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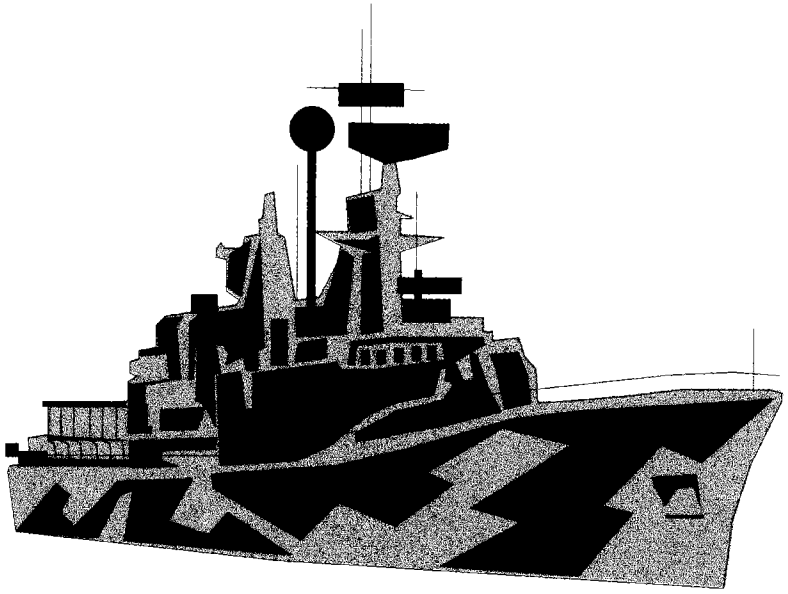
CNC CHARLESTON
5090.3a

RESOURCE CONSERVATION AND RECOVERY INVESTIGATION RESULTS ZONE H CNC CHARLESTON SC
2/13/1996
SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Zone H
RCRA Facility Investigation Results

Naval Base Charleston



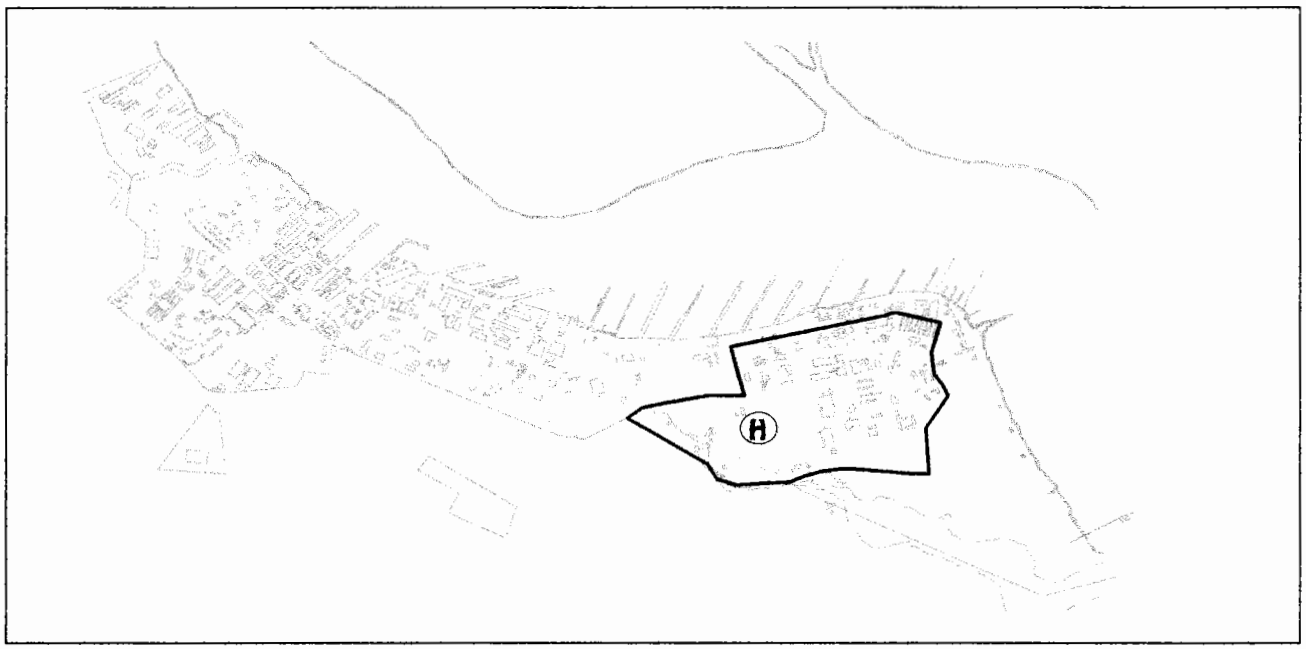
Presented by: EnSafe/Allen&Hoshall

February 13, 1996

ACRONYMS

AOC	Area of Concern
BaP	Benzo(a)pyrene equivalents
BRA	Baseline Risk Assessment
CMS	Corrective Measures Study
COC	Chemical of Concern
COPC	Chemical of Potential Concern
DHEC	South Carolina Department of Health and Environmental Control
EOD	Explosive Ordnance Disposal
EPA	U. S. Environmental Protection Agency
HI	Hazard Index
HQ	Hazard Quotient
ILCR	Incremental lifetime excess cancer risk
NFA	No Further Action
NNPA	N-nitroso-di-n-propylamine
PCB	Polychlorinated Biphenyl
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound

Zone H Overview



Location

- Zone H is in the southern portion of the peninsula formed by Shipyard Creek and the Cooper River.

Reuse

- Identified for transfer to the State Department, Naval Support Activities, training areas, and administrative areas.

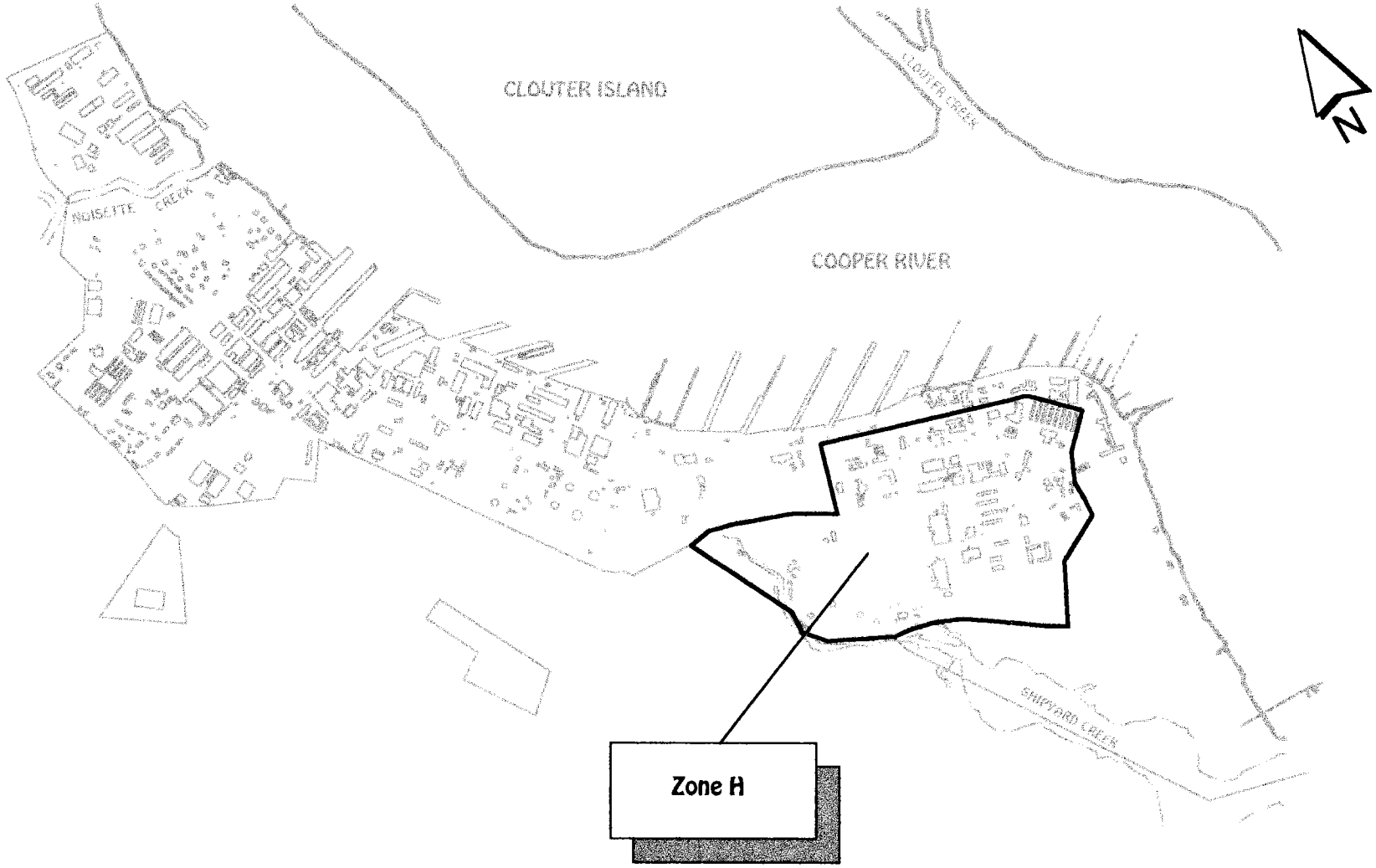
Purpose of Investigation

- To evaluate the nature and extent of hazardous wastes and to identify, develop and implement appropriate corrective measures to protect human health and the environment.

