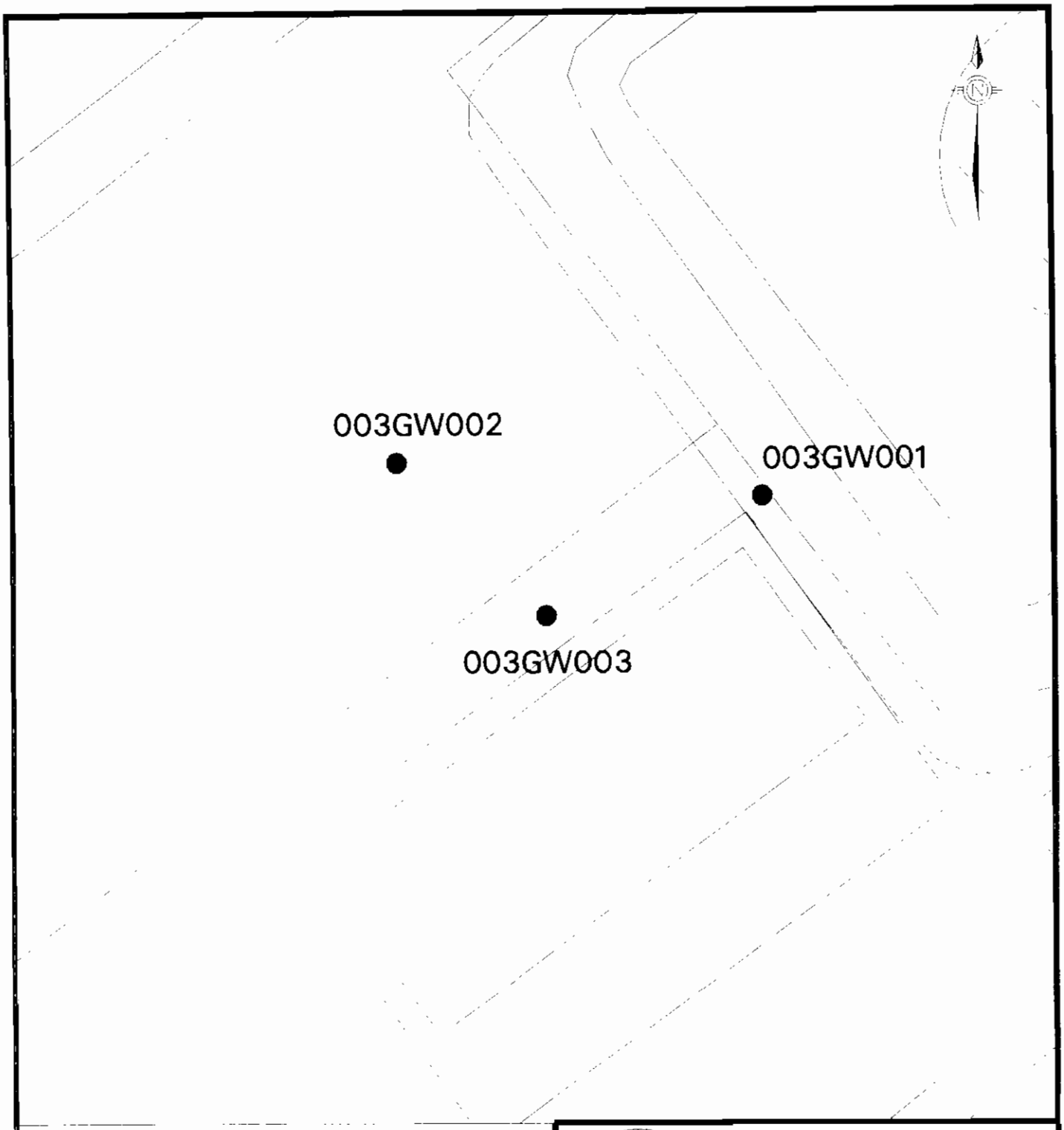
Groundwater RGOs based on the site resident scenario are shown in Table 10.11.27.

10.11.7 Corrective Measures Considerations

Based on the analytical results and the human health risk assessment for SWMU 3, COCs requiring further evaluation through the CMS process have been identified for surface soil and groundwater. The site is currently in an industrial setting, however risk to human health was evaluated under both the residential and industrial (site worker) scenarios for incidental ingestion and dermal contact exposure pathways.

Table 10.11.25
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
003	001	Aluminum (Al)	9930	UG/L	0.6348	15.9	NA	
003	001	Beryllium (Be)	1.1	UG/L	0.0141	0.4	70.3483	100
003	001	Chromium (Cr)	20.4	UG/L	0.2608	6.5	NA	
003	001	Thallium (Tl)	3.5	UG/L	2.7968	70.0	NA	
003	001	Vanadium (V)	31.4	UG/L	0.2868	7.2	NA	
		Total			3.9932		70.3483	
003	002	Aluminum (Al)	2465	UG/L	0.1576	6.0	NA	
003	002	Beryllium (Be)	0.545	UG/L	0.0070	0.3	34.8544	100
003	002	Chromium (Cr)	5.6	UG/L	0.0716	2.7	NA	
003	002	Thallium (Tl)	2.9	UG/L	2.3174	88.5	NA	
003	002	Vanadium (V)	7.1	UG/L	0.0648	2.5	NA	
		Total			2.6183		34.8544	
003	003	Aluminum (Al)	15200	UG/L	0.9717	24.0	NA	
003	003	Beryllium (Be)	1.1	UG/L	0.0141	0.3	70.3483	100
003	003	Chromium (Cr)	31.6	UG/L	0.4040	10.0	NA	
003	003	Thallium (Tl)	2.8	UG/L	2.2374	55.2	NA	
003	003	Vanadium (V)	46.7	UG/L	0.4265	10.5	NA	
		Total			4.0537		70.3483	



LEGEND

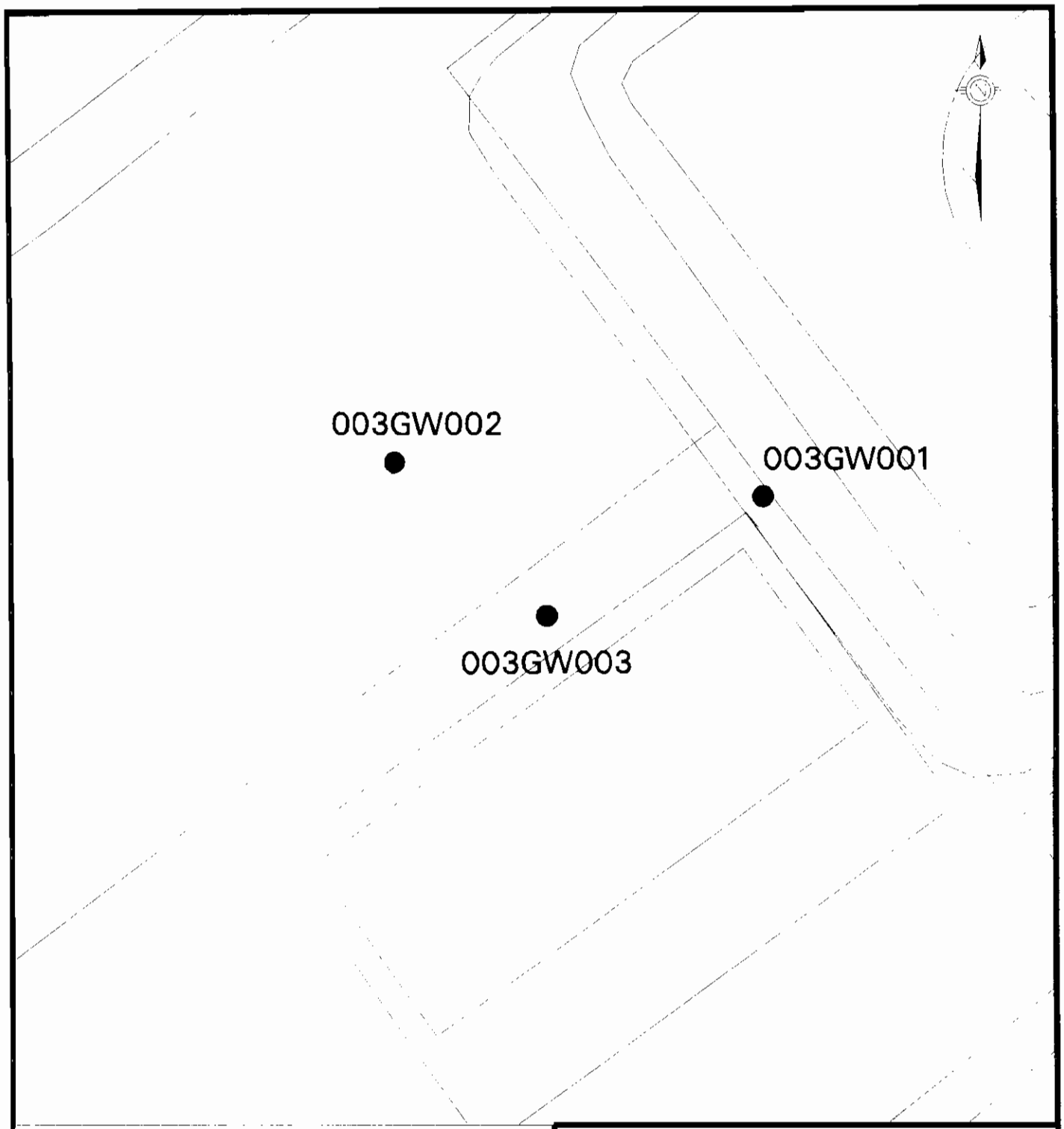
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 50

ZONE G - RCRA FACILITY INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-18
POINT RISK ESTIMATES FOR GROUNDWATER RESIDENTIAL SCENARIO
SWMU 3

AML: /home3/projects/charleston_dir/zone_g_dir/risk_el



LEGEND

- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

0 feet 50

ZONE G - RCRA FACILITY INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.11-19
POINT HAZARD ESTIMATES FOR GROUNDWATER
RESIDENTIAL SCENARIO
SWMU 3

AML /home3/projects/charleston_dir/zone_g_dir/risk_dir

Table 10.11.26
Remedial Goal Options for Soil
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Residential-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 1E-06 mg/kg	1E-05 mg/kg	1E-04 mg/kg	Background Concentration mg/kg
Inorganic										
Manganese (Mn)	NA	0.023	341.0	5032	1677	167.7	ND	ND	ND	325
Pesticides/PCBs										
Aroclor-1248	2	NA	28.0	ND	ND	ND	0.22	2.2	22	NA
4,4'-DDE	0.34	NA	2.6	ND	ND	ND	1.3	13	130	NA
alpha-Chlordane	0.35	0.0005	16.0	91	30	3.0	1.3	13	126	NA
gamma-Chlordane	0.35	0.0005	22.0	91	30	3.0	1.3	13	126	NA
Heptachlor	4.5	0.0005	0.5	91	30	3.0	0.10	1.0	10	NA

Worker-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 1E-06 mg/kg	1E-05 mg/kg	1E-04 mg/kg	Background Concentration mg/kg
Pesticides/PCBs										
Aroclor-1248	2	NA	28.0	ND	ND	ND	1.1	11	108	NA
alpha-Chlordane	0.35	0.0005	16.0	1161	387	39	6.2	62	619	NA
gamma-Chlordane	0.35	0.0005	22.0	1161	387	39	6.2	62	619	NA
Heptachlor	4.5	0.0005	0.5	1161	387	39	0.48	4.8	48	NA

NOTES:

EPC Exposure point concentration
NA Not applicable
ND Not determined
- Remedial goal options were based on the residential or site worker lifetime weighted average for carcinogens and the child resident or site worker for noncareinogens

Table 10.11.27
Remedial Goal Options - Shallow Groundwater
SWMU 3
Naval Base Charleston, Zone G
Charleston, South Carolina

Residential-Based Remedial Goal Options

Chemical	Oral SF (mg/kg-day)-1	Oral RfD (mg/kg-day)	EPC mg/l	Hazard-Based Remedial Goal Options **0.1** mg/l	**1.0** mg/l	**3** mg/l	Risk-Based Remedial Goal Options **1E-06** mg/l	**1E-05** mg/l	**1E-04** mg/l	MCL mg/l	Background Concentration mg/l
Inorganics											
Aluminum (Al)	NA	1	15.2	1.6	15.6	46.9	ND	ND	ND	NA	0.692
Beryllium (Be)	4.3	0.005	0.0011	0.0078	0.078	0.23	0.000015	0.00015	0.0015	0.004	NA
Chromium (Cr)	NA	0.005	0.0316	0.0078	0.078	0.23	ND	ND	ND	0.1	0.00388
Thallium (Tl)	NA	0.00008	0.0035	0.00013	0.0013	0.0038	ND	ND	ND	0.002	NA
Vanadium (V)	NA	0.007	0.0467	0.011	0.11	0.33	ND	ND	ND	NA	0.0154

NOTES:
EPC exposure point concentration
NA not applicable
ND not determined
- remedial goal options for site residents were based on the residential lifetime weighted average for carcinogens and the child resident for noncarcinogens

As recommended by SCDHEC, a COC is considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual risk exceeds 1E-06 or whose hazard quotient exceeds 0.1.

Aroclor-1248, alpha-chlordane, and gamma-chlordane were identified as soil pathway COCs for SWMU 3. Aluminum, beryllium, chromium, thallium, and vanadium were identified as groundwater pathway COCs for SWMU 3. Table 10.11.28 presents cumulative and COC-specific exposure risks and hazard quotients.

Table 10.11.28
Zone G
SWMU 3
Cumulative and Chemical-Speeific Exposure Risks and Hazard

	Risk		Hazard	
Chemical	**Industrial**	**Residential**	**Industrial**	**Residential**
Soil				
Aroclor-1248	2.6E-06	1.3E-05	ND	ND
alpha-chlordane	2.6E-07	1.3E-06	0.004	0.053
gamma-chlordane	3.5E-07	1.7E-06	0.006	0.072
Cumulative	3.2E-06	1.6E-05	0.1	.125
Groundwater				
Aluminum	ND	ND	0.15	0.97
Beryllium	2.3E-05	7.1E-05	.002	0.01
Chromium	ND	ND	0.06	0.40
Thallium	ND	ND	0.43	2.8
Vanadium	ND	ND	0.07	0.43
Cumulative	2.3E-05	7.1E-05	0.7	4.6

Note:
ND = Not determined

Risk-based remedial goals for the COCs at SWMU 3 for soil and groundwater are presented in Tables 10.11.26 and 10.11.27, respectively. Potential corrective measures are presented in Table 10.11.29.

Table 10.11.29
Zone G
SWMU 3
Potential Corrective Measures

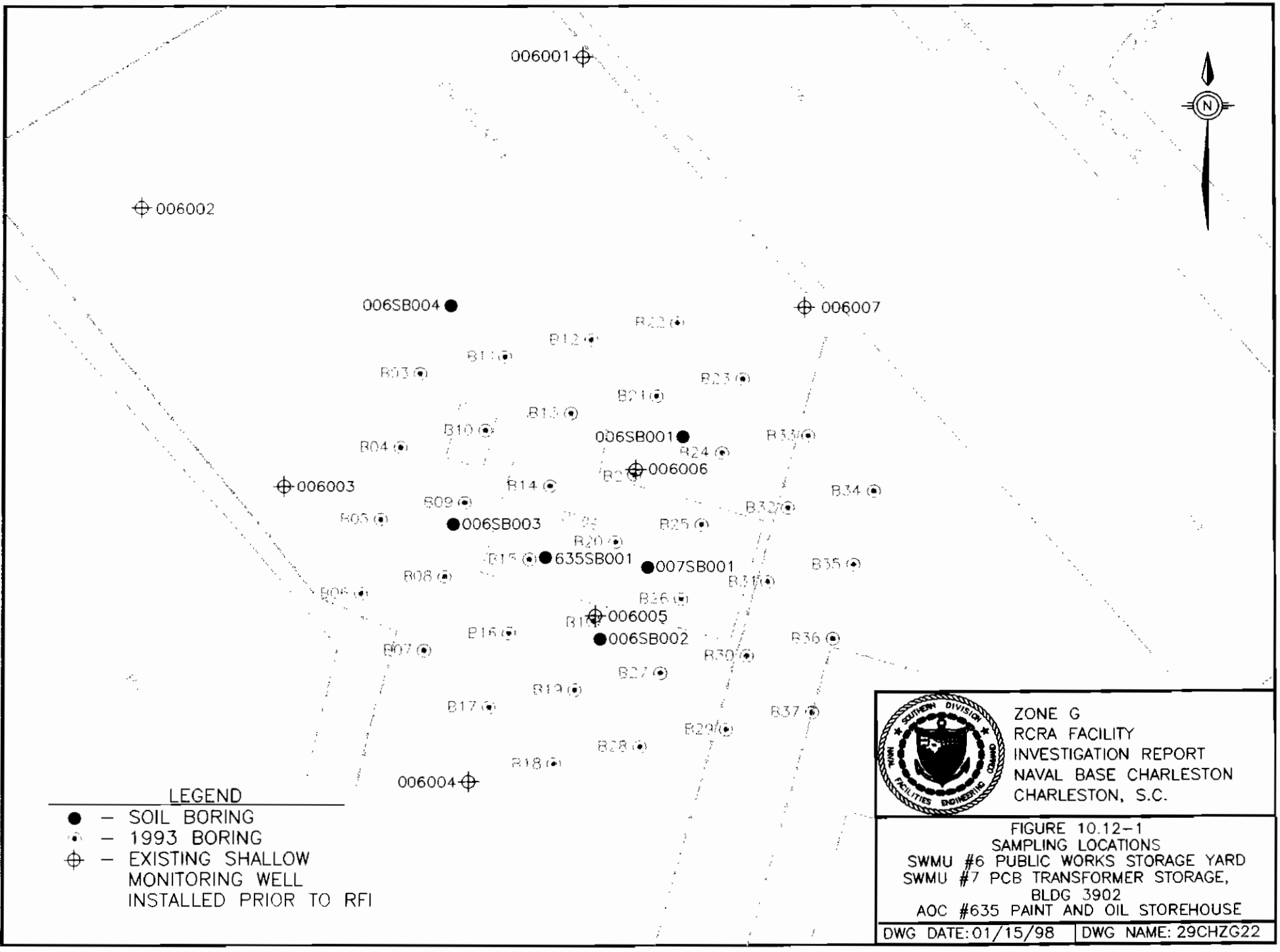
Medium	Compounds	Potential Corrective Measures
Soil	Aroclor-1248, alpha-chlordane, and gamma-chlordane	a) No action b) Excavate, offsite disposal, and monitoring c) Containment/Capping d) Ex-situ, chemical/physical treatment
Groundwater	Aluminum, Beryllium, Chromium, Thallium, Vanadium	a) No action b) Monitoring c) Ex-situ physical/chemical treatment and discharge to POTW d) Ex-situ physical/chemical treatment and discharge through NPDES permitting

10.12 SWMU 6, Public Works Storage Yard; SWMU 7, PCB Transformer Storage Yard; and AOC 635, Paint and Oil Storehouse, Building 3902

All RFI sites, these sites were combined into one investigation due to their close proximity and their potential for similar COPCs. Known as the Public Works Storage Yard, SWMU 6 is an unpaved, open, fenced storage yard located north of Hobson Avenue, south of River Road, and Southeast of Thirteenth Street. Routinely generated containerized wastes (cleaning solvents and used motor oil from vehicle maintenance, along with wastes from building maintenance and pest control operations) were stored at this site prior to shipment offsite. The fenced area within SWMU 6 encompasses two other RFI sites associated with activities which took place in and around Building 3902. These are SWMU 7 and AOC 635. SWMU 7 consists of Building 3902, the concrete slab adjacent the building, and the surrounding areas which were used for storage of transformers and associated electrical equipment between 1970 and 1976. Transformers that were taken out of use were temporarily stored here prior to being shipped off base. Previous oil spills around the pad were evident during the RFA. AOC 635 consists of the paint and oil storehouse at Building 3902. The small steel storehouse was erected in 1942 on a 25 foot by 25 foot pad, and was used until 1976. Leaking transformers, old electrical equipment, paint cans and drums, used motor oil, paint solvents and plating wastes were stored there. The western parking lot was also a drum storage area. Building 3902 and its associated area lies within the fenced compound of SWMU 6.

10.12.1 Site Geology and Hydrogeology

Figure 10.12-1 depicts the soil and groundwater sampling locations within this area. Appendix A contains the boring logs and the monitoring well construction diagrams for the seven previously installed wells at SWMU 6, 7 and AOC 635. Based on the monitoring well boring logs, the stratigraphy at the combined SWMU 6 generally consists of silt, silty clay, and clayey sand overlying poorly sorted sand and silt to approximately 15 ft bgs. In accordance with the work plan, no physical parameter samples were collected at the site.



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-1
SAMPLING LOCATIONS
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 01/15/98 | DWG NAME: 29CHZG22

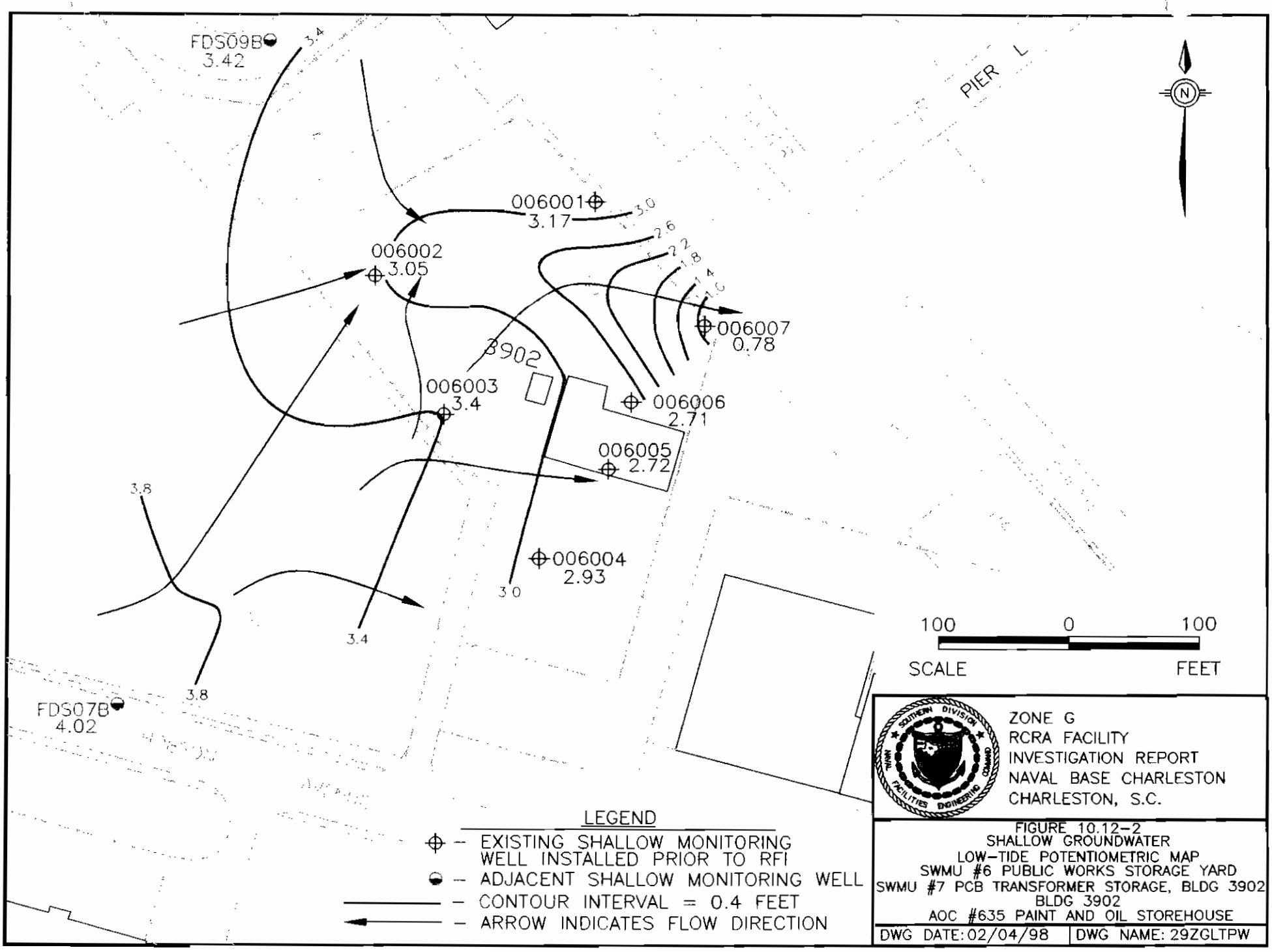
The groundwater elevation at the site is approximately 3.0 ft msl. Figures 10.12-2 and 10.12-3 depict the shallow groundwater potentiometric surface and inferred flow direction at low- and high-tide respectively. Minor differences in the static water levels and the overall flow pattern at the site were observed, the overall flow is to the east-southeast. However an area of low static elevation is observed in the area of well 006002. This low is most pronounced during high-tide. The horizontal hydraulic gradient of the eastern component of flow, based on Figure 10.12-3 is 4.0E-03. Employing the geometric mean of the shallow horizontal hydraulic conductivity of 2.1 ft/day and the effective porosity of 41% the horizontal flow velocity was calculated at 2.0E-02 ft/day.

10.12.2 Field Investigation Approach

The objective of the field investigation at SWMUs 6, 7 and AOC 635 was to: (1) confirm the presence or absence of contamination in the site area; (2) delineate any contamination found; and (3) provide sufficient data to support a detailed evaluation of treatment alternatives, if required. Media sampled within the investigation area included soil and groundwater. Section 3 of this report details the methods used during the field investigation. Included in this section are descriptions of the hollow stem auger drilling procedures used for shallow well installation; the hand-auger procedures used for soil sampling; groundwater sampling procedures; and miscellaneous procedures used during the field investigation. Also discussed are the analytical protocols for sample analyses. Appendix D contains the analytical data report for samples collected in Zone G.

10.12.3 Soil Sampling and Analysis

Pre-RFI soil sampling was performed in 1993 and included 41 soil borings. Table 10.12.1 summarizes the 1993 sampling and analyses. The approved final RFI work plan proposed advancing six soil borings within the SWMUs 6, 7 and AOC 635 area to confirm the presence of soil contamination from this site. Upper and lower interval soil samples were proposed from each


FDS09B
3.42
3.4
006001
3.17
3.0
2.6
2.2
1.8
1.4
1.0
006002
3.05
006007
0.78
3902
006003
3.4
006006
2.71
006005
2.72
3.8
006004
2.93
3.0
3.4
3.8
FDS07B
4.02
PIER L
N
100 0 100
SCALE FEET
LEGEND
EXISTING SHALLOW MONITORING WELL INSTALLED PRIOR TO RFI
ADJACENT SHALLOW MONITORING WELL
CONTOUR INTERVAL = 0.4 FEET
ARROW INDICATES FLOW DIRECTION
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 10.12-2
SHALLOW GROUNDWATER
LOW-TIDE POTENTIOMETRIC MAP
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE
DWG DATE: 02/04/98
DWG NAME: 29ZGLTPW

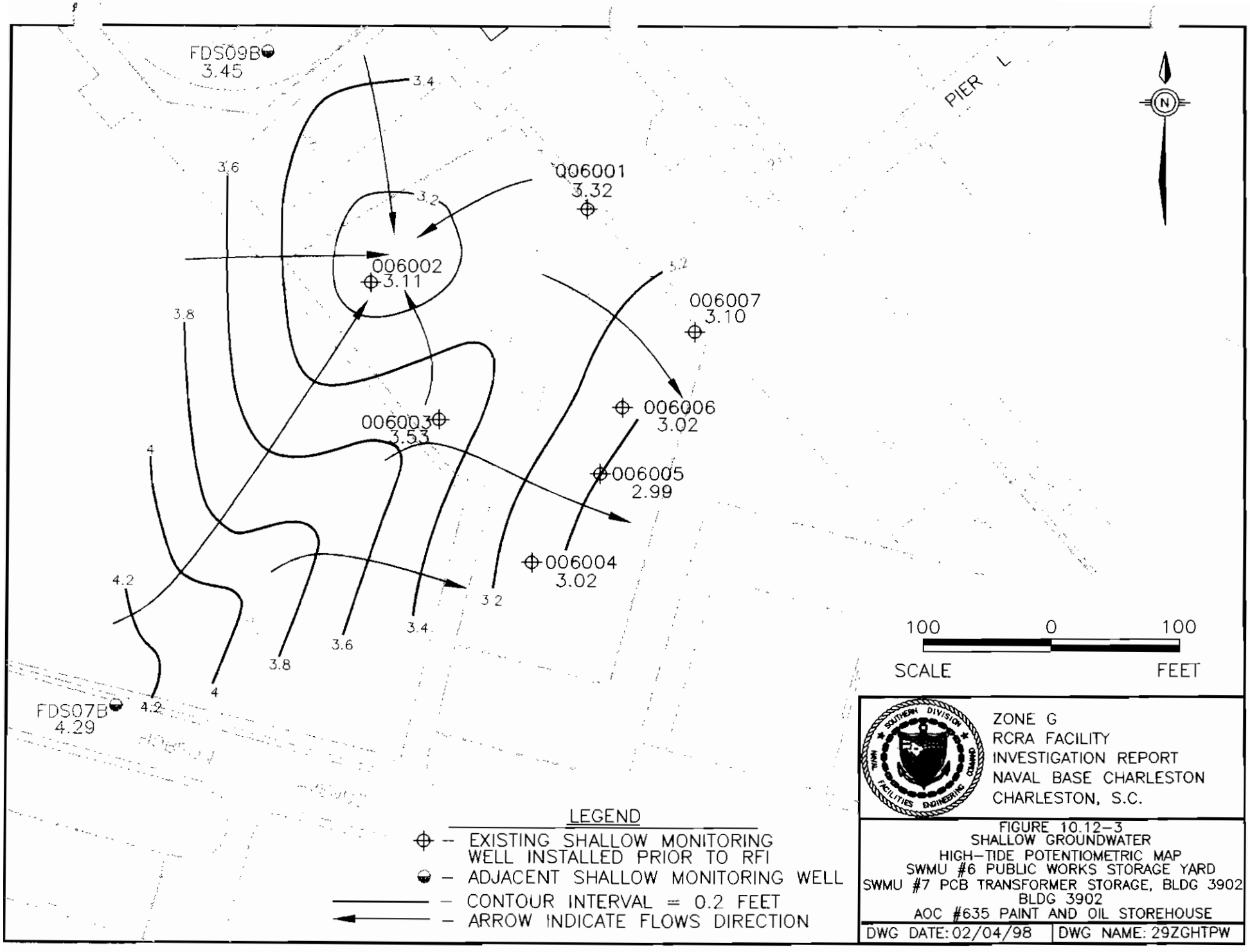

FDS09B
3.45
3.4
3.6
3.2
006001
3.32
006002
3.11
3.8
006007
3.10
006006
3.02
006003
3.53
4
006005
2.99
006004
3.02
4.2
3.2
3.4
3.6
3.8
4
FDS07B
4.29
4.2
PIER L
N
100
0
100
SCALE
FEET
LEGEND
– EXISTING SHALLOW MONITORING WELL INSTALLED PRIOR TO RFI
– ADJACENT SHALLOW MONITORING WELL
– CONTOUR INTERVAL = 0.2 FEET
– ARROW INDICATE FLOWS DIRECTION
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 10.12-3
SHALLOW GROUNDWATER
HIGH-TIDE POTENTIOMETRIC MAP
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE
DWG DATE: 02/04/98
DWG NAME: 29ZGHTPW

Table 10.12.1
Zone G
SWMU 6,7 and AOC 635
1933 Soil Samples and Analyses
(Pre-RFI Samples)

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
S06-B01	S06B0101	Upper	9/21/93	Note 1	
S06-B02	S06B0201 S06B0202	Upper Lower	9/21/93	Note 1	
S06-B03	S06B0301	Upper	9/21/93	Note 1	
S06-B04	S06B0401 S06B0402	Upper Lower	9/21/93	Note 1	
S06-B05	S06B0501	Upper	9/22/93	Note 1	
S06-B06	S06B0601	Upper	9/22/93	Note 1	
S06-B07	S06B0701 S06B0702	Upper Lower	9/22/93	Note 1	
S06-B09	S06B0902	Lower	10/27/93	Note 1	
S06-B12	S06B1202	Lower	10/20/93	Note 1	
S06-B14	S06B1401 S06B1402	Upper Lower	10/27/93	Note 1	
S06-B15	S06B1501 S06B1502	Upper Lower	10/27/93	Note 1	
S06-B17	S06B1702	Lower	10/27/93	Note 1	
S06-B20	S06B2001 S06B2002	Upper Lower	10/27/93	Note 1	
S06-B21	S06B2102	Lower	10/26/93	Note 1	
S06-B25	S06B2501 S06B251D* S06B2502	Upper Lower	10/27/93	Note 1	 *Duplicate Sample
S06-B26	S06B2601 S06B2602	Upper Lower	10/27/93	Note 1	
S06-B27	S06B2702 S06B272D*	Lower	10/27/93	Note 1	*Duplicate Sample
S06-B29	S06B2902	Lower	10/27/93	Note 1	
S06-B31	S06B3102	Lower	10/27/93	Note 1	

Table 10.12.1
Zone G
SWMU 6,7 and AOC 635
1933 Soil Samples and Analyses
(Pre-RFI Samples)

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
S06-B32	S06B3202	Lower	10/27/93	Note 1	
S06-B33	S06B3302	Lower	10/2793	Note 1	
B07-B03	S07B0301 S07B031D* S07B0302	Upper	10/09/93	Note 1	*Duplicate Sample
B07-B04	S07B0401	Upper	10/09/93	Note 1	
S07-B05	S07B0501	Upper	10/09/93	Note 1	
S07-B06	S07B0601	Upper	10/09/93	Note 1	
S07-B07	S07B0701	Upper	10/09/93	Note 1	
S07-B08	S07B0801	Upper	10/09/93	Note 1	
S07-B09	S08B0901	Upper	10/09/93	Note 1	
S07-B10	S07B1001	Upper	10/09/93	Note 1	
S07-B11	S07B1101 S07B1102	Upper Lower	10/09/93	Note 1	
S07-B12	S07B1201	Upper	10/09/93	Note 1	
S07-B13	S07B1301 S07B1302 S07B132D*	Upper Lower	10/09/93	Note 1	*Duplicate Sample
S07-B16	S07B1601	Upper	10/11/93	Note 1	
S07-B17	S07B1701	Upper	10/11/93	Note 1	
S07-B18	S07B1801 S07B1802	Upper Lower	10/11/93	Note 1	
S07-B19	S07B1901 S07B191D*	Upper	10/11/93	Note 1	*Duplicate Sample
S07-B21	S07B2101	Upper	10/11/93	Note 1	
S07-B22	S07B2201 S07B2202	Upper Lower	10/11/93	Note 1	

Table 10.12.1
Zone G
SWMU 6,7 and AOC 635
1933 Soil Samples and Analyses
(Pre-RFI Samples)

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
S07-B23	S07B2301 S07B231D*	Upper	10/11/93	Note 1	*Duplicate Sample
S07-B24	S07B2401 S07B2402	Upper Lower	10/11/93	Note 1	
S07-B37	S07B3701 S07B3702	Upper Lower	10/13/93	Note 1	

Notes:
1 = SW-846 (metals, pesticides/PCBs, SVOCs, VOCs) at DQO Level III
• = Duplicate sample

boring. During the field investigation, six soil borings were advanced within the site area. Two borings included both upper and lower sampling intervals, while four borings included the upper interval only. Where not collected, the lower interval sample was deleted due to obstructions in the borehole. Per the approved final RFI work plan, soil samples were analyzed for metals, pesticides/PCBs, SVOCs and VOCs at DQO Level III. Additionally, two upper interval duplicate soil samples were collected for Appendix IX analyses at DQO Level IV. Table 10.12.2 summarizes the SWMUs 6, 7 and AOC 635 RFI soil samples and analyses.

Table 10.12.2
Zone G
SWMUs 6, 7 and AOC 635
Soil Samples and Analyses

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
006SB001	006SB00101 006SB00102	Upper Lower	9/19/96	Note 1	
006SB002	006SB00201 006CB00201*	Upper	9/19/96	Note 1 *Note 2*	Lower interval not sampled *due to obstruction*
006SB003	006SB00301	Upper	9/19/96	Note 1	
006SB004	006SB00401 006SB00402	Upper Lower	9/19/96	Note 1	

Table 10.12.2
Zone G
SWMUs 6, 7 and AOC 635
Soil Samples and Analyses

Boring Location	Sample Identifier	Sample Interval	Date Collected	Analyses	Remarks
007SB001	007SB00101	Upper	10/03/96	Notes ½	Lower interval not sampled due to obstruction
635SB001	635SB00501	Upper	10/03/96	Note 1	Lower interval not sampled due to obstruction

Notes:
1 = SW-846 (metals, pesticides/PCBs, SVOCs, VOCs). Level III
2 = Appendix IX suite: SW-846 (metals, pesticides/PCBs, herbicides, OP-pesticides, dioxins, SVOCs, VOCs); cyanide; hex-chrome. Level IV
* = Duplicate sample collected

10.12.3.1 Nature of Contamination in Soil

Organic and inorganic analytical results for the 1993 pre-RFI soil samples are summarized in Tables 10.12.3 and 10.12.4 respectively. Organic and inorganic analytical results for RFI soil samples are summarized in Tables 10.12.5 and 10.12.6 respectively. Table 10.12.7 summarizes all analytes detected in soil samples collected during the two investigations the combined SWMUs 6, 7 and AOC 635. Appendix D contains a complete analytical data report for all of Zone G samples.

Volatile Organic Compounds in Soil

Nine VOCs were detected in surface soil at the combined SWMUs 6, 7 and AOC 635, along with seven VOCs detected in subsurface soil. No surface or subsurface soil VOC concentrations exceed their respective RBCs or SSLs.

Table 10.12.3
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil (1993 Data)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
Volatile Organic Compounds (Upper Interval -42 Samples plus 6 Duplicate Samples/Lower Interval - 27 Samples plus 2 Duplicate Samples) (μg/kg)						
Acetone	Upper	6/42	99 - 2100	578	780000	0
	Lower	20/27	140 - 1200	451	16000	0
2-Butanone (MEK)	Upper	1/42	13	13	4700000	0
	Lower	1/27	93	93	7900	0
Carbon Disulfide	Upper	1/42	26	26	780000	0
	Lower	3/27	14 - 60	39	32000	0
Chlorobenzene	Upper	21/42	6.4 - 160	43.2	160000	0
	Lower	12/27	13 - 450	90.8	1000	0
1,1-Dichloroethane	Upper	1/42	37	37	780000	0
	Lower	0/27	ND	ND	23000	0
Tetrachloroethene	Upper	1/42	11	11	12000	0
	Lower	0/27	ND	ND	60	0
Toluene	Upper	3/42	5.2 - 10	7.5	1600000	0
	Lower	1/27	3.9	3.9	12000	0
1,1,1-Trichloroethane	Upper	2/42	8.6 - 240	124	160000	0
	Lower	1/27	3.9	3.9	2000	0
Xylene (Total)	Upper	2/42	7.6 - 57	32.3	16000000	0
	Lower	3/27	3.3 - 2.4	14.8	148000	0

Table 10.12.3
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil (1993 Data)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Semivolatile Organic Compounds (Upper Interval - 42 Samples plus 6 Duplicate Samples/Lower Interval - 27 Samples plus 2 Duplicate Samples) (µg/kg)						
BEQs[1]	Upper	39/42	7.163 - 14323	1409	88	34
	Lower	0/0	NA	NA	NA	NA
Benzo(a)anthracene	Upper	33/42	66 - 14000	1080	880	10
	Lower	10/27	84 - 2700	485	2000	1
Benzo(b)fluoranthene	Upper	39/42	71 - 13000	1545	880	12
	Lower	21/27	64 - 2800	346	5000	0
Benzo(k)fluoranthene	Upper	31/42	60 - 5200	519	8800	0
	Lower	10/27	27 - 1100	248	49000	0
Benzo(a)pyrene	Upper	38/42	48 - 10000	997	88	33
	Lower	20/27	63 - 2200	309	8000	0
Chrysene	Upper	38/42	63 - 11000	1209	88000	0
	Lower	18/27	54 - 2400	334	160000	0
Dibenz(a,h)anthracene	Upper	15/42	47 - 1300	321	88	12
	Lower	2/27	140 - 380	260	2000	0
Indeno(1,2,3-cd)pyrene	Upper	33/42	40 - 6000	745	880	8
	Lower	10/27	59 - 1300	282	14000	0
Acenaphthene	Upper	13/42	37 - 3400	547	470000	0
	Lower	1/27	610	610	570000	0
Acenaphthylene	Upper	11/42	35 - 11000	1069	230000	0
	Lower	2/27	83 - 140	112	293000	0

Table 10.12.3
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil (1993 Data)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Anthracene	Upper	25/42	33 - 14000	830	2300000	0
	Lower	8/27	29 - 1700	267	12000000	0
Benzo(g,h,i)perylene	Upper	30/42	70 - 3100	550	230000	0
	Lower	10/27	89 - 1200	338	4.66E08	0
Carbazole	Upper	19/42	52 - 4800	482	32000	0
	Lower	2/27	93 - 720	407	600	1
Dibenzofuran	Upper	11/42	33 - 7900	878	31000	0
	Lower	2/27	130 - 640	385	50000	0
1,2-Dichlorobenzene	Upper	1/42	9200	9200	700000	0
	Lower	0/27	ND	ND	17000	0
1,4'-Dichlorobenzene	Upper	2/42	280 - 10000	5140	27000	0
	Lower	0/27	ND	ND	2000	0
Di-n-butylphthalate	Upper	0/42	ND	ND	780000	0
	Lower	1/27	98	98	2300000	0
bis(2-Ethylhexyl)phthalate	Upper	8/42	51 - 1600	292	46000	0
	Lower	1/27	180	180	3600000	0
Fluoranthene	Upper	40/42	58 - 24000	2208	310000	0
	Lower	24/27	58 - 6000	465	4300000	0
Fluorene	Upper	13/42	53 - 14000	1389	310000	0
	Lower	2/27	120 - 1500	810	560000	0

Table 10.12.3
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil (1993 Data)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
2-Methylnaphthalene	Upper	10/42	35 - 15000	1654	310000	0
	Lower	2/27	260 - 350	305	126000	0
Naphthalene	Upper	13/42	33 - 16000	1429	310000	0
	Lower	3/27	44 - 430	298	84000	0
Pentachlorophenol	Upper	1/42	650	650	5300	0
	Lower	0/27	ND	ND	30	0
Phenanthrene	Upper	38/42	35 - 30000	1972	230000	0
	Lower	10/27	56 - 6600	836	1380000	0
Pyrene	Upper	40/42	55 - 30000	2517	230000	0
	Lower	23/27	111 - 5200	604	4200000	0
1,2,4-Trichlorobenzene	Upper	3/42	25 - 17000	8142	78000	0
	Lower	0/27	ND	ND	5000	0
Pesticides and PCBs (Upper Interval - 42 Samples plus 6 Duplicate Samples/Lower Interval - 27 Samples Plus 2 Duplicate Samples) (μg/kg)						
alpha-BHC	Upper	1/42	39000	39000	100	1
	Lower	0/27	ND	ND	0.5	0
beta-BHC	Upper	1/42	3800	3800	350	1
	Lower	0/27	ND	ND	3	0
delta-BHC	Upper	7/42	2.2 - 28000	4012	100	1
	Lower	2/27	3.8 - 119	61	3	2
gamma-BHC	Upper	6/42	4.6 - 76000	12688	490	1
	Lower	0/27	ND	ND	9	0

Table 10.12.3
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil (1993 Data)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
alpha-Chlordane	Upper	19/42	2.95 - 7100	413	1800	1
	Lower	3/27	5 - 73.6	30	10000	0
gamma-Chlordane	Upper	18/42	2.8 - 7400	477	1800	1
	Lower	3/27	9.6 - 99.7	40	10000	0
4,4'DDD	Upper	29/42	4.2 - 82000	3307	2700	3
	Lower	8/27	5.5 - 1325	233	16000	0
4,4'-DDE	Upper	31/42	6.3 - 1800	324	1900	0
	Lower	6/27	8.3 - 186.5	56.3	54000	0
4,4'-DDT	Upper	34/42	4.7 - 100000	3453	1900	5
	Lower	8/27	7.3 - 687	130	32000	0
Endosulfan I	Upper	1/42	2.6	47000	47000	0
	Lower	0/27	ND	ND	18000	0
Endosulfan sulfate	Upper	2/42	4 - 6	5	47000	0
	Lower	0/27	ND	ND	18000	0
Endrin adehyde	Upper	2/42	7.5 - 21	14.3	2300	0
	Lower	0/27	ND	ND	1000	0
Heptachlor	Upper	2/42	9.8 - 1100	555	140	1
	Lower	0/27	ND	ND	23000	0
Heptachlor epoxide	Upper	3/42	3.7 - 37	15.7	70	0
	Lower	0/27	ND	ND	700	0

Table 10.12.3
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil (1993 Data)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
Methoxychlor	Upper	1/42	22	22	39000	0
	Lower	0/27	ND	ND	160000	0
Aroclor-1254	Upper	1/42	26000	26000	160	1
	Lower	0/27	ND	ND	1000	0
Aroclor-1260	Upper	21/42	100 - 510000	25154	320	12
	Lower	2/27	120 - 440	280	1000	0

Notes:

1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995b)

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil to groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples

ND = Not detected

NA = Not applicable

mg/kg = Milligrams per kilogram

μg/kg = Micrograms per kilogram

Table 10.12.4
Zone G
SWMU 6, SWMU 7, AOC 635
Inorganic Analytical Results for Soil (1993)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Inorganics (Upper Interval - 42 Samples plus 6 Duplicate Samples/Lower Interval - 27 Samples plus 2 Duplicate Samples) (mg/kg)						
Aluminum (Al)	Upper	42/42	1400 - 13000	4991	7800	6
	Lower	27/27	10000 - 30000	19309	1000000	0
Antimony (Sb)	Upper	1/42	7.5	7.5	3.10	1
	Lower	0/27	ND	ND	5	0
Arsenic (As)	Upper	39/42	1.4 - 38	8.3	0.430	39
	Lower	27/27	5.1 - 43	25.0	29	7
Barium (Ba)	Upper	42/42	13 - 170	37.1	550	0
	Lower	27/27	22 - 50	32.7	1600	0
Beryllium (Be)	Upper	4/42	0.56 - 1.1	0.8	0.150	4
	Lower	27/27	0.74 - 1.7	1.2	63	0
Cadmium (Cd)	Upper	13/42	0.6 - 2.7	1.0	3.90	0
	Lower	0/27	ND	ND	8	0
Calcium (Ca)	Upper	42/42	260 - 260000	57635	NA	NA
	Lower	27/27	4500 - 31000	12803	NA	NA
Chromium (Cr)	Upper	42/42	5.5 - 68	18.9	39.0	2
	Lower	26/27	24 - 55	41.3	1000000	0
Cobalt (Co)	Upper	39/42	1.1 - 26	4.0	470	0
	Lower	27/27	1 - 11	8.0	2000	0

Table 10.12.4
Zone G
SWMU 6, SWMU 7, AOC 635
Inorganic Analytical Results for Soil (1993)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Copper (Cu)	Upper	40/42	3.4 - 540	33	27000	0
	Lower	27/27	17 - 69	34	920	0
Iron (Fe)	Upper	42/42	2500 - 30000	9636	2300	42
	Lower	27/27	17000 - 45000	33626	NL	NA
Lead (Pb)	Upper	42/42	2 - 1000	101	400	2
	Lower	27/27	44 - 123	62	NA	0
Magnesium (Mg)	Upper	41/41	200 - 15000	2006	NL	NA
	Lower	27/27	3000 - 7500	5423	NL	NA
Manganese (Mn)	Upper	42/42	17 - 580	125	180	9
	Lower	27/27	190 - 1000	547	1100	0
Mercury (Hg)	Upper	40/42	0.015 - 0.55	0.12	2.30	0
	Lower	27/27	0.14 - 4	0.5	2.1	0
Nickel (Ni)	Upper	28/42	51 - 24	9.8	160	0
	Lower	27/27	7-16	11.7	130	0
Potassium (K)	Upper	42/42	130 - 2400	390	NA	NA
	Lower	27/27	1600 - 3800	2688	NA	NA
Silver (Ag)	Upper	1/42	2.5	2.5	39	0
	Lower	0/27	ND	ND	0.95	0
Sodium (Na)	Upper	34/42	70 - 6600	434	NL	NA
	Lower	27/27	620 - 6640	3397	NL	NA

Table 10.12.4
Zone G
SWMU 6, SWMU 7, AOC 635
Inorganic Analytical Results for Soil (1993)

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Vanadium (V)	Upper	42/42	5.3 - 66	16.8	55.0	1
	Lower	27/27	41 - 91	69.3	6000	0
Zinc (Zn)	Upper	42/42	9.7 - 930	105	2300	0
	Lower	27/27	60 - 200	125	12000	0

Notes:
* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil to groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples
ND = Not detected
NL = Not listed
NA = Not applicable
mg/kg = Milligrams per kilogram

Table 10.12.5
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
Volatile Organic Compounds (Upper Interval - 6 Samples plus 2 Duplicate Samples/Lower Interval - 2 Samples (μg/kg)						
Acetone	Upper	0/6	ND	ND	780000	0
	Lower	1/2	540	540	16000	0
Carbon Disulfide	Upper	1/6	1.00	1.00	780000	0
	Lower	2/2	2.00 - 12.0	7.00	32000	0
Chlorobenzene	Upper	1/6	64.5	64.5	160000	0
	Lower	0/2	ND	ND	1000	0
Semivolatile Organic Compounds (Upper Interval - 6 Samples plus 2 Duplicate Samples/Lower Interval - 2 Samples) (μg/kg)						
BEQs[1]	Upper	5/6	285 - 3690	1380	88	5
	Lower	0/0	NA	NA	NA	NA
Benzo(a)anthracene	Upper	5/6	140 - 2650	1080	880	3
	Lower	2/2	140 - 190	165	2000	0
Benzo(b)fluoranthene	Upper	4/6	180 - 3450	1070	880	1
	Lower	1/2	190	190	5000	0
Benzo(k)fluoranthene	Upper	5/6	170 - 2700	1020	8800	0
	Lower	2/2	160 - 240	200	49000	0
Benzo(a)pyrene	Upper	5/6	180 - 2250	879	88	5
	Lower	1/2	210	210	8000	0
Chrysene	Upper	5/6	150 - 3000	1230	88000	0
	Lower	2/2	160 - 180	170	160000	0

Table 10.12.5
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
Dibenz(a,h)anthracene	Upper	5/6	56.0 - 655	248	88	3
	Lower	0/2	ND	ND	2000	0
Indeno(1,2,3-cd)pyrene	Upper	5/6	120 - 1450	525	880	1
	Lower	2/2	75.0 - 95.0	85.0	14000	0
Acenaphthene	Upper	2/6	580 - 1850	1220	470000	0
	Lower	0/2	ND	ND	570000	0
Acenaphthylene	Upper	3/6	57.0 - 97.0	80.3	310000	0
	Lower	0/2	ND	ND	293000	0
Anthracene	Upper	3/6	530 - 1950	1120	2300000	0
	Lower	0/2	ND	ND	12000000	0
Benzo(g,h,i)perylene	Upper	5/6	140 - 1650	594	310000	0
	Lower	2/2	110 - 120	115	4.66E08	0
Dibenzofuran	Upper	3/6	140 - 1150	505	31000	0
	Lower	0/2	ND	ND	50000	0
1,4-Dichlorobenzene	Upper	2/6	52.0 - 160	106	27000	0
	Lower	0/2	ND	ND	2000	0
3,3'-Dichlorobenzidine	Upper	1/6	82.0	82.0	1400	0
	Lower	0/2	ND	ND	7	0
Di-n-butylphthalate	Upper	1/6	48.5	48.5	780000	0
	Lower	0/2	ND	ND	2300000	0

Table 10.12.5
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
Fluoranthene	Upper	6/6	150 - 5800	2000	310000	0
	Lower	2/2	160 - 300	230	4300000	0
Fluorene	Upper	3/6	250 - 2650	1120	310000	0
	Lower	0/2	ND	ND	560000	0
2-Methylnaphthalene	Upper	3/6	76.0 - 2650	967	310000	0
	Lower	0/2	ND	ND	126000	0
Naphthalene	Upper	2/6	310 - 3050	1680	310000	0
	Lower	0/2	ND	ND	84000	0
Pentachlorophenol	Upper	2/6	160 - 2900	1530	5300	0
	Lower	0/2	ND	ND	30	0
Phenanthrene	Upper	4/6	260 - 7600	3330	230000	0
	Lower	0/2	ND	ND	1380000	0
Pyrene	Upper	6/6	110 - 6150	2110	230000	0
	Lower	2/2	280 - 370	325	4200000	0
2,3,4,6-Tetrachlorophenol	Upper	1/2	120	120	230000	0
	Lower	0/2	ND	ND	9000	0
Pesticides and PCBs (Upper Interval - 6 Samples plus 2 Duplicate Samples/Lower Interval - 2 Samples) (μg/kg)						
alpha-BHJC	Upper	2/6	14.0 - 16.0	15.0	100	0
	Lower	0/2	ND	ND	0.5	0
beta-BHC	Upper	2/6	18.0 - 24.0	21.0	350	0
	Lower	0/2	ND	ND	3	0

Table 10.12.5
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)	Reference Conc.* (µg/kg)	Number of Samples Exceeding Reference
delta-BHC	Upper	2/6	120 - 200	160	100	2
	Lower	0/2	ND	ND	3	0
gamma-BHC (Lindane)	Upper	2/6	87.5 - 110	98.8	490	0
	Lower	0/2	ND	ND	9	0
alpha-Chlordane	Upper	3/6	4.10 - 425	193	1800	0
	Lower	1/2	10.0	10.0	10000	0
gamma-Chlordane	Upper	3/6	2.60 - 350	171	1800	0
	Lower	1/2	9.60	9.60	10000	0
4,4'DDD	Upper	2/6	930 - 20000	10500	2700	1
	Lower	1/2	32.0	32.0	16000	0
4,4'-DDE	Upper	4/6	24.0 - 4900	1660	1900	1
	Lower	1/2	84.0	84.0	54000	0
4,4'-DDT	Upper	4/6	23.0 - 5450	1930	1900	2
	Lower	1/2	120	120	32000	0
Endrin	Upper	1/6	160	160	2300	0
	Lower	0/2	ND	ND	1000	0
Heptachlor	Upper	1/6	18.0	18.0	140	0
	Lower	0/2	ND	ND	23000	0
Heptachlor epoxide	Upper	1/6	4.30	4.30	70	0
	Lower	0/2	ND	ND	700	0

Table 10.12.5
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Compound Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)	Reference Conc.* (μg/kg)	Number of Samples Exceeding Reference
Aroclor-1260	Upper	3/6	240 - 8600	4810	83	3
	Lower	1/2	930	930	1000	0
Dioxins (Upper Interval - 1 Sample)						
Dioxin(2,3,7,8-TCDD TEQ)[1]	Upper	2/2	0.138 - 1020	511	1000	1
	Lower	0/0	NA	NA	NA	NA

Notes:
1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995b).
* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil to groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples.
ND = Not detected.
NA = Not applicable.
mg/kg = Milligrams per kilogram
μg/kg = Micrograms per kilogram

Table 10.12.6
Zone G
SWMU 6, SWMU 7, AOC 635
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Inorganics (Upper Interval - 6 Samples plus 2 Duplicate Samples/Lower Interval - 2 Samples) (mg/kg)						
Aluminum (Al)	Upper	6/6	4720 - 13300	8500	7800	3
	Lower	2/2	22900 - 32300	27600	1000000	0
Arsenic (As)	Upper	6/6	4.10 - 17.3	10.4	0.430	6
	Lower	2/2	21.4 - 25.0	23.2	29	0
Barium (Ba)	Upper	6/6	26.7 - 63.7	36.9	550	0
	Lower	2/2	36.8 - 56.6	46.7	1600	0
Beryllium (Be)	Upper	6/6	0.24 - 0.80	0.43	0.150	6
	Lower	2/2	1.30 - 1.60	1.45	63	0
Cadmium (Cd)	Upper	4/6	0.06 - 0.82	0.37	3.90	0
	Lower	0/2	ND	ND	8	0
Calcium (Ca)	Upper	6/6	1950 - 21100	8030	NA	NA
	Lower	2/2	15300 - 15600	15500	NA	NA
Chromium (Cr)	Upper	6/6	10.0 - 25.0	18.2	39.0	0
	Lower	2/2	38.9 - 49.7	44.3	1000000	0
Cobalt (Co)	Upper	6/6	1.10 - 8.70	3.53	470	0
	Lower	2/2	7.00 - 8.80	7.90	2000	0
Copper (Cu)	Upper	5/6	11.4 - 61.8	31.7	27000	0
	Lower	2/2	28.4 - 126	77.2	920	0

Table 10.12.6
Zone G
SWMU 6, SWMU 7, AOC 635
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Iron (Fe)	Upper	6/6	6100 - 28000	15000	2300	6
	Lower	2/2	32000 - 39200	35600	NA	NA
Lead (Pb)	Upper	6/6	12.4 - 138	63.2	400	0
	Lower	2/2	52.1 - 131	91.6	NA	NA
Magnesium (Mg)	Upper	6/6	465 - 3310	1150	NA	NA
	Lower	2/2	6120 - 6620	6370	NA	NA
Manganese (Mn)	Upper	6/6	22.4 - 568	142	180	1
	Lower	2/2	411 - 528	470	1100	0
Mercury (Hg)	Upper	6/6	0.04 - 0.20	0.10	2.30	0
	Lower	2/2	0.32 - 0.78	0.55	2.1	0
Nickel (Ni)	Upper	5/6	3.40 - 9.65	6.41	160	0
	Lower	2/2	12.4 - 26.0	19.2	130	0
Potassium (K)	Upper	6/6	254 - 1270	596	NA	NA
	Lower	2/2	2790 - 3690	3240	NA	NA
Selenium (Se)	Upper	6/6	0.49 - 1.60	1.00	39.0	0
	Lower	2/2	2.40	2.40	34	0
Sodium (Na)	Upper	2/6	622 - 1260	941	NA	NA
	Lower	2/2	2530 - 3560	3050	NA	NA
Thallium (Tl)	Upper	2/6	0.54 - 0.89	0.72	0.630	1
	Lower	0/2	ND	ND	0.95	0

Table 10.12.6
Zone G
SWMU 6, SWMU 7, AOC 635
Inorganic Analytical Results for Soil

Parameters	Sample Interval	Frequency of Detection	Range of Detections (mg/kg)	Mean of Detections (mg/kg)	Reference Conc.* (mg/kg)	Number of Samples Exceeding Reference
Tin (Sn)	Upper	4/6	6.50 - 8.30	7.48	4700	0
	Lower	2/2	12.1 - 14.4	13.3	11000	0
Vanadium (V)	Upper	6/6	11.3 - 43.7	24.9	55.0	0
	Lower	2/2	68.5 - 85.2	76.9	6000	0
Zinc (Zn)	Upper	6/6	15.9 - 152	82.0	2300	0
	Lower	2/2	112 - 232	172	12000	0

Notes:

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil to groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples

