AGENDA
RESTORATION ADVISORY BOARD (RAB)
St. Juliens Creek Annex
Chesapeake, Virginia

9/14/00-00457

SPAWAR Conference Room, Building 68
St. Juliens Creek Annex
Thursday, September 14, 2000, 6:30 PM

WELCOME & INTRODUCTION	John Ballinger Regional Environmental Group
RAB FACILITY TOUR	Bob Mann Community Co-Chair
NPL LISTING & TEAM PARTNERING Upcoming Events	Jeff Harlow Regional Environmental Group
COMMUNITY RELATIONS PLAN Community comments	John Ballinger Regional Environmental Group
SITE MANAGEMENT PLAN **& MASTER PROJECT PLANS** Purpose and Status	Jeff Harlow Regional Environmental Group
REMEDIAL INVESTIGATIONS Update & Status **SITE 2 (LANDFILL B) & SITE 4 (LANDFILL D)** Preliminary Findings	Lynne France CDM Federal
HUMAN HEALTH RISK ASSESSMENT What is risk? How is risk calculated? What does the determined risk mean? **SITE 2 (LANDFILL B) & SITE 4 (LANDFILL D)** Preliminary Risk Assessment Findings	Sherri Eng Naval Facilities Engineering Command
BREAK	
ECOLOGICAL RISK ASSESSMENT The ERA process **SITE 2 (LANDFILL B) & SITE 4 (LANDFILL D)** Preliminary Risk Assessment Findings	Tim Reisch Naval Facilities Engineering Command
ROUNDTABLE / Q&As Comments Schedule site visit & next meeting	Jeff Harlow/Bob Mann

COMMENTS/ANNOUNCEMENT OF FUTURE MEETINGS:
RAB MEETINGS Thursday, 14 December 2000
Thursday, 08 March 2001.

CLOSING REMARKS & ADJOURN

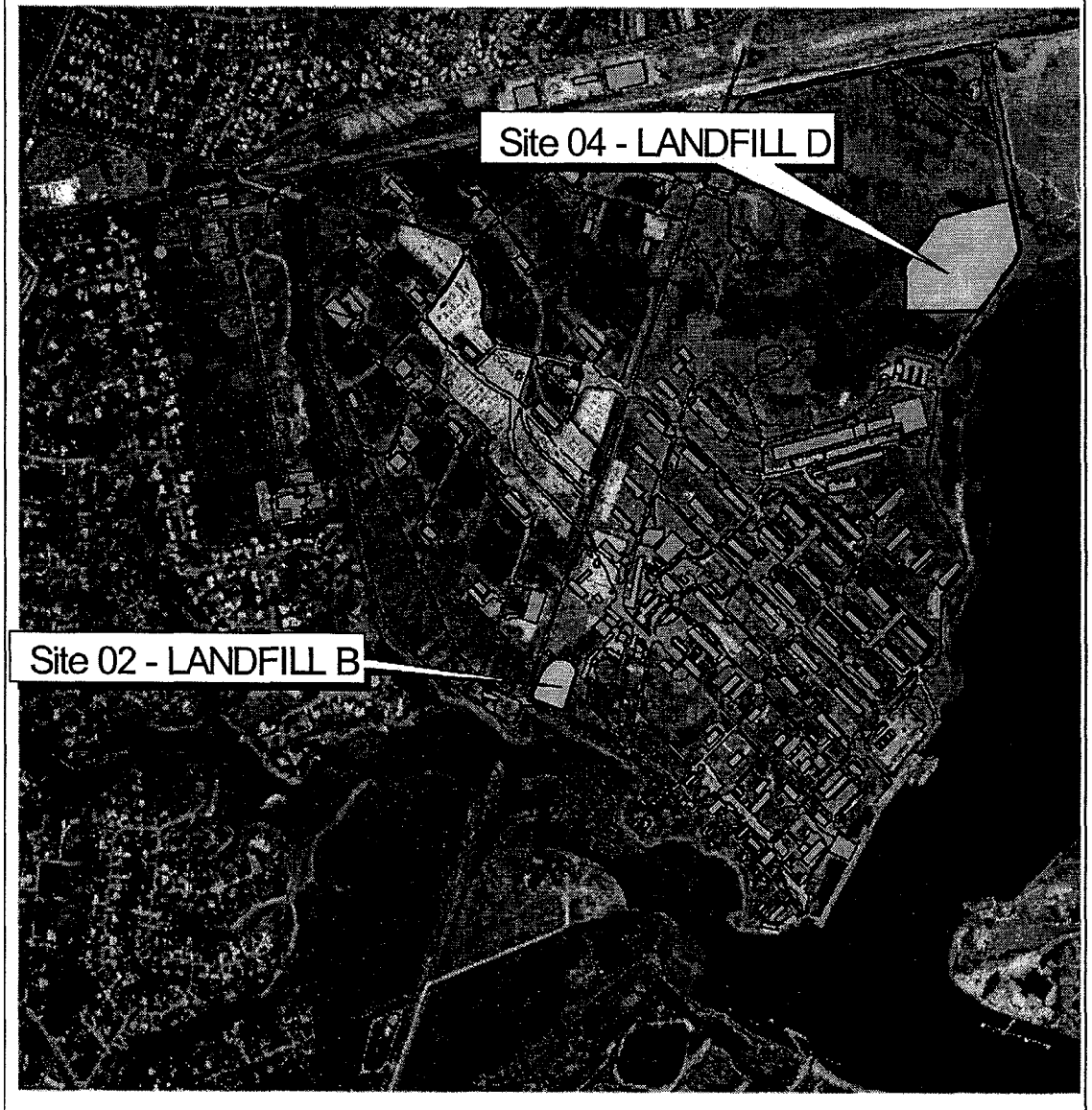
St. Juliens Creek Annex

Landfill B (Site 2) and Landfill D (Site 4) Remedial Investigation

Preliminary Results

Remedial Investigation Objectives

- Determine Contaminants of Concern
- Delineate the Extent of Contamination
- Determine Potential Risk to Human Health
- Determine Potential Risk to the Environment

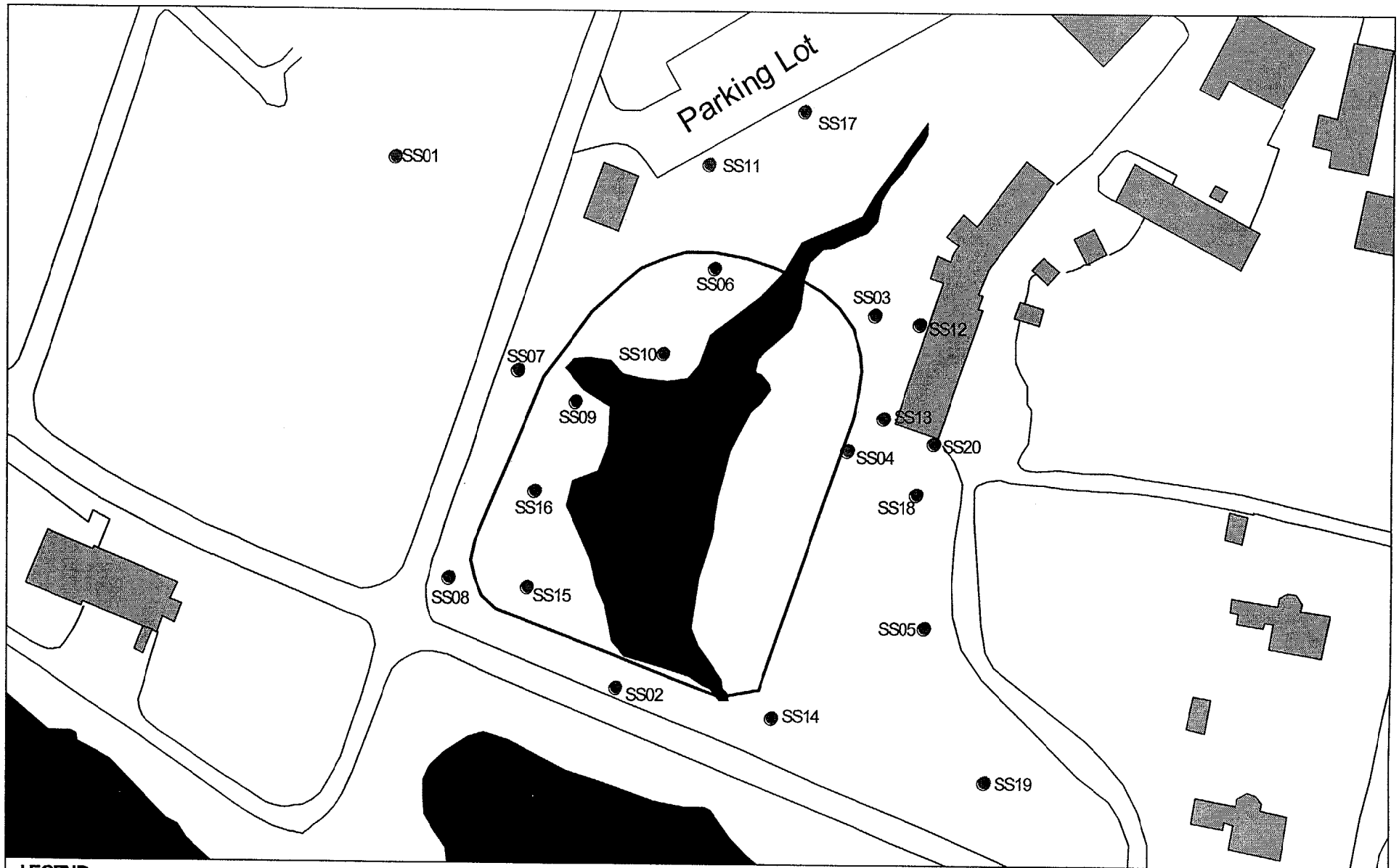


LEGEND

N

Landfill B - Field Investigation

- Surface Geophysical Surveys
- Surface water and sediment sample collection
- Surface and subsurface soil sample collection
- Ground water investigation of water-table and Upper Yorktown Aquifers
- Tidal study



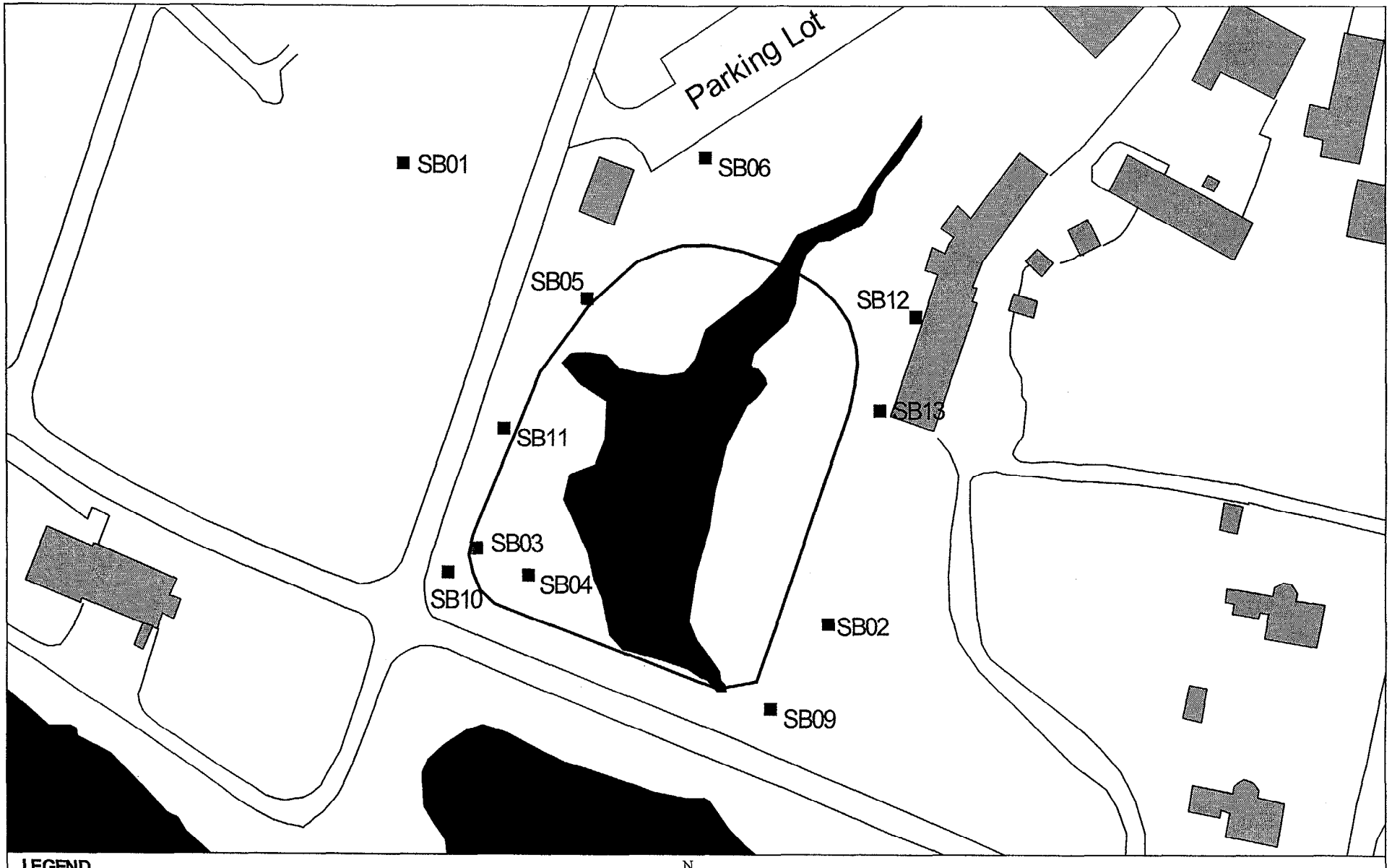
LEGEND

- Surface Soil Sample Locations
- Roads
- Onsite Buildings
- Water Bodies

N
W E
S

0 60 120 Feet

Surface Soil Sample Locations
Site 2
St. Juliens Creek Annex



LEGEND

- Subsurface Soil Sample Locations
- Roads
- Onsite Buildings
- Water Bodies

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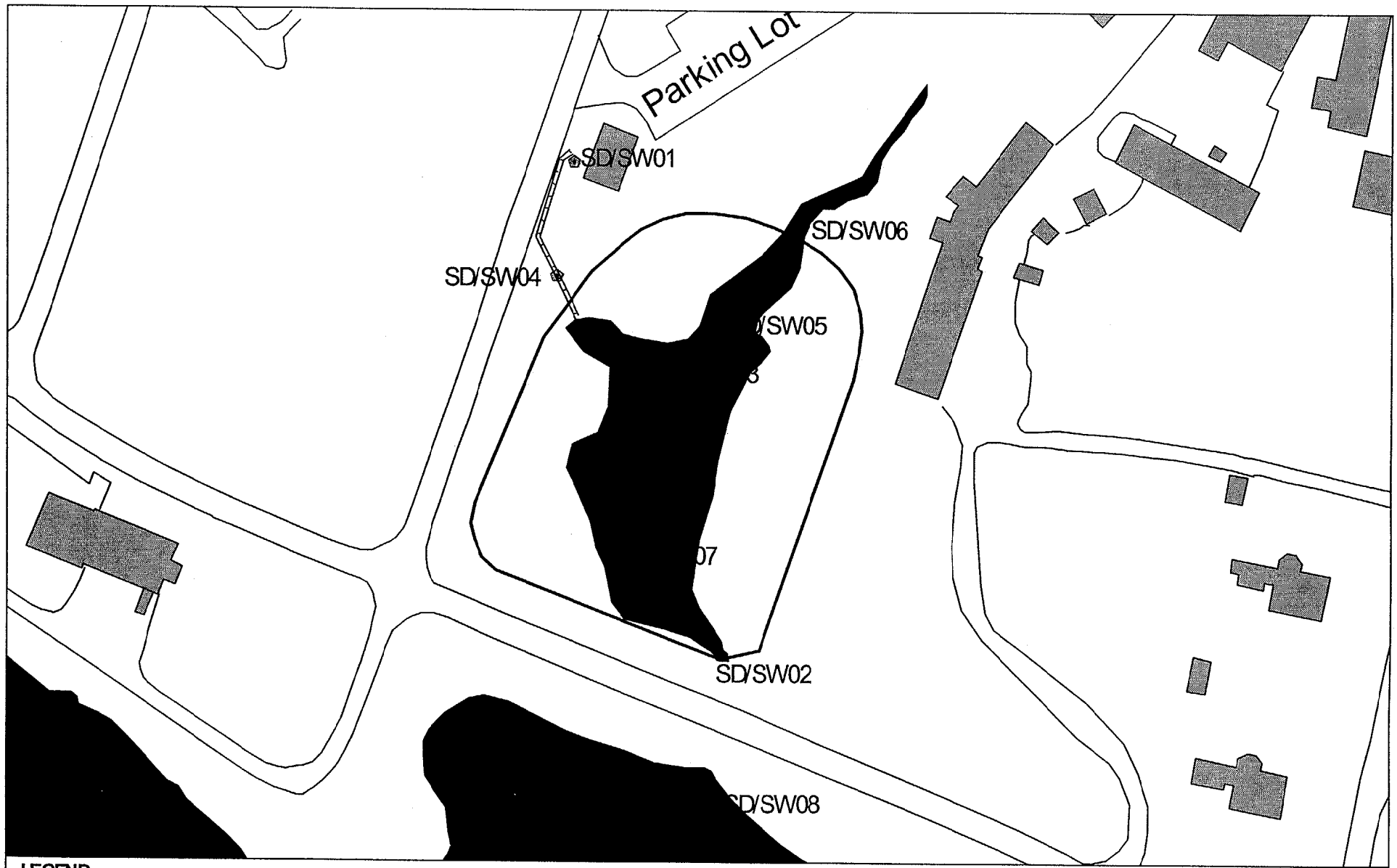
0 60 120 Feet

Subsurface Soil Sample Locations
Site 2
St. Juliens Creek Annex



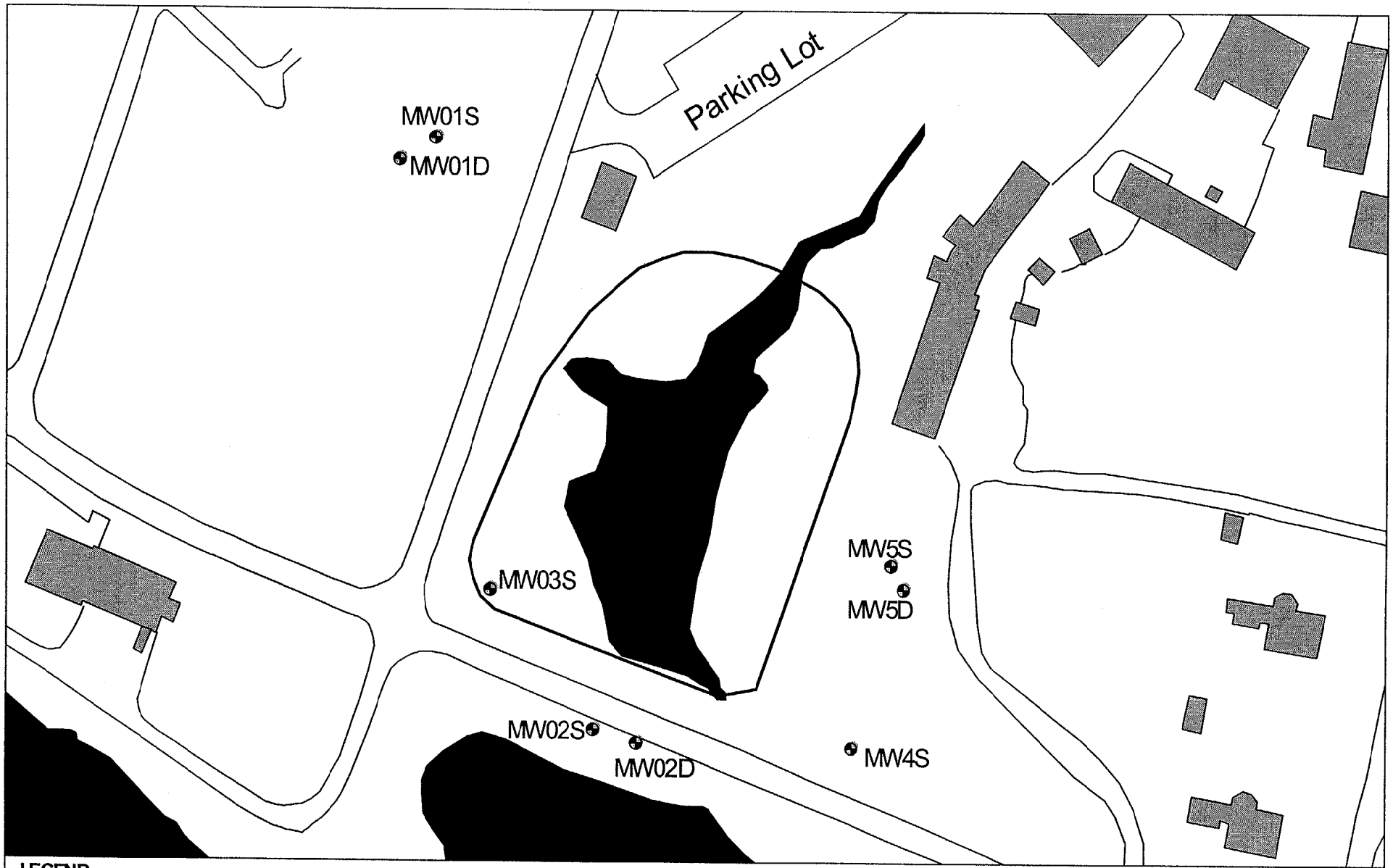
LEGEND

- Sediment & Surface Water Sample Locations
- Roads
- Onsite Buildings
- Water Bodies