Sampling Approach

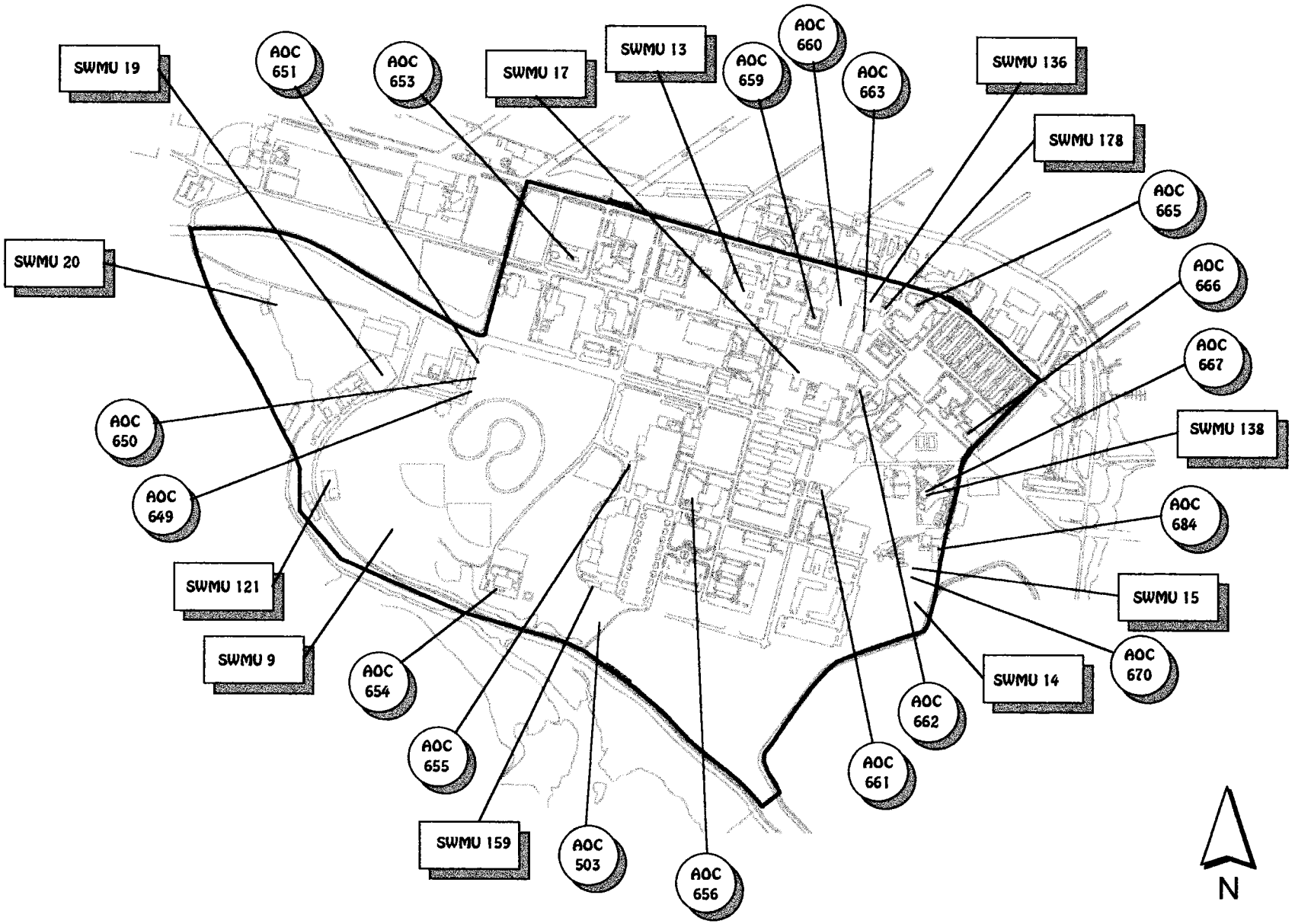
- 12 Solid Waste Management Units
- 18 Areas Of Concern
- 714 soil samples, 119 water samples

Charleston Naval Shipyard



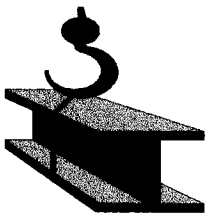
I-3

Zone H AOCs/SWMUs



Common Contaminant Categories

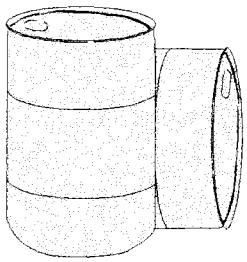
Metals



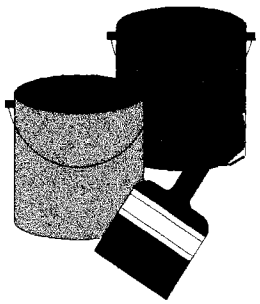
Metals are naturally occuring elements that are generally flexible and good conductors of electricity. These properties, along with the relative abundance of metals, make them valuable materials in industrial and manufacturing processes. Household items that commonly contain metals include paint and enamel, batteries, coins, and electrical components.

Pesticides, Herbicides, & PCBs

Pesticides are chemicals used to eliminate insects and other pests. Herbicides are chemicals used to kill unwanted plants or weeds. PCBs, or Polychlorinated Biphenyls, are industrial compounds that are used as insulating and heat exchange fluids in electrical transformers, and are found in hydraulic fluids used in electrical components and systems.



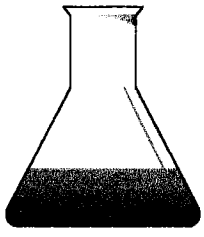
Semivolatile Organic Compounds



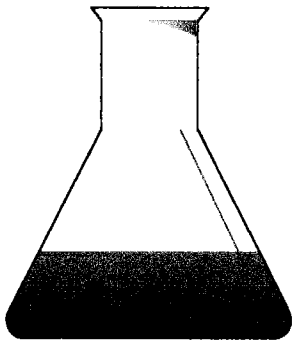
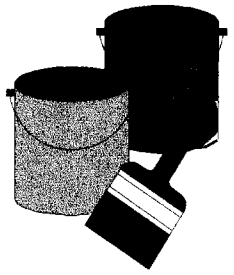
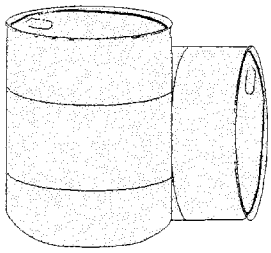
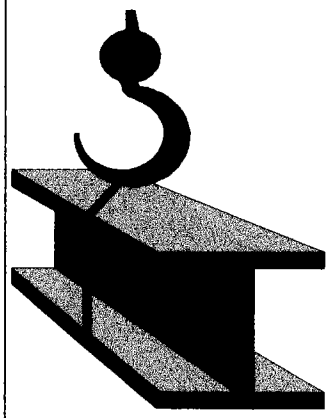
Semivolatile Organic Compounds, also called SVOCs, are common components of asphalt, coal tar, and pitch. Some SVOCs are components of diesel, jet fuel, waste oil, and hydraulic oil. A commonly used household SVOC is naphthalene, which is the main ingredient in many furniture refinishing products including paints, stains, finishes and varnish thinner.

Volatile Organic Compounds

Volatile Organic Compounds, also called VOCs, are commonly used chemicals. Many VOCs are solvents, which are liquid compounds used to dissolve other substances. Ordinary household solvents include paint thinner and mineral spirits. Other household products that contain VOCs include hair spray, nail polish remover, air fresheners, and oven cleaners.



Zone H Chemicals of Concern (COCs)

	Contaminant	Category
	1,2,4-Trichlorobenzene (1,2,4-TCB)	VOC
	1,4-Dichlorobenzene (1,4-DCB)	VOC
	Chlorobenzene	VOC
	Chloroform	VOC
	Chloromethane	VOC
	Hexachlorobenzene	VOC
	Vinyl chloride	VOC
	BEHP	SVOC
	Benzidine	SVOC
	Benzo(a)pyrene equivalents (BaP)	SVOC
	Dioxins/Furans (2,3,7,8-TCDD equivalents)	SVOC
	N-nitroso-di-n-propylamine (NNPA)	SVOC
	4,4'-DDE	Pesticide
	Chlordane	Pesticide
	Dieldrin	Pesticide
	Heptachlor Epoxide	Pesticide
	PCBs (Aroclor-1248, -1254, -1260)	PCB
	Aluminum	Metal
	Arsenic	Metal
	Beryllium	Metal
	Copper	Metal
	Manganese	Metal
	Mercury	Metal
	Thallium	Metal
	Vanadium	Metal

Note: This table includes only COCs that are primary contributors to Risk/Hazard.