ND = Not detected

NL = Not listed

NA = Not applicable

mg/kg = Milligrams per kilogram

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Volatile Organic Compounds (μg/kg)							
Acetone	S06B04	ND	780000	NA	250	16000	NA
	S06B07	ND			630		
	S06B09	NT			310		
	S06B12	NT			400		
	S06B14	150			ND		
	S06B15	ND			140		
	S06B17	NT			1200		
	S06B20	120			ND		
	S06B21	NT			270		
	S06B25	110			420		
	S06B26	99			310		
	S06B27	NT			540		
	S06B29	NT			220		
	S06B31	NT			680		
	S06B32	NT			490		
	006SB002	ND			540		
	S07B09	2100			NT		
	S07B13	ND			200		
	S07B18	ND			310		
	S07B22	ND			780		
	S07B30	890			250		
	S07B34	ND			460		
	S07B36	ND			300		
	S07B37	ND			850		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Carbon disulfide	S06B14	ND	780000	NA	42	32000	NA
	S06B15	26			ND		
	S06B17	NT			60		
	S06B27	NT			14		
	006SB001	ND			12		
	006SB002	1			NT		
	006SB004	ND			2		
2-Butanone (MEK)	S06B25	13	4700000	NA	NT	7900	NA
	S06B27	NT			93		
Chlorobenzene	S06B01	23	160000	NA	NT	1000	NA
	S06B02	9			ND		
	S06B03	11			NT		
	S06B04	ND			13		
	S06B12	NT			34		
	S06B21	NT			54		
	S06B26	ND			70		
	S06B27	NT			40		
	S07B04	8.3			ND		
	S07B11	ND			86		
	S07B16	13			NT		
	S07B17	14			ND		
	S07B18	17			18		
	S07B19	18			NT		
	S07B21	10			NT		
	S07B22	87			ND		
	S07B23	79			NT		
	S07B24	50			13		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Chlorobenzene (cont.)	S07B27	160	160000	NA	NT	1000	NA
	S07B28	24			NT		
	S07B29	15			NT		
	S07B30	ND			150		
	S07B31	6.4			NT		
	S07B32	48			NT		
	S07B33	55			NT		
	S07B34	110			450		
	S07B36	75			320		
	S07B37	74			170		
1,1-Dichloroethane	S07B34	37	780000	NA	ND	23000	NA
Tetrachloroethene	S07B18	11	58000	NA	ND	60	NA
Toluene	S06B01	7.2	1600000	NA	NT	12000	NA
	S06B25	5.2			NT		
	S06B27	NT			3.9		
	S07B30	10			NT		
Xylene (Total)	S06B12	NT	16000000	NA	17	148000	NA
	S06B25	7.6			NT		
	S06B27	NT			3.3		
	S07B30	57			ND		
	S07B34	ND			24		
1,1,1-Trichloroethane	S06B25	8.6	160000	NA	NT	2000	NA
	S06B27	NT			3.9		
	S07B34	240			ND		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Semivolatile Organic Compounds (µg/kg)							
BEQs[1]	S06B01	**691.93**	88.0	NA	NA	NA	NA
	S06B02	**1807.3**			NA		
	S06B03	**145.81**			NA		
	S06B04	**454.55**			NA		
	S06B05	**175.72**			NA		
	S06B06	**213.89**			NA		
	S06B07	**350.16**			NA		
	S06B12	ND			NA		
	S06B14	**248.27**			NA		
	S06B15	**1873.6**			NA		
	S06B17	ND			NA		
	S06B20	**339.67**			NA		
	S06B21	ND			NA		
	S06B25	78.05			NA		
	S06B26	ND			NA		
	S06B27	ND			NA		
	S06B29	ND			NA		
	S06B31	ND			NA		
	S06B33	ND			NA		
	006SB001	**1766.3**			NA		
	006SB002	**3710**			NA		
	006SB003	**335.85**			NA		
	006SB004	**285.25**			NA		
	S07B03	60.6725			NA		
	S07B04	**232.25**			NA		
	S07B05	57.065			NA		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
BEQs[1] (continued)	S07B06	**1297.2**	88.0	NA	NA	NA	NA
	S07B07	**221.18**			NA		
	S07B08	**641.41**			NA		
	S07B09	**373.34**			NA		
	S07B10	**281.35**			NA		
	S07B11	**201.03**			NA		
	S07B12	80.09			NA		
	S07B13	**371.96**			NA		
	S07B16	**3083**			NA		
	S07B17	7.163			NA		
	S07B18	**429.27**			NA		
	S07B19	**2956.25**			NA		
	S07B21	**1620**			NA		
	S07B22	**290.81**			NA		
	S07B23	**1426.85**			NA		
	S07B24	**578.38**			NA		
	S07B27	**8309.6**			NA		
	S07B28	**3377.4**			NA		
	S07B29	**899.18**			NA		
	S07B30	**14323**			NA		
	S07B31	**289.5**			NA		
	S07B34	**410.575**			NA		
	S07B35	**199.13**			NA		
	S07B36	**288.86**			NA		
	S07B37	**6098.2**			NA		
	007SB001	**845.95**			NA		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
1,4-Dichlorobenzene	006SB002	52	27000	NA	NT	2000	NA
	S07B21	280			NT		
	S07B27	10000			NT		
	007SB001	160			NT		
1,2-Dichlorobenzene	S07B27	9200	700000	NA	NT	17000	NA
1,2,4-Trichlorobenzene	S07B16	25	78000	NA	NT	5000	NA
	S07B21	17000			NT		
	S07B27	7400			NT		
Naphthalene	S06B01	36	310000	NA	NT	84000	NA
	S06B02	66			ND		
	S06B15	470			420		
	S06B20	150			ND		
	S06B31	NT			430		
	006SB002	310			NT		
	S07B06	100			NT		
	S07B07	33			NT		
	S07B08	41			NT		
	S07B16	340			NT		
	S07B18	ND			44		
	S07B19	795			NT		
	S07B23	245			NT		
	S07B28	65			NT		
	S07B30	16000			ND		
	S07B31	240			NT		
	007SB001	3050			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
2-Methylnaphthalene	S06B02	35	310000	NA	NT	126000	NA
	S06B15	280			350		
	S06B31	NT			260		
	006SB001	76			ND		
	006SB002	175			NT		
	S07B07	40			NT		
	S07B10	38			NT		
	S07B19	470			NT		
	S07B23	260			NT		
	S07B28	57.5			NT		
	S07B30	15000			ND		
	S07B31	300			NT		
	007SB001	2650			NT		
Acenaphthylene	S06B01	35	230000	NA	NT	293000	NA
	S06B15	54			83		
	S06B31	NT			140		
	006SB001	57			ND		
	006SB002	97			NT		
	006SB003	87			NT		
	S07B06	91			NT		
	S07B08	52			NT		
	S07B09	78			NT		
	S07B16	45			NT		
	S07B18	39			ND		
	S07B19	94			NT		
	S07B23	72.5			NT		
	S07B28	193.5			NT		
	S07B30	11000			ND		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Acenaphthene	S06B01	42	470000	NA	NT	570000	NA
	S06B02	170			ND		
	S06B04	37			ND		
	S06B15	590			610		
	S06B20	160			ND		
	006SB002	580			NT		
	S07B16	590			NT		
	S07B19	1140			NT		
	S07B23	510			NT		
	S07B29	74			NT		
	S07B30	3400			ND		
	S07B31	260			NT		
	S07B34	66			ND		
	S07B37	69			ND		
	007SB001	1850			NT		
Dibenzofuran	S06B01	35	31000	NA	NT	50000	NA
	S06B02	99			ND		
	S06B04	33			ND		
	S06B15	400			640		
	S06B20	75			ND		
	S06B31	NT			130		
	006SB001	140			ND		
	006SB002	205			NT		
	S07B16	240			NT		
	S07B19	475			NT		
	S07B23	215			NT		
	S07B28	39.5			NT		
	S07B30	7900			ND		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Dibenzofuran (continued)	S07B31	150	31000	NA	NT	50000	NA
	007SB001	1150			NT		
Fluorene	S06B01	54	310000	NA	NT	560000	NA
	S06B02	200			ND		
	S06B14	53			ND		
	S06B15	1100			1500		
	S06B20	140			ND		
	S06B31	NT			120		
	006SB001	250			ND		
	006SB002	460			NT		
	S07B16	580			NT		
	S07B19	925			NT		
	S07B23	625			NT		
	S07B28	58			NT		
	S07B29	64			NT		
	S07B30	14000			ND		
	S07B31	170			NT		
	S07B34	88			ND		
	007SB001	2650			NT		
Pentachlorophenol	006SB001	160	5300	NA	ND	30	NA
	006SB002	2900			NT		
	S07B29	650			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Phenanthrene	S06B01	550	230000	NA	NT	1380000	NA
	S06B02	2200			77		
	S06B03	47			NT		
	S06B04	470			79		
	S06B05	180			NT		
	S06B06	225			NT		
	S06B07	78			ND		
	S06B14	390			220		
	S06B15	5000			6600		
	S06B20	810			ND		
	S06B26	44			ND		
	S06B27	NT			495		
	S06B31	NT			310		
	S06B33	NT			320		
	006SB001	2200			ND		
	006SB002	3250			NT		
	S07B03	53			56		
	S07B04	170			ND		
	S07B05	35			NT		
	S07B06	240			NT		
	S07B07	100			NT		
	S07B08	200			NT		
	S07B09	36			NT		
	S07B10	200			NT		
	S07B11	92			ND		
	S07B12	38			NT		
	S07B13	370			ND		
	S07B16	3000			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Phenanthrene (continued)	S07B18	320	230000	NA	110	1380000	NA
	S07B19	4400			NT		
	S07B21	900			NT		
	S07B22	190			ND		
	S07B23	2550			NT		
	S07B24	250			ND		
	S07B27	18000			NT		
	S07B28	810			NT		
	S07B29	560			NT		
	S07B30	30000			89		
	S07B31	400			NT		
	S07B34	490			ND		
	S07B35	64			NT		
	S07B36	66			NT		
	S07B37	1400			ND		
	007SB001	7600			NT		
	635SB001	260			NT		
Anthracene	S06B01	150	2300000	NA	NT	12000000	NA
	S06B02	350			ND		
	S06B04	100			29		
	S06B06	ND			40		
	S06B07	ND			41		
	S06B14	96			ND		
	S06B15	1100			1700		
	S06B20	200			ND		
	S06B27	NT			155		
	S06B31	NT			45		
	S06B33	NT			68		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Anthracene (continued)	006SB001	530	2300000	NA	ND	12000000	NA
	006SB002	875			NT		
	S07B04	33			ND		
	S07B06	59			NT		
	S07B08	43			NT		
	S07B10	44			NT		
	S07B13	98			ND		
	S07B16	760			NT		
	S07B18	97			61		
	S07B19	1580			NT		
	S07B21	190			NT		
	S07B22	40			ND		
	S07B23	715			NT		
	S07B24	72			ND		
	S07B28	166			NT		
	S07B29	140			NT		
	S07B30	14000			ND		
	S07B31	78			NT		
	S07B34	112			ND		
	S07B37	490			ND		
	007SB001	1950			NT		
Di-n-butylphthalate	006SB002	49	780000	NA	NT	2300000	NA
	S07B11	ND			98		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Fluoranthene	S06B01	550	310000	NA	NT	4300000	NA
	S06B02	2600			220		
	S06B03	170			NT		
	S06B04	670			280		
	S06B05	250			NT		
	S06B06	355			NT		
	S06B07	230			140		
	S06B12	ND			58		
	S06B14	390			470		
	S06B15	5300			6000		
	S06B17	NT			240		
	S06B20	890			140		
	S06B21	NT			120		
	S06B25	185			180		
	S06B26	54			91		
	S06B27	NT			1090		
	S06B29	NT			110		
	S06B31	NT			320		
	S06B32	NT			130		
	006SB001	3100			300		
	006SB002	5800			NT		
	006SB003	150			NT		
	006SB004	300			160		
	S07B03	100			240		
	S07B04	380			ND		
	S07B05	94			NT		
	S07B06	1400			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Fluoranthene (continued)	S07B07	240	310000	NA	NT	4300000	NA
	S07B08	600			NT		
	S07B09	180			NT		
	S07B10	380			NT		
	S07B11	270			ND		
	S07B12	110			NT		
	S07B13	570			110		
	S07B16	3800			NT		
	S07B17	110			NT		
	S07B18	1500			330		
	S07B19	5400			NT		
	S07B21	3300			NT		
	S07B22	650			85		
	S07B23	2400			NT		
	S07B24	540			150		
	S07B27	24000			NT		
	S07B28	2350			NT		
	S07B29	1000			NT		
	S07B30	21000			160		
	S07B31	440			NT		
	S07B34	670			170		
	S07B35	250			NT		
	S07B36	230			250		
	S07B37	4600			73		
	007SB001	2500			NT		
	635SB001	160			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Pyrene	S06B01	1100	230000	NA	NT	4200000	NA
	S06B02	2900			550		
	S06B03	230			NT		
	S06B04	930			440		
	S06B05	270			NT		
	S06B06	365			NT		
	S06B07	310			520		
	S06B09	NT			130		
	S06B12	NT			140		
	S06B1401	920			530		
	S06B15	4700			5200		
	S06B17	NT			1400		
	S06B20	640			160		
	S06B21	NT			260		
	S06B25	120			300		
	S06B26	55			120		
	S06B27	NT			1320		
	006SB001	2200			370		
	006SB002	6150			NT		
	006SB003	160			NT		
	006SB004	260			280		
	S07B03	113			340		
	S07B04	440			ND		
	S07B05	110			NT		
	S07B06	1800			NT		
	S07B07	240			NT		
	S07B08	620			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Pyrene (continued)	S07B11	250	230000	NA	110	4200000	NA
	S07B12	110			NT		
	S07B13	600			170		
	S07B16	3700			NT		
	S07B17	85			NT		
	S07B18	1200			310		
	S07B19	4700			NT		
	S07B21	3900			NT		
	S07B22	590			160		
	S07B23	3750			NT		
	S07B24	630			200		
	S07B27	23000			NT		
	S07B28	2600			NT		
	S07B29	1400			NT		
	S07B30	30000			400		
	S07B31	750			NT		
	S07B34	785			320		
	S07B35	390			NT		
	S07B36	310			660		
	S07B37	5400			150		
	007SB001	3800			NT		
	635SB001	110			NT		
3,3'-Dichlorobenzidene	006SB002	82	1400	NA	NA	7	NA

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(a)anthraeene	S06B01	400	880	NA	NT	2000	NA
	S06B02	**1100**			140		
	S06B04	290			150		
	S06B05	120			NT		
	S06B06	160			NT		
	S06B07	120			ND		
	S06B14	180			350		
	S06B15	**1800**			**2700**		
	S06B17	NT			210		
	S06B20	260			ND		
	S06B21	NT			120		
	S06B25	66			ND		
	S06B27	NT			730		
	006SB001	**1300**			190		
	006SB002	**2750**			NT		
	006SB003	140			NT		
	006SB004	140			140		
	S07B03	ND			140		
	S07B04	170			NT		
	S07B06	**960**			NT		
	S07B07	150			NT		
	S07B08	350			NT		
	S07B09	180			NT		
	S07B10	210			NT		
	S07B11	130			ND		
	S07B13	310			ND		
	S07B16	**2200**			NT		
	S07B18	280			230		
	S07B19	**2500**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(a)anthracene (continued)	S07B21	**960**	880	NA	NT	2000	NA
	S07B22	180			84		
	S07B23	**1260**			NT		
	S07B24	330			ND		
	S07B28	**1250**			NT		
	S07B29	480			NT		
	S07B30	**14000**			ND		
	S07B31	180			NT		
	S07B34	200			ND		
	S07B35	160			NT		
	S07B36	210			ND		
	S07B37	**4500**			ND		
	007SB001	**1190**			NT		
Carbazole	S06B01	110	32000	NA	NT	600	NA
	S06B02	550			ND		
	S06B04	85			ND		
	S06B05	52			NT		
	S06B06	63.5			NT		
	S06B14	61			ND		
	S06B15	430			**720**		
	S06B20	170			ND		
	S06B27	NT			93		
	S07B16	760			NT		
	S07B18	160			ND		
	S07B19	880			NT		
	S07B23	370			NT		
	S07B24	230			ND		
	S07B28	121			NT		
	S07B29	80			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Carbazole	S07B30	4800	32000	NA	ND	600	NA
	S07B31	64			NT		
	S07B34	93			ND		
	S07B37	83			ND		
Chrysene	S06B01	430	88000	NA	NT	160000	NA
	S06B02	1200			250		
	S06B03	140			NT		
	S06B04	450			180		
	S06B05	120			NT		
	S06B06	175			NT		
	S06B07	260			ND		
	S06B14	250			330		
	S06B15	1700			2400		
	S06B17	NT			510		
	S06B20	270			74		
	S06B21	NT			94		
	S06B27	NT			820		
	S06B29	NT			68		
	S06B31	NT			91		
	S06B33	NT			280		
	006SB001	1300			180		
	006SB002	3000			NT		
	006SB003	150			NT		
	006SB004	250			160		
	S07B03	72.5			140		
	S07B04	250			ND		
	S07B05	65			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Chrysene (continued)	S07B06	1200	88000	NA	NT	160000	NA
	S07B07	220			NT		
	S07B08	510			NT		
	S07B09	240			NT		
	S07B11	190			54		
	S07B12	90			NT		
	S07B13	360			72.5		
	S07B16	2000			NT		
	S07B17	63			NT		
	S07B18	670			310		
	S07B19	2500			NT		
	S07B21	1600			NT		
	S07B22	310			ND		
	S07B23	1250			NT		
	S07B24	380			ND		
	S07B27	9600			NT		
	S07B28	2400			NT		
	S07B29	580			NT		
	S07B30	11000			ND		
	S07B31	200			NT		
	S07B34	325			130		
	S07B35	130			NT		
	S07B36	260			150		
	S07B37	4200			66		
	007SB001	1500			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
bis(2-Ethylhexyl)phthalate (BEHP)	S06B04	85	46000	NA	ND	3600000	NA
	S06B07	51			NT		
	S06B27	NT			180		
	S07B03	54.5			ND		
	S07B11	78			ND		
	S07B16	1600			NT		
	S07B23	310			NT		
	S07B34	110			ND		
	S07B36	51			ND		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(b)fluoranthene	S06B01	660	880	NA	NT	5000	NA
	S06B02	**1700**			240		
	S06B03	230			NT		
	S06B04	600			250		
	S06B05	200			NT		
	S06B06	245			NT		
	S06B07	440			ND		
	S06B12	NT			64		
	S06B14	290			450		
	S06B15	**1700**			2800		
	S06B17	NT			330		
	S06B20	360			ND		
	S06B21	NT			140		
	S06B25	94.5			210		
	S06B26	NT			110		
	S06B27	NT			1005		
	S06B33	NT			390		
	006SB001	ND			190		
	006SB002	**3450**			NT		
	006SB003	180			NT		
	006SB004	230			ND		
	S07B03	96			200		
	S07B04	320			ND		
	S07B05	90			NT		
	S07B06	**1800**			NT		
	S07B07	320			NT		
	S07B08	660			NT		
	S07B09	290			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Resideutial RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(b)fluoranthene (continued)	S07B10	330	880	NA	NT	5000	NA
	S07B11	260			86		
	S07B12	120			NT		
	S07B13	410			99.5		
	S07B16	**3400**			NT		
	S07B17	71			NT		
	S07B18	830			320		
	S07B19	**3050**			NT		
	S07B21	**2000**			NT		
	S07B22	480			120		
	S07B23	**1450**			NT		
	S07B24	600			100		
	S07B27	**13000**			NT		
	S07B28	**4250**			NT		
	S07B29	**950**			NT		
	S07B30	**12000**			160		
	S07B31	360			NT		
	S07B34	455			190		
	S07B35	230			NT		
	S07B36	400			360		
	S07B37	**5500**			86		
	007SB001	455			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(k)fluoranthene	S06B01	250	8800	NA	NT	49000	NA
	S06B02	610			ND		
	S06B03	67			NT		
	S06B04	210			ND		
	S06B05	60			NT		
	S06B06	86.5			NT		
	S06B07	190			220		
	S06B14	102			120		
	S06B15	590			1100		
	S06B20	140			ND		
	S06B27	NT			420		
	S06B33	NT			150		
	006SB001	1600			160		
	006SB002	2700			NT		
	006SB003	170			NT		
	006SB004	200			240		
	S07B03	ND			83		
	S07B04	100			ND		
	S07B06	600			NT		
	S07B07	96			NT		
	S07B08	190			NT		
	S07B09	110			NT		
	S07B10	110			NT		
	S07B11	84			ND		
	S07B13	160			ND		
	S07B16	1100			NT		
	S07B18	260			120		
	S07B19	975			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(k)fluoranthene (continued)	S07B23	360	8800	NA	NT	49000	NA
	S07B28	1500			NT		
	S07B29	360			NT		
	S07B30	5200			ND		
	S07B31	130			NT		
	S07B34	175			88		
	S07B36	160			150		
	S07B37	1400			27		
	007SB001	445			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(a)pyrene	S06B01	**540**	88	NA	NT	8000	NA
	S06B02	**1200**			280		
	S06B03	**110**			ND		
	S06B04	**330**			200		
	S06B05	**130**			ND		
	S06B06	**160**			NT		
	S06B07	**270**			200		
	S06B14	**200**			300		
	S06B15	**1200**			2200		
	S06B17	NT			330		
	S06B20	**260**			ND		
	S06B21	NT			150		
	S06B25	58			140		
	S06B27	NT			755		
	S06B29	NT			87		
	S06B33	NT			260		
	006SB001	**1200**			210		
	006SB002	**2250**			NT		
	006SB003	**220**			NT		
	006SB004	**180**			ND		
	S07B03	51			160		
	S07B04	**170**			ND		
	S07B05	48			NT		
	S07B06	**950**			NT		
	S07B07	**160**			NT		
	S07B08	**430**			NT		
	S07B09	**260**			NT		
	S07B10	**210**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(a)pyrene (continued)	S07B13	**280**	88	NA	73.5	8000	NA
	S07B16	**2100**			NT		
	S07B18	**240**			220		
	S07B19	**2000**			ND		
	S07B21	**970**			NT		
	S07B22	**210**			100		
	S07B23	**780**			NT		
	S07B24	**200**			81		
	S07B27	**6400**			NT		
	S07B28	**2050**			NT		
	S07B29	**590**			NT		
	S07B30	**10000**			110		
	S07B31	**220**			NT		
	S07B34	**315**			170		
	S07B35	**160**			NT		
	S07B36	**210**			300		
	S07B37	**4200**			63		
	007SB001	**545**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Indeno(1,2,3-cd)pyrene	S06B01	430	880	NA	NT	14000	NA
	S06B02	**1100**			ND		
	S06B03	120			NT		
	S06B04	330			130		
	S06B05	130			NT		
	S06B06	130			NT		
	S06B07	220			150		
	S06B15	760			1300		
	S06B17	NT			230		
	S06B20	160			ND		
	S06B25	40			ND		
	S06B27	NT			475		
	006SB001	690			95		
	006SB002	**1550**			NT		
	006SB003	120			NT		
	006SB004	120			75		
	S07B03	ND			87		
	S07B04	120			ND		
	S07B06	640			NT		
	S07B07	130			NT		
	S07B08	320			NT		
	S07B09	180			NT		
	S07B10	160			NT		
	S07B11	110			ND		
	S07B13	180			ND		
	S07B16	**1300**			NT		
	S07B18	210			120		
	S07B19	**1040**			NT		
	S07B21	**970**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Indeno(1,2,3-cd)pyrene (continued)	S07B27	**6000**	880	NA	NT	14000	NA
	S07B28	**1850**			NT		
	S07B29	500			NT		
	S07B30	**3600**			ND		
	S07B31	140			NT		
	S07B34	280			88		
	S07B36	160			180		
	S07B37	**2100**			59		
	007SB001	235			NT		
Dibenz(a,h)anthracene	S06B02	**210**	88	NA	ND	2000	NA
	S06B15	**240**			380		
	S06B27	NT			140		
	006SB001	**350**			ND		
	006SB002	**655**			NT		
	006SB003	70			NT		
	006SB004	56			ND		
	S07B06	**170**			NT		
	S07B08	76			NT		
	S07B09	47			NT		
	S07B16	**280**			NT		
	S07B18	54			ND		
	S07B19	**285**			NT		
	S07B21	**250**			NT		
	S07B23	**300**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Dibenz(a,h)anthracene (conttinued)	S07B24	**250**	88	NA	ND	2000	NA
	S07B28	**575**			NT		
	S07B29	**112**			NT		
	S07B30	**1300**			ND		
	S07B37	**670**			ND		
	007SB001	**107**			NT		
Benzo(g,h,i)perylene	S06B01	440	230000	NA	NT	4.66E08	NA
	S06B02	1100			180		
	S06B03	110			NT		
	S06B04	340			130		
	S06B05	140			NT		
	S06B06	120			NT		
	S06B07	ND			380		
	S06B15	740			1200		
	S06B17	NT			510		
	S06B20	140			ND		
	S06B27	NT			440		
	S06B33	NT			120		
	006SB001	760			120		
	006SB002	1650			NT		
	006SB003	170			NT		
	006SB004	140			110		
	S07B04	110			ND		
	S07B06	560			NT		
	S07B07	120			NT		
	S07B08	310			NT		
	S07B09	200			NT		
	S07B10	160			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Benzo(g,h,i)perylene (continued)	S07B11	110	230000	NA	ND	4.66E08	NA
	S07B13	180			NT		
	S07B16	1200			130		
	S07B18	180			ND		
	S07B19	910			NT		
	S07B21	1100			NT		
	S07B22	110			ND		
	S07B28	1850			NT		
	S07B29	520			NT		
	S07B30	3100			ND		
	S07B31	120			NT		
	S07B34	195			ND		
	S07B36	140			200		
	S07B37	1700			89		
	007SB001	250			NT		
2,3,4,6-Tetrachlorophenol	006SB002	120	230000	NA	NT	9000	NA
Pesticides/PCBs (μg/kg)							
4,4'-DDE	S06B02	42	1900.0	NA	ND	54000	NA
	S06B03	53			NT		
	S06B04	99			8.3		
	S06B05	1000			NT		
	S06B06	140			NT		
	S06B07	430			ND		
	S06B20	9.9			ND		
	S06B25	49.5			ND		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
4,4'-DDE (continued)	S06B27	NT	1900.0	NA	186.5	54000	NA
	S06B32	NT			27		
	S06B33	NT			54		
	006SB001	1600			84		
	006SB002	**4900**			NT		
	006SB003	100			NT		
	006SB004	24			ND		
	S07B03	28.5			42		
	S07B04	430			ND		
	S07B05	210			NT		
	S07B06	240			NT		
	S07B07	340			NT		
	S07B08	530			NT		
	S07B10	71			NT		
	S07B12	6.3			NT		
	S07B13	570			NT		
	S07B16	1400			NT		
	S07B17	16			NT		
	S07B18	120			ND		
	S07B19	625			NT		
	S07B22	130			ND		
	S07B23	175			NT		
	S07B24	1800			20		
	S07B28	130			NT		
	S07B29	830			NT		
	S07B31	430			NT		
	S07B32	6.8			NT		
	S07B34	28.5			NT		
	S07B36	54			NT		
	S07B37	19			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
4,4'-DDD	S06B02	110	2700	NA	18	16000	NA
	S06B03	13			NT		
	S06B04	27			ND		
	S06B05	590			NT		
	S06B06	77			140		
	S06B07	420			ND		
	S06B20	8.2			ND		
	S06B25	13.5			ND		
	S06B27	NT			1325		
	S06B29	NT			15		
	S06B32	NT			92		
	S06B33	NT			240		
	006SB001	930			32		
	006SB002	**20000**			ND		
	S07B03	5.3			30		
	S07B04	180			ND		
	S07B05	4.2			NT		
	S07B07	120			NT		
	S07B08	110			NT		
	S07B11	30			ND		
	S07B13	78			ND		
	S07B16	**5900**			NT		
	S07B18	240			ND		
	S07B19	198.5			NT		
	S07B22	61			ND		
	S07B23	77			NT		
	S07B24	100			55		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
4,4'-DDD (continued)	S07B2701	**82000**	2700	NA	NT	16000	NA
	S07B2801	53.5			NT		
	S07B2901	**4000**			NT		
	S07B3002	ND			5.5		
	S07B3101	1100			NT		
	S07B3401	180			NT		
	S07B3601	8.8			NT		
	S07B3701	120			NT		
4,4'-DDT	S06B02	72	1900	NA	ND	32000	NA
	S06B03	11			NT		
	S06B04	200			ND		
	S06B05	**4200**			NT		
	S06B06	445			NT		
	S06B07	**2000**			ND		
	S06B12	NT			7.9		
	S06B21	NT			7.7		
	S06B25	36			ND		
	S06B27	NT			687		
	S06B29	NT			7.3		
	S06B32	NT			130		
	S06B33	NT			100		
	006SB001	**2200**			120		
	006SB002	**5450**			NT		
	006SB003	60			NT		
	006SB004	23			ND		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
4,4'-DDT (continued)	S07B03	18.5	1900	NA	ND	32000	NA
	S07B04	160			ND		
	S07B05	110			NT		
	S07B06	120			NT		
	S07B07	65			NT		
	S07B08	480			NT		
	S07B10	24			NT		
	S07B11	90			ND		
	S07B12	7.8			NT		
	S07B13	460			ND		
	S07B16	360			NT		
	S07B17	10			NT		
	S07B18	79			ND		
	S07B19	233			NT		
	S07B22	100			ND		
	S07B23	260			NT		
	S07B24	**3400**			87		
	S07B27	**100000**			NT		
	S07B28	195			NT		
	S07B29	**2800**			NT		
	S07B30	45			10		
	S07B31	1100			NT		
	S07B32	26			NT		
	S07B33	4.7			NT		
	S07B34	97			ND		
	S07B36	16			NT		
	S07B37	22			ND		
alpha-BHC	006SB001	16	100	NA	ND	0.5	NA
	S07B27	**39000**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surfaee and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
beta-BHC	006SB001	24	350	NA	ND	3	NA
	006SB002	16			ND		
	S07B27	**3800**			NT		
delta-BHC	S06B25	2.4	100	NA	ND	3	NA
	S06B27	NT			**119**		
	S06B33	NT			**3.8**		
	006SB001	**120**			ND		
	006SB002	**200**			NT		
	S07B06	3.8			NT		
	S07B16	61			NT		
	S07B18	2.2			ND		
	S07B19	11			NT		
	S07B23	9.4			NT		
	S07B27	**28000**			NT		
	S07B34	2.5			ND		
gamma-BHC (Lindane)	S06B07	26	490	NA	ND	9	NA
	S06B25	46			ND		
	006SB001	110			ND		
	006SB002	88			NT		
	S07B16	28			NT		
	S07B23	11			NT		
	S07B27	**76000**			NT		
	S07B29	57			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
alpha-Chlordane	S06B04	20	1800	NA	ND	10000	NA
	S06B07	66			ND		
	S06B25	5.35			ND		
	S06B27	NT			73.6		
	S06B33	NT			5		
	006SB001	150			10		
	006SB002	425			NT		
	006SB004	4.1			ND		
	S07B04	9.8			ND		
	S07B08	13			NT		
	S07B11	150			ND		
	S07B13	14			ND		
	S07B16	120			NT		
	S07B18	9.1			ND		
	S07B19	13			NT		
	S07B23	13			NT		
	S07B24	94			ND		
	S07B27	**7100**			NT		
	S07B28	2.95			NT		
	S07B29	150			NT		
	S07B31	38			NT		
	S07B34	6.4			ND		
	S07B36	19			NT		
	S07B37	5.1			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
gamma-Chlordane	S06B03	2.8	1800	NA	NT	10000	NA
	S06B04	34			ND		
	S06B07	91			ND		
	S06B25	8.4			ND		
	S06B27	NT			99.65		
	S06B33	NT			10		
	006SB001	160			9.6		
	006SB002	360			NT		
	006SB004	2.6			ND		
	S07B03	6			ND		
	S07B05	2.9			NT		
	S07B11	220			ND		
	S07B16	95			NT		
	S07B18	40			ND		
	S07B19	27.85			NT		
	S07B23	39			NT		
	S07B24	260			ND		
	S07B27	**7400**			NT		
	S07B28	5.4			NT		
	S07B29	270			NT		
	S07B30	23			ND		
	S07B31	78			NT		
	S07B34	10.3			ND		
	S07B37	5.2			ND		
Heptachlor epoxide	006SB004	4.3	70	NA	ND	700	NA
	S07B07	37			NT		
	S07B19	6.4			NT		
	S07B36	3.7			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Heptachlor	006SB002	18	140	NA	NT	23000	NA
	S07B24	9.8			ND		
	S07B27	**1100**			NT		
Endosulfan I	S06B14	2.6	47000	NA	ND	18000	NA
Endosulfan sulfate	S06B14	6	47000	NA	ND	18000	NA
	S07B03	4			ND		
Endrin aldehyde	S07B10	21	2300	NA	NT	1000	NA
	S07B37	7.5			ND		
Endrin	006SB002	160	2300	NA	NT	1000	NA
Methoxychlor	S06B01	22	39000	NA	NT	160000	NA
Aroclor-1254	S06B05	**26000**	160	NA	NT	1000	NA

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Aroclor-1260	S06B06	**2400**	320	NA	NT	1000	NA
	S06B15	**970**			120		
	S06B20	**420**			ND		
	S06B21	NT			440		
	006SB001	**8600**			930		
	006SB003	240			NT		
	S07B03	**410**			ND		
	S07B05	**330**			NT		
	S07B07	**780**			NT		
	S07B08	**1400**			NT		
	S07B09	270			NT		
	S07B10	290			NT		
	S07B11	**1500**			ND		
	S07B12	130			NT		
	S07B16	**5800**			NT		
	S07B17	100			NT		
	S07B19	**910**			NT		
	S07B21	**510000**			NT		
	S07B23	**1565**			NT		
	S07B28	200			NT		
	S07B34	120			ND		
	S07B36	110			NT		
	S07B37	110			ND		
Dioxins (ng/kg)							
Dioxin (2,3,7,8-TCDD TEQs)[1]	006SB002	0.138	1000	NA	ND	1900	NA
	007SB001	**1021**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Inorganics (mg/kg)							
Aluminum (Al)	S06B01	7300	7800	18700	NT	1000000	23600
	S06B02	3300			22000		
	S06B03	7400			NT		
	S06B04	5200			14000		
	S06B05	4700			NT		
	S06B06	9450			NT		
	S06B07	6600			19000		
	S06B09	NT			16000		
	S06B12	NT			17000		
	S06B14	7300			21000		
	S06B15	7100			14000		
	S06B17	NT			22000		
	S06B20	5700			20000		
	S06B21	NT			23000		
	S06B25	5985			22000		
	S06B26	7100			16000		
	S06B27	NT			24050		
	S06B29	NT			17000		
	S06B31	NT			20000		
	S06B32	NT			27000		
	S06B33	NT			18000		
	006SB001	4740			32300		
	006SB002	4715			NT		
	006SB003	6370			NT		
	006SB004	13300			22900		
	S07B03	4105			12000		
	S07B04	4000			NT		
	S07B05	2300			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Aluminum (continued)	S07B06	2300	7800	18700	NT	1000000	23600
	S07B07	1800			NT		
	S07B08	4500			NT		
	S07B09	3100			NT		
	S07B10	7900			NT		
	S07B11	3400			18000		
	S07B12	2500			NT		
	S07B13	6600			19300		
	S07B16	1400			NT		
	S07B17	3600			NT		
	S07B18	2700			15000		
	S07B19	3515			NT		
	S07B21	4200			NT		
	S07B22	6700			30000		
	S07B23	3710			NT		
	S07B24	3700			20000		
	S07B27	1700			NT		
	S07B28	1745			NT		
	S07B29	3800			NT		
	S07B30	5200			18000		
	S07B31	7800			NT		
	S07B32	7900			NT		
	S07B33	7800			NT		
	S07B34	3560			20000		
	S07B35	13000			NT		
	S07B36	3200			27000		
	S07B37	5200			10000		
	007SB001	9145			NT		
	635SB001	12700			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Antimony	S06B15	7.5	3.1	2.89	ND	5	NL
Arsenic (As)	S06B01	9.3	0.43	17.2[a]	NT	29	15.5[a]
	S06B02	5.1			22		
	S06B03	8			NT		
	S06B04	8.2			28		
	S06B05	2.4			NT		
	S06B06	1.85			NT		
	S06B07	5			37		
	S06B09	NT			25		
	S06B12	NT			16		
	S06B14	3.7			26		
	S06B15	4.8			19		
	S06B17	NT			20		
	S06B20	3.7			43		
	S06B21	NT			21		
	S06B25	4.5			36		
	S06B26	1.6			20		
	S06B27	NT			28.15		
	S06B29	NT			18		
	S06B31	NT			27		
	S06B32	NT			31		
	S06B33	NT			20		
	006SB001	9.5			25		
	006SB002	11.7			NT		
	006SB003	4.1			NT		
	006SB004	17.3			21.4		
	S07B03	2.45			35		
	S07B04	9.6			NT		
	S07B05	2.7			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Arsenic (continued)	S07B06	11	0.43	17.2[a]	NT	29	15.5[a]
	S07B07	16			NT		
	S07B08	7.4			NT		
	S07B09	2.3			NT		
	S07B10	**38**			NT		
	S07B11	4.7			21		
	S07B12	6.3			NT		
	S07B13	**24**			26.5		
	S07B16	6.7			NT		
	S07B17	12			NT		
	S07B18	3.9			15		
	S07B19	14.25			NT		
	S07B21	6.7			NT		
	S07B22	17			**30**		
	S07B23	6.55			NT		
	S07B24	3.9			**33**		
	S07B27	6.4			NT		
	S07B28	15.15			NT		
	S07B29	7.3			NT		
	S07B30	NT			28		
	S07B31	1.4			NT		
	S07B34	9.5			27		
	S07B35	**24**			NT		
	S07B36	2.1			5.1		
	S07B37	5.8			17		
	007SB001	5.3			NT		
	635SB001	**17.7**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Barium (Ba)	S06B01	55	550.0	109	NT	1600	64.5
	S06B02	45			33		
	S06B03	43			NT		
	S06B04	31			47		
	S06B05	20			NT		
	S06B06	48			NT		
	S06B07	31			32		
	S06B09	NT			29		
	S06B12	NT			31		
	S06B14	29			36		
	S06B15	170			50		
	S06B17	NT			34		
	S06B20	28			39		
	S06B21	NT			33		
	S06B25	24.7			40		
	S06B26	31			34		
	S06B27	NT			39.1		
	S06B29	NT			32		
	S06B31	NT			35		
	S06B32	NT			45		
	S06B33	NT			34		
	006SB001	26.7			56.6		
	006SB002	43.4			NT		
	006SB003	31			NT		
	006SB004	32.8			36.8		
	S07B03	20.35			26		
	S07B04	39			NT		
	S07B05	15			NT		
	S07B06	65			NT		
	S07B07	53			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Barium (continued)	S07B08	64	550.0	109	NT	1600	64.5
	S07B09	13			NT		
	S07B10	29			NT		
	S07B11	14			29		
	S07B12	16			NT		
	S07B13	35			32.7		
	S07B16	13			NT		
	S07B17	110			NT		
	S07B18	21			32		
	S07B19	46.9			NT		
	S07B21	42			NT		
	S07B22	28			41		
	S07B23	22.9			NT		
	S07B24	27			31		
	S07B27	28			NT		
	S07B28	32.95			NT		
	S07B29	16			NT		
	S07B30	27			33		
	S07B31	23			NT		
	S07B32	20			NT		
	S07B33	21			NT		
	S07B34	20.85			31		
	S07B35	30			NT		
	S07B36	92			40		
	S07B37	16			22		
	007SB001	27.4			NT		
	635SB001	63.7			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Beryllium (Be)	S06B01	0.81	0.15	1.2	NT	63	1.63
	S06B02	ND			1.2		
	S06B04	ND			1.1		
	S06B06	0.705			NT		
	S06B07	ND			1.3		
	S06B09	NT			1.1		
	S06B12	NT			1.2		
	S06B14	ND			1.2		
	S06B15	ND			0.88		
	S06B17	NT			1.4		
	S06B20	ND			1.5		
	S06B21	NT			1.2		
	S06B25	ND			1.4		
	S06B26	ND			1.3		
	S06B27	NT			1.45		
	S06B29	NT			1.1		
	S06B31	NT			1.7		
	S06B32	NT			1.7		
	S06B33	NT			0.98		
	006SB001	0.24			1.6		
	006SB002	0.38			NT		
	006SB003	0.29			NT		
	006SB004	0.8			1.3		
	S07B03	ND			0.92		
	S07B11	ND			1.3		
	S07B13	ND			1.25		
	S07B18	ND			0.93		
	S07B21	0.56			NT		
	S07B22	ND			1.4		
	S07B24	ND			1.1		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Beryllium (Be)	S07B30	ND	0.15	1.2	1.2	63	1.63
	S07B34	ND			1.2		
	S07B35	1.1			NT		
	S07B36	ND			1.3		
	S07B37	ND			0.74		
	007SB001	0.36			NT		
	635SB001	0.51			NT		
Cadmium (Cd)	S06B01	0.95	3.9	1.07	ND	8	0.48
	S06B14	1.1			ND		
	S06B15	2.7			ND		
	S06B25	1.01			ND		
	006SB001	0.51			ND		
	006SB002	0.82			NT		
	006SB003	0.11			NT		
	006SB004	0.06			ND		
	S07B08	0.8			NT		
	S07B12	0.97			NT		
	S07B16	0.73			NT		
	S07B21	1.1			NT		
	S07B22	0.87			NT		
	S07B23	0.61			NT		
	S07B27	0.65			NT		
	S07B34	1.5			NT		
	S07B36	0.6			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Calcium (Ca)	S06B01	3500	NL	NL	NT	NL	NL
	S06B02	63000			12000		
	S06B03	11000			NT		
	S06B04	38000			8000		
	S06B05	200000			NT		
	S06B06	7100			NT		
	S06B07	6800			9100		
	S06B09	NT			12000		
	S06B12	NT			16000		
	S06B14	22000			13000		
	S06B15	21000			21000		
	S06B17	NT			7800		
	S06B20	21000			13000		
	S06B21	NT			31000		
	S06B25	26250			9200		
	S06B26	29000			11000		
	S06B27	NT			17200		
	S06B29	NT			12000		
	S06B31	NT			12000		
	S06B32	NT			13000		
	S06B33	NT			11000		
	006SB001	2630			15300		
	006SB002	10800			NT		
	006SB003	9670			NT		
	006SB004	21100			15600		
	S07B03	107500			4900		
	S07B04	22000			NT		
	S07B05	81000			NT		
	S07B06	68000			NT		
	S07B07	4300			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Calcium (continued)	S07B08	100000	NL	NL	NT	NL	NL
	S07B09	150000			NT		
	S07B10	7600			NT		
	S07B11	70000			12000		
	S07B12	240000			NT		
	S07B13	11000			12000		
	S07B16	260000			NT		
	S07B17	5500			NT		
	S07B18	4700			25000		
	S07B19	13950			NT		
	S07B21	140000			NT		
	S07B22	51000			13000		
	S07B23	187500			NT		
	S07B24	29000			11000		
	S07B27	140000			NT		
	S07B28	6550			NT		
	S07B29	2000			NT		
	S07B30	1400			12000		
	S07B31	1100			NT		
	S07B32	480			NT		
	S07B33	260			NT		
	S07B34	215500			11000		
	S07B35	11000			NT		
	S07B36	7000			12000		
	S07B37	31000			4500		
	007SB001	1945			NT		
	635SB001	2060			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Chromium (Cr)	S06B01	17	39 VI	42.8	NT	1000000	43.2[a]
	S06B02	11	7800 III		41		
	S06B03	17			NT		
	S06B04	20			35		
	S06B05	10			NT		
	S06B06	7.3			NT		
	S06B07	16			43		
	S06B09	NT			37		
	S06B12	NT			39		
	S06B14	23			44		
	S06B15	25			37		
	S06B17	NT			45		
	S06B20	38			43		
	S06B21	NT			42		
	S06B25	64			45		
	S06B26	30			37		
	S06B27	NT			46.65		
	S06B29	NT			39		
	S06B31	NT			46		
	S06B32	NT			55		
	S06B33	NT			36		
	006SB001	19.6			49.7		
	006SB002	12.1			NT		
	006SB003	10			NT		
	006SB004	24.6			38.9		
	S07B03	8.1			31		
	S07B04	15			NT		
	S07B05	7.7			NT		
	S07B06	17			NT		
	S07B07	18			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Chromium (continued)	S07B08	22	39 VI	42.8	NT	1000000	43.2[a]
	S07B09	5.5	7800 III		NT		
	S07B10	21			NT		
	S07B11	9			43		
	S07B12	9.1			NT		
	S07B13	19			42.35		
	S07B16	9.9			NT		
	S07B17	17			43		
	S07B18	19			36		
	S07B19	18.3			NT		
	S07B21	17			NT		
	S07B22	23			54		
	S07B23	15.9			NT		
	S07B24	17			41		
	S07B27	16			NT		
	S07B28	17.9			NT		
	S07B29	**68**			NT		
	S07B30	8			43		
	S07B31	11			NT		
	S07B32	10			NT		
	S07B33	10			NT		
	S07B34	14.25			42		
	S07B35	35			NT		
	S07B36	24			48		
	S07B37	12			24		
	007SB001	11.8			NT		
	635SB001	25			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Cobalt (Co)	S06B01	3.3	470.0	6.6	NT	2000	8.14
	S06B02	4			7.3		
	S06B03	2.9			NT		
	S06B04	2.1			5.9		
	S06B05	2.5			NT		
	S06B06	1.2			NT		
	S06B07	1.4			7.4		
	S06B09	NT			7.3		
	S06B12	NT			7.6		
	S06B14	23			8		
	S06B15	11			7		
	S06B17	NT			7.9		
	S06B20	26			9		
	S06B21	NT			7.2		
	S06B25	2.65			8.9		
	S06B26	4.6			7.9		
	S06B27	NT			9.6		
	S06B29	NT			7.2		
	S06B31	NT			9.9		
	S06B32	NT			11		
	S06B33	NT			6.8		
	006SB001	1.5			8.8		
	006SB002	2.3			NT		
	006SB003	1.1			NT		
	006SB004	4.7			7		
	S07B03	1.75			5.3		
	S07B04	2			NT		
	S07B05	1.8			NT		
	S07B06	3.9			NT		
	S07B07	2.9			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Cobalt (cont.)	S07B08	4.6	470.0	6.6	NT	2000	8.14
	S07B09	1.3			NT		
	S07B10	5.3			NT		
	S07B11	1.6			7.9		
	S07B12	2.4			NT		
	S07B13	4.6					
	S07B16	2.1			7.8		
	S07B17	4.7			NT		
	S07B18	1.1			NT		
	S07B19	1.8			6.7		
	S07B21	2.3			NT		
	S07B22	2.8			NT		
	S07B23	2.75			1		
	S07B24	1.3			NT		
	S07B27	1.6			6.8		
	S07B28	2.4			NT		
	S07B29	1.1			NT		
	S07B30	1.3			NT		
	S07B34	2.55			8.2		
	S07B35	6.7			7.5		
	S07B36	1.2			NT		
	S07B37	2.1			8.6		
	007SB001	2.9			4.1		
	635SB001	8.7			NT		
					NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Copper (Cu)	S06B01	62	27000	260	NT	920	32.6
	S06B02	42			30		
	S06B03	23			NT		
	S06B04	47			48		
	S06B06	5.15			NT		
	S06B07	15			27		
	S06B09	NT			32		
	S06B12	NT			33		
	S06B14	12			34		
	S06B15	540			69		
	S06B17	NT			37		
	S06B20	12			36		
	S06B21	NT			32		
	S06B25	19.75			34		
	S06B26	7.9			30		
	S06B27	NT			34.9		
	S06B29	NT			32		
	S06B31	NT			40		
	S06B32	NT			47		
	S06B33	NT			29		
	006SB001	27.3			126		
	006SB002	39.4			NT		
	006SB003	18.7			NT		
	006SB004	61.8			28.4		
	S07B03	7.8			26		
	S07B04	22			NT		
	S07B05	11			NT		
	S07B06	33			NT		
	S07B07	23			NT		
	S07B08	25			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Copper (continued)	S07B09	3.8	27000	260	NT	920	32.6
	S07B10	27			NT		
	S07B11	17			32		
	S07B12	11			NT		
	S07B13	30			33.15		
	S07B16	13			NT		
	S07B17	17			NT		
	S07B18	15			22		
	S07B19	27.4			NT		
	S07B21	23			NT		
	S07B22	18			37		
	S07B23	23.2			NT		
	S07B24	16			31		
	S07B27	30			NT		
	S07B28	22.15			NT		
	S07B29	21			NT		
	S07B30	5.4			32		
	S07B31	4.1			NT		
	S07B32	3.4			NT		
	S07B34	23.8			33		
	S07B35	35			NT		
	S07B36	17			31		
	S07B37	10			17		
	007SB001	11.4			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected In Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Iron (Fe)	S06B01	**15000**	2300.0	NL	NT	NL	NL
	S06B02	**5100**			29000		
	S06B03	**11000**			NT		
	S06B04	**6900**			32000		
	S06B05	**5000**			NT		
	S06B06	**5900**			NT		
	S06B07	**6000**			34000		
	S06B09	NT			39000		
	S06B12	NT			38000		
	S06B14	**14000**			36000		
	S06B15	**21000**			28000		
	S06B17	NT			33000		
	S06B20	**17000**			37000		
	S06B21	NT			29000		
	S06B25	**11600**			36000		
	S06B26	**12000**			34000		
	S06B27	NT			39000		
	S06B29	NT			31000		
	S06B31	NT			40000		
	S06B32	NT			45000		
	S06B33	NT			29000		
	006SB001	**12500**			39200		
	006SB002	**11000**			NT		
	006SB003	**6100**			NT		
	006SB004	**20500**			32000		
	S07B03	**4230**			21000		
	S07B04	**8100**			NT		
	S07B05	**3800**			NT		
	S07B06	**14000**			NT		
	S07B07	**6300**			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Iron (continued)	S07B08	15000	2300.0	NL	NT	NL	NL
	S07B09	3900			NT		
	S07B10	18000			NT		
	S07B11	3700			33000		
	S07B12	4800			NT		
	S07B13	13000			32900		
	S07B16	2500			NT		
	S07B17	8100			NT		
	S07B18	15000			35000		
	S07B19	7475			NT		
	S07B21	17000			NT		
	S07B22	15000			40000		
	S07B23	9815			NT		
	S07B24	5900			33000		
	S07B27	7000			NT		
	S07B28	5245			NT		
	S07B29	6700			NT		
	S07B30	3700			36000		
	S07B31	6300			NT		
	S07B32	5600			NT		
	S07B33	5900			NT		
	S07B34	7450			34000		
	S07B35	30000			NT		
	S07B36	13000			37000		
	S07B37	7900			17000		
	007SB001	12700			NT		
	635SB001	28000			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Lead(Pb)	S06B01	320	400.0	181	NT	400	66.3
	S06B02	72			48		
	S06B03	57			NT		
	S06B04	100			123		
	S06B05	6.9			NT		
	S06B06	12			NT		
	S06B07	64			48		
	S06B09	NT			52		
	S06B12	NT			70		
	S06B14	20			62		
	S06B15	**1000**			103		
	S06B17	NT			52		
	S06B20	8.5			66		
	S06B21	NT			53		
	S06B25	12.05			52		
	S06B26	4.9			47		
	S06B27	NT			58.45		
	S06B29	NT			86		
	S06B31	NT			58		
	S06B32	NT			81		
	S06B33	NT			62		
	006SB001	138			131		
	006SB002	110			NT		
	006SB003	28.6			NT		
	006SB004	78.4			52.1		
	S07B03	22.45			45		
	S07B04	74			NT		
	S07B05	45			NT		
	S07B06	43			NT		
	S07B07	220			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Lead (continued)	S07B08	60	400.0	181	NT	400	66.3
	S07B09	12			NT		
	S07B10	28			NT		
	S07B11	46			55		
	S07B12	28			NT		
	S07B13	58			57.5		
	S07B16	30			NT		
	S07B17	23			NT		
	S07B18	290			66		
	S07B19	107			NT		
	S07B21	80			NT		
	S07B22	55			69		
	S07B23	60.5			NT		
	S07B24	42			58		
	S07B27	97			NT		
	S07B28	557			NT		
	S07B29	380			NT		
	S07B30	32			47		
	S07B31	9.6			NT		
	S07B32	2.2			NT		
	S07B33	2			NT		
	S07B34	39.75			54		
	S07B35	50			NT		
	S07B36	42			45		
	S07B37	25			44		
	007SB001	12.4			NT		
	635SB001	12.5			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Magnesium (Mg)	S06B01	640	NL	NL	NT	NL	NL
	S06B02	1200			5200		
	S06B03	1500			NT		
	S06B04	1200			4100		
	S06B05	2900			NT		
	S06B06	465			NT		
	S06B07	680			6000		
	S06B09	NT			6300		
	S06B12	NT			6100		
	S06B14	800			6000		
	S06B15	1100			4500		
	S06B17	NT			5200		
	S06B20	830			6300		
	S06B21	NT			4500		
	S06B25	747.5			5900		
	S06B26	810			5200		
	S06B27	NT			6235		
	S06B29	NT			4600		
	S06B31	NT			6300		
	S06B32	NT			7500		
	S06B33	NT			4900		
	006SB001	465			6620		
	006SB002	754			NT		
	006SB003	600			NT		
	006SB004	3310			6120		
	S07B03	7160			3300		
	S07B04	460			NT		
	S07B05	940			NT		
	S07B06	1000			NT		
	S07B07	200			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Magnesium (continued)	S07B08	1300	NL	NL	NT	NL	NL
	S07B09	15000			NT		
	S07B10	2100			NT		
	S07B11	880			5600		
	S07B12	2900			NT		
	S07B13	14000			5885		
	S07B16	2400			NT		
	S07B17	370			NT		
	S07B18	280			5100		
	S07B19	479			NT		
	S07B21	1800			NT		
	S07B22	1500			5700		
	S07B23	2435			NT		
	S07B24	540			5400		
	S07B27	1400			NT		
	S07B28	229.5			NT		
	S07B29	360			NT		
	S07B30	320			5900		
	S07B31	460			NT		
	S07B33	560			NT		
	S07B34	3045			5800		
	S07B35	5800			NT		
	S07B36	330			5900		
	S07B37	1100			3000		
	007SB001	483			NT		
	635SB001	1260			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Manganese (Mn)	S06B01	75	180.0	325	NT	1100	291
	S06B02	120			360		
	S06B03	190			NT		
	S06B04	89			400		
	S06B05	150			NT		
	S06B06	44.5			NT		
	S06B07	48			320		
	S06B09	NT			630		
	S06B12	NT			650		
	S06B14	55			520		
	S06B15	160			530		
	S06B17	NT			360		
	S06B20	65			470		
	S06B21	NT			460		
	S06B25	74.95			440		
	S06B26	59			550		
	S06B27	NT			758		
	S06B29	NT			600		
	S06B31	NT			720		
	S06B32	NT			690		
	S06B33	NT			480		
	006SB001	76.4			411		
	006SB002	101			NT		
	006SB003	50.6			NT		
	006SB004	**568**			528		
	S07B03	136			190		
	S07B04	73			NT		
	S07B05	120			NT		
	S07B06	140			NT		
	S07B07	38			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Manganese (continued)	S07B08	230	180.0	325	NT	1100	291
	S07B09	110			NT		
	S07B10	320			NT		
	S07B11	99			450		
	S07B12	280			NT		
	S07B13	160			524		
	S07B16	220			NT		
	S07B17	85			NT		
	S07B18	140			1000		
	S07B19	80.45			NT		
	S07B21	190			NT		
	S07B22	190			720		
	S07B23	209.5			NT		
	S07B24	67			560		
	S07B27	120			NT		
	S07B28	39.05			NT		
	S07B29	43			NT		
	S07B30	18			700		
	S07B31	24			NT		
	S07B32	17			NT		
	S07B33	18			NT		
	S07B34	158.5			710		
	S07B35	**580**			NT		
	S07B36	65			760		
	S07B37	150			230		
	007SB001	22.8			NT		
	635SB001	31.9			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Mercury (Hg)	S06B01	0.35	2.3	1.03	NT	2.1	0.31
	S06B02	0.054			0.25		
	S06B03	0.17			NT		
	S06B04	0.21			4		
	S06B05	0.025			NT		
	S06B06	0.565			NT		
	S06B07	0.076			0.82		
	S06B09	NT			0.23		
	S06B12	NT			1.5		
	S06B14	0.055			0.34		
	S06B15	0.12			0.35		
	S06B17	NT			0.37		
	S06B20	0.023			0.22		
	S06B21	NT			0.24		
	S06B25	0.031			0.25		
	S06B26	0.019			0.42		
	S06B27	NT			0.315		
	S06B29	NT			0.22		
	S06B31	NT			0.27		
	S06B32	NT			0.57		
	S06B33	NT			0.42		
	006SB001	0.08			0.78		
	006SB002	0.16			NT		
	006SB003	0.04			NT		
	006SB004	0.2			0.32		
	S07B03	0.026			0.21		
	S07B04	0.055			NT		
	S07B05	0.041			NT		
	S07B06	0.058			NT		
	S07B07	0.07			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Mercury (continued)	S07B08	0.065	2.3	1.03	NT	2.1	0.31
	S07B09	0.025			NT		
	S07B10	0.2			NT		
	S07B11	0.12			0.36		
	S07B12	0.25			NT		
	S07B13	0.34			0.355		
	S07B16	0.096			NT		
	S07B17	0.035			NT		
	S07B18	0.042			0.16		
	S07B19	0.0615			NT		
	S07B21	0.17			NT		
	S07B22	0.13			0.31		
	S07B23	0.13			NT		
	S07B24	0.13			0.4		
	S07B27	0.18			NT		
	S07B28	0.0615			NT		
	S07B29	0.14			NT		
	S07B30	0.015			0.23		
	S07B31	0.025			NT		
	S07B34	0.07			0.33		
	S07B35	0.48			NT		
	S07B36	0.063			0.27		
	S07B37	0.071			0.14		
	007SB001	0.05			NT		
	635SB001	0.05			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Nickel (Ni)	S06B01	19	160.0	20.6	NT	130	18.3
	S06B02	10			11		
	S06B03	5.3			NT		
	S06B04	8.5			9.9		
	S06B05	6.8			NT		
	S06B07	ND			12		
	S06B09	NT			10		
	S06B12	NT			11		
	S06B14	ND			12		
	S06B15	24			11		
	S06B17	NT			13		
	S06B20	ND			13		
	S06B21	NT			11		
	S06B25	6.1			13		
	S06B26	NT			11		
	S06B27	NT			14.7		
	S06B29	NT			12		
	S06B31	NT			13		
	S06B32	NT			16		
	S06B33	NT			9.8		
	006SB001	6.3			26		
	006SB002	9.7			NT		
	006SB003	3.4			NT		
	006SB004	9.2			12.4		
	S07B03	5.1			8.7		
	S07B04	7.5			NT		
	S07B05	5.2			NT		
	S07B06	13			NT		
	S07B07	9.4			NT		
	S07B08	14			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Nickel (continued)	S07B10	14	160.0	20.6	NT	130	18.3
	S07B11	5.3			12		
	S07B12	6.6			NT		
	S07B13	14			12.1		
	S07B16	8.1			NT		
	S07B17	15			NT		
	S07B18	5.3			11		
	S07B19	8.55			NT		
	S07B21	8.8			NT		
	S07B22	7.7			16		
	S07B23	8.8			NT		
	S07B24	NT			11		
	S07B27	8.2			NT		
	S07B28	9.35			NT		
	S07B30	NT			12		
	S07B34	9.8			11		
	S07B35	9.8			NT		
	S07B36	NT			13		
	S07B37	NT			7		
	635SB001	3.5			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Potassium (K)	S06B01	350	NL	NL	NT	NL	NL
	S06B02	360			2600		
	S06B03	650			NT		
	S06B04	340			1900		
	S06B05	350			NT		
	S06B06	140			NT		
	S06B07	450			3100		
	S06B09	NT			2600		
	S06B12	NT			2600		
	S06B14	440			2800		
	S06B15	520			2200		
	S06B17	NT			3000		
	S06B20	320			3200		
	S06B21	NT			2800		
	S06B25	196.5			2900		
	S06B26	420			2700		
	S06B27	NT			3085		
	S06B29	NT			2100		
	S06B31	NT			3200		
	S06B32	NT			3800		
	S06B33	NT			2400		
	006SB001	254			3690		
	006SB002	389			NT		
	006SB003	292			NT		
	006SB004	1270			2790		
	S07B03	152.5			1700		
	S07B04	180			NT		
	S07B05	200			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Potassium (continued)	S07B06	190	NL	NL	NT	NL	NL
	S07B07	130			NT		
	S07B08	300			NT		
	S07B09	200			NT		
	S07B10	1000			NT		
	S07B11	200			2700		
	S07B12	380			NT		
	S07B13	710			2995		
	S07B16	200			NT		
	S07B17	330			NT		
	S07B18	130			2200		
	S07B19	162.5			NT		
	S07B21	350			NT		
	S07B22	510			2900		
	S07B23	499.5			NT		
	S07B24	180			2800		
	S07B27	200			NT		
	S07B28	130			NT		
	S07B29	230			NT		
	S07B30	260			2800		
	S07B31	450			NT		
	S07B32	500			NT		
	S07B33	570			NT		
	S07B34	484.5			3000		
	S07B35	2400			NT		
	S07B36	140			2900		
	S07B37	490			1600		
	007SB001	349			NT		
	635SB001	1020			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Silver (Ag)	S06B15	2.5	39	NL	ND	34	NL
Selenium (Se)	006SB001	0.49	39.0	1.22	2.4	5	1.26
	006SB002	0.84			NT		
	006SB003	0.82			NT		
	006SB004	1.6			2.4		
	007SB001	0.65			NT		
	635SB001	1.6			NT		
Sodium (Na)	S06B02	800	NL	NL	4100	NL	NL
	S06B03	520			NT		
	S06B04	280			1400		
	S06B05	280			NT		
	S06B06	335			NL		
	S06B07	ND			5800		
	S06B09	NT			5500		
	S06B12	NT			2200		
	S06B14	230			4800		
	S06B15	620			3400		
	S06B17	NT			3900		
	S06B20	350			4500		
	S06B21	NT			2100		
	S06B25	NT			2100		
	S06B26	120			3500		
	S06B27	NT			3635		
	S06B29	NT			620		
	S06B31	NT			3200		
	S06B32	NT			4300		
	S06B33	NT			3500		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Sodium (continued)	006SB001	ND	NL	NL	3560	NL	NL
	006SB004	622			2530		
	S07B03	145.5			820		
	S07B04	210			NT		
	S07B05	240			NT		
	S07B06	100			NT		
	S07B07	70			NT		
	S07B08	120			NT		
	S07B09	360			NT		
	S07B10	330			NT		
	S07B11	120			1800		
	S07B12	240			NT		
	S07B13	130			6640		
	S07B16	140			NT		
	S07B17	190			NT		
	S07B18	80			2600		
	S07B19	83.3			NT		
	S07B21	170			NT		
	S07B22	130			710		
	S07B23	424.5			NT		
	S07B24	290			3800		
	S07B27	190			NT		
	S07B30	120			4800		
	S07B33	77			NT		
	S07B34	434.5			4700		
	S07B35	6600			NT		
	S07B36	190			4800		
	S07B37	NT			2500		
Thallium (Tl)	635SB001	0.89	0.63	0.85	NT	0.95	0.95

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Tin (Sn)	006SB001	7.3	4700	9.67	14.4	11000	2.96
	006SB002	8.3			NT		
	006SB003	6.5			NT		
	006SB004	7.8			12.1		
Vanadium (V)	S06B01	26	55.0	60.9	NT	6000	72.5
	S06B02	11			71		
	S06B03	24			NT		
	S06B04	15			59		
	S06B05	10			NT		
	S06B06	10.05			NT		
	S06B07	19			73		
	S06B09	NT			68		
	S06B12	NT			73		
	S06B14	20			72		
	S06B15	42			52		
	S06B17	NT			68		
	S06B20	18			77		
	S06B21	NT			69		
	S06B25	16.25			77		
	S06B26	18			65		
	S06B27	NT			77.1		
	S06B29	NT			60		
	S06B31	NT			84		
	S06B32	NT			91		
	S06B33	NT			62		
	006SB001	17.4			14.4		
	006SB002	17			NT		
	006SB003	11.3			NT		
	006SB004	41.2			68.5		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Vanadium (continued)	S07B03	7.7	55.0	60.9	51	6000	72.5
	S07B04	6.8			NT		
	S07B05	6.8			NT		
	S07B06	19			NT		
	S07B07	12			NT		
	S07B08	25			NT		
	S07B09	6.7			NT		
	S07B10	38			NT		
	S07B11	7.7			75		
	S07B12	8.9			NT		
	S07B13	28			72.25		
	S07B16	5.3			NT		
	S07B17	13			NT		
	S07B18	8.3			53		
	S07B19	13.1			NT		
	S07B21	22			NT		
	S07B22	20			85		
	S07B23	13.05			NT		
	S07B24	9.9			70		
	S07B27	7.5			NT		
	S07B28	10.85			NT		
	S07B29	14			NT		
	S07B30	11			77		
	S07B31	16			NT		
	S07B32	18			NT		
	S07B33	21			NT		
	S07B34	12.7			73		
	S07B35	66			NT		
	S07B36	9			76		
	S07B37	20			41		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Vanadium (continued)	007SB001	19.4	55	60.9	NT	6000	72.5
	635SB001	43.7			NT		
Zinc (Zn)	S06B01	230	2300.0	519	NT	12000	145
	S06B02	65			100		
	S06B03	110			NT		
	S06B04	120			200		
	S06B05	19			NT		
	S06B06	14.5			NT		
	S06B07	58			100		
	S06B09	NT			110		
	S06B12	NT			130		
	S06B14	41			120		
	S06B15	930			180		
	S06B17	NT			120		
	S06B20	14			120		
	S06B21	NT			120		
	S06B25	28.55			120		
	S06B26	14			110		
	S06B27	NT			131		
	S06B29	NT			120		
	S06B31	NT			140		
	S06B32	NT			160		
	S06B33	NT			110		
	006SB001	109			232		
	006SB002	152			NT		
	006SB003	78			NT		
	006SB004	108			112		
	S07B03	45.25			120		
	S07B04	92			NT		

Table 10.12.7
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Surface and Subsurface Soil

Parameters	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Zinc (continued)	S07B05	47	2300.0	198	NT	12000	145
	S07B06	130			NT		
	S07B07	91			NT		
	S07B08	390			NT		
	S07B09	15			NT		
	S07B10	74			NT		
	S07B11	63			120		
	S07B12	64			NT		
	S07B13	110			132		
	S07B16	57			NT		
	S07B17	270			NT		
	S07B18	40			90		
	S07B19	99.25			NT		
	S07B21	110			NT		
	S07B22	190			160		
	S07B23	80.75			NT		
	S07B24	55			130		
	S07B27	90			NT		
	S07B28	58.85			NT		
	S07B29	96			NT		
	S07B30	35			120		
	S07B31	42			NT		
	S07B32	9.7			NT		
	S07B33	22			NT		
	S07B34	89.2			120		
	S07B35	130			NT		
	S07B36	150			120		
	S07B37	36			60		
	007SB001	15.9			NT		
	635SB001	28.8			NT		

Notes:

a	=	Background value for non-clay samples
*	=	Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil to groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) were used as a reference concentration for lower interval samples
1	=	Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995b)
ND	=	Not detected
NT	=	Not taken
NL	=	Not listed
NA	=	Not applicable
SU	=	Standard Units
µg/kg	=	Micrograms per kilograms
mg/kg	=	Milligrams per kilograms
ng/kg	=	Nanograms per kilograms

Bolded concentrations exceed both the reference coocentration (RBC or SSL) and the zone background
All background reference values for Zone G are based on twice the means of the grid sample concentrations

Semivolatile Organic Compounds in Soil

Twenty-seven SVOCs were detected in surface soil at the combined SWMUs 6, 7 and AOC 635. Benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, Indeno(1,2,3-cd)pyrene and dibenz(a,h)anthracene exceeded their respective RBCs in surface soil samples at this site. Figure 10.12-4 presents total BEQ concentrations detected in surface soil.