N
W E
S

0 60 120 Feet

Sediment and
Surface Water Sample Locations
Site 2
St. Juliens Creek Annex



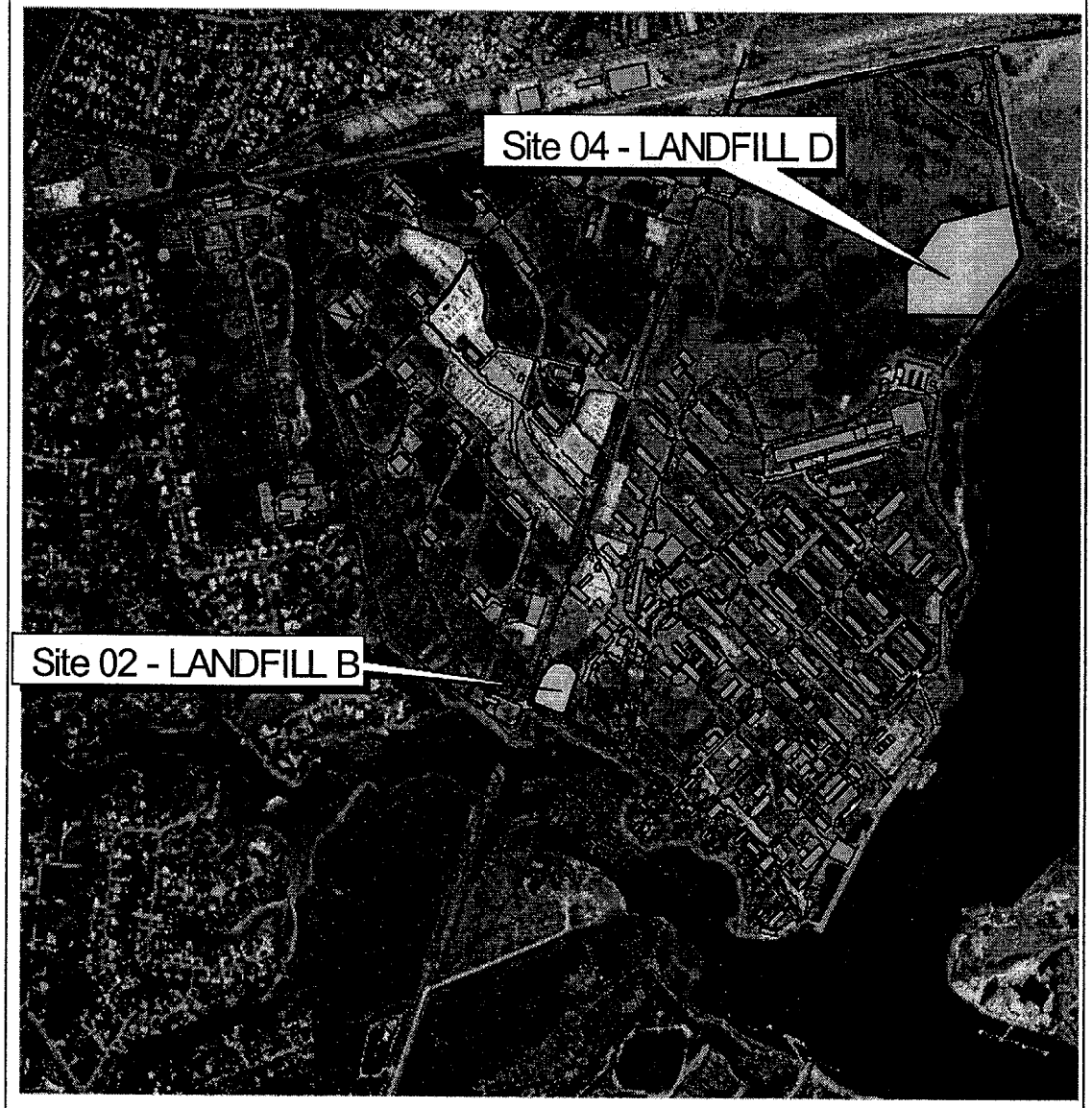
LEGEND

- Groundwater Sample Locations
- Roads
- Onsite Buildings
- Water Bodies

N
W E
S

0 60 120 Feet

Groundwater Sample Locations
Site 2
St. Juliens Creek Annex

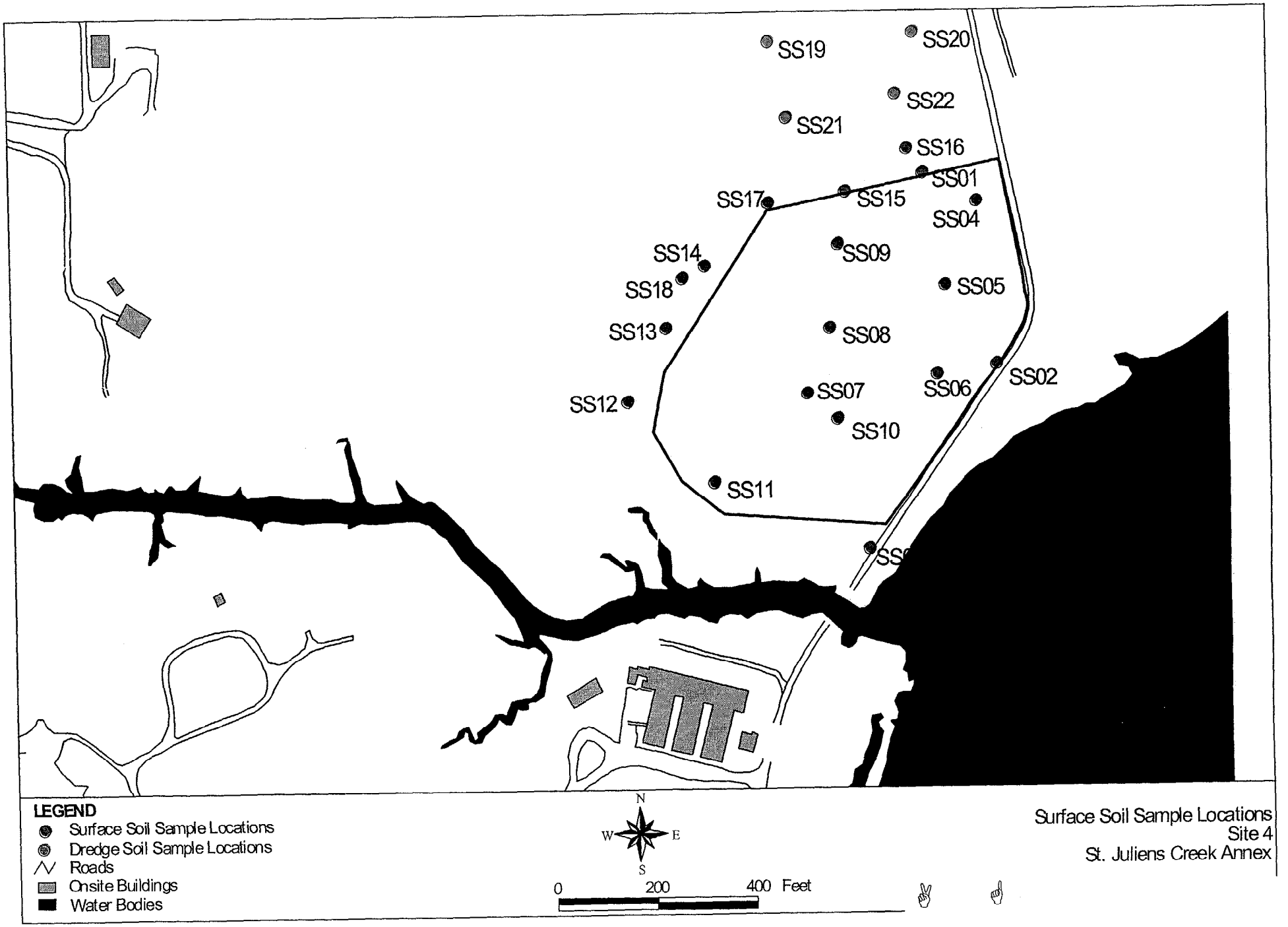


LEGEND

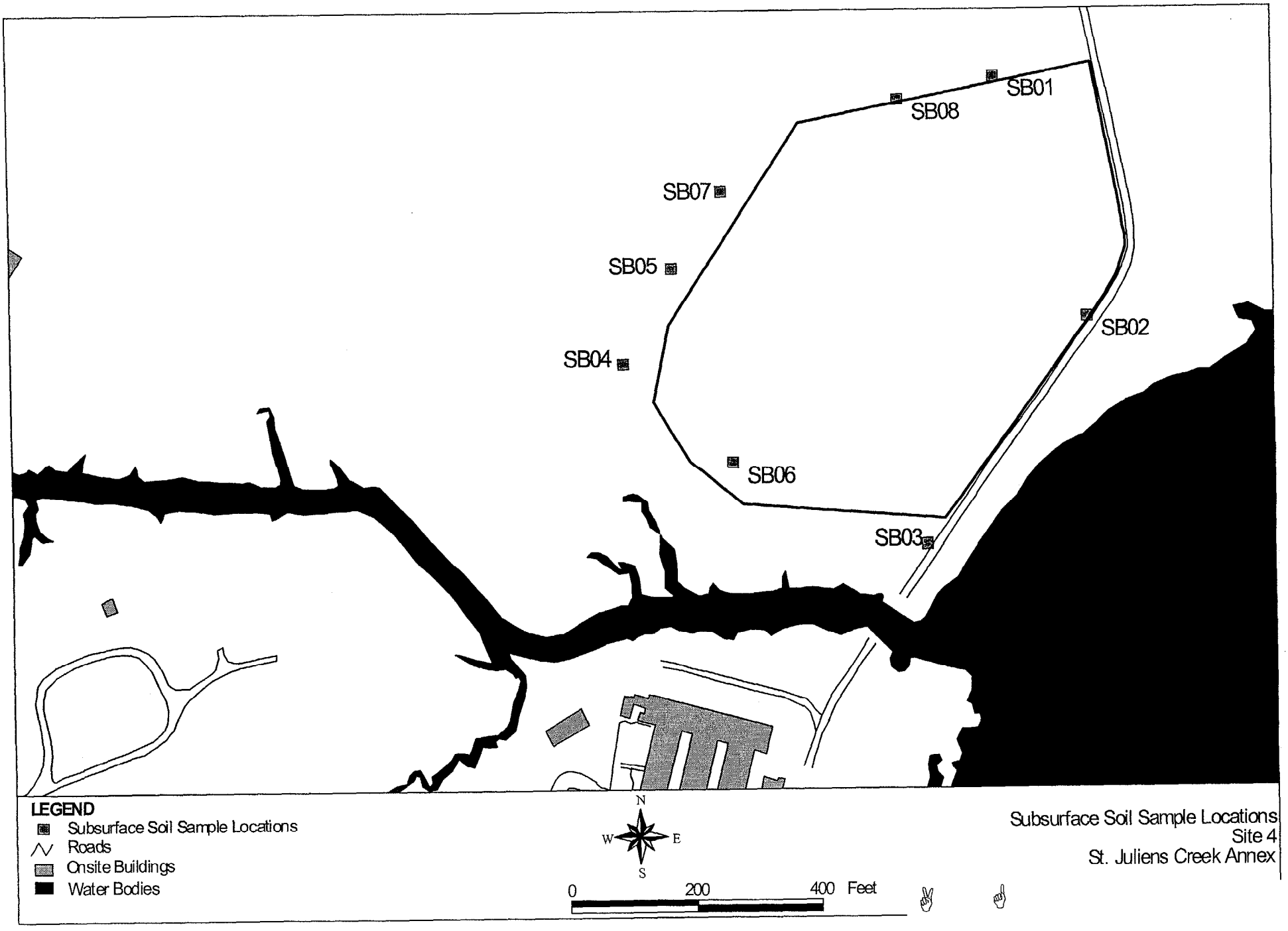
N

Landfill D - Field Investigation

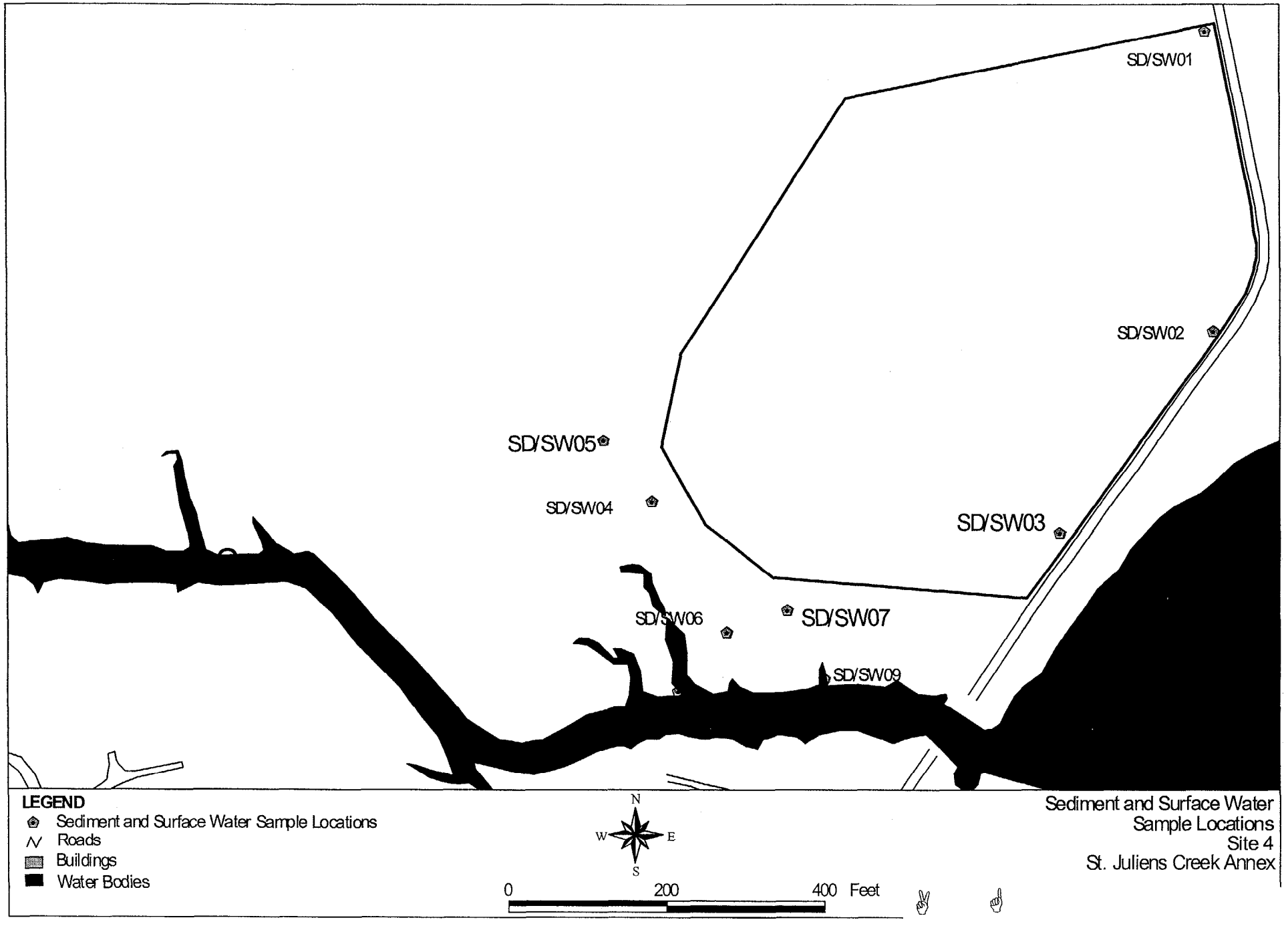
- Surface Geophysical Surveys
- UXO clearance
- Surface water and sediment sample collection
- Surface and subsurface soil sample collection
- Ground water investigation of water-table and Upper Yorktown Aquifers



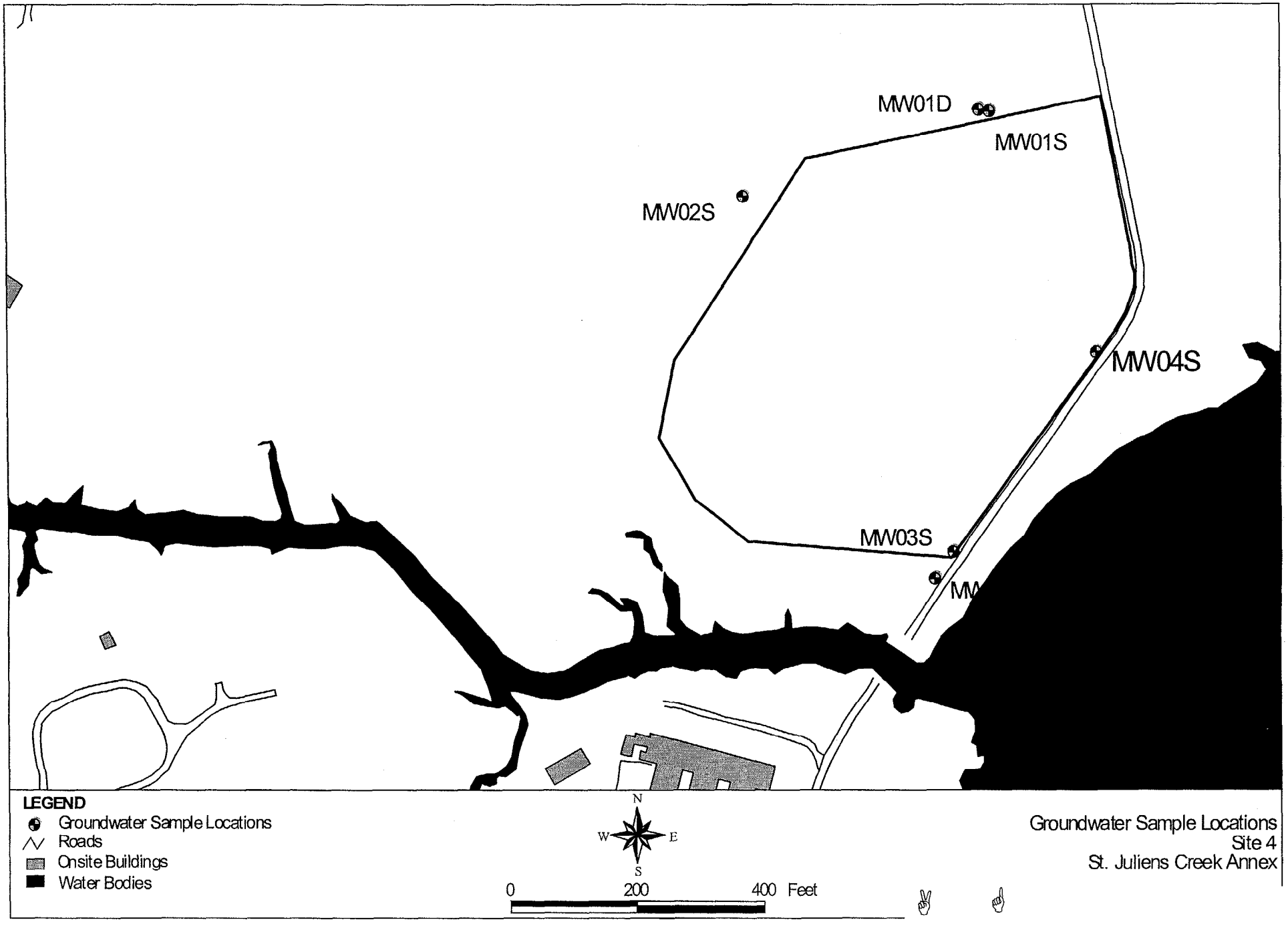
Surface Soil Sample Locations
Site 4
St. Juliens Creek Annex