Groupings of Sites

Grouping 1 - Landfill

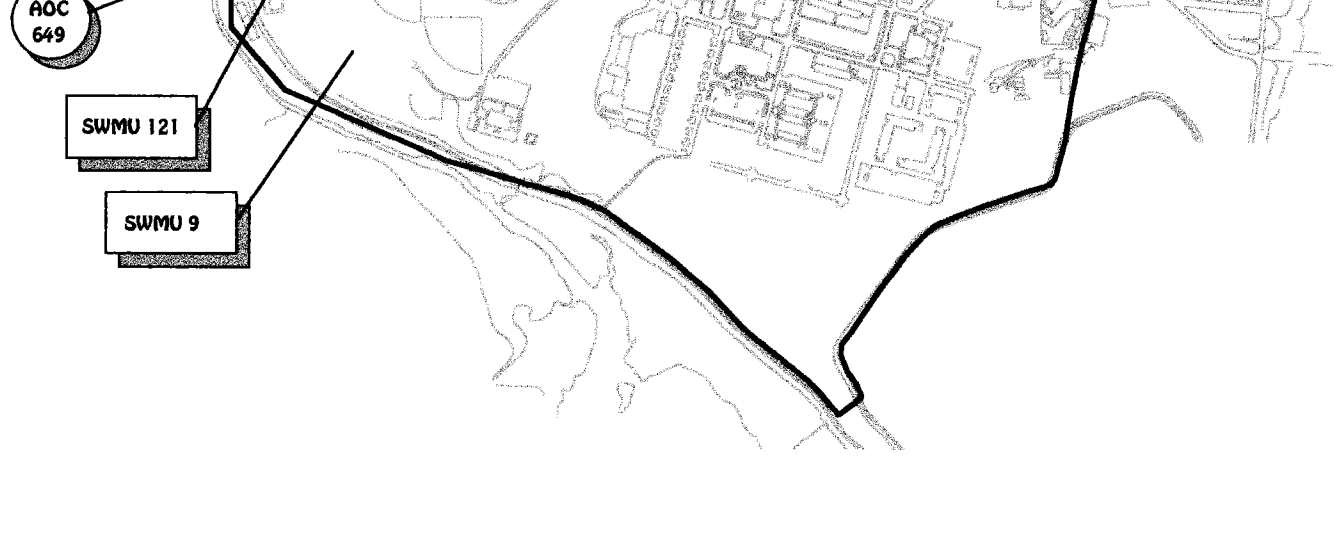
Grouping 2 - Petroleum Sites

Grouping 3 - Chemical Disposal Area

Grouping 4 - Submarine Training Facility

Grouping 5 - Unexploded Ordnance (UXO)

Grouping 6 - Sites Recommended for No Further Action



Zone H RFI Results - 2/13/96

Grouping 1 - Landfill

Site #	Site Description	Samples Collected
SWMU 9	Closed Landfill	Soil (11) Sediment (15)
SWMU 19	Solid Waste Transfer Station	Soil (20)
SWMU 20	Waste Disposal Area	Soil (12)
SWMU 121	Satellite Accumulation Area	Soil (18)
AOC 649	Storage Area	Soil (20)
AOC 650	Storage Area	
AOC 651	Storage Area	
Total water samples collected		Groundwater (29) Surface Water (4)

Grouping 1 - SWMU 9

Primary Contributors to Risk/Hazard

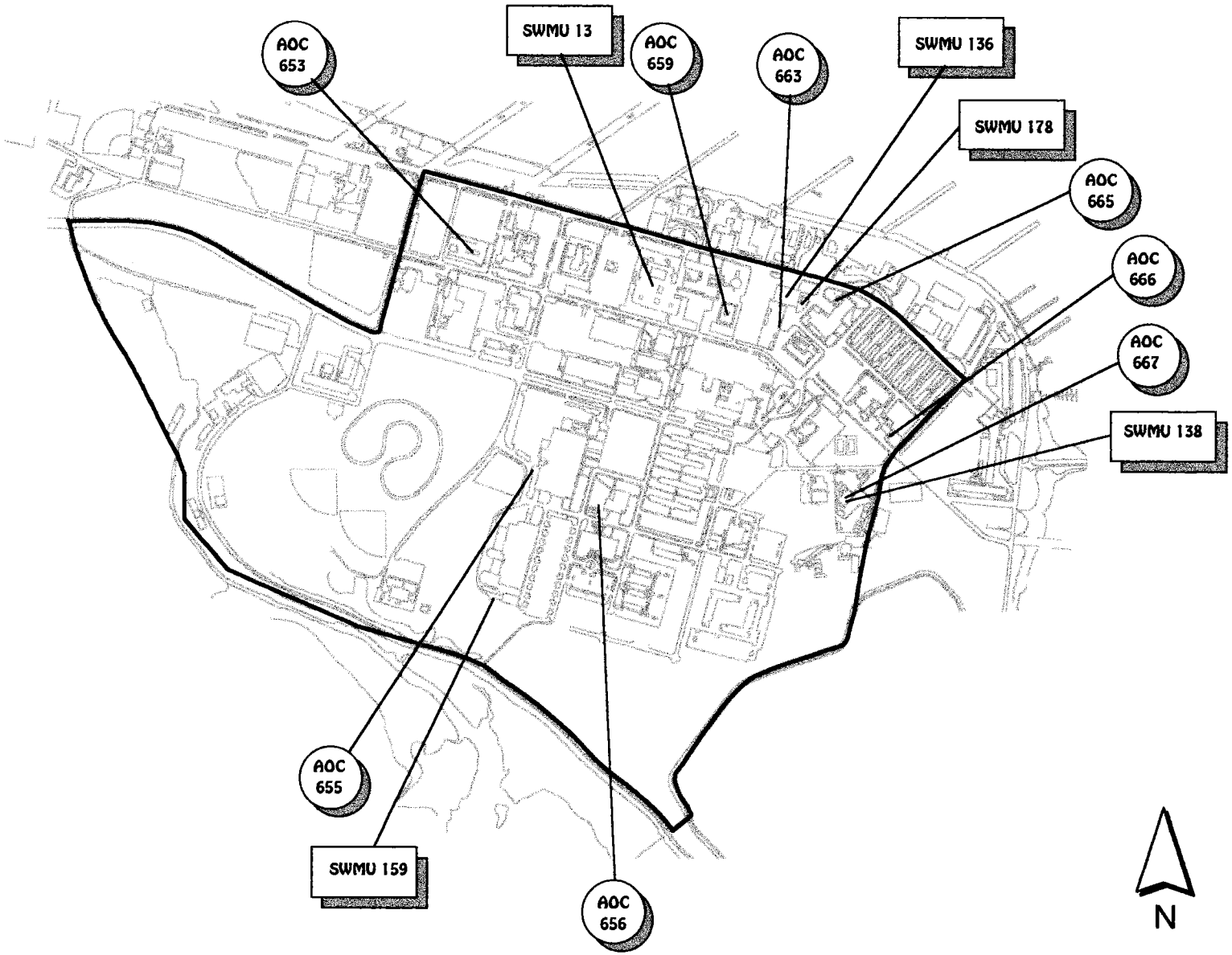
Soil:
- Arsenic
- Benzo(a)pyrene Equivalents
- Beryllium
- Copper
- Polychlorinated Byphenols (PCBs)

Groundwater:
- Aluminum
- Benzidine
- Chloroform
- Hexachlorobenzene
- Manganese
- Thallium
- Vinyl chloride

- Soil Boring
- Monitoring Well
- Temporary Monitoring Well
- Trench

N

Grouping 2 - Petroleum Sites



Grouping 2 - Petroleum Sites

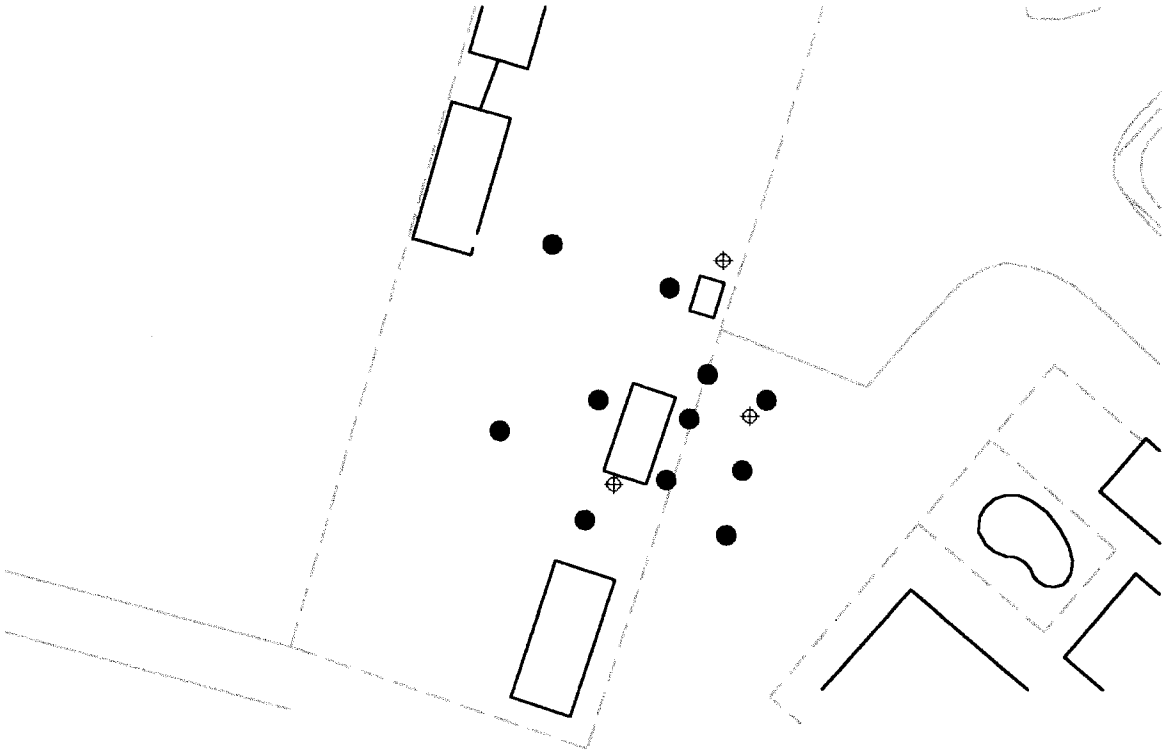
Site #	Site Description	Samples Collected
SWMU 13	Current Fire Fighter Training Area	Soil (49) Groundwater (9)
SWMU 136	Bldg. NS-53 - Satellite Accumulation Area 19	Soil (14) Groundwater (3)
AOC 663	Gas/Diesel Pumping Station - Bldg. 851	
SWMU 138	Satellite Accumulation Area - Bldg. 1776	Soil (14) Groundwater (2)
AOC 667	Vehicle Maintenance Area - Bldg. 1776	
SWMU 159	Satellite Accumulation Area - Bldg. 665	Soil (19) Sediment (2) Surface Water (1)
SWMU 178	Site of Apparent Transformer Fire	Soil (12) Groundwater (2)
AOC 653	Hobby Shop - Bldg. 1508	Soil (14) Groundwater (2)
AOC 655	Oil Spill Area - Bldg. 656	Soil (21) Groundwater (3)
AOC 656	Petroleum Spill between Bldgs. 602 and NS-71	Soil (18) Groundwater (3)
AOC 659	Diesel Storage - Bldg. 14	Soil (8)
AOC 665	Pyrotechnic Storage - Bldg. 159	Soil (8)
AOC 666	Fuel Storage - Bldg. NS 45	Soil (13) Groundwater (2)