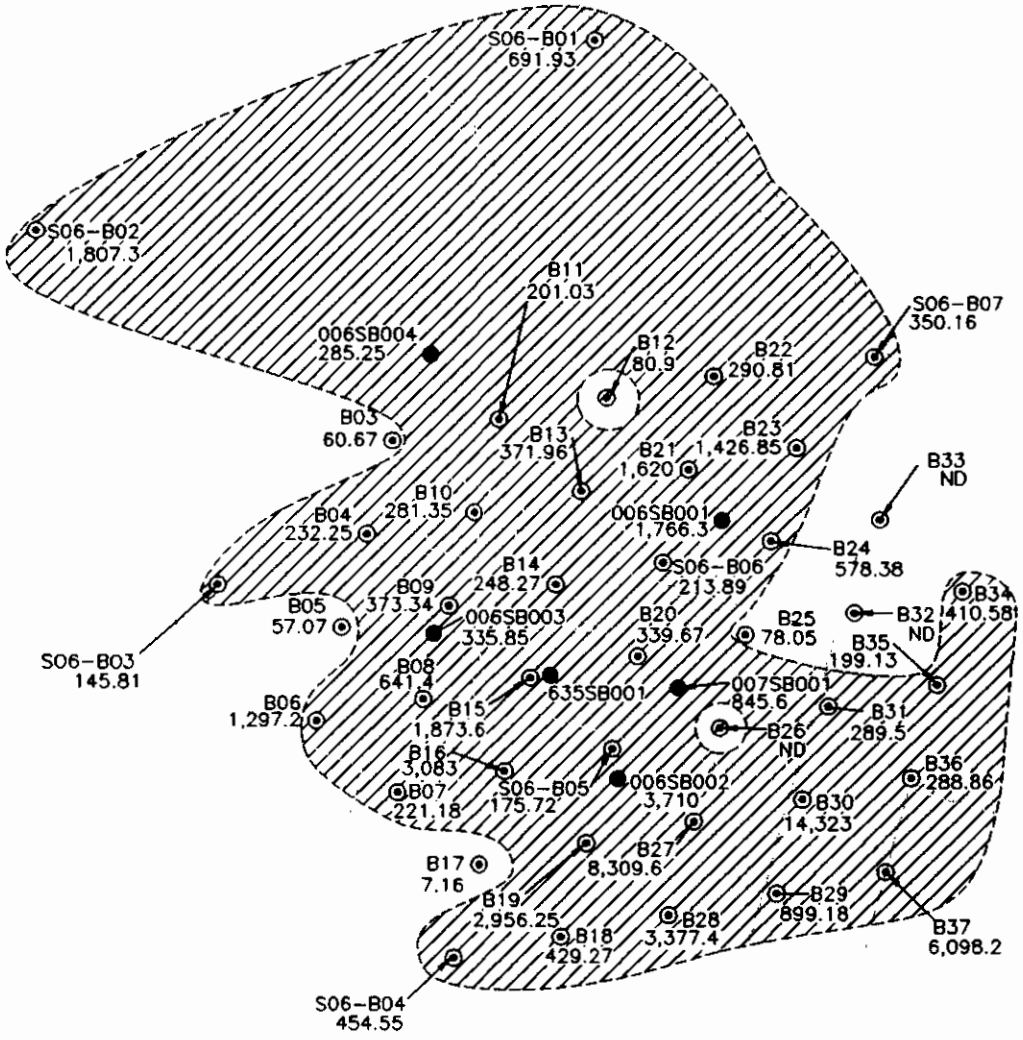
Twenty-one SVOCs were detected in subsurface soil. Benzo(a)anthracene and carbazole exceeded their respective SSLs at this site. Figure 10.12-5 presents benzo(a)anthracenes, distribution in subsurface soil. Figure 10.12-6 presents cabazole distribution in subsurface soil.

Pesicides and PCBs in Soil

Sixteen pesticides were detected in surface soil at the combined SWMUs 6, 7 and AOC 635. Of these, 4,4'-DDE, 4-4'-DDD, 4,4'-DDT, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, alpha-chlordane, gamma-chlordane and heptachlor exceeded their respective RBCs. Figures 10.12-7 through 10.12-16 present 4,4'-DDE, 4,4'-DDT, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, alpha-chlordane, gamma-chlordane, and heptachlor, respectively in surface soil at SWMUs 6, 7 and AOC 635.

Two PCBs, Aroclor-1254 and Arclor-1260 were detected in surface soil at concentrations exceeding their respective RBCs. Figures 10.12-17 and 10.12-18 present Aroclor-1254 and Aroclor-1260 distributions respective in surface soil.

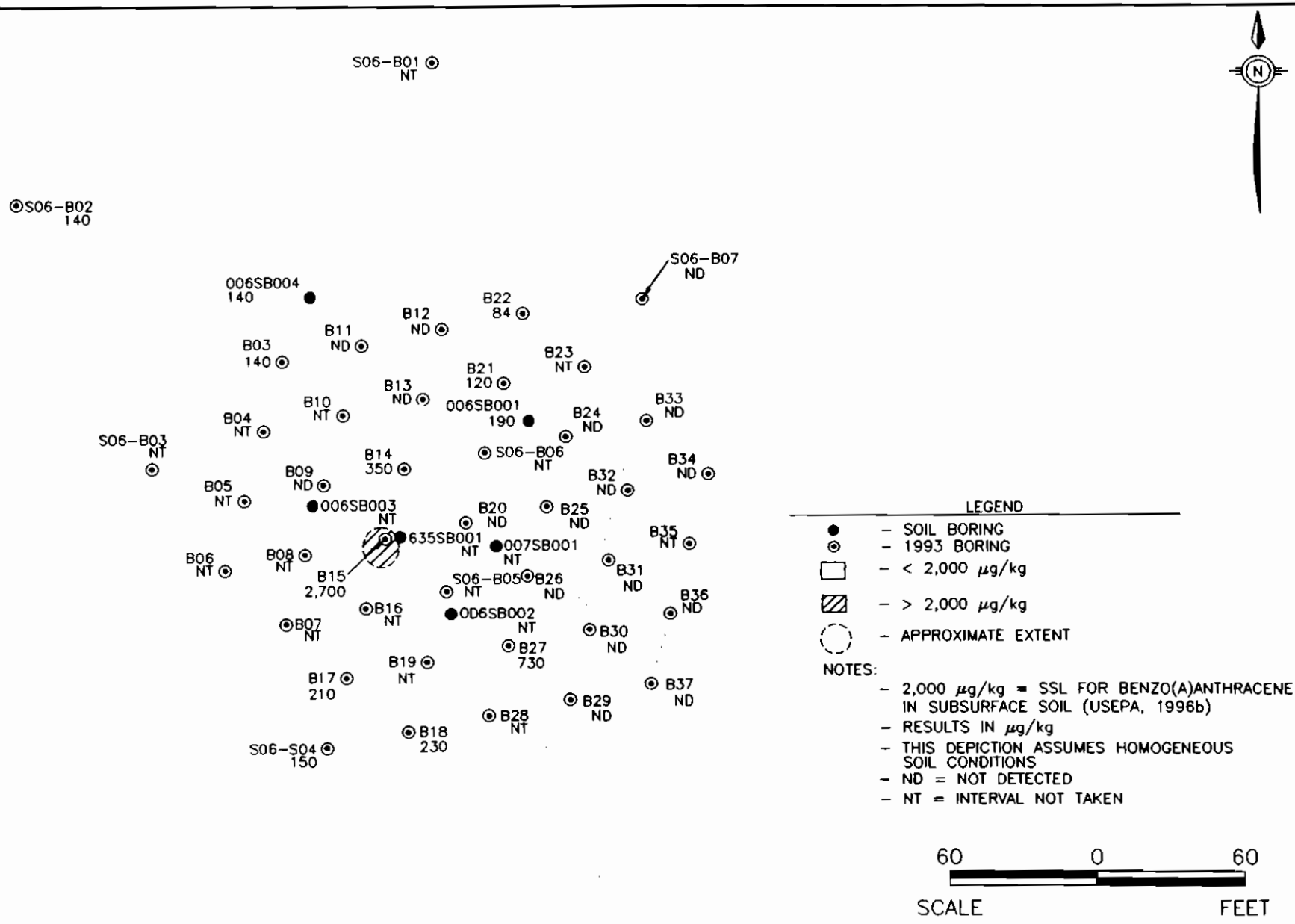
Six pesticides were detected in subsurface soil. Of these, only delta-BHC exceed its SSL. Figure 10.12-19 presents delta-BHC concentrations in subsurface soil at SWMUs 6, 7 and AOC 635. Aroclor-1260 was also detected in subsurface soil at a concentration below its respective SSL.



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-4
BEQs IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

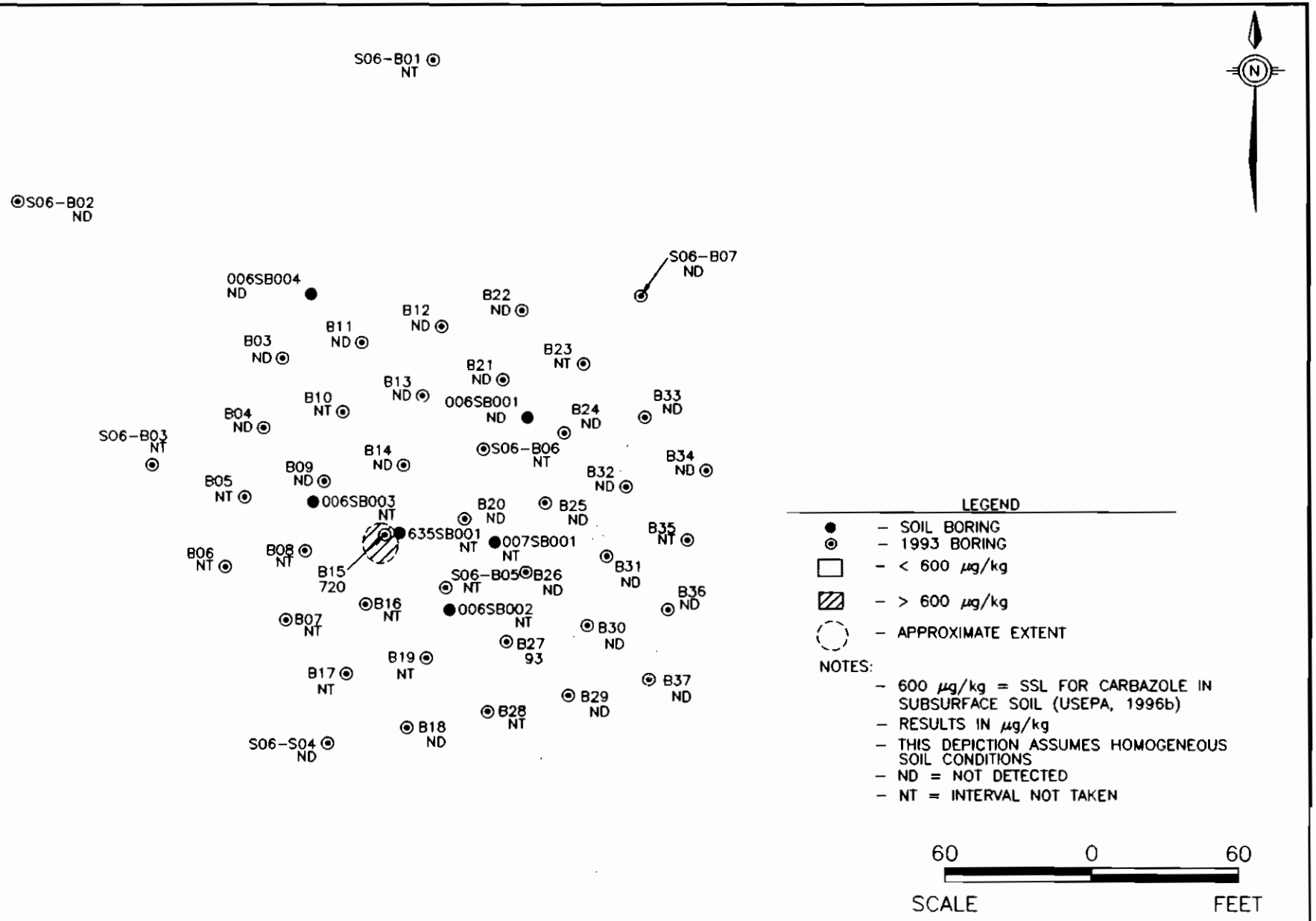
DWG DATE: 02/16/98 | DWG NAME: 2907M225



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-5
BENZO(A)ANTHRACENE IN
SUBSURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE,
BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

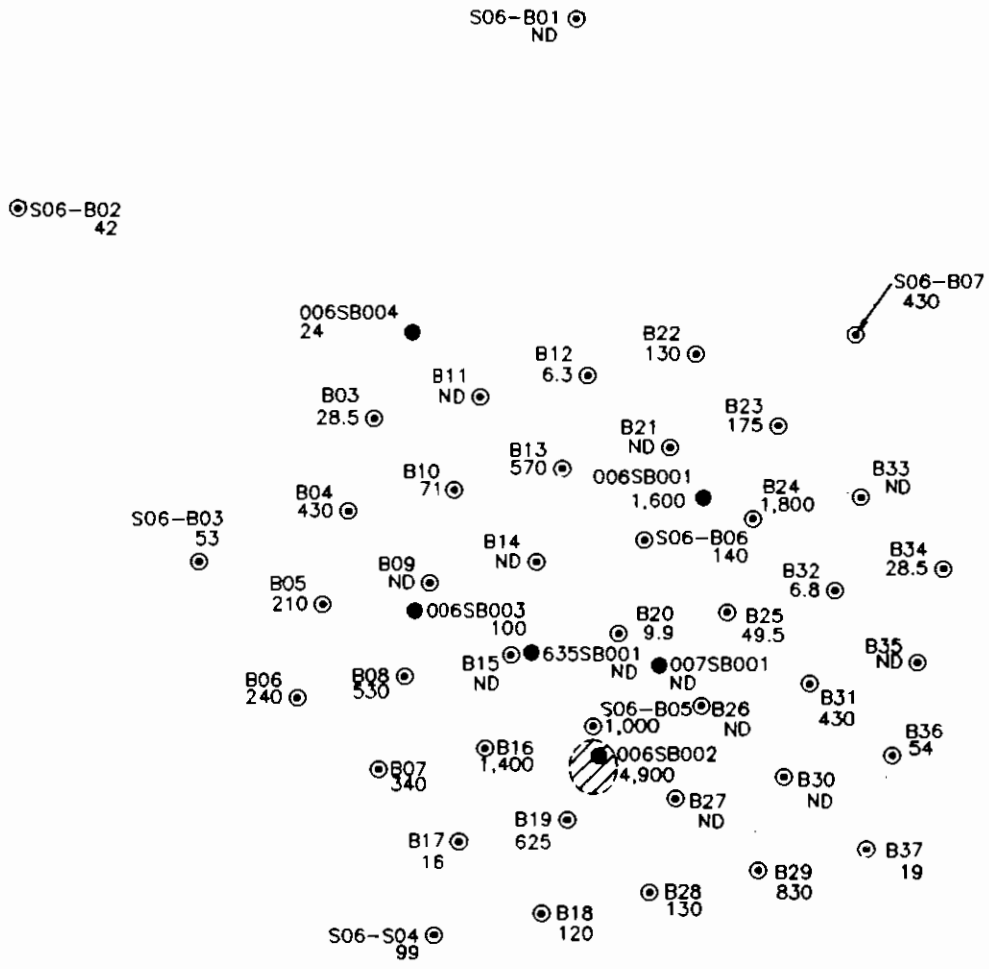
DWG DATE: 02/15/98 | DWG NAME: 2907M200



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-6
CARBAZOLE IN SUBSURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/15/98 | DWG NAME: 2907M201



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 1,900 μg/kg
- ▨ – > 1,900 μg/kg
- ◯ – APPROXIMATE EXTENT

NOTES:

- 1,900 μg/kg = RBC FOR 4,4'-DDE IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED
- NT = INTERVAL NOT TAKEN

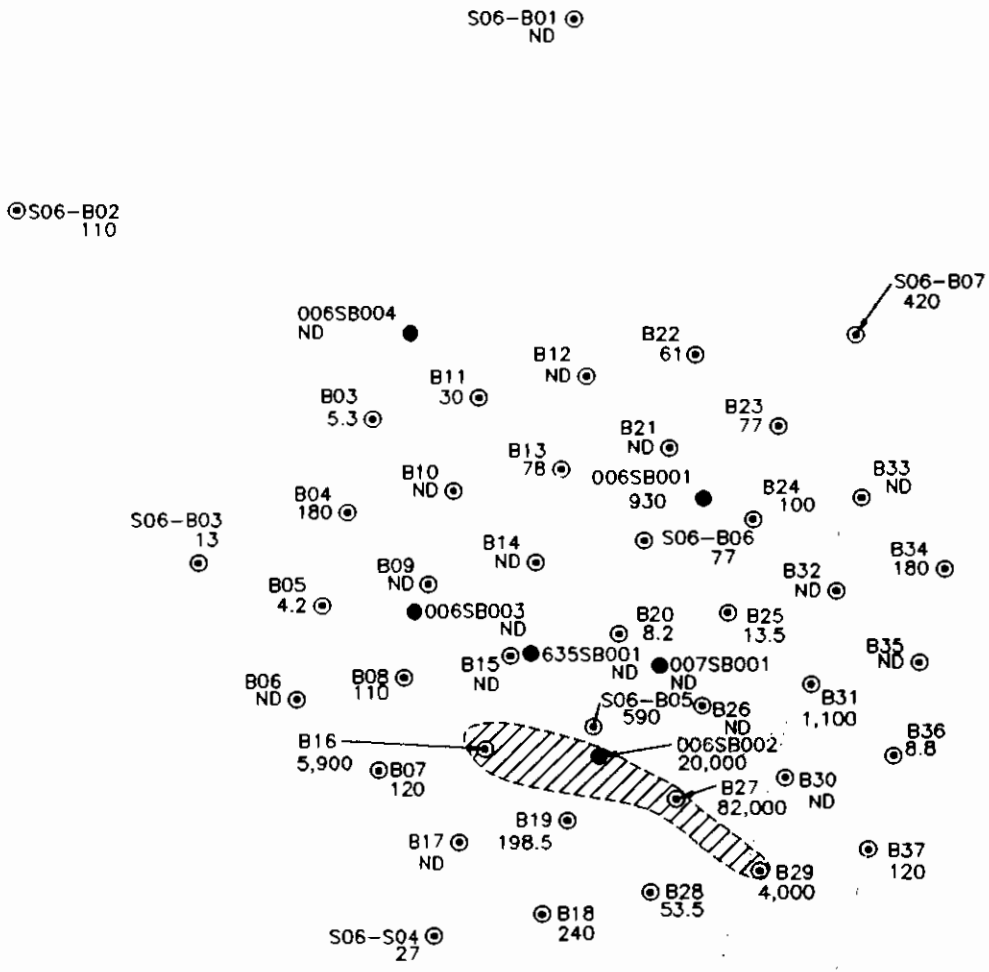
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-7
4,4'-DDE IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/15/98 | DWG NAME: 2907M202



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 2,700 μg/kg
- ▨ – > 2,700 μg/kg
- ◯ – APPROXIMATE EXTENT

NOTES:

- 2,700 μg/kg = RBC FOR 4,4'-DDD IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED
- NT = INTERVAL NOT TAKEN

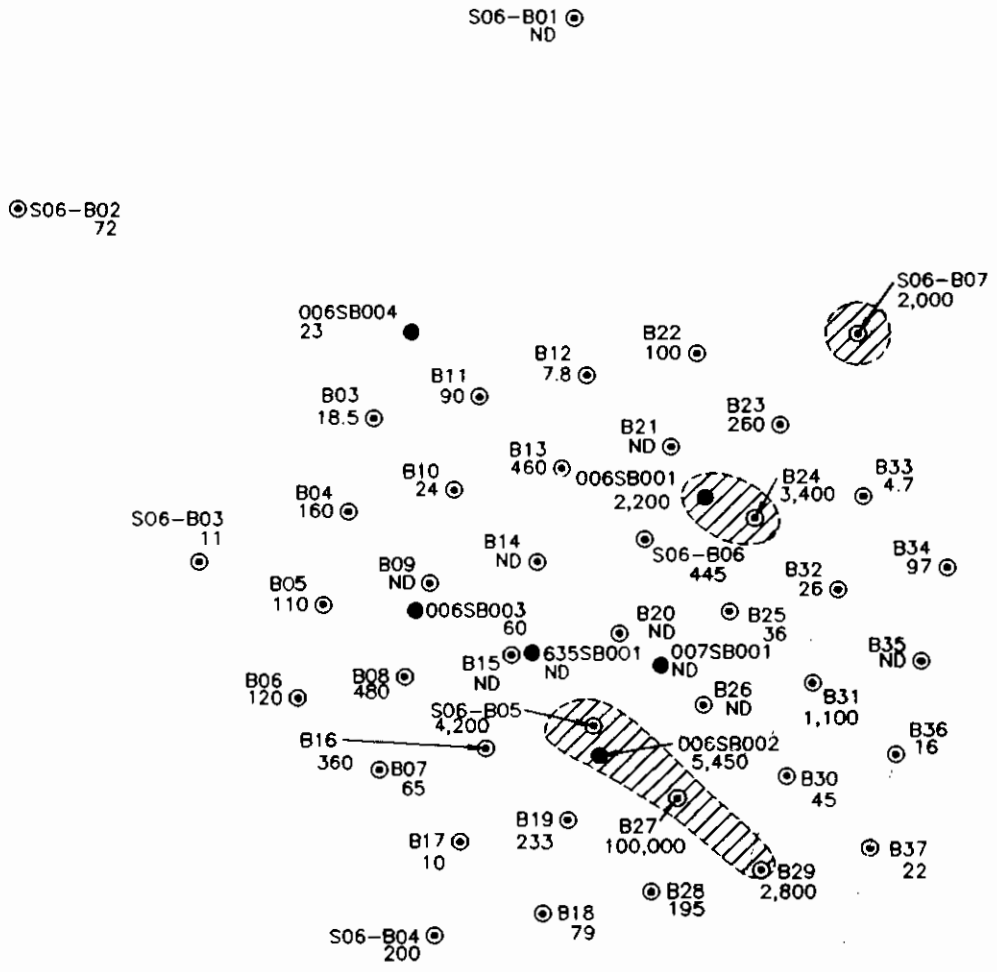
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-8
4,4'-DDD IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M203



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- ▭ – < 1,900 μg/kg
- ▨ – > 1,900 μg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 1,900 μg/kg = RBC FOR 4,4'-DDT IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED
- NT = INTERVAL NOT TAKEN

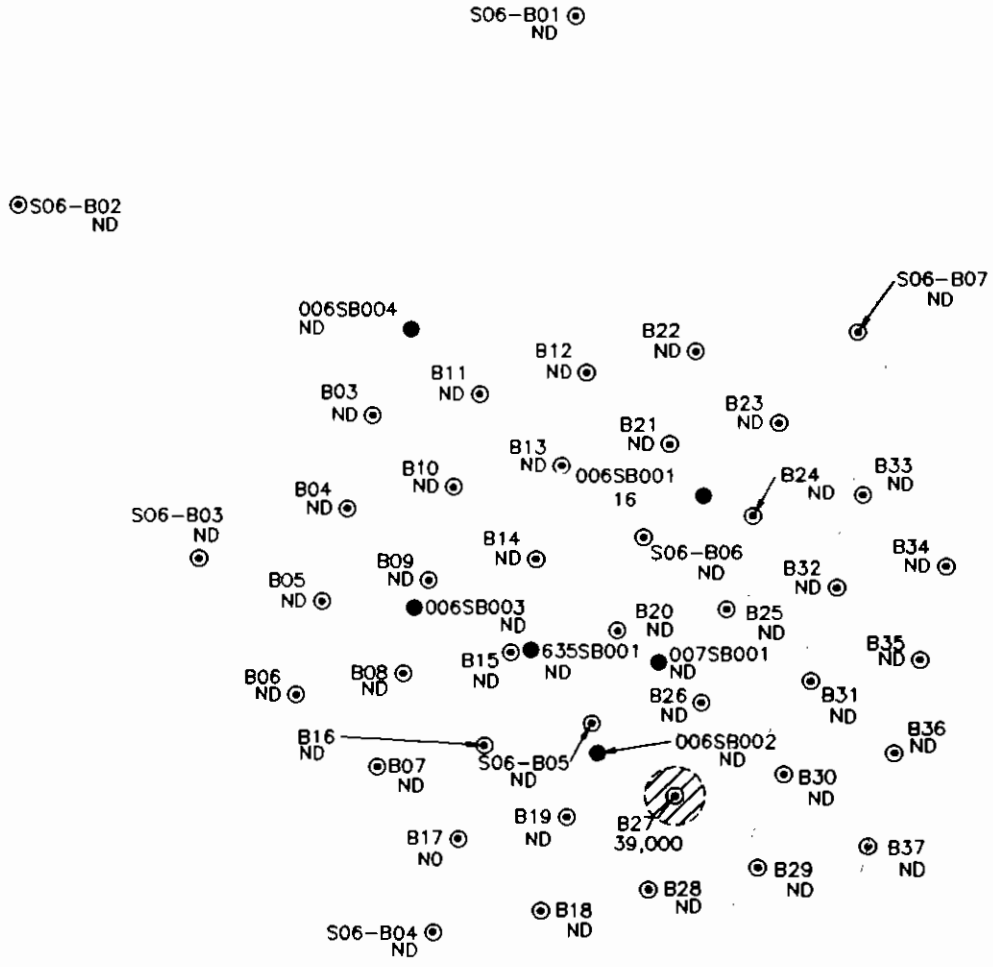
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-9
4-4'-DDT IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M204



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 100 μg/kg
- ▨ – > 100 μg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 100 μg/kg = RBC FOR ALPHA-BHC IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

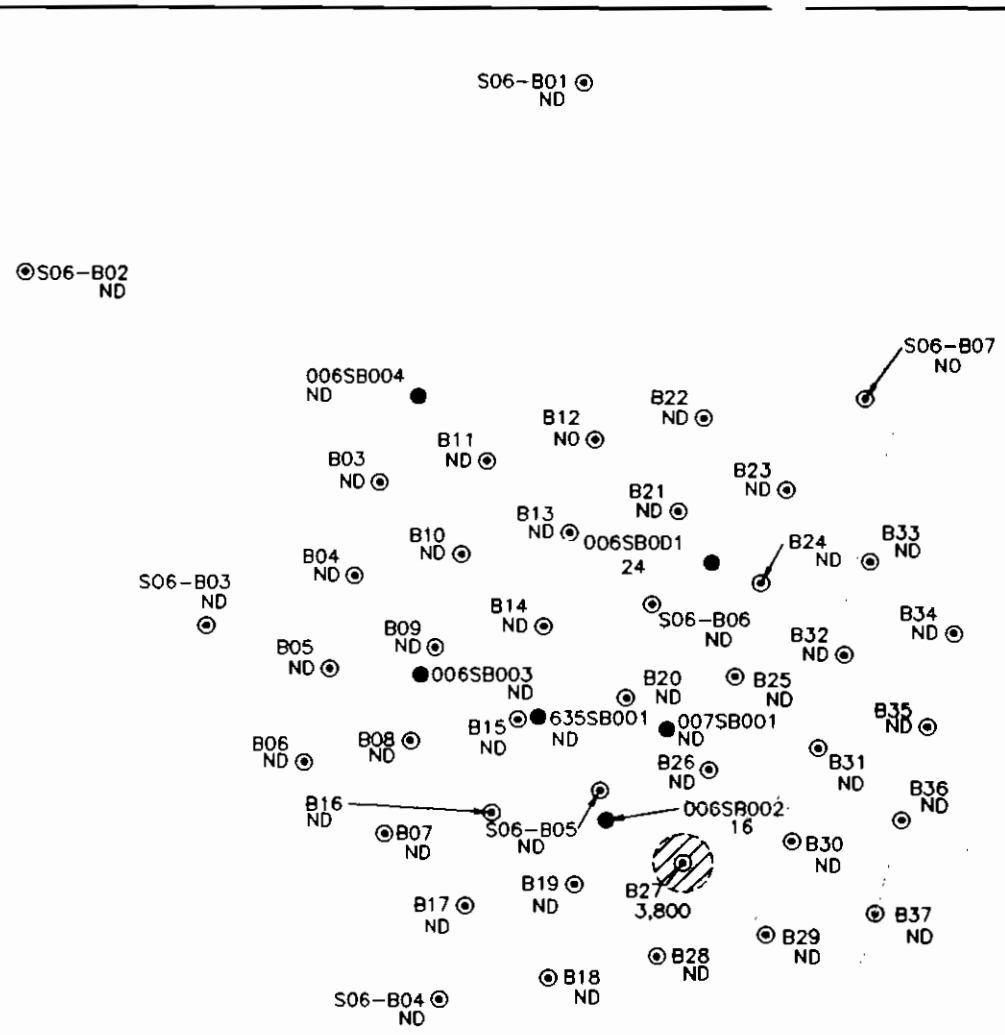
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-10
ALPHA-BHC IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M205



LEGEND

- ● – SOIL BORING
- ◉ – 1993 BORING
- □ – < 350 μg/kg
- ▨ – > 350 μg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 350 μg/kg = RBC FOR BETA-BHC IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

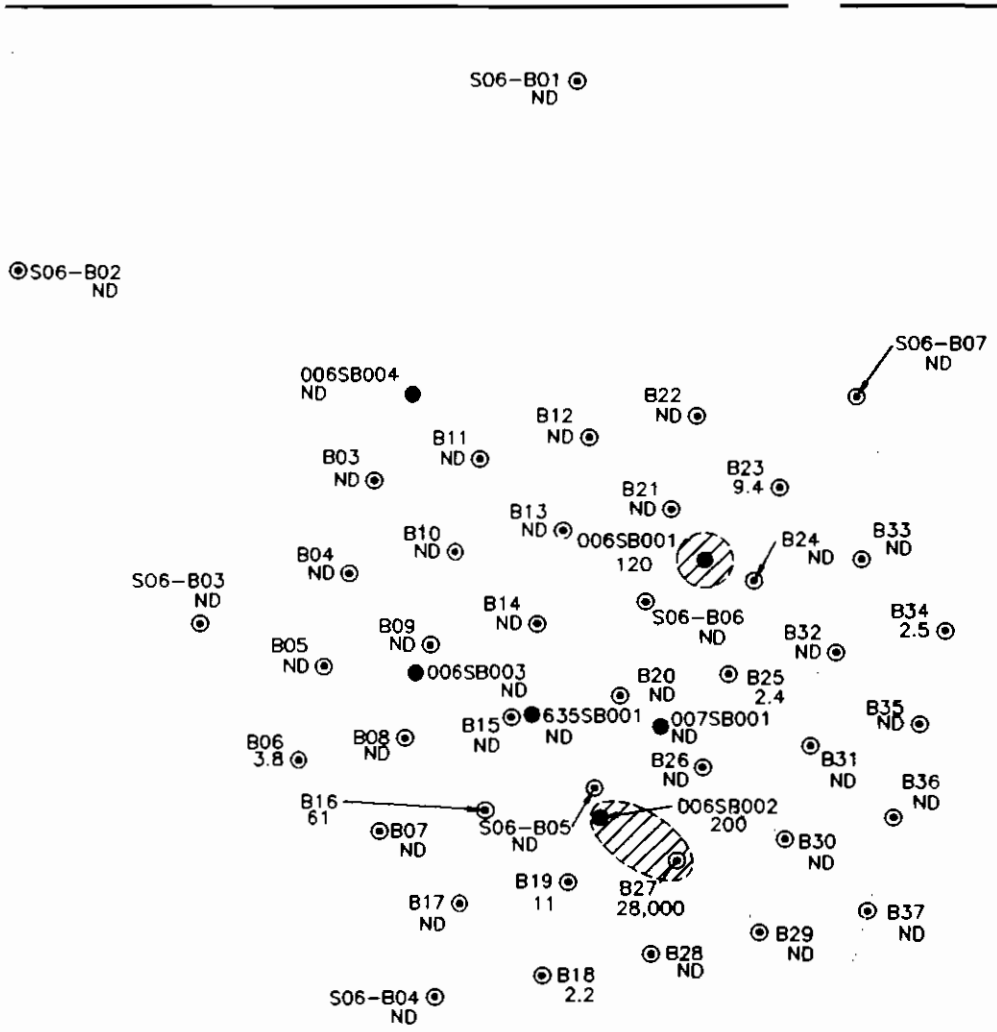
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-11
BETA-BHC IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M206



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 100 μg/kg
- ▨ – > 100 μg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 100 μg/kg = RBC FOR DELTA-BHC IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

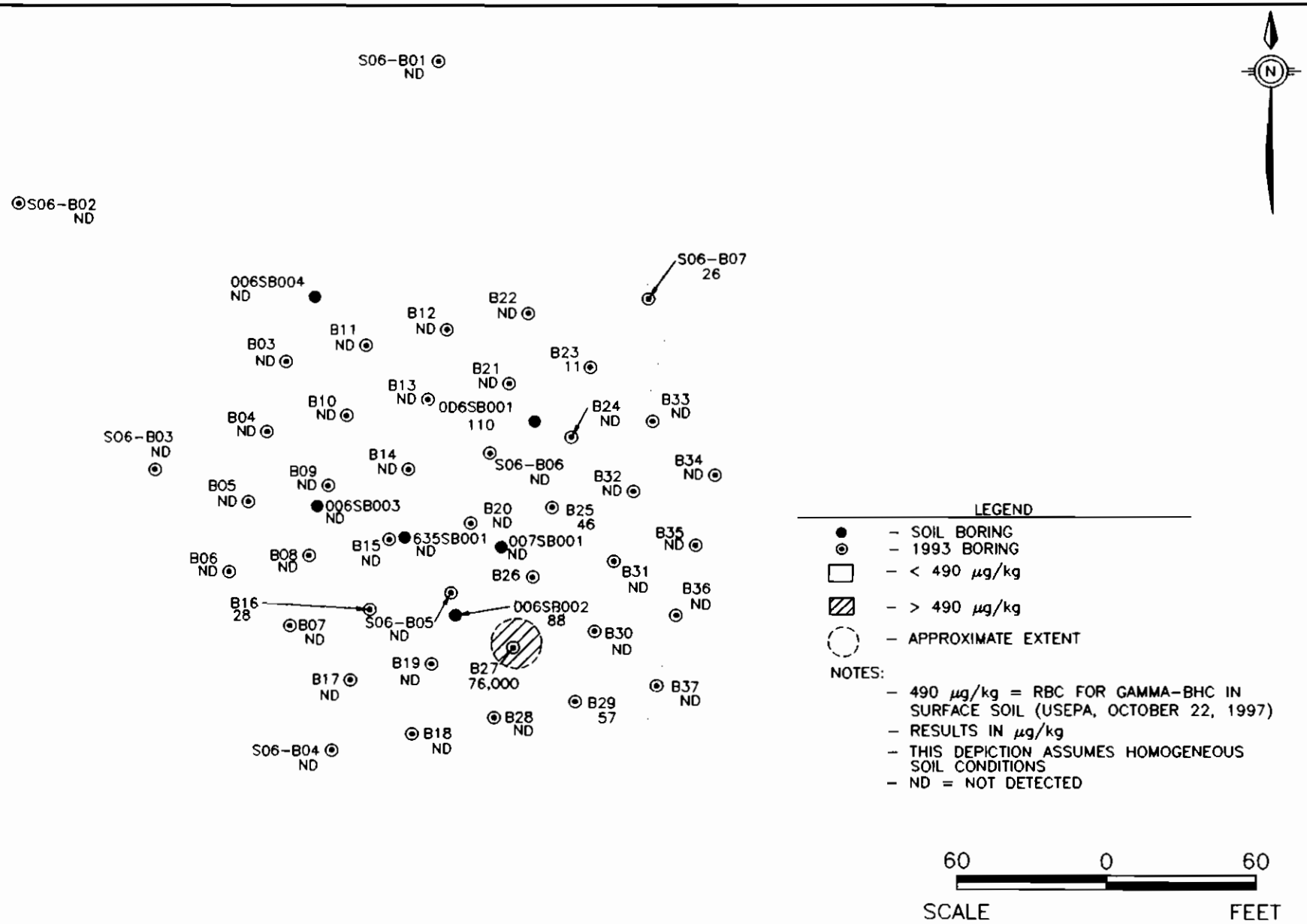
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-12
DELTA-BHC IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

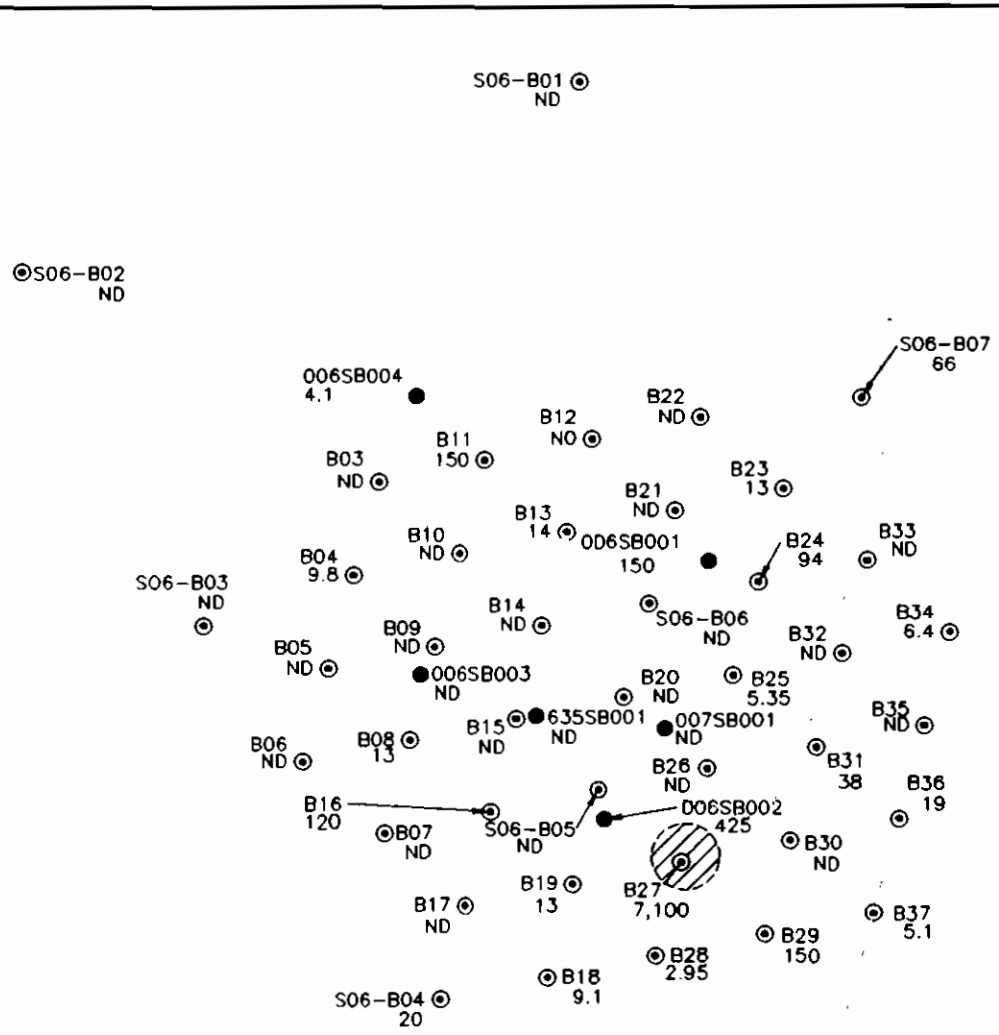
DWG DATE: 02/16/98 | DWG NAME: 2907M207



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-13
GAMMA-BHC IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M208



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 1,800 μg/kg
- ▨ – > 1,800 μg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 1,800 μg/kg = RBC FOR ALPHA-CHLORDANE IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

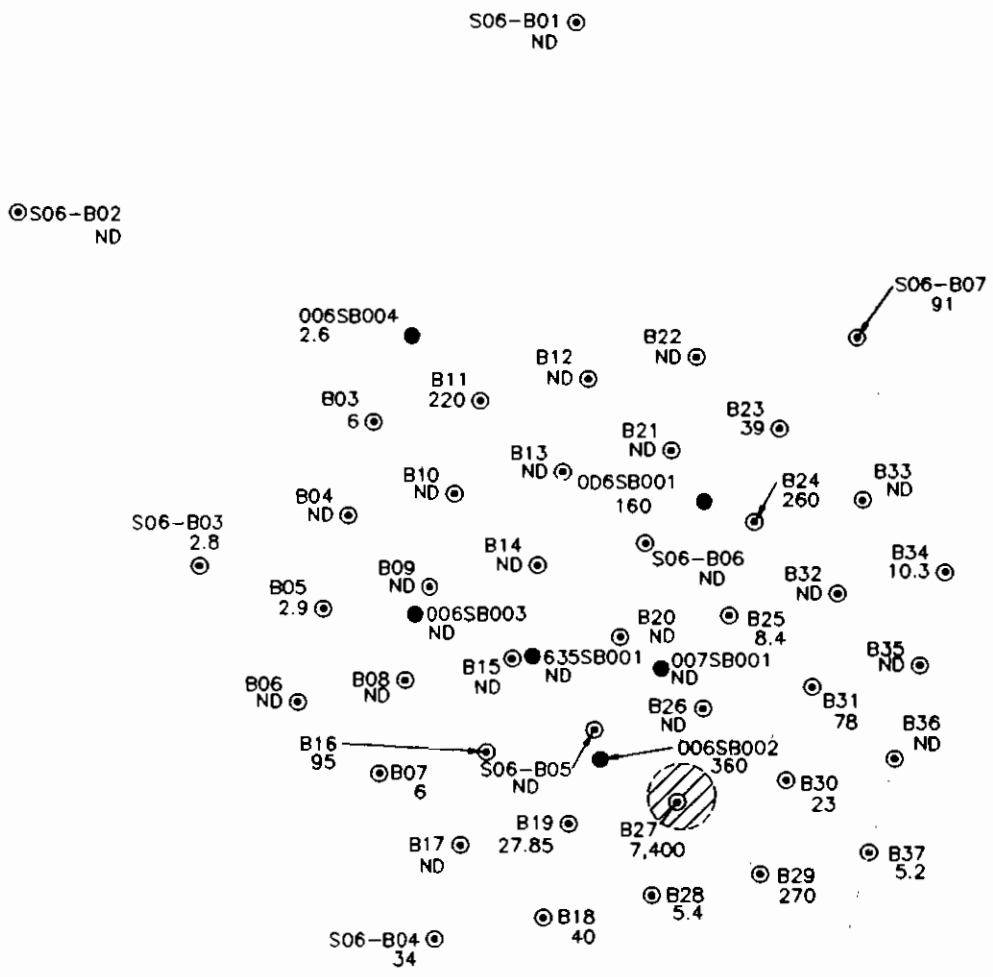
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-14
ALPHA-CHLORDANE IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M209



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 1,800 μg/kg
- ▨ – > 1,800 μg/kg
- ◯ – APPROXIMATE EXTENT

NOTES:

- 1,800 μg/kg = RBC FOR GAMMA-CHLORDANE IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

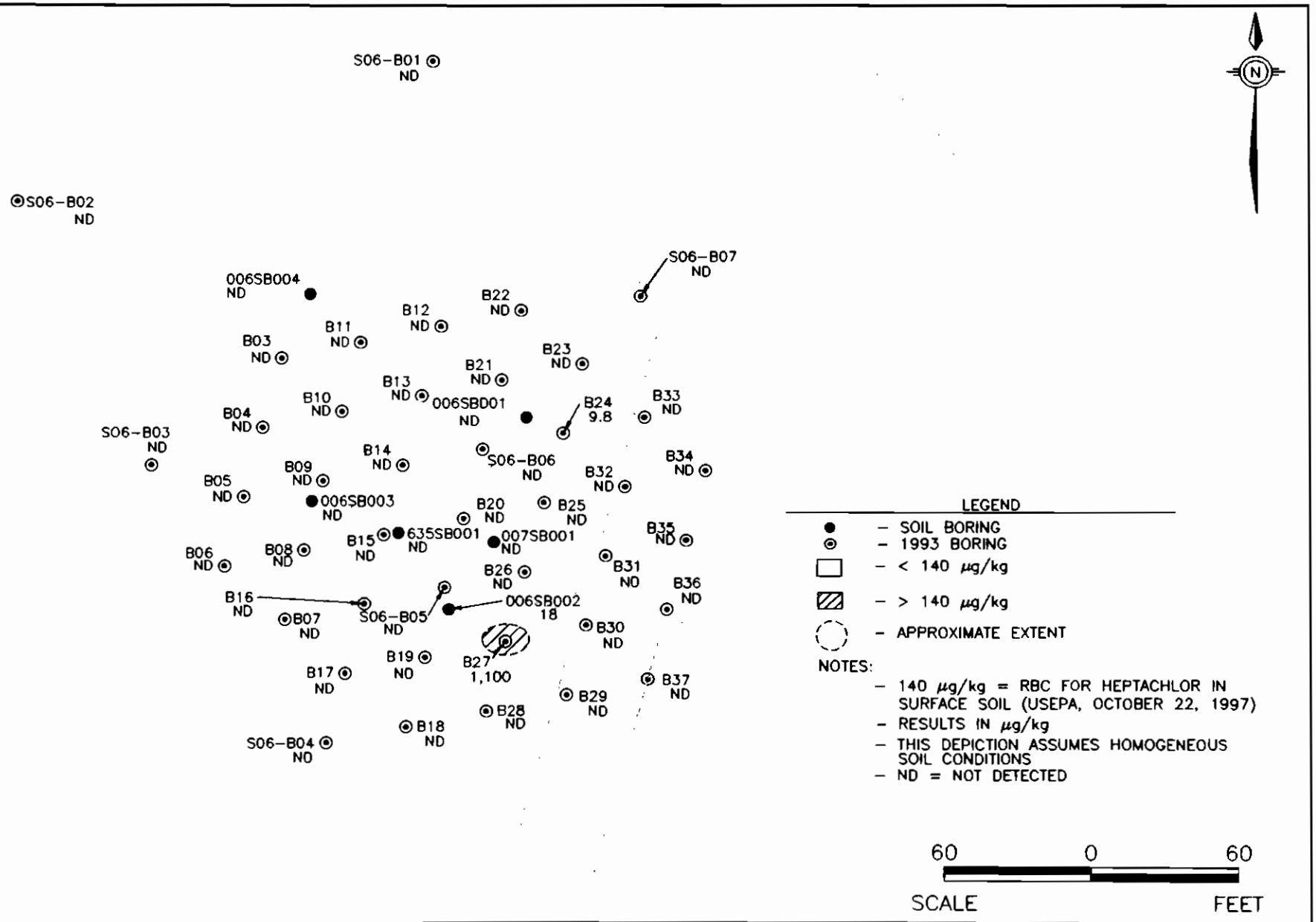
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-15
GAMMA-CHLORDANE IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

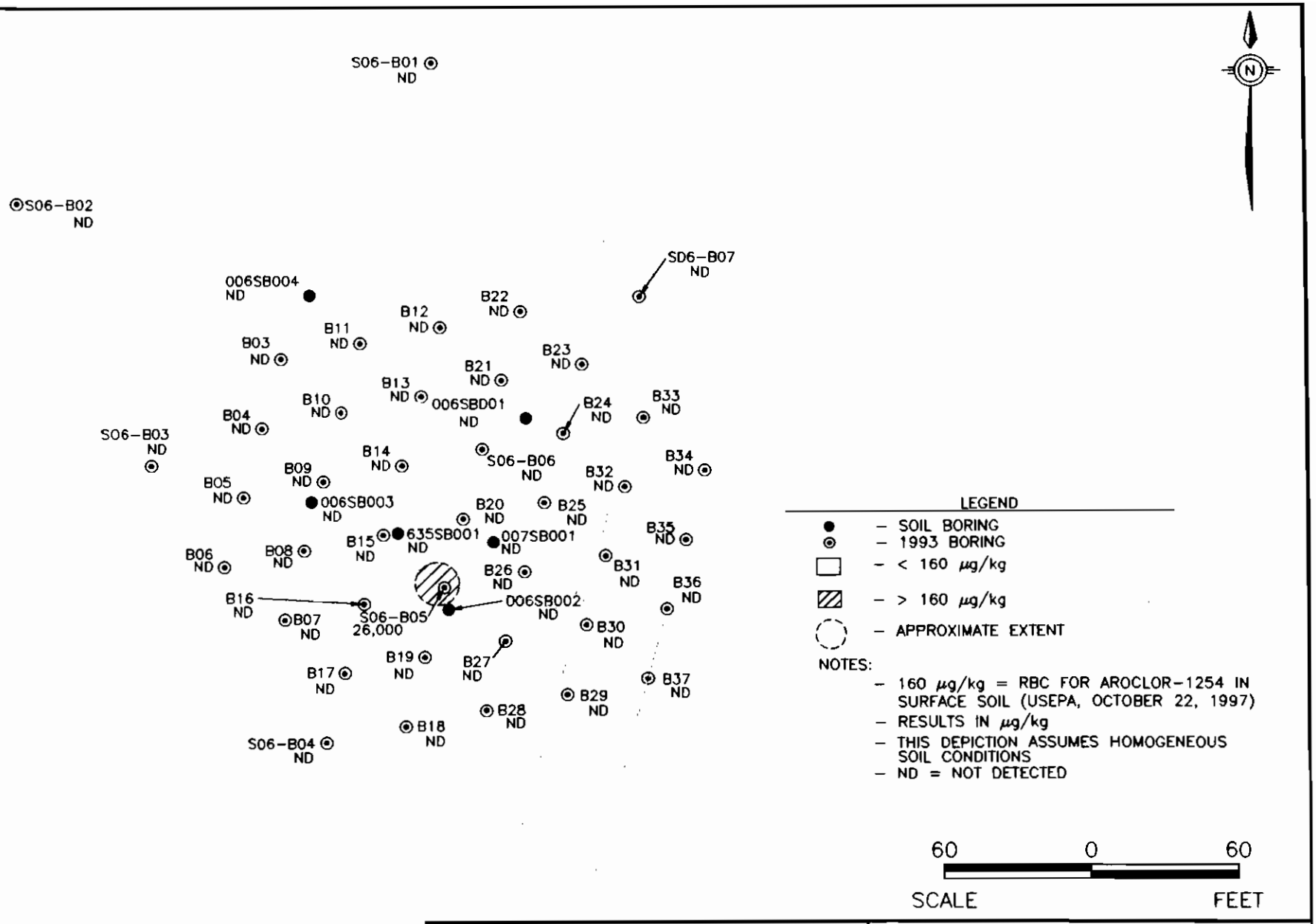
DWG DATE: 02/16/98 | DWG NAME: 2907M210



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-16
HEPTACHLOR IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

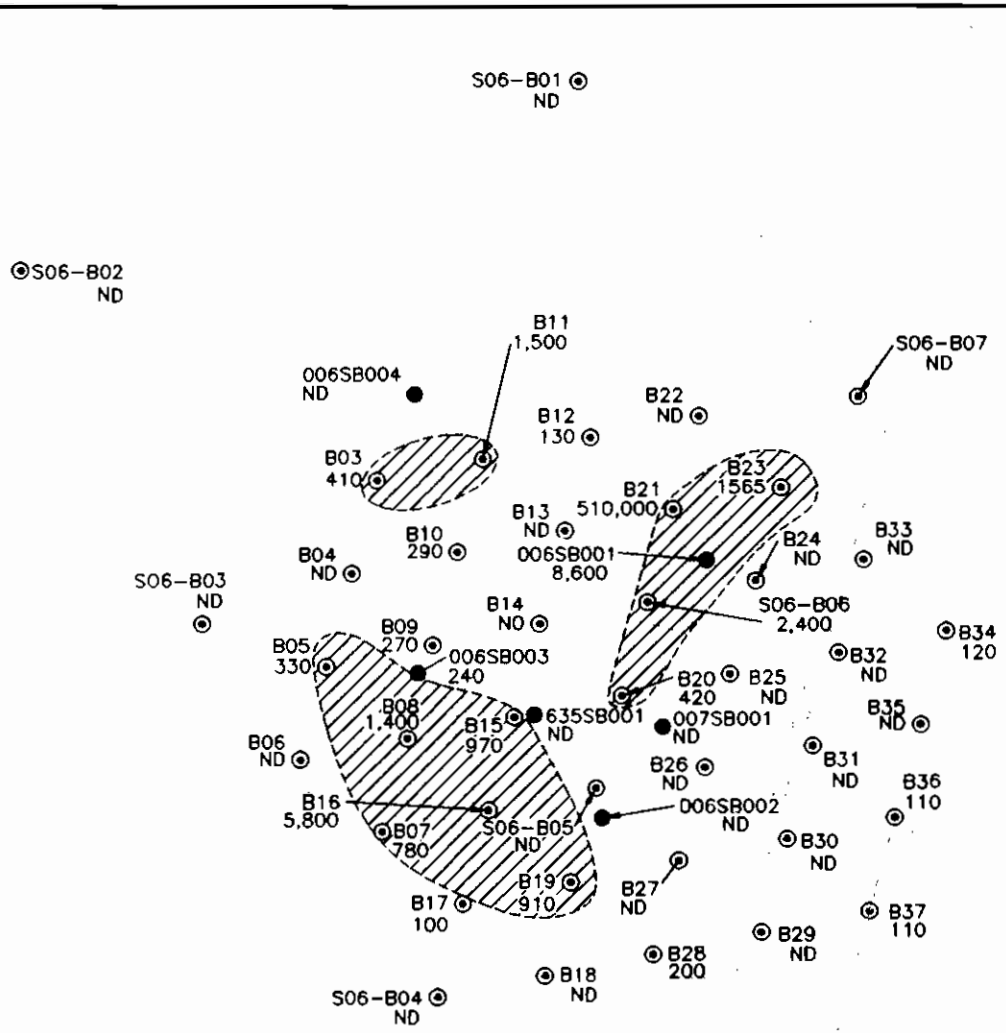
DWG DATE: 02/16/98 | DWG NAME: 2907M211



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-17
AROCLOR-1254 IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M212



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 320 μg/kg
- ▨ – > 320 μg/kg
- ◯ – APPROXIMATE EXTENT

NOTES:

- 320 μg/kg = RBC FOR AROCLOR-1260 IN SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

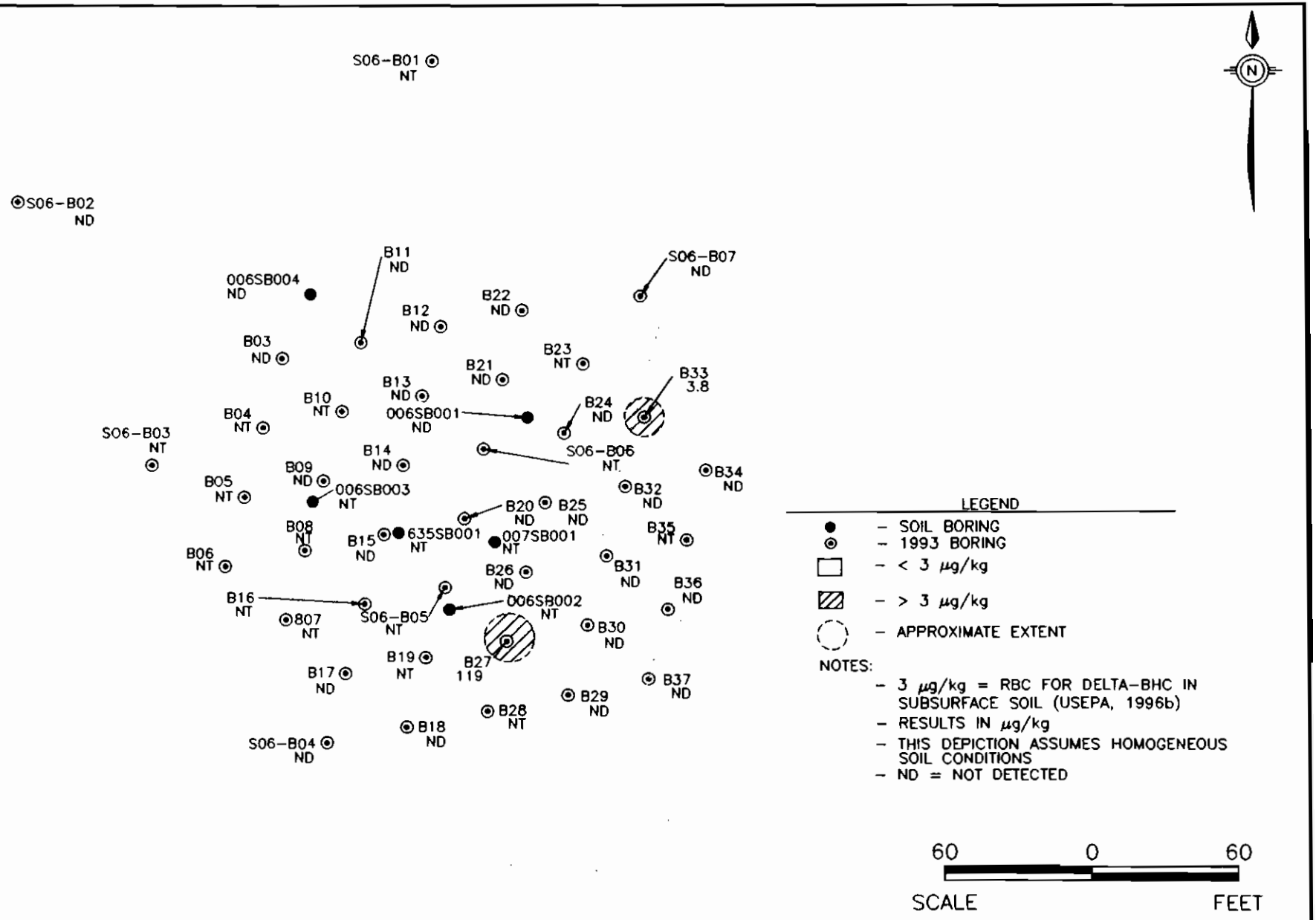
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-18
AROCLOR-1260 IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M213



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-19
DELTA-BHC IN SUBSURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M214

Other Organic Compounds in Soil

Dioxin (2,3,7,8-TCDD TEQ) was detected in two surface soil duplicate samples. Dioxin was detected at a concentration above the RBC for this parameter at one location. Figure 10.12-20 presents dioxin in surface soil at SWMUs 6, 7 and AOC 635.