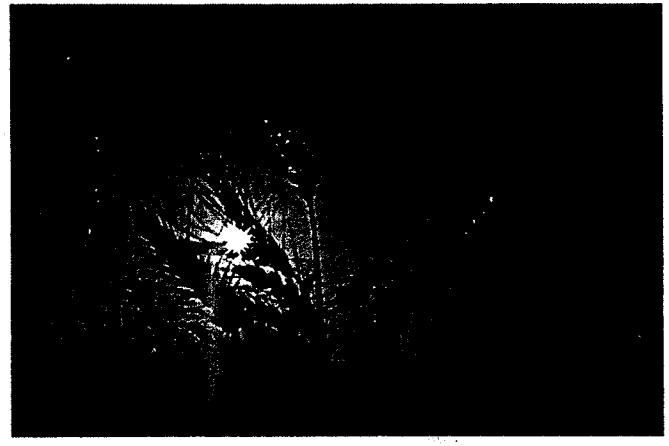
Subsurface Soil Sample Locations
Site 4
St. Juliens Creek Annex



Sediment and Surface Water
Sample Locations
Site 4
St. Juliens Creek Annex


MW01D
MW01S
MW02S
MW04S
MW03S
MW
LEGEND
Groundwater Sample Locations
Roads
Onsite Buildings
Water Bodies
N
W
E
S
0
200
400 Feet
Groundwater Sample Locations
Site 4
St. Juliens Creek Annex

RISK ASSESSMENT



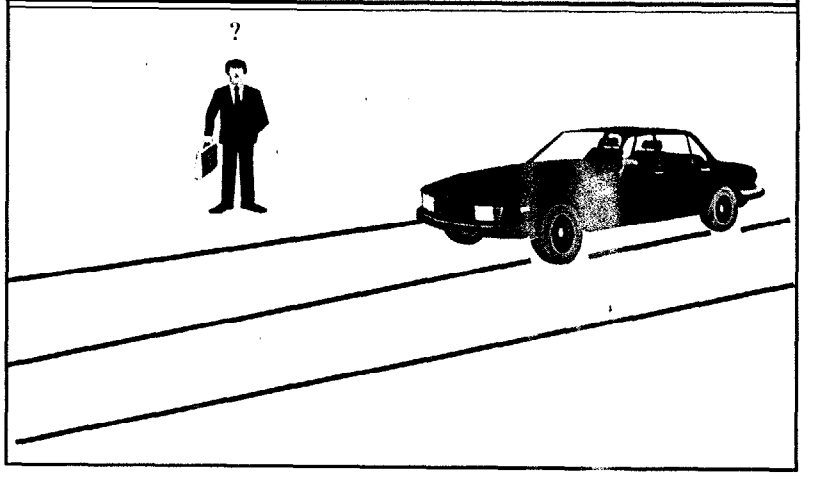
Overview

- Definitions
- Uses of Risk Assessment
- Components of the Risk Assessment Process
- New Directions in Risk Assessment
- Communicating Risks

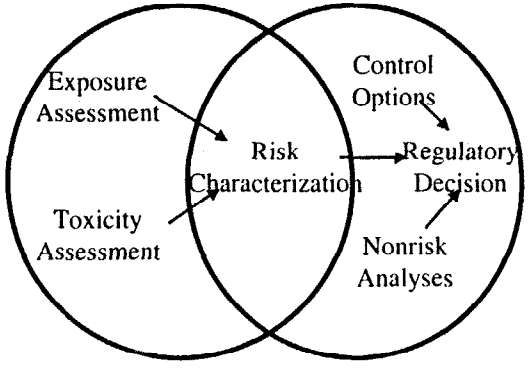
Definitions

- Risk: The Likelihood of injury or disease Resulting from Exposure to Potential Hazard
- Safety: The probability of no adverse occurrences under a specific set of circumstances
- Risk Assessment: The science of evaluating the potential for adverse occurrences

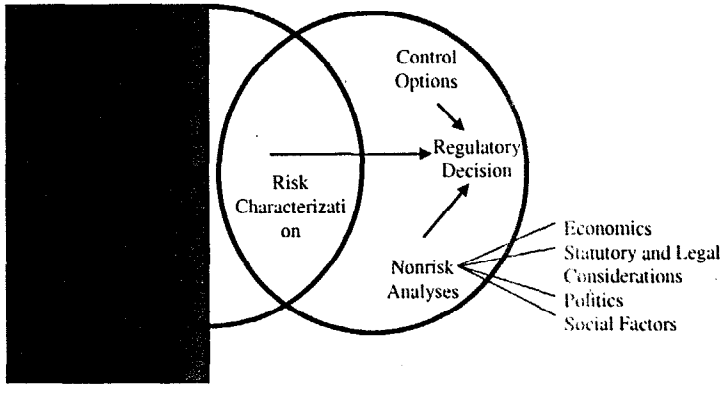
Risk Assessment is Something we all do



Risk Assessment -vs- Risk Management



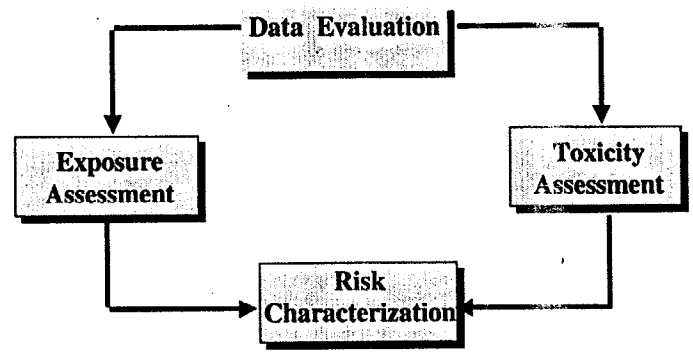
Risk Management



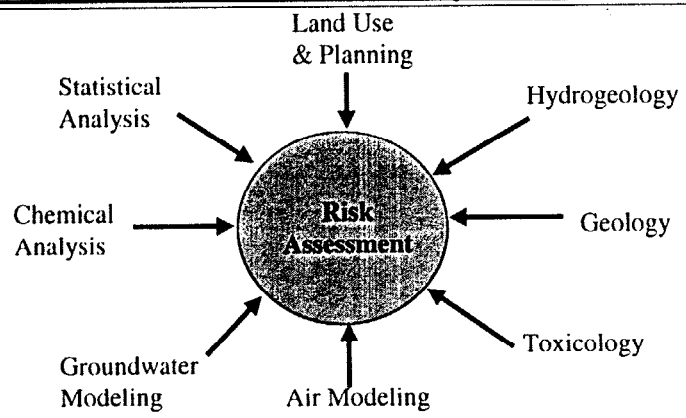
Principal Uses of Risk Assessment

- Baseline (no-action) Risk
  - How bad is it now?
  - How bad could it become if nothing is done?
- Prioritization of Remedial Alternatives
  - Which alternative reduces risk the most?
- Cleanup Goal Identification
  - What concentrations can be left behind?

Elements of Risk Assessment



Risk Assessment is a Multi-Disciplinary Process

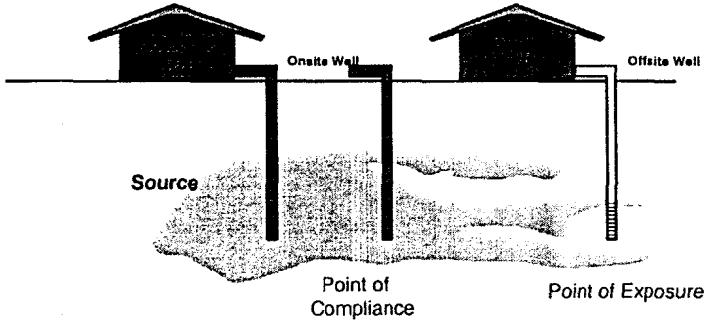


Exposure Concentrations

Things to Consider

- How were concentrations aggregated?
  - Hot spot averaged in?
- Over What Time Period Were Data Generated?
  - Seasonal Fluctuations?
  - Attenuation?
- Groundwater Filtered or Unfiltered?

Estimation of Exposure Point Concentrations



Human Exposure Evaluation

- Who is potentially exposed?
- How many people are potentially exposed?
- Through which routes?
- What is the magnitude, frequency, and duration of possible exposure?

Who Could Be Exposed?

- Residents
- Workers
- Visitors or Trespassers
- Sensitive Subpopulations
  - School children
- Future Population Groups

How Might They Be Exposed?

- Exposure Route
  - Ingestion
  - Inhalation
  - Skin contact
- Environmental Medium
  - Soil
  - Water
  - Food
  - Air

Elements of a Complete Exposure Pathway

[redacted]

Fuel Tank

Leaks

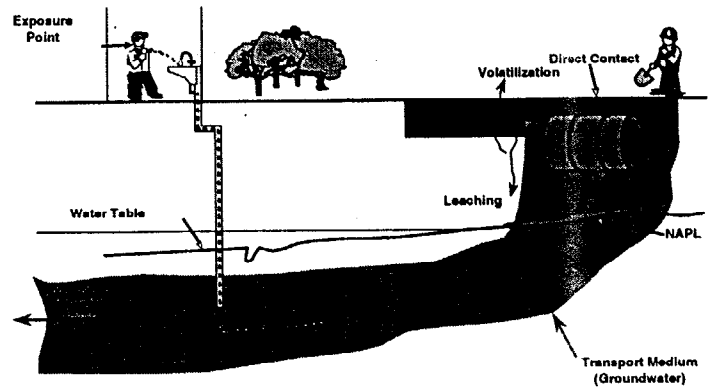
Groundwater

Ingestion

Downgradient Well

Future Worker

Exposure Pathway Analysis



Five Basic Variables Used to Estimate Intake

- Exposure Point Concentrations: [redacted]
- Media Contact Rate: [redacted]
- Exposure Frequency/Duration: [redacted]
- Body Weight: [redacted]
- Exposure Averaging Time: [redacted]

Use of "Default" Exposure Assumptions Results in Multiplicative Conservatism

$$\text{Intake} = \frac{\text{Concentration} \times \text{Medium Intake Rate} \times \text{Exposure Frequency} \times \text{Exposure Duration}}{[redacted] \times [redacted]}$$

Upper Bound Value

[redacted]

Thus, RME intake > 99.9th percentile !

Toxicity Evaluation

**"All substances are poisons.
The right dose differentiates
between a poison and a remedy."**

Philipus Aureolus Theophrastus Bonmastes von Hohenheim-Paracelsus (1493-1541)

Risk Characterization

- Noncarcinogenic Risks:
  are expressed as a ratio of predicted dose to an estimated allowable dose
- Carcinogenic Risks:
  are quantitatively expressed as a probability over a specific period of time (lifetime)

Toxicity Values for Carcinogens

The dose-response relationship for cancer effects is expressed as a cancer slope factor (CSF). The CSF is route-specific and is derived as the <u>upper confidence limit on the slope</u> of the dose-response curve.

Cancer Slope Factor = Excess lifetime cancer risk per level of intake

= Risk per mg/kg-day

e.g., for benzene, the CSF is 0.029 per mg/kg-day

Sources of Toxicity Values

- USEPA's Integrated Risk Information System (IRIS) Database
- USEPA Health Effects Assessment Summary Tables (HEAST), Annual update

What Does One-in-a-Million Mean?

Comparison Table

Unit	Equivalent
Length	One foot per 192 miles
Time	One minute per 2 years
Weight	One pound of salt per 500 tons of pretzels
Volume	One ounce vermouth per 7,800 gallons gin
Area	One square foot per 23 acres
Action	One bogey per 56,000 rounds of golf
Quality	One bad apple per 2,000 barrels

Uncertainty versus Variability

- Uncertainty: Represents lack of knowledge. Gathering more data reduces uncertainty. (e.g., lifestyle)

- Variability: Arises from true heterogeneity in characteristics. Gathering more data does not reduce variability. (e.g., body weight)

Comparison to Everyday Risks

Activities Increasing Chance of Death by One in a Million Yearly	Cause of Death
Smoking 1.4 cigarettes	Cancer, Heart disease
Traveling 300 miles by car	Accident
Traveling 10 miles by bicycle	Accident
Traveling 6 minutes by canoe	Accident
Flying 6000 miles by jet	Cancer for cosmic radiation
Living 2 months in Denver	Cancer for cosmic radiation
Drinking 30 12-ounce diet sodas	Cancer from saccharin
Eating 100 charbroiled steaks	Cancer from benzo(a)pyrene
One chest X-ray	Cancer from radiation
Eating 40 Tbs of peanut butter	Cancer from aflatoxin
Drinking 1/2 liter of wine	Cirrhosis of the liver

Conclusion

Three General Principles of Risk Assessment

- Toxicity is not the same as risk
- With no exposure, there is no risk
- Zero risk does not exist

[redacted]

U.S. NAVY

St. Juliens Creek Annex

Exposure Scenarios for Site 2

Media	Exposure Route	Current/Future				Future			
		Trespasser		Offsite Resident		Construction Worker	Other Worker	Onsite Resident	
		Adult	Adolescent	Adult	Child			Adult	Child
Surface Soil	Ingestion	X	X						
	Dermal	X	X						
	Inhalation	X	X						
Groundwater (Deep)	Ingestion			X	X				
	Dermal			X	X				
	Inhalation			X					
Shallow Groundwater	Ingestion								
	Dermal					X			
	Inhalation								
Surface Water[1]	Ingestion								
	Dermal	X	X					X	X
	Inhalation								
Sediment[1]	Ingestion	X	X					X	X
	Dermal	X	X					X	X
	Inhalation								
Soil[2]	Ingestion					X	X	X	X
	Dermal					X	X	X	X
	Inhalation					X			

X Quantitative evaluation.

[1] Surface water and sediment exposure scenarios are for waders.

[2] Includes both surface soil and subsurface soil.

COPCs for Site 2

Surface Soil	Surface and Subsurface Soil	Surface Water	Sediment	Shallow Groundwater	Deep Groundwater
			*Current/Future**		
Benzo(a)Pyrene	4,4'-DDD	1,1-Dichloroethene	Phosphorus	RDX	Chloroform
Phosphorus	4,4'-DDE	cis-1,2-Dichloroethene		Heptachlor	Phosphorus
Arsenic	4,4'-DDT	Chloroform	*Future**	1,4-Dichlorobenzene	Arsenic
Iron	Benzo(a)Anthracene	Trichloroethene	Benzo(a)Pyrene	Phosphorus	Iron
Lead	Benzo(a)Pyrene	Vinyl Chloride	Phosphorus	Aluminum	Manganese
	Benzo(b)Fluoranthene	Bis(2-Ethylhexyl)Phthalate	Arsenic	Arsenic	
	Dibenz(a,h)Anthracene	Phosphorus	Chromium	Barium	
	Phosphorus	Arsenic	Iron	Chromium	
	Aluminum	Chromium	Lead	Iron	
	Antimony	Iron		Lead	
	Arsenic	Lead		Manganese	
	Chromium	Manganese		Thallium	
	Copper			Vanadium	
	Iron				
	Lead				
	Manganese				
	Nickel				
	Thallium				
	Vanadium				
	Zinc				

* COPCs for Current/Future were determined using an industrial RBC screen. COPCs for Future scenario were determined using a residential RBC screen.

Summary of RME Risks for Site 2

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways
	Inhalation		Ingestion		Dermal			
	Risk	HI	Risk	HI	Risk	HI		
Surface Soil								
Current/Future Trespasser Adult	2E-10	NA	2E-06	0.03	4E-07	0.01	**2E-06**	**0.04**
Current/Future Trespasser Adolescent	5E-11	NA	4E-07	0.03	4E-08	0.01	**4E-07**	**0.04**
Shallow Groundwater								
Future Construction Worker	NA	NA	NA	NA	2E-09	0.2	**2E-09**	**0.2**
Deep Groundwater								
Current/Future Residential Adult	5E-06	2	4E-05	0.8	1E-07	0.01	**4E-05**	**3**
Current/Future Residential Child	NA	NA	2E-05	2	6E-08	0.02	**2E-05**	**2**
Current/Future Age-adjusted Resident	5E-06	NA	6E-05	NA	2E-07	NA	**6E-05**	**NA**
Soil								
Future Residential Adult	NA	NA	1E-05	0.3	8E-06	0.6	**2E-05**	**0.9**
Future Residential Child	NA	NA	3E-05	3	4E-06	1	**3E-05**	**4**
Future Construction Worker	2E-10	NA	8E-07	0.7	1E-07	0.1	**9E-07**	**0.9**
Future Other Worker	NA	NA	4E-06	0.1	2E-06	0.04	**6E-06**	**0.1**
Surface Water								
Current/Future Treapasser Adult	NA	NA	NA	NA	2E-06	0.1	**2E-06**	**0.1**
Current/Future Trespasser Adolescent	NA	NA	NA	NA	3E-07	0.02	**3E-07**	**0.02**
Future Residential Adult	NA	NA	NA	NA	3E-06	0.1	**3E-06**	**0.1**
Future Residential Child	NA	NA	NA	NA	2E-06	0.1	**2E-06**	**0.1**
Sediment								
Future Residential Adult	NA	NA	2E-06	0.2	6E-07	2	**3E-06**	**2**
Future Residential Child	NA	NA	5E-06	0.6	2E-05	32	**2E-05**	**32**

Risk = carcinogenic risk as determined by the risk calculations in Appendix
HI = Hazard index as determined by the risk calculation in Appendix.
N/A - not calculated.

Summary of CT Risks for Site 2

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways
	Inhalation		Ingestion		Dermal			
	Risk	HI	Risk	HI	Risk	HI		
Soil								
Future Residential Adult	NA	NA	7E-07	0.1	1E-07	0.04	9E-07	0.1
Future Residential Child	NA	NA	4E-06	0.5	2E-07	0.1	5E-06	0.6
Sediment								
Future Residential Adult	NA	NA	9E-08	0.01	9E-09	0.1	1E-07	0.1
Future Residential Child	NA	NA	6E-07	0.04	9E-07	0.3	1E-06	0.4

Risk = carcinogenic risk as determined by the risk calculations in Appendix.

HI = Hazard index as determined by the risk calculation in Appendix.

RME Risk Drivers for Site 2

Media: Deep Groundwater

	Current/Future Residential Adult								Current/Future Residential Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Chloroform	2	0.01	0.0003	2	5E-06	2E-07	5E-09	5E-06	NA	0.03	0.001	0.03	NA	1E-07	3E-09	1E-07
Totals	2	0.01	0.0003	2	5E-06	2E-07	5E-09	5E-06	NA	0.03	0.001	0.03	NA	1E-07	3E-09	1E-07

Media: Soil

	Future Residential Adult								Future Residential Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
4,4'-DDT	NA	0.1	0.1	0.2	NA	5E-06	5E-06	9E-06	NA	0.7	0.2	0.9	NA	1E-05	2E-06	1E-05
Aluminum	NA	0.01	0.005	0.02	NA	NA	NA	NA	NA	0.1	0.5	0.6	NA	NA	NA	NA
Arsenic	NA	0.03	0.01	0.04	NA	5E-06	1E-06	6E-06	NA	0.3	0.02	0.3	NA	1E-05	7E-07	1E-05
Iron	NA	0.1	0.05	0.2	NA	NA	NA	NA	NA	1	0.10	1.1	NA	NA	NA	NA
Manganese	NA	0.02	0.1	0.2	NA	NA	NA	NA	NA	0.2	0.3	0.4	NA	NA	NA	NA
Totals	NA	0.2	0.3	0.5	NA	9E-06	6E-06	2E-05	NA	2	1	3	NA	2E-05	3E-06	2E-05

Media: Sediment

	Future Resident Adult								Future Resident Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Chromium	NA	0.2	2	2	NA	NA	NA	NA	NA	0.2	30	30	NA	NA	NA	NA
Iron	NA	0.02	0.01	0.03	NA	NA	NA	NA	NA	0.2	1	1.4	NA	NA	NA	NA
Totals	NA	0.2	2	2	NA	0E+00	0E+00	0E+00	NA	4E-01	31	32	NA	0E+00	0E+00	0E+00

Information on RME Risk Drivers for Site 2

	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration
Deep Groundwater (ug/l)				
Chloroform	2/7	0.6	6	GW2D
Soil (mg/kg)				
4,4'-DDT	28/28	6.90E-04	2.90E+02	SB08
Aluminum	29/29	1.96E+03	2.17E+04	SB07
Arsenic	28/29	1.20E+00	1.80E+01	SS13
Iron	29/29	1.85E+03	1.06E+05	SS03/SS06
Manganese	29/29	5.90E+00	6.88E+02	SS03
Sediment (mg/kg)				
Chromium	9/9	6.5	2,630	SD03
Iron	9/9	2,050	31,100	SD03

Exposure Scenarios for Site 3

Media	Exposure Route	Current/Future				Future			
		Trespasser		Offsite Resident		Construction Worker	Other Worker	Onsite Resident	
		Adult	Adolescent	Adult	Child			Adult	Child
Surface Soil	Ingestion	x	x						
	Dermal	x	x						
	Inhalation	x	x						
Groundwater (Deep)	Ingestion			x	x				
	Dermal			x	x				
	Inhalation			x					
Shallow Groundwater	Ingestion								
	Dermal					x			
	Inhalation								
Surface Water[1]	Ingestion								
	Dermal	x	x					x	x
	Inhalation								
Sediment[1]	Ingestion	x	x					x	x
	Dermal	x	x					x	x
	Inhalation								
Soil[2]	Ingestion					x	x	x	x
	Dermal					x	x	x	x
	Inhalation					x			

x Quantitative evaluation

[1] Surface water and sediment exposure scenarios are for waders

[2] Includes both surface soil and subsurface soil

COPCs for Site 3

Surface Soil	Surface and Subsurface Soil	Surface Water	Sediment	Shallow Groundwater	Deep Groundwater
			*Current/Future***		
Benzo(a)Pyrene	Benzo(a)Anthracene	Phosphorus	Phosphorus	Heptachlor	Chloroform
Phosphorus	Benzo(a)Pyrene*	Aluminum	Lead	Bis(2-ethylhexyl)Phthalate	Phosphorus
Antimony	Benzo(b)Fluoranthene	Arsenic		Dibenzofuran	Arsenic
Arsenic	Dibenz(a,h)Anthracene	Iron	*Future***	Naphthalene	Thallium
Iron	Indeno(1,2,3-cd)Pyrene	Lead	Phosphorus	Phosphorus	Manganese
Lead	Phosphorus*	Manganese	Antimony	Aluminum	
	Aluminum		Arsenic	Antimony	
	Antimony*		Iron	Arsenic	
	Arsenic*		Lead	Chromium	
	Barium			Iron	
	Cadmium			Manganese	
	Chromium			Nickel	
	Copper			Vanadium	
	Iron*				
	Lead*				
	Manganese				
	Thallium				
	Vanadium				
	Zinc				

* All COPCs for residential screen and indicated COPCs for both residential and industrial scenarios.