Grouping 2 - AOC 663/SWMU 136

Primary Contributors to Risk/Hazard

Soil:
- Aluminum
- Arsenic
- Benzo(a)pyrene Equivalents
- Polychlorinated Byphenols (PCBs)
- 4,4'-DDE

Shallow Groundwater:
- 2,3,7,8-TCDD Equivalents

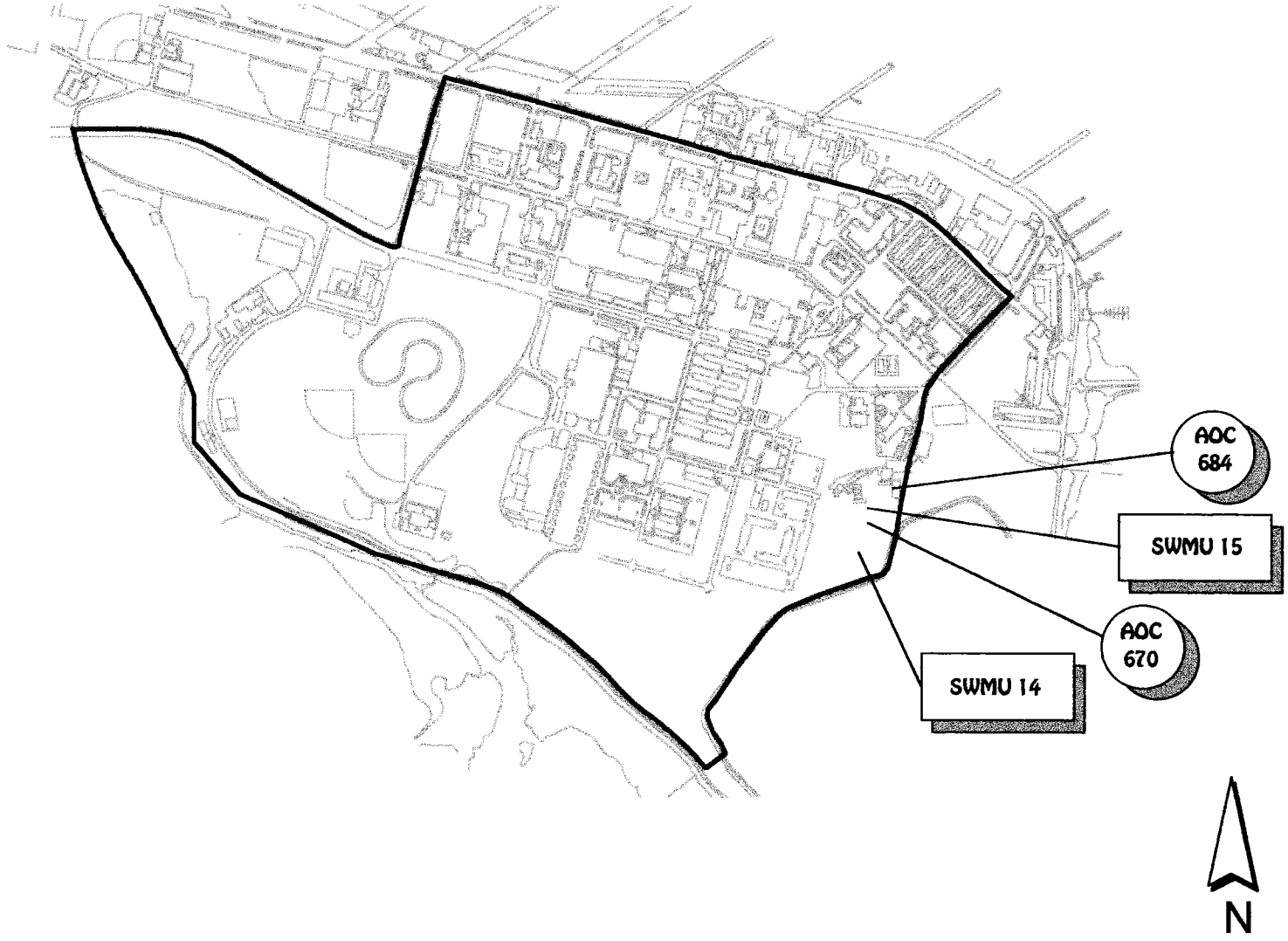


● Soil Boring

⊕ Monitoring Well

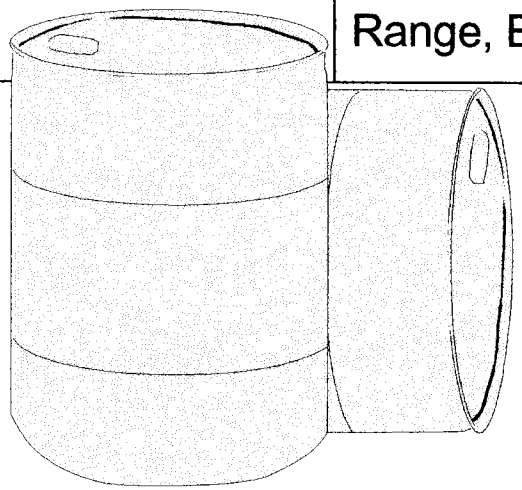
N

Grouping 3 - Chemical Disposal Area



Grouping 3 - Chemical Disposal Area

Site #	Site Description	Samples Collected
SWMU 14	Chemical Disposal Area	Soil (175) Sediment (4) Groundwater (10) Surface water (1)
SWMU 15	Incinerator	
AOC 670	Former Skeet Range, South of Bldg. 1897	
AOC 684	Former Outdoor Pistol Range, Bldg. 1888	



Grouping 3 - SWMU 14

Primary Contributors to Risk/Hazard

Soil:

- Arsenic
- Benzo(a)pyrene Equivalents
- Beryllium

Groundwater:

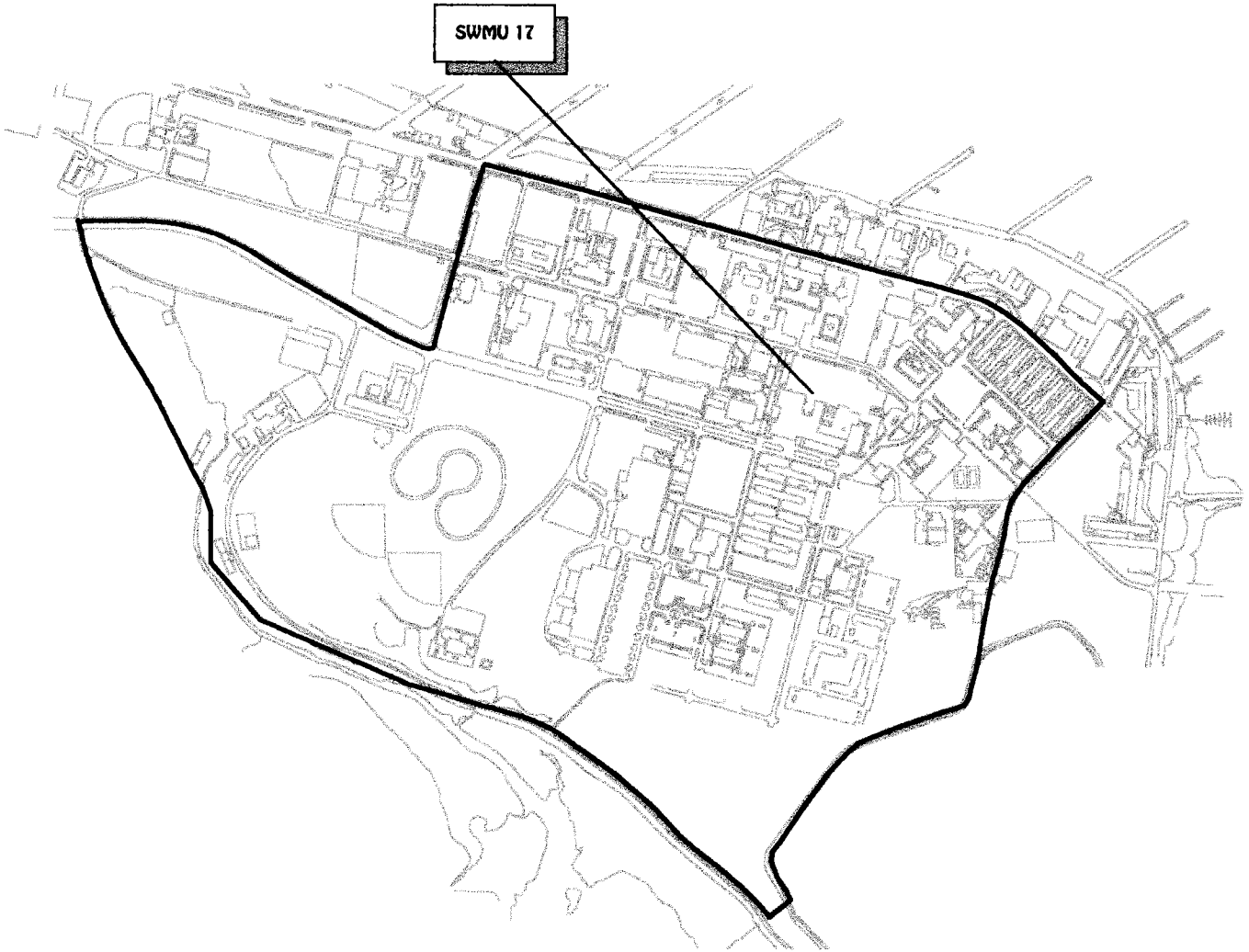
- Aluminum
- BEHP
- 2,3,7,8-TCDD Equivalents
- Heptachlor epoxide