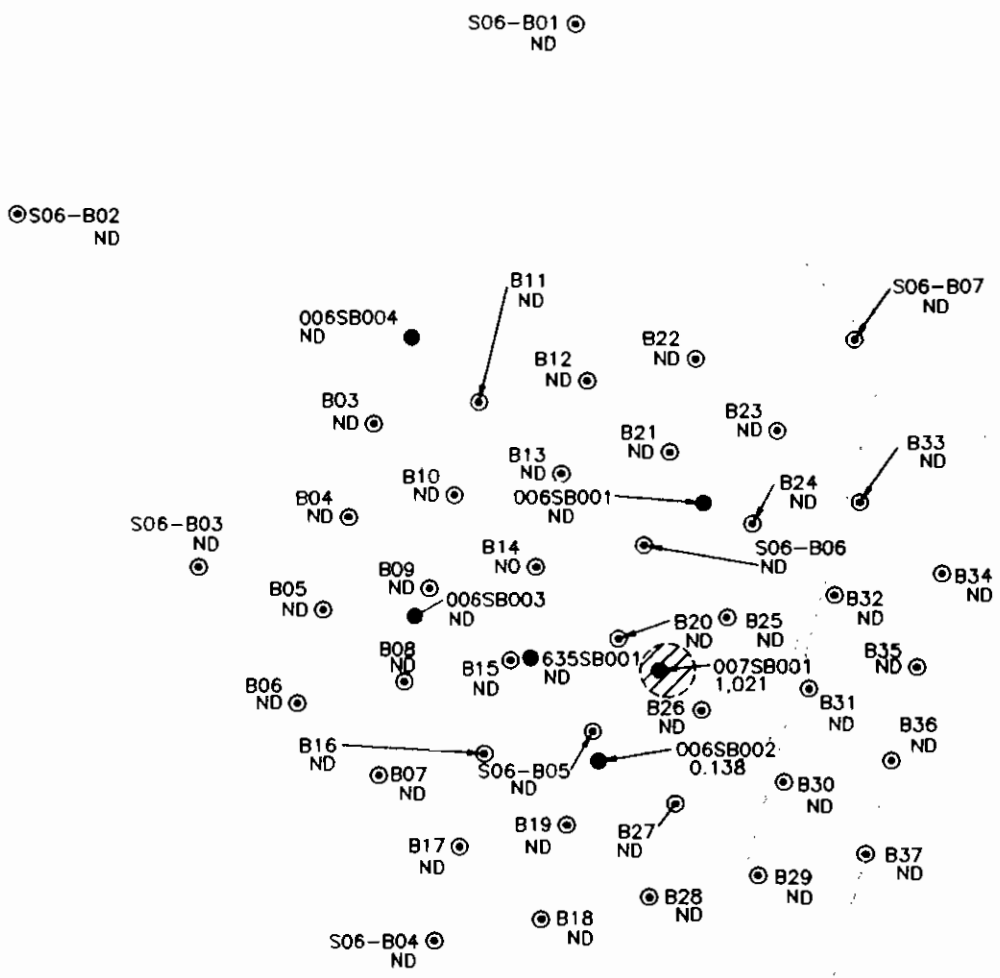
Inorganic Elements in Soil

Twenty-four metals were detected in surface soil at the combined SWMUs 6, 7 and AOC 635 site. Antimony, arsenic, chromium, lead, manganese, thallium and vanadium were detected at concentrations exceeding their respective RBCs and Zone G background concentrations for surface soil. Figures 10.12-21 through 10.12-27 present antimony, arsenic, chromium, lead, manganese, thallium, and vanadium concentrations in surface soil. Iron was also detected above its RBC. However, because iron is considered an essential nutrient no background concentration was established.

Twenty metals were detected in subsurface soil. Arsenic and mercury exceeded their respective SSLs and Zone G background concentrations for subsurface soil. Figure 10.12-28 presents arsenic concentrations in subsurface soil. Figure 10.12-29 presents mercury concentrations in subsurface soil.

10.12.4 Groundwater Sampling and Analysis

The approved final RFI work plan called for redeveloping and sampling seven existing shallow monitoring wells within the site area to identify contaminants which may be migrating from the site in the shallow aquifer. During the field investigation, seven existing monitoring wells were actually redeveloped and sampled. These wells were installed at approximately 12 ft bgs in the upper sand layer of the Wando Formation. In accordance with the approved final RFI work plan, groundwater samples were analyzed for metals, pesticides/PCBs, SVOCs and VOCs at DQO Level III. Additionally, one groundwater duplicate sample was collected for Appendix IX



LEGEND

- ● – SOIL BORING
- ◉ – 1993 BORING
- □ – < 1,000 ng/kg
- ▨ – > 1,000 ng/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 1,000 ng/kg = RBC FOR DIOXIN(2,3,7,8-TCDD TEQ) SURFACE SOIL (USEPA, OCTOBER 22, 1997)
- RESULTS IN ng/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

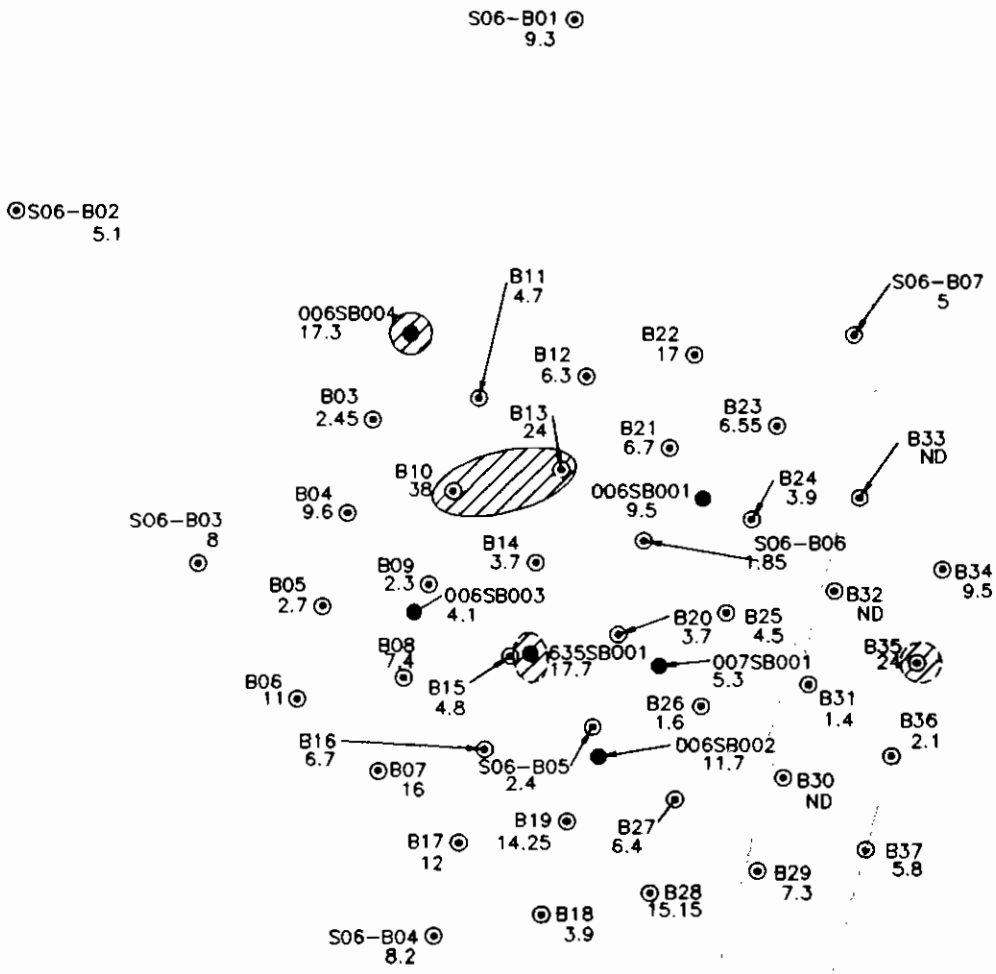
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-20
DIOXIN IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M215



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 17.2 mg/kg
- ▨ – > 17.2 mg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 17.2 mg/kg = ZONE G BACKGROUND CONCENTRATION FOR ARSENIC IN SURFACE SOIL
- RESULTS IN mg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

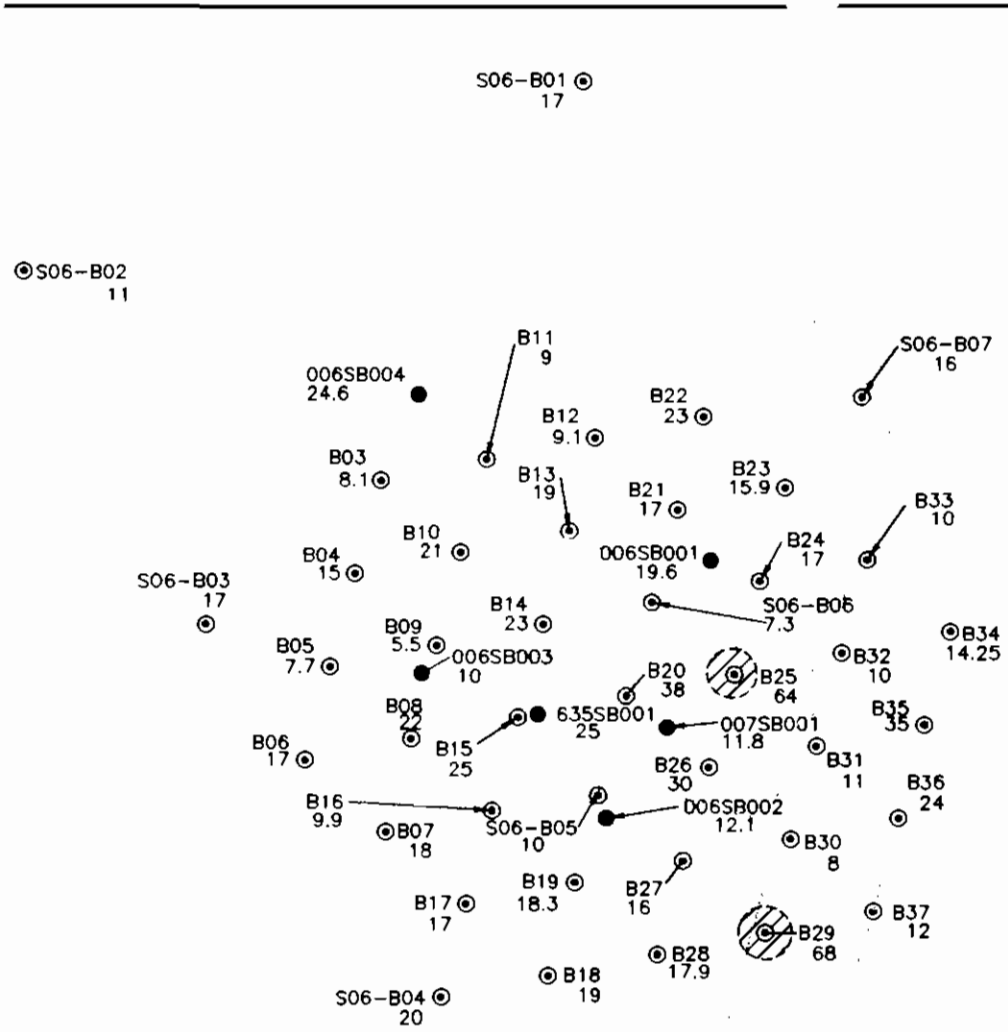
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-22
ARSENIC IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M217



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 42.8 mg/kg
- ▨ – > 42.8 mg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 42.8 mg/kg = ZONE G BACKGROUND CONCENTRATION FOR CHROMIUM IN SURFACE SOIL
- RESULTS IN mg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS

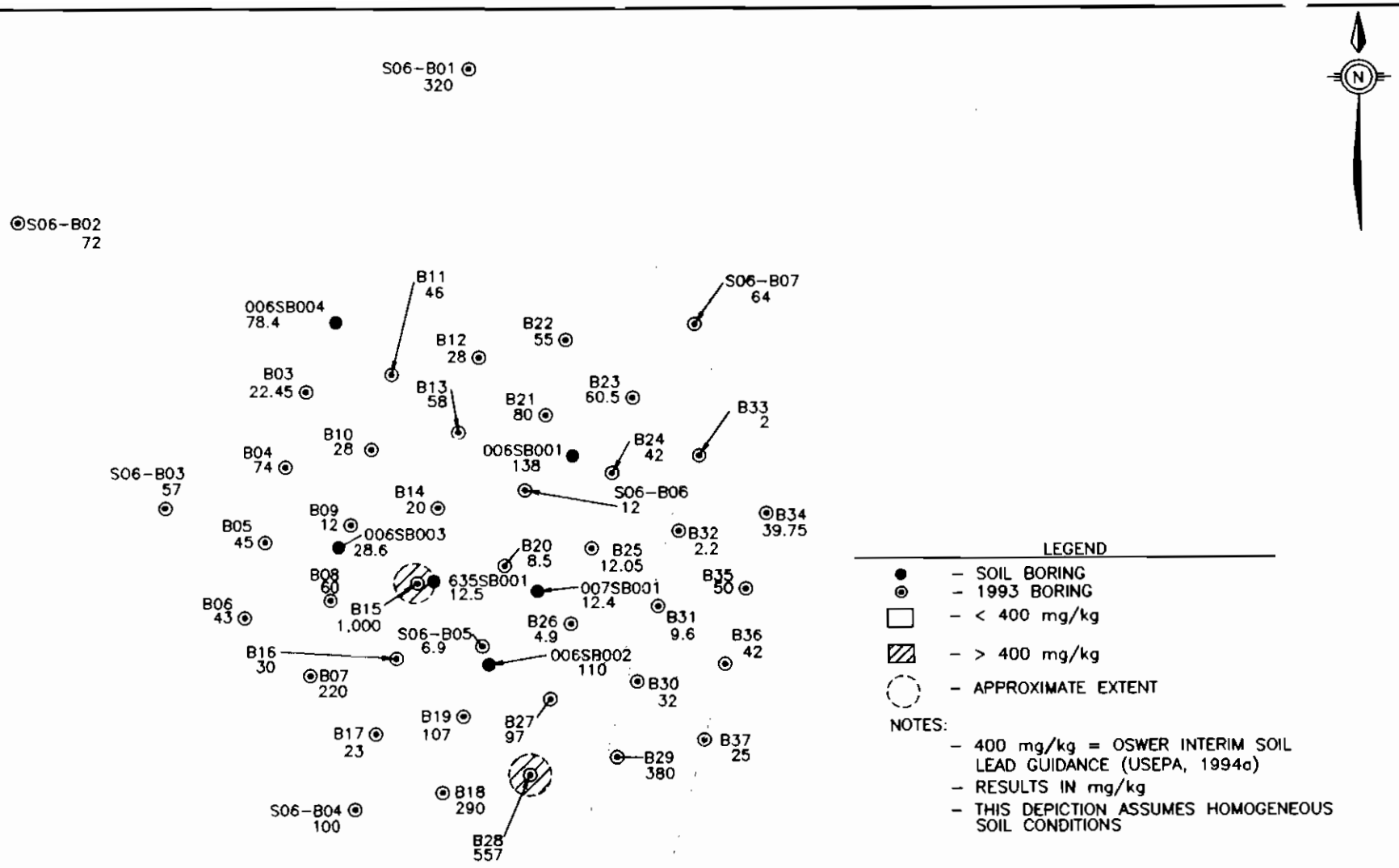
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-23
CHROMIUM IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

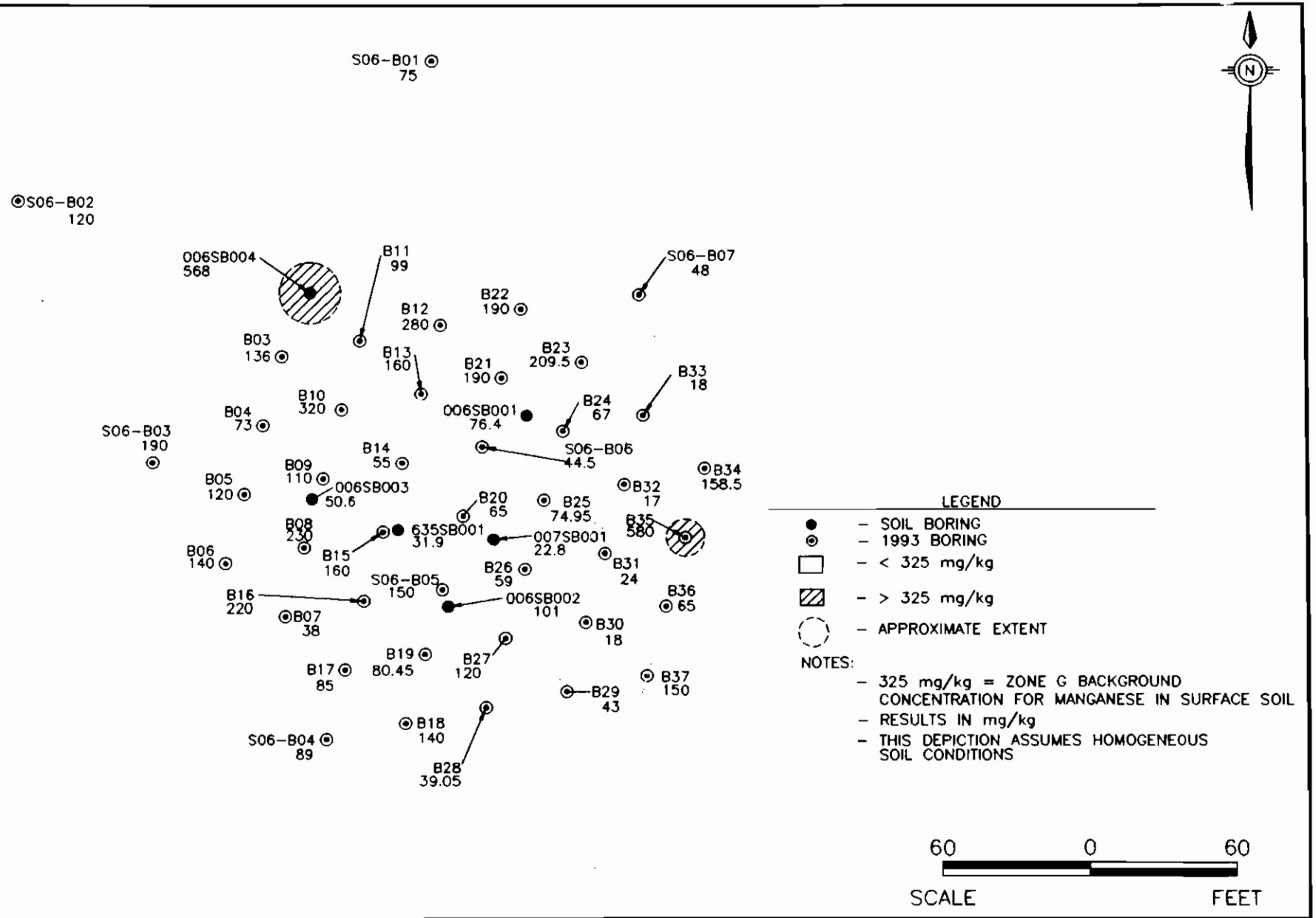
DWG DATE: 02/16/98 | DWG NAME: 2907M218



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-24
LEAD IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

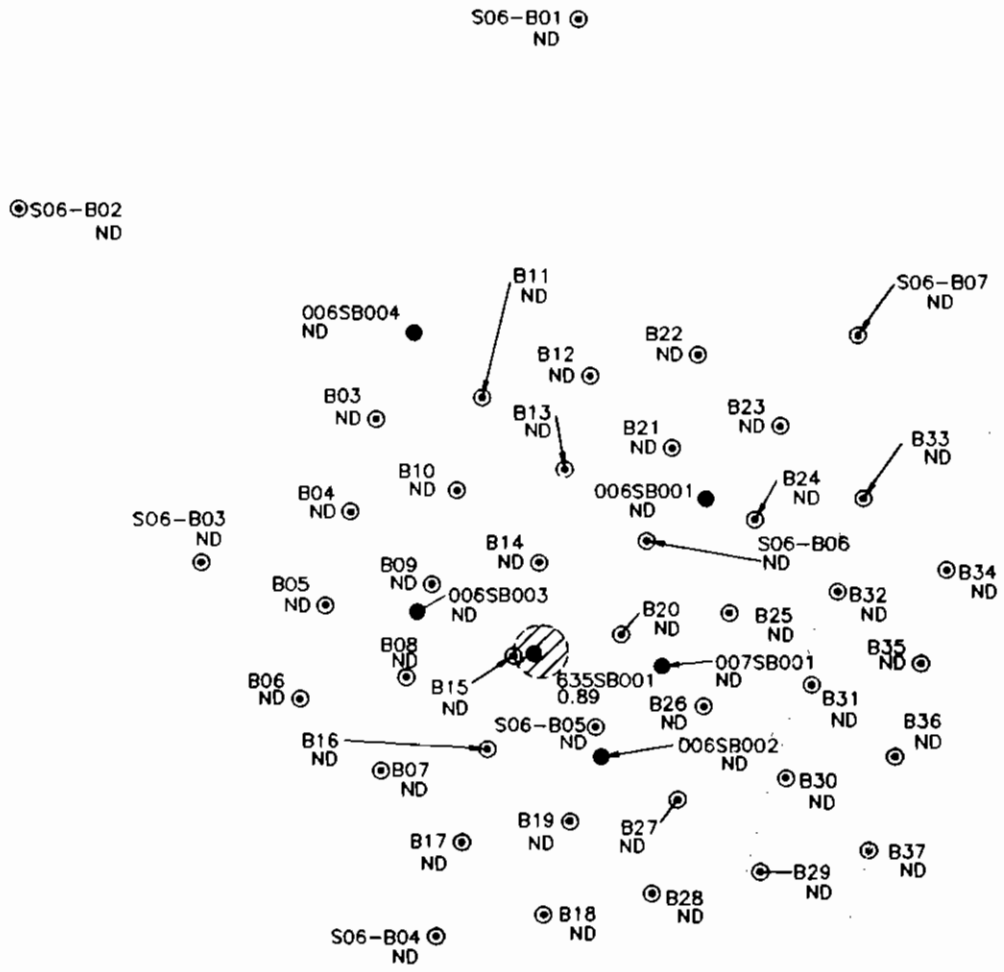
DWG DATE: 02/16/98 | DWG NAME: 2907M219



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-25
MANGANESE IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M220



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 0.85 mg/kg
- ▨ – > 0.85 mg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 0.85 mg/kg = ZONE G BACKGROUND CONCENTRATION FOR THALLIUM IN SURFACE SOIL
- RESULTS IN mg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

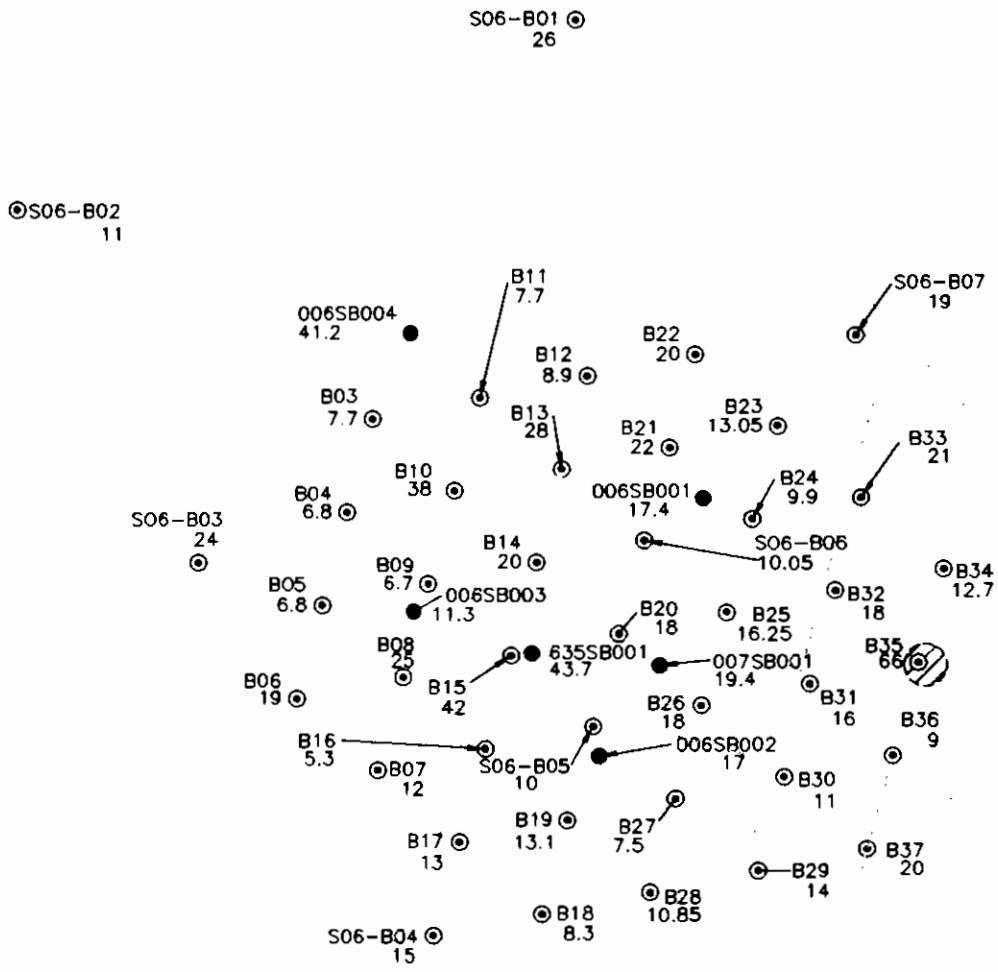
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-26
THALLIUM IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M221



LEGEND

- ● – SOIL BORING
- ⊙ – 1993 BORING
- □ – < 60.9 mg/kg
- ▨ – > 60.9 mg/kg
- ◯ – APPROXIMATE EXTENT

NOTES:

- 60.9 mg/kg = ZONE G BACKGROUND CONCENTRATION FOR VANADIUM IN SURFACE SOIL
- RESULTS IN mg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- ND = NOT DETECTED

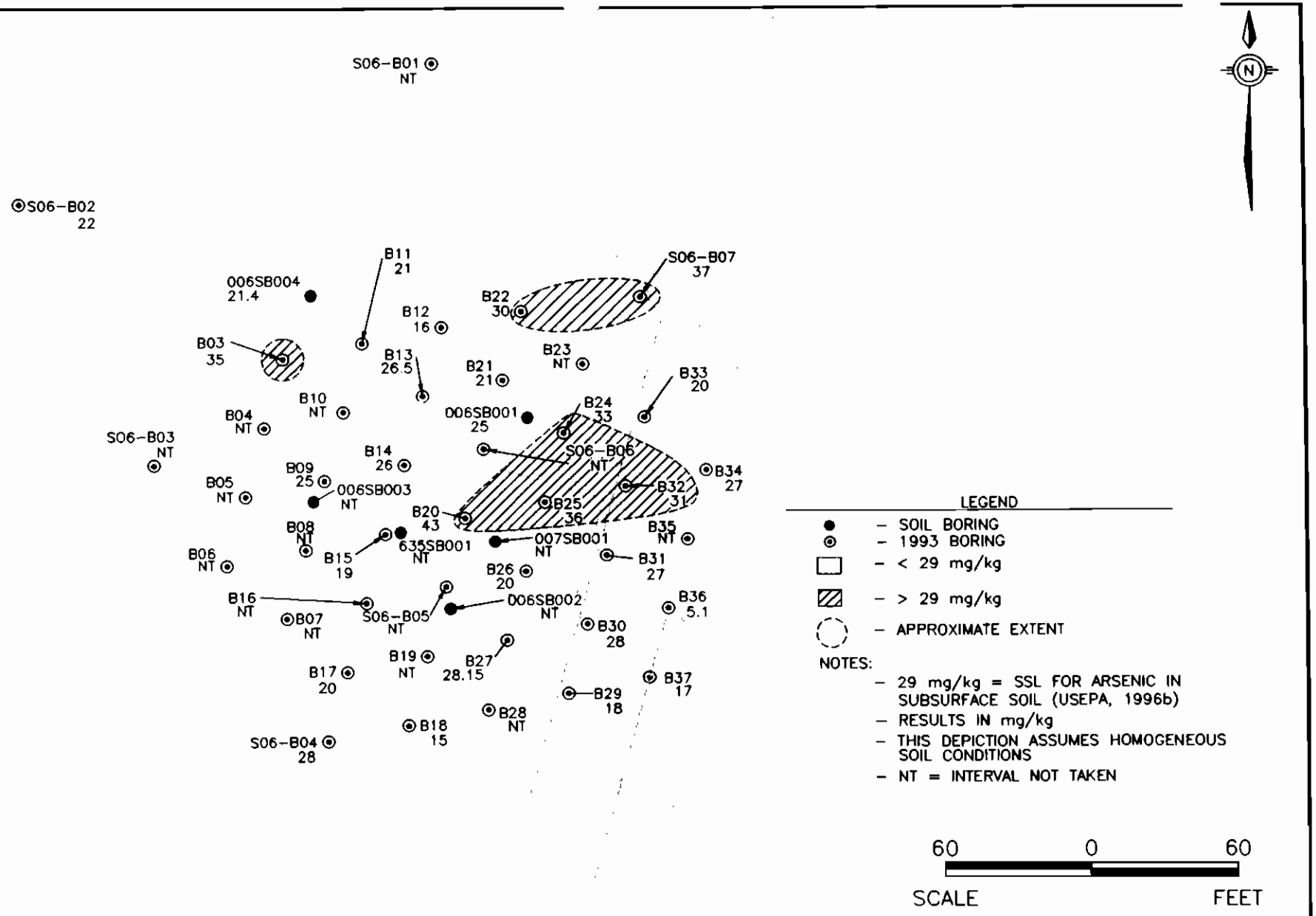
60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-27
VANADIUM IN SURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

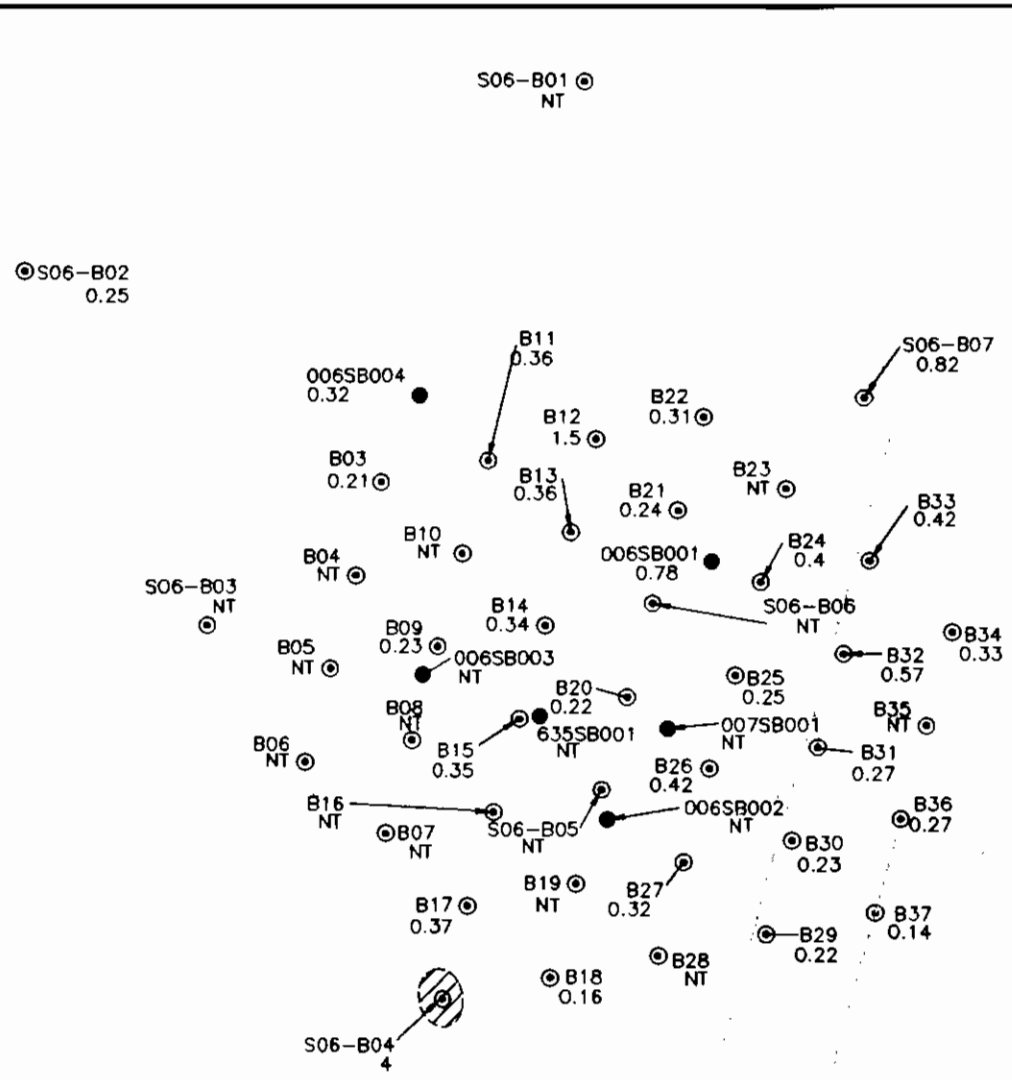
DWG DATE: 02/16/98 | DWG NAME: 2907M222



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12–28
ARSENIC IN SUBSURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M223



LEGEND

- ● – SOIL BORING
- ◉ – 1993 BORING
- □ – < 2.1 mg/kg
- ▨ – > 2.1 mg/kg
- ◌ – APPROXIMATE EXTENT

NOTES:

- 2.1 mg/kg = SSL FOR MERCURY IN SUBSURFACE SOIL (USEPA, 1996b)
- RESULTS IN mg/kg
- THIS DEPICTION ASSUMES HOMOGENEOUS SOIL CONDITIONS
- NT = INTERVAL NOT TAKEN

60 0 60

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-29
MERCURY IN SUBSURFACE SOIL
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M224

analyses at DQO Level IV. Table 10.12.8 summarized the groundwater sampling and analyses for the previously sampled SWMU 6 wells. Table 10.12.9 summarizes groundwater samples and analyses performed for the RFI.

Table 10.12.8
Zone G
SWMU 6, 7 and AOC 635
1993 Groundwater Samples and Analyses
(Pre-RFI Samples)

Well Number	Well Depth	Sample Identifier	Date Sampled	Analyses	Remarks
006001	Shallow	S06W0101	11/10/93	Note 1	
006002	Shallow	S06W0201	11/10/93	Note 1	
006003	Shallow	S06W0301	11/10/93	Note 1	
006004	Shallow	S06W0401	11/10/93	Note 1	
006005	Shallow	S06W0501	11/10/93	Note 1	
006006	Shallow	S06W0601 S06W061D*	11/10/93	Note 1	*Duplicate Sample
006007	Shallow	S06W0701	11/1/93	Note 1	

Notes:
1 = SW-846 (metals, pesticides/PCBs, SVOCs, VOCs) at DQO Level III
• = Duplicate sample

Table 10.12.9
Zone G
SWMUs 6, 7 and AOC 635
Groundwater Samples and Analyses

Well Number	Well Depth	Sample Identifier	Date Sampled	Analyses	Remarks
006001	Shallow	00600101	11/14/96	Note 1	
006002	Shallow	00600201	11/14/96	Note 1	
006003	Shallow	00600301	11/14/96	Note 1	
006004	Shallow	00600401*	11/14/96	Notes 1/2*	
006005	Shallow	00600501	11/14/96	Note 1	
060006	Shallow	00600601	11/14/96	Note 1	
006007	Shallow	00600701	11/14/96	Note 1	

Notes:
1 = SW-846 (metals, pesticides/PCBs, SVOAs, VOAs). DQO Level III
2 = Appendix IX suite: SW-846 (metals, pesticides/PCBs, herbicides, OP pesticides, dioxins, SVOAs, VOAs); cyanide; hexchrome. At DQO Level IV
* = Duplicate sample collected

10.12.4.1 Nature of Contamination in Groundwater

Organic analytical results for the RFI groundwater samples are summarized in Table 10.12.10. Inorganic analytical results for the RFI groundwater samples are summarized in Table 10.12.11. Table 10.12.12 summarizes all analytes detected in groundwater at SWMUs 6, 7 and AOC 635 during both investigations. Appendix D contains a complete analytical data report for all Zone G samples. The following nature discussion, fate and transport and HHRA use the RFI data only. The 1993 data is presented for comparison.

Volatile Organic Compounds in Groundwater

No VOCs were detected in shallow groundwater samples from SWMUs 6, 7 and AOC 635.

Semivolatile Organic Compounds in Groundwater

Two SVOCs were detected in shallow groundwater samples from SWMUs 6, 7 and AOC 635, pentachlorophenol was detected at a concentration exceeding its tap water RBC. Figure 10.12-30 presents pentachlorophenol concentrations in groundwater at the combined SWMUs 6, 7 and AOC 635.

Pesticides and PCBs in Groundwater

No pesticides or PCBs were detected in shallow groundwater at SWMUs 6, 7 and AOC 635.

Inorganic Elements in Groundwater

Nineteen metals were detected in shallow groundwater samples at the combined SWMUs 6, 7 and AOC 635. Concentrations of arsenic, barium, and beryllium exceeded their respective tap water RBCs and Zone G shallow groundwater background concentrations. Figures 10.12-31 through 10.12-33 present arsenic, barium, and beryllium concentrations respectively in shallow groundwater. Iron was detected above its tap water RBC but because it is considered an essential element, no background was established.

Table 10.12.10
Zone G
SWMU 6, SWMU 7, AOC 635
Organic Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μG/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding Reference
Semivolatile Organic Compounds (7 Shallow Samples) (μg/L)							
Acenaphthene	Shallow	2/7	1 - 2	1.5	220	NL	0
Pentachlorophenol	Shallow	1/7	2	2	0.56	1	1

Notes:
NL = Not listed
* = Tap Water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from Drinking Water Regulations and Health Advisories (USEPA, 1996d)
μg/L = Micrograms per liter

Table 10.12.11
Zone G
SWMU 6, SWMU 7, AOC 635
Inorganic Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μg/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding RBC
Inorganics (7 Shallow Samples) (μg/L)							
Aluminum (Al)	Shallow	7/7	18.2 - 2400	740	3700	50	0
Arsenic (As)	Shallow	7/7	6.10 - 269	48.6	0.045	50	7
Barium (Ba)	Shallow	7/7	15.7 - 302	102	260	2000	1
Beryllium (Be)	Shallow	7/7	0.360 - 1.40	1.05	0.016	4	7
Calcium (Ca)	Shallow	7/7	118000 - 284000	197000	NL	NL	NA
Chromium (Cr)	Shallow	4/7	0.860 - 9.20	5.24	18	100	0
Cobalt (Co)	Shallow	5/7	1.20 - 4.50	2.22	220	NL	0
Iron (Fe)	Shallow	7/7	6590 - 75100	28900	NL	300	NA
Lead (Pb)	Shallow	7/7	1.80 - 7.00	3.33	15	15	0
Magnesium (Mg)	Shallow	7/7	163000 - 714000	466000	NL	NL	NA
Manganese (Mn)	Shallow	7/7	488 - 1610	973	84	50	7
Mercury (Hg)	Shallow	2/7	0.1000	0.1000	1.1	2	0
Nickel (Ni)	Shallow	1/7	55.1	55.1	73	100	0
Potassium (K)	Shallow	7/7	52900 - 203000	139000	NL	NL	NA

Table 10.12.11
Zone G
SWMU 6, SWMU 7, AOC 635
Inorganic Analytical Results for Groundwater

Parameters	Interval	Frequency of Detection	Range of Detections (μg/L)	Mean of Detections (μg/L)	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Number of Samples Exceeding RBC
Selenium (Se)	Shallow	2/7	3.10 - 5.30	4.20	18	50	0
Silver (Ag)	Shallow	2/7	5.00 - 5.90	5.45	18	100	0
Sodium (Na)	Shallow	7/7	1260000 - 6040000	3760000	NL	NL	NA
Vanadium (V)	Shallow	7/7	0.590 - 13.5	4.24	26	NL	0
Zinc (Zn)	Shallow	2/7	5.40 - 49.9	27.7	1100	5000	0

Notes:

*	=	Tap Water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996d)
μg/L	=	Micrograms per liter
NL	=	Not listed
NA	=	Not applicable

Table 10.12.12
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (µg/L)	MCL/SMCL* (µg/L)	Shallow Background
Volatile Organic Compounds (µg/L)							
Xylene (Total)	S06W05	12	NT	NT	1200	10000	NA
	006005	ND	2	2			
Semivolatile Organic Compounds (µg/L)							
Pentachlorophenol	006004	2	ND	ND	0.56	1	NA
Di-n-butylphthalate	006001	ND	ND	2	370	NL	NA
Anthracene	S06W05	0.74	NT	NT			NA
Acenaphthene	S06W05	2	NT	NT	220	NL	NA
	006004	1	3	2			
	006005	2	1	1			
Dibenzofuran	S06W05	1.3	NT	NT	15	NL	NA
2-Methylnaphthalene	S06W05	2.9	NT	NT	150	NL	NA
	006005	ND	2	ND			
4-Methylphenol (p-Cresol)	S06W01	2.9	NT	NT	18	NL	NA
Naphthalene	S06W05	2.9	NT	NT	150	NL	NA
Fluorene	S06W05	3.5	NT	NT	150	NL	NA
	006005	ND	2	2			
Phenol	S06W03	7.2	NT	NT	2200	NL	NA

Table 10.12.12
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (µg/L)	MCL/SMCL* (µg/L)	Shallow Background
Phenanthrene	S06W05	5.1	NT	NT	150	NL	NA
	006005	ND	3	3			
Pesticides/PCBs (µg/L)							
4,4'-DDD	006005	ND	0.1	ND	0.28	NL	NA
Inorganics (µg/L)							
Aluminum (Al)	S06W03	630	NT	NT	3700	50	692
	006001	2400	ND	23.5			
	006002	136	226	562			
	006003	394	160	104			
	006004	1281	74.8	195			
	006005	191	278	ND			
	006006	758	ND	ND			
	006007	18.2	ND	54.9			
Arsenic (As)	S06W06	12.3	NT	NT	0.045	50	17.8
	006001	8.5	ND	23.5			
	006002	6.1	ND	562			
	006003	269	560	373			
	006004	21.7	6.4	13.9			
	006005	7.2	ND	2.5			
	006006	10.1	4.9	5.5			
	006007	17.8	4.3	11.3			

Table 10.12.12
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Barium (Ba)	S06W02	48	NT	NT	260	2000	31
	S06W03	140	NT	NT			
	S06W04	150	NT	NT			
	S06W05	46	NT	NT			
	S06W06	34.35	NT	NT			
	S06W07	11	NT	NT			
	006001	54	19.9	10.7			
	006002	38.4	39.5	46.1			
	006003	**302**	**400**	**559**			
	006004	208	**273**	**302**			
	006005	41	32.9	47			
	006006	51.7	18.9	22			
	006007	15.7	11.3	16.8			
Beryllium (Be)	006001	**1.4**	**0.2**	ND	0.016	4	NL
	006002	**1.2**	**0.48**	**0.76**			
	006003	**0.92**	**0.3**	**0.3**			
	006004	**0.95**	**0.27**	**0.24**			
	006005	**1.1**	**0.33**	**0.34**			
	006006	**1.4**	**0.26**	ND			
	006007	**0.36**	ND	ND			

Table 10.12.12
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Calcium (Ca)	S06W01	130000	NT	NT	NL	NL	NL
	S06W02	170000	NT	NT			
	S06W03	280000	NT	NT			
	S06W04	240000	NT	NT			
	S06W05	150000	NT	NT			
	S06W06	150000	NT	NT			
	S06W07	72000	NT	NT			
	006001	279000	198000	95900			
	006002	170000	156000	162000			
	006003	284000	226000	289000			
	006004	207500	213500	180000			
	006005	157000	127000	148500			
	006006	165000	88700	98900			
	006007	118000	102000	97000			
Chromium (Cr)	006001	9.2	ND	ND	18	100	3.88
	006002	ND	ND	1.6			
	006003	0.86	ND	ND			
	006004	5.8	ND	1.8			
	006005	ND	ND	1.2			
	006006	5.1	ND	ND			
	006007	ND	ND	1.3			
Cobalt (Co)	006001	2.2	ND	ND	220	NL	1.45
	006002	1.5	1.9	2.5			
	006003	ND	ND	0.9			
	006004	1.7	ND	1.2			
	006005	1.2	1.7	2.2			
	006006	4.5	0.82	ND			
	006007	ND	0.98	ND			

Table 10.12.12
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Iron (Fe)	S06W01	**1700**	NT	NT	1100	300	NL
	S06W02	**14000**	NT	NT			
	S06W03	**19000**	NT	NT			
	S06W04	**34000**	NT	NT			
	S06W05	**13000**	NT	NT			
	S06W06	**7700**	NT	NT			
	S06W07	**1700**	NT	NT			
	006001	**12400**	**3420**	660			
	006002	**17600**	**15500**	**14500**			
	006003	**75100**	**62900**	**68400**			
	006004	**66200**	**53450**	**36500**			
	006005	**16800**	**13400**	**13900**			
	006006	**17300**	**5330**	**5180**			
	006007	**6590**	**3020**	**4500**			
Lead (Pb)	006001	4.9	ND	ND	15	15	4.6
	006002	2.2	ND	ND			
	005003	2.3	ND	ND			
	006004	7.0	ND	ND			
	006005	1.8	ND	ND			
	006006	1.8	ND	ND			
	006007	3.3	ND	ND			

Table 10.12.12
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Magnesium (Mg)	S06W01	57000	NT	NT	NL	NL	NL
	S06W02	670000	NT	NT			
	S06W03	74000	NT	NT			
	S06W04	400000	NT	NT			
	S06W05	630000	NT	NT			
	S06W06	503000	NT	NT			
	S06W07	120000	NT	NT			
	006001	562000	596000	20900			
	006002	634000	552000	588000			
	006003	163000	114000	68400			
	006004	360000	170500	195000			
	006005	614000	470000	562500			
	006006	714000	278000	283000			
	006007	214000	133000	199000			
Manganese (Mn)	S06W01	920	NT	NT	84	50	2906
	S06W02	640	NT	NT			
	S06W03	1600	NT	NT			
	S06W04	510	NT	NT			
	S06W05	420	NT	NT			
	S06W06	136.5	NT	NT			
	S06W07	470	NT	NT			
	006001	1610	864	252			
	006002	720	720	562			
	006003	1590	1100	1280			
	006004	554	626	420			
	006005	488	378	404			
	006006	1000	118	120			
	006007	849	669	385			
Mercury (Hg)	006004	0.1	ND	ND	1.1	2.0	NL
	006005	0.1	ND	ND			

Table 10.12.12
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Shallow Groundwater

Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Nickel (Ni)	006001	ND	ND	1.3	73	100	4.08
	006004	ND	ND	1.2			
	006005	ND	2.4	2.9			
	006006	55.1	ND	0.72			
	006007	ND	1.4	ND			
Potassium (K)	S06W01	31000	NT	NT	NL	NL	NL
	S06W02	190000	NT	NT			
	S06W03	36000	NT	NT			
	S06W04	130000	NT	NT			
	S06W05	190000	NT	NT			
	S06W06	152500	NT	NT			
	S06W07	57000	NT	NT			
	006001	151000	28500	15700			
	006002	193000	169000	177000			
	006003	52900	49600	56400			
	006004	108400	69250	73100			
	006005	189000	142000	171000			
	006006	203000	105000	112000			
	006007	73100	49300	73800			
Selenium (Se)	006003	5.3	ND	ND	18	50	4.3
	006004	3.1	ND	ND			
Silver (Ag)	006002	ND	ND	1.1	18	100	1.65
	006004	5	ND	ND			
	006006	5.9	ND	ND			

Table 10.12.12
Zone G
SWMU 6, SWMU 7, AOC 635
Analytes Detected in Shallow Groundwater

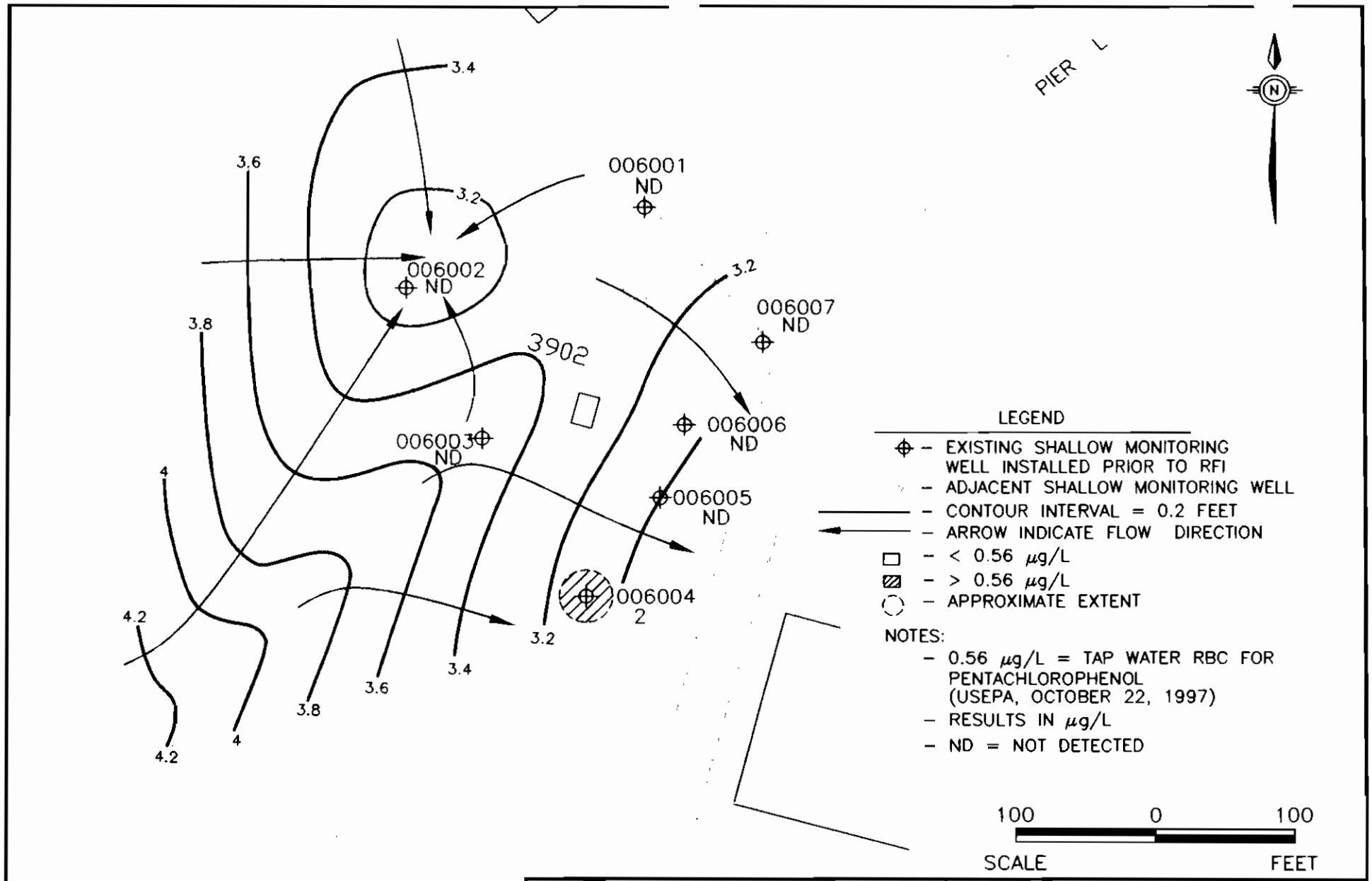
Parameters	Location	1st Quarter Conc.	2nd Quarter Conc.	3rd Quarter Conc.	Tap Water RBC* (μg/L)	MCL/SMCL* (μg/L)	Shallow Background
Sodium (Na)	S06W01	480000	NT	NT	NL	NL	NL
	S06W02	5700000	NT	NT			
	S06W03	690000	NT	NT			
	S06W04	3500000	NT	NT			
	S06W05	6000000	NT	NT			
	S06W06	2385000	NT	NT			
	S06W07	1300000	NT	NT			
	006001	4430000	242000	52900			
	006002	5530000	5230000	5590000			
	006003	1260000	1070000	1450000			
	006004	1450000	1450000	1860000			
	006005	5040000	4000000	4780000			
	006006	6040000	2710000	3060000			
	006007	1290000	893000	1590000			
Thallium (Tl)	006002	ND	**6.7**	ND	0.29	2	NL
	006003	ND	**6.8**	ND			
	006004	ND	**9.3**	ND			
	006005	ND	**6.3**	ND			
Vanadium (V)	006001	13.5	1.9	1.6	26	NL	15.4
	006002	1.8	3.3	3.8			
	006003	1.1	ND	2.3			
	006004	5.4	1.4	2.6			
	006005	1.7	4	3.5			
	006006	5.6	1.4	1.2			
	006007	0.59	3	2.2			
Zinc (Zn)	S06W03	21	NT	NT	1100	5000	15.6
	006003	5.4	ND	ND			
	006004	49.9	ND	ND			
	006006	ND	ND	6.5			

Notes:

NL	=	Not listed
NA	=	Not applicable
NT	=	Not taken
µg/L	=	Micrograms per liter
*	=	Tap Water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996d)

Bolded concentrations exceed both the RBC and the zone background

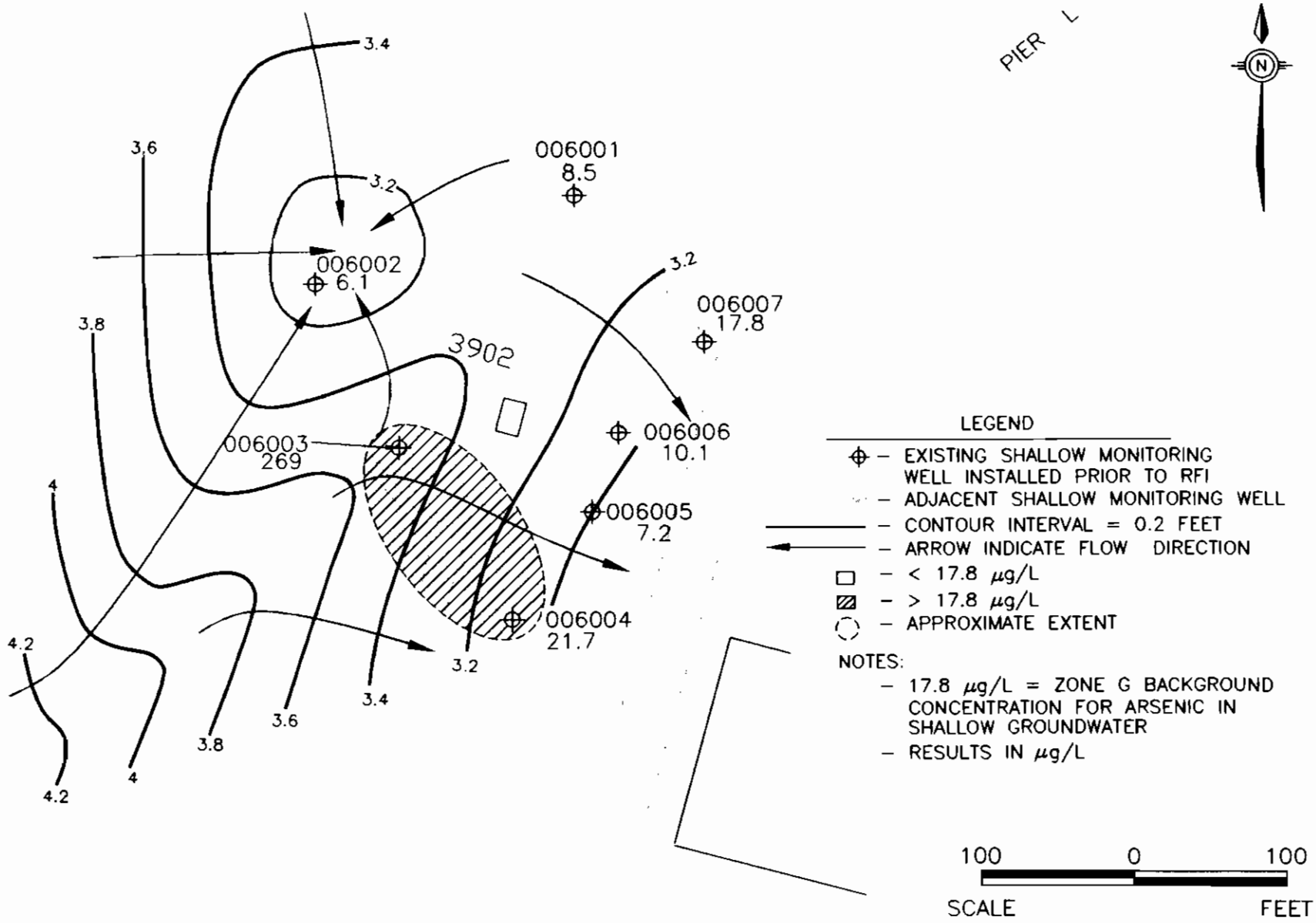
All background values for Zone G are based on twice the means of the grid sample concentrations. Background values for groundwater are based on two sampling rounds in two wells at each depth



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-30
PENTACHLOROPHENOL IN SHALLOW GROUNDWATER
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 390
BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

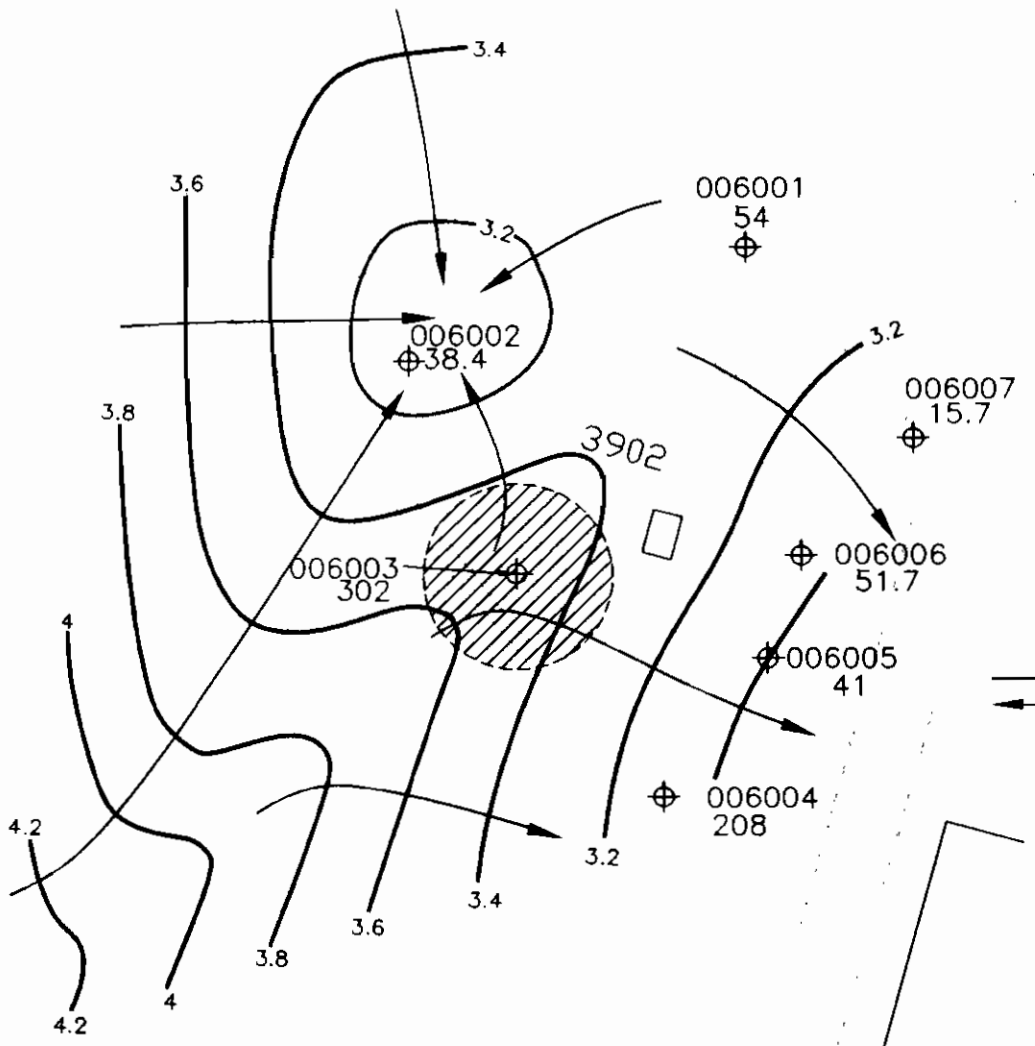
DWG DATE: 02/16/98 | DWG NAME: 2907M226



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12–31
ARSENIC IN SHALLOW GROUNDWATER
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 390
BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M227



LEGEND

- ⊕ – EXISTING SHALLOW MONITORING WELL INSTALLED PRIOR TO RFI
- – ADJACENT SHALLOW MONITORING WELL
- – CONTOUR INTERVAL = 0.2 FEET
- – ARROW INDICATE FLOW DIRECTION
- □ – < 260 μg/L
- ▨ – > 260 μg/L
- ◌ – APPROXIMATE EXTENT