** COPCs for Current/Future were determined using an industrial RBC screen. COPCs for Future scenario were determined using a residential RBC screen.

Exposure Scenarios for Site 4

Media	Exposure Route	Current/Future				Future			
		Trespasser		Offsite Resident		Construction Worker	Other Worker	Onsite Resident	
		Adult	Adolescent	Adult	Child			Adult	Child
Surface Soil									
	Ingestion	X	X						
	Dermal	X	X						
	Inhalation	X	X						
Groundwater									
	Ingestion			X	X				
	Dermal			X	X				
	Inhalation			X					
Shallow Groundwater	Ingestion								
	Dermal					X			
	Inhalation								
Surface Water[1]	Ingestion								
	Dermal	X	X					X	X
	Inhalation								
Sediment[1]									
	Ingestion	X	X					X	X
	Dermal	X	X					X	X
	Inhalation								
Soil[2]									
	Ingestion					X	X	X	X
	Dermal					X	X	X	X
	Inhalation					X			

X Quantitative evaluation.

[1] Surface water and sediment exposure scenarios are for wading.

[2] Includes both surface soil and subsurface soil.

COPCs for Site 4

Surface Soil	Surface and Subsurface Soil	Surface Water	Sediment	Shallow Groundwater	Deep Groundwater
			*Current/Future**		
Aroclor-1260	Aroclor-1260	Dibenz(a,h)anthracene	Phosphorus	bis(2-Ethylhexyl)phthalate	bis(2-Ethylhexyl)phthalate
Benzo(a)Pyrene	Dieldrin	Indeno(1,2,3-cd)pyrene		Phosphorus	Chloroform
Phosphorus	Benzo(a)Anthracene	Phosphorus	*Future**	Aluminum	Phosphorus
Arsenic	Benzo(a)Pyrene	Aluminum	Benzo(a)Pyrene	Antimony	Arsenic
Chromium	Benzo(b)Fluoranthene	Arsenic	Phosphorus	Arsenic	Barium
Iron	Dibenz(a,h)Anthracene	Iron	Arsenic	Barium	Iron
Lead	Indeno(1,2,3-cd)Pyrene	Lead	Iron	Cadmium	Manganese
	Phosphorus	Manganese	Lead	Chromium	
	Aluminum			Iron	
	Antimony			Lead	
	Arsenic			Manganese	
	Barium			Nickel	
	Cadmium			Silver	
	Chromium			Thallium	
	Copper			Vanadium	
	Iron				
	Lead				
	Manganese				
	Nickel				
	Thallium				
	Vanadium				
	Zinc				

* COPCs for Current/Future were determined using an industrial RBC screen. COPCs for Future scenario were determined using a residential RBC screen.

Summary of RME Risks for Site 4

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways
	Inhalation		Ingestion		Dermal			
	Risk	HI	Risk	HI	Risk	HI		
Surface Soil								
Current/Future Trespasser Adult	6E-09	0.00001	4E-06	0.04	8E-07	0.1	5E-06	0.1
Current/Future Trespasser Adolescents	1E-09	0.000001	9E-07	0.04	9E-08	0.02	1E-06	0.06
Shallow Groundwater								
Future Construction Worker	NA	NA	NA	NA	4E-09	0.08	4E-09	0.08
Deep Groundwater								
Future Residential Adult	1E-05	5	9E-05	24	4E-07	0.2	1E-04	29
Future Residential Child	NA	NA	5E-05	56	2E-07	0.5	5E-05	57
Future Residential Age-Adjusted	1E-05	NA	1E-04	NA	5E-07	NA	2E-04	--
Soil								
Future Residential Adult	NA	NA	4E-05	0.8	8E-06	0.9	4E-05	1
Future Residential Child	NA	NA	6E-05	4	4E-06	1	9E-05	5
Future Residential Age-Adjusted	NA	NA	1E-04	NA	1E-05	NA	1E-04	--
Future Construction Worker	5E-09	0.00005	2E-06	1	2E-07	0.2	2E-06	1
Future Other Worker	NA	NA	1E-05	0.1	2E-06	0.1	1E-05	0.3
Surface Water								
Current/Future Trespasser Adult	NA	NA	NA	NA	2E-07	0.02	2E-07	0.02
Current/Future Trespasser Adolescents	NA	NA	NA	NA	4E-08	0.02	4E-08	0.02
Future Resident Adult	NA	NA	NA	NA	3E-07	0.04	3E-07	0.04
Future Resident Child	NA	NA	NA	NA	2E-07	0.1	2E-07	0.1
Sediment								
Current/Future Trespasser Adult	NA	NA	NA	NA	NA	NA	--	--
Current/Future Trespasser Adolescents	NA	NA	NA	NA	NA	NA	--	--
Future Resident Adult	NA	NA	3E-06	0.06	8E-07	0.02	4E-06	0.07
Future Resident Child	NA	NA	7E-06	0.4	2E-05	2	3E-05	3

Risk = carcinogenic risk as determined by the risk calculations in Appendix.
HI = Hazard index as determined by the risk calculation in Appendix.
N/A - could not be calculated because incomplete exposure pathway or no toxicity values for COPCs.

Summary of CT Risks for Site 4

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways
	Inhalation		Ingestion		Dermal			
	Risk	HI	Risk	HI	Risk	HI		
Deep Groundwater								
Future Residential Adult	5E-07	1	7E-06	5	3E-08	0.04	8E-06	6
Future Residential Child	NA	NA	1E-05	16	6E-08	0.1	1E-05	16
Future Residential Age-Adjusted	5E-07	NA	2E-05	NA	9E-08	NA	2E-05	--
Soil								
Future Residential Adult	NA	NA	2E-06	0.1	2E-07	0.07	3E-06	0.2
Future Residential Child	NA	NA	2E-05	0.9	4E-07	0.1	2E-05	1
Future Residential Age-Adjusted	NA	NA	2E-05	NA	6E-07	NA	2E-05	--
Future Construction Worker	2E-07	0.00004	3E-07	0.3	7E-09	0.0	5E-07	0.3
Future Other Worker	NA	NA	6E-07	0.03	4E-08	0.005	6E-07	0.04
Sediment								
Future Resident Child	NA	NA	1E-06	0.07	2E-06	0.2	3E-06	0.2

Risk = carcinogenic risk as determined by the risk calculations in Appendix.

HI = Hazard index as determined by the risk calculation in Appendix.

N/A - could not be calculated because incomplete exposure pathway or no toxicity values for COPCs.

RME Risk Drivers for Site 4

Media: Deep Groundwater

	Current/Future Residential Adult								Current/Future Residential Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Chloroform	5	0.02	0.0005	4.8	1E-05	5E-07	1E-08	1E-05	NA	0.06	0.001	0.06	NA	3E-07	6E-09	3E-07
Arsenic	NA	0.8	0.002	0.8	NA	9E-05	2E-07	9E-05	NA	1	0.003	1	NA	5E-05	1E-07	5E-05
Barium	NA	0.2	0.0005	0.2	NA	NA	NA	NA	NA	0.4	0.001	0.4	NA	NA	NA	NA
Iron	NA	8	0.08	8	NA	NA	NA	NA	NA	15	0.2	15	NA	NA	NA	NA
Manganese	NA	17	0.1	17	NA	NA	NA	NA	NA	40	0.3	40	NA	NA	NA	NA
Totals	5	24	0.2	29	1E-05	9E-05	3E-07	1E-04	NA	56	0.5	57	NA	5E-05	1E-07	5E-05

Media: Soil

	Future Residential Adult								Future Residential Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Aroclor-1260	NA	NA	NA	NA	NA	6E-07	4E-07	1E-06	NA	NA	NA	NA	NA	2E-06	2E-07	2E-06
Benzo(a)Anthracene	NA	NA	NA	NA	NA	7E-07	NA	7E-07	NA	NA	NA	NA	NA	2E-06	NA	2E-06
Benzo(a)Pyrene	NA	NA	NA	NA	NA	8E-06	NA	8E-06	NA	NA	NA	NA	NA	2E-05	NA	2E-05
Benzo(b)Fluoranthene	NA	NA	NA	NA	NA	9E-07	NA	9E-07	NA	NA	NA	NA	NA	2E-06	NA	2E-06
Dibenz(a,h)Anthracene	NA	NA	NA	NA	NA	1E-06	NA	1E-06	NA	NA	NA	NA	NA	3E-06	NA	3E-06
Aluminum	NA	0.02	0.009	0.03	NA	NA	NA	NA	NA	0.2	0.02	0.2	NA	NA	NA	NA
Antimony	NA	0.02	0.02	0.05	NA	NA	NA	NA	NA	0.2	0.04	0.3	NA	NA	NA	NA
Arsenic	NA	0.2	0.05	0.2	NA	2E-05	8E-06	3E-05	NA	1	0	2	NA	6E-05	4E-06	6E-05
Chromium	NA	0.04	0.4	0.5	NA	NA	NA	NA	NA	0.06	0.1	0.2	NA	NA	NA	NA
Copper	NA	0.01	0.002	0.01	NA	NA	NA	NA	NA	0.1	0.003	0.1	NA	NA	NA	NA
Iron	NA	0.1	0.07	0.2	NA	NA	NA	NA	NA	1	0.1	2	NA	NA	NA	NA
Manganese	NA	0.02	0.2	0.2	NA	NA	NA	NA	NA	0.2	0.3	0.5	NA	NA	NA	NA
Nickel	NA	0.006	0.06	0.06	NA	NA	NA	NA	NA	0.06	0.1	0.2	NA	NA	NA	NA
Thallium	NA	0.02	0.002	0.02	NA	NA	NA	NA	NA	0.2	0.004	0.2	NA	NA	NA	NA
Vanadium	NA	0.02	0.07	0.09	NA	NA	NA	NA	NA	0.1	0.1	0.3	NA	NA	NA	NA
Totals	NA	0.5	0.9	1	NA	4E-05	8E-06	4E-05	NA	4	1	5	NA	8E-05	4E-06	9E-05

RME Risk Drivers for Site 4 (continued)

Media: Soil

Chemical	Future Construction Worker								Future Other Worker							
	HQ				CR				HQ				CR			
	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Benzo(a)Pyrene	NA	NA	NA	NA	4E-10	6E-07	NA	6E-07	NA	NA	NA	NA	NA	3E-06	NA	3E-06
Arsenic	NA	0.5	0.05	0.6	5E-10	2E-06	1E-07	2E-06	NA	0.06	0.01	0.07	NA	9E-06	2E-06	1E-05
Chromium	0.00005	0.02	0.06	0.08	4E-09	NA	NA	4E-09	NA	0.02	0.1	0.1	NA	NA	NA	NA
Iron	NA	0.5	0.06	0.6	NA	NA	NA	NA	NA	0.05	0.02	0.07	NA	NA	NA	NA
Totals	0.00005	1.1	0.2	1.2	5E-09	2E-06	1E-07	2E-06	NA	0.1	0.1	0.3	NA	1E-05	2E-06	1E-05

Media: Sediment

Chemical	Future Resident Child							
	HQ				CR			
	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Benzo(a)Pyrene	NA	NA	NA	NA	NA	1E-06	NA	1E-06
Arsenic	NA	0.2	0.6	0.8	NA	6E-06	2E-05	3E-05
Iron	NA	0.3	1.7	2.0	NA	NA	NA	NA
Totals	NA	0.4	2.3	2.8	NA	7E-06	2E-05	3E-05

Information on RME Risk Drivers for Site 4

	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration
Deep Groundwater (ug/l)				
Chloroform*	2/6	6.00E-01	9.00E+00	GW3D
Arsenic*	3/5	3.80E+00	6.50E+00	GW3D
Barium	5/5	6.50E+01	4.89E+02	GW1D
Iron*	5/5	9.12E+03	6.85E+04	GW1D
Manganese*	5/5	1.90E+03	1.25E+04	GW1D
Soil (mg/kg)				
Aroclor-1260	6/26	2.20E-02	6.30E+00	SS08
Benzo(a)Anthracene	23/26	3.90E-02	3.00E+00	SS11
Benzo(a)Pyrene	23/26	3.50E-02	2.30E+00	SS11
Benzo(b)Fluoranthene	23/26	7.90E-02	3.00E+00	SS11
Dibenz(a,h)Anthracene	3/26	1.00E-01	3.20E-01	SS11
Aluminum	26/26	3.91E+03	1.81E+04	SB01
Antimony	13/23	6.70E-01	5.35E+01	SB06
Arsenic*	26/26	1.90E+00	2.36E+02	SB06
Chromium	26/26	7.20E+00	6.80E+02	SS05
Copper	26/26	7.00E+00	8.74E+02	SS11
Iron	26/26	2.92E+03	6.51E+04	SS11
Manganese	26/26	3.86E+01	8.83E+02	SS11
Nickel	24/24	3.70E+00	5.46E+02	SS05
Thallium	6/26	5.00E-01	3.40E+00	SS01
Vanadium	26/26	1.12E+01	3.54E+02	SS04
Sediment (mg/kg)				
Benzo(a)Pyrene	8/9	7.10E-02	1.20E+00	SD04
Arsenic	9/9	3.90E+00	3.31E+01	SD03
Iron	9/9	1.05E+04	5.60E+04	SD01

*Constituent is also a risk driver for CT risk

Exposure Scenarios for Site 5

Media	Exposure Route	Current/Future				Future			
		Trespasser		Offsite Resident		Construction Worker	Other Worker	Onsite Resident	
		Adult	Adolescent	Adult	Child			Adult	Child
Surface Soil									
	Ingestion	X	X						
	Dermal	X	X						
	Inhalation	X	X						
Groundwater									
	Ingestion			X	X				
	Dermal			X	X				
	Inhalation			X					
Shallow Groundwater	Ingestion								
	Dermal					X			
	Inhalation								
Surface Water[1]									
	Ingestion								
	Dermal	X	X					X	X
	Inhalation								
Sediment[1]									
	Ingestion	X	X					X	X
	Dermal	X	X					X	X
	Inhalation								
Soil[2]									
	Ingestion					X	X	X	X
	Dermal					X	X	X	X
	Inhalation					X			

X Quantitative evaluation.

[1] Surface water and sediment exposure scenarios are for waders.

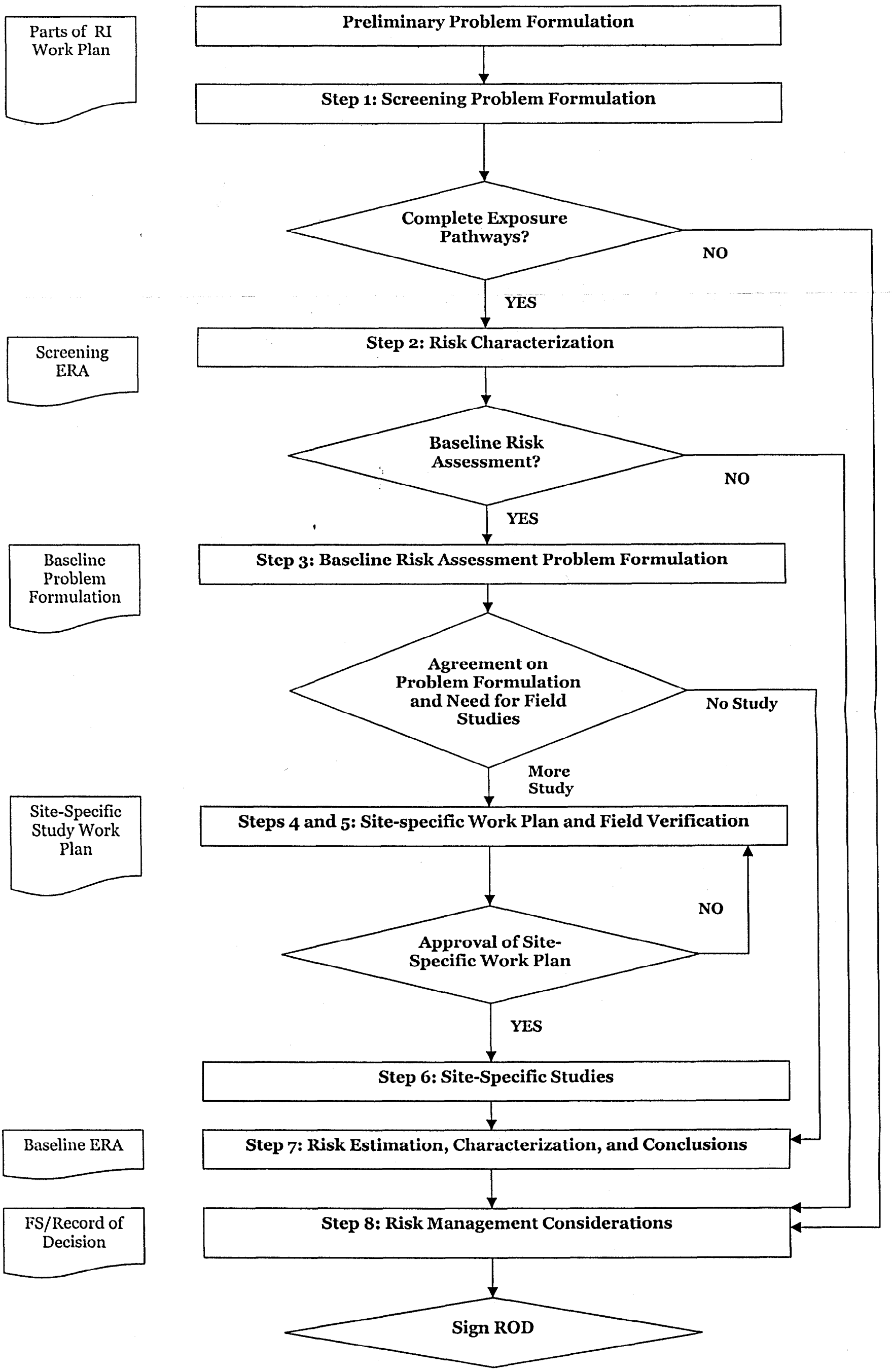
[2] Includes both surface soil and subsurface soil.

COPCs for Site 5

Surface Soil	Surface and Subsurface Soil	Surface Water	Sediment	Shallow Groundwater	Deep Groundwater
			*Current/Future***		
Benzo(a)Pyrene	Dioxin TEQ	Phosphorus	Phosphorus	Phosphorus	RDX
Phosphorus	4,4-DDT	Arsenic		Aluminum	Heptachlor
Arsenic	4,4-DDE	Iron		Antimony	Chloroform
Chromium	Benzo(a)Anthracene	Lead	*Future***	Arsenic	Phosphorus
Iron	Benzo(a)Pyrene*	Manganese	Phosphorus	Barium	Antimony
Lead	Benzo(b)Fluoranthene		Arsenic	Beryllium	Arsenic
	Dibenz(a,h)Anthracene		Iron	Cadmium	Iron
	Phosphorus*		Thallium	Chromium	Manganese
	Aluminum			Cobalt	
	Antimony			Iron	
	Arsenic*			Lead	
	Barium			Manganese	
	Cadmium			Nickel	
	Chromium*			Thallium	
	Copper			Vanadium	
	Iron*			Zinc	
	Lead*				
	Manganese				
	Thallium				
	Vanadium				
	Zinc				

* COPCs for both industrial and residential scenarios based on industrial RBC and residential RBCs, respectively

** COPCs for Current/Future were determined using an industrial RBC screen. COPCs for Future scenario were determined using a residential RBC screen.