● Soil Boring

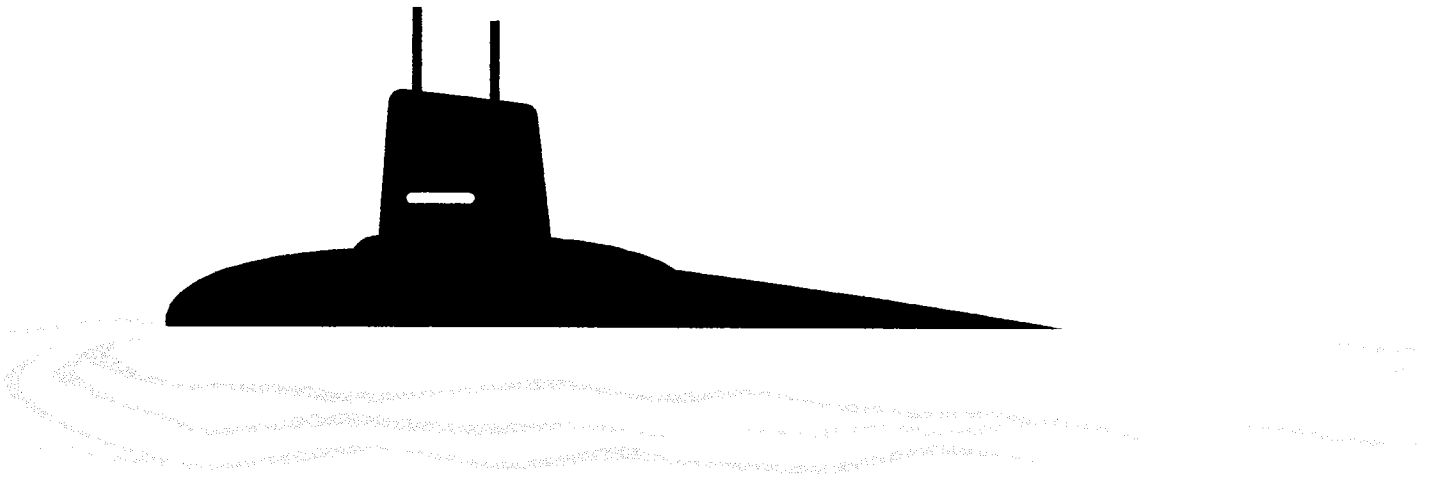
⊕ Monitoring Well

N

Grouping 4 - Submarine Training Facility



Grouping 4 - Submarine Training Facility



Site #	Site Description	Samples Collected
SWMU 17	Oil Spill Area	Soil (65) Groundwater (6)

Grouping 4 - SWMU 17

Primary Contributors to Risk/Hazard

Soil:

Benzo(a)pyrene Equivalents
Polyclorinated Byphenols (PCBs)

Shallow Groundwater:

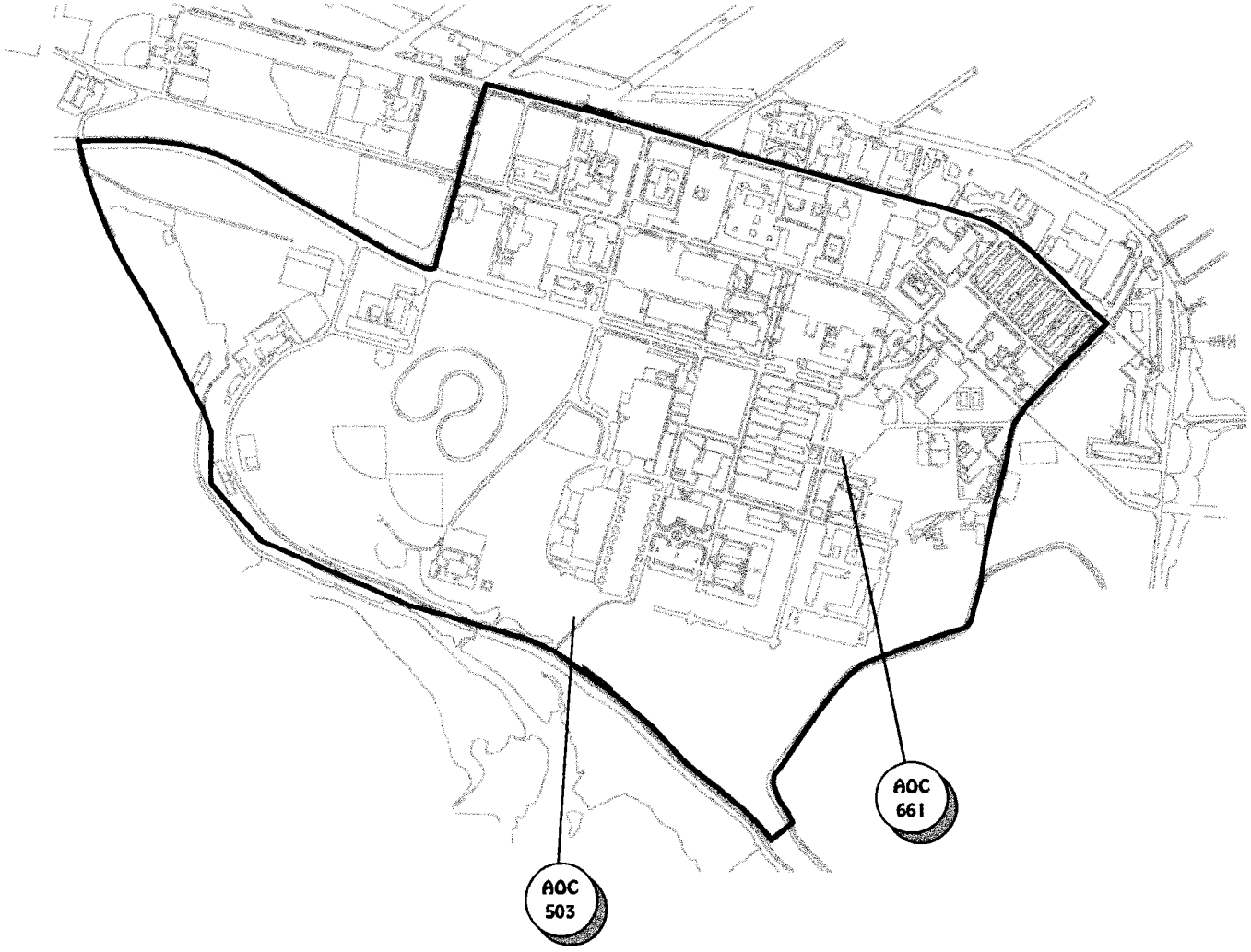
Benzidine
Chlorobenzene
1,4-Dichlorobenzene
1,2,4-Trichlorobenzene