NOTES:

- 260 μg/L = TAP WATER RBC FOR BARIUM (USEPA, OCTOBER 22, 1997)
- RESULTS IN μg/L

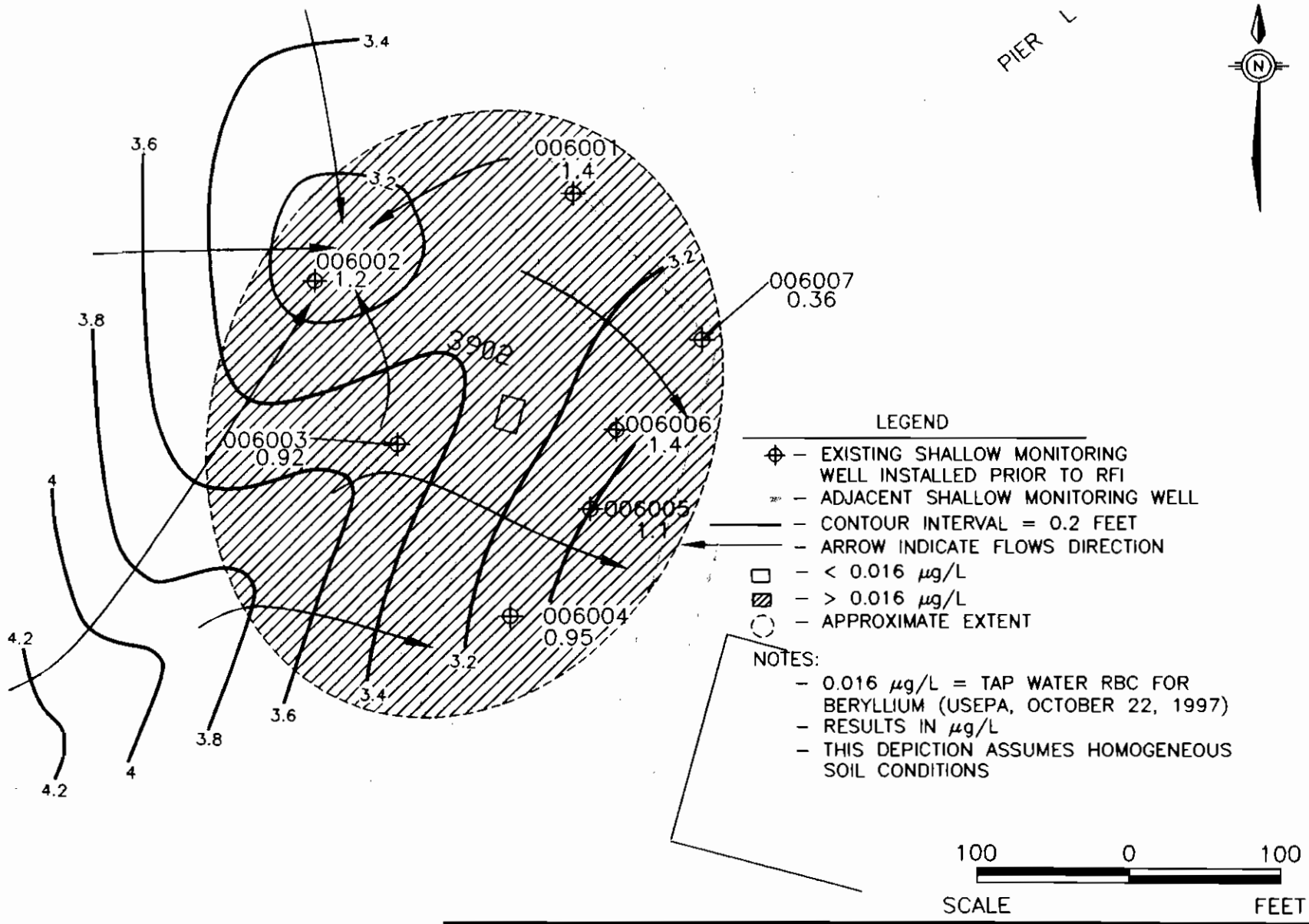
100 0 100

SCALE FEET

ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-32
BARIUM IN SHALLOW GROUNDWATER
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 390
BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

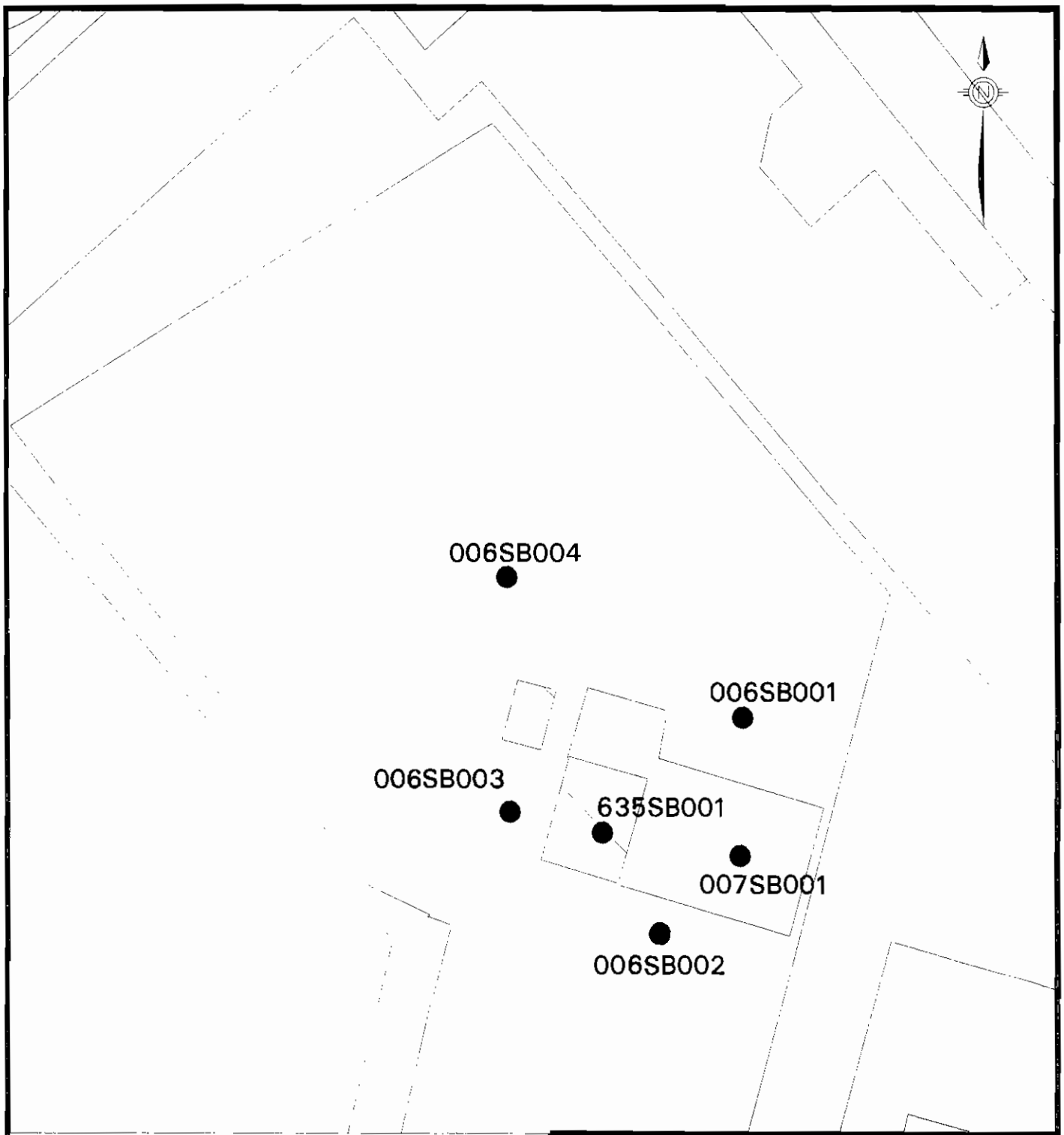
DWG DATE: 02/16/98 | DWG NAME: 2907M228



ZONE G
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-33
BERYLLIUM IN SHALLOW GROUNDWATER
SWMU #6 PUBLIC WORKS STORAGE YARD
SWMU #7 PCB TRANSFORMER STORAGE, BLDG 390
BLDG 3902
AOC #635 PAINT AND OIL STOREHOUSE

DWG DATE: 02/16/98 | DWG NAME: 2907M229



LEGEND

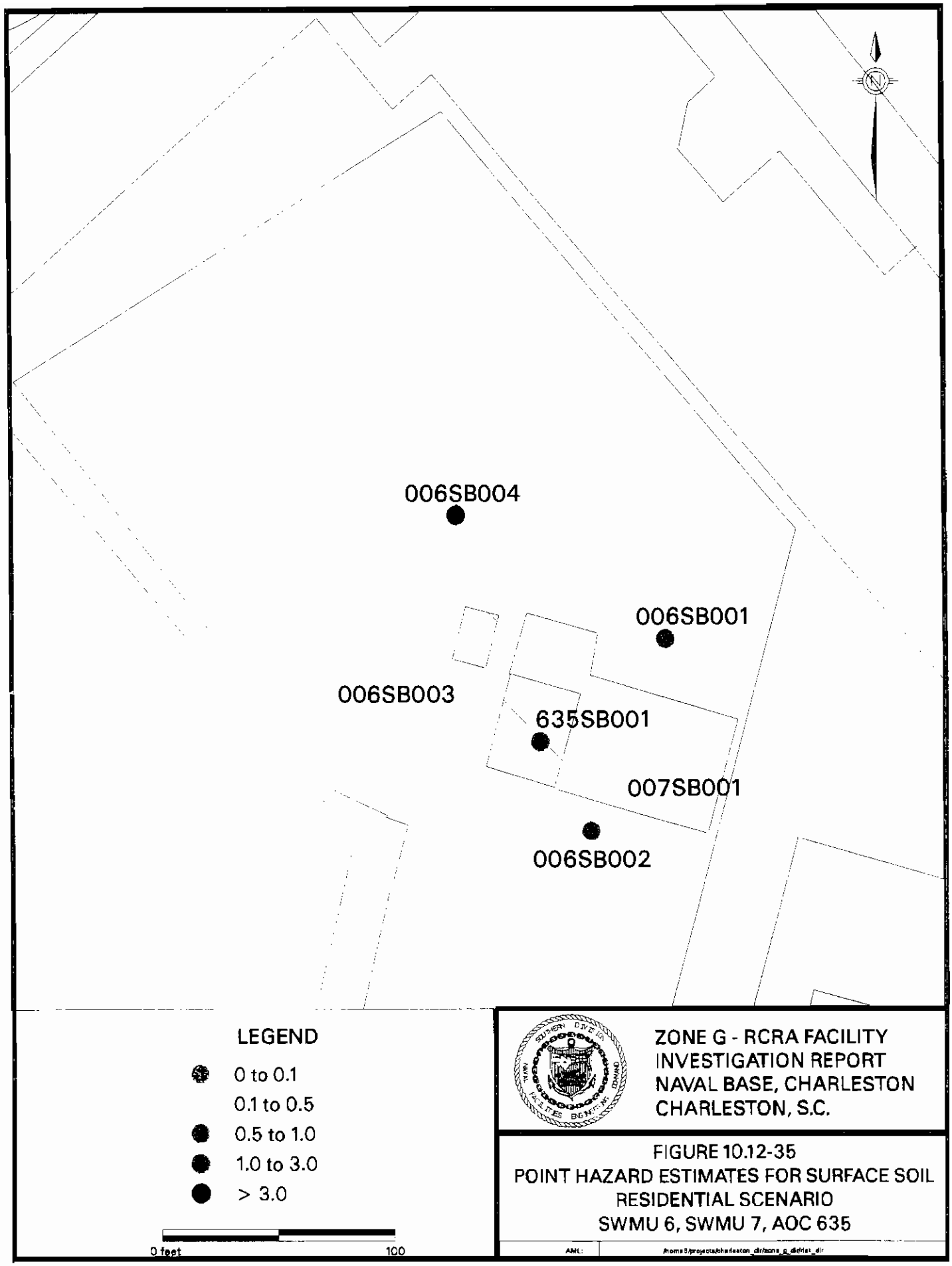
- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 100

ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-34
POINT RISK ESTIMATES FOR SURFACE SOIL
RESIDENTIAL SCENARIO
SWMU 6, SWMU 7, AOC 635

AML: /home3/projects/charleston_dir/zone_g_dir/risk_el



ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-35
POINT HAZARD ESTIMATES FOR SURFACE SOIL
RESIDENTIAL SCENARIO
SWMU 6, SWMU 7, AOC 635

AML: /home3/projects/charleston_dir/zone_g_dir/rist_dir

10.12.5 Fate and Transport Assessment

These sites were combined into one investigation due to their close proximity and their potential for similar COPCs. Known as the Public Works Storage Yard, SWMU 6 is an unpaved, open, fenced storage yard located north of Hobson Avenue, south of River Road, and southeast of Thirteenth Street. The fenced area within SWMU 6 encompasses two other RFI sites associated with activities which took place in and around Building 3902. SWMU 7 consisted of Building 3902, the concrete slab adjacent to the building, and the surrounding areas which were used for storage of transformers and associated electrical equipment between 1970 and 1976. AOC 635 consists of the paint and oil storehouse at Building 3902.

10.12.5.1 Soil-to-Groundwater Cross-Media Transport

Table 10.12.13 compares maximum detected organic constituent concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels or (b) background concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 20:1, with no attenuation of constituents in soil (DAF=20).

Sixteen organic compounds exceeded SSLs in both surface and subsurface soil. Eight of these were SVOCs and the remainder were pesticides or PCBs. Of the eight species of SVOCs, only two (see Table 10.12.13) exceeded the applicable SSLs in subsurface soil. Of the eight species of pesticides and PCBs, only one-delta BHC- was greater that the applicable SSL in subsurface soil. Both the nature and distribution of organic contamination in soil is consistent with past site activities, namely storage of various types of wastes which likely resulted in unavoidable surface releases. The vertical distribution of contamination is remarkable in the attenuation of contaminants as a function of depth within the soil column, a trend that is to be expected with surface releases and with the types of contaminants involved. Notably, of all of the compounds

Table 10.12.13
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Saltwater Surface Water Chronic Screening Levels, and Background Concentrations
NAVBASE Charleston, Zone G: SWMUs 6 and 7 and AOC 635
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Saltwater Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Acetone	2100	1200	ND	NA	16000	3700	NA	UG/KG	UG/L	NO	NO	NO
2-Butanone	13	93	ND	NA	7900	1900	NA	UG/KG	UG/L	NO	NO	NO
Carbon disulfide	26	60	ND	NA	32000	1000	NA	UG/KG	UG/L	NO	NO	NO
Chlorobenzene	160	450	ND	NA	1000	39	105	UG/KG	UG/L	NO	NO	NO
1,1-Dichloroethane	37	ND	ND	NA	23000	810	NA	UG/KG	UG/L	NO	NO	NO
Tetrachloroethene	11	ND	ND	NA	60	1.1	NA	UG/KG	UG/L	NO	NO	NO
Toluene	10	3.9	ND	NA	12000	750	37	UG/KG	UG/L	NO	NO	NO
1,1,1-Trichloroethane	240	3.9	ND	NA	2000	540	NA	UG/KG	UG/L	NO	NO	NO
Xylene (Total)	57	24	ND	NA	148000	12000	ND	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Acenaphthene	3400	610	2	NA	570000	2200	9.7	UG/KG	UG/L	NO	NO	NO
Acenaphthylene	11000	140	ND	NA	293000	1500	NA	UG/KG	UG/L	NO	NO	NO
Anthracene	14000	1700	ND	NA	12000000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	3100	1200	ND	NA	4.66E+08	1500	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	14000	2700	ND	NA	2000	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(a)pyrene	10000	2200	ND	NA	8000	0.0092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(b)fluoranthene	13000	2800	ND	NA	5000	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(k)fluoranthene	5200	1100	ND	NA	49000	0.92	NA	UG/KG	UG/L	NO	NO	NO
Chrysene	11000	2400	ND	NA	160000	9.2	NA	UG/KG	UG/L	NO	NO	NO
Dibenzo(a,h)anthracene	1300	380	ND	NA	2000	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Indeno(1,2,3-cd)pyrene	6000	1300	ND	NA	14000	0.092	NA	UG/KG	UG/L	NO	NO	NO
Bis(2-Ethylhexyl)phthalate (BEHP)	1600	180	ND	NA	3600000	4.8	NA	UG/KG	UG/L	NO	NO	NO
Carbazole	4800	720	ND	NA	600	3.4	NA	UG/KG	UG/L	YES	NO	NO
Dibenzofuran	7900	640	ND	NA	240000	150	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	48.5	98	ND	NA	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
1,2-Dichlorobenzene	9200	ND	ND	NA	17000	64	NA	UG/KG	UG/L	NO	NO	NO
1,4-Dichlorobenzene	10000	ND	ND	NA	2000	0.44	19.9	UG/KG	UG/L	YES	NO	NO
3,3'-Dichlorobenzidine	82	ND	ND	NA	7	0.15	NA	UG/KG	UG/L	YES	NO	NO
Fluoranthene	24000	6000	ND	NA	4300000	1500	1.6	UG/KG	UG/L	NO	NO	NO
Fluorene	14000	1500	ND	NA	560000	1500	NA	UG/KG	UG/L	NO	NO	NO
2-Methylnaphthalene	15000	350	ND	NA	126000	1500	NA	UG/KG	UG/L	NO	NO	NO
Naphthalene	16000	430	ND	NA	84000	1500	23.5	UG/KG	UG/L	NO	NO	NO
Pentachlorophenol	2900	ND	2	NA	30	0.56	7.9	UG/KG	UG/L	YES	YES	NO
Phenanthrene	30000	6600	ND	NA	1380000	1500	NA	UG/KG	UG/L	NO	NO	NO
Pyrene	30000	5200	ND	NA	4200000	1100	NA	UG/KG	UG/L	NO	NO	NO
1,2,4-Trichlorobenzene	17000	ND	ND	NA	5000	190	NA	UG/KG	UG/L	YES	NO	NO
2,3,4,6-Tetrachlorophenol	120	NA	ND	NA	9000	1100	NA	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
Aroclor-1254	26000	ND	ND	NA	1000	0.034		UG/KG	UG/L	YES	NO	NO
Aroclor-1260	510000	930	ND	NA	1000	0.034	0.03	UG/KG	UG/L	YES	NO	NO
alpha-BHC	39000	ND	ND	NA	0.5	0.011	1400	UG/KG	UG/L	YES	NO	NO
beta-BHC	3800	ND	ND	NA	3	0.037	NA	UG/KG	UG/L	YES	NO	NO
delta-BHC	28000	119	ND	NA	3	0.037	NA	UG/KG	UG/L	YES	NO	NO
gamma-BHC (Lindane)	76000	ND	ND	NA	9	0.052	0.016	UG/KG	UG/L	YES	NO	NO
alpha-Chlordane	7100	73.6	ND	NA	10000	0.19	0.004	UG/KG	UG/L	NO	NO	NO
gamma-Chlordane	7400	99.7	ND	NA	10000	0.19	0.004	UG/KG	UG/L	NO	NO	NO
4,4'-DDD	82000	1325	ND	NA	16000	0.28	0.025	UG/KG	UG/L	YES	NO	NO
4,4'-DDE	4900	186.5	ND	NA	54000	0.2	0.14	UG/KG	UG/L	NO	NO	NO
4,4'-DDT	100000	687	ND	NA	32000	0.2	0.001	UG/KG	UG/L	YES	NO	NO
Endosulfan I	2.6	ND	ND	NA	18000	220	NA	UG/KG	UG/L	NO	NO	NO
Endosulfan Sulfate	6	ND	ND	NA	18000	220	NA	UG/KG	UG/L	NO	NO	NO
Endrin	160	ND	ND	NA	1000	11	0.0023	UG/KG	UG/L	NO	NO	NO
Endrin Aldehyde	21	ND	ND	NA	1000	11	NA	UG/KG	UG/L	NO	NO	NO
Endrin Ketone	ND	11	ND	NA	1000	11	NA	UG/KG	UG/L	NO	NO	NO
Heptachlor	1100	ND	ND	NA	23000	0.0023	0.0036	UG/KG	UG/L	NO	NO	NO
Heptachlor epoxide	37	ND	ND	NA	700	0.0012	0.0036	UG/KG	UG/L	NO	NO	NO

Table 10.12.13
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Saltwater Surface Water Chronic Screening Levels, and Background Concentrations
NAVBASE Charleston, Zone G: SWMUs 6 and 7 and AOC 635
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Saltwater Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Methoxychlor	22	ND	ND	NA	160000	180	0.03	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	1021	NA	NA	NA	1900	0.45	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	13300	32300	2400	NA	1000000	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	7.5	ND	ND	NA	5	15	NA	MG/KG	UG/L	YES	NO	NO
Arsenic	38	43	269	NA	29	18.7	36	MG/KG	UG/L	YES	YES	YES
Barium	170	56.6	302	NA	1600	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	1.1	1.7	1.4	NA	63	1.2	NA	MG/KG	UG/L	NO	YES	NO
Cadmium	2.7	ND	ND	NA	8	18	9.3	MG/KG	UG/L	NO	NO	NO
Chromium (total)	68	55	9.2	NA	1000000	180	50	MG/KG	UG/L	NO	NO	NO
Cobalt	26	11	4.5	NA	2000	2200	NA	MG/KG	UG/L	NO	NO	NO
Copper	540	126	ND	NA	920	130000	8.33	MG/KG	UG/L	NO	NO	NO
Lead	1000	131	7	NA	400	15	8.5	MG/KG	UG/L	YES	NO	NO
Manganese	580	1000	1610	NA	1100	2560	NA	MG/KG	UG/L	NO	NO	NO
Mercury	0.56	4	0.1	NA	2.1	11	0.025	MG/KG	UG/L	YES	NO	YES
Nickel	24	26	55.1	NA	130	730	21.7	MG/KG	UG/L	NO	NO	YES
Selenium	1.6	2.4	5.3	NA	5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	2.5	ND	5.9	NA	34	180	2.9	MG/KG	UG/L	NO	NO	YES
Thallium	0.89	ND	ND	NA	0.95	2.9	21.3	MG/KG	UG/L	NO	NO	NO
Tin	8.3	14.4	ND	NA	11000	22000	NA	MG/KG	UG/L	NO	NO	NO
Vanadium	66	91	13.5	NA	6000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	930	232	49.9	NA	12000	11000	86	MG/KG	UG/L	NO	NO	NO

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 20, from 1996 Soil Screening Guidance or calculated using values from Table 6.4
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, October 22, 1997
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region IV Bulletins, Ecological Risk Assessment, November, 1995; Table 2
For inorganics, the value shown is the greater of the relevant screening value or the corresponding background value.

NA - Not available/Not applicable
ND - Not detected
RBC - Risk based concentration
SSL - Soil screening level
MG/KG - Milligrams per kilogram
NG/KG - Nanograms per kilogram
PG/L - Picograms per liter
UG/KG - Micrograms per kilogram
UG/L - Micrograms per liter

which exceeded the SSLs, only pentachlorophenol was detected in shallow groundwater. The occurrence of pentachlorophenol in groundwater is notable because a) its dissolved concentration was greater than the tap water RBC and b) it was not present in subsurface soil. However, as will be discussed, this organic was not detected in groundwater during the third-quarter sampling event, invalidating the soil-to-groundwater migration pathway for pentachlorophenol.

Seven inorganic analytes (Table 10.12.13) were present in soil above applicable screening values. Of these, only two arsenic and mercury were present above SSLs in subsurface soil. A number of these analytes could conceivably be attributed to past site activities. For example, the presence of lead, nickel, and silver could be associated with waste oils and/or transformer fluid, and the presence of arsenic could be associated with arsenate-based pesticide wastes. Overall, the general distribution exhibits a decrease in concentration with depth. The fill material used to reclaim NAVBASE has consistently shown a number of these inorganic analytes to be common constituents, and therefore consideration that at least some of these represent site specific ambient conditions should be evaluated.

Overall, the soil-to-groundwater pathway appears to have some merit with respect to arsenic and mercury. The lack of other constituents which exceeded SSLs in subsurface soil and/or groundwater indicated that this pathway for those inorganics is not expected to be significant.

10.12.5.2 Soil-to-Air Cross-Media Transport

Table 10.12.14 lists the VOCs detected in surface soil samples collected at SWMU 6, SWMU 7, and AOC 635, along with the corresponding soil-to-air volatilization criteria. Nine VOCs were detected in the surface soil samples collected at this site, but none exceeded the corresponding soil-to-air volatilization screening levels. Consequently, the soil-to-air migration pathway is insignificant at SWMU 6, SWMU 7 and AOC 635.

Table 10.12.14
Soil-to-Air Volatilization Screening Analysis
NAVBASE Charleston, Zone G: SWMU 6, SWMU 7 and AOC 635
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Acetone	2100	100000000	UG/KG	NO
2-Butanone (MEK)	13	10000	UG/KG	NO
Carbon disulfide	26	720000	UG/KG	NO
Chlorobenzene	160	130000	UG/KG	NO
1,1-Dichloroethane	37	1300000	UG/KG	NO
Tetrachloroethene	11	11000	UG/KG	NO
Toluene	10	650000	UG/KG	NO
1,1,1-Trichloroethane	240	1200000	UG/KG	NO
Xylene (total)	57	410000	UG/KG	NO

* - Soil screening levels for transfers from soil to air were obtained from USEPA Soil Screening Guidance, Technical Background Document Appendix A, May 1996 (first preference) or from Soil Screening Levels - Transfers from Soil to Air, USEPA Region III Risk-Based Concentration Table, June 1996. Value for 2-butanone was estimated.

NA - Not available

10.12.5.3 Groundwater-to-Surface Water Cross-Media Transport

Table 10.12.13 compares maximum detected organic constituent concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background concentrations for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

Only one organic constituent - pentachlorophenol - exceeded an RBC and/or surface water screening criteria. By the third-quarter sampling event, this compound was not detected, thereby invalidating this pathway for this constituent.

Five inorganics exceeded an RBC and/or surface water screening criteria. Arsenic and beryllium were detected above applicable RBC values; by the third-quarter, beryllium was not detected above the RBC, but arsenic was exceeded in four wells and showed an overall increase in groundwater site-wide. Arsenic, mercury, nickel, and silver all exceeded surface water screening values, but were either non-detect or below screening criteria by the third-quarter. Potential sources for these analytes were presented in the soil-to-groundwater pathway discussion.

The risk-based pathway for groundwater (exposure to a receptor through consumption) has some merit based on arsenic, but is invalidated through non-use of the resource. The surface water discharge pathway, based on first-quarter sampling results, has merit chemically for several inorganics, but by the third-quarter is only valid for arsenic. The nearest surface water receptor is the Cooper River, approximately 200 feet northeast of the site. Groundwater flow direction, at least during low-tide, from the site is essentially parallel to the trend of the river. Given that

the Cooper River is strongly influenced by tidal stage, it is very likely that head differential between groundwater and surface water will be large enough to hydraulically indicate discharge to the river. Consequently, this pathway has merit; however, significant concentration reduction of arsenic through dilution upon discharge will occur, and can be tested empirically through collection of surface water samples.

10.12.5.4 Fate and Transport Summary

A number of organic and inorganic constituents were present above applicable SSLs. With a few exceptions, attenuation of organics was remarkable with depth, and only one - delta BHC - exceeded its SSL in subsurface soil. However, this pathway is not expected to be significant because delta BHC was not detected in groundwater. Significant trends in the vertical distribution of inorganics, several of which exceeded SSLs in surface soil, are not immediately evident, but only arsenic is above its SSL in subsurface soil. The source of inorganics is not clear, and their occurrence may be related to the non-native fill material on the surface of the site. Arsenic was also present in groundwater above screening levels, thereby validating the pathway for arsenic.

Only one organic - pentachlorophenol - was present above screening levels in groundwater, but was not detected by the third-quarter sampling event. Only arsenic and beryllium were present above tap water RBCs, and arsenic, mercury, nickel, and silver were present above surface water screening criteria. Of these, only arsenic remained above the tap water RBC and surface water screening criteria by the third-quarter. Additionally, it is likely that groundwater discharge to the Cooper River occurs during a complete tidal cycle, thereby validating the pathway. However, dilutional effects of discharge will occur, and can be tested empirically through collection of surface water samples.

Nine VOCs were detected in the surface soil samples collected at this site, but none exceeded the corresponding soil-to-air volatilization screening levels. Consequently, the soil-to-air migration pathway is insignificant at SWMU 6, SWMU 7 and AOC 635.

10.12.6 Human Health Risk Assessment

10.12.6.1 Site Background and Investigative Approach

SWMU 6 is the Public Works Storage Yard, SWMU 7 is the PCB transformer storage yard at Building 3902, and AOC 635 is the paint and oil storehouse at Building 3902. These sites are located north of Hobson Avenue and south of River Road. The RFI activities were centered around the containerized waste storage at SWMU 6, PCB transformer storage at SWMU 7, and the paint and oil storage at AOC 635. The following refers to these sites as combined SWMU 6.

During the RFI, a total of six soil borings were advanced from both the upper and lower intervals to confirm impacts identified during a 1993 sampling event. During the 1993 sampling event, a total of 42 soil borings were advanced in the upper interval. Surface soil data was used to quantitatively assess the direct contact soil exposure pathways. Indirect exposures to contaminants reported in subsurface soil via cross media transfer were assessed in the previous section, Fate and Transport Assessment for combined SWMU 6. Seven monitoring wells that were installed in the shallow aquifer during the 1993 sampling event were redeveloped and sampled during the RFI. Data from the initial RFI sampling event for each well were used to quantitatively assess groundwater exposure pathways. Sections 10.12.3 and 10.12.4 provide summaries of the sampling effort for combined SWMU 6 soil and groundwater.

10.12.6.2 COPC Identification

Soil

Based on the screening comparisons described in Section 7 of this RFI and presented in Table 10.12.15, arsenic, Aroclor-1260, BEQs, delta-BHC, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT,

dioxin equivalents, manganese, and thallium were identified as COPCs for surface soil. In addition to these COPCs, antimony, Aroclor-1254, alpha-BHC, beta-BHC, gamma-BHC, alpha-chlordane, gamma-chlordane, chromium, heptachlor, lead, and vanadium were identified as COPCs based on the 1993 data. Table 10.12.16 summarizes 1993 surface soil data. Aluminum and beryllium were detected at maximum concentrations exceeding their RBCs but not exceeding their background concentrations. Therefore, these inorganics were eliminated from further consideration in the combined SWMU 6 HHRA. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out on the basis of background concentration.

Groundwater

As shown in 10.12.17, arsenic, barium, beryllium, and pentachlorophenol were identified as COPCs in shallow groundwater for combined SWMU 6. Manganese was detected at maximum concentrations exceeding its RBC but not exceeding its background concentration. Manganese was therefore eliminated from further consideration in the combined SWMU 6 HHRA. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out on the basis of background concentration.

10.12.6.3 Exposure Assessment

Exposure Setting

Combined SWMU 6 is a fenced area (approximately two acres) located in a moderately developed urban setting, approximately 300 feet southwest of the waterfront along the Cooper River. Except for the remaining concrete footing from Building 3902, the site is an open, unpaved area. All potable water is provided through the city's water supply. Shallow groundwater at the site is not currently nor anticipated to be used in the future as potable or process water.

Potentially Exposed Populations

Potentially exposed populations are current and future site workers, hypothetical future site residents, and adolescent trespassers. Future site resident and site worker exposure scenarios were addressed quantitatively in this risk assessment. Current exposure to workers is discussed qualitatively in relation to the future workers and future residents. The hypothetical future site worker scenario assumes continuous exposure to surface soil conditions. Current site workers' exposure would be less than that assumed for the hypothetical future site worker scenario because of their limited soil contact (portions of the site are covered by concrete pads). Therefore, future worker assessment is considered to be conservatively representative of current site workers. Additionally, the perimeter fencing would inhibit the access of potential adolescent trespassers under a current use scenario. Since future use of the site is uncertain, the adolescent trespasser was qualitatively addressed relative to the child resident. The future site resident scenario was built on the premise that existing buildings would be removed and replaced with dwellings.

Exposure Pathways

Exposure pathways for the hypothetical future site residents are dermal contact with surface soil, incidental ingestion of surface soils, and inhalation of dust borne contaminants eliminating from surface soil. The exposure pathways for current and future site workers are the same as those for the future site resident with respect to soil. Uniform exposure was assumed for all sample locations. The groundwater pathway for the hypothetical future site residents and site workers is incidental ingestion of groundwater. No volatile COPC were identified for groundwater and, as a result, the inhalation pathway was not considered for combined SWMU 6. Table 10.12.18 presents the justification for exposure pathways assessed in this HHRA.

Table 10.12.15
Chemical Present in Site Samples
SWMU 6, SWMU 7, and AOC 635 - Surface Soil
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection		Average Detected Conc.	Range of SQL		Screening Concentrations RBC	Screening Concentrations Background	Units	Number Exceeding RBC	Number Exceeding Bkgd
PBCs													
Aroclor-1260	*	3	6	240	8600	4813	65	86	320	NA	UG/KG	3	
Carcinogenic PAHs													
B(a)P Equiv.	*	5	6	285.25	3690	1385	970.62	970.62	88	NA	UG/KG	5	
Benzo(a)anthracene	*	5	6	140	2650	1084	420	420	880	NA	UG/KG	3	
Benzo(b)fluoranthene	*	4	6	180	3450	1074	380	420	880	NA	UG/KG	1	
Chrysene		5	6	150	3000	1230	420	420	88000	NA	UG/KG		
Dibenz(a,h)anthracene	*	5	6	56	655	248	420	420	88	NA	UG/KG	3	
Indeno(1,2,3-cd)pyrene	*	5	6	120	1450	525	420	420	880	NA	UG/KG	1	
Benzo(k)fluoranthene		5	6	170	2700	1021	420	420	8800	NA	UG/KG		
Benzo(a)pyrene	*	5	6	180	2250	879	420	420	88	NA	UG/KG	5	
TCDD Equivalents													
Dioxin Equiv.	*	2	2	0.138	1021	511	NA	NA	1000	NA	NG/KG	1	
1234678-HpCDD		1	2	23200	23200	23200	1.74	1.74	NA	NA	NG/KG		
1234678-HpCDF		1	2	24400	24400	24400	0.432	0.432	NA	NA	NG/KG		
1234789-HpCDF		1	2	860	860	860	0.119	0.119	NA	NA	NG/KG		
123478-HxCDD		1	2	530	530	530	0.295	0.295	NA	NA	NG/KG		
123678-HxCDD		1	2	901	901	901	0.214	0.214	NA	NA	NG/KG		
123789-HxCDD		1	2	299	299	299	0.223	0.223	NA	NA	NG/KG		
234678-HxCDF		1	2	218	218	218	0.153	0.153	NA	NA	NG/KG		
123678-HxCDF		1	2	68.4	68.4	68.4	0.12	0.12	NA	NA	NG/KG		
123478-HxCDF		1	2	1020	1020	1020	0.165	0.165	NA	NA	NG/KG		
OCDD		2	2	138	145000	72569	NA	NA	NA	NA	NG/KG		
OCDF		1	2	52200	52200	52200	0.362	0.362	NA	NA	NG/KG		
12378-PeCDD		1	2	32.1	32.1	32.1	0.105	0.105	NA	NA	NG/KG		
12378-PeCDF		1	2	24.7	24.7	24.7	0.094	0.094	NA	NA	NG/KG		
2378-TCDD		1	2	15.7	15.7	15.7	0.141	0.141	NA	NA	NG/KG		
2378-TCDF		1	2	25	25	25.0	0.19	0.19	NA	NA	NG/KG		
Inorganics													
Aluminum (Al)		6	6	4715	13300	8495	NA	NA	7800	18700	MG/KG	3	
Arsenic (As)	*	6	6	4.1	17.3	10.4	NA	NA	0.43	17.2	MG/KG	6	1
Barium (Ba)		6	6	26.7	63.7	36.9	NA	NA	550	109	MG/KG		
Beryllium (Be)		6	6	0.24	0.8	0.43	NA	NA	0.15	1.2	MG/KG	6	
Cadmium (Cd)		4	6	0.06	0.815	0.37	0.05	0.05	3.9	1.07	MG/KG		
Calcium (Ca)	N	6	6	1945	21100	6034	NA	NA	NA	NA	MG/KG		
Chromium (Cr)		6	6	10	25	18.2	NA	NA	39	42.8	MG/KG		
Cobalt (Co)		6	6	1.1	8.7	3.5	NA	NA	470	6.6	MG/KG		1
Copper (Cu)		5	6	11.4	61.8	31.7	1.7	1.7	27000	260	MG/KG		
Iron (Fe)	N	6	6	6100	28000	14983	NA	NA	NA	NA	MG/KG		
Lead (Pb)		6	6	12.35	136	63.2	NA	NA	400	181	MG/KG		
Magnesium (Mg)	N	6	6	465	3310	1145	NA	NA	NA	NA	MG/KG		
Manganese (Mn)	*	6	6	22.4	568	142	NA	NA	180	325	MG/KG	1	1
Mercury (Hg)		6	6	0.04	0.2	0.095	NA	NA	2.3	1.03	MG/KG		
Nickel (Ni)		5	6	3.4	9.65	6.4	1.5	1.5	160	20.6	MG/KG		
Potassium (K)	N	6	6	254	1270	596	NA	NA	NA	NA	MG/KG		
Selenium (Se)		6	6	0.49	1.6	0.999	NA	NA	39	1.22	MG/KG		2
Sodium (Na)	N	2	6	622	1260	941	213	394	NA	NA	MG/KG		
Thallium (Tl)	*	2	6	0.54	0.89	0.72	0.35	0.39	0.63	0.85	MG/KG	1	1
Tin (Sn)		4	6	6.5	8.3	7.5	1.4	2.1	4700	9.67	MG/KG		
Vanadium (V)		6	6	11.3	43.7	24.9	NA	NA	55	60.9	MG/KG		
Zinc (Zn)		6	6	15.9	152	82.0	NA	NA	2300	519	MG/KG		
Pesticides													
beta-BHC		2	6	18	24	21.0	1.5	1.7	350	NA	UG/KG		
alpha-BHC		2	6	14	16	15.0	1.5	1.7	100	NA	UG/KG		
delta-BHC	*	2	6	120	200	160	1.5	1.7	100	NA	UG/KG	2	
gamma-BHC (Lindane)		2	6	87.5	110	98.8	1.5	1.7	490	NA	UG/KG		
alpha-Chlordane		3	6	4.1	425	193	1.5	1.7	1800	NA	UG/KG		
gamma-Chlordane		3	6	2.6	350	171	1.5	1.7	1800	NA	UG/KG		
4,4'-DDD	*	2	6	930	20000	10465	3.1	4.6	2700	NA	UG/KG	1	
4,4'-DDE	*	4	6	24	4900	1656	3.1	3.2	1900	NA	UG/KG	1	
4,4'-DDT	*	4	6	23	5450	1933	3.1	3.2	1900	NA	UG/KG	2	
Endrin		1	6	160	160	160	2.9	29	2300	NA	UG/KG		
Heptachlor		1	6	18	18	18.0	1.5	15	140	NA	UG/KG		
Heptachlor epoxide		1	6	4.3	4.3	4.3	1.5	15	70	NA	UG/KG		

Table 10.12.15
Chemical Present in Site Samples
SWMU 6, SWMU 7, and AOC 635 - Surface Soil
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection		Average Detected Conc.	Range of SQL		Screening Concantrations RBC	Background	Units	Number Exceeding RBC	Bkgd
Semivolatile Organics												
Acenaphthene	2	6	580	1850	1215	380	430	470000	NA	UG/KG		
Acenaphthylene	3	6	57	97	80.3	410	430	230000	NA	UG/KG		
Anthracene	3	6	530	1950	1118	380	430	2300000	NA	UG/KG		
Benzo(g,h,i)perylene	5	6	140	1650	594	420	420	230000	NA	UG/KG		
Dibenzofuran	3	6	140	1150	505	380	430	31000	NA	UG/KG		
Di-n-butylphthalate	1	6	48.5	48.5	48.5	380	430	780000	NA	UG/KG		
1,4-Dichlorobenzene	2	6	52	160	106	380	430	27000	NA	UG/KG		
3,3'-Dichlorobenzidine	1	6	82	82	82.0	760	870	1400	NA	UG/KG		
Fluoranthene	6	6	150	5800	2002	NA	NA	310000	NA	UG/KG		
Fluorene	3	6	250	2650	1120	380	430	310000	NA	UG/KG		
2-Methylnaphthalene	3	6	76	2650	967	380	430	310000	NA	UG/KG		
Naphthalene	2	6	310	3050	1680	380	430	310000	NA	UG/KG		
Pentachlorophenol	2	6	160	2900	1530	1800	2100	5300	NA	UG/KG		
Phenanthrene	4	6	260	7600	3328	380	430	230000	NA	UG/KG		
Pyrene	6	6	110	6150	2113	NA	NA	230000	NA	UG/KG		
2,3,4,6-Tetrachlorophenol	1	2	120	120	120	810	810	230000	NA	UG/KG		
Volatile Organics												
Carbon disulfide	1	6	1	1	1.0	6	6	780000	NA	UG/KG		
Chlorobenzene	1	6	64.5	64.5	64.5	6	6	180000	NA	UG/KG		

Table 10.12.16
Chemicals Present in Site Samples
SWMU 6 and SWMU 7 - 1993 Surface Soil Data
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection		Average Detected Conc.	Range of SQL		Screening Concentrations RBC	Screening Concentrations Background	Number Exceeding RBC	Number Exceeding Bkgd
PCBs												
Aroclor-1254	*	1	42	26000	26000	26000	36	19000	160	NA	1	
Aroclor-1260	*	21	42	100	510000	25154	36	19000	320	NA	12	
Carcinogenic PAHs												
Benzo(a)pyrene Equiv.	*	39	42	7.163	14323	1409	878.18	878.18	88	NA	34	
Benzo(a)anthracene	*	33	42	66	14000	1080	360	38000	880	NA	10	
Benzo(a)pyrene	*	38	42	48	10000	997	380	410	88	NA	33	
Benzo(b)fluoranthene	*	39	42	71	13000	1545	380	380	880	NA	12	
Benzo(k)fluoranthene		31	42	60	5200	519	360	38000	8800	NA		
Chrysene		38	42	63	11000	1209	370	380	88000	NA		
Dibenz(a,h)anthracene	*	15	42	47	1300	321	350	38000	88	NA	12	
Indeno(1,2,3-cd)pyrene	*	33	42	40	6000	745	360	750	880	NA	8	
Inorganics												
Aluminum		42	42	1400	13000	4991	NA	NA	7800	18700	6	
Antimony	*	1	42	7.5	7.5	7.5	5.3	11	3.1	2.89	1	1
Arsenic	*	39	42	1.4	38	8.3	1.1	1.2	0.43	17.2	39	3
Barium		42	42	13	170	37.1	NA	NA	550	109		2
Beryllium		4	42	0.56	1.1	0.80	0.53	0.69	0.15	1.2	4	
Cadmium		13	42	0.6	2.7	1.0	0.53	1.1	3.9	1.07		4
Calcium	N	42	42	280	260000	57635	NA	NA	NA	NA		
Chromium	*	42	42	5.5	88	18.9	NA	NA	39	42.8	2	2
Cobalt		39	42	1.1	26	4.0	1.2	1.2	470	6.6		4
Copper		40	42	3.4	540	33.0	2.9	2.9	27000	260		1
Iron	N	42	42	2500	30000	9636	NA	NA	NA	NA		
Lead	*	42	42	2	1000	101	NA	NA	400	181	2	6
Magnesium	N	41	41	200	15000	2006	NA	NA	NA	NA		
Manganese	*	42	42	17	580	125	NA	NA	180	325	9	1
Mercury		40	42	0.015	0.55	0.12	0.012	0.012	2.3	1.03		
Nickel		28	42	5.1	24	9.8	4.4	5.3	160	20.6		1
Potassium	N	42	42	130	2400	390	NA	NA	NA	NA		
Silver (Ag)		1	42	2.5	2.5	2.5	1.1	2.3	39	NA		
Sodium	N	34	42	70	6600	434	56	60	NA	NA		
Vanadium	*	42	42	5.3	66	16.8	NA	NA	55	80.9	1	1
Zinc		42	42	9.7	930	105	NA	NA	2300	519		1
Pesticides												
alpha-BHC	*	1	42	39000	39000	39000	1.9	920	100	NA	1	
beta-BHC	*	1	42	3800	3800	3800	1.9	920	350	NA	1	
delta-BHC	*	7	42	2.2	28000	4012	1.9	920	100	NA	1	
gamma-BHC	*	6	42	4.6	76000	12688	1.9	920	490	NA	1	
alpha-Chlordane	*	19	42	2.95	7100	413	1.9	920	1800	NA	1	
gamma-Chlordane	*	18	42	2.8	7400	477	1.9	920	1800	NA	1	
4,4'-DDD	*	29	42	4.2	82000	3307	3.6	1800	2700	NA	3	
4,4'-DDE		31	42	6.3	1800	324	3.8	1900	1900	NA		
4,4'-DDT	*	34	42	4.7	100000	3453	3.8	1800	1900	NA	5	
Endosulfan I		1	42	2.6	2.6	2.6	1.9	960	47000	NA		
Endosulfan sulfate		2	42	4	6	5.0	3.6	1900	47000	NA		
Endrin aldehyde		2	42	7.5	21	14.3	3.6	1900	2300	NA		
Heptachlor	*	2	42	9.8	1100	555	1.9	920	140	NA	1	
Heptachlor epoxide		3	42	3.7	37	15.7	1.9	960	70	NA		
Methoxychlor		1	42	22	22	22.0	19	9700	39000	NA		

Table 10.12.17
Chemical Present in Site Samples
SWMU 6, SWMU 7, and AOC 635 - Groundwater
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detections		Average Detected Conc.	Range of SQL		Screening Concentrations RBC	Background	Units	Number Exceeding RBC	Bkgd
Inorganics													
Aluminum (Al)		7	7	18.2	2400	740	NA	NA	3700	692	UG/L		3
Arsenic (As)	*	7	7	6.1	269	48.6	NA	NA	0.045	17.8	UG/L	7	3
Barium (Ba)	*	7	7	15.7	302	102	NA	NA	260	31	UG/L	1	6
Beryllium (Be)	*	7	7	0.36	1.4	1.0	NA	NA	0.016	NA	UG/L	7	
Calcium (Ca)	N	7	7	118000	284000	197214	NA	NA	NA	NA	UG/L		
Chromium (Cr)		4	7	0.86	9.2	5.2	1.9	3.1	18	3.88	UG/L		3
Cobalt (Co)		5	7	1.2	4.5	2.2	0.9	0.9	220	1.45	UG/L		4
Iron (Fe)	N	7	7	6590	75100	28927	NA	NA	NA	NA	UG/L		
Lead (Pb)		7	7	1.8	7	3.3	NA	NA	15	4.6	UG/L		2
Magnesium (Mg)	N	7	7	163000	714000	465857	NA	NA	NA	NA	UG/L		
Manganese (Mn)		7	7	488	1610	973	NA	NA	84	2906	UG/L	7	
Mercury (Hg)		2	7	0.1	0.1	0.10	0.1	0.1	1.1	NA	UG/L		
Nickel (Ni)		1	7	55.1	55.1	55.1	1.3	4.5	73	4.08	UG/L		1
Potassium (K)	N	7	7	52900	203000	138629	NA	NA	NA	NA	UG/L		
Selenium (Se)		2	7	3.1	5.3	4.2	2.8	2.8	18	4.3	UG/L		1
Silver (Ag)		2	7	5	5.9	5.5	1.2	1.2	18	1.65	UG/L		2
Sodium (Na)	N	7	7	1260000	6040000	3760000	NA	NA	NA	NA	UG/L		
Vanadium (V)		7	7	0.59	13.5	4.2	NA	NA	26	15.4	UG/L		
Zinc (Zn)		2	7	5.4	49.9	27.7	5.3	5.3	1100	15.6	UG/L		1
Semivolatile Organics													
Acenaphthene		2	7	1	2	1.5	10	10	220	NA	UG/L		
Pentachlorophenol	*	1	7	2	2	2.0	50	50	0.56	NA	UG/L	1	

* - Identified as a COPC
N - Essential nutrient
SQL - Sample quantitation limit
UG/L - microgram per liter
NA - Not applicable

Table 10.12.18
Exposure Pathways Summary — Combined SWMU 6
NAVBASE — Zone G
Charleston, South Carolina

Potentially Exposed Population	Medium and Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Current Land Uses			
Current Site Users/Maintenance	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No (qualified)	Future land use assessment is considered to be conservatively representative of current receptors.
	Shallow groundwater, Ingestion of contaminants during potable or general use	No	Shallow groundwater is not currently used as a source of potable or process water at combined SWMU 6.
	Shallow groundwater, Inhalation of volatilized shallow groundwater contaminants	No	Shallow groundwater is not currently used as a source of potable or process water at combined SWMU 6.
	Soil, Incidental ingestion	No (Qualified)	Future land use assessment is considered to be conservatively representative of current receptors.
	Soil, Dermal contact	No (Qualified)	Future land use assessment is considered to be conservatively representative of current receptors.
Future Land Uses			
Future Site Residents (Child and Adult) and Future Site Worker	Air, Inhalation of gaseous contaminants emanating from soil	No	No COPCs were identified subsequent to risk-based screening comparisons.
	Air, Inhalation of chemicals entrained in fugitive dust	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Shallow groundwater, Ingestion of contaminants during potable or general use	Yes	Shallow groundwater is not likely to be used as a source of potable water at combined SWMU 6, however, this pathway was considered as a conservative measure.
	Shallow groundwater, Inhalation of volatilized contaminants during domestic use	No	No volatile COPCs were identified subsequent to risk-based screening comparisons.
	Soil, Incidental ingestion	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Soil, Dermal contact	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Wild game or domestic animals, Ingestion of tissue impacted by media contamination	No	Hunting/taking of game and/or raising livestock is prohibited within the Charleston, South Carolina city limits.

Table 10.12.18
Exposure Pathways Summary — Combined SWMU 6
NAVBASE — Zone G
Charleston, South Carolina

Potentially Exposed Population	Medium and Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
	Fruits and vegetables, Ingestion of plant tissues grown in media	No	The potential for significant exposure via this pathway is low relative to that of other exposure pathways assessed.

Exposure Point Concentrations

As discussed in Section 7 of this RFI, except for dioxin equivalents and thallium, exposure point concentrations for soil pathways were set equal to the 95% UCL calculated using the combined data from the RFI and 1993 sampling events. Dioxin equivalents were only analyzed in two surface soil samples, the 95% UCL for thallium exceeded its maximum concentration. As a result, the EPCs for dioxin equivalents and thallium were set equal to their respective maximum concentrations. Soil sampling conducted at combined SWMU 6 was concentrated in a area representing approximately three quarters of an acre. This three quarter acre parcel was considered a reasonable exposure unit area on which to base the EPC determination. Table 10.12.19 provides a summary of the statistical analysis of the SWMU 6 surface soil data.

Since there were only seven groundwater samples collected during the first-quarter RFI sampling event, the maximum detected concentration of each COPC was used as the EPC used to evaluate the groundwater pathway.

Quantification of Exposure

Soil

CDIs for ingestion of soils, dermal contact with soils, calculated as described in Section 7, are shown in Tables 10.12.20 and 10.12.21, respectively. The CDIs for inhalation of dust borne

Table 5.12.19
Summary of Statistical Analysis
Surface Soil COPCs; SWMU 6, SWMU 7, and AOC 635
Naval Base Charleston, Zone G
Charleston, South Carolina

COPC	Natural Log Transformed n	mean	SD	H-stat	UCL (mg/kg)	MAX (mg/kg)	EPC (mg/kg)
PCBs							
Aroclor-1254	48	4.189	1.679	3.143	0.58	26	0.58 UCL
Aroclor-1260	48	5.503	2.055	3.653	6.06	510	6.1 UCL
Carcinogenic PAHs							
Benzo(a)pyrene Equiv.	48	6.679	1.032	2.359	1.93	14.323	1.9 UCL
TCDD Equivalents							
Dioxin Equivalents	2	NA	NA	NA	NA	0.001021	0.001021 Max
Inorganics							
Antimony	48	0.780	0.900	2.222	4.4	7.5	4.4 UCL
Arsenic	48	1.720	0.946	2.268	11.9	38	11.9 UCL
Chromium	48	2.789	0.520	1.898	21.5	68	21.5 UCL
Lead	48	3.727	1.302	2.667	161	1000	161 UCL
Manganese	48	4.513	0.837	2.161	169	580	169 UCL
Thallium	48	-0.382	0.683	2.023	1.1	0.89	0.89 Max
Vanadium	48	2.717	0.558	1.925	20.7	66	20.7 UCL
Pesticides							
alpha-BHC	48	1.134	1.942	3.496	0.055	39	0.055 UCL
beta-BHC	48	1.099	1.732	3.212	0.030	3.8	0.030 UCL
delta-BHC	48	1.366	2.060	3.66	0.10	28	0.098 UCL
gamma-BHC	48	1.359	2.158	3.798	0.13	76	0.13 UCL
alpha-Chlordane	48	1.962	2.170	3.815	0.25	7.1	0.25 UCL
gamma-Chlordane	48	2.046	2.256	3.937	0.36	7.4	0.36 UCL
4,4'-DDD	48	3.566	2.777	4.687	11.2	82	11.2 UCL
4,4'-DDE	48	4.129	2.298	3.996	3.32	4.9	3.3 UCL
4,4'-DDT	48	4.287	2.589	4.412	11.0	100	11.0 UCL
Heptachlor	48	1.064	1.614	3.059	0.022	1.1	0.022 UCL

NOTES:

mean Arithmetic mean of the logtransformed data
n Number of samples analyzed
SD Standard deviation for a sample of data
H-stat "H" statistic from Gilbert 1987; cuboidal interpolation was used to determine the value in accordance with USEPA Supplemental Guidance to RAGS, Calculating the Concentration Term
NA Not applicable
EPC Exposure point concentration
UCL 95 percentile upper confidence level mean
MAX Maximum reported concentration

Table 10.12.20
Chronic Daily Intakes
Incidental Ingestion of Surface Soil
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Chemical	Fraction Ingested from Contaminated Source *	Exposure Point Concentration (mg/kg)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Site Worker adult H-CDI (mg/kg-day)	Future Site Worker adult C-CDI (mg/kg-day)
Inorganics							
Antimony	1	4.4	6.00E-06	5.60E-05	6.85E-06	2.14E-06	7.65E-07
Arsenic	1	11.9	1.64E-05	1.53E-04	1.87E-05	5.84E-06	2.09E-06
Chromium	1	21.5	2.95E-05	2.75E-04	3.37E-05	1.05E-05	3.76E-06
Lead	1	161	2.20E-04	2.06E-03	2.52E-04	7.87E-05	2.81E-05
Manganese	1	169	2.31E-04	2.15E-03	2.64E-04	8.25E-05	2.94E-05
Thallium	1	0.89	1.22E-06	1.14E-05	1.39E-06	4.35E-07	1.56E-07
Vanadium	1	20.7	2.83E-05	2.64E-04	3.24E-05	1.01E-05	3.61E-06
Semivolatile Organics							
Benzo(a)pyrene equivalents	1	1.93	2.65E-06	2.47E-05	3.03E-06	9.46E-07	3.38E-07
Pesticides/PCBs/Dioxin							
Aroclor 1254	1	0.58	7.99E-07	7.45E-06	9.13E-07	2.85E-07	1.02E-07
Aroclor 1260	1	6.06	8.30E-06	7.75E-05	9.49E-06	2.96E-06	1.06E-06
alpha-BHC	1	0.055	7.55E-08	7.05E-07	8.63E-08	2.70E-08	9.64E-09
beta-BHC	1	0.030	4.15E-08	3.87E-07	4.74E-08	1.48E-08	5.29E-09
delta-BHC	1	0.098	1.35E-07	1.26E-06	1.54E-07	4.81E-08	1.72E-08
gamma-BHC	1	0.13	1.81E-07	1.69E-06	2.07E-07	6.46E-08	2.31E-08
alpha-Chlordane	1	0.25	3.43E-07	3.20E-06	3.92E-07	1.23E-07	4.38E-08
gamma-Chlordane	1	0.36	4.93E-07	4.60E-06	5.64E-07	1.76E-07	6.29E-08
4,4'-DDD	1	11.2	1.53E-05	1.43E-04	1.75E-05	5.46E-06	1.95E-06
4,4'-DDE	1	3.3	4.55E-06	4.25E-05	5.20E-06	1.63E-06	5.81E-07
4,4'-DDT	1	11.0	1.51E-05	1.41E-04	1.72E-05	5.38E-06	1.92E-06
Dioxin equivalents	1	0.0010	1.40E-09	1.31E-08	1.60E-09	5.00E-10	1.78E-10
Heptachlor	1	0.022	3.00E-08	2.80E-07	3.43E-08	1.07E-08	3.83E-09

NOTES:

lwa Lifetime weighted average; used to calculate carcinogenic CDI, RAGS Parts A and B
CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
* Reflects the estimated fraction of the site impacted by the corresponding COPC.

Table 10.12.21
Chronic Daily Intakes
Dermal Contact with Surface Soil
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Chemical	Exposure Point Concentration (mg/kg)	Fraction Contacted from Contaminated Source *	Dermal Absorption Factor (unitless)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Site Worker adult H-CDI (mg/kg-day)	Future Site Worker adult C-CDI (mg/kg-day)
Inorganics								
Antimony	4.4	1	0.001	2.46E-07	8.12E-07	1.54E-07	1.76E-07	6.27E-08
Arsenic	11.9	1	0.001	6.71E-07	2.21E-06	4.20E-07	4.79E-07	1.71E-07
Chromium	21.5	1	0.001	1.21E-06	3.99E-06	7.56E-07	8.63E-07	3.08E-07
Lead	161	1	0.001	9.04E-06	2.98E-05	5.66E-06	6.46E-06	2.31E-06
Manganese	169	1	0.001	9.47E-06	3.12E-05	5.92E-06	6.76E-06	2.41E-06
Thallium	0.89	1	0.001	5.00E-08	1.65E-07	3.13E-08	3.57E-08	1.28E-08
Vanadium	20.7	1	0.001	1.16E-06	3.83E-06	7.27E-07	8.30E-07	2.96E-07
Semivolatile Organics								
Benzo(a)pyrene Equivalent	1.9	1	0.01	1.09E-06	3.58E-06	6.79E-07	7.75E-07	2.77E-07
Pesticides/PCBs/Dioxin								
Aroclor 1254	0.58	1	0.01	3.27E-07	1.08E-06	2.05E-07	2.34E-07	8.35E-08
Aroclor 1260	6.1	1	0.01	3.40E-06	1.12E-05	2.13E-06	2.43E-06	8.68E-07
alpha-BHC	0.055	1	0.01	3.10E-08	1.02E-07	1.94E-08	2.21E-08	7.90E-09
beta-BHC	0.030	1	0.01	1.70E-08	5.61E-08	1.06E-08	1.21E-08	4.34E-09
delta-BHC	0.098	1	0.01	5.52E-08	1.82E-07	3.45E-08	3.94E-08	1.41E-08
gamma-BHC	0.13	1	0.01	7.42E-08	2.45E-07	4.64E-08	5.30E-08	1.89E-08
alpha-Chlordane	0.25	1	0.01	1.41E-07	4.65E-07	8.81E-08	1.01E-07	3.59E-08
gamma-Chlordane	0.36	1	0.01	2.02E-07	6.68E-07	1.27E-07	1.44E-07	5.16E-08
4,4'-DDD	11.2	1	0.01	6.27E-06	2.07E-05	3.92E-06	4.48E-06	1.60E-06
4,4'-DDE	3.3	1	0.01	1.87E-06	6.16E-06	1.17E-06	1.33E-06	4.76E-07
4,4'-DDT	11.0	1	0.01	6.17E-06	2.04E-05	3.86E-06	4.41E-06	1.57E-06
Dioxin Equivalents	0.0010	1	0.01	5.73E-10	1.89E-09	3.59E-10	4.10E-10	1.46E-10
Heptachlor	0.022	1	0.01	1.23E-08	4.06E-08	7.70E-09	8.79E-09	3.14E-09

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
- The dermal absorption factor was applied to the exposure point concentration to reflect the different trans-dermal migration of inorganic versus organic chemicals
* Reflects the estimated fraction of the site impacted by the corresponding COPC.

contaminants emanating for surface soil are shown in Table 10.12.22 and were calculated as follows.