ECOLOGICAL RISK ASSESSMENT PROCESS

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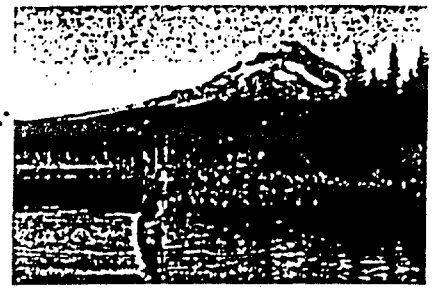
Ecological Risk Assessment Workshop

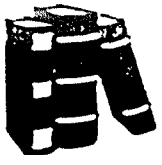


OVERVIEW

- What is an Ecological Risk Assessment?
  - A logical process that determines whether chemicals in site media have the potential to negatively impact ecological receptors at a site
    - Document actual or potential ecological risks
    - Identify which contaminants pose a risk
    - Generate data to be used in evaluating remedial options

OVERVIEW

- Primary guidance documents & policies used to develop this Workshop
  - EPA "8-Steps" (1994-1997)
  - DoD Tri-Service "3-Tiers" (1996)
  - CNO ERA Policy (1999)
  - Navy/Region III BTAG ERA Process (1999)



ERA PROCESS
Preliminary Planning

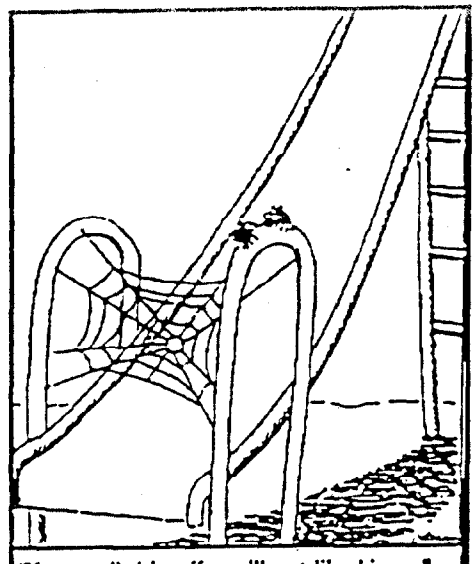
- Preliminary Problem Formulation
  - Completed prior to entering Step 1 of Process
  - Objective is data compilation and evaluation to allow initial planning of ERA
  - Gather & evaluate existing information
    - Historical use of site
    - Sampling results
    - Natural resources evaluations & inventories
  - Meeting and site visit

ERA PROCESS
STEP 1 - Screening Problem Formulation

- Problem Formulation Includes:
  - Environmental setting
  - Known/suspected contaminants
  - Contaminant fate & transport
  - Mechanisms of ecotoxicity
  - Exposure pathways
    - Preliminary Assessment Endpoints
- Generates initial Conceptual Model

ERA PROCESS
STEP 2 - Screening Risk Characterization

- Compares site chemical concentrations w/conservatively derived screening values
  - Chronic exposures
  - NOEC/NOAEL
- Components:
  - Screening effects evaluation
  - Screening exposure estimate
  - Risk calculation
- Conservative



"If we pull this off, we'll eat like kings."

ERA PROCESS
Step 3 - Baseline ERA Problem Formulation

- Refines the Screening Problem Formulation
  - What is refined:
    - COPCs
    - Ecological effects of COPCs
    - Conceptual Model
      - Contaminant fate & transport
      - Complete exposure pathways
    - Assessment endpoints
    - Measurement endpoints
    - Risk hypotheses

ERA PROCESS
Step 4 - Site-Specific Study/WP

- Problem Formulation
  - Scoping additional studies
    - Develop additional lines of evidence
    - Eco Subgroup
- Work Plan (WP) Components
  - Data Quality Objectives (DQOs)
  - Field methods
  - Field Sampling Plan
  - Data evaluation methods
  - Contingencies
- Agreement/approval of WP

ERA Process
Step 4 - Site-Specific Study/WP

- Types of Studies
  - Specific to identified needs/data gaps at site
    - Linked to endpoints and risk hypotheses
  - Examples:
    - Biological sampling
    - Bioavailability
    - Toxicity testing
    - Tissue residue/bioaccumulation
  - Reference areas/concentration gradients

ERA PROCESS
Step 5 - Field Verification of Site-Specific Study

- Problem Formulation
- Check to ensure study is appropriate and implementable
- Prior to Work Plan approval

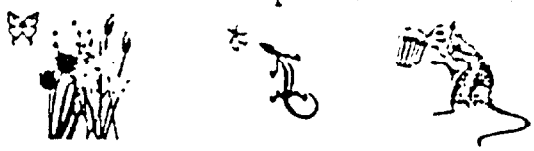
ERA Process
Step 6 - Site-Specific Study

- Conduct field studies
  - As specified in Work Plan
  - Field changes may be necessary but should be minimal
    - Field changes require prior approval
  - Validate data
- Tabulate data

Keep on Crunchin'

ERA PROCESS
Step 7 - Risk Characterization

- Synthesis & analysis of all data/evaluations from previous steps
- Integration of exposure and effects
- Determine likelihood, magnitude and areal extent of risk
  - Linked to assessment endpoints



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ERA PROCESS
Step 7 - Risk Characterization

- Relies on evaluation methods agreed to in Step 4 Work Plan
- Based on weighting of lines of evidence
- Uncertainties
  - Degree of confidence in risk estimates
  - Exposure/effects assumptions
  - Natural variation
  - Measurement error
  - Model limitations and assumptions

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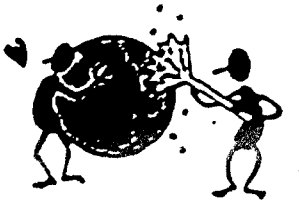
ERA PROCESS

Step 8 - Risk Management

- Eco risk is only one of many decision inputs
- Eco risk assessor input can help answer:
  - Is the remedy protective?
  - Is the reduction in risk worth the effort?
  - Is the cure worse than the disease?



St. Juliens Creek

Sites 2 and 4
Screening-Level Ecological Risk Assessment (SERA) and Refinement of SERA

St. Juliens Creek
Sites 2 and 4 SERA

- Overview
- Site 2 Landfill B
- Site 4 Landfill D
- Conclusions

Presentation of Each Site

- Overview
- Screening-level ERA (SERA)Problem Formulation
- Screening-level ERA COPC Identification
- Conclusions from SERA
- Realistic Refinement Step; Step 3a of the Baseline Ecological Risk Assessment (BERA)

Presentation of Each Site

- Conclusion Based on Refinement Step 3a
  - COPCs-Screening
  - Food Chain Exposure

St. Juliens Creek

Site 2 Landfill B

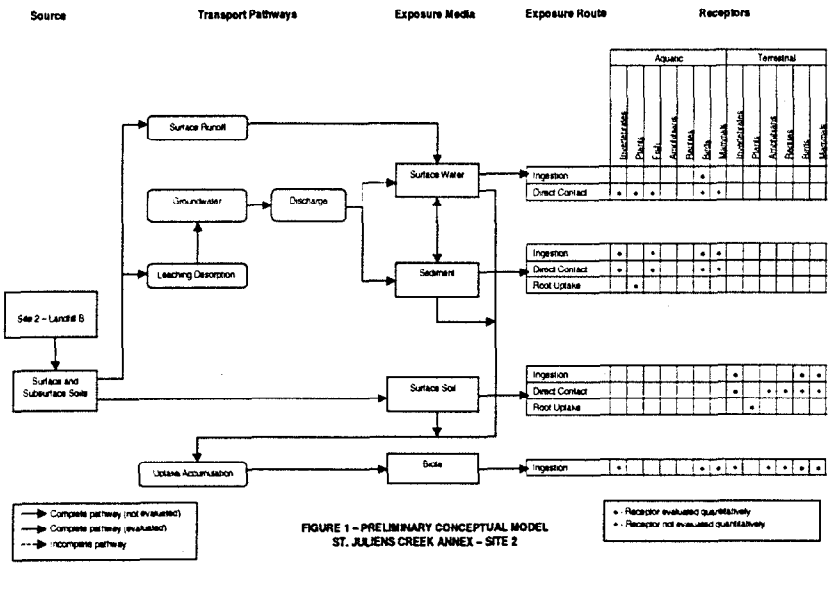


FIGURE 1 - PRELIMINARY CONCEPTUAL MODEL
ST. JULIENS CREEK ANNEX - SITE 2

Site 2 Landfill B

Assessment Endpoints, Risk Hypotheses, Measurement Endpoints, and Receptor Species

Assessment Endpoints	Risk Hypotheses	Measurement Endpoint	Receptor Species
Protection of soil invertebrate communities from the toxic effects (on survival and growth) of site-related chemicals present in surface soil	Are levels of site-related chemicals present in surface soils sufficient to cause adverse effects on the survival and growth of soil invertebrates at the site?	Comparison of exposure HQs to a reference HQ of 1.0. Exposure HQs are calculated for individual chemicals by dividing the soil concentrations by an invertebrate-based soil screening values. A reference HQ of 1.0 represents a condition where the soil concentrations are equal to the screening values	Soil invertebrates
Protection of aquatic receptors (invertebrates and fish) communities from the toxic effects (on survival and growth) of site-related chemicals present in sediment and surface water	Are levels of site-related chemicals present in sediment and surface water sufficient to cause adverse effects on the survival and growth of aquatic receptors at the site?	Comparison of exposure HQs to a reference HQ of 1.0. Exposure HQs are calculated for individual chemicals by dividing the sediment and surface water concentrations by an invertebrate-based sediment and surface water screening values. A reference HQ of 1.0 represents a condition where the sediment and surface water concentrations equal to the screening values	Aquatic receptors (invertebrates and fish)
Protection of semiaquatic herbivorous, sometimes omnivorous, mammals to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of herbivorous mammals using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value.	Muskrat
Protection of insectivorous mammals to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of insectivorous mammals using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Short-tailed shrew
Protection of omnivorous birds to ensure that ingestion of contaminants in soil, prey, and forage does not have negative impacts on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of omnivorous birds using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Robin
Protection of carnivorous, sometimes insectivorous, birds to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of carnivorous birds using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Heron

Site 2 Landfill B Screening-level COPC

- Surface Water (15 Total)
  - Conc > SV -- 9 Inorganics, 1 VOC, 1 Pesticide
  - No SV -- 3 Inorganics, 1 VOC
- Sediment (40 Total)
  - Conc > SV -- 14 Inorganics, 11 SVOCs, 6 Pesticides, 1 PCB
  - No SV -- 2 Inorganics, 6 VOCs

Site 2 Landfill B Screening-level COPC

- Soil (42 Total)
  - Conc > SV -- 15 Inorganics, 14 SVOCs, 1 PCB, 3 Pesticides
  - No SV -- 6 SVOCs, 2 VOCs, 1 Pesticide
- Food Web (40 Total)
  - 17 Inorganics, 15 SVOCs, 1 PCB, 7 pesticides

Site 2 Landfill B Screening-level ERA

- Conclusion
  - One or more COPCs were identified in each of the media, thus additional evaluation in Step 3 is recommended

Site 2 Landfill B
Step 3a--Realistic Refinement Steps

- Used average chemical concentrations instead of maximum detected values when completing the media screening and the Food Chain Exposure models.
- Used average receptor species, body weights, and food ingestion rates instead of minimum body weights and maximum ingestion rates.
- Calculated realistic site use factors based upon actual home range or territory size instead of the conservative assumption that the receptor species home range was equal to the area of the site.

Site 2 Landfill B
Step 3a—Refined COPC

- Surface Water (13 Total)
  - Conc > SV -- 7 Inorganics, 1 VOC, 1 Pesticide
  - No SV -- 3 Inorganics, 1 VOC
- Sediment (32 Total)
  - Conc > SV -- 10 Inorganics, 7 SVOCs, 6 Pesticides, 1 PCB
  - No SV -- 2 Inorganics, 6 VOCs

Site 2 Landfill B
Step 3a—Refined COPC

- Soil (34 Total)
  - Conc > SV -- 10 Inorganics, 12 SVOCs, 3 Pesticides
  - No SV -- 6 SVOCs, 2 VOCs, 1 Pesticide
- Food Web (27 Total)
  - 11 Inorganics, 10 SVOCs, 1 PCB, 5 Pesticides

Site 2 Landfill B
Realistic Refinements, Step 3a of the Baseline ERA

- Conclusions
  - Using average concentrations instead of maximum values one or more COPCs were identified in each of the media thus additional evaluation under Step 3 (BERA) is recommended.
  - Using realistic exposure assumptions, risk due to exposure via the food chain was indicated for the muskrat, shrew, robin, woodcock, raccoon, and deer mouse. Further evaluation of the risk to these receptors will be made under Step 3 (completion of the BERA).

St. Juliens Creek

Site 4 Landfill D

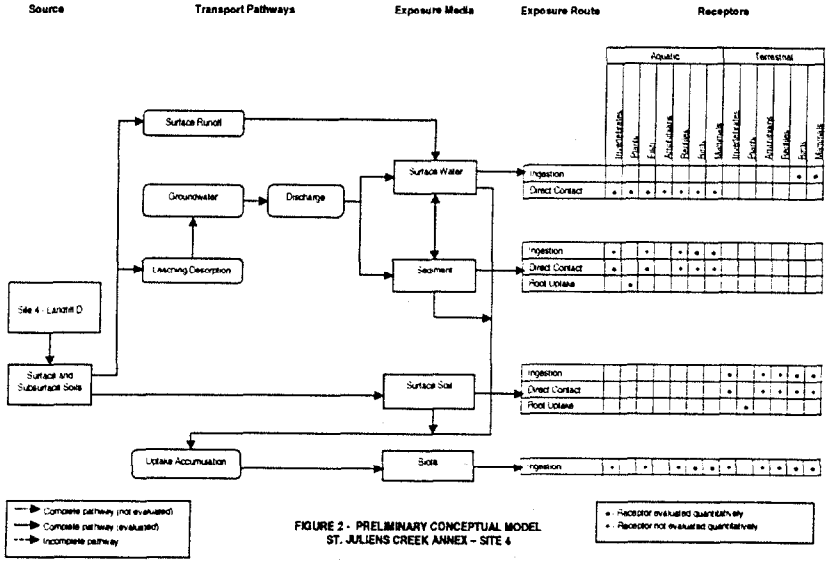


FIGURE 2 - PRELIMINARY CONCEPTUAL MODEL
ST. JULIENS CREEK ANNEX – SITE 4

Site 4 Landfill D

Assessment Endpoints, Risk Hypotheses, Measurement Endpoints, and Receptor Species

Assessment Endpoints	Risk Hypotheses	Measurement Endpoint	Receptor Species
Protection of soil invertebrate communities (from the toxic effects (on survival and growth) of site-related chemicals present in surface soil	Are levels of site-related chemicals present in surface soils sufficient to cause adverse effects on the survival and growth of soil invertebrates at the site?	Comparison of exposure HQs to a reference HQ of 1.0. Exposure HQs are calculated for individual chemicals by dividing the soil concentrations by an invertebrate-based soil screening values. A reference HQ of 1.0 represents a condition where the soil concentration is equal to the screening values	Soil invertebrates
Protection of aquatic receptors (invertebrates and fish) communities from the toxic effects (on survival and growth) of site-related chemicals present in sediment and surface water	Are levels of site-related chemicals present in sediment and surface water sufficient to cause adverse effects on the survival and growth of aquatic receptors at the site?	Comparison of exposure HQs to a reference HQ of 1.0. Exposure HQs are calculated for individual chemicals by dividing the sediment and surface water concentrations by an invertebrate-based sediment and surface water screening values. A reference HQ of 1.0 represents a condition where the sediment and surface water concentration is equal to the screening values	Aquatic receptors (invertebrates and fish)
Protection of semiaquatic herbivorous, sometimes omnivorous, mammals to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of herbivorous mammals using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Muskrat
Protection of insectivorous mammals to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of insectivorous mammals using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Short-tailed shrew
Protection of omnivorous birds to ensure that ingestion of contaminants in soil, prey, and forage does not have negative impacts on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of omnivorous birds using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Robin
Protection of carnivorous, sometimes insectivorous, birds to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of carnivorous birds using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Heron

Site 4 Landfill D Screening-level COPC

- Surface Water (25 Total for Both Marine and Freshwater)
  - Marine
    - Conc > SV -- 8 Inorganics
    - No SV -- 2 Inorganics
  - Freshwater
    - Conc > SV -- 13 Inorganics, 1 VOC
    - No SV -- 1 SVOC

Site 4 Landfill D
Screening-level COPC

- Sediment (57 Total Both Marine and Freshwater)
  - Marine
    - Conc > SV -- 12 Inorganics, 8 SVOCs, 1 Pesticide
    - No SV -- 3 VOCs
  - Freshwater
    - Conc > SV -- 12 Inorganics, 12 SVOCs, 1 PCB, 4 Pesticides
    - No SV -- 2 Inorganics, 2 VOCs

Site 4 Landfill D
Screening-level COPC

- Soil (37 Total)
  - Conc > SV -- 14 Inorganics, 12 SVOCs, 1 PCB, 1 Pesticide
  - No SV -- 7 SVOCs, 2 VOCs
- Food Web (38 Total)
  - 17 Inorganics, 15 SVOCs, 1 PCB, 5 Pesticides

Site 4 Landfill D
Screening-level ERA

- Conclusion
  - One or more COPCs were identified in each of the media, thus additional evaluation in Step 3 is recommended

Site 4 Landfill D
Step 3a--Realistic Refinement Steps

- Used average chemical concentrations instead of maximum detected values when completing the media screening and the Food Chain Exposure models.
- Used average receptor species, body weights, and food ingestion rates instead of minimum body weights and maximum ingestion rates.
- Calculated realistic site use factors based upon actual home range or territory size instead of the conservative assumption that the receptor species home range was equal to the area of the site.

Site 4 Landfill D
Step 3a—Refined COPC

- Surface Water (21 Total for Both Marine and Freshwater)
  - Marine
    - Conc > SV -- 6 Inorganics
    - No SV -- 2 Inorganics
  - Freshwater
    - Conc > SV -- 11 Inorganics, 1 VOC
    - No SV -- 1 SVOC

Site 4 Landfill D
Step 3a—Refined COPC

- Sediment (44 Total for Both Marine and Freshwater)
  - Marine
    - Conc > SV -- 8 Inorganics, 5 SVOCs, 1 Pesticide
    - No SV -- 3 VOCs
  - Freshwater
    - Conc > SV -- 6 Inorganics, 12 SVOCs, 1 PCB, 4 Pesticides
    - No SV -- 2 Inorganics, 2 VOCs

Site 4 Landfill D
Step 3a—Refined COPC

- Soil (31 Total)
  - Conc > SV -- 9 Inorganics, 11 SVOCs, 1 PCB, 1 Pesticide
  - No SV -- 7 SVOCs, 2 VOCs
- Food Web (26 Total)
  - 12 Inorganics, 11 SVOCs, 1 PCB, 2 Pesticides

Site 2 Landfill B
Realistic Refinements, Step 3a of the Baseline ERA

- Conclusion
  - Using average concentrations instead of maximum concentrations one or more COPCs were identified in each media thus additional evaluation under Step 3 (BERA) is recommended.
  - Using realistic exposure assumptions, risk due to exposure via the food chain was indicated for the muskrat, shrew, robin, hawk, woodcock, raccoon, fox, and mouse. Further evaluation of the risk to these receptors will be made under Step 3 (completion of the BERA).