● Soil Boring

⊕ Monitoring Well

N

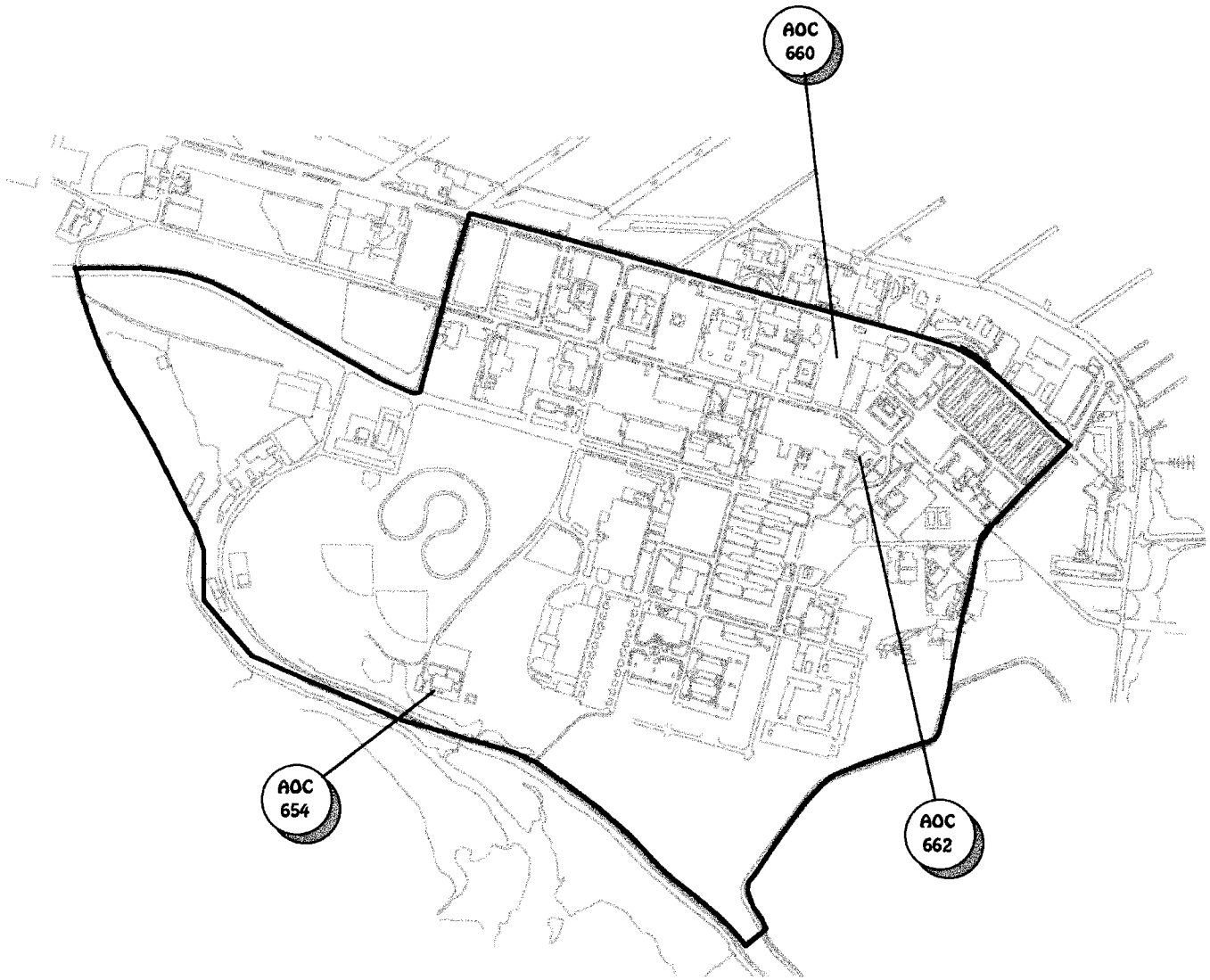
Grouping 5 - Unexploded Ordnance (UXO)



Grouping 5 - Unexploded Ordnance (UXO)

Site #	Site Description	Samples Collected
AOC 503	UXO Site South of Bldg. 665	* None
AOC 661	Explosives Storage	* None
*Awaiting clearance by Navy Explosives Ordnance Disposal (EOD)		

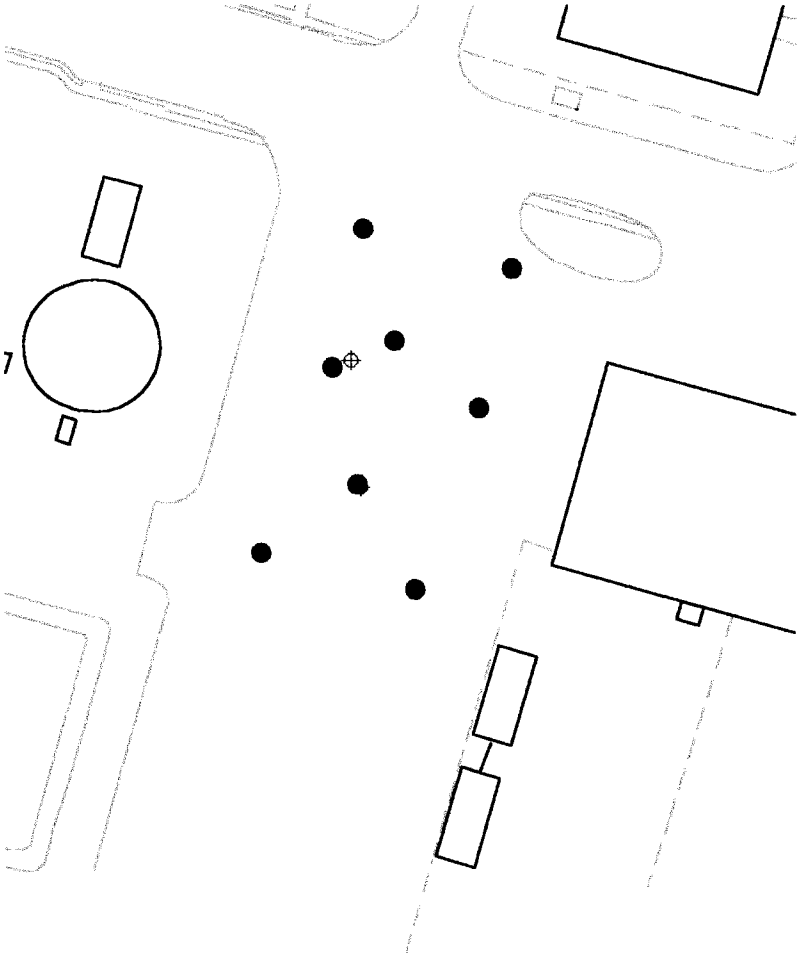
Grouping 6 - Sites Recommended for No Further Action



Grouping 6 - Sites Recommended for No Further Action

Site #	Site Description	Samples Collected
AOC 654	Septic Tank and Drain Field	Soil (11)
AOC 660	Mosquito Control	Soil (10) Groundwater (2)
AOC 662	Former Gasoline Station	Soil (8) Groundwater (2)

Grouping 6 - AOC 660



Primary Contributors to Risk/Hazard

Soil:
None

Shallow Groundwater:
None

Soil Boring

Monitoring Well

N

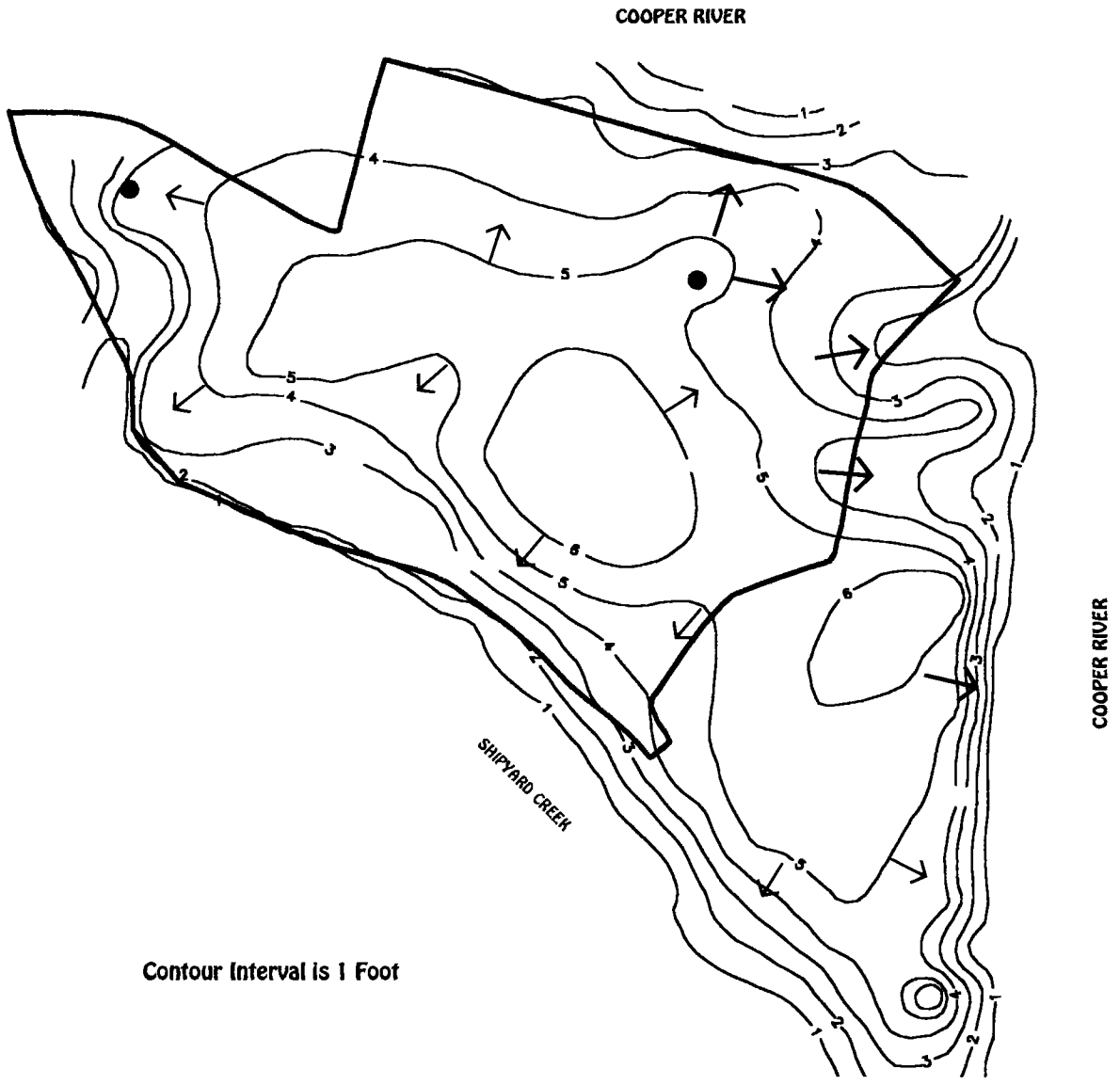
Groundwater Monitoring Network

Zone H Results - 2/13/96

Groundwater - COCs

Area of Significant Impact	Site Description	COCs Driving Risk
SWMU 9	Closed Landfill	Arsenic Benzidine Hexachlorobenzene Vinyl Chloride
SWMU 17	Submarine Training Facility (Site of Oil Spill)	Benzidine Chlorobenzene 1,4-Dichlorobenzene 1,2,4-Trichlorobenzene

Zone H Groundwater Flow



Review of Risk

There is no such thing as ZERO risk.