Inhalation of Dust Borne Contaminants Emanating from Soil:

Noncarcinogens:

$$CDI_{child} = \frac{C_S * IR_{child} * EF_{res} * ED_{child} * 1/PEF * FC}{BW_{child} * AT_{NC-child}}$$

$$CDI_{adult} = \frac{C_S * IR_{adult} * EF_{res} * ED_{adult} * 1/PEF * FC}{AT_{NC-adult} * BW_{adult}}$$

Carcinogens:

$$CDI_{res} = \frac{C_S * IRadj * EF_{res} * 1/PEF * FC}{AT_C}$$

$$CDI_w = \frac{C_S * IR_{adult} * EF_w * ED_w * 1/PEF}{AT_C * BW_{adult}}$$

Variable	Description
BW_{adult}	average adult body weight (70 kg)
BW_{child}	average child body weight-ages 1 to 6 years (15 kg)
ED_{child}	residential child exposure duration (6 yr)
ED_{adult}	residential adult exposure duration (24 yr)
ED_w	site worker exposure duration (25 yr)
EF_{res}	residential exposure frequency (350 days/year)
EF_w	worker exposure frequency (250 days/year)
IR_{child}	child inhalation rate (12 m^3/day)
IR_{adj}	lifetime weighted average inhalation rate (11.66 m^3-yr/kg-day)
IR_{adult}	adult inhalation rate (20 m^3/day)
$AT_{NC-child}$	averaging time - noncarcinogen, child (2,190 days)
$AT_{NC-adult}$	averaging time - noncarcinogen, adult (8,760 days)

Table 10.12.22
Chronic Daily Intakes
Inhalation of Surface Soil COPCs Resulting from Dust Emission
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Chemical	Fraction Contacted from Contaminated Source *	Exposure Point Concentration (mg/kg)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Site Worker adult H-CDI (mg/kg-day)	Future Site Worker adult C-CDI (mg/kg-day)
Inorganics							
Antimony	1	4.4	9.09E-10	2.54E-09	5.29E-10	6.49E-10	2.32E-10
Arsenic	1	11.9	2.48E-09	6.94E-09	1.44E-09	1.77E-09	6.33E-10
Chromium	1	21.5	4.46E-09	1.25E-08	2.60E-09	3.19E-09	1.14E-09
Lead	1	161	3.34E-08	9.35E-08	1.95E-08	2.39E-08	8.52E-09
Manganese	1	169	3.50E-08	9.79E-08	2.04E-08	2.50E-08	8.92E-09
Thallium	1	0.89	1.85E-10	5.17E-10	1.08E-10	1.32E-10	4.71E-11
Vanadium	1	20.7	4.29E-09	1.20E-08	2.50E-09	3.07E-09	1.10E-09
Semivolatile Organics							
Benzo(a)pyrene equivalents	1	1.9	4.01E-10	1.12E-09	2.34E-10	2.87E-10	1.02E-10
Pesticides/PCBs/Dioxin							
Aroclor 1254	1	0.58	1.21E-10	3.39E-10	7.05E-11	8.64E-11	3.09E-11
Aroclor 1260	1	6.1	1.26E-09	3.52E-09	7.33E-10	8.98E-10	3.21E-10
alpha-BHC	1	0.055	1.14E-11	3.21E-11	6.67E-12	8.18E-12	2.92E-12
beta-BHC	1	0.030	6.28E-12	1.76E-11	3.66E-12	4.49E-12	1.60E-12
delta-BHC	1	0.098	2.04E-11	5.71E-11	1.19E-11	1.46E-11	5.20E-12
gamma-BHC	1	0.13	2.74E-11	7.67E-11	1.60E-11	1.96E-11	6.99E-12
alpha-Chlordane	1	0.25	5.20E-11	1.46E-10	3.03E-11	3.72E-11	1.33E-11
gamma-Chlordane	1	0.36	7.47E-11	2.09E-10	4.35E-11	5.34E-11	1.91E-11
4,4'-DDD	1	11.2	2.32E-09	6.49E-09	1.35E-09	1.66E-09	5.91E-10
4,4'-DDE	1	3.3	6.90E-10	1.93E-09	4.02E-10	4.93E-10	1.76E-10
4,4'-DDT	1	11.0	2.28E-09	6.39E-09	1.33E-09	1.63E-09	5.82E-10
Dioxin equivalents	1	0.0010	2.12E-13	5.93E-13	1.23E-13	1.51E-13	5.41E-14
Heptachlor	1	0.022	4.55E-12	1.27E-11	2.65E-12	3.25E-12	1.16E-12

NOTES:

lwa Lifetime weighted average; used to calculate carcinogenic CDI, RAGS Parts A and B
CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
* Reflects the estimated fraction of the site impacted by the corresponding COPC.

AT_{NC-w}	averaging time - noncarcinogen, site worker (9,125 days)
AT_C	averaging time - carcinogen (25,550 days)
C_s	chemical concentration in surface soil - EPC (mg/kg)
PEF	particulate emission factor (1.32E+09 m^3/kg) - Soil Screening Guidance
FC	Fraction contacted (1)

Groundwater

The CDIs for groundwater ingestion are presented in Table 10.12.23.

10.12.6.4 Toxicity Assessment

Toxicity assessment terms and methods are discussed in Section 7 of this report. Table 10.12.24 presents toxicological information specific to each COPC identified at combined SWMU 6. This information was used in the quantification of risk/hazard associated with soil and groundwater contaminants. Brief toxicological profiles for each COPC are provided in the following paragraphs.

Antimony belongs to the same periodic group as arsenic. This element is absorbed slowly through the gastrointestinal tract, which is the target of this element. Another target is the blood, where antimony concentrates. Due to frequent industrial use, the primary exposure route for antimony to the general population is food. Antimony is also a common air pollutant from industrial emissions. USEPA has not classified antimony as a carcinogen, and the oral RfD is 0.0004 mg/kg-day (Klaassen, et al, 1986). The oral RfD is based on a LOAEL of 0.35 mg/kg-day, an uncertainty factor of 1000, and a modifying factor of 1 (IRIS).

Arsenic exposure via the ingestion route causes darkening and hardening of the skin in chronically exposed humans. Inhalation exposure to arsenic causes neurological deficits, anemia, and cardiovascular effects (Klaassen, et al., 1986). USEPA set 0.3 μg/kg-day as the RfD for arsenic

Table 10.12.23
Chronic Daily Intakes
Ingestion of COPCs in Groundwater
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Chemical	Exposure Point Concentration (mg/liter)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Future Site Worker adult H-CDI (mg/kg-day)	Future Site Worker adult C-CDI (mg/kg-day)
Inorganics						
Arsenic (As)	0.269	7.37E-03	1.72E-02	4.05E-03	2.63E-03	9.40E-04
Barium (Ba)	0.302	8.27E-03	1.93E-02	4.55E-03	2.95E-03	1.06E-03
Beryllium (Be)	0.0014	3.84E-05	8.95E-05	2.11E-05	1.37E-05	4.89E-06
Semivolatile Organics						
Pentachlorophenol	0.002	5.48E-05	1.28E-04	3.01E-05	1.96E-05	6.99E-06

NOTES:
lwa Lifetime weighted average
CDI Chronic Daily Intake
H-CDI Noncarcinogenic hazard based Chronic Daily Intake
C-CDI Carcinogenic risk based Chronic Daily Intake

Table 10.12.24
Toxicological Reference Information
for Chemicals of Potential Concern
SWMU 6, SWMU 7, and AOC 635
Naval Base, Charleston, Zone G
Charleston, South Carolina

	Non-Carcinogenic Toxicity Data										*Carcinogenic Toxicity Data*					
Chemical	Oral Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Oral	Inhalation Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Inhalation	Oral Slope Factor (kg-day/mg)		Inhalation Slope Factor (kg-day/mg)		Weight of Evidence	Tumor Type
Antimony	0.0004	a	L	whole body/blood increased mortality	1,000	NA		NA	NA	NA	NA		NA		D	NA
Arsenic	0.0003	a	M	hyperpigmentation	3	NA		NA	NA	NA	1.5	a	15.1	a	A	various
Barium	0.07	a	M	increased blood pressure	3	0.000143	b	NA	NA	NA	NA		NA		D	NA
Beryllium	0.005	a	L	microscopic organ changes	100	NA		NA	NA	NA	4.3	a	8.4	a	B2	osteosarcoma
Chromium III	1	a	L	NA	100/10	5.71E-07	e	NA	NA	NA	NA		NA	a	D	NA
Chromium VI	0.005	a	L	NA	500	NA		NA	NA	NA	NA		42	a	A	lung
Lead	NA		NA	NA	NA	NA		NA	NA	NA	NA		NA		B2	various
Manganese	0.047	a	NA	neurological effects	1	0.0000143	a	M	neurological effects	1000	NA		NA		D	NA
Thallium	8E-05	a	L	increased SGOT (liver) increased serum LDH	3000	NA		NA	NA	NA	NA		NA		D	NA
Vanadium	0.007	a	NA	unclear	100	NA		NA	NA	NA	NA		NA		D	NA
Benzo(a)pyrene equiv.	NA		NA	NA	NA	NA		NA	NA	NA	7.3	a	3.1	a	B2	mutagen
Pentachlorophenol	0.03	a	M	fetotoxicity	100	NA		NA	NA	NA	0.12	a	NA		B2	multiple tumor types
PCB Aroclor-1260	NA		NA	NA	NA	NA		NA	NA	NA	2	a	2	a	B2	hepatocellular carcinoma
PCB Aroclor-1254	2E-05	a	M	various	NA	NA		NA	NA	NA	2	a	2		B2	hepatocellular carcinoma
alpha-BHC	NA		NA	NA	NA	NA		NA	NA	NA	6.3	a	6.3	a	B2	hepatocellular carcinoma
beta-BHC	NA		NA	NA	NA	NA		NA	NA	NA	1.8	a	1.8	a	C	hepatocellular carcinoma
delta-BHC	NA		NA	NA	NA	NA		NA	NA	NA	6.3	d	6.3	d	D	NA
gamma-BHC	0.0003	a	M	Liver and kidney toxicity	1000	NA		NA	NA	NA	1.3	b	NA		B2	liver
Chlordane	0.0005	a	L	liver hypertrophy	NA	NA		NA	NA	NA	0.35	a	0.35	a	B2	liver carcinoma
4,4'-DDD	NA		NA	NA	NA	NA		NA	NA	NA	0.24	a	NA		B2	liver
4,4'-DDE	NA		NA	NA	NA	NA		NA	NA	NA	0.34	a	NA		B2	liver
4,4'-DDT	0.0005	a	M	liver lesions	100	NA		NA	NA	NA	0.34	a	0.34	a	B2	liver
Dioxin equivalents	NA		NA	NA	NA	NA		NA	NA	NA	150000	b	150000	b	B2	respiratory system and liver
Heptachlor	0.0005	a	L	liver weight increase	300	NA		NA	NA	NA	4.5	a	4.55	a	B2	liver tumors

Notes:

a = Integrated Risk Information System (IRIS)
b = Health Effects Assessment Summary Tables (HEAST)
c = HEAST alternative method
d = Toxicity values cross assigned from alpha-BHC
e = EPA-NCEA regional support value
NA = Not applicable or not available
H = High confidence
L = Low confidence
M = Medium confidence

based on a NOAEL of 0.8 μg/kg-day in a human exposure study. Arsenic's effects on the nervous and cardiovascular systems are primarily associated with acute exposure to higher levels. Exposure to arsenic-containing materials has been shown to cause cancer in humans. Inhalation of these materials can lead to increased lung cancer risk, and ingestion of these materials is associated with increased skin cancer rates. Arsenic has been classified as a group A carcinogen by USEPA, which set the 1.5 $(mg/kg\text{-}day)^{-1}$ oral SF. As listed in IRIS the basis for the classification is sufficient evidence from human data. An increased lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Also, increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in inorganic arsenic. Human milk contains about 3 μg/L arsenic. As listed in IRIS the critical effect of this chemical is hyperpigmentation, keratosis, and possible vascular complications. The oral uncertainty factor was determined to be 3 and the modifying factor was determined to be 1.

Barium is used in various alloys, paints, soap, and manufacture processes. Barium sulfate is used to aid x-ray diagnosis. This element is relatively abundant in nature and is found in plant and animal tissue. Brazil nuts contain 3 to 4 mg per gram nuts. The fatal absorbed dose of barium is approximately 1000 mg (for humans). Assuming an absorption efficiency of five percent for barium, 20,000 mg ingested barium could be fatal. Major toxic effects of this element are muscle stimulation, central nervous system effects, and effects on the heart. The major critical effect is increased blood pressure. USEPA determined the oral RfD and inhalation RfD to be 0.07 and 1.43E-4 mg/kg-day, respectively (Dreisbach, et al, 1987) (Klaassen, et al, 1986), based on a medium confidence level. The oral uncertainty factor for barium is 3 and the oral modifying factor is 1. Barium has been issued a carcinogenic weight-of-evidence classification of "D".

BEQs include the following list of PAHs:

Benzo(a)anthracene TEF 0.1

Benzo(b)fluoranthene	TEF	0.1
Dibenz(a,h)anthracene	TEF	1.0
Benzo(k)fluoranthene	TEF	0.01
Benzo(a)pyrene	TEF	1.0
Indeno(1,2,3-cd)pyrene	TEF	0.1
Chrysene	TEF	0.001

Some PAHs are toxic to the liver, kidney, and blood. However, the toxic effects of the PAHs above have not been well established. There are no RfDs for the PAHs above due to a lack of data. All PAHs listed above are classified by USEPA as B2 carcinogens, and their carcinogenicity is addressed relative to that of benzo(a)pyrene, having an oral SF 7.3 $(mg/kg\text{-}day)^{-1}$. TEFs, also set by USEPA, are multipliers that are applied to the detected concentrations, which are subsequently used to calculate excess cancer risk. These multipliers are discussed further in the exposure and toxicity assessment sections. Most carcinogenic PAHs have been classified as such due to animal studies using large doses of purified PAHs. There is some doubt as to the validity of these listings, and the SFs listed in USEPA's RBC table are provisional. However, these PAHs are carcinogens when the exposure involves a mixture of other carcinogenic substances (e.g., coal tar, soot, cigarette smoke, etc.). As listed in IRIS, the basis for the benzo(a)pyrene B2 classification is human data specifically linking benzo(a)pyrene to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating benzo(a)pyrene to be carcinogenic by numerous routes.

Benzo(a)pyrene has produced positive results in numerous genotoxicity assays. At the June 1992 CRAVE Work Group meeting, a revised risk estimate for benzo(a)pyrene was verified (see Additional Comments for Oral Exposure). This section provides information on three aspects of the carcinogenic risk assessment for the agent in question: the USEPA classification and quantitative estimates of exposure. The classification reflects a weight-of-evidence judgment of

the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in application of a low-dose extrapolation procedure and presented as the risk per (mg/kg-day). The unit risk is the quantitative estimate in terms of either risk per μg/L drinking water or risk per $\mu g/m^3$ air breathed. The third form in which risk is presented is drinking water or air concentration providing cancer risks of 1 in 10,000 or 1 in 1,000,000. The Carcinogenicity Background Document provides details on the carcinogenicity values found in IRIS. Users are referred to the Oral Reference Dose and Reference Concentration sections for information on long-term toxic effects other than carcinogenicity.

As listed in IRIS, the basis for the dibenz(a,h)anthracene and benzo(b)fluoranthene B2 classification is no human data and sufficient data from animal bioassays. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal or subcutaneous injection, and skin painting. As listed in IRIS, the basis for the benzo(a)anthracene B2 classification is no human data and sufficient data from animal bioassays. Benzo(a)anthracene produced tumors in mice exposed by gavage; intraperitoneal, subcutaneous or intramuscular injection; and topical application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. As listed in IRIS, the basis for the benzo(k)fluoranthene B2 classification is no human data and sufficient data from animal bioassays. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in skin-painting studies. Equivocal results have been found in a lung adenoma assay in mice. Benzo(k)fluoranthene is mutagenic in bacteria. (Klaassen, et al., 1986).

Hexachlorocyclohexane or ***(HCH)*** is made by chlorinating benzene, and was previously, erroneously called ***benzenehexachloride (BHC)***. HCH is a synthetic chemical that exists in eight isomers. One of the isomers, gamma (γ)-HCH (commonly called ***lindane***) was once used as an insecticide on fruit, vegetable, and forest crops. It is still used today in the United States and in other countries as a human medicine to threat head and body lice and scabies. Although HCH is

no longer used as an insecticide in the United States, α, β, γ, and δ- HCH have been found in the soil and surface water at hazardous waste sites.

Exposure to excessive amounts of HCH, primarily γ-HCH, by inhalation or ingestion, has been reported to result in death in humans. The cause of acute lethality of HCH in animals may be its effects on the central nervous system since convulsions and coma were often observed prior to death. The doses associated with death and increased mortality in animals are much higher than would be fond in the environment or in water or soil surrounding waste sites, so it is not likely that humans would die following brief or prolonged exposure to HCH in food, water, or soil.

Blood disorders, including anemia, leukopenia, leukocytosis, granulocytopenia, granulocytosis, eosinophilia, monocytosis, pancytopenia, and thrombocytopenia have been observed in individuals exposed to γ-HCH where HCH vaporizers were operated (Brassow et al., 1981). In animals, hematological effects were observed in fats fed δ- HCH in the diet for 13 weeks (Van Velsen et al., 1986).

Hepatic effects, such as increased liver enzymes, have been reported in individuals exposed to technical-grade HCH principally by inhalation in a pesticide formulating plant (Kashyap, 1986); similar effects were not reported in individuals who ingested HCH or applied γ-HCH to their skin.

In humans, neurological effects including parathesis of the face and extremities, headaches, vertigo, abnormal EEG patterns and often seizures and convulsions have been reported in individuals occupationally exposed to γ-HCH or in individuals exposed to large amounts of γ-HCH by ingestion or dermal application (Czegledi-Janko and Avar, 1970; Davies et al., 1983; Harris et al., 1969; Heiberg and Wright, 1955; Kashyap, 1986; Lee and Groth, 1977; Matsuoka, 1981, Munk and Nantel, 1977; Nantel, 1977; Powell, 1980; Starr and Clifford, 1972; Telch and Jarvis, 1982). Acute- and intermediate-duration exposure of animals to high oral or dermal doses

of γ- or β- HCH affects the central nervous system as evidenced by behavior disorders, decreased nerve velocity, convulsions and seizures, and coma (Albertson et al., 1985; Desi, 1974; Hanig et al., 1976; Muller et al., 1981; Tilson et al., 1987; Tusell et al., 1987; Van Velsen et al., 1986). No histological examinations were conducted in the brain or nervous system of animals exposed by any route for any duration. There is no evidence available regarding the presence or absence of carcinogenic effects in humans following exposure by any route. Weight of evidence, cancer slope factors and reference doses for each of the HCH isomers are shown in Table 10.12.25.

Table 10.12.25
HCH Isomer Information
SWMU 6, SWMU 7, AOC 635
NAVBASE Charleston, Zone G
Charleston, South Carolina

HCH isomer	Weight of Evidence Class	Oral RfD	Oral SF	Inhalation SF
α- HCH	B2$_I$	NA	6.3E+00$_I$	6.3E+00$_I$
β- HCH	C$_I$	NA	1.8E+00$_I$	1.8E+00$_I$
γ- HCH	B2-C$_H$	3.0E-04$_I$	1.3E+00$_H$	NA
δ- HCH	NA	NA	NA	NA
-technical	NA	NA	1.8E+00$_I$	1.8E+00$_I$

Notes:
I - IRIS, 1996
H - USEPA, 1996
NA - Not available

Beryllium exposure via the inhalation route can inflame the lungs, a condition known as Acute Beryllium Disease, as a result of short-term exposure to high concentrations. Removal from exposure reverses the symptoms. Chronic exposure to much lower concentrations of beryllium or beryllium oxide by inhalation has been reported to cause chronic beryllium disease, with symptoms including shortness of breath, scarring of the lungs, and berylliosis, which is noncancerous growths in the lungs of humans. Both forms of beryllium disease can be fatal, depending on the severity of the exposure. Additionally, a skin allergy may develop when soluble

beryllium compounds come into contact with the skin of sensitized individuals (Gradient, 1991). An oral RfD of 0.0054 mg/kg-day has been set for beryllium based on a chronic oral bioassay (rats were the study species) which determined an NOAEL of 0.54 mg/kg-day. Beryllium has been classified by USEPA as a group B2 carcinogen based on animal studies. Human epidemiology studies of beryllium are inadequate. As listed in IRIS, classification is based on beryllium being shown to induce lung cancer via inhalation in rats and monkeys and to induce osteosarcomas in rabbits via intravenous or intramedullary injection. An inhalation SF of 8.4 $(mg/kg\text{-}day)^{-1}$ and an oral SF of 4.3 $(mg/kg\text{-}day)^{-1}$ have been set by USEPA. As listed in IRIS, the critical effect of this chemical is no adverse effect. The uncertainty factor was 100 and the modifying factor was 1. The IRIS RfD in drinking water is 0.005 mg/kg-day.

Chlordane is a polycyclic chlorinated pesticide. Acute exposure to high doses of chlordane causes tremors and convulsions. Chronic exposure can cause emotional and neuromuscular disturbances. Exposed individuals revert to normal approximately one week after the source is removed (Dreisbach et al., 1987). USEPA has established an oral RfD of 0.0005 mg/kg-day and an oral SF and inhalation SF of 0.35 $(mg/kg\text{-}day)^{-1}$.

Chromium exists in two stable, natural forms: CrIII and CrVI. Acute exposure to chromium can result in kidney damage following oral exposure or damage to the nasal mucosa and septum following inhalation exposure. Chronic inhalation exposure to CrVI has resulted in kidney and respiratory tract damage, as well as excess lung cancer in both animals and humans following occupational exposure. Only CrVI is believed to be carcinogenic by inhalation (IRIS). Oral RfD values for CrIII CrVI are 1.0 and 5E-3 (mg/kg-day), respectively. For CrVI, the RfD is based on liver toxicity in the rat. For the CrVI, the RfD is based on unspecified pathological changes observed in rat studies. In addition, CrVI is considered a group A carcinogen for inhalation exposures, and an oral SF of 42 $(mg/kg\text{-}day)^{-1}$ has been established for the hexavalent form. Vitamin supplements contain approximately 0.025 mg of chromium. As listed in IRIS, no critical

effects were observed for CrIII. The uncertainty factor for CrIII was 100 and the modifying factor was 10. As listed in IRIS, no critical effects were observed for CrVI. The uncertainty factor for CrVI was 500 and the modifying factor was 1.

4,4'-DDD, a by-product of the pesticide DDT, is a compound typical of halobenzene derivatives. It is soluble in fat, but not in water, and its target organ is the brain. This analog of DDT is the least toxic of the three primary DDT analogues (i.e., the least likely to cause cancer). Other DDD effects could include cell death in the liver, fatty change of heart muscles, and kidney damage. In a study mentioned in Dreisbach, et al., workers historically exposed to DDT had up to 648 ppm DDT in their body fat no adverse health effects were observed. If an individual loses body fat, DDD concentrations are not stored at sufficient concentrations to induce toxic effects. This compound is listed as a B2 carcinogen, and USEPA set the oral SF for DDD to 0.24 $(mg/kg\text{-}day)^{-1}$ (Dreisbach, et al, 1987).

4,4'-DDE, a by-product of the pesticide DDT, is a compound typical of halobenzene derivatives. It is soluble in fat, but not in water, and its target organ is the brain. This analog of DDT is the second-most toxic of the three primary DDT analogues (i.e., the second-most likely to cause cancer). Other DDE effects could include cell death in the liver, fatty change of heart muscles, and kidney damage. In a study mentioned in Dreisbach, et al, workers historically exposed to DDT had up to 648 ppm DDT in their body fat, yet no adverse health effects were observed. If an individual loses body fat, DDE concentrations are not stored at sufficient concentrations to induce toxic effects. This compound is listed as a B2 carcinogen, and USEPA set the oral SF for DDE to 0.34 $(mg/kg\text{-}day)^{-1}$ (Dreisbach, et al, 1987).

DDT, or ***1,1,1-trichloro-2,2-bis-(p-chlorophenyl)ethane***, was one of the most widely used chemicals for controlling insect pests on agriculture crops and controlling insects that carry such diseases as malaria and typhus. Technical DDT is primarily a mixture of three forms (p,p'-DDT, o,p'-DDT, and

o,o'-DDT), all of which are white, crystalline, tasteless, and almost odorless solids. DDT does not occur naturally in the environment and its presence in the environment is a result of contamination due to past production, use and subsequent movement from sites of application to land, water, and air. Several waste sites contain these compounds and might act as additional sources of environmental contamination. Some DDT may be degraded in air, but the compound may persist for a long time bound to certain soils. ***DDE (1,1-dichloro-2,2-bis [p-chlorophenyl] ethylene)*** and ***DDD (1,1-dichloro-2,2-bis [p-chlorophenyl] ethane)*** are found in small amounts as contaminants in technical grade DDT. DDD has had some use as a pesticide and also as a treatment for cancer of the adrenal gland. The use of DDD, DDE, and DDT is banned in the United States (ATSDR, 1992).

With acute exposure to high doses, the nervous system appears to be the major target in both humans and experimental animals (Herr and Tilson, 1987; Hayes, 1982). Information on health effects in humans following acute inhalation exposure to DDD or DDE is limited (ATSDR, 1992). Chronic exposure of experimental animals to DDT is associated with tremors and general hyper irritability (NCI, 1978; Rossi et al., 1977). In male and female mice a single oral dose of 237 to 32 mg DDT/kg caused death of all the mice (Bathe et al., 1976; Kashyap et al., 1977; Tomatis et al., 1972). There is evidence of mild to severe hepatic effects in experimental animals as a result of acute, subchronic, or chronic oral administration of DDT (Pasha, 1981).

Epidemiological evidence is inconclusive for establishing, with reasonable certainty, if DDT is a human carcinogen. Evidence exists from animal studies to consider DDT, DDE, and DDD probable human carcinogens based on USEPA's B2 classification (IRIS). For example, DDT is carcinogenic in most strains of mice tested (Innes et al., 1969; Thorpe and Walker, 1973; Tomatis et al., 1972; Kashyap et al., 1977; Shabad et al., 1973) and in a few studies was carcinogenic in rats (Cabral et al., 1982b; Rossi et al., 1977). However, several other rat studies reported negative results (Legator et al., 1973; Palmer et al., 1973; Cameron and Cheng, 1951; Shivapurkar et al., 1986), as were most of those in hamsters (Agthe et al., 1970; Cabral et al., 1982a; Graillot et al., 1975), and the one study

in monkeys (Adamson and Sieber, 1979, 1983). One area of uncertainty is the significance of liver tumors in certain strains of mice and the appropriateness of extrapolating this information to humans. Several studies in rats, mice and hamsters have been conducted to determine the potential carcinogenicity of DDD and DDE. A chronic feeding study in mice has shown DDE to produce liver tumors at doses of 19-34 mg/kg-day for 124 weeks (NCI 1978; Tomatis et al., 1974a). A similar study produced liver tumors in hamsters given 40 mg/kg-day for 124 weeks (Rossi et al., 1983). However, DDE did not induce significant increases in rats given 12 to 42 mg/kg-day for 78 weeks (NCI, 1978). DDD induced liver tumors and lung adenomas in CF-1 mice (Tomatis et al., 1974a) and thyroid follicular cell tumors in Fischer-344 rats (NCI, 1978) but was not tumor producing in B6C3F1 mice (NCI, 1978).

The oral SF for DDD is 2.4E-01. The oral SF for DDE is 3.4E-01. The oral SF for DDT is 3.4E-01, which is the same as the inhalation SF for DDT. An oral RfD has been issued for DDT as 5E-04 (IRIS).

Dioxins are a group of chlorinated hydrocarbons that accumulate in fat tissue. Exposure to dioxins, known to be potent mutagens and teratogens, causes burning pain in the tongue, abdomen, and pharynx, chloracne, loss of body weight, degenerative changes to the liver and thymus, and psychiatric disturbances. Chloracne is the primary sign of human exposure (Klaassen, et al., 1986; Dreisbach, et al., 1987). USEPA classified dioxins as group B2 carcinogens and determined the oral SF to be 150,000 $(mg/kg\text{-}day)^{-1}$ for 2,3,7,8-TCDD. Equivalent concentrations of other dioxin congeners were calculated based on their corresponding toxic equivalents, as recommended by USEPA.

Heptachlor is a man-made chemical that was used in the past for killing insects in homes, buildings, and on food crops. Pure heptachlor is a white powder. Technical-grade heptachlor is a tan powder

and has a lower level of purity than pure heptachlor. Heptachlor smells somewhat like camphor, and does not burn easily or explode (ATSDR, 1991).

No studies were located regarding lethal effects in humans after oral exposure to heptachlor. However, since heptachlor is a major component of the insecticide chlordane, chlordane poisoning can be considered when evaluating heptachlor toxicity data. There are no data on chronic oral exposures in humans. There are occupational studies of workers engaged in the manufacture of heptachlor in which the exposures are presumed to be predominantly inhalation with contributions from the dermal route. No adverse health effects have been identified in these cohorts that could be positively associated with heptachlor exposure.

Heptachlor has been issued the USEPA weight of classification of B2, probable human carcinogen (IRIS). Heptachlor has an oral RfD of 5E-04 mg/kg-day, and an oral SF of 4.5 $(mg/kg\text{-}day)^{-1}$, and an inhalation SF of 4.55 $(mg/kg\text{-}day)^{-1}$ (IRIS).

Lead has been classified as a group B2 carcinogen by USEPA based on animal data. No RfD or SF has been set by USEPA. However, an action level for soil protective of child residents has been proposed by USEPA Region IV: 400 mg/kg. USEPA's Office of Water has established a treatment technique action level of 15 μg/L. As listed in IRIS, the classification is base on sufficient animal evidence. Ten rat bioassays and one mouse assay have shown statistically significant increases in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Animal assays provide reproducible results in several laboratories, in multiple rat strains with some evidence of multiple tumor sites. Short-term studies show that lead affects gene expression. Human evidence is inadequate. An RfD and SF have not been set because of the confounding nature of lead toxicity. Lead can accumulate in bone marrow, and effects have been observed in the CNS, blood, and mental development of children. RfDs are based on the assumption that a threshold must be exceeded to result in toxic effects (other than carcinogenicity).

Once lead accumulates in the body, other influences cause the actual levels in the blood to fluctuate – sometimes the lead is attached to binding sites; sometimes lead is free flowing. If an exposed individual has previously been exposed to lead, this individual could lose weight and set fat-bound lead free. This fluctuation and lack of previous lead exposure data are two of the reasons lead effects are difficult to predict (Klaassen et al., 1986).

Manganese is an essential nutrient, but chronic exposure (0.8 mg/kg-day) causes mental disturbances. Studies have shown that manganese uptake from water is greater than manganese uptake from food, and the elderly appear to be more sensitive than children (Klaassen et al., 1986; Dreisbach et al., 1987). USEPA determined the RfD to be 0.14 mg/kg-day based on dietary uptake. USEPA recommended using a modifying factor of 3 when estimating intake from soil and water. In addition, the body is roughly twice as efficient absorbing manganese in water compared to manganese in food. Because of the different uptake rates in water and food, two RfDs were used in this HHRA – one for water and one for food. The RfDs used are 0.047 and 0.023 mg/kg-day, respectively. Inhalation of manganese dust causes neurological effects and increased incidence of pneumonia. An inhalation RfD was set to 0.0000143 mg/kg-day. According to USEPA, manganese cannot be classified as to its carcinogenicity. Therefore, the cancer class for manganese is group D. As listed in IRIS, the classification is based on studies that are inadequate to assess the carcinogenicity of manganese. Manganese is an element considered essential to human health. The typical vitamin supplement dose of manganese is 2.5 mg/day. As listed in IRIS, the critical effects of this chemical in water in the oral summary are CNS effects. The uncertainty factor was 1 and the recommended modifying factor of 3 was used to estimate soil and groundwater intake. The critical effects of this chemical are CNS effects. As listed in IRIS, the critical effect of this chemical in the inhalation summary is impairment of neuro-behavioral function. For inhalation uptake, the uncertainty factor was 1,000 and the modifying factor was 1. The IRIS RfC is 0.00005 mg/m^3.

PCB Aroclors are a group of chlorinated hydrocarbons (such as ***Aroclors-1254, and 1260***) that accumulate in fat tissue. Occupational exposure (both inhalation and dermal) to PCBs causes eye and lung irritation, loss of appetite, liver enlargement, increased serum liver enzyme levels, rashes and chloracne, and decreased birth weight of infants in heavily exposed worker/mothers. Of the effects listed above, the liver is the primary target organ (Klaassen, et al, 1986) (Dreisbach, et. al., 1987). USEPA classified PCB aroclors as group B2 probable human carcinogens, primarily based on animal data. Oral ingestion of PCBs causes liver and stomach tumors in rat studies. The cancer potency of PCB mixtures is determined using a tiered approach. The high risk and persistence tier uses an upper-bound slope factor of 2.0 $(mg/kg\text{-}day)^{-1}$ and is appropriate for food chain exposures, sediment and soil ingestion, dust or aerosol inhalation, and dermal exposure. The low risk and persistence tier uses an upper-bound slope factor of 0.4 $(mg/kg\text{-}day)^{-1}$ and is appropriate for ingestion of water soluble congeners and inhalation of evaporated congeners. The lowest risk and persistence tier uses an upper-bound slope factor of 0.07 $(mg/kg\text{-}day)^{-1}$ and is appropriate for PCB congener mixtures with congeners having more than four chlorines comprising less than 1/2% of the mixture.

Pentachlorophenol and most compounds related to phenol are cellular toxicants. These compounds can cause bladder tumors, and might be carcinogens and/or sensitizers (Dreisbach, et al, 1987). USEPA has determined the oral RfD to be 0.03 mg/kg-day and the oral SF to be 0.12 $(mg/kg\text{-}day)^{-1}$, respectively.

Thallium is readily absorbed through the gut and skin. Primary effects are stomach and bowel disturbances, kidney and liver damage, and neurological disturbances. Thallium was used in the past as a rodenticide and ant killer, and its use for these purposes is now prohibited. This element remains in the body for a relatively long time, and could accumulate if the chronic dose is large. USEPA's oral RfD for thallium is 0.00008 mg/kg-day (Klaassen, et al., 1986; Dreisbach, et al., 1987). The oral uncertainty factor for thallium is 3000.

Vanadium is not readily absorbed through the skin or oral ingestion and is a ubiquitous element. It is also a by-product of petroleum refining. Vanadium is soluble in fats and oils (Klaassen et al., 1986). Municipal water supplies contain 0.001 to 0.006 mg/L. The target organ is unclear, and the primary focus of toxicological information is inhalation of vanadium dust. Typical vitamin supplements contain approximately 0.010 mg in a daily dose. The oral RfD set by USEPA is 0.007 mg/kg-day. The oral uncertainty factor of vanadium is 100.

10.12.6.5 Risk Characterization

Surface Soil Pathways

Exposure to surface soil onsite was evaluated under both residential and site worker scenarios. For these scenarios, the incidental ingestion of surface soil, dermal contact with surface soil, and inhalation of dust borne contaminants were the evaluated exposure pathways. For noncarcinogenic contaminants evaluated for future site residents, hazard was computed separately to address child and adult exposure. Tables 10.12.26, 10.12.27, and 10.12.28 present the computed carcinogenic risks and/or HQs associated with the ingestion, dermal contact, and inhalation surface soil exposure pathways, respectively.

Hypothetical Site Residents

The ILCRs (based on the adult and child lifetime weighted average) for combined SWMU 6 surface soils are 3E-04 for the ingestion pathway, 1E-04 for the dermal pathway, and 2E-07 for the inhalation pathway. Arsenic, Aroclor-1260, BEQs, and dioxin equivalents were the primary contributors to the ingestion and dermal pathways. Secondary contributors to the ingestion and dermal pathways include Aroclor-1254, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT. Though the adolescent trespasser was not quantitatively addressed for this site, the following semiquantitative analysis was performed using the results of the residential risk analysis. Exposure frequency and duration under the residential scenario are 350 days/year and 30 years, respectively, compared to 52 day/year and 7 years for the adolescent trespasser. Substituting the trespasser exposure frequency and duration

Table 10.12.26
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Surface Soil Ingestion
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident adult Hazard Quotient	Future Resident child Hazard Quotient	Future Resident lwa ILCR	Future Site Worker adult Hazard Quotient	Future Site Worker adult ILCR
Inorganics							
Antimony	0.0004	NA	0.015	0.14	ND	0.0054	ND
Arsenic	0.0003	1.5	0.055	0.51	2.8E-05	0.019	3.1E-06
Chromium	0.005	NA	0.0059	0.055	ND	0.0021	ND
Lead	NA	NA	ND	ND	ND	ND	ND
Manganese	0.047	NA	0.0049	0.046	ND	0.0018	ND
Thallium	8E-05	NA	0.015	0.14	ND	0.0054	ND
Vanadium	0.007	NA	0.0040	0.038	ND	0.0014	ND
Semivolatile Organics							
Benzo(a)pyrene equivalents	NA	7.3	ND	ND	2.2E-05	ND	2.5E-06
Pesticides/PCBs/Dioxin							
Aroclor 1254	2E-05	2	0.040	0.37	1.8E-06	0.014	2.0E-07
Aroclor 1260	NA	2	ND	ND	1.9E-05	ND	2.1E-06
alpha-BHC	NA	6.3	ND	ND	5.4E-07	ND	6.1E-08
beta-BHC	NA	1.8	ND	ND	8.5E-08	ND	9.5E-09
delta-BHC	NA	6.3	ND	ND	9.7E-07	ND	1.1E-07
gamma-BHC	0.0003	1.3	0.00060	0.0056	2.7E-07	0.00022	3.0E-08
alpha-Chlordane	0.0005	0.35	0.00069	0.0064	1.4E-07	0.00025	1.5E-08
gamma-Chlordane	0.0005	0.35	0.0010	0.0092	2.0E-07	0.00035	2.2E-08
4,4'-DDD	NA	0.24	ND	ND	4.2E-06	ND	4.7E-07
4,4'-DDE	NA	0.34	ND	ND	1.8E-06	ND	2.0E-07
4,4'-DDT	0.0005	0.34	0.030	0.28	5.8E-06	0.011	6.5E-07
Dioxin equivalents	NA	150000	ND	ND	2.4E-04	ND	2.7E-05
Heptachlor	0.0005	4.5	0.000060	0.00056	1.5E-07	0.000021	1.7E-08
SUM Hazard Index/ILCR			0.2	2	3E-04	0.06	4E-05

NOTES:
NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk

Table 10.12.27
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact With Surface Soil
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Chemical	Dermal Adjustment	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident adult Hazard Quotient	Future Resident child Hazard Quotient	Future Resident lwa ILCR	Futre Site Worker adult Hazard Quotient	Future Site Worker adult ILCR
Inorganics								
Antimony	0.2	8E-05	NA	0.0031	0.010	ND	0.0022	ND
Arsenic	0.2	6E-05	7.5	0.011	0.037	3.1E-06	0.0080	1.3E-06
Chromium	0.2	0.001	NA	0.0012	0.0040	ND	0.00086	ND
Lead	0.2	NA	NA	ND	ND	ND	ND	ND
Manganese	0.2	0.0094	NA	0.0010	0.0033	ND	0.00072	ND
Thallium	0.2	1.6E-05	NA	0.0031	0.010	ND	0.0022	ND
Vanadium	0.2	0.0014	NA	0.00083	0.0027	ND	0.0006	ND
Semivolatile Organics								
Benzo(a)pyrene equivalents	0.5	NA	14.6	ND	ND	9.9E-06	ND	4.0E-06
Pesticides/PCBs/Dioxin								
Aroclor 1254	0.5	1E-05	4	0.033	0.11	8.2E-07	0.023	3.3E-07
Aroclor 1260	0.5	NA	4	ND	ND	8.5E-06	ND	3.5E-06
alpha-BHC	0.5	NA	12.6	ND	ND	2.4E-07	ND	1.0E-07
beta-BHC	0.5	NA	3.6	ND	ND	3.8E-08	ND	1.6E-08
delta-BHC	0.5	NA	12.6	ND	ND	4.4E-07	ND	1.8E-07
gamma-BHC	0.5	0.00015	2.6	0.00049	0.0016	1.2E-07	0.00035	4.9E-08
alpha-Chlordane	0.5	0.00025	0.7	0.00056	0.0019	6.2E-08	0.00040	2.5E-08
gamma-Chlordane	0.5	0.00025	0.7	0.00081	0.0027	8.9E-08	0.00058	3.6E-08
4,4'-DDD	0.5	NA	0.48	ND	ND	1.9E-06	ND	7.7E-07
4,4'-DDE	0.5	NA	0.68	ND	ND	7.9E-07	ND	3.2E-07
4,4'-DDT	0.5	0.00025	0.68	ND	ND	2.6E-06	ND	1.1E-06
Dioxin equivalents	0.5	NA	300000	ND	ND	1.1E-04	ND	4.4E-05
Heptachlor	0.5	0.00025	9	0.000049	0.00016	6.9E-08	0.000035	2.8E-08
SUM Hazard Index/ILCR				0.06	0.2	1E-04	0.04	6E-05

NOTES:

NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk
- Dermal to absorbed dose adjustment factor is applied to adjust for Oral SF and RfD (i.e., the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI)

Table 10.12.28
Hazard Quotients and Incremental Lifetime Cancer Risks
Inhalation of Surfaee Soil COPCs Resulting from Dust Emission
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Chemical	Inhalation RfD Used (mg/kg-day)	Inhalation SF Used (mg/kg-day)-1	Future Resident adult Hazard Quotient	Future Resident child Hazard Quotient	Future Resident lwa ILCR	Future Site Worker adult Hazard Quotient	Future Site Worker adult ILCR
Inorganics							
Antmony	NA	NA	ND	ND	ND	ND	ND
Arsenic	NA	15.1	ND	ND	2.2E-08	ND	9.6E-09
Chromium	5.71E-07	42	0.0078	0.022	1.1E-07	0.0056	4.8E-08
Lead	NA	NA	ND	ND	ND	ND	ND
Manganese	1.43E-05	NA	0.0024	0.007	ND	0.0017	ND
Thallium	NA	NA	ND	ND	ND	ND	ND
Vanadium	NA	NA	ND	ND	ND	ND	ND
Semivolatile Organics							
Benzo(a)pyrene equivalents	NA	3.1	ND	ND	7.2E-10	ND	3.2E-10
Pesticides/PCBs/Dioxin							
Aroclor 1254	NA	2	ND	ND	1.4E-10	ND	6.2E-11
Aroclor 1260	NA	2	ND	ND	1.5E-09	ND	6.4E-10
alpha-BHC	NA	6.3	ND	ND	4.2E-11	ND	1.8E-11
beta-BHC	NA	1.8	ND	ND	6.6E-12	ND	2.9E-12
delta-BHC	NA	6.3	ND	ND	7.5E-11	ND	3.3E-11
gamma-BHC	NA	NA	ND	ND	ND	ND	ND
alpha-Chlordane	NA	0.35	ND	ND	1.1E-11	ND	4.6E-12
gamma-Chlordane	NA	0.35	ND	ND	1.5E-11	ND	6.7E-12
4,4'-DDD	NA	NA	ND	ND	ND	ND	ND
4,4'-DDE	NA	NA	ND	ND	ND	ND	ND
4,4'-DDT	NA	0.34	ND	ND	4.5E-10	ND	2.0E-10
Dioxin equivalents	NA	150000	ND	ND	1.9E-08	ND	8.1E-09
Heptachlor	NA	4.55	ND	ND	1.2E-11	ND	5.3E-12
SUM Hazard Index/ILCR			0.01	0.03	2E-07	0.007	7E-08

NOTES:
NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk

into the CDI equation would result in a risk estimate approximately 98% below the residential risk estimate. Assuming that the concrete pad and perimeter fencing are removed from the site, the cumulative soil pathway (ingestion, dermal, and inhalation) risk for the adolescent trespasser was estimated to be approximately 2E-05.

The computed hazard indices for the adult resident were 0.2 for the soil ingestion pathway, 0.06 for the dermal contact pathway, and 0.01 for the inhalation pathway. The computed hazard indices for the child resident were 2 for the ingestion pathway, 0.2 for the dermal contact pathway and 0.03 for the inhalation pathway. Antimony, Aroclor -1254, arsenic, 4,4'-DDT, and thallium were the primary contributors to HI projections for the ingestion pathway. The semiquantitative analysis for adolescent trespasser hazard index is similar to the risk estimate detailed the paragraph above. Exposure frequency and duration for the child resident are 350 days/year and 6 years, respectively, compared to 52 days/year and 7 years for the trespasser. Substituting the trespasser exposure frequency and duration into the CDI equation would result in a hazard estimate approximately 83% below the residential hazard estimate. Assuming that the concrete pad and perimeter fencing were removed from the site, the cumulative soil pathway (ingestion, dermal, and inhalation) hazard for the adolescent trespasser was estimated to be approximately 0.3.

Hypothetical Site Workers

Site worker ILCRs for surface soil are 4E-05 for the ingestion pathway, 6E-05 for the dermal pathway, and 7E-08 for the inhalation pathway. Arsenic, Aroclor-1260, and BEQs were the primary contributors for the ingestion and dermal pathways. Site worker HIs are 0.06 for the ingestion pathway, 0.02 for the dermal pathway, and 0.007 for the inhalation pathway.

Groundwater Pathways

Exposure to shallow groundwater onsite was evaluated under a residential scenario based on the results of the RFI first-quarter sampling event. The ingestion exposure pathway was evaluated

assuming the site groundwater will be used for potable and/or domestic purposes and that an unfiltered well, drawing from the corresponding water bearing zone, will be installed. For noncarcinogenic contaminants evaluated relative to future site residents, hazard was computed separately for child and adult receptors. Table 10.12.29 presents the risk and hazard for the ingestion pathway.

Hypothetical Site Residents

The ingestion ILCR for combined SWMU 6 shallow groundwater (based on the adult and child lifetime weighted average) is 6E-03, with arsenic as the primary contributor and beryllium and pentachlorophenol as secondary contributors to ILCR projections. The HIs for the adult and child resident are 25 and 58, respectively. Arsenic is the primary contributors to ingestion HI. Barium is a secondary contributor.

Hypothetical Site Workers

The site worker ingestion ILCR for combined SWMU 6 shallow groundwater is 1E-03, with arsenic as the primary contributor and beryllium as a secondary contributor to ILCR projections. The site worker ingestion HI is 9. Arsenic is the primary contributors to ingestion HI.

Current Site Workers

Shallow groundwater is not currently used as a potable water source for combined SWMU 6 or other areas of Zone G. In the absence of a completed exposure pathway, no threat to human health is posed by reported shallow groundwater contamination.

Lead

Lead was identified as a COPC based on screening comparisons using the 1993 surface soil data summarized on Table 10.12.16. The reported soil lead concentration only exceeded the 400 mg/kg AL in two of 42 samples collected (S06B15; 1,000 mg/kg and S07B28; 557 mg/kg).

Table 10.12.29
Hazard Quotients and Incremental Lifetime Cancer Risks
Groundwater Ingestion
SWMU 6, SWMU 7, and AOC 635
Naval Base Charleston, Zone G
Charleston, South Carolina

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident adult Hazard Quotient	Future Resident child Hazard Quotient	Future Resident lwa ILCR	Future Site Worker adult Hazard Quotient	Future Site Worker adult ILCR
Inorganics							
Arsenic (As)	0.0003	1.5	25	57	6.1E-03	8.8	1.4E-03
Barium (Ba)	0.07	NA	0.12	0.28	ND	0.042	ND
Beryllium (Be)	0.005	4.3	0.0077	0.018	9.1E-05	0.0027	2.1E-05
Semivolatile Organics							
Pentachlorophenol	0.03	0.12	0.0018	0.0043	3.6E-06	0.00065	8.4E-07
SUM Hazard Index/ILCR			25	58	6E-03	9	1E-03

Notes:
NA Not available
ND Not Determined due to lack of available information
lwa Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR Incremental Lifetime Cancer Risk

The 95% UCL for lead determined using surface soil data generated during both the 1993 and RFI sampling events is 161 mg/kg which is below the AL for lead (summarized on Table 10.12.19). As a result, lead was not addressed further in this assessment.

COCs Identified

COCs were identified based on cumulative (all pathway) risk and hazard projected for this site on a medium-specific basis. USEPA has established a generally acceptable risk range of 1E-04 to 1E-06, and a hazard index threshold of 1.0 (unity). As recommended by SCDHEC, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual ILCR exceeds 1E-06 or whose hazard quotient exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-04 (and individual ILCR of 1E-06) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used to provide a more comprehensive evaluation of chemicals contributing to carcinogenic risk or noncarcinogenic hazard during the RGO development process. Table 10.12.30 presents the COCs identified for combined SWMU 6 surface soil and shallow groundwater.

Surface Soils

Future Site Residents

Aroclor-1260, Aroclor-1254, arsenic, BEQs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dioxin were identified as soil pathway COCs based on their contribution to cumulative ILCR projections. Antimony, Aroclor-1254, arsenic, 4,4'-DDT, and thallium were identified as soil pathway COC based on their contribution to cumulative HI projections.

Future Site Workers

Aroclor-1260, arsenic, BEQs, 4,4'-DDT, and dioxin were identified as soil pathway COCs based on their contribution to cumulative ILCR projections.

Table 10.12.30
Summary of Risk and Hazard-based COCs
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident Iwa ILCR	Site Worker Hazard Quotient	Site Worker ILCR	Identification of COCs		
Surface Soil	Incidental Ingestion	**Inorganics**								
		Antimony	0.015	0.14	ND	0.0054	ND	1		
		Arsenic	0.055	0.51	2.8E-05	0.019	3.1E-06	1	2	4
		Chromium	0.0059	0.055	ND	0.0021	ND			
		Lead	ND	ND	ND	ND	ND			
		Manganese	0.0049	0.046	ND	0.0018	ND			
		Thallium	0.015	0.14	ND	0.0054	ND	1		
		Vanadium	0.0040	0.038	ND	0.0014	ND			
		Semivolatile Organics								
		Benzo(a)pyrene equivalents	ND	ND	2.2E-05	ND	2.5E-06		2	4
		Pesticides/PCBs/Dioxin								
		Aroclor 1254	0.040	0.37	1.8E-06	0.014	2E-07	1	2	
		Aroclor 1260	ND	ND	1.9E-05	ND	2.1E-06		2	4
		alpha-BHC	ND	ND	5.4E-07	ND	6.1E-08			
		beta-BHC	ND	ND	8.5E-08	ND	9.5E-09			
		delta-BHC	ND	ND	9.7E-07	ND	1.1E-07			
		gamma-BHC	0.00060	0.0056	2.7E-07	0.00022	3E-08			
		alpha-Chlordane	0.00069	0.0064	1.4E-07	0.00025	1.5E-08			
		gamma-Chlordane	0.0010	0.0092	2.0E-07	0.00035	2.2E-08			
		4,4'-DDD	ND	ND	4.2E-06	ND	4.7E-07		2	
		4,4'-DDE	ND	ND	1.8E-06	ND	2E-07		2	
		4,4'-DDT	0.030	0.28	5.8E-06	0.011	6.5E-07	1	2	
		Dioxin equivalents	ND	ND	2.4E-04	ND	2.7E-05		2	4
		Heptachlor	0.000060	0.00056	1.5E-07	0.000021	1.7E-08			
	Dermal Contact	**Inorganics**								
		Antimony	0.0031	0.010	ND	0.0022	ND			
		Arsenic	0.011	0.037	3.1E-06	0.0080	1.3E-06		2	4
		Chromium	0.0012	0.0040	ND	0.00086	ND			
		Lead	ND	ND	ND	ND	ND			
		Manganese	0.0010	0.0033	ND	0.00072	ND			
		Thallium	0.0031	0.010	ND	0.0022	ND			
		Vanadium	0.00083	0.0027	ND	0.00059	ND			
		Semivolatile Organics								
		Benzo(a)pyrene equivalents	ND	ND	9.9E-06	ND	4.0E-06		2	4
		Pesticides/PCBs/Dioxin								
		Aroclor 1254	0.033	0.11	8.2E-07	0.023	3.3E-07	1		
		Aroclor 1260	ND	ND	8.5E-06	ND	3.5E-06		2	4
		alpha-BHC	ND	ND	2.4E-07	ND	1E-07			
		beta-BHC	ND	ND	3.8E-08	ND	1.6E-08			
		delta-BHC	ND	ND	4.4E-07	ND	1.8E-07			
		gamma-BHC	0.00049	0.0016	1.2E-07	0.00035	4.9E-08			
		alpha-Chlordane	0.00056	0.0019	6.2E-08	0.00040	2.5E-08			
		gamma-Chlordane	0.00081	0.0027	8.9E-08	0.00058	3.6E-08			
		4,4'-DDD	ND	ND	1.9E-06	ND	7.7E-07		2	
		4,4'-DDE	ND	ND	7.9E-07	ND	3.2E-07			
		4,4'-DDT	ND	ND	2.6E-06	ND	1.1E-06		2	4
		Dioxin equivalents	ND	ND	1.1E-04	ND	4.4E-05		2	4
		Heptachlor	0.000049	0.00016	6.9E-08	0.000035	2.8E-08			
	Inhalation	**Inorganics**								
		Antimony	ND	ND	ND	ND	ND			
		Arsenic	ND	ND	2.2E-08	ND	9.6E-09			
		Chromium	0.0078	0.022	1.1E-07	0.0056	4.8E-08			
		Lead	ND	ND	ND	ND	ND			

Table 10.12.30
Summary of Risk and Hazard-based COCs
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Site Worker Hazard Quotient	Site Worker ILCR	Identification of COCs
		Manganese	0.0024	0.0068	ND	0.0017	ND	
		Thallium	ND	ND	ND	ND	ND	
		Vanadium	ND	ND	ND	ND	ND	
		Semivolatile Organics						
		Benzo(a)pyrene equivalents	ND	ND	7.2E-10	ND	3.2E-10	
		Pesticides/PCBs/Dioxin						
		Aroclor 1254	ND	ND	1.4E-10	ND	6.2E-11	
		Aroclor 1260	ND	ND	1.5E-09	ND	6.4E-10	
		alpha-BHC	ND	ND	4.2E-11	ND	1.8E-11	
		beta-BHC	ND	ND	6.6E-12	ND	2.9E-12	
		delta-BHC	ND	ND	7.5E-11	ND	3.3E-11	
		gamma-BHC	ND	ND	ND	ND	ND	
		alpha-Chlordane	ND	ND	1.1E-11	ND	4.6E-12	
		gamma-Chlordane	ND	ND	1.5E-11	ND	6.7E-12	
		4,4'-DDD	ND	ND	ND	ND	ND	
		4,4'-DDE	ND	ND	ND	ND	ND	
		4,4'-DDT	ND	ND	4.5E-10	ND	2.0E-10	
		Dioxin equivalents	ND	ND	1.9E-08	ND	8.1E-09	
		Heptachlor	ND	ND	1.2E-11	ND	5.3E-12	
Surface Soil Pathway Sum			0.2	2	5E-04	0.11	9E-05	
Groundwater Pathways	Ingestion	**Inorganics**						
		Arsenic (As)	25	57	6.1E-03	8.8	1.4E-03	1 2 3 4
		Barium (Ba)	0.12	0.28	ND	0.042	ND	1
		Beryllium (Be)	0.0077	0.018	9.1E-05	0.0027	2.1E-05	2 4
		Semivolatile Organics						
		Pentachlorophenol	0.0018	0.0043	3.6E-06	0.00065	8.4E-07	2
Groundwater Pathway Sum			25	58	6E-03	9	1E-03	
Sum of All Pathways			25	59	7E-03	9	2E-03	

Notes:
ND Indicates not determined due to the lack of available risk information.
NA Not applicable
ILCR Indicates incremental excess lifetime cancer risk
HI Indicates hazard index
1- Chemical is a COC by virtue of projected child residence non-carcinogenic hazard.
2- Chemical is a COC by virtue of projected future resident lifetime ILCR.
3- Chemical is a COC by virtue of projected site worker non-carcinogenic hazard.
4- Chemical is a COC by virtue of projected site worker ILCR.

The extent of the COCs identified in surface soil is briefly discussed below. To facilitate this discussion of the extent of COC concentrations, residential soil RBCs were compared to each reported concentration for each COC. Antimony was only detected in one surface soil sample out of 48 collected (both 1993 and RFI samples). Thallium was only detected in two of 48 surface soil samples and the concentration reported in only one exceeded its RBC. Arsenic was detected in 45 of 48 surface soil samples at concentrations exceeding its RBC, however, it was only reported in four surface soil sample at a concentration exceeding its background concentration (one only marginally above its background concentration). BEQs were detected above the residential RBC in 39 of 48 surface soil samples collected for combined SWMU 6. Aroclor-1260 was detected in 16 of 48 surface soil samples at concentrations above its RBC. Aroclor -1254 was only detected in one of 48 surface soil samples. The surface soil concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were reported at concentrations exceeding their RBCs in four, one, and seven out of 48 samples, respectively. The highest concentrations of BEQs, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were reported in samples collected to the south of the concrete pad.

First-quarter Groundwater

Future Site Residents

Arsenic, beryllium, and pentachlorophenol were identified as the groundwater COCs for combined SWMU 6, based on their contribution to ILCR projections. Arsenic and barium were identified as COCs for combined SWMU 6, based on their contributions to HI projections.

Future Site Workers

Arsenic and beryllium were identified as the groundwater COCs for combined SWMU 6, based on their contribution to ILCR projections. Arsenic was identified as a COC for combined SWMU 6, based on its contribution to HI projections.

The extent of the COCs identified in groundwater is briefly discussed below. To facilitate this discussion of the extent of COC concentrations, tap water RBCs were compared to each reported concentration for each COC identified above. Arsenic was detected in all seven first-quarter groundwater samples at concentrations exceeding its RBC and in two samples at concentrations exceeding its background concentration. Arsenic equaled its background concentration at one other location. Barium was detected in only one first-quarter groundwater sample at a concentration exceeding its RBC. The highest concentrations of arsenic and barium were reported in the first-quarter groundwater sample collected from monitoring well 006003. Beryllium was detected at a concentration exceeding its RBC in all seven first-quarter groundwater samples with the highest concentrations reported in the samples collected from monitoring wells 006001 and 006006. The only detected concentration of pentachlorophenol was reported in the first-quarter groundwater sample collected from monitoring well 006004.

10.12.6.6 Risk Uncertainty

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure. Residential use of the site would not be expected, based on current site uses and the nature of surrounding features. Current reuse plans call for continued commercial/industrial or recreational use of Zone G. If this area were to be used as a residential site, existing features would be demolished, and the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, exposure to surface soil conditions as represented by samples collected during the RFI would not be likely under a true future residential scenario. These factors indicate that exposure pathways assessed in this HHRA would generally overestimate the risk and hazard posed to current site workers and future site residents.

Groundwater is not currently used at combined SWMU 6 for potable or industrial purposes. A base-wide system provides drinking and process water to buildings throughout Zone G. This system is planned to remain in operation under the current base reuse plan. As a result, use of shallow groundwater would not be expected under future site use scenarios. Therefore, the scenario established to project risk/hazard associated with shallow groundwater exposure is highly conservative, and associated pathways are not expected to be completed in the future.

Determination of Exposure Point Concentrations

Exposure point concentrations for soil were set equal to the 95% UCL calculated on the combined data set assembled from both the 1993 and RFI sampling events. Use of 95% UCLs represent conservative assumptions when applied as EPCs, such that it is unlikely that the 95% UCLs underestimate the true mean site concentrations. Groundwater risk/hazard was calculated using the maximum detected concentration of each COPC as an EPC. It is unlikely that the maximum concentration detected in first-quarter groundwater samples underestimates the true mean concentration, and would generally overestimate risk and/or hazard.

Frequency of Detection and Spatial Distribution

Aroclor-1260, BEQs, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in most of the surface soil samples collected for combined SWMU 6 and each of these COCs were well characterized with in the three-quarter-acre sampling grid. Dioxin analysis was only conducted in two surface soil samples, and as a result, the extent of dioxin has not been adequately characterized. Antimony, arsenic, and thallium each exceeded their background concentrations in few samples which suggests a relation to ambient soil conditions.

Except for the second-quarter sample collected from monitoring well 006003, the second-quarter arsenic concentrations were either nondetect or nearly half of the reported first-quarter concentrations. Arsenic concentrations reported in the first and second-quarter groundwater samples collected from 006003 exceeded its RBC, its background concentration, and its MCL.

Second-quarter concentrations of beryllium were close to half of the reported first-quarter concentrations. The concentrations of barium were consistent between the first two quarters. Pentachlorophenol was only detected in one first-quarter groundwater sample and was nondetect for the second-quarter sampling round.

Quantification of Risk/Hazard

As indicated by the discussions above, the uncertainty and variability inherent in the risk assessment process is great. In addition, many site-specific factors have affected the uncertainty of this assessment that would upwardly bias the risk and hazard estimates. Exposure pathway-specific sources of uncertainty are discussed below.

Soil

A conservative screening process was used to identify COPCs for combined SWMU 6. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens, the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, none was reported at a concentration close to its RBC (e.g., within 10% of its RBC).

Groundwater

The same conservative screening process used for soil is also used for groundwater. Of the CPSSs screened and eliminated from formal assessment, none was reported at a concentration close to its RBC (e.g., within 10% of its RBC).

Groundwater is not currently used as a potable water source at combined SWMU 6, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable source of potable water.

Background-related Risk

Soil

Aluminum and beryllium were detected in combined SWMU 6 surface soil above their respective RBCs and manganese was detected in combined SWMU 6 groundwater above its tap water RBC. These elements were not considered in the risk assessment based on comparison to background concentrations. It is not unusual for naturally occurring or background concentrations of some elements to exceed RBCs. It is the risk assessment's function to identify excess risk and/or hazard, or that which is above background levels. The following is a discussion of the residential scenario risk/hazard associated with background concentrations of these elements.

The beryllium background surface soil concentration (1.2 mg/kg) equates with an ILCR of 9E-06 (based on the adult and child lifetime weighted average). The background surface soil concentrations of aluminum (18,700 mg/kg) and beryllium (1.2 mg/kg) equate with an HI of 0.3 (based on the resident child). The background groundwater concentration of manganese (2,906 ug/L) equates with a an HI of 3.

10.12.6.7 Risk Summary

The risk and hazard posed by contaminants at combined SWMU 6 were assessed for the future site worker and the future site resident under RME assumptions. In surface soils, the incidental ingestion, dermal contact, and inhalation pathways were assessed in this HHRA. The groundwater

pathway was based on ingestion of shallow groundwater which was represented by the RFI initial quarter groundwater data. Table 10.12.31 presents the risk summary for each soil pathway/receptor group evaluated for combined SWMU 6.