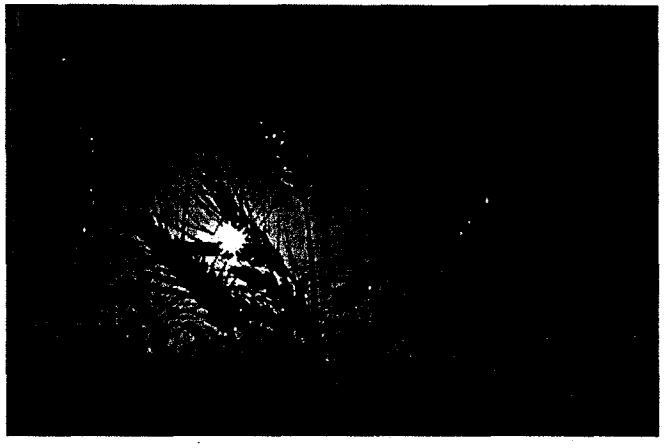
St. Juliens Creek

Uncertainty

Screening-Level ERA and Baseline ERA Uncertainty

- Detection limits
- No screening values (SVs)
- Total vs. dissolved metals in water
- No site-specific bioavailability
- Lack of species-specific toxicities, life history parameters, bioaccumulation factors
- Chemical Mixtures

RISK ASSESSMENT



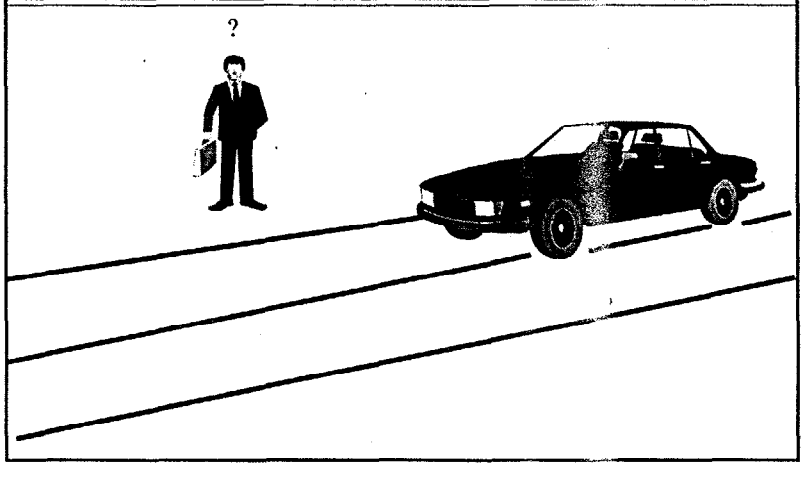
Overview

- Definitions
- Uses of Risk Assessment
- Components of the Risk Assessment Process
- New Directions in Risk Assessment
- Communicating Risks

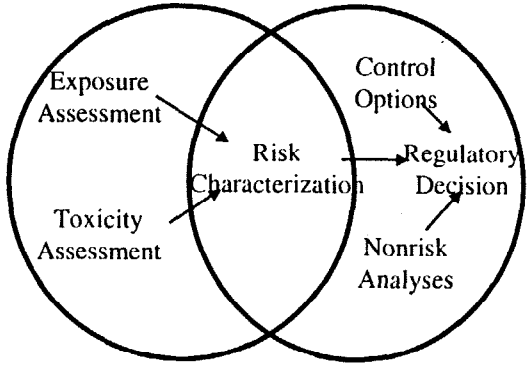
Definitions

- Risk: The Likelihood of injury or disease Resulting from Exposure to Potential Hazard
- Safety: The probability of no adverse occurrences under a specific set of circumstances
- Risk Assessment: The science of evaluating the potential for adverse occurrences

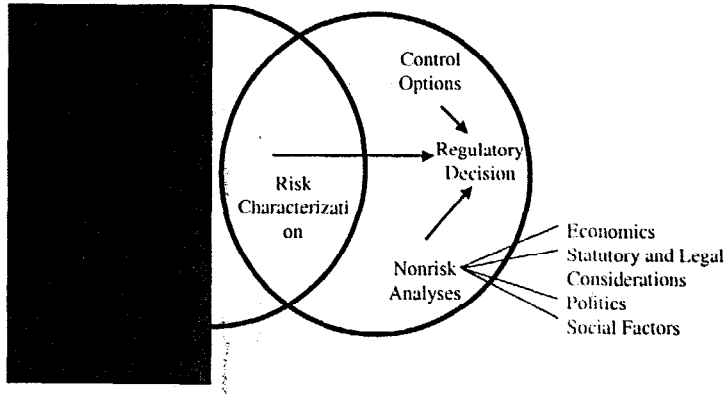
Risk Assessment is Something we all do



Risk Assessment -vs- Risk Management



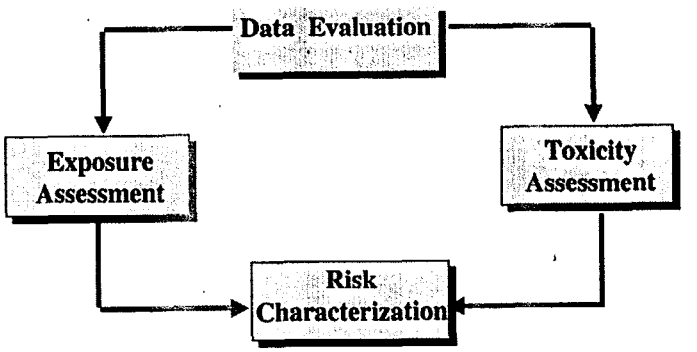
Risk Management



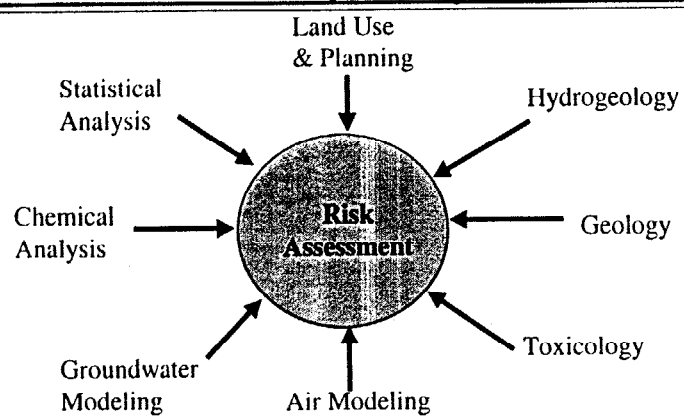
Principal Uses of Risk Assessment

- Baseline (no-action) Risk
  - How bad is it now?
  - How bad could it become if nothing is done?
- Prioritization of Remedial Alternatives
  - Which alternative reduces risk the most?
- Cleanup Goal Identification
  - What concentrations can be left behind?

Elements of Risk Assessment



Risk Assessment is a Multi-Disciplinary Process

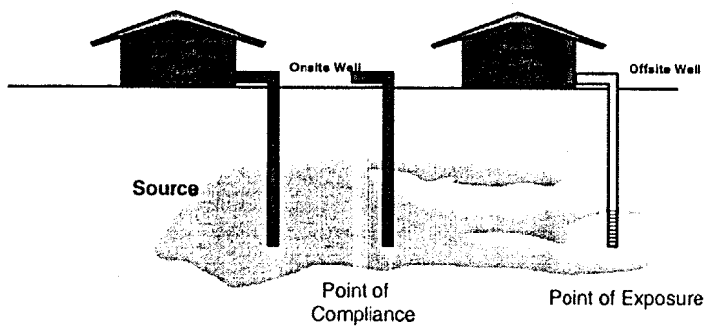


Exposure Concentrations

Things to Consider

- How were concentrations aggregated?
  - Hot spot averaged in?
- Over What Time Period Were Data Generated?
  - Seasonal Fluctuations?
  - Attenuation?
- Groundwater Filtered or Unfiltered?

Estimation of Exposure Point Concentrations



Human Exposure Evaluation

- Who is potentially exposed?
- How many people are potentially exposed?
- Through which routes?
- What is the magnitude, frequency, and duration of possible exposure?

Who Could Be Exposed?

- Residents
- Workers
- Visitors or Trespassers
- Sensitive Subpopulations
  - School children
- Future Population Groups

How Might They Be Exposed?

- Exposure Route
  - Ingestion
  - Inhalation
  - Skin contact
- Environmental Medium
  - Soil
  - Water
  - Food
  - Air

Elements of a Complete Exposure Pathway

[redacted]

Fuel Tank

Leaks

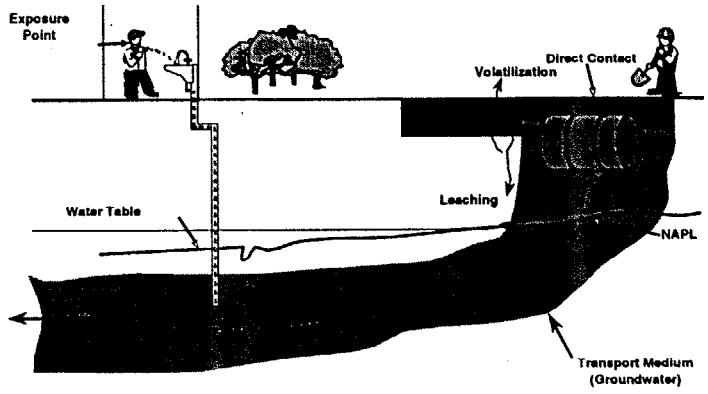
Groundwater

Ingestion

Downgradient Well

Future Worker

Exposure Pathway Analysis



Five Basic Variables Used to Estimate Intake

- Exposure Point Concentrations: [redacted]
- Media Contact Rate: [redacted]
- Exposure Frequency/Duration: [redacted]
- Body Weight: [redacted]
- Exposure Averaging Time: [redacted]

Use of "Default" Exposure Assumptions Results in Multiplicative Conservatism

$$\text{Intake} = \frac{\text{Concentration} \times \text{Medium Intake Rate} \times \text{Exposure Frequency} \times \text{Exposure Duration}}{\text{[redacted]} \times \text{[redacted]}}$$

Upper Bound Value

[redacted]

Thus, RME intake > 99.9th percentile !

Toxicity Evaluation

**"All substances are poisons.
The right dose differentiates
between a poison and a remedy."**

Philipus Aureolus Theophrastus Bonmastes von Hohenheim-Paracelsus (1493-1541)

Risk Characterization

- Noncarcinogenic Risks:
  are expressed as a ratio of predicted dose to an estimated allowable dose

- Carcinogenic Risks:
  are quantitatively expressed as a probability over a specific period of time (lifetime)

Toxicity Values for Carcinogens

The dose-response relationship for cancer effects is expressed as a cancer slope factor (CSF). The CSF is route-specific and is derived as the <u>upper confidence limit on the slope</u> of the dose-response curve.

Cancer Slope Factor = Excess lifetime cancer risk per level of intake

= Risk per mg/kg-day

e.g., for benzene, the CSF is 0.029 per mg/kg-day

Sources of Toxicity Values

- USEPA's Integrated Risk Information System (IRIS) Database
- USEPA Health Effects Assessment Summary Tables (HEAST), Annual update

What Does One-in-a-Million Mean?

Comparison Table

Unit	Equivalent
Length	One foot per 192 miles
Time	One minute per 2 years
Weight	One pound of salt per 500 tons of pretzels
Volume	One ounce vermouth per 7,800 gallons gin
Area	One square foot per 23 acres
Action	One bogey per 56,000 rounds of golf
Quality	One bad apple per 2,000 barrels

Uncertainty versus Variability

- Uncertainty: Represents lack of knowledge. Gathering more data reduces uncertainty. (e.g., lifestyle)

- Variability: Arises from true heterogeneity in characteristics. Gathering more data does not reduce variability. (e.g., body weight)

Comparison to Everyday Risks

Activities Increasing Chance of Death by One in a Million Yearly	Cause of Death
Smoking 1.4 cigarettes	Cancer, Heart disease
Traveling 300 miles by car	Accident
Traveling 10 miles by bicycle	Accident
Traveling 6 minutes by canoe	Accident
Flying 6000 miles by jet	Cancer for cosmic radiation
Living 2 months in Denver	Cancer for cosmic radiation
Drinking 30 12-ounce diet sodas	Cancer from saccharin
Eating 100 charbroiled steaks	Cancer from benzo(a)pyrene
One chest X-ray	Cancer from radiation
Eating 40 Tbs of peanut butter	Cancer from aflatoxin
Drinking 1/2 liter of wine	Cirrhosis of the liver

Conclusion

Three General Principles of Risk Assessment

- Toxicity is not the same as risk
- With no exposure, there is no risk
- Zero risk does not exist

Ecological Risk Assessment Workshop

OVERVIEW

- What is an Ecological Risk Assessment?
  - A logical process that determines whether chemicals in site media have the potential to negatively impact ecological receptors at a site
    - Document actual or potential ecological risks
    - Identify which contaminants pose a risk
    - Generate data to be used in evaluating remedial options

OVERVIEW

- Primary guidance documents & policies used to develop this Workshop
  - EPA "8-Steps" (1994-1997)
  - DoD Tri-Service "3-Tiers" (1996)
  - CNO ERA Policy (1999)
  - Navy/Region III BTAG ERA Process (1999)

ERA PROCESS
Preliminary Planning

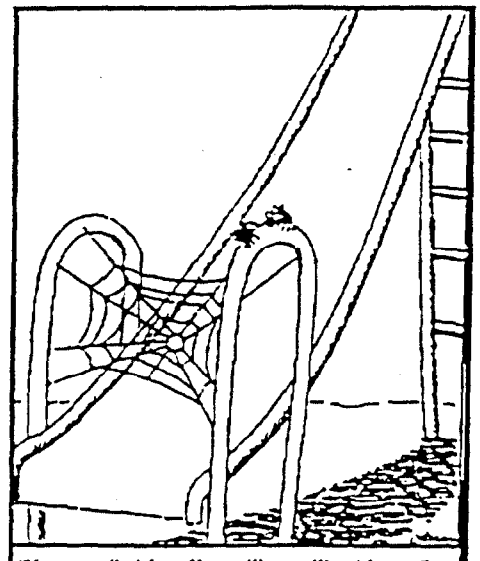
- Preliminary Problem Formulation
  - Completed prior to entering Step 1 of Process
  - Objective is data compilation and evaluation to allow initial planning of ERA
  - Gather & evaluate existing information
    - Historical use of site
    - Sampling results
    - Natural resources evaluations & inventories
  - Meeting and site visit

ERA PROCESS
STEP 1 - Screening Problem Formulation

- Problem Formulation Includes:
  - Environmental setting
  - Known/suspected contaminants
  - Contaminant fate & transport
  - Mechanisms of ecotoxicity
  - Exposure pathways
    - Preliminary Assessment Endpoints
- Generates initial Conceptual Model

ERA PROCESS
STEP 2 - Screening Risk Characterization

- Compares site chemical concentrations w/conservatively derived screening values
  - Chronic exposures
  - NOEC/NOAEL
- Components:
  - Screening effects evaluation
  - Screening exposure estimate
  - Risk calculation
- Conservative



"If we pull this off, we'll eat like kings."

ERA PROCESS
Step 3 - Baseline ERA Problem Formulation

- Refines the Screening Problem Formulation
  - What is refined:
    - COPCs
    - Ecological effects of COPCs
    - Conceptual Model
      - Contaminant fate & transport
      - Complete exposure pathways
    - Assessment endpoints
    - Measurement endpoints
    - Risk hypotheses

ERA PROCESS
Step 4 - Site-Specific Study/WP

- Problem Formulation
  - Scoping additional studies
    - Develop additional lines of evidence
    - Eco Subgroup
- Work Plan (WP) Components
  - Data Quality Objectives (DQOs)
  - Field methods
  - Field Sampling Plan
  - Data evaluation methods
  - Contingencies
- Agreement/approval of WP

ERA Process
Step 4 - Site-Specific Study/WP

- Types of Studies
  - Specific to identified needs/data gaps at site
    - Linked to endpoints and risk hypotheses
  - Examples:
    - Biological sampling
    - Bioavailability
    - Toxicity testing
    - Tissue residue/bioaccumulation
  - Reference areas/concentration gradients

ERA PROCESS
Step 5 - Field Verification of Site-Specific Study

- Problem Formulation
- Check to ensure study is appropriate and implementable
- Prior to Work Plan approval

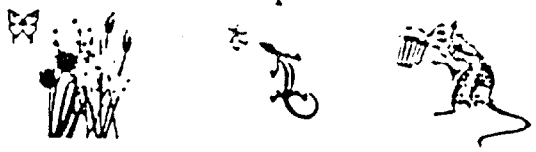
ERA Process
Step 6 - Site-Specific Study

- Conduct field studies
  - As specified in Work Plan
  - Field changes may be necessary but should be minimal
    - Field changes require prior approval
  - Validate data
- Tabulate data

Keep on Crunchin'

ERA PROCESS
Step 7 - Risk Characterization

- Synthesis & analysis of all data/evaluations from previous steps
- Integration of exposure and effects
- Determine likelihood, magnitude and areal extent of risk
  - Linked to assessment endpoints



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ERA PROCESS
Step 7 - Risk Characterization

- Relies on evaluation methods agreed to in Step 4 Work Plan
- Based on weighting of lines of evidence
- Uncertainties
  - Degree of confidence in risk estimates
  - Exposure/effects assumptions
  - Natural variation
  - Measurement error
  - Model limitations and assumptions

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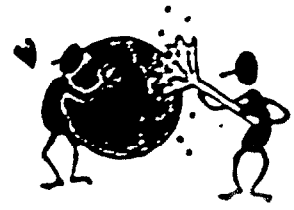
ERA PROCESS

Step 8 - Risk Management

- Eco risk is only one of many decision inputs
- Eco risk assessor input can help answer:
  - Is the remedy protective?
  - Is the reduction in risk worth the effort?
  - Is the cure worse than the disease?



St. Juliens Creek Annex

Landfill B (Site 2) and Landfill D (Site 4) Remedial Investigation

Preliminary Results

Remedial Investigation Objectives

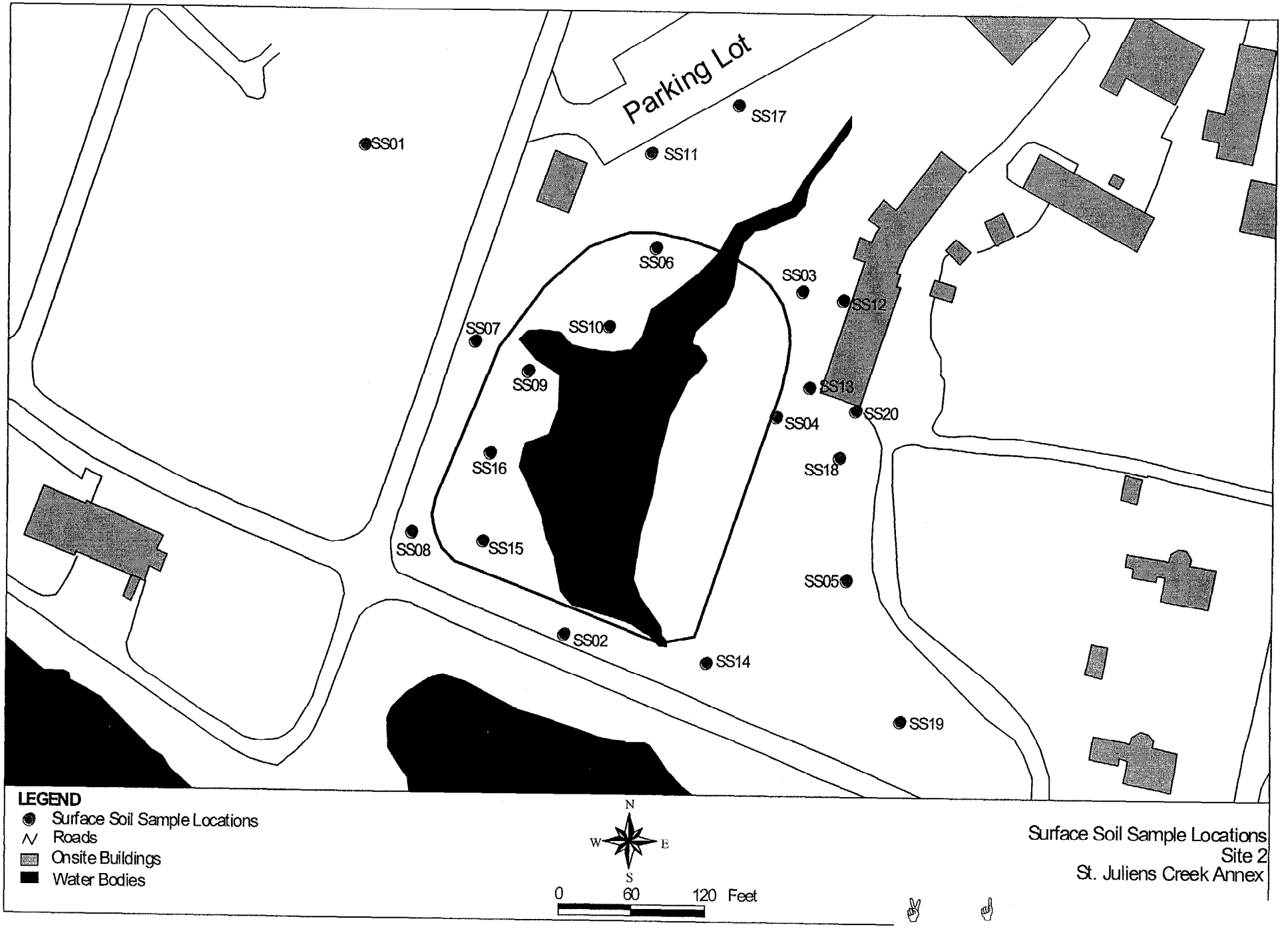
- Determine Contaminants of Concern
- Delineate the Extent of Contamination
- Determine Potential Risk to Human Health
- Determine Potential Risk to the Environment