Risk Assessment: Methods to evaluate risk

STEP 1 . . . . . Hazard Identification

Collect samples. Analyze for type and concentration of contaminants.

STEP 2 . . . . . Exposure Assessment

Will people come into contact with the hazard? And if so, who? how? how often? and why?

STEP 3 . . . . . Toxicity Assessment

What is harmful about the chemical? Is it carcinogenic or non-carcinogenic?

STEP 4 . . . . . Risk Characterization

Determine if potential exposures are great enough to cause human health problems.

Risk Management: How to manage risk

Question 1 . . . . Should cleanup be undertaken?

Question 2 . . . . What should cleanup levels be?

Question 3 . . . . What cleanup methods should, or can be used?

Review of Risk (cont'd)

Carcinogenic Risk

- Potential to cause cancer.
- Risk estimated as probability of getting cancer from exposure.
  - ✓ 1 in 10,000 risk = 10(-4) or 1E-4
  - ✓ 1 in a million (1,000,000) = 10(-6) or 1E-6

Non-carcinogenic Risk (Toxicity)

- Health effects other than cancer.
- Risk is compared to a calculated value called a hazard index or hazard quotient.
  - ✓ $\frac{\text{Intake}}{\text{Reference Dose}}$ = Hazard Quotient (HQ)
  - ✓ Sum of Hazard Quotients = Hazard Index (HI)

Review of Risk (cont'd)

Carcinogenic Risk

- ✓ < 10(-6) EPA/DHEC generally doesn't require action.
- ✓ >10(-4) EPA/DHEC generally requires action.
- ✓ Risk Management: EPA/DHEC must consider many factors that may influence risk such as:
  - ▲ Who will be affected and how?
  - ▲ Future site use.
  - ▲ Existing features (e.g., buildings).
  - ▲ Probability of exposure.

Non-carcinogenic Risk (Toxicity)

- ✓ A hazard index < 1 indicates that no toxic effect is likely.
- ✓ A hazard index >1 indicates that a toxic effect is likely, typically in sensitive individuals.
- ✓ Example of a Conservative Assumption:

Chemical 1:	HQ = 0.7	- lungs
Chemical 2:	HQ = 0.2	- kidney
Chemical 3:	HQ = 0.2	- mucus membrane
	HI = 1.1	

(Although no organ specific HQ is > 1, assume an overall toxic effect is possible.)

Summary of Groundwater COCs
Naval Base Charleston Zone H
Charleston, South Carolina

Chemical	SWMU 9 GROUP	SWMU 14 GROUP	SWMU 13	SWMU 17	AOC 663/ SWMU 136	AOC 667/ SWMU 138	SWMU 178	AOC 653	AOC 655	AOC 656	AOC 660	AOC 662	AOC 666
Volatile Organic Compounds													
1,2,4-Trichlorobenzene				1,2									
1,2-Dichlorobenzene				1,2									
1,2-Dichloroethane	1,2												
1,2-Dichloroethene (total)													
1,3-Dichlorobenzene				1,2									
1,4-Dichlorobenzene	1,2			1,2									
Benzene	1,2				2								
Bis(2-Chloroethyl)ether	1												
Carbon disulfide	1												
Chlorobenzene	1,2			1,2									
Chloroform	1	1											
Chloromethane													1
Ethylbenzene													
Hexachlorobenzene	2												
Hexachlorobutadiene	2												
Hexachlorocyclopentadiene	1												
Hexachloroethane	2												
Methylene chloride	2												
Trichloroethene													
Vanadium													
Vinyl chloride	1,2												1
Semivolatile Organic Compounds													
2,4-Dimethylphenol	1,2												
2-Methylphenol													
4-Methylphenol	1,2												
Azobenzene	1												
BEHP		1											
Benzidine	1			1									
Pentachlorophenol	1												
Chlorinated Pesticides													
Chlordane									1,2				
Heptachlor epoxide		1											
Dioxins/Furans													
2,3,7,8-TCDD equivalents	1	1			1					1			
Metals													
Aluminum		1,2											
Antimony	1												
Arsenic	2							2	1,2				
Barium	1,2												
Beryllium	2		2										
Cadmium	1,2	2											
Chromium (+III)				2									
Copper													
Lead	1												
Manganese	1,2												
Thallium	1	1											
Vanadium		1,2											

NOTES:

1 indicates the COC was detected in first quarter samples.

2 indicates the COC was detected in second quarter samples.

Summary of Surface Soil COCs
Naval Base Charleston Zone H
Charleston, South Carolina

	SWMU 9 GROUP						SWMU 14 GROUP																	
Chemical	SWMU 19	SWMU 20	SWMU 121	AOC 649	AOC 650	AOC 654	SWMU 14	SWMU 15	AOC 670	AOC 684	SWMU 13	SWMU 17	AOC 663/ SWMU 136	AOC 667/ SWMU 138	SWMU 159	SWMU 178	AOC 653	AOC 655	AOC 656	AOC 659	AOC 660	AOC 662	AOC 665	AOC 666
Volatile Organic Compounds																								
1,1-Dichloroethene (soil to air)	X																							
1,2,3-Trichloropropane (soil to air)							X																	
Semivolatile Organic Compounds																								
Benzo(a)pyrene Equiv.	X	X	X	X	X		X	X	X	X		X	X	X	X	X		X	X				X	X
N-Nitroso-di-n-propylamine																								X
Polychlorinated Biphenyls																								
Aroclor-1248			X																					
Aroclor-1254	X		X		X								X					X						
Aroclor-1260	X		X									X						X						X
Chlorinated Pesticides																								
4,4'-DDE													X											
Dieldrin																		X						
Metals																								
Aluminum							X		X				X											
Antimony	X		X						X	X														
Arsenic	X		X				X	X	X	X			X											X
Beryllium	X		X				X			X														
Cadmium													X											
Chromium			X				X																	
Copper	X		X		X																			
Lead	X		X				X		X															
Manganese			X										X						X					
Mercury			X	X																				
Nickel	X		X																					
Thallium			X						X	X														
Vanadium			X				X						X											X
Zinc	X		X																					
General Petroleum Products																								
Total Petroleum HC	Y		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y

NOTES:
X indicates the chemical was identified as a COC in surface soil.
Y indicates petroleum hydrocarbons were detected in soil at concentrations exceeding 100 mg/kg.

Summary of Risk and Hazard Projections
Naval Base Charleston Zone H
Charleston, South Carolina

Site	Matrix	ILCR < 1E-6	ILCR 1E-6/1E-4	ILCR >1E-4	Hazard < 1	Hazard Index > 1	TPH	Primary Contributors to Risk/Hazard
SWMU 9 GROUP								
SWMU 19	Soil		R,W		W	R	YES	PCBs, Arsenic, BaP, Copper
SWMU 20	Soil		R,W		R,W			BaP
SWMU 121	Soil		W	R	W	R	YES	PCBs, Arsenic, BaP, Beryllium, Copper
AOC 649	Soil	W	R		R,W		YES	BaP
AOC 650	Soil		R,W		R,W		YES	BaP, PCBs
AOC 654	Soil	R,W			R,W			None
SWMU 9	Shallow Groundwater		R,W			R,W		Benzidine, Arsenic, Vinyl chloride, Hexachlorobenzene
SWMU 9	Deep Groundwater		R,W			R,W		Thallium(1), Manganese, Chloroform(1)
SWMU 14 GROUP								
SWMU 14	Soil		R,W		W	R	YES	Arsenic, BaP, Beryllium
SWMU 15	Soil		W	R	W	R		Arsenic, BaP
AOC 670	Soil		R,W		W	R	YES	Arsenic, BaP
AOC 684	Soil		R,W		R,W		YES	Arsenic, BaP, Beryllium
SWMU 14	Shallow Groundwater		R,W		W	R		BEHP, TCDD, Aluminum
SWMU 14	Deep Groundwater		W	R		R,W		Heptachlor epoxide, TCDD, BEHP
SWMU 13	Soil	W	R		R,W		YES	BaP
	Shallow Groundwater		R,W		R,W			Beryllium
SWMU 17	Soil		W	R	R,W		YES	PCBs, BaP
	Shallow Groundwater			R,W		R,W		Benzidine, Chlorobenzene, 1,4-DCB, 1,2,4-TCB
SWMU 159	Soil	R,W			R,W		YES	None
	Sediment	R,W			R,W			None
SWMU 178	Soil	W	R		R,W		YES	BaP
	Shallow Groundwater	R,W			R,W			None
AOC 653	Soil		R,W		R,W		YES	BaP
	Shallow Groundwater			R,W		R,W		Arsenic
AOC 655	Soil		R,W		R,W		YES	PCBs, BaP, Dieldrin
	Shallow Groundwater			R,W		R,W		Arsenic, Chlordane
AOC 656	Soil	W	R		R,W		YES	BaP
	Shallow Groundwater		R,W		R,W			TCDD
AOC 659	Soil	R,W			R,W		YES	None
AOC 660	Soil	R,W			R,W			None
	Shallow Groundwater	R,W			R,W			None
AOC 662	Soil	R,W			R,W			None
	Shallow Groundwater	R,W			R,W			None
AOC 663/SWMU 136	Soil		W	R	W	R	YES	Arsenic, BaP, PCBs, 4,4'-DDE, Aluminum
	Shallow Groundwater		W	R		R,W		TCDD
AOC 665	Soil	W	R				YES	BaP
AOC 666	Soil		W	R	W	R	YES	Arsenic, BaP, PCBs, Mercury, Vanadium, NNPA
	Shallow Groundwater		R,W		R,W			Vinyl chloride, Chloromethane
AOC 667/SWMU 138	Soil	R,W			R,W		YES	BaP
	Shallow Groundwater	R,W			R,W			None