Soil — Residential Scenario

Residential soil pathway COCs identified for combined SWMU 6 include antimony, Aroclor-1260, Aroclor-1254, arsenic, BEQs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dioxin, and thallium. Figures 10.12-34 and 10.12-35 illustrate point risk and hazard estimates, respectively, for combined SWMU 6 surface soil pathways under a residential scenario. Table 10.12.32 summarizes the risk and hazard contribution of each COPC at each sample location. This point risk map is based on the unlikely assumption that a potential future site resident will be chronically exposed to specific points. Exposure to surface soil conditions is more likely the result of uniform exposure to the soil conditions of the entire site (or exposure unit area) rather than specific points. With this in mind, risk maps supplemented by the tables are useful in that they allow the reader to visualize how chemicals driving risk estimates are spatially distributed across the site.

Risk estimates associated with the surface soil pathways exceeded 1E-06 at all 48 locations. With a few exceptions, arsenic and BEQs were the primary contributors to risk estimates above 1E-06 at each surface soil sample location. Other contributors to risk include Aroclor-1260, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, alpha-chlordane, gamma-chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dioxin, and heptachlor which were significant contributors to risk estimates associated with 006SB001, 006SB002, and S07B27. Aroclor-1260 was also the primary contributor to risk estimates associated with surface soil samples S06B06 and S07B21, and a secondary contributor to risk estimates associated with 006SB003, S06B15, S06B20, S07B03, S07B05, S07B06, S07B07, S07B08, S07B09, S07B10, S07B11, S07B16, S07B19, and S07B23. Aroclor-1254 was the primary contributor to risk estimates associated with surface soil location S06B05. Risks estimates ranged from 4E-09 (S07B33) to 2E-03 (S07B21) with a mean risk of 1E-04.

Table 10.12.31
Summary of Risk and Hazard
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)
Surface Soil	Incidental Ingestion	0.2	2	3E-04	0.06	4E-05
	Dermal Contact	0.06	0.2	1E-04	0.04	6E-05
	Inhalation	0.010	0.03	2E-07	0.007	7E-08
Groundwater	Ingestion	25	58	6E-03	9	1E-03
Sum of All Pathways		25	59	7E-03	9	2E-03

Notes:
ND Indicates not determined due to the lack of available risk information.
ILCR Indicates incremental lifetime cancer risk
HI Indicates hazard index

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
006	SB001	4,4'-DDD	930	UG/KG	NA		0.5063	0.52
006	SB001	4,4'-DDE	1600	UG/KG	NA		1.2341	1.26
006	SB001	4,4'-DDT	2200	UG/KG	0.0726	13.14	1.6969	1.73
006	SB001	Aroclor-1260	8600	UG/KG	NA		39.0188	39.72
006	SB001	Arsenic (As)	9.5	MG/KG	0.4342	78.61	24.8140	25.26
006	SB001	B(a)P Equiv.	1766.3	UG/KG	NA		29.2505	29.78
006	SB001	Manganese (Mn)	76.4	MG/KG	0.0455	8.25	NA	
006	SB001	Thallium (Tl)	ND	MG/KG	NA		NA	
006	SB001	delta-BHC	120	UG/KG	NA		1.7150	1.75
		Total			0.5523		98.2356	
006	SB002	4,4'-DDD	20000	UG/KG	NA		10.8890	2.24
006	SB002	4,4'-DDE	4900	UG/KG	NA		3.7794	0.78
006	SB002	4,4'-DDT	5450	UG/KG	0.1798	23.27	4.2036	0.86
006	SB002	Aroclor-1260	5600	UG/KG	NA		25.4076	5.23
006	SB002	Arsenic (As)	11.65	MG/KG	0.5325	68.94	30.4298	6.26
006	SB002	B(a)P Equiv.	3690	UG/KG	NA		61.1076	12.57
006	SB002	Dioxin Equiv.	1020.925	NG/KG	NA		347.4008	71.47
006	SB002	Manganese (Mn)	100.95	MG/KG	0.0602	7.79	NA	
006	SB002	Thallium (Tl)	ND	MG/KG	NA		NA	
006	SB002	delta-BHC	200	UG/KG	NA		2.8584	0.59
		Total			0.7725		486.0760	
006	SB003	4,4'-DDD	ND	UG/KG	NA		NA	
006	SB003	4,4'-DDE	100	UG/KG	NA		0.0771	0.44
006	SB003	4,4'-DDT	60	UG/KG	0.0020	0.90	0.0463	0.26
006	SB003	Aroclor-1260	240	UG/KG	NA		1.0889	6.23
006	SB003	Arsenic (As)	4.1	MG/KG	0.1874	85.36	10.7092	61.25
006	SB003	B(a)P Equiv.	335.85	UG/KG	NA		5.5618	31.81
006	SB003	Manganese (Mn)	50.6	MG/KG	0.0302	13.74	NA	
006	SB003	Thallium (Tl)	ND	MG/KG	NA		NA	
006	SB003	delta-BHC	ND	UG/KG	NA		NA	
		Total			0.2195		17.4833	
006	SB004	4,4'-DDD	ND	UG/KG	NA		NA	
006	SB004	4,4'-DDE	24	UG/KG	NA		0.0185	0.04
006	SB004	4,4'-DDT	23	UG/KG	0.0008	0.07	0.0177	0.04
006	SB004	Aroclor-1260	ND	UG/KG	NA		NA	
006	SB004	Arsenic (As)	17.3	MG/KG	0.7907	69.97	45.1876	90.47
006	SB004	B(a)P Equiv.	285.25	UG/KG	NA		4.7238	9.46
006	SB004	Manganese (Mn)	568	MG/KG	0.3386	29.96	NA	
006	SB004	Thallium (Tl)	ND	MG/KG	NA		NA	
006	SB004	delta-BHC	ND	UG/KG	NA		NA	
		Total			1.1301		49.9477	
007	SB001	4,4'-DDD	ND	UG/KG	NA		NA	
007	SB001	4,4'-DDE	ND	UG/KG	NA		NA	
007	SB001	4,4'-DDT	ND	UG/KG	NA		NA	
007	SB001	Aroclor-1260	ND	UG/KG	NA		NA	
007	SB001	Arsenic (As)	5.25	MG/KG	0.2400	69.38	13.7130	49.37
007	SB001	B(a)P Equiv.	846.3	UG/KG	NA		14.0150	50.46
007	SB001	Dioxin Equiv.	0.138	NG/KG	NA		0.0470	0.17
007	SB001	Manganese (Mn)	22.4	MG/KG	0.0134	3.86	NA	
007	SB001	Thallium (Tl)	0.54	MG/KG	0.0926	26.76	NA	
007	SB001	delta-BHC	ND	UG/KG	NA		NA	
		Total			0.3459		27.7750	
635	SB001	4,4'-DDD	ND	UG/KG	NA		NA	
635	SB001	4,4'-DDE	ND	UG/KG	NA		NA	
635	SB001	4,4'-DDT	ND	UG/KG	NA		NA	
635	SB001	Aroclor-1260	ND	UG/KG	NA		NA	
635	SB001	Arsenic (As)	14.7	MG/KG	0.6719	79.66	38.3964	100.00
635	SB001	B(a)P Equiv.	ND	UG/KG	NA		NA	
635	SB001	Manganese (Mn)	31.9	MG/KG	0.0190	2.25	NA	
635	SB001	Thallium (Tl)	0.89	MG/KG	0.1525	18.09	NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S06	B15	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.7227		47.966	
S06	B21	4,4'-DDD	8.2	UG/KG	NA		0.004	0.03
S06	B21	4,4'-DDE	9.9	UG/KG	NA		0.008	0.04
S06	B21	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B21	Antimony	ND	MG/KG	NA		NA	
S06	B21	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B21	Aroclor 1260	420	UG/KG	NA		1.906	11.07
S06	B21	Arsenic	3.7	MG/KG	0.1891	48.69	9.664	56.17
S06	B21	Benzo(a)pyrene equiv.	339.67	UG/KG	NA		5.625	32.69
S06	B21	Chromium	38	MG/KG	0.1042	30.00	NA	
S06	B21	Heptachlor	ND	UG/KG	NA		NA	
S06	B21	Lead	8.5	MG/KG	NA		NA	
S06	B21	Manganese	65	MG/KG	0.0388	11.16	NA	
S06	B21	Thallium	ND	MG/KG	NA		NA	
S06	B21	Vanadium	18	MG/KG	0.0353	10.15	NA	
S06	B21	alpha-BHC	ND	UG/KG	NA		NA	
S06	B21	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B21	beta-BHC	ND	UG/KG	NA		NA	
S06	B21	delta-BHC	ND	UG/KG	NA		NA	
S06	B21	gamma-BHC	ND	UG/KG	NA		NA	
S06	B21	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.3473		17.207	
S06	B25	4,4'-DDD	13.5	UG/KG	NA		0.007	0.06
S06	B25	4,4'-DDE	49.5	UG/KG	NA		0.038	0.29
S06	B25	4,4'-DDT	36	UG/KG	0.0012	0.26	0.028	0.21
S06	B25	Antimony	ND	MG/KG	NA		NA	
S06	B25	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B25	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B25	Arsenic	4.5	MG/KG	0.2057	44.75	11.754	89.36
S06	B25	Benzo(a)pyrene equiv.	78.05	UG/KG	NA		1.293	9.83
S06	B25	Chromium	64	MG/KG	0.1755	38.19	NA	
S06	B25	Heptachlor	ND	UG/KG	NA		NA	
S06	B25	Lead	12.05	MG/KG	NA		NA	
S06	B25	Manganese	74.95	MG/KG	0.0447	9.72	NA	
S06	B25	Thallium	ND	MG/KG	NA		NA	
S06	B25	Vanadium	16.25	MG/KG	0.0318	6.93	NA	
S06	B25	alpha-BHC	ND	UG/KG	NA		NA	
S06	B25	alpha-Chlordane	5.35	UG/KG	0.0002	0.04	0.004	0.03
S06	B25	beta-BHC	ND	UG/KG	NA		NA	
S06	B25	delta-BHC	2.4	UG/KG	NA		0.010	0.07
S06	B25	gamma-BHC	4.6	UG/KG	0.0003	0.06	0.014	0.10
S06	B25	gamma-Chlordane	8.4	UG/KG	0.0003	0.06	0.007	0.05
		Total			0.4596		13.154	
S06	B26	4,4'-DDD	ND	UG/KG	NA		NA	
S06	B26	4,4'-DDE	ND	UG/KG	NA		NA	
S06	B26	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B26	Antimony	ND	MG/KG	NA		NA	
S06	B26	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B26	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B26	Arsenic	1.6	MG/KG	0.0731	32.38	4.179	100.00
S06	B26	Benzo(a)pyrene equiv.	ND	UG/KG	NA		NA	
S06	B26	Chromium	30	MG/KG	0.0823	36.43	NA	
S06	B26	Heptachlor	ND	UG/KG	NA		NA	
S06	B26	Lead	4.9	MG/KG	NA		NA	
S06	B26	Manganese	59	MG/KG	0.0352	15.58	NA	
S06	B26	Thallium	ND	MG/KG	NA		NA	
S06	B26	Vanadium	18	MG/KG	0.0353	15.61	NA	
S06	B26	alpha-BHC	ND	UG/KG	NA		NA	
S06	B26	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B26	beta-BHC	ND	UG/KG	NA		NA	
S06	B26	delta-BHC	ND	UG/KG	NA		NA	
S06	B26	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
635	SB001	delta-BHC	ND	UG/KG	NA		NA	
		Total			0.8435		38.3964	
S06	B01	4,4'-DDD	ND	UG/KG	NA		NA	
S06	B01	4,4'-DDE	ND	UG/KG	NA		NA	
S06	B01	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B01	Antimony	ND	MG/KG	NA		NA	
S06	B01	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B01	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B01	Arsenic	9.3	MG/KG	0.4251	74.92	24.292	67.95
S06	B01	Benzo(a)pyrene equiv.	691.93	UG/KG	NA		11.459	32.05
S06	B01	Chromium	17	MG/KG	0.0466	8.22	NA	
S06	B01	Heptachlor	ND	UG/KG	NA		NA	
S06	B01	Lead	320	MG/KG	NA		NA	
S06	B01	Manganese	75	MG/KG	0.0447	7.88	NA	
S06	B01	Thallium	ND	MG/KG	NA		NA	
S06	B01	Vanadium	26	MG/KG	0.0509	8.98	NA	
S06	B01	alpha-BHC	ND	UG/KG	NA		NA	
S06	B01	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B01	beta-BHC	ND	UG/KG	NA		NA	
S06	B01	delta-BHC	ND	UG/KG	NA		NA	
S06	B01	gamma-BHC	ND	UG/KG	NA		NA	
S06	B01	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.5674		35.750	
S06	B02	4,4'-DDD	110	UG/KG	NA		0.060	0.14
S06	B02	4,4'-DDE	42	UG/KG	NA		0.032	0.07
S06	B02	4,4'-DDT	72	UG/KG	0.0024	0.66	0.056	0.13
S06	B02	Antimony	ND	MG/KG	NA		NA	
S06	B02	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B02	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B02	Arsenic	5.1	MG/KG	0.2331	64.98	13.321	30.70
S06	B02	Benzo(a)pyrene equiv.	1807.3	UG/KG	NA		29.929	68.96
S06	B02	Chromium	11	MG/KG	0.0302	8.41	NA	
S06	B02	Heptachlor	ND	UG/KG	NA		NA	
S06	B02	Lead	72	MG/KG	NA		NA	
S06	B02	Manganese	120	MG/KG	0.0715	19.94	NA	
S06	B02	Thallium	ND	MG/KG	NA		NA	
S06	B02	Vanadium	11	MG/KG	0.0215	6.01	NA	
S06	B02	alpha-BHC	ND	UG/KG	NA		NA	
S06	B02	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B02	beta-BHC	ND	UG/KG	NA		NA	
S06	B02	delta-BHC	ND	UG/KG	NA		NA	
S06	B02	gamma-BHC	ND	UG/KG	NA		NA	
S06	B02	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.3587		43.396	
S06	B03	4,4'-DDD	13	UG/KG	NA		0.007	0.03
S06	B03	4,4'-DDE	53	UG/KG	NA		0.041	0.17
S06	B03	4,4'-DDT	11	UG/KG	0.0004	0.06	0.008	0.04
S06	B03	Antimony	ND	MG/KG	NA		NA	
S06	B03	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B03	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B03	Arsenic	8	MG/KG	0.3657	63.81	20.896	89.42
S06	B03	Benzo(a)pyrene equiv.	145.81	UG/KG	NA		2.415	10.33
S06	B03	Chromium	17	MG/KG	0.0466	8.14	NA	
S06	B03	Heptachlor	ND	UG/KG	NA		NA	
S06	B03	Lead	57	MG/KG	NA		NA	
S06	B03	Manganese	190	MG/KG	0.1133	19.77	NA	
S06	B03	Thallium	ND	MG/KG	NA		NA	
S06	B03	Vanadium	24	MG/KG	0.0470	8.20	NA	
S06	B03	alpha-BHC	ND	UG/KG	NA		NA	
S06	B03	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B03	beta-BHC	ND	UG/KG	NA		NA	
S06	B03	delta-BHC	ND	UG/KG	NA		NA	
S06	B03	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Paramater	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S06	B03	gamma-Chlordane	2.8	UG/KG	0.0001	0.02	0.002	0.01
		Total			0.5730		23.369	
S06	B04	4,4'-DDD	27	UG/KG	NA		0.015	0.05
S06	B04	4,4'-DDE	99	UG/KG	NA		0.076	0.26
S06	B04	4,4'-DDT	200	UG/KG	0.0066	1.27	0.154	0.53
S06	B04	Antimony	ND	MG/KG	NA		NA	
S06	B04	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B04	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B04	Arsenic	8.2	MG/KG	0.3748	72.01	21.418	73.27
S06	B04	Benzo(a)pyrene equiv.	454.55	UG/KG	NA		7.527	25.75
S06	B04	Chromium	20	MG/KG	0.0548	10.54	NA	
S06	B04	Heptachlor	ND	UG/KG	NA		NA	
S06	B04	Lead	100	MG/KG	NA		NA	
S06	B04	Manganese	89	MG/KG	0.0531	10.19	NA	
S06	B04	Thallium	ND	MG/KG	NA		NA	
S06	B04	Vanadium	15	MG/KG	0.0294	5.65	NA	
S06	B04	alpha-BHC	ND	UG/KG	NA		NA	
S06	B04	alpha-Chlordane	20	UG/KG	0.0007	0.13	0.016	0.05
S06	B04	beta-BHC	ND	UG/KG	NA		NA	
S06	B04	delta-BHC	ND	UG/KG	NA		NA	
S06	B04	gamma-BHC	ND	UG/KG	NA		NA	
S06	B04	gamma-Chlordane	34	UG/KG	0.0011	0.22	0.027	0.09
		Total			0.5205		29.234	
S06	B05	4,4'-DDD	590	UG/KG	NA		0.321	0.24
S06	B05	4,4'-DDE	1000	UG/KG	NA		0.771	0.59
S06	B05	4,4'-DDT	4200	UG/KG	0.1385	0.63	3.239	2.46
S06	B05	Antimony	ND	MG/KG	NA		NA	
S06	B05	Aroclor 1254	26000	UG/KG	21.4411	98.24	117.964	89.72
S06	B05	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B05	Arsenic	2.4	MG/KG	0.1097	0.50	6.269	4.77
S06	B05	Benzo(a)pyrene equiv.	175.72	UG/KG	NA		2.910	2.21
S06	B05	Chromium	10	MG/KG	0.0274	0.13	NA	
S06	B05	Heptachlor	ND	UG/KG	NA		NA	
S06	B05	Lead	6.9	MG/KG	NA		NA	
S06	B05	Manganese	150	MG/KG	0.0894	0.41	NA	
S06	B05	Thallium	ND	MG/KG	NA		NA	
S06	B05	Vanadium	10	MG/KG	0.0196	0.09	NA	
S06	B05	alpha-BHC	ND	UG/KG	NA		NA	
S06	B05	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B05	beta-BHC	ND	UG/KG	NA		NA	
S06	B05	delta-BHC	ND	UG/KG	NA		NA	
S06	B05	gamma-BHC	ND	UG/KG	NA		NA	
S06	B05	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			21.8258		131.475	
S06	B06	4,4'-DDD	140	UG/KG	NA		0.076	0.38
S06	B06	4,4'-DDE	170	UG/KG	NA		0.131	0.65
S06	B06	4,4'-DDT	600	UG/KG	0.0198	11.51	0.463	2.30
S06	B06	Antimony	ND	MG/KG	NA		NA	
S06	B06	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B06	Aroclor 1260	2400	UG/KG	NA		10.889	54.21
S06	B06	Arsenic	1.9	MG/KG	0.0868	50.50	4.963	24.71
S06	B06	Benzo(a)pyrene equiv.	215.19	UG/KG	NA		3.564	17.74
S06	B06	Chromium	7.1	MG/KG	0.0195	11.32	NA	
S06	B06	Heptachlor	ND	UG/KG	NA		NA	
S06	B06	Lead	11	MG/KG	NA		NA	
S06	B06	Manganese	47	MG/KG	0.0280	16.30	NA	
S06	B06	Thallium	ND	MG/KG	NA		NA	
S06	B06	Vanadium	9.1	MG/KG	0.0178	10.37	NA	
S06	B06	alpha-BHC	ND	UG/KG	NA		NA	
S06	B06	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B06	beta-BHC	ND	UG/KG	NA		NA	
S06	B06	delta-BHC	ND	UG/KG	NA		NA	
S06	B06	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S06	B06	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.1720		20.086	
S06	B07	4,4'-DDD	420	UG/KG	NA		0.229	1.08
S06	B07	4,4'-DDE	430	UG/KG	NA		0.332	1.57
S06	B07	4,4'-DDT	2000	UG/KG	0.0660	16.06	1.543	7.29
S06	B07	Antimony	ND	MG/KG	NA		NA	
S06	B07	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B07	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B07	Arsenic	5	MG/KG	0.2285	55.63	13.060	61.71
S06	B07	Benzo(a)pyrene equiv.	350.16	UG/KG	NA		5.799	27.40
S06	B07	Chromium	16	MG/KG	0.0439	10.68	NA	
S06	B07	Heptachlor	ND	UG/KG	NA		NA	
S06	B07	Lead	64	MG/KG	NA		NA	
S06	B07	Manganese	48	MG/KG	0.0286	6.97	NA	
S06	B07	Thallium	ND	MG/KG	NA		NA	
S06	B07	Vanadium	19	MG/KG	0.0372	9.06	NA	
S06	B07	alpha-BHC	ND	UG/KG	NA		NA	
S06	B07	alpha-Chlordane	66	UG/KG	0.0022	0.53	0.052	0.25
S06	B07	beta-BHC	ND	UG/KG	NA		NA	
S06	B07	delta-BHC	ND	UG/KG	NA		NA	
S06	B07	gamma-BHC	26	UG/KG	0.0014	0.35	0.077	0.36
S06	B07	gamma-Chlordane	91	UG/KG	0.0030	0.73	0.072	0.34
		Total			0.4108		21.163	
S06	B14	4,4'-DDD	ND	UG/KG	NA		NA	
S06	B14	4,4'-DDE	ND	UG/KG	NA		NA	
S06	B14	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B14	Antimony	ND	MG/KG	NA		NA	
S06	B14	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B14	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B14	Arsenic	3.7	MG/KG	0.1691	55.60	9.664	70.15
S06	B14	Benzo(a)pyrene equiv.	248.27	UG/KG	NA		4.111	29.85
S06	B14	Chromium	23	MG/KG	0.0631	20.74	NA	
S06	B14	Heptachlor	ND	UG/KG	NA		NA	
S06	B14	Lead	20	MG/KG	NA		NA	
S06	B14	Manganese	55	MG/KG	0.0328	10.78	NA	
S06	B14	Thallium	ND	MG/KG	NA		NA	
S06	B14	Vanadium	20	MG/KG	0.0392	12.88	NA	
S06	B14	alpha-BHC	ND	UG/KG	NA		NA	
S06	B14	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B14	beta-BHC	ND	UG/KG	NA		NA	
S06	B14	delta-BHC	ND	UG/KG	NA		NA	
S06	B14	gamma-BHC	ND	UG/KG	NA		NA	
S06	B14	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.3042		13.776	
S06	B15	4,4'-DDD	ND	UG/KG	NA		NA	
S06	B15	4,4'-DDE	ND	UG/KG	NA		NA	
S06	B15	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B15	Antimony	7.5	MG/KG	0.2571	35.57	NA	
S06	B15	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B15	Aroclor 1260	970	UG/KG	NA		4.401	9.18
S06	B15	Arsenic	4.8	MG/KG	0.2194	30.36	12.538	26.14
S06	B15	Benzo(a)pyrene equiv.	1873.6	UG/KG	NA		31.027	64.69
S06	B15	Chromium	25	MG/KG	0.0686	9.49	NA	
S06	B15	Heptachlor	ND	UG/KG	NA		NA	
S06	B15	Lead	1000	MG/KG	NA		NA	
S06	B15	Manganese	160	MG/KG	0.0954	13.20	NA	
S06	B15	Thallium	ND	MG/KG	NA		NA	
S06	B15	Vanadium	42	MG/KG	0.0823	11.38	NA	
S06	B15	alpha-BHC	ND	UG/KG	NA		NA	
S06	B15	alpha-Chlordane	ND	UG/KG	NA		NA	
S06	B15	beta-BHC	ND	UG/KG	NA		NA	
S06	B15	delta-BHC	ND	UG/KG	NA		NA	
S06	B15	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S06	B26	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.2258		4.179	
S07	B03	4,4'-DDD	5.3	UG/KG	NA		0.003	0.03
S07	B03	4,4'-DDE	28.5	UG/KG	NA		0.022	0.24
S07	B03	4,4'-DDT	18.5	UG/KG	0.0006	0.26	0.014	0.15
S07	B03	Antimony	ND	MG/KG	NA		NA	
S07	B03	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B03	Aroclor 1260	410	UG/KG	NA		1.860	19.98
S07	B03	Arsenic	2.45	MG/KG	0.1120	48.44	6.399	68.75
S07	B03	Benzo(a)pyrene equiv.	60.6725	UG/KG	NA		1.005	10.79
S07	B03	Chromium	8.1	MG/KG	0.0222	9.61	NA	
S07	B03	Heptachlor	ND	UG/KG	NA		NA	
S07	B03	Lead	22.45	MG/KG	NA		NA	
S07	B03	Manganese	136	MG/KG	0.0811	35.07	NA	
S07	B03	Thallium	ND	MG/KG	NA		NA	
S07	B03	Vanadium	7.7	MG/KG	0.0151	6.52	NA	
S07	B03	alpha-BHC	ND	UG/KG	NA		NA	
S07	B03	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B03	beta-BHC	ND	UG/KG	NA		NA	
S07	B03	delta-BHC	ND	UG/KG	NA		NA	
S07	B03	gamma-BHC	ND	UG/KG	NA		NA	
S07	B03	gamma-Chlordane	6	UG/KG	0.0002	0.09	0.005	0.05
		Total			0.2312		9.308	
S07	B04	4,4'-DDD	160	UG/KG	NA		0.098	0.33
S07	B04	4,4'-DDE	430	UG/KG	NA		0.332	1.12
S07	B04	4,4'-DDT	160	UG/KG	0.0053	0.97	0.123	0.42
S07	B04	Antimony	ND	MG/KG	NA		NA	
S07	B04	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B04	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B04	Arsenic	9.6	MG/KG	0.4388	80.90	25.075	85.05
S07	B04	Benzo(a)pyrene equiv.	232.25	UG/KG	NA		3.846	13.05
S07	B04	Chromium	15	MG/KG	0.0411	7.58	NA	
S07	B04	Heptachlor	ND	UG/KG	NA		NA	
S07	B04	Lead	74	MG/KG	NA		NA	
S07	B04	Manganese	73	MG/KG	0.0435	8.02	NA	
S07	B04	Thallium	ND	MG/KG	NA		NA	
S07	B04	Vanadium	6.8	MG/KG	0.0133	2.46	NA	
S07	B04	alpha-BHC	ND	UG/KG	NA		NA	
S07	B04	alpha-Chlordane	9.8	UG/KG	0.0003	0.06	0.008	0.03
S07	B04	beta-BHC	ND	UG/KG	NA		NA	
S07	B04	delta-BHC	ND	UG/KG	NA		NA	
S07	B04	gamma-BHC	ND	UG/KG	NA		NA	
S07	B04	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.5424		29.482	
S07	B05	4,4'-DDD	4.2	UG/KG	NA		0.002	0.02
S07	B05	4,4'-DDE	210	UG/KG	NA		0.162	1.66
S07	B05	4,4'-DDT	110	UG/KG	0.0036	1.56	0.085	0.87
S07	B05	Antimony	ND	MG/KG	NA		NA	
S07	B05	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B05	Aroclor 1260	330	UG/KG	NA		1.497	15.36
S07	B05	Arsenic	2.7	MG/KG	0.1234	52.94	7.052	72.36
S07	B05	Benzo(a)pyrene equiv.	57.065	UG/KG	NA		0.945	9.70
S07	B05	Chromium	7.7	MG/KG	0.0211	9.06	NA	
S07	B05	Heptachlor	ND	UG/KG	NA		NA	
S07	B05	Lead	45	MG/KG	NA		NA	
S07	B05	Manganese	120	MG/KG	0.0715	30.69	NA	
S07	B05	Thallium	ND	MG/KG	NA		NA	
S07	B05	Vanadium	6.8	MG/KG	0.0133	5.71	NA	
S07	B05	alpha-BHC	ND	UG/KG	NA		NA	
S07	B05	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B05	beta-BHC	ND	UG/KG	NA		NA	
S07	B05	delta-BHC	ND	UG/KG	NA		NA	
S07	B05	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B05	gamma-Chlordane	2.9	UG/KG	0.0001	0.04	0.002	0.02
		Total			0.2331		9.746	
S07	B06	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B06	4,4'-DDE	240	UG/KG	NA		0.185	0.33
S07	B06	4,4'-DDT	120	UG/KG	0.0040	0.59	0.093	0.17
S07	B06	Antimony	ND	MG/KG	NA		NA	
S07	B06	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B06	Aroclor 1260	550	UG/KG	NA		2.495	4.47
S07	B06	Arsenic	11	MG/KG	0.5028	74.59	28.732	51.47
S07	B06	Benzo(a)pyrene equiv.	1467.2	UG/KG	NA		24.297	43.53
S07	B06	Chromium	17	MG/KG	0.0466	6.92	NA	
S07	B06	Heptachlor	ND	UG/KG	NA		NA	
S07	B06	Lead	43	MG/KG	NA		NA	
S07	B06	Manganese	140	MG/KG	0.0835	12.38	NA	
S07	B06	Thallium	ND	MG/KG	NA		NA	
S07	B06	Vanadium	19	MG/KG	0.0372	5.52	NA	
S07	B06	alpha-BHC	ND	UG/KG	NA		NA	
S07	B06	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B06	beta-BHC	ND	UG/KG	NA		NA	
S07	B06	delta-BHC	3.8	UG/KG	NA		0.016	0.03
S07	B06	gamma-BHC	ND	UG/KG	NA		NA	
S07	B06	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.6741		55.818	
S07	B07	4,4'-DDD	120	UG/KG	NA		0.065	0.13
S07	B07	4,4'-DDE	340	UG/KG	NA		0.262	0.53
S07	B07	4,4'-DDT	65	UG/KG	0.0021	0.26	0.050	0.10
S07	B07	Antimony	ND	MG/KG	NA		NA	
S07	B07	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B07	Aroclor 1260	780	UG/KG	NA		3.539	7.17
S07	B07	Arsenic	16	MG/KG	0.7313	88.22	41.792	84.65
S07	B07	Benzo(a)pyrene equiv.	221.18	UG/KG	NA		3.663	7.42
S07	B07	Chromium	18	MG/KG	0.0494	5.95	NA	
S07	B07	Heptachlor	ND	UG/KG	NA		NA	
S07	B07	Lead	220	MG/KG	NA		NA	
S07	B07	Manganese	38	MG/KG	0.0227	2.73	NA	
S07	B07	Thallium	ND	MG/KG	NA		NA	
S07	B07	Vanadium	12	MG/KG	0.0235	2.84	NA	
S07	B07	alpha-BHC	ND	UG/KG	NA		NA	
S07	B07	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B07	beta-BHC	ND	UG/KG	NA		NA	
S07	B07	delta-BHC	ND	UG/KG	NA		NA	
S07	B07	gamma-BHC	ND	UG/KG	NA		NA	
S07	B07	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.8290		49.371	
S07	B08	4,4'-DDD	110	UG/KG	NA		0.060	0.16
S07	B08	4,4'-DDE	530	UG/KG	NA		0.409	1.10
S07	B08	4,4'-DDT	480	UG/KG	0.0158	2.63	0.370	1.00
S07	B08	Antimony	ND	MG/KG	NA		NA	
S07	B08	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B08	Aroclor 1260	1400	UG/KG	NA		6.352	17.10
S07	B08	Arsenic	7.4	MG/KG	0.3382	56.29	19.329	52.03
S07	B08	Benzo(a)pyrene equiv.	641.41	UG/KG	NA		10.622	28.59
S07	B08	Chromium	22	MG/KG	0.0603	10.04	NA	
S07	B08	Heptachlor	ND	UG/KG	NA		NA	
S07	B08	Lead	60	MG/KG	NA		NA	
S07	B08	Manganese	230	MG/KG	0.1371	22.82	NA	
S07	B08	Thallium	ND	MG/KG	NA		NA	
S07	B08	Vanadium	25	MG/KG	0.0490	8.15	NA	
S07	B08	alpha-BHC	ND	UG/KG	NA		NA	
S07	B08	alpha-Chlordane	13	UG/KG	0.0004	0.07	0.010	0.03
S07	B08	beta-BHC	ND	UG/KG	NA		NA	
S07	B08	delta-BHC	ND	UG/KG	NA		NA	
S07	B08	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B08	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.6009		37.152	
S07	B09	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B09	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B09	4,4'-DDT	ND	UG/KG	NA		NA	
S07	B09	Antimony	ND	MG/KG	NA		NA	
S07	B09	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B09	Aroclor 1260	270	UG/KG	NA		1.225	9.13
S07	B09	Arsenic	2.3	MG/KG	0.1051	52.85	6.008	44.78
S07	B09	Benzo(a)pyrene equiv.	373.34	UG/KG	NA		6.183	46.09
S07	B09	Chromium	5.5	MG/KG	0.0151	7.58	NA	
S07	B09	Heptachlor	ND	UG/KG	NA		NA	
S07	B09	Lead	12	MG/KG	NA		NA	
S07	B09	Manganese	110	MG/KG	0.0656	32.97	NA	
S07	B09	Thallium	ND	MG/KG	NA		NA	
S07	B09	Vanadium	6.7	MG/KG	0.0131	6.60	NA	
S07	B09	alpha-BHC	ND	UG/KG	NA		NA	
S07	B09	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B09	beta-BHC	ND	UG/KG	NA		NA	
S07	B09	delta-BHC	ND	UG/KG	NA		NA	
S07	B09	gamma-BHC	ND	UG/KG	NA		NA	
S07	B09	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.1989		13.415	
S07	B10	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B10	4,4'-DDE	71	UG/KG	NA		0.055	0.05
S07	B10	4,4'-DDT	24	UG/KG	0.0008	0.04	0.019	0.02
S07	B10	Antimony	ND	MG/KG	NA		NA	
S07	B10	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B10	Aroclor 1260	290	UG/KG	NA		1.316	1.25
S07	B10	Arsenic	38	MG/KG	1.7369	84.29	99.256	94.26
S07	B10	Benzo(a)pyrene equiv.	281.35	UG/KG	NA		4.659	4.42
S07	B10	Chromium	21	MG/KG	0.0576	2.80	NA	
S07	B10	Heptachlor	ND	UG/KG	NA		NA	
S07	B10	Lead	28	MG/KG	NA		NA	
S07	B10	Manganese	320	MG/KG	0.1908	9.26	NA	
S07	B10	Thallium	ND	MG/KG	NA		NA	
S07	B10	Vanadium	38	MG/KG	0.0744	3.61	NA	
S07	B10	alpha-BHC	ND	UG/KG	NA		NA	
S07	B10	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B10	beta-BHC	ND	UG/KG	NA		NA	
S07	B10	delta-BHC	ND	UG/KG	NA		NA	
S07	B10	gamma-BHC	ND	UG/KG	NA		NA	
S07	B10	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			2.0605		105.304	
S07	B11	4,4'-DDD	30	UG/KG	NA		0.016	0.07
S07	B11	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B11	4,4'-DDT	90	UG/KG	0.0030	0.90	0.069	0.30
S07	B11	Antimony	ND	MG/KG	NA		NA	
S07	B11	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B11	Aroclor 1260	1500	UG/KG	NA		6.806	29.86
S07	B11	Arsenic	4.7	MG/KG	0.2148	65.34	12.276	53.87
S07	B11	Benzo(a)pyrene equiv.	201.03	UG/KG	NA		3.329	14.61
S07	B11	Chromium	9	MG/KG	0.0247	7.51	NA	
S07	B11	Heptachlor	ND	UG/KG	NA		NA	
S07	B11	Lead	46	MG/KG	NA		NA	
S07	B11	Manganese	99	MG/KG	0.0590	17.95	NA	
S07	B11	Thallium	ND	MG/KG	NA		NA	
S07	B11	Vanadium	7.7	MG/KG	0.0151	4.59	NA	
S07	B11	alpha-BHC	ND	UG/KG	NA		NA	
S07	B11	alpha-Chlordane	150	UG/KG	0.0049	1.50	0.119	0.52
S07	B11	beta-BHC	ND	UG/KG	NA		NA	
S07	B11	delta-BHC	ND	UG/KG	NA		NA	
S07	B11	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B11	gamma-Chlordane	220	UG/KG	0.0073	2.21	0.175	0.77
		Total			0.3288		22.791	
S07	B12	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B12	4,4'-DDE	6.3	UG/KG	NA		0.005	0.03
S07	B12	4,4'-DDT	7.8	UG/KG	0.0003	0.05	0.006	0.03
S07	B12	Antimony	ND	MG/KG	NA		NA	
S07	B12	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B12	Aroclor 1260	130	UG/KG	NA		0.590	3.21
S07	B12	Arsenic	6.3	MG/KG	0.2880	57.88	16.456	89.52
S07	B12	Benzo(a)pyrene equiv.	80.09	UG/KG	NA		1.326	7.22
S07	B12	Chromium	9.1	MG/KG	0.0250	5.02	NA	
S07	B12	Heptachlor	ND	UG/KG	NA		NA	
S07	B12	Lead	28	MG/KG	NA		NA	
S07	B12	Manganese	280	MG/KG	0.1669	33.55	NA	
S07	B12	Thallium	ND	MG/KG	NA		NA	
S07	B12	Vanadium	8.9	MG/KG	0.0174	3.50	NA	
S07	B12	alpha-BHC	ND	UG/KG	NA		NA	
S07	B12	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B12	beta-BHC	ND	UG/KG	NA		NA	
S07	B12	delta-BHC	ND	UG/KG	NA		NA	
S07	B12	gamma-BHC	ND	UG/KG	NA		NA	
S07	B12	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.4975		18.383	
S07	B13	4,4'-DDD	78	UG/KG	NA		0.042	0.06
S07	B13	4,4'-DDE	570	UG/KG	NA		0.440	0.63
S07	B13	4,4'-DDT	460	UG/KG	0.0152	1.15	0.355	0.51
S07	B13	Antimony	ND	MG/KG	NA		NA	
S07	B13	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B13	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B13	Arsenic	24	MG/KG	1.0970	83.42	62.688	89.95
S07	B13	Benzo(a)pyrene equiv.	371.96	UG/KG	NA		6.160	8.84
S07	B13	Chromium	19	MG/KG	0.0521	3.96	NA	
S07	B13	Heptachlor	ND	UG/KG	NA		NA	
S07	B13	Lead	58	MG/KG	NA		NA	
S07	B13	Manganese	160	MG/KG	0.0954	7.25	NA	
S07	B13	Thallium	ND	MG/KG	NA		NA	
S07	B13	Vanadium	28	MG/KG	0.0548	4.17	NA	
S07	B13	alpha-BHC	ND	UG/KG	NA		NA	
S07	B13	alpha-Chlordane	14	UG/KG	0.0005	0.04	0.011	0.02
S07	B13	beta-BHC	ND	UG/KG	NA		NA	
S07	B13	delta-BHC	ND	UG/KG	NA		NA	
S07	B13	gamma-BHC	ND	UG/KG	NA		NA	
S07	B13	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			1.3150		69.696	
S07	B16	4,4'-DDD	5900	UG/KG	NA		3.212	3.21
S07	B16	4,4'-DDE	1400	UG/KG	NA		1.080	1.08
S07	B16	4,4'-DDT	360	UG/KG	0.0119	2.40	0.278	0.28
S07	B16	Antimony	ND	MG/KG	NA		NA	
S07	B16	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B16	Aroclor 1260	5800	UG/KG	NA		26.315	26.33
S07	B16	Arsenic	6.7	MG/KG	0.3062	61.81	17.500	17.51
S07	B16	Benzo(a)pyrene equiv.	3083	UG/KG	NA		51.055	51.08
S07	B16	Chromium	9.9	MG/KG	0.0272	5.48	NA	
S07	B16	Heptachlor	ND	UG/KG	NA		NA	
S07	B16	Lead	30	MG/KG	NA		NA	
S07	B16	Manganese	220	MG/KG	0.1312	26.47	NA	
S07	B16	Thallium	ND	MG/KG	NA		NA	
S07	B16	Vanadium	5.3	MG/KG	0.0104	2.10	NA	
S07	B16	alpha-BHC	ND	UG/KG	NA		NA	
S07	B16	alpha-Chlordane	120	UG/KG	0.0040	0.80	0.095	0.10
S07	B16	beta-BHC	ND	UG/KG	NA		NA	
S07	B16	delta-BHC	61	UG/KG	NA		0.249	0.25
S07	B16	gamma-BHC	28	UG/KG	0.0015	0.31	0.083	0.08

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B16	gamma-Chlordane	95	UG/KG	0.0031	0.63	0.075	0.08
		Total			0.4954		99.943	
S07	B17	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B17	4,4'-DDE	16	UG/KG	NA		0.012	0.04
S07	B17	4,4'-DDT	10	UG/KG	0.0003	0.05	0.008	0.02
S07	B17	Antimony	ND	MG/KG	NA		NA	
S07	B17	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B17	Aroclor 1260	100	UG/KG	NA		0.454	1.42
S07	B17	Arsenic	12	MG/KG	0.5485	81.67	31.344	98.15
S07	B17	Benzo(a)pyrene equiv.	7.163	UG/KG	NA		0.119	0.37
S07	B17	Chromium	17	MG/KG	0.0466	6.94	NA	
S07	B17	Heptachlor	ND	UG/KG	NA		NA	
S07	B17	Lead	23	MG/KG	NA		NA	
S07	B17	Manganese	85	MG/KG	0.0507	7.55	NA	
S07	B17	Thallium	ND	MG/KG	NA		NA	
S07	B17	Vanadium	13	MG/KG	0.0255	3.79	NA	
S07	B17	alpha-BHC	ND	UG/KG	NA		NA	
S07	B17	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B17	beta-BHC	ND	UG/KG	NA		NA	
S07	B17	delta-BHC	ND	UG/KG	NA		NA	
S07	B17	gamma-BHC	ND	UG/KG	NA		NA	
S07	B17	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.6716		31.936	
S07	B18	4,4'-DDD	240	UG/KG	NA		0.131	0.74
S07	B18	4,4'-DDE	120	UG/KG	NA		0.093	0.53
S07	B18	4,4'-DDT	79	UG/KG	0.0026	0.78	0.061	0.35
S07	B18	Antimony	ND	MG/KG	NA		NA	
S07	B18	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B18	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B18	Arsenic	3.9	MG/KG	0.1783	53.32	10.187	57.79
S07	B18	Benzo(a)pyrene equiv.	429.27	UG/KG	NA		7.109	40.33
S07	B18	Chromium	19	MG/KG	0.0521	15.59	NA	
S07	B18	Heptachlor	ND	UG/KG	NA		NA	
S07	B18	Lead	290	MG/KG	NA		NA	
S07	B18	Manganese	140	MG/KG	0.0835	24.97	NA	
S07	B18	Thallium	ND	MG/KG	NA		NA	
S07	B18	Vanadium	8.3	MG/KG	0.0163	4.86	NA	
S07	B18	alpha-BHC	ND	UG/KG	NA		NA	
S07	B18	alpha-Chlordane	9.1	UG/KG	0.0003	0.09	0.007	0.04
S07	B18	beta-BHC	ND	UG/KG	NA		NA	
S07	B18	delta-BHC	2.2	UG/KG	NA		0.009	0.05
S07	B18	gamma-BHC	ND	UG/KG	NA		NA	
S07	B18	gamma-Chlordane	40	UG/KG	0.0013	0.39	0.032	0.18
		Total			0.3343		17.628	
S07	B19	4,4'-DDD	198.5	UG/KG	NA		0.108	0.12
S07	B19	4,4'-DDE	625	UG/KG	NA		0.482	0.53
S07	B19	4,4'-DDT	233	UG/KG	0.0077	0.98	0.180	0.20
S07	B19	Antimony	ND	MG/KG	NA		NA	
S07	B19	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B19	Aroclor 1260	910	UG/KG	NA		4.129	4.53
S07	B19	Arsenic	14.25	MG/KG	0.6513	83.06	37.221	40.83
S07	B19	Benzo(a)pyrene equiv.	2956.25	UG/KG	NA		48.956	53.71
S07	B19	Chromium	18.3	MG/KG	0.0502	6.40	NA	
S07	B19	Heptachlor	ND	UG/KG	NA		NA	
S07	B19	Lead	107	MG/KG	NA		NA	
S07	B19	Manganese	80.45	MG/KG	0.0480	6.12	NA	
S07	B19	Thallium	ND	MG/KG	NA		NA	
S07	B19	Vanadium	13.1	MG/KG	0.0257	3.27	NA	
S07	B19	alpha-BHC	ND	UG/KG	NA		NA	
S07	B19	alpha-Chlordane	13	UG/KG	0.0004	0.05	0.010	0.01
S07	B19	beta-BHC	ND	UG/KG	NA		NA	
S07	B19	delta-BHC	11	UG/KG	NA		0.045	0.05
S07	B19	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B19	gamma-Chlordane	27.85	UG/KG	0.0009	0.12	0.022	0.02
		Total			0.7842		91.153	
S07	B21	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B21	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B21	4,4'-DDT	ND	UG/KG	NA		NA	
S07	B21	Antimony	ND	MG/KG	NA		NA	
S07	B21	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B21	Aroclor 1260	510000	UG/KG	NA		2313.907	98.12
S07	B21	Arsenic	6.7	MG/KG	0.3062	60.14	17.500	0.74
S07	B21	Benzo(a)pyrene equiv.	1620	UG/KG	NA		26.828	1.14
S07	B21	Chromium	17	MG/KG	0.0466	9.16	NA	
S07	B21	Heptachlor	ND	UG/KG	NA		NA	
S07	B21	Lead	80	MG/KG	NA		NA	
S07	B21	Manganese	190	MG/KG	0.1133	22.24	NA	
S07	B21	Thallium	ND	MG/KG	NA		NA	
S07	B21	Vanadium	22	MG/KG	0.0431	8.46	NA	
S07	B21	alpha-BHC	ND	UG/KG	NA		NA	
S07	B21	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B21	beta-BHC	ND	UG/KG	NA		NA	
S07	B21	delta-BHC	ND	UG/KG	NA		NA	
S07	B21	gamma-BHC	ND	UG/KG	NA		NA	
S07	B21	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.5092		2358.235	
S07	B22	4,4'-DDD	61	UG/KG	NA		0.033	0.07
S07	B22	4,4'-DDE	130	UG/KG	NA		0.100	0.20
S07	B22	4,4'-DDT	100	UG/KG	0.0033	0.33	0.077	0.16
S07	B22	Antimony	ND	MG/KG	NA		NA	
S07	B22	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B22	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B22	Arsenic	17	MG/KG	0.7770	78.03	44.404	89.83
S07	B22	Benzo(a)pyrene equiv.	290.81	UG/KG	NA		4.816	9.74
S07	B22	Chromium	23	MG/KG	0.0631	6.33	NA	
S07	B22	Heptachlor	ND	UG/KG	NA		NA	
S07	B22	Lead	55	MG/KG	NA		NA	
S07	B22	Manganese	190	MG/KG	0.1133	11.37	NA	
S07	B22	Thallium	ND	MG/KG	NA		NA	
S07	B22	Vanadium	20	MG/KG	0.0392	3.93	NA	
S07	B22	alpha-BHC	ND	UG/KG	NA		NA	
S07	B22	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B22	beta-BHC	ND	UG/KG	NA		NA	
S07	B22	delta-BHC	ND	UG/KG	NA		NA	
S07	B22	gamma-BHC	ND	UG/KG	NA		NA	
S07	B22	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.9959		49.431	
S07	B23	4,4'-DDD	77	UG/KG	NA		0.042	0.09
S07	B23	4,4'-DDE	175	UG/KG	NA		0.135	0.28
S07	B23	4,4'-DDT	260	UG/KG	0.0086	1.70	0.201	0.42
S07	B23	Antimony	ND	MG/KG	NA		NA	
S07	B23	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B23	Aroclor 1260	1565	UG/KG	NA		7.101	14.71
S07	B23	Arsenic	6.55	MG/KG	0.2994	59.51	17.109	35.45
S07	B23	Benzo(a)pyrene equiv.	1426.85	UG/KG	NA		23.629	48.96
S07	B23	Chromium	15.9	MG/KG	0.0436	8.67	NA	
S07	B23	Heptachlor	ND	UG/KG	NA		NA	
S07	B23	Lead	60.5	MG/KG	NA		NA	
S07	B23	Manganese	209.5	MG/KG	0.1249	24.83	NA	
S07	B23	Thallium	ND	MG/KG	NA		NA	
S07	B23	Vanadium	13.05	MG/KG	0.0256	5.08	NA	
S07	B23	alpha-BHC	ND	UG/KG	NA		NA	
S07	B23	alpha-Chlordane	13	UG/KG	0.0004	0.09	0.010	0.02
S07	B23	beta-BHC	ND	UG/KG	NA		NA	
S07	B23	delta-BHC	ND	UG/KG	NA		NA	
S07	B23	gamma-BHC	11	UG/KG	0.0006	0.12	0.032	0.07

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B23	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.5031		48.258	
S07	B24	4,4'-DDD	100	UG/KG	NA		0.054	0.22
S07	B24	4,4'-DDE	1800	UG/KG	NA		1.388	5.73
S07	B24	4,4'-DDT	3400	UG/KG	0.1122	27.46	2.622	10.83
S07	B24	Antimony	ND	MG/KG	NA		NA	
S07	B24	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B24	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B24	Arsenic	3.9	MG/KG	0.1783	43.65	10.187	42.07
S07	B24	Benzo(a)pyrene equiv.	578.38	UG/KG	NA		9.578	39.56
S07	B24	Chromium	17	MG/KG	0.0466	11.42	NA	
S07	B24	Heptachlor	9.8	UG/KG	0.0003	0.08	0.100	0.41
S07	B24	Lead	42	MG/KG	NA		NA	
S07	B24	Manganese	67	MG/KG	0.0399	9.78	NA	
S07	B24	Thallium	ND	MG/KG	NA		NA	
S07	B24	Vanadium	9.9	MG/KG	0.0194	4.75	NA	
S07	B24	alpha-BHC	ND	UG/KG	NA		NA	
S07	B24	alpha-Chlordane	94	UG/KG	0.0031	0.76	0.075	0.31
S07	B24	beta-BHC	ND	UG/KG	NA		NA	
S07	B24	delta-BHC	ND	UG/KG	NA		NA	
S07	B24	gamma-BHC	ND	UG/KG	NA		NA	
S07	B24	gamma-Chlordane	260	UG/KG	0.0086	2.10	0.206	0.85
		Total			0.4084		24.211	
S07	B27	4,4'-DDD	82000	UG/KG	NA		44.645	3.69
S07	B27	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B27	4,4'-DDT	100000	UG/KG	3.2986	39.20	77.130	6.37
S07	B27	Antimony	ND	MG/KG	NA		NA	
S07	B27	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B27	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B27	Arsenic	6.4	MG/KG	0.2925	3.48	16.717	1.38
S07	B27	Benzo(a)pyrene equiv.	8309.6	UG/KG	NA		137.610	11.37
S07	B27	Chromium	16	MG/KG	0.0439	0.52	NA	
S07	B27	Heptachlor	1100	UG/KG	0.0363	0.43	11.229	0.93
S07	B27	Lead	97	MG/KG	NA		NA	
S07	B27	Manganese	120	MG/KG	0.0715	0.85	NA	
S07	B27	Thallium	ND	MG/KG	NA		NA	
S07	B27	Vanadium	7.5	MG/KG	0.0147	0.17	NA	
S07	B27	alphe-BHC	39000	UG/KG	NA		557.379	46.06
S07	B27	alpha-Chlordane	7100	UG/KG	0.2342	2.78	5.637	0.47
S07	B27	beta-BHC	3800	UG/KG	NA		15.517	1.28
S07	B27	delta-BHC	28000	UG/KG	NA		114.334	9.45
S07	B27	gamma-BHC	76000	UG/KG	4.1783	49.66	224.131	18.52
S07	B27	gemma-Chlordene	7400	UG/KG	0.2441	2.90	5.876	0.49
		Total			8.4141		1210.205	
S07	B28	4,4'-DDD	53.5	UG/KG	NA		0.029	0.03
S07	B28	4,4'-DDE	130	UG/KG	NA		0.100	0.10
S07	B28	4,4'-DDT	195	UG/KG	0.0064	0.81	0.150	0.16
S07	B28	Antimony	ND	MG/KG	NA		NA	
S07	B28	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B28	Aroclor 1260	200	UG/KG	NA		0.907	0.94
S07	B28	Arsenic	15.15	MG/KG	0.6925	87.34	39.572	40.92
S07	B28	Benzo(a)pyrene equiv.	3377.4	UG/KG	NA		55.931	57.84
S07	B28	Chromium	17.9	MG/KG	0.0491	6.19	NA	
S07	B28	Heptachlor	ND	UG/KG	NA		NA	
S07	B28	Lead	557	MG/KG	NA		NA	
S07	B28	Manganese	39.05	MG/KG	0.0233	2.94	NA	
S07	B28	Thallium	ND	MG/KG	NA		NA	
S07	B28	Vanadium	10.85	MG/KG	0.0213	2.68	NA	
S07	B28	alpha-BHC	ND	UG/KG	NA		NA	
S07	B28	alpha-Chlordane	2.95	UG/KG	0.0001	0.01	0.002	
S07	B28	beta-BHC	ND	UG/KG	NA		NA	
S07	B28	delta-BHC	ND	UG/KG	NA		NA	
S07	B28	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B28	gamma-Chlordane	5.4	UG/KG	0.0002	0.02	0.004	
		Total			0.7928		96.696	
S07	B29	4,4'-DDD	4000	UG/KG	NA		2.178	5.52
S07	B29	4,4'-DDE	830	UG/KG	NA		0.640	1.62
S07	B29	4,4'-DDT	2800	UG/KG	0.0924	13.53	2.160	5.48
S07	B29	Antimony	ND	MG/KG	NA		NA	
S07	B29	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B29	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B29	Arsenic	7.3	MG/KG	0.3337	48.88	19.068	48.35
S07	B29	Benzo(a)pyrene equiv.	899.18	UG/KG	NA		14.891	37.76
S07	B29	Chromium	68	MG/KG	0.1865	27.32	NA	
S07	B29	Heptachlor	ND	UG/KG	NA		NA	
S07	B29	Lead	380	MG/KG	NA		NA	
S07	B29	Manganese	43	MG/KG	0.0256	3.76	NA	
S07	B29	Thallium	ND	MG/KG	NA		NA	
S07	B29	Vanadium	14	MG/KG	0.0274	4.02	NA	
S07	B29	alpha-BHC	ND	UG/KG	NA		NA	
S07	B29	alpha-Chlordane	150	UG/KG	0.0049	0.72	0.119	0.30
S07	B29	beta-BHC	ND	UG/KG	NA		NA	
S07	B29	delta-BHC	ND	UG/KG	NA		NA	
S07	B29	gamma-BHC	57	UG/KG	0.0031	0.46	0.168	0.43
S07	B29	gamma-Chlordane	270	UG/KG	0.0089	1.30	0.214	0.54
		Total			0.6826		39.438	
S07	B30	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B30	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B30	4,4'-DDT	45	UG/KG	0.0015	2.63	0.035	0.01
S07	B30	Antimony	ND	MG/KG	NA		NA	
S07	B30	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B30	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B30	Arsenic	ND	MG/KG	NA		NA	
S07	B30	Benzo(a)pyrene equiv.	14323	UG/KG	NA		237.193	99.98
S07	B30	Chromium	8	MG/KG	0.0219	38.86	NA	
S07	B30	Heptachlor	ND	UG/KG	NA		NA	
S07	B30	Lead	32	MG/KG	NA		NA	
S07	B30	Manganese	18	MG/KG	0.0107	19.01	NA	
S07	B30	Thallium	ND	MG/KG	NA		NA	
S07	B30	Vanadium	11	MG/KG	0.0215	38.16	NA	
S07	B30	alpha-BHC	ND	UG/KG	NA		NA	
S07	B30	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B30	beta-BHC	ND	UG/KG	NA		NA	
S07	B30	delta-BHC	ND	UG/KG	NA		NA	
S07	B30	gamma-BHC	ND	UG/KG	NA		NA	
S07	B30	gamma-Chlordane	23	UG/KG	0.0008	1.34	0.018	0.01
		Total			0.0565		237.246	
S07	B31	4,4'-DDD	1100	UG/KG	NA		0.599	5.60
S07	B31	4,4'-DDE	430	UG/KG	NA		0.332	3.21
S07	B31	4,4'-DDT	1100	UG/KG	0.0363	20.17	0.848	8.22
S07	B31	Antimony	ND	MG/KG	NA		NA	
S07	B31	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B31	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B31	Arsenic	1.4	MG/KG	0.0640	35.57	3.657	35.43
S07	B31	Benzo(a)pyrene equiv.	289.5	UG/KG	NA		4.794	46.45
S07	B31	Chromium	11	MG/KG	0.0302	16.77	NA	
S07	B31	Heptachlor	ND	UG/KG	NA		NA	
S07	B31	Lead	9.6	MG/KG	NA		NA	
S07	B31	Manganese	24	MG/KG	0.0143	7.95	NA	
S07	B31	Thallium	ND	MG/KG	NA		NA	
S07	B31	Vanadium	16	MG/KG	0.0313	17.42	NA	
S07	B31	alpha-BHC	ND	UG/KG	NA		NA	
S07	B31	alpha-Chlordane	38	UG/KG	0.0013	0.70	0.030	0.29
S07	B31	beta-BHC	ND	UG/KG	NA		NA	
S07	B31	delta-BHC	ND	UG/KG	NA		NA	
S07	B31	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B31	gamma-Chlordane	78	UG/KG	0.0026	1.43	0.062	0.60
		Total			0.1799		10.322	
S07	B32	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B32	4,4'-DDE	6.8	UG/KG	NA		0.005	20.73
S07	B32	4,4'-DDT	26	UG/KG	0.0009	1.16	0.020	79.27
S07	B32	Antimony	ND	MG/KG	NA		NA	
S07	B32	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B32	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B32	Arsenic	ND	MG/KG	NA		NA	
S07	B32	Benzo(a)pyrene equiv.	ND	UG/KG	NA		NA	
S07	B32	Chromium	10	MG/KG	0.0274	37.22	NA	
S07	B32	Heptachlor	ND	UG/KG	NA		NA	
S07	B32	Lead	2.2	MG/KG	NA		NA	
S07	B32	Manganese	17	MG/KG	0.0101	13.76	NA	
S07	B32	Thallium	ND	MG/KG	NA		NA	
S07	B32	Vanadium	18	MG/KG	0.0353	47.86	NA	
S07	B32	alpha-BHC	ND	UG/KG	NA		NA	
S07	B32	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B32	beta-BHC	ND	UG/KG	NA		NA	
S07	B32	delta-BHC	ND	UG/KG	NA		NA	
S07	B32	gamma-BHC	ND	UG/KG	NA		NA	
S07	B32	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.0737		0.025	
S07	B33	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B33	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B33	4,4'-DDT	4.7	UG/KG	0.0002	0.20	0.004	100.00
S07	B33	Antimony	ND	MG/KG	NA		NA	
S07	B33	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B33	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B33	Arsenic	ND	MG/KG	NA		NA	
S07	B33	Benzo(a)pyrene equiv.	ND	UG/KG	NA		NA	
S07	B33	Chromium	10	MG/KG	0.0274	34.52	NA	
S07	B33	Heptachlor	ND	UG/KG	NA		NA	
S07	B33	Lead	2	MG/KG	NA		NA	
S07	B33	Manganese	18	MG/KG	0.0107	13.51	NA	
S07	B33	Thallium	ND	MG/KG	NA		NA	
S07	B33	Vanadium	21	MG/KG	0.0411	51.78	NA	
S07	B33	alpha-BHC	ND	UG/KG	NA		NA	
S07	B33	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B33	beta-BHC	ND	UG/KG	NA		NA	
S07	B33	delta-BHC	ND	UG/KG	NA		NA	
S07	B33	gamma-BHC	ND	UG/KG	NA		NA	
S07	B33	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.0794		0.004	
S07	B34	4,4'-DDD	180	UG/KG	NA		0.098	0.30
S07	B34	4,4'-DDE	28.5	UG/KG	NA		0.022	0.07
S07	B34	4,4'-DDT	97	UG/KG	0.0032	0.54	0.075	0.23
S07	B34	Antimony	ND	MG/KG	NA		NA	
S07	B34	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B34	Aroclor 1260	120	UG/KG	NA		0.544	1.68
S07	B34	Arsenic	9.5	MG/KG	0.4342	72.80	24.814	76.64
S07	B34	Benzo(a)pyrene equiv.	410.575	UG/KG	NA		6.799	21.00
S07	B34	Chromium	14.25	MG/KG	0.0391	6.55	NA	
S07	B34	Heptachlor	ND	UG/KG	NA		NA	
S07	B34	Lead	39.75	MG/KG	NA		NA	
S07	B34	Manganese	158.5	MG/KG	0.0945	15.84	NA	
S07	B34	Thallium	ND	MG/KG	NA		NA	
S07	B34	Vanadium	12.7	MG/KG	0.0249	4.17	NA	
S07	B34	alpha-BHC	ND	UG/KG	NA		NA	
S07	B34	alpha-Chlordane	6.4	UG/KG	0.0002	0.04	0.005	0.02
S07	B34	beta-BHC	ND	UG/KG	NA		NA	
S07	B34	delta-BHC	2.5	UG/KG	NA		0.010	0.03
S07	B34	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B34	gamma-Chlordane	10.3	UG/KG	0.0003	0.06	0.008	0.03
		Total			0.5964		32.376	
S07	B35	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B35	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B35	4,4'-DDT	ND	UG/KG	NA		NA	
S07	B35	Antimony	ND	MG/KG	NA		NA	
S07	B35	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B35	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B35	Arsenic	24	MG/KG	1.0970	65.76	62.688	95.00
S07	B35	Benzo(a)pyrene equiv.	199.13	UG/KG	NA		3.298	5.00
S07	B35	Chromium	35	MG/KG	0.0960	5.75	NA	
S07	B35	Heptachlor	ND	UG/KG	NA		NA	
S07	B35	Lead	50	MG/KG	NA		NA	
S07	B35	Manganese	580	MG/KG	0.3458	20.73	NA	
S07	B35	Thallium	ND	MG/KG	NA		NA	
S07	B35	Vanadium	66	MG/KG	0.1293	7.75	NA	
S07	B35	alpha-BHC	ND	UG/KG	NA		NA	
S07	B35	alpha-Chlordane	ND	UG/KG	NA		NA	
S07	B35	beta-BHC	ND	UG/KG	NA		NA	
S07	B35	delta-BHC	ND	UG/KG	NA		NA	
S07	B35	gamma-BHC	ND	UG/KG	NA		NA	
S07	B35	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			1.6681		65.986	
S07	B36	4,4'-DDD	8.8	UG/KG	NA		0.005	0.04
S07	B36	4,4'-DDE	54	UG/KG	NA		0.042	0.38
S07	B36	4,4'-DDT	16	UG/KG	0.0005	0.24	0.012	0.11
S07	B36	Antimony	ND	MG/KG	NA		NA	
S07	B36	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B36	Aroclor 1260	110	UG/KG	NA		0.499	4.60
S07	B36	Arsenic	2.1	MG/KG	0.0960	43.76	5.485	50.59
S07	B36	Benzo(a)pyrene equiv.	288.86	UG/KG	NA		4.784	44.12
S07	B36	Chromium	24	MG/KG	0.0658	30.01	NA	
S07	B36	Heptachlor	ND	UG/KG	NA		NA	
S07	B36	Lead	42	MG/KG	NA		NA	
S07	B36	Manganese	65	MG/KG	0.0388	17.67	NA	
S07	B36	Thallium	ND	MG/KG	NA		NA	
S07	B36	Vanadium	9	MG/KG	0.0176	8.04	NA	
S07	B36	alpha-BHC	ND	UG/KG	NA		NA	
S07	B36	alpha-Chlordane	19	UG/KG	0.0006	0.29	0.015	0.14
S07	B36	beta-BHC	ND	UG/KG	NA		NA	
S07	B36	delta-BHC	ND	UG/KG	NA		NA	
S07	B36	gamma-BHC	ND	UG/KG	NA		NA	
S07	B36	gamma-Chlordane	ND	UG/KG	NA		NA	
		Total			0.2193		10.842	
S07	B37	4,4'-DDD	120	UG/KG	NA		0.065	0.06
S07	B37	4,4'-DDE	19	UG/KG	NA		0.015	0.01
S07	B37	4,4'-DDT	22	UG/KG	0.0007	0.17	0.017	0.01
S07	B37	Antimony	ND	MG/KG	NA		NA	
S07	B37	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B37	Aroclor 1260	110	UG/KG	NA		0.499	0.43
S07	B37	Arsenic	5.8	MG/KG	0.2651	61.99	15.150	12.98
S07	B37	Benzo(a)pyrene equiv.	6098.2	UG/KG	NA		100.988	86.51
S07	B37	Chromium	12	MG/KG	0.0329	7.69	NA	
S07	B37	Heptachlor	ND	UG/KG	NA		NA	
S07	B37	Lead	25	MG/KG	NA		NA	
S07	B37	Manganese	150	MG/KG	0.0894	20.91	NA	
S07	B37	Thallium	ND	MG/KG	NA		NA	
S07	B37	Vanadium	20	MG/KG	0.0392	9.16	NA	
S07	B37	alpha-BHC	ND	UG/KG	NA		NA	
S07	B37	alpha-Chlordane	5.1	UG/KG	0.0002	0.04	0.004	
S07	B37	beta-BHC	ND	UG/KG	NA		NA	
S07	B37	delta-BHC	ND	UG/KG	NA		NA	
S07	B37	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.32
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B37	gamma-Chlordane	5.2	UG/KG	0.0002		0.004	
		Total			0.4277		116.742	

Hazard index estimates exceeded unity at six surface soil sample locations (006SB004, S06B05, S07B10, S07B13, S07B27, and S07B35). Contributors to hazard index projections include Aroclor-1254, arsenic, gamma-BHC, gamma-chlordane, and 4,4'-DDT. Hazard index estimates range from 0.06 (S07B30) to 22 (S06B05) with a mean hazard index of 1.