LEGEND

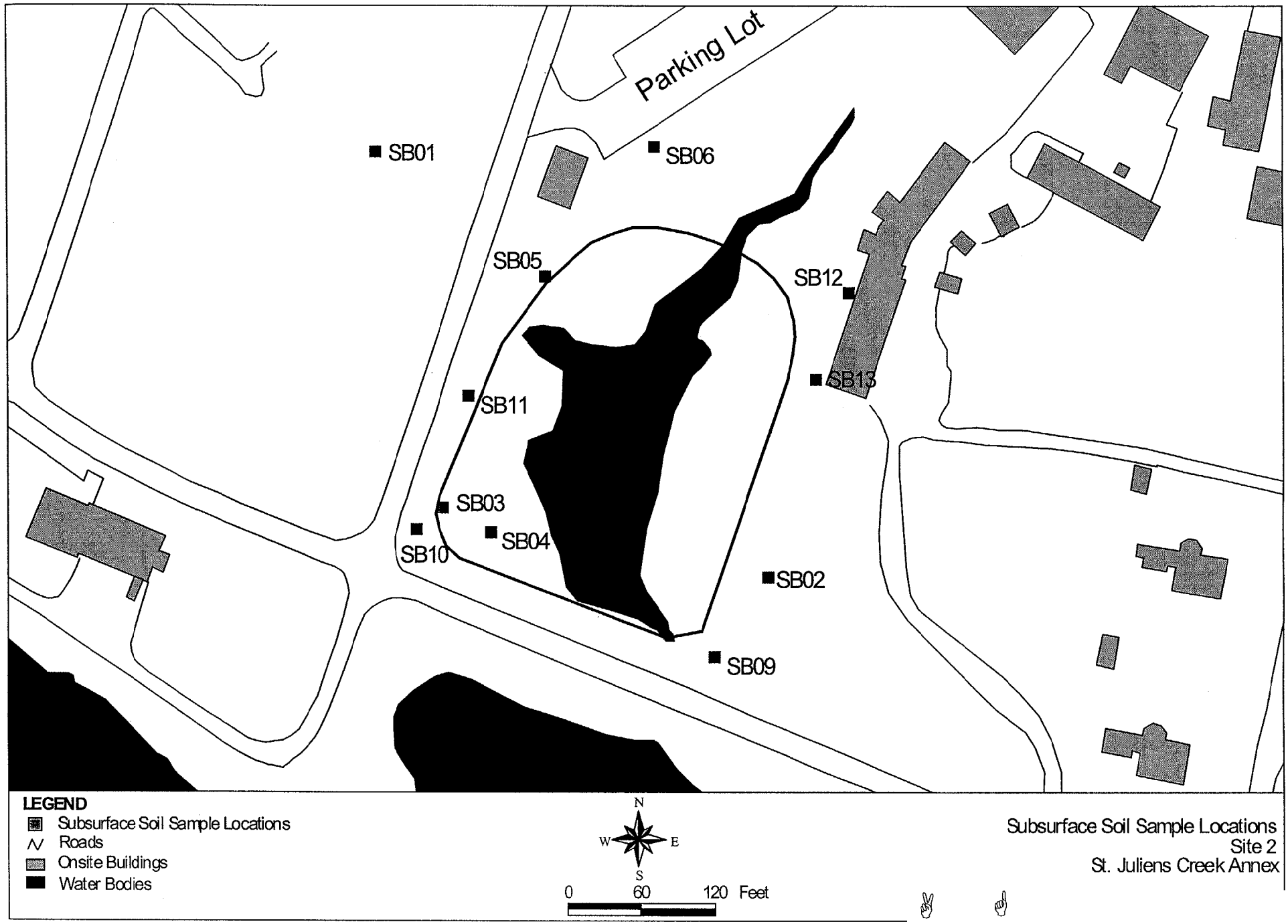
N

Landfill B - Field Investigation

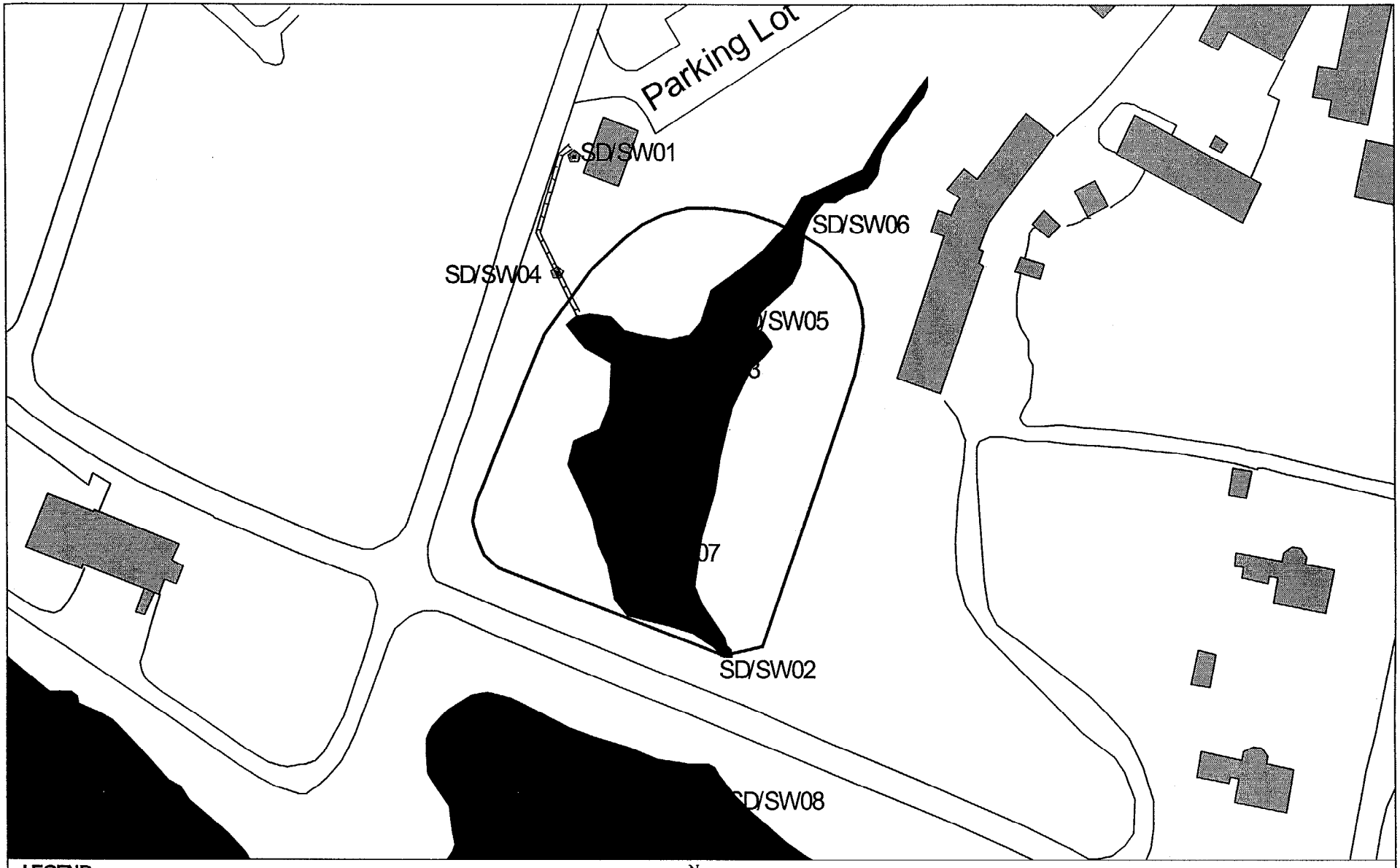
- Surface Geophysical Surveys
- Surface water and sediment sample collection
- Surface and subsurface soil sample collection
- Ground water investigation of water-table and Upper Yorktown Aquifers
- Tidal study



Surface Soil Sample Locations
Site 2
St. Juliens Creek Annex



Subsurface Soil Sample Locations
Site 2
St. Juliens Creek Annex



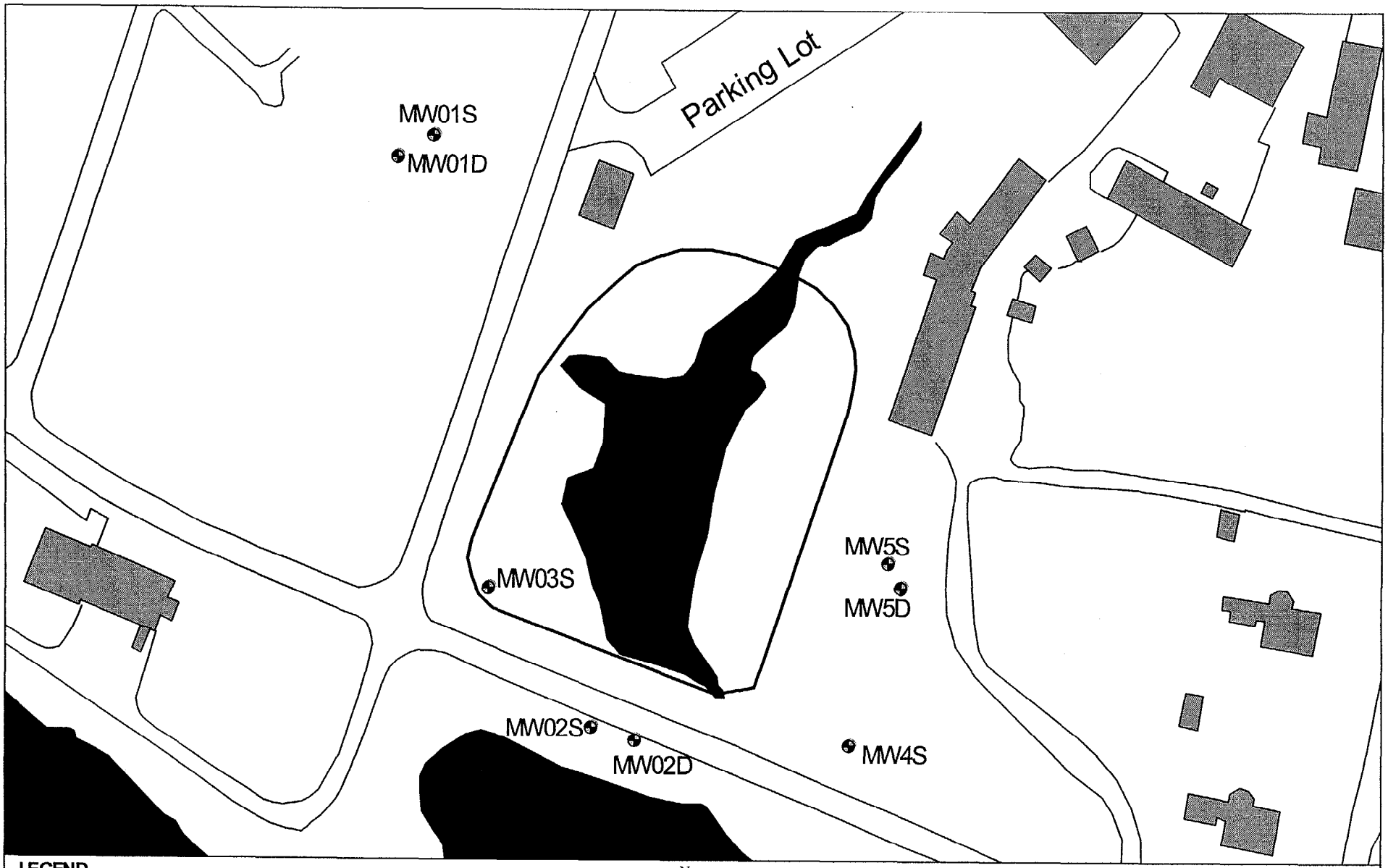
LEGEND

- Sediment & Surface Water Sample Locations
- Roads
- Onsite Buildings
- Water Bodies