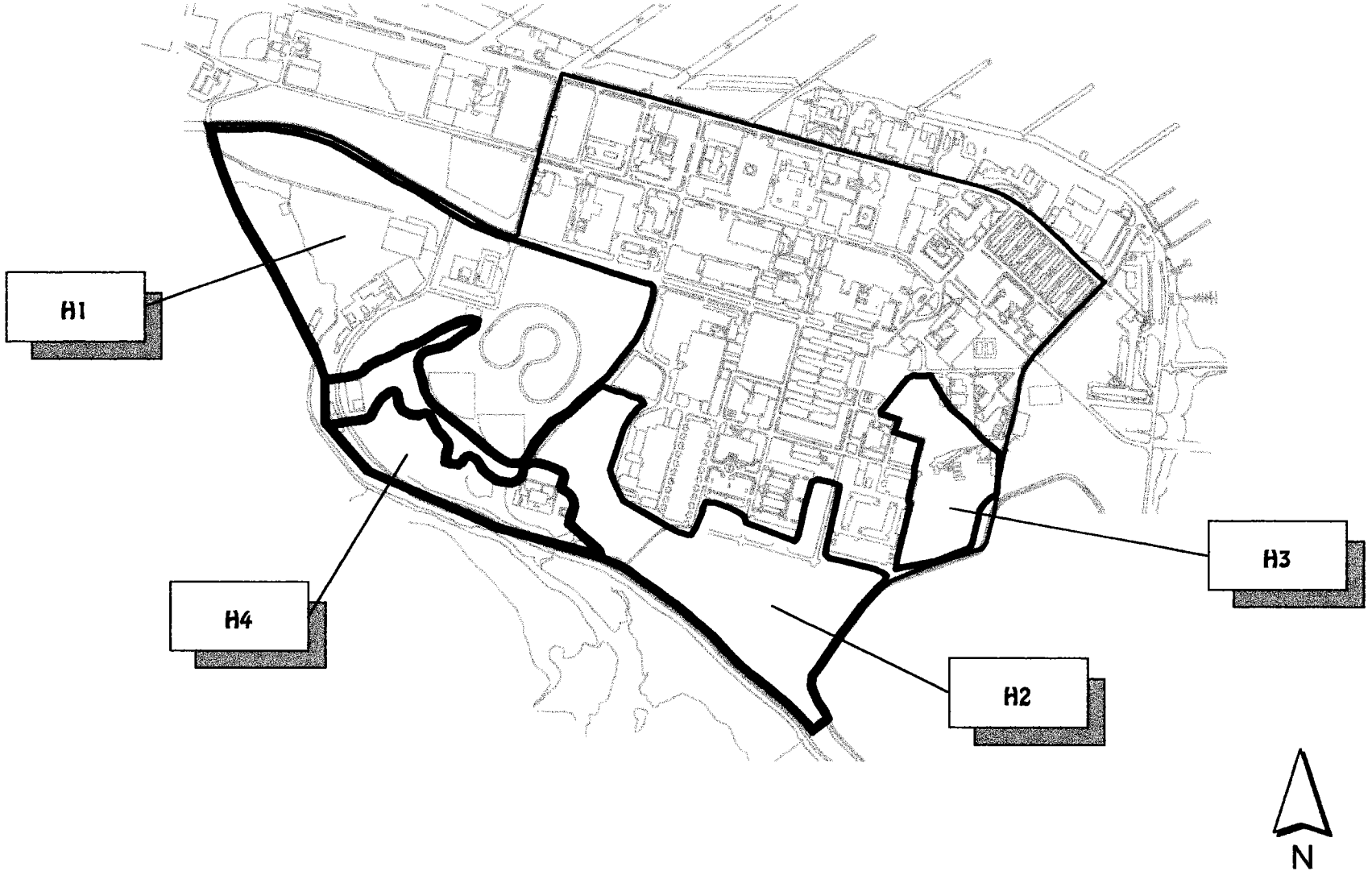
NOTES:

R indicates the resident projections fell within the corresponding risk/hazard range.

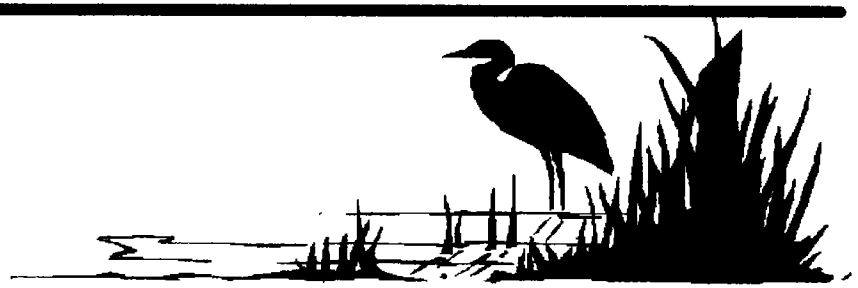
W indicates the site worker projections fell within the corresponding risk/hazard range.

(1) indicates that the chemical was detected exclusively in first quarter groundwater samples.

Ecological Impact Areas

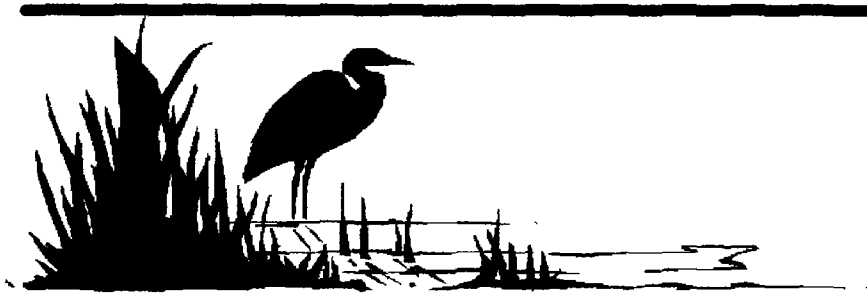


Ecological Impacts



Ecological Zone	Description	Sites Contributing to Impact
H-1	Terrestrial Grass fields with low shrub cover	SWMUs 9, 19, 20 AOCs 649, 650, 651
H-2	Terrestrial Densely forested	SWMU 121
H-3	Terrestrial Grass fields bordered by shrubs	SWMUs 14, 15 AOCs 670, 684
H-4	Aquatic Marshy area north of Least Tern Lane	SWMUs 9, 20

Ecological Impacts (cont'd)



Species	Impacted SubZones	Chemicals Contributing to Impact
Terrestrial Wildlife (Rabbit/Robin)	H-2	Metals
Aquatic Wildlife	H-4	Metals/Organics (Sediment)
Invertebrates	H-1 H-2 H-3	Organics Metals Lead/Organics
Vegetation (Seedlings)	H-2	Lead/Zinc

Recommendations

Site #	Site Description	NFA	Further Action	
			TPH	BRA
SWMU 9	Closed Landfill			✓
SWMU 13	Current Fire Fighter Training Area		✓	✓
SWMU 14	Chemical Disposal Area		✓	✓
SWMU 17	Oil Spill Area		✓	✓
SWMU 19	Solid Waste Transfer Station		✓	✓
SWMU 20	Waste Disposal Area			✓
SWMU 121	Satellite Accumulation Area		✓	✓
SWMU 136	Satellite Accumulation Area		✓	✓
SWMU 138	Satellite Accumulation Area		✓	
SWMU 159	Satellite Accumulation Area		✓	✓
SWMU 178	Apparent Transformer Fire Site		✓	✓
AOC 649	Storage Area		✓	✓
AOC 650	Storage Area		✓	✓
AOC 651	Storage Area		✓	✓
AOC 653	Hobby Shop		✓	✓
AOC 654	Septic Tank and Drain Field	✓		
AOC 655	Oil Spill Area		✓	✓
AOC 656	Petroleum Spill		✓	✓
AOC 659	Diesel Storage		✓	
AOC 660	Mosquito Control	✓		
AOC 662	Former Gasoline Station	✓		
AOC 663	Gas/Diesel Pumping Station		✓	✓
AOC 665	Pyrotechnic Storage		✓	✓
AOC 666	Fuel Storage		✓	✓
AOC 667	Vehicle Maintenance Area		✓	
AOC 503	Unexploded Ordnance Site	To be addressed by Navy's EOD		
AOC 661	Explosives Storage			

► SWMU 14 includes SWMU 15 and AOCs 670 and 684

Next Steps

- Regulatory Review
- Public Comment
- Permit Revision