Soil — Site Worker Scenario

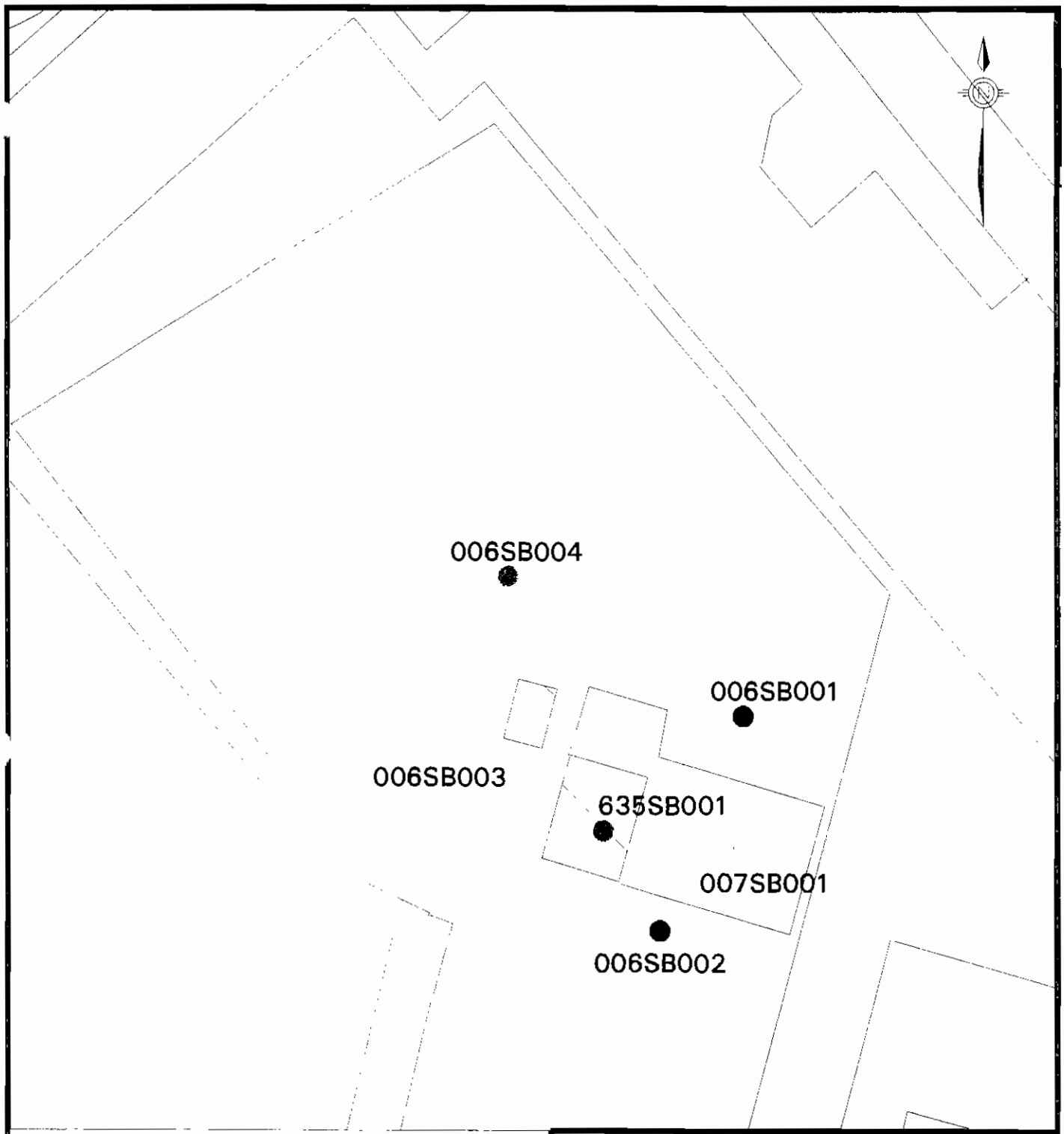
Aroclor-1260, arsenic, BEQs, dioxin, and 4,4'-DDT were identified as industrial soil pathway COCs for AOC 637. Figure 10.12-36 illustrates point risk for combined SWMU 6 surface soil pathways under an industrial scenario. Table 10.12.33 summarizes the risk and hazard contribution of each COPC at each sample location.

With a few exceptions, arsenic and BEQs are the primary contributors to risk estimates above 1E-06 at each surface soil sample location. Dioxin was the primary contributor to risk estimates associated with surface soil location 006SB002. Aroclor-1254 was the primary contributor to risk estimates associated with surface soil location S06B05. Aroclor-1260 was the primary contributor to risk estimates associated with surface soil locations 006SB001 and S07B21, and a secondary contributor to risk estimates associated with surface soil locations 006SB002, S06B06, S07B08, S07B11, S07B16, and S07B23. Contributors to risk estimates associated with surface soil location S07B27 include 4,4'-DDD, 4,4'-DDT, arsenic, BEQs, alpha-BHC, beta-BHC, delta-BHC, and gamma-BHC. Industrial risk estimates ranged from 1E-09 (S07B33) to 5E-04 (S07SB21) with a mean risk of 2E-05. Hazard index estimates exceeded unity at only one surface soil location (S06SB05) primarily associated with the concentration of Aroclor-1254.

Groundwater — Residential Scenario

Residential groundwater pathway COCs identified for combined SWMU 6 include arsenic, barium, benzene, and pentachlorophenol. Figures 10.12-37 and 10.12-38 illustrate point risk and hazard estimates for combined SWMU 6 groundwater pathways under a residential scenario.

Figure 10.12-36 Point Risk Estimates for Surface Soil Residential Scenario



LEGEND

- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 100

ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-36
POINT RISK ESTIMATES FOR SURFACE SOIL
INDUSTRIAL SCENARIO
SWMU 6, SWMU 7, AOC 635

AML: /home3/projects/charleston_dir/zone_g_district_dir

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B08	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0183		6.356	
S07	B09	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B09	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B09	4,4'-DDT	ND	UG/KG	NA		NA	
S07	B09	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B09	Aroclor 1260	270	UG/KG	NA		0.249	10.57
S07	B09	Arsenic	2.3	MG/KG	0.0053	100.00	0.850	36.07
S07	B09	Benzo(a)pyrene equiv.	373.34	UG/KG	NA		1.257	53.36
S07	B09	alpha-BHC	ND	UG/KG	NA		NA	
S07	B09	beta-BHC	ND	UG/KG	NA		NA	
S07	B09	delta-BHC	ND	UG/KG	NA		NA	
S07	B09	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0053		2.356	
S07	B10	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B10	4,4'-DDE	71	UG/KG	NA		0.011	0.07
S07	B10	4,4'-DDT	24	UG/KG	0.0001	0.07	0.004	0.02
S07	B10	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B10	Aroclor 1260	290	UG/KG	NA		0.268	1.75
S07	B10	Arsenic	38	MG/KG	0.0874	99.93	14.041	91.95
S07	B10	Benzo(a)pyrene equiv.	281.35	UG/KG	NA		0.947	6.20
S07	B10	alpha-BHC	ND	UG/KG	NA		NA	
S07	B10	beta-BHC	ND	UG/KG	NA		NA	
S07	B10	delta-BHC	ND	UG/KG	NA		NA	
S07	B10	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0874		15.271	
S07	B11	4,4'-DDD	30	UG/KG	NA		0.003	0.09
S07	B11	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B11	4,4'-DDT	90	UG/KG	0.0002	2.11	0.014	0.37
S07	B11	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B11	Aroclor 1260	1500	UG/KG	NA		1.384	36.27
S07	B11	Arsenic	4.7	MG/KG	0.0108	97.89	1.737	45.53
S07	B11	Benzo(a)pyrene equiv.	201.03	UG/KG	NA		0.677	17.74
S07	B11	alpha-BHC	ND	UG/KG	NA		NA	
S07	B11	beta-BHC	ND	UG/KG	NA		NA	
S07	B11	delta-BHC	ND	UG/KG	NA		NA	
S07	B11	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0110		3.815	
S07	B12	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B12	4,4'-DDE	6.3	UG/KG	NA		0.001	0.04
S07	B12	4,4'-DDT	7.8	UG/KG	0.00002	0.14	0.001	0.04
S07	B12	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B12	Aroclor 1260	130	UG/KG	NA		0.120	4.41
S07	B12	Arsenic	6.3	MG/KG	0.0145	99.86	2.328	85.59
S07	B12	Benzo(a)pyrene equiv.	80.09	UG/KG	NA		0.270	9.92
S07	B12	alpha-BHC	ND	UG/KG	NA		NA	
S07	B12	beta-BHC	ND	UG/KG	NA		NA	
S07	B12	delta-BHC	ND	UG/KG	NA		NA	
S07	B12	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0145		2.720	
S07	B13	4,4'-DDD	78	UG/KG	NA		0.009	0.08
S07	B13	4,4'-DDE	570	UG/KG	NA		0.089	0.87
S07	B13	4,4'-DDT	460	UG/KG	0.0012	2.11	0.072	0.70
S07	B13	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B13	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B13	Arsenic	24	MG/KG	0.0552	97.89	8.868	86.18
S07	B13	Benzo(a)pyrene equiv.	371.96	UG/KG	NA		1.252	12.17
S07	B13	alpha-BHC	ND	UG/KG	NA		NA	
S07	B13	beta-BHC	ND	UG/KG	NA		NA	
S07	B13	delta-BHC	ND	UG/KG	NA		NA	
S07	B13	gamma-BHC	ND	UG/KG	NA		NA	

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
		Total			0.0564		10.291	
S07	B16	4,4'-DDD	5900	UG/KG	NA		0.653	3.40
S07	B16	4,4'-DDE	1400	UG/KG	NA		0.220	1.14
S07	B16	4,4'-DDT	360	UG/KG	0.0009	5.65	0.056	0.29
S07	B16	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B16	Aroclor 1260	5800	UG/KG	NA		5.351	27.86
S07	B16	Arsenic	6.7	MG/KG	0.0154	93.62	2.476	12.89
S07	B16	Benzo(a)pyrene equiv.	3083	UG/KG	NA		10.381	54.06
S07	B16	alpha-BHC	ND	UG/KG	NA		NA	
S07	B16	beta-BHC	ND	UG/KG	NA		NA	
S07	B16	delta-BHC	61	UG/KG	NA		0.051	0.26
S07	B16	gamma-BHC	26	UG/KG	0.0001	0.73	0.017	0.09
		Total			0.0165		19.204	
S07	B17	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B17	4,4'-DDE	16	UG/KG	NA		0.003	0.06
S07	B17	4,4'-DDT	10	UG/KG	0.00003	0.09	0.002	0.03
S07	B17	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B17	Aroclor 1260	100	UG/KG	NA		0.092	2.03
S07	B17	Arsenic	12	MG/KG	0.0276	99.91	4.434	97.36
S07	B17	Benzo(a)pyrene equiv.	7.163	UG/KG	NA		0.024	0.53
S07	B17	alpha-BHC	ND	UG/KG	NA		NA	
S07	B17	beta-BHC	ND	UG/KG	NA		NA	
S07	B17	delta-BHC	ND	UG/KG	NA		NA	
S07	B17	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0276		4.555	
S07	B18	4,4'-DDD	240	UG/KG	NA		0.027	0.90
S07	B18	4,4'-DDE	120	UG/KG	NA		0.019	0.64
S07	B18	4,4'-DDT	79	UG/KG	0.0002	2.23	0.012	0.42
S07	B18	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B18	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B18	Arsenic	3.9	MG/KG	0.0090	97.77	1.441	48.91
S07	B18	Benzo(a)pyrene equiv.	429.27	UG/KG	NA		1.445	49.06
S07	B18	alpha-BHC	ND	UG/KG	NA		NA	
S07	B18	beta-BHC	ND	UG/KG	NA		NA	
S07	B18	delta-BHC	2.2	UG/KG	NA		0.002	0.06
S07	B18	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0092		2.946	
S07	B19	4,4'-DDD	198.5	UG/KG	NA		0.022	0.14
S07	B19	4,4'-DDE	625	UG/KG	NA		0.098	0.60
S07	B19	4,4'-DDT	233	UG/KG	0.0006	1.80	0.037	0.23
S07	B19	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B19	Aroclor 1260	910	UG/KG	NA		0.839	5.17
S07	B19	Arsenic	14.25	MG/KG	0.0328	98.20	5.265	32.45
S07	B19	Benzo(a)pyrene equiv.	2956.25	UG/KG	NA		9.954	61.35
S07	B19	alpha-BHC	ND	UG/KG	NA		NA	
S07	B19	beta-BHC	ND	UG/KG	NA		NA	
S07	B19	delta-BHC	11	UG/KG	NA		0.009	0.06
S07	B19	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0334		16.225	
S07	B21	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B21	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B21	4,4'-DDT	ND	UG/KG	NA		NA	
S07	B21	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B21	Aroclor 1260	510000	UG/KG	NA		470.477	98.34
S07	B21	Arsenic	6.7	MG/KG	0.0154	100.00	2.476	0.52
S07	B21	Benzo(a)pyrene equiv.	1620	UG/KG	NA		5.455	1.14
S07	B21	alpha-BHC	ND	UG/KG	NA		NA	
S07	B21	beta-BHC	ND	UG/KG	NA		NA	
S07	B21	delta-BHC	ND	UG/KG	NA		NA	
S07	B21	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0154		478.408	

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B22	4,4'-DDD	61	UG/KG	NA		0.007	0.09
S07	B22	4,4'-DDE	130	UG/KG	NA		0.020	0.28
S07	B22	4,4'-DDT	100	UG/KG	0.0003	0.66	0.016	0.21
S07	B22	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B22	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B22	Arsenic	17	MG/KG	0.0391	99.34	6.282	86.01
S07	B22	Benzo(a)pyrene equiv.	290.81	UG/KG	NA		0.979	13.41
S07	B22	alpha-BHC	ND	UG/KG	NA		NA	
S07	B22	beta-BHC	ND	UG/KG	NA		NA	
S07	B22	delta-BHC	ND	UG/KG	NA		NA	
S07	B22	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0393		7.304	
S07	B23	4,4'-DDD	77	UG/KG	NA		0.009	0.10
S07	B23	4,4'-DDE	175	UG/KG	NA		0.027	0.31
S07	B23	4,4'-DDT	260	UG/KG	0.0007	4.26	0.041	0.47
S07	B23	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B23	Aroclor 1260	1565	UG/KG	NA		1.444	16.50
S07	B23	Arsenic	6.55	MG/KG	0.0151	95.44	2.420	27.65
S07	B23	Benzo(a)pyrene equiv.	1426.85	UG/KG	NA		4.804	54.90
S07	B23	alpha-BHC	ND	UG/KG	NA		NA	
S07	B23	beta-BHC	ND	UG/KG	NA		NA	
S07	B23	delta-BHC	ND	UG/KG	NA		NA	
S07	B23	gamma-BHC	11	UG/KG	0.00005	0.30	0.007	0.08
		Total			0.0158		8.752	
S07	B24	4,4'-DDD	100	UG/KG	NA		0.011	0.26
S07	B24	4,4'-DDE	1800	UG/KG	NA		0.282	6.70
S07	B24	4,4'-DDT	3400	UG/KG	0.0088	49.48	0.533	12.65
S07	B24	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B24	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B24	Arsenic	3.9	MG/KG	0.0090	50.52	1.441	34.19
S07	B24	Benzo(a)pyrene equiv.	578.38	UG/KG	NA		1.947	46.20
S07	B24	alpha-BHC	ND	UG/KG	NA		NA	
S07	B24	beta-BHC	ND	UG/KG	NA		NA	
S07	B24	delta-BHC	ND	UG/KG	NA		NA	
S07	B24	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0177		4.215	
S07	B27	4,4'-DDD	82000	UG/KG	NA		9.077	3.78
S07	B27	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B27	4,4'-DDT	100000	UG/KG	0.2583	43.04	15.683	6.52
S07	B27	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B27	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B27	Arsenic	6.4	MG/KG	0.0147	2.45	2.365	0.98
S07	B27	Benzo(a)pyrene equiv.	8309.6	UG/KG	NA		27.980	11.64
S07	B27	alpha-BHC	39000	UG/KG	NA		113.330	47.14
S07	B27	beta-BHC	3800	UG/KG	NA		3.155	1.31
S07	B27	delta-BHC	28000	UG/KG	NA		23.247	9.67
S07	B27	gamma-BHC	76000	UG/KG	0.3272	54.51	45.572	18.96
		Total			0.6002		240.408	
S07	B28	4,4'-DDD	53.5	UG/KG	NA		0.006	0.03
S07	B28	4,4'-DDE	130	UG/KG	NA		0.020	0.12
S07	B28	4,4'-DDT	195	UG/KG	0.0005	1.43	0.031	0.18
S07	B28	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B28	Aroclor 1260	200	UG/KG	NA		0.185	1.07
S07	B28	Arsenic	15.15	MG/KG	0.0348	98.57	5.598	32.52
S07	B28	Benzo(a)pyrene equiv.	3377.4	UG/KG	NA		11.372	66.07
S07	B28	alpha-BHC	ND	UG/KG	NA		NA	
S07	B28	beta-BHC	ND	UG/KG	NA		NA	
S07	B28	delta-BHC	ND	UG/KG	NA		NA	
S07	B28	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0353		17.212	

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B29	4,4'-DDD	4000	UG/KG	NA		0.443	6.54
S07	B29	4,4'-DDE	830	UG/KG	NA		0.130	1.92
S07	B29	4,4'-DDT	2800	UG/KG	0.0072	29.81	0.439	6.48
S07	B29	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B29	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B29	Arsenic	7.3	MG/KG	0.0168	69.18	2.697	39.84
S07	B29	Benzo(a)pyrene equiv.	899.18	UG/KG	NA		3.028	44.71
S07	B29	alpha-BHC	ND	UG/KG	NA		NA	
S07	B29	beta-BHC	ND	UG/KG	NA		NA	
S07	B29	delta-BHC	ND	UG/KG	NA		NA	
S07	B29	gamma-BHC	57	UG/KG	0.0002	1.01	0.034	0.50
		Total			0.0243		6.771	
S07	B30	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B30	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B30	4,4'-DDT	45	UG/KG	0.0001	100.00	0.007	0.01
S07	B30	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B30	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B30	Arsenic	ND	MG/KG	NA		NA	
S07	B30	Benzo(a)pyrene equiv.	14323	UG/KG	NA		48.228	99.99
S07	B30	alpha-BHC	ND	UG/KG	NA		NA	
S07	B30	beta-BHC	ND	UG/KG	NA		NA	
S07	B30	delta-BHC	ND	UG/KG	NA		NA	
S07	B30	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0001		48.235	
S07	B31	4,4'-DDD	1100	UG/KG	NA		0.122	6.57
S07	B31	4,4'-DDE	430	UG/KG	NA		0.067	3.64
S07	B31	4,4'-DDT	1100	UG/KG	0.0028	46.88	0.173	9.31
S07	B31	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B31	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B31	Arsenic	1.4	MG/KG	0.0032	53.12	0.517	27.91
S07	B31	Benzo(a)pyrene equiv.	289.5	UG/KG	NA		0.975	52.58
S07	B31	alpha-BHC	ND	UG/KG	NA		NA	
S07	B31	beta-BHC	ND	UG/KG	NA		NA	
S07	B31	delta-BHC	ND	UG/KG	NA		NA	
S07	B31	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0061		1.854	
S07	B32	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B32	4,4'-DDE	6.8	UG/KG	NA		0.001	20.73
S07	B32	4,4'-DDT	26	UG/KG	0.0001	100.00	0.004	79.27
S07	B32	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B32	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B32	Arsenic	ND	MG/KG	NA		NA	
S07	B32	Benzo(a)pyrene equiv.	ND	UG/KG	NA		NA	
S07	B32	alpha-BHC	ND	UG/KG	NA		NA	
S07	B32	beta-BHC	ND	UG/KG	NA		NA	
S07	B32	delta-BHC	ND	UG/KG	NA		NA	
S07	B32	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0001		0.005	
S07	B33	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B33	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B33	4,4'-DDT	4.7	UG/KG	0.00001	100.00	0.001	100.00
S07	B33	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B33	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B33	Arsenic	ND	MG/KG	NA		NA	
S07	B33	Benzo(a)pyrene equiv.	ND	UG/KG	NA		NA	
S07	B33	alpha-BHC	ND	UG/KG	NA		NA	
S07	B33	beta-BHC	ND	UG/KG	NA		NA	
S07	B33	delta-BHC	ND	UG/KG	NA		NA	
S07	B33	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.00001		0.001	
S07	B34	4,4'-DDD	180	UG/KG	NA		0.020	0.39

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B34	4,4'-DDE	28.5	UG/KG	NA		0.004	0.09
S07	B34	4,4'-DDT	97	UG/KG	0.0003	1.13	0.015	0.30
S07	B34	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B34	Aroclor 1260	120	UG/KG	NA		0.111	2.19
S07	B34	Arsenic	9.5	MG/KG	0.0218	98.87	3.510	69.58
S07	B34	Benzo(a)pyrene equiv.	410.575	UG/KG	NA		1.382	27.40
S07	B34	alpha-BHC	ND	UG/KG	NA		NA	
S07	B34	beta-BHC	ND	UG/KG	NA		NA	
S07	B34	delta-BHC	2.5	UG/KG	NA		0.002	0.04
S07	B34	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0221		5.045	
S07	B35	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B35	4,4'-DDE	ND	UG/KG	NA		NA	
S07	B35	4,4'-DDT	ND	UG/KG	NA		NA	
S07	B35	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B35	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B35	Arsenic	24	MG/KG	0.0552	100.00	8.868	92.97
S07	B35	Benzo(a)pyrene equiv.	199.13	UG/KG	NA		0.670	7.03
S07	B35	alpha-BHC	ND	UG/KG	NA		NA	
S07	B35	beta-BHC	ND	UG/KG	NA		NA	
S07	B35	delta-BHC	ND	UG/KG	NA		NA	
S07	B35	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0552		9.539	
S07	B36	4,4'-DDD	8.8	UG/KG	NA		0.001	0.05
S07	B36	4,4'-DDE	54	UG/KG	NA		0.008	0.45
S07	B36	4,4'-DDT	16	UG/KG	0.00004	0.85	0.003	0.13
S07	B36	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B36	Aroclor 1260	110	UG/KG	NA		0.101	5.45
S07	B36	Arsenic	2.1	MG/KG	0.0048	99.15	0.776	41.67
S07	B36	Benzo(a)pyrene equiv.	288.86	UG/KG	NA		0.973	52.24
S07	B36	alpha-BHC	ND	UG/KG	NA		NA	
S07	B36	beta-BHC	ND	UG/KG	NA		NA	
S07	B36	delta-BHC	ND	UG/KG	NA		NA	
S07	B36	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0049		1.862	
S07	B37	4,4'-DDD	120	UG/KG	NA		0.013	0.06
S07	B37	4,4'-DDE	19	UG/KG	NA		0.003	0.01
S07	B37	4,4'-DDT	22	UG/KG	0.0001	0.42	0.003	0.02
S07	B37	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B37	Aroclor 1260	110	UG/KG	NA		0.101	0.45
S07	B37	Arsenic	5.8	MG/KG	0.0133	99.58	2.143	9.40
S07	B37	Benzo(a)pyrene equiv.	6098.2	UG/KG	NA		20.533	90.07
S07	B37	alpha-BHC	ND	UG/KG	NA		NA	
S07	B37	beta-BHC	ND	UG/KG	NA		NA	
S07	B37	delta-BHC	ND	UG/KG	NA		NA	
S07	B37	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0134		22.798	

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
006	SB001	Aroclor-1260	8600	UG/KG	NA		7.9335	45.62
006	SB001	Arsenic (As)	9.5	MG/KG	0.0218	100.00	3.5103	20.18
006	SB001	B(a)P Equiv.	1766.3	UG/KG	NA		5.9474	34.20
		Total			0.0218		17.3912	
006	SB002	Aroclor-1260	5600	UG/KG	NA		5.1660	5.58
006	SB002	Arsenic (As)	11.65	MG/KG	0.0268	100.00	4.3048	4.65
006	SB002	B(a)P Equiv.	3690	UG/KG	NA		12.4247	13.43
006	SB002	Dioxin Equiv.	1020.925	NG/KG	NA		70.6356	76.34
		Total			0.0268		92.5311	
006	SB003	Aroclor-1260	240	UG/KG	NA		0.2214	7.72
006	SB003	Arsenic (As)	4.1	MG/KG	0.0094	100.00	1.5150	52.84
006	SB003	B(a)P Equiv.	335.85	UG/KG	NA		1.1309	39.44
		Total			0.0094		2.8672	
006	SB004	Aroclor-1260	ND	UG/KG	NA		NA	
006	SB004	Arsenic (As)	17.3	MG/KG	0.0398	100.00	6.3925	86.94
006	SB004	B(a)P Equiv.	285.25	UG/KG	NA		0.9605	13.06
		Total			0.0398		7.3529	
007	SB001	Aroclor-1260	ND	UG/KG	NA		NA	
007	SB001	Arsenic (As)	5.25	MG/KG	0.0121	100.00	1.9399	40.42
007	SB001	B(a)P Equiv.	846.3	UG/KG	NA		2.8496	59.38
007	SB001	Dioxin Equiv.	0.138	NG/KG	NA		0.0095	0.20
		Total			0.0121		4.7991	
635	SB001	Aroclor-1260	ND	UG/KG	NA		NA	
635	SB001	Arsenic (As)	14.7	MG/KG	0.0338	100.00	5.4318	100.00
635	SB001	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			0.0338		5.4318	
S06	B01	4,4'-DDD	ND	UG/KG	NA		NA	
S06	B01	4,4'-DDE	ND	UG/KG	NA		NA	
S06	B01	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B01	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B01	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B01	Arsenic	9.3	MG/KG	0.0214	100.00	3.436	59.60
S06	B01	Benzo(a)pyrene equiv.	691.93	UG/KG	NA		2.330	40.40
S06	B01	alpha-BHC	ND	UG/KG	NA		NA	
S06	B01	beta-BHC	ND	UG/KG	NA		NA	
S06	B01	delta-BHC	ND	UG/KG	NA		NA	
S06	B01	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0214		5.766	
S06	B02	4,4'-DDD	110	UG/KG	NA		0.012	0.15
S06	B02	4,4'-DDE	42	UG/KG	NA		0.007	0.08
S06	B02	4,4'-DDT	72	UG/KG	0.0002	1.56	0.011	0.14
S06	B02	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B02	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B02	Arsenic	5.1	MG/KG	0.0117	98.44	1.884	23.56
S06	B02	Benzo(a)pyrene equiv.	1807.3	UG/KG	NA		6.085	76.07
S06	B02	alpha-BHC	ND	UG/KG	NA		NA	
S06	B02	beta-BHC	ND	UG/KG	NA		NA	
S06	B02	delta-BHC	ND	UG/KG	NA		NA	
S06	B02	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0119		8.000	
S06	B03	4,4'-DDD	13	UG/KG	NA		0.001	0.04
S06	B03	4,4'-DDE	53	UG/KG	NA		0.008	0.24
S06	B03	4,4'-DDT	11	UG/KG	0.00003	0.15	0.002	0.05
S06	B03	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B03	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B03	Arsenic	8	MG/KG	0.0184	99.85	2.956	85.47
S06	B03	Benzo(a)pyrene equiv.	145.81	UG/KG	NA		0.491	14.20

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

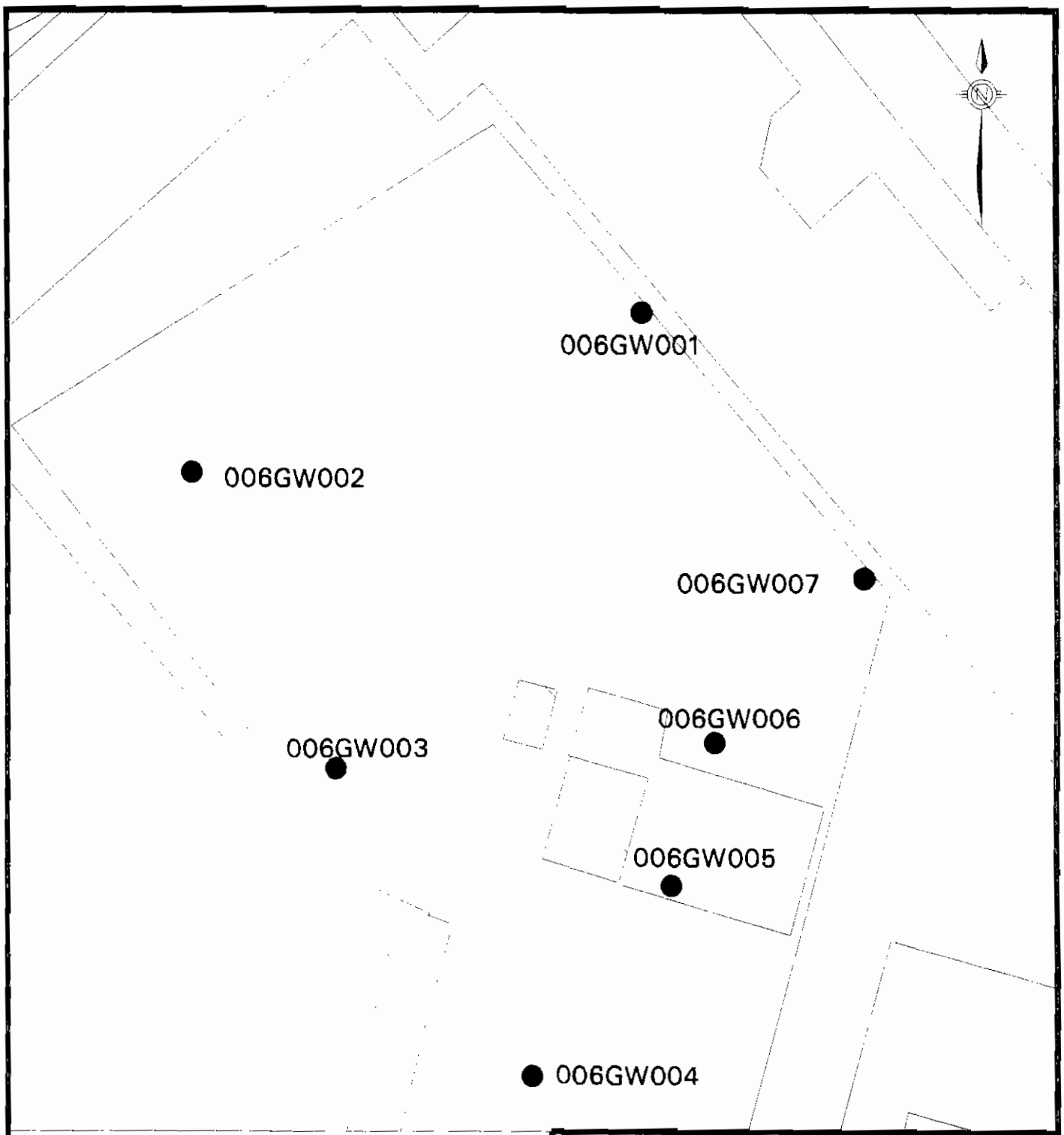
Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S06	B03	alpha-BHC	ND	UG/KG	NA		NA	
S06	B03	beta-BHC	ND	UG/KG	NA		NA	
S06	B03	delta-BHC	ND	UG/KG	NA		NA	
S06	B03	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0184		3.458	
S06	B04	4,4'-DDD	27	UG/KG	NA		0.003	0.06
S06	B04	4,4'-DDE	99	UG/KG	NA		0.016	0.34
S06	B04	4,4'-DDT	200	UG/KG	0.0005	2.67	0.031	0.68
S06	B04	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B04	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B04	Arsenic	8.2	MG/KG	0.0189	97.33	3.030	65.72
S06	B04	Benzo(a)pyrene equiv.	454.55	UG/KG	NA		1.531	33.20
S06	B04	alpha-BHC	ND	UG/KG	NA		NA	
S06	B04	beta-BHC	ND	UG/KG	NA		NA	
S06	B04	delta-BHC	ND	UG/KG	NA		NA	
S06	B04	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0194		4.610	
S06	B05	4,4'-DDD	590	UG/KG	NA		0.065	0.25
S06	B05	4,4'-DDE	1000	UG/KG	NA		0.157	0.60
S06	B05	4,4'-DDT	4200	UG/KG	0.0108	0.64	0.659	2.50
S06	B05	Aroclor 1254	26000	UG/KG	1.6790	99.03	23.985	91.04
S06	B05	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B05	Arsenic	2.4	MG/KG	0.0055	0.33	0.887	3.37
S06	B05	Benzo(a)pyrene equiv.	175.72	UG/KG	NA		0.592	2.25
S06	B05	alpha-BHC	ND	UG/KG	NA		NA	
S06	B05	beta-BHC	ND	UG/KG	NA		NA	
S06	B05	delta-BHC	ND	UG/KG	NA		NA	
S06	B05	gamma-BHC	ND	UG/KG	NA		NA	
		Total			1.6954		26.344	
S06	B06	4,4'-DDD	140	UG/KG	NA		0.015	0.41
S06	B06	4,4'-DDE	170	UG/KG	NA		0.027	0.71
S06	B06	4,4'-DDT	600	UG/KG	0.0015	26.19	0.094	2.49
S06	B06	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B06	Aroclor 1260	2400	UG/KG	NA		2.214	58.62
S06	B06	Arsenic	1.9	MG/KG	0.0044	73.81	0.702	18.59
S06	B06	Benzo(a)pyrene equiv.	215.19	UG/KG	NA		0.725	19.18
S06	B06	alpha-BHC	ND	UG/KG	NA		NA	
S06	B06	beta-BHC	ND	UG/KG	NA		NA	
S06	B06	delta-BHC	ND	UG/KG	NA		NA	
S06	B06	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0059		3.777	
S06	B07	4,4'-DDD	420	UG/KG	NA		0.046	1.34
S06	B07	4,4'-DDE	430	UG/KG	NA		0.067	1.94
S06	B07	4,4'-DDT	2000	UG/KG	0.0052	30.80	0.314	9.04
S06	B07	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B07	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B07	Arsenic	5	MG/KG	0.0115	68.53	1.848	53.25
S06	B07	Benzo(a)pyrene equiv.	350.16	UG/KG	NA		1.179	33.98
S06	B07	alpha-BHC	ND	UG/KG	NA		NA	
S06	B07	beta-BHC	ND	UG/KG	NA		NA	
S06	B07	delta-BHC	ND	UG/KG	NA		NA	
S06	B07	gamma-BHC	26	UG/KG	0.0001	0.67	0.016	0.45
		Total			0.0168		3.470	
S06	B14	4,4'-DDD	ND	UG/KG	NA		NA	
S06	B14	4,4'-DDE	ND	UG/KG	NA		NA	
S06	B14	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B14	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B14	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B14	Arsenic	3.7	MG/KG	0.0085	100.00	1.367	62.06
S06	B14	Benzo(a)pyrene equiv.	248.27	UG/KG	NA		0.836	37.94
S06	B14	alpha-BHC	ND	UG/KG	NA		NA	

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S07	B03	delta-BHC	ND	UG/KG	NA		NA	
S07	B03	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0057		1.367	
S07	B04	4,4'-DDD	180	UG/KG	NA		0.020	0.45
S07	B04	4,4'-DDE	430	UG/KG	NA		0.067	1.52
S07	B04	4,4'-DDT	160	UG/KG	0.0004	1.84	0.025	0.56
S07	B04	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B04	Aroclor 1260	ND	UG/KG	NA		NA	
S07	B04	Arsenic	9.6	MG/KG	0.0221	98.16	3.547	79.86
S07	B04	Benzo(a)pyrene equiv.	232.25	UG/KG	NA		0.782	17.61
S07	B04	alpha-BHC	ND	UG/KG	NA		NA	
S07	B04	beta-BHC	ND	UG/KG	NA		NA	
S07	B04	delta-BHC	ND	UG/KG	NA		NA	
S07	B04	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0225		4.442	
S07	B05	4,4'-DDD	4.2	UG/KG	NA		0.0005	0.03
S07	B05	4,4'-DDE	210	UG/KG	NA		0.033	2.13
S07	B05	4,4'-DDT	110	UG/KG	0.0003	4.38	0.017	1.12
S07	B05	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B05	Aroclor 1260	330	UG/KG	NA		0.304	19.71
S07	B05	Arsenic	2.7	MG/KG	0.0062	95.62	0.998	64.58
S07	B05	Benzo(a)pyrene equiv.	57.065	UG/KG	NA		0.192	12.44
S07	B05	alpha-BHC	ND	UG/KG	NA		NA	
S07	B05	beta-BHC	ND	UG/KG	NA		NA	
S07	B05	delta-BHC	ND	UG/KG	NA		NA	
S07	B05	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0065		1.545	
S07	B06	4,4'-DDD	ND	UG/KG	NA		NA	
S07	B06	4,4'-DDE	240	UG/KG	NA		0.038	0.39
S07	B06	4,4'-DDT	120	UG/KG	0.0003	1.21	0.019	0.20
S07	B06	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B06	Aroclor 1260	550	UG/KG	NA		0.507	5.30
S07	B06	Arsenic	11	MG/KG	0.0253	98.79	4.065	42.46
S07	B06	Benzo(a)pyrene equiv.	1467.2	UG/KG	NA		4.940	51.61
S07	B06	alpha-BHC	ND	UG/KG	NA		NA	
S07	B06	beta-BHC	ND	UG/KG	NA		NA	
S07	B06	delta-BHC	3.8	UG/KG	NA		0.003	0.03
S07	B06	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0256		9.572	
S07	B07	4,4'-DDD	120	UG/KG	NA		0.013	0.18
S07	B07	4,4'-DDE	340	UG/KG	NA		0.053	0.72
S07	B07	4,4'-DDT	65	UG/KG	0.0002	0.45	0.010	0.14
S07	B07	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B07	Aroclor 1260	780	UG/KG	NA		0.720	9.65
S07	B07	Arsenic	16	MG/KG	0.0368	99.55	5.912	79.32
S07	B07	Benzo(a)pyrene equiv.	221.18	UG/KG	NA		0.745	9.99
S07	B07	alpha-BHC	ND	UG/KG	NA		NA	
S07	B07	beta-BHC	ND	UG/KG	NA		NA	
S07	B07	delta-BHC	ND	UG/KG	NA		NA	
S07	B07	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0370		7.453	
S07	B08	4,4'-DDD	110	UG/KG	NA		0.012	0.19
S07	B08	4,4'-DDE	530	UG/KG	NA		0.083	1.31
S07	B08	4,4'-DDT	480	UG/KG	0.0012	6.79	0.075	1.18
S07	B08	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B08	Aroclor 1260	1400	UG/KG	NA		1.292	20.32
S07	B08	Arsenic	7.4	MG/KG	0.0170	93.21	2.734	43.02
S07	B08	Benzo(a)pyrene equiv.	641.41	UG/KG	NA		2.160	33.98
S07	B08	alpha-BHC	ND	UG/KG	NA		NA	
S07	B08	beta-BHC	ND	UG/KG	NA		NA	
S07	B08	delta-BHC	ND	UG/KG	NA		NA	

Table 10.12.33
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
S06	B14	beta-BHC	ND	UG/KG	NA		NA	
S06	B14	delta-BHC	ND	UG/KG	NA		NA	
S06	B14	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0085		2.203	
S06	B15	4,4'-DDD	ND	UG/KG	NA		NA	
S06	B15	4,4'-DDE	ND	UG/KG	NA		NA	
S06	B15	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B15	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B15	Aroclor 1260	970	UG/KG	NA		0.895	9.97
S06	B15	Arsenic	4.8	MG/KG	0.0110	100.00	1.774	19.76
S06	B15	Benzo(a)pyrene equiv.	1873.6	UG/KG	NA		6.309	70.27
S06	B15	alpha-BHC	ND	UG/KG	NA		NA	
S06	B15	beta-BHC	ND	UG/KG	NA		NA	
S06	B15	delta-BHC	ND	UG/KG	NA		NA	
S06	B15	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0110		8.977	
S06	B20	4,4'-DDD	8.2	UG/KG	NA		0.001	0.03
S06	B20	4,4'-DDE	9.9	UG/KG	NA		0.002	0.05
S06	B20	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B20	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B20	Aroclor 1260	420	UG/KG	NA		0.387	13.36
S06	B20	Arsenic	3.7	MG/KG	0.0085	100.00	1.367	47.13
S06	B20	Benzo(a)pyrene equiv.	339.67	UG/KG	NA		1.144	39.43
S06	B20	alpha-BHC	ND	UG/KG	NA		NA	
S06	B20	beta-BHC	ND	UG/KG	NA		NA	
S06	B20	delta-BHC	ND	UG/KG	NA		NA	
S06	B20	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0085		2.901	
S06	B25	4,4'-DDD	13.5	UG/KG	NA		0.001	0.08
S06	B25	4,4'-DDE	49.5	UG/KG	NA		0.008	0.40
S06	B25	4,4'-DDT	36	UG/KG	0.0001	0.89	0.006	0.29
S06	B25	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B25	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B25	Arsenic	4.5	MG/KG	0.0103	98.92	1.663	85.48
S06	B25	Benzo(a)pyrene equiv.	78.05	UG/KG	NA		0.263	13.51
S06	B25	alpha-BHC	ND	UG/KG	NA		NA	
S06	B25	beta-BHC	ND	UG/KG	NA		NA	
S06	B25	delta-BHC	2.4	UG/KG	NA		0.002	0.10
S06	B25	gamma-BHC	4.6	UG/KG	0.0000	0.19	0.003	0.14
		Total			0.0105		1.945	
S06	B26	4,4'-DDD	ND	UG/KG	NA		NA	
S06	B26	4,4'-DDE	ND	UG/KG	NA		NA	
S06	B26	4,4'-DDT	ND	UG/KG	NA		NA	
S06	B26	Aroclor 1254	ND	UG/KG	NA		NA	
S06	B26	Aroclor 1260	ND	UG/KG	NA		NA	
S06	B26	Arsenic	1.6	MG/KG	0.0037	100.00	0.591	100.00
S06	B26	Benzo(a)pyrene equiv.	ND	UG/KG	NA		NA	
S06	B26	alpha-BHC	ND	UG/KG	NA		NA	
S06	B26	beta-BHC	ND	UG/KG	NA		NA	
S06	B26	delta-BHC	ND	UG/KG	NA		NA	
S06	B26	gamma-BHC	ND	UG/KG	NA		NA	
		Total			0.0037		0.591	
S07	B03	4,4'-DDD	5.3	UG/KG	NA		0.001	0.04
S07	B03	4,4'-DDE	28.5	UG/KG	NA		0.004	0.33
S07	B03	4,4'-DDT	18.5	UG/KG	0.00005	0.84	0.003	0.21
S07	B03	Aroclor 1254	ND	UG/KG	NA		NA	
S07	B03	Aroclor 1260	410	UG/KG	NA		0.249	18.23
S07	B03	Arsenic	2.45	MG/KG	0.0056	99.16	0.905	66.24
S07	B03	Benzo(a)pyrene equiv.	60.6725	UG/KG	NA		0.204	14.95
S07	B03	alpha-BHC	ND	UG/KG	NA		NA	
S07	B03	beta-BHC	ND	UG/KG	NA		NA	



LEGEND

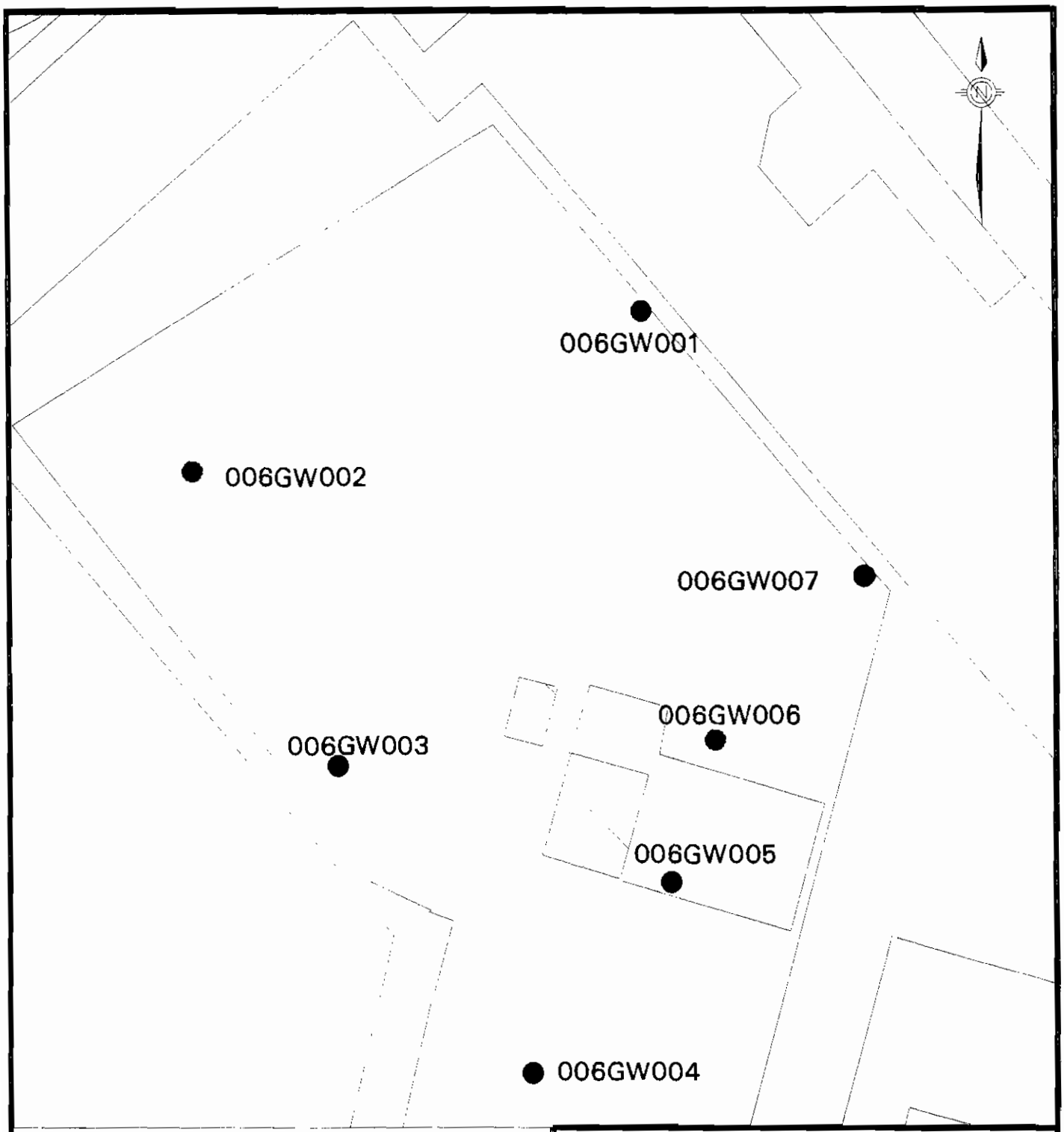
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 100

ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-37
POINT RISK ESTIMATES FOR GROUNDWATER
RESIDENTIAL SCENARIO
SWMU 6, SWMU 7, AOC 635

AML: /home3/projects/charleston_dir/zone_g_dir/risk_air



LEGEND

- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

0 feet 100

ZONE G - RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.12-38
POINT HAZARD ESTIMATES FOR GROUNDWATER
RESIDENTIAL SCENARIO
SWMU 6, SWMU 7, AOC 635

AML: /home3/projects/charleston_dir/zone_g_district_dir

Table 10.12.34 summarizes the risk and hazard contribution of each COPC at each monitoring well location. Arsenic and beryllium are the primary contributors to risk estimates at all seven first-quarter groundwater sample locations. Pentachlorophenol is a secondary contributor to risk estimates associated with the groundwater sample collected from monitoring well 006004. Risk estimates ranged from 2E-04 (006002) and 6E-03 (006003). Arsenic was the primary contributors to hazard index projections above unity at all seven monitoring well locations. Barium was a secondary contributor the hazard index projections associated with groundwater sample collected from monitoring wells 006003 and 006004. Hazard indices ranged from 1 (006002) to 58 (006003).

Groundwater — Site Worker Scenario

Site worker groundwater pathway COCs identified for combined SWMU 6 include arsenic and beryllium. Combined SWMU 6 groundwater is not currently used as a source of potable or process water nor is it anticipated to be used in the future. Risk and hazard projections under the site worker are less conservative than those calculated under the residential site use scenario. Therefore any remedial decisions regarding groundwater should consider the residential risk assessment.

10.12.6.8 Remedial Goal Options

Soil

Risk-based residential RGOs for surface soil were based on the lifetime weighted average risk for the site resident as presented in Table 10.12.35. Risk-based industrial RGOs were based on the site worker. Residential hazard-based RGOs were calculated based on the child resident and industrial hazard-based RGOs were calculated based on the site worker.

Table 10.12.34
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Hazard Index	% HI	Risk (E-06)	% Risk
006	001	Arsenic (As)	8.5	UG/L	1.6113	96.42	189.6282	67.93
006	001	Barium (Ba)	54	UG/L	0.0493	2.63	NA	
006	001	Beryllium (Be)	1.4	UG/L	0.0179	0.95	89.5342	32.07
006	001	Pentachlorophenol	ND	UG/L	NA		NA	
006	001	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			1.6785		279.1624	
006	002	Arsenic (As)	6.1	UG/L	1.2998	96.27	136.0861	63.94
006	002	Barium (Ba)	38.4	UG/L	0.0351	2.60	NA	
006	002	Beryllium (Be)	1.2	UG/L	0.0153	1.14	76.7436	36.06
006	002	Pentachlorophenol	ND	UG/L	NA		NA	
006	002	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			1.3503		212.8297	
006	003	Arsenic (As)	269	UG/L	57.3212	99.50	6001.1742	99.03
006	003	Barium (Ba)	302	UG/L	0.2758	0.48	NA	
006	003	Beryllium (Be)	0.92	UG/L	0.0118	0.02	58.8368	0.97
006	003	Pentachlorophenol	ND	UG/L	NA		NA	
006	003	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			57.6087		6060.0110	
006	004	Arsenic (As)	21.7	UG/L	4.6240	95.73	484.1096	88.32
006	004	Barium (Ba)	208	UG/L	0.1900	3.93	NA	
006	004	Beryllium (Be)	0.945	UG/L	0.0121	0.25	60.4356	11.03
006	004	Pentachlorophenol	2	UG/L	0.0043	0.09	3.5695	0.65
006	004	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			4.8303		548.1147	
006	005	Arsenic (As)	7.2	UG/L	1.5342	96.75	160.6262	69.54
006	005	Barium (Ba)	41	UG/L	0.0374	2.36	NA	
006	005	Beryllium (Be)	1.1	UG/L	0.0141	0.69	70.3483	30.46
006	005	Pentachlorophenol	ND	UG/L	NA		NA	
006	005	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			1.5858		230.9746	
006	006	Arsenic (As)	10.1	UG/L	2.1522	97.06	225.3229	71.56
006	006	Barium (Ba)	51.7	UG/L	0.0472	2.13	NA	
006	006	Beryllium (Be)	1.4	UG/L	0.0179	0.81	89.5342	28.44
006	006	Pentachlorophenol	ND	UG/L	NA		NA	
006	006	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			2.2173		314.8571	
006	007	Arsenic (As)	17.8	UG/L	3.7930	99.50	397.1037	94.52
006	007	Barium (Ba)	15.7	UG/L	0.0143	0.38	NA	
006	007	Beryllium (Be)	0.36	UG/L	0.0046	0.12	23.0231	5.48
006	007	Pentachlorophenol	ND	UG/L	NA		NA	
006	007	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			3.8119		420.1268	

Table 10.12.35
Remedial Goal Options Surface Soil
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Residential-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 1E-06 mg/kg	1E-05 mg/kg	1E-04 mg/kg	Background Concentration mg/kg
Inorganics										
Arsenic	1.5	0.0003	11.9	66	22	2.2	0.38	3.8	38	17.2
Manganese	NA	0.047	169	9025	3008	301	ND	ND	ND	325
Thallium	NA	8E-05	0.89	18	5.8	0.58	ND	ND	ND	0.85
Semivolatile Organics										
Benzo(a)pyrene Equivalents	7.3	NA	1.9	ND	ND	ND	0.060	0.60	6.0	NA
Pesticides/PCBs/Dioxin										
Aroclor 1254	2	2E-05	0.58	3.6	1.2	0.12	0.22	2.2	22	NA
Aroclor 1260	2	NA	6.1	ND	ND	ND	0.22	2.2	22	NA
4,4'-DDD	0.24	NA	11.2	ND	ND	ND	1.8	18	184	NA
4,4'-DDE	0.34	NA	3.3	ND	ND	ND	1.3	13	130	NA
4,4'-DDT	0.34	0.0005	11.0	ND	ND	ND	1.3	13	130	NA
Dioxin equivalents	150000	NA	0.0010	ND	ND	ND	0.0000029	0.000029	0.00029	NA

Worker-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 1E-06 mg/kg	1E-05 mg/kg	1E-04 mg/kg	Background Concentration mg/kg
Inorganics										
Arsenic	1.5	0.0003	11.9	1305	435	43	2.7	27	270	17.2
Semivolatile Organics										
Benzo(a)pyrene Equivalents	7.3	NA	1.9	ND	ND	ND	0.30	3.0	30	NA
Pesticides/PCBs/Dioxin										
Aroclor 1260	2	NA	6.1	ND	ND	ND	1.1	11	108	NA
4,4'-DDT	0.34	0.0005	11.0	3066	1022	102	6.4	64	638	NA
Dioxin equivalents	150000	NA	0.0010	ND	ND	ND	0.000014	0.00014	0.0014	NA

NOTES:
EPC Exposure point concentration
NA Not applicable
ND Not determined
- Remedial goal options were based on the residential lifetime weighted average for carcinogens and the child resident or site worker for noncarcinogens

Groundwater

Risk-based residential RGOs for groundwater were based on the lifetime weighted average risk for the site resident as shown in Table 10.12.36. Risk-based industrial RGOs were based on the site worker. Residential hazard-based RGOs were calculated based on the child resident and industrial hazard-based RGOs were calculated based on the site worker.

10.12.7 Corrective Measures Considerations

Based on the analytical results and the human health risk assessment for SMWU 6, SMWU 7, and AOC 635. COCs requiring further evaluation through the CMS process have been identified for surface soil and groundwater. The site is currently in an urban setting and risk to human health was evaluated under both the residential and industrial (site worker) scenarios for incidental ingestion, dermal contact, and inhalation exposure pathways. Hazard was evaluated for noncarcinogenic contaminants through incidental ingestion, dermal contact, and inhalation scenarios as well.

As recommended by SCDHEC, a COC is considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, and whose individual risk exceeds 1E-06 or whose hazard quotient exceeds 0.1.

Antimony, Aroclor-1254, Aroclor-1260, arsenic, BEQs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dioxin, and thallium were identified as soil pathway COCs for the combined area of SMWU 6, SMWU 7, and AOC 635. Arsenic and beryllium were identified as groundwater pathway COCs for the combined area of SMWU 6, SMWU 7, and AOC 635. Table 10.12.37 presents cumulative and COC-specific exposure risks and hazard quotients.

Table 10.12.36
Remedial Goal Options Groundwater
SWMU 6, SWMU 7, and AOC 635
NAVBASE - Charleston, Zone G
Charleston, South Carolina

Residential-Based Remedial Goal Options

Chemical	Oral SF (mg/kg-day)-1	Oral RfD (mg/kg-day)	EPC mg/l	Hazard-Based Remedial Goal Options 0.1 mg/l	1.0 mg/l	3 mg/l	Risk-Based Remedial Goal Options 1E-06 mg/l	1E-05 mg/l	1E-04 mg/l	Background Concentration mg/l	MCL mg/l
Inorganics											
Arsenic (As)	1.5	0.0003	0.269	0.00047	0.0047	0.014	0.000044	0.00044	0.0044	0.178	0.05
Barium (Ba)	NA	0.07	0.302	0.11	1.1	3.3	ND	ND	ND	0.316	2
Beryllium (Be)	4.3	0.005	0.0014	0.0078	0.078	0.23	0.000015	0.00015	0.0015	NA	0.004
Semivolatile Organics											
Pentachlorophenol	0.12	0.03	0.002	0.047	0.47	1.41	0.00055	0.0055	0.055	NA	0.001

NOTES:
EPC Exposure point concentration
NA Not applicable
ND Not determined
- Remedial goal options were based on the residential lifetime weighted average for carcinogens and the child resident or site worker for noncarcinogens

Risk-based remedial goals for the COCs at combined area of SMWU 6, SMWU 7, and AOC 635 for soil and groundwater are presented in Tables 10.12.35 and 10.12.36, respectively. Potential corrective measures are presented in Table 10.12.38.

Table 10.12.37
Zone G
SWMUs 6, 7 and AOC 635
Cumulative and Chemical-Specific Exposure Risks and Hazard

	Risk		Hazard	
Chemical	**Industrial**	**Residential**	**Industrial**	**Residential**
Soil				
Antimony	ND	ND	.0076	0.15
Aroclor-1254	5.3E-07	2.6E-06	0.037	0.48
Aroclor-1260	3.6E-06	2.8E-05	ND	ND
Arsenic	4.4E-06	3.1E-05	0.027	0.547
BEQs	6.5E-06	3.2E-05	ND	ND
4,4'-DDD	1.2E-06	6.1E-06	ND	ND
4,4'-DDE	5.2E-07	2.6E-06	ND	ND
4,4'-DDT	1.8E-06	8.4E-06	0.011	0.28
Dioxin	7.1E-05	3.5E-04	ND	ND
Thallium	ND	ND	.0076	0.15
Cumulative	9.2E-05	4.6E-04	0.11	1.8
Groundwater				
Arsenic	1.4E-03	6.1E-03	8.8	57
Beryllium	2.1E-05	9.1E-05	.0027	0.018
Cumulative	1.4E-03	6.1E-03	8.8	57.3

Note:
ND = Not Determined

Table 10.12.38
Zone G
SWMUs 6, 7 and AOC 635
Potential Corrective Measures

Medium	Compounds	Potential Corrective Measures
Soil	Antimony, Aroclor-1254, Aroclor-1260, Arsenic, BEQs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Dioxin, and Thallium	a) No Action b) Excavate, offsite disposal, and monitoring c) Containment/Capping d) Ex-situ, chemical/physical treatment
Groundwater	Arsenic and Beryllium	a) No Action b) Monitoring c) Ex-situ physical/chemical treatment and discharge to POTW d) Ex-situ physical/chemical treatment and discharge through NPDES permitting