N
W E
S

0 60 120 Feet

Sediment and
Surface Water Sample Locations
Site 2
St. Juliens Creek Annex



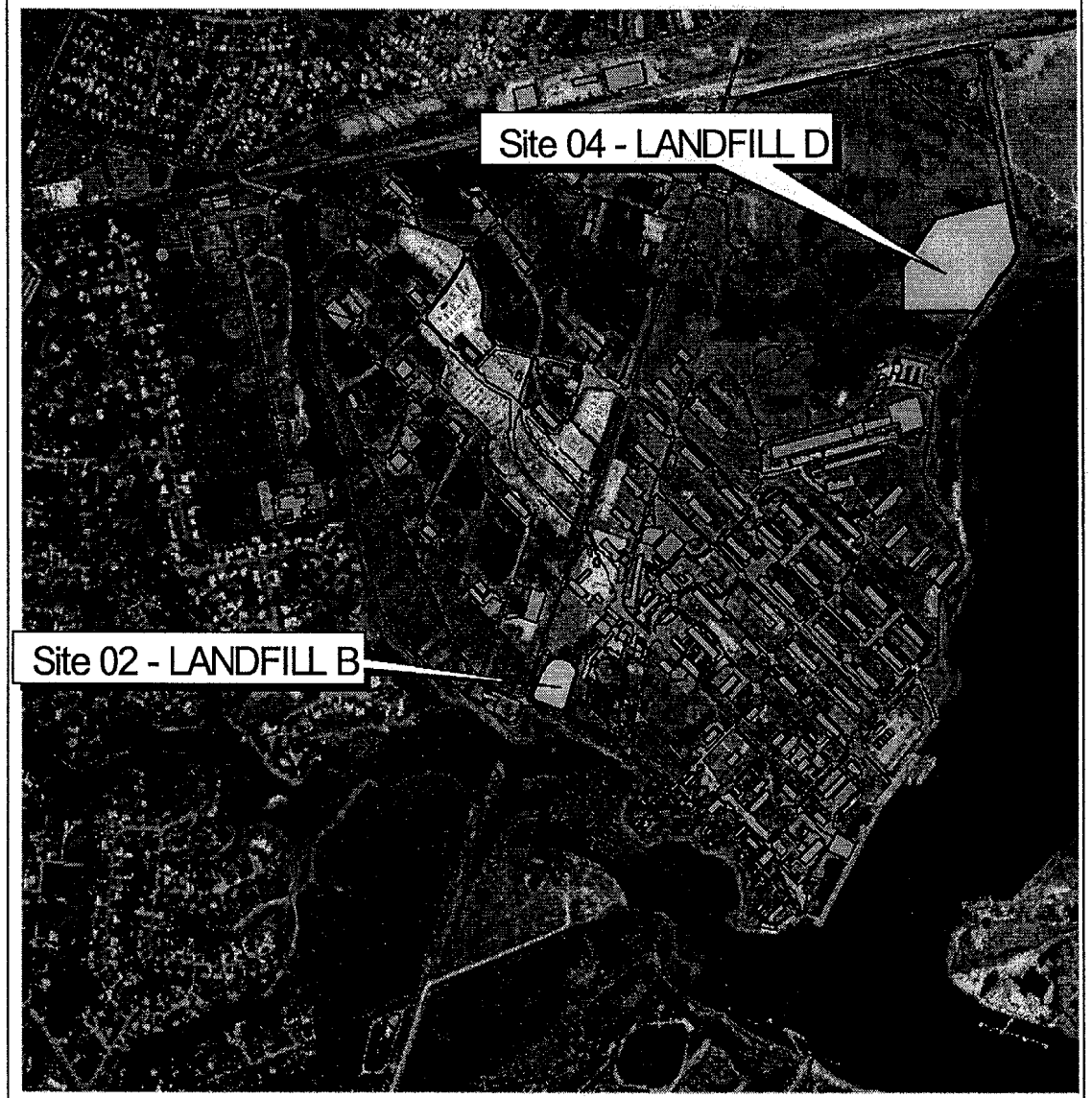
LEGEND

- Groundwater Sample Locations
- Roads
- Onsite Buildings
- Water Bodies

N
W E
S

0 60 120 Feet

Groundwater Sample Locations
Site 2
St. Juliens Creek Annex

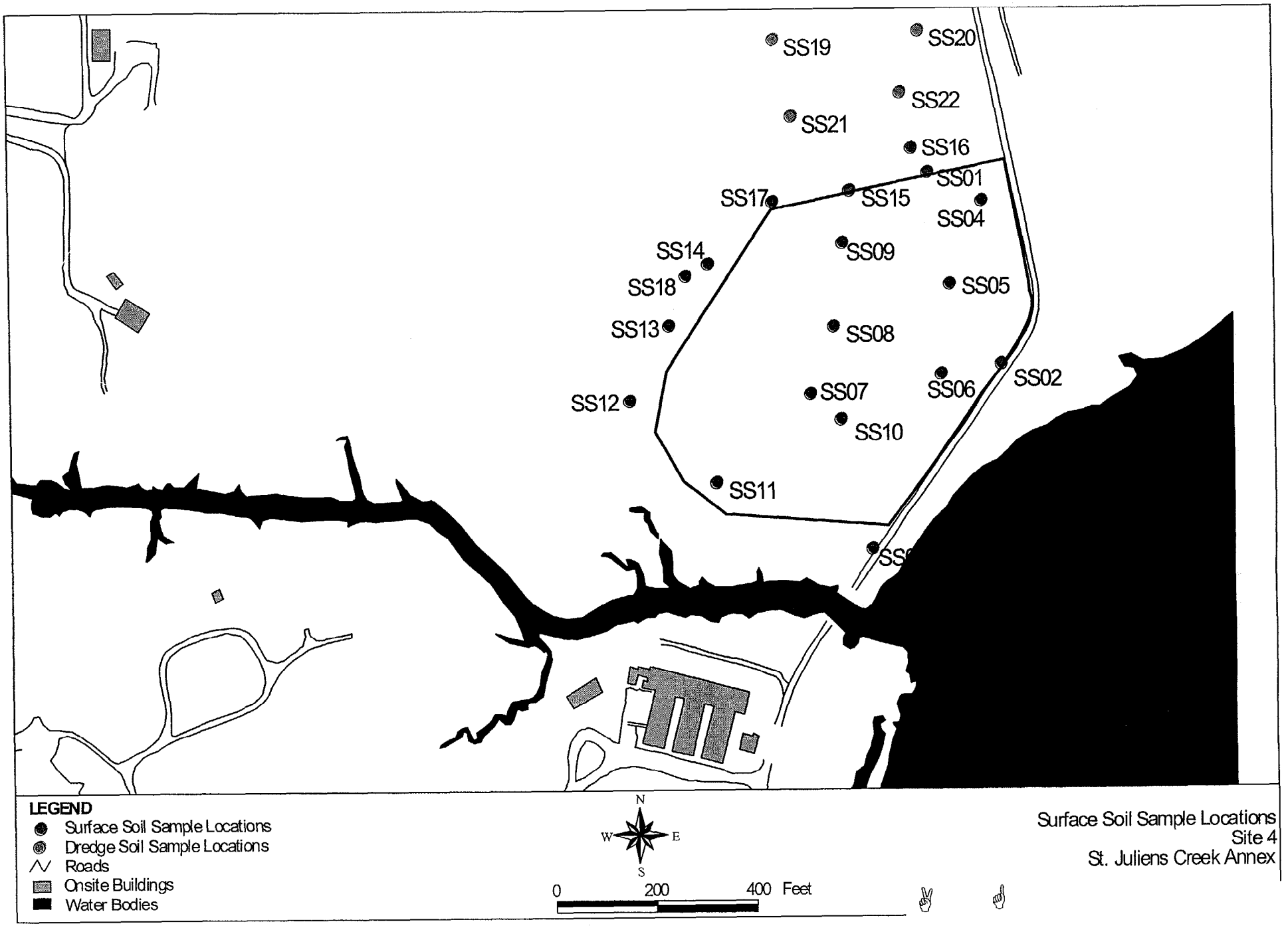


LEGEND

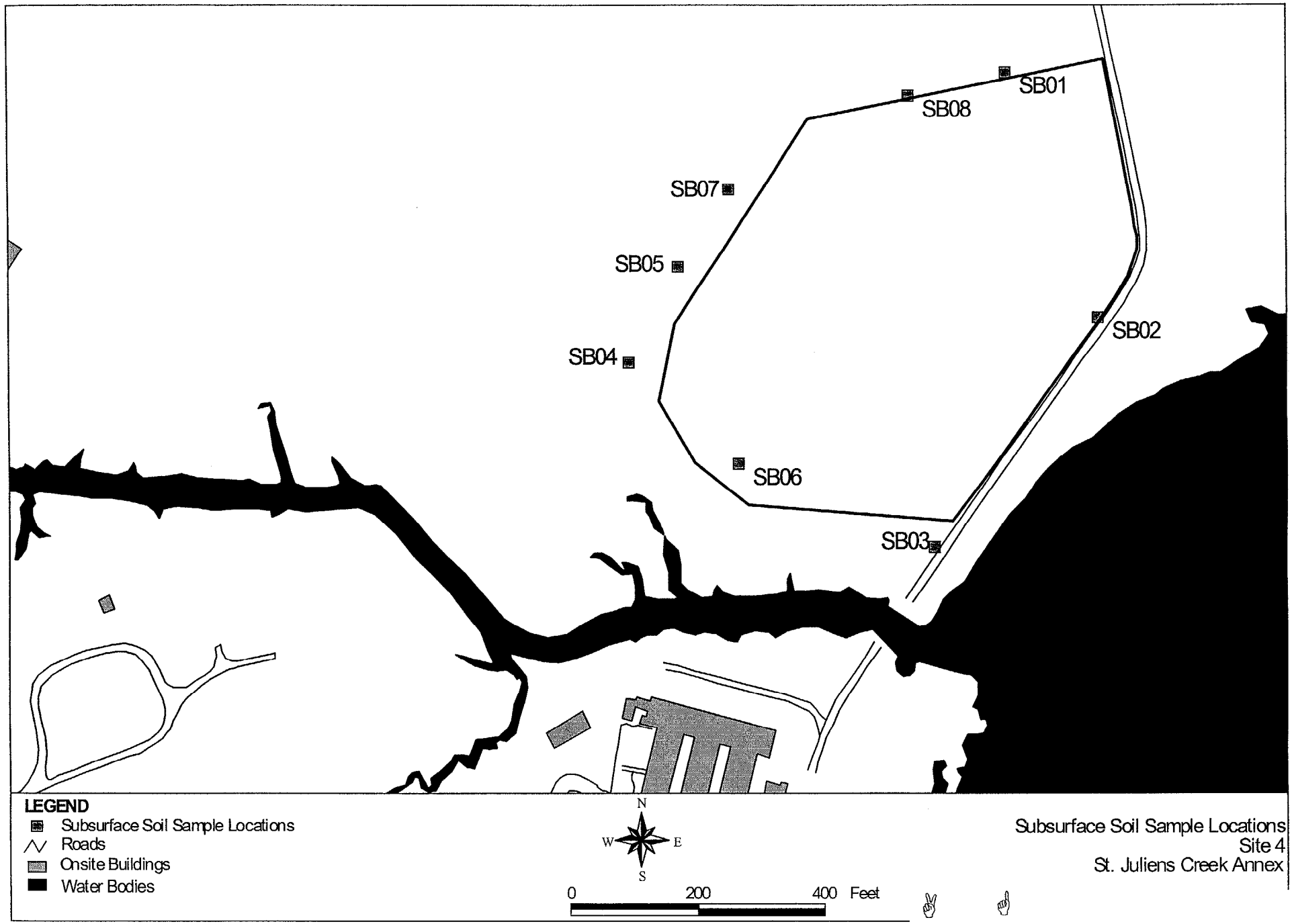
N

Landfill D - Field Investigation

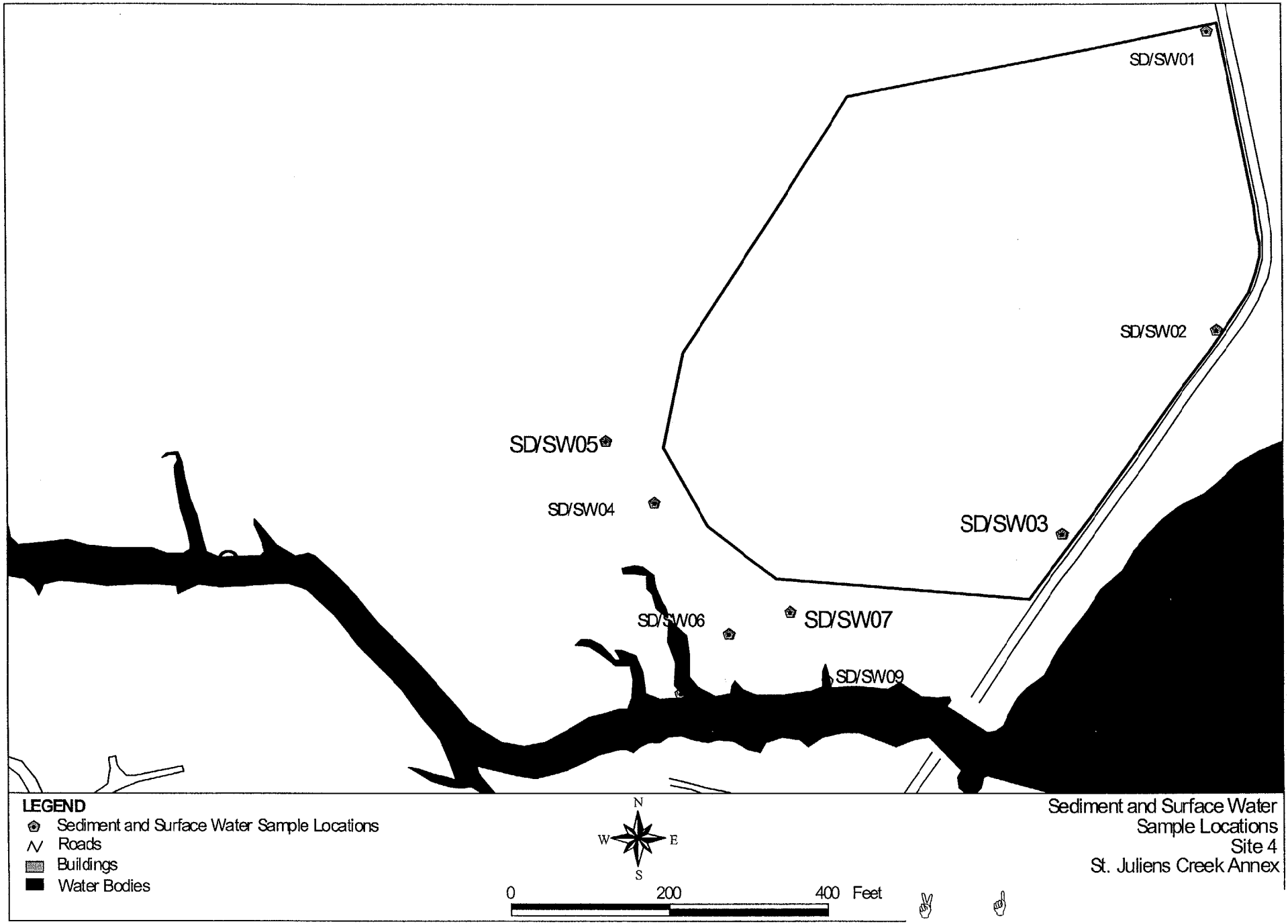
- Surface Geophysical Surveys
- UXO clearance
- Surface water and sediment sample collection
- Surface and subsurface soil sample collection
- Ground water investigation of water-table and Upper Yorktown Aquifers



Surface Soil Sample Locations
Site 4
St. Juliens Creek Annex



Subsurface Soil Sample Locations
Site 4
St. Juliens Creek Annex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SD/SW02
SD/SW03
SD/SW04
SD/SW05
SD/SW06
SD/SW07
SD/SW09
LEGEND
Sediment and Surface Water Sample Locations
Roads
Buildings
Water Bodies
N
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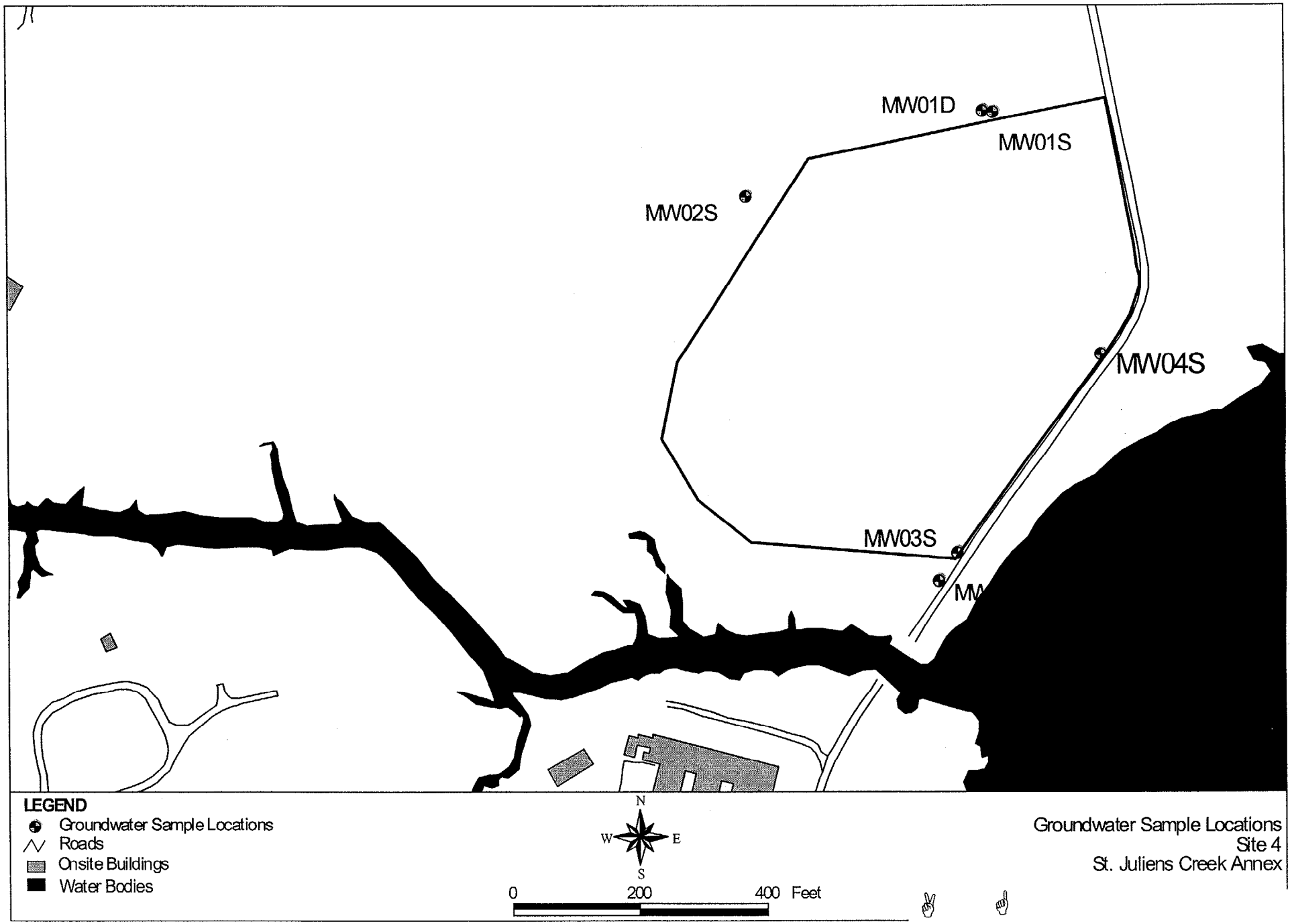
200
400 Feet
Sediment and Surface Water
Sample Locations
Site 4
St. Juliens Creek Annex


MW01D
MW01S
MW02S
MW04S
MW03S
LEGEND
Groundwater Sample Locations
Roads
Onsite Buildings
Water Bodies
N
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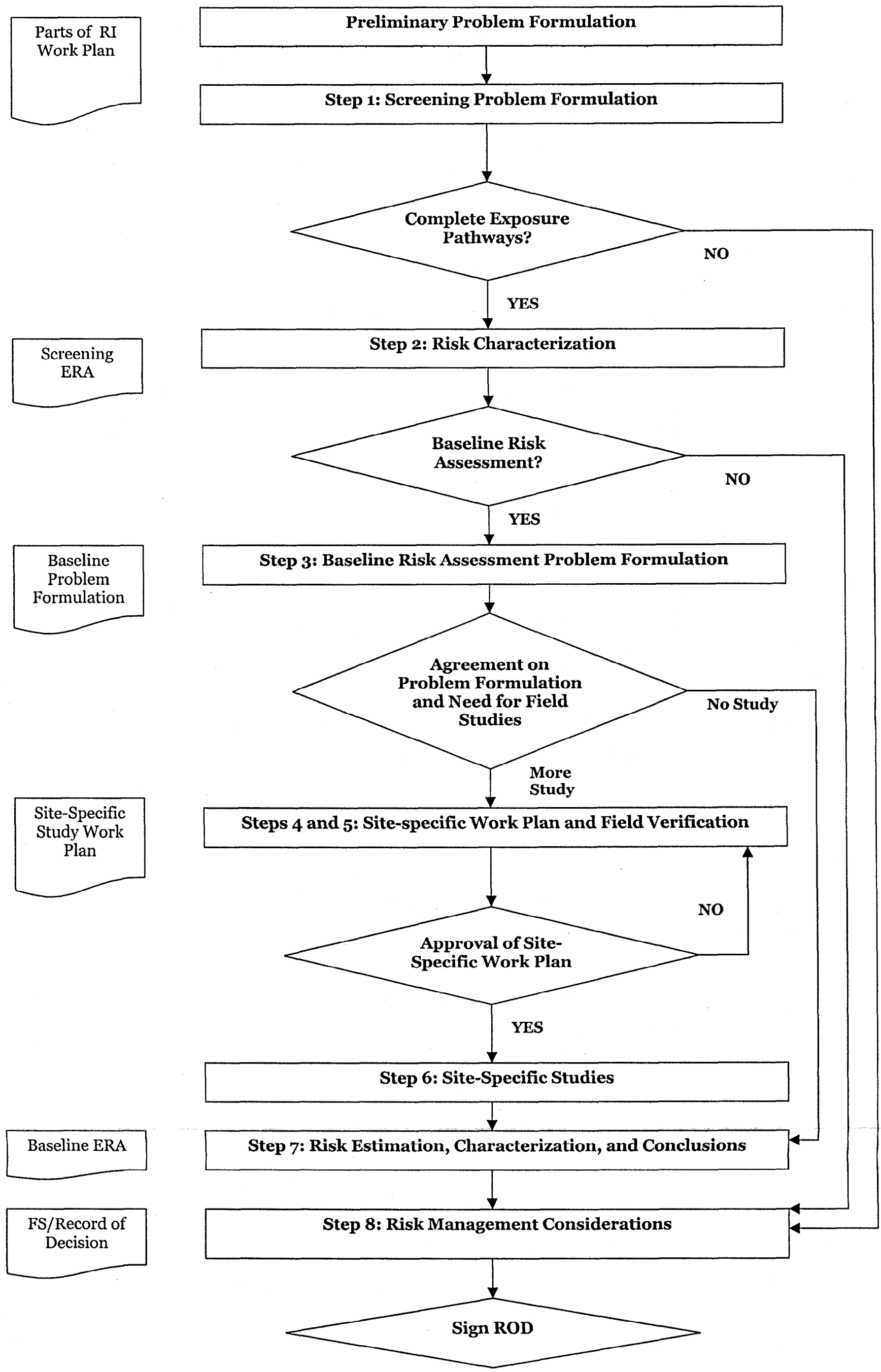
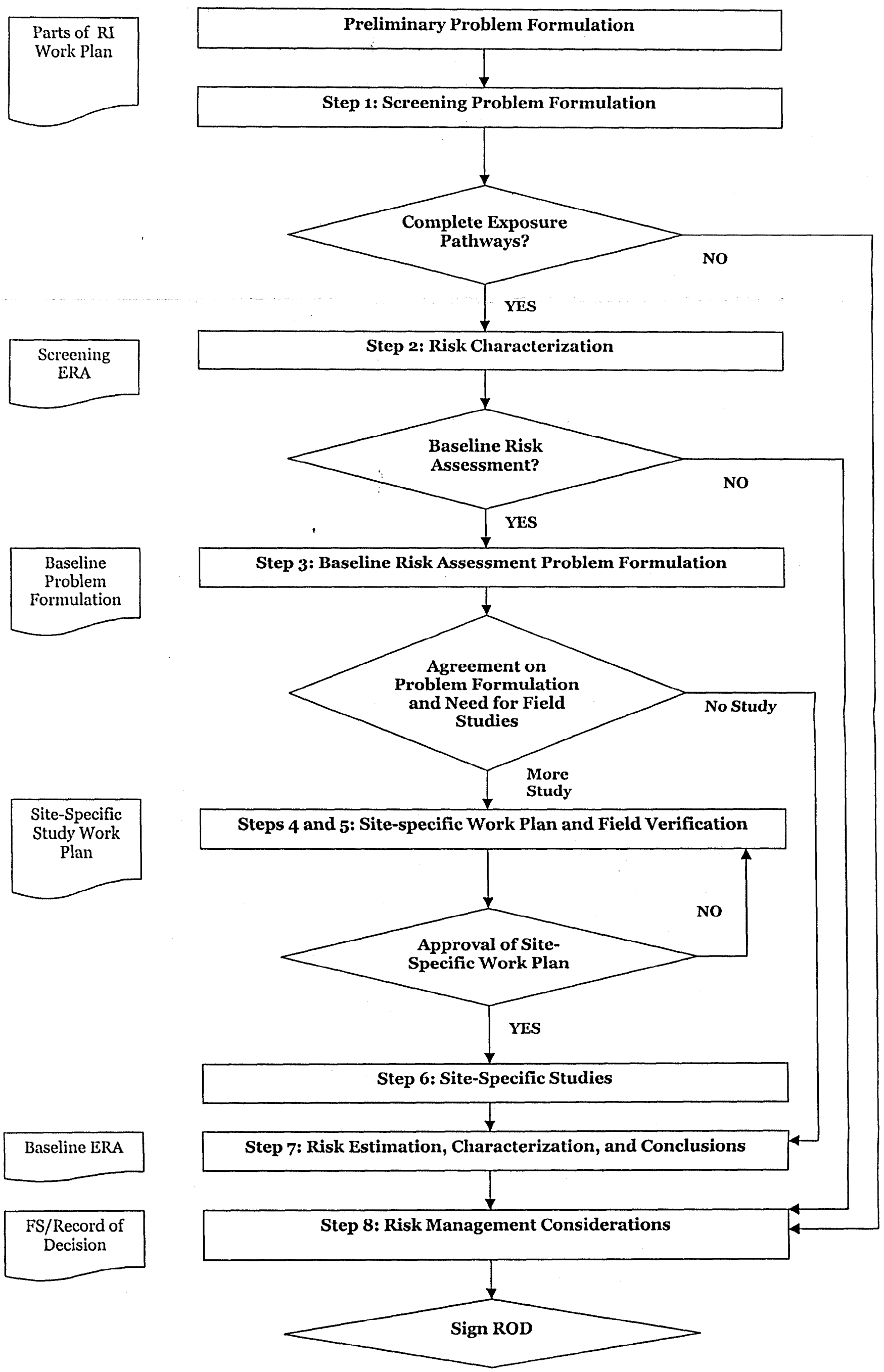
0
200
400 Feet
Groundwater Sample Locations
Site 4
St. Juliens Creek Annex



ECOLOGICAL RISK ASSESSMENT PROCESS

00457AB22



ECOLOGICAL RISK ASSESSMENT PROCESS

U.S. NAVY

St. Juliens Creek Annex

Exposure Scenarios for Site 2

Media	Exposure Route	Current/Future				Future			
		Trespasser		Offsite Resident		Construction Worker	Other Worker	Onsite Resident	
		Adult	Adolescent	Adult	Child			Adult	Child
Surface Soil	Ingestion	X	X						
	Dermal	X	X						
	Inhalation	X	X						
Groundwater (Deep)	Ingestion			X	X				
	Dermal			X	X				
	Inhalation			X					
Shallow Groundwater	Ingestion								
	Dermal					X			
	Inhalation								
Surface Water[1]	Ingestion								
	Dermal	X	X					X	X
	Inhalation								
Sediment[1]	Ingestion	X	X					X	X
	Dermal	X	X					X	X
	Inhalation								
Soil[2]	Ingestion					X	X	X	X
	Dermal					X	X	X	X
	Inhalation					X			

X Quantitative evaluation.

[1] Surface water and sediment exposure scenarios are for waders.

[2] Includes both surface soil and subsurface soil.

COPCs for Site 2

Surface Soil	Surface and Subsurface Soil	Surface Water	Sediment	Shallow Groundwater	Deep Groundwater
			*Current/Future**		
Benzo(a)Pyrene	4,4'-DDD	1,1-Dichloroethene	Phosphorus	RDX	Chloroform
Phosphorus	4,4'-DDE	cis-1,2-Dichloroethene		Heptachlor	Phosphorus
Arsenic	4,4'-DDT	Chloroform	*Future**	1,4-Dichlorobenzene	Arsenic
Iron	Benzo(a)Anthracene	Trichloroethene	Benzo(a)Pyrene	Phosphorus	Iron
Lead	Benzo(a)Pyrene	Vinyl Chloride	Phosphorus	Aluminum	Manganese
	Benzo(b)Fluoranthene	Bis(2-Ethylhexyl)Phthalate	Arsenic	Arsenic	
	Dibenz(a,h)Anthracene	Phosphorus	Chromium	Barium	
	Phosphorus	Arsenic	Iron	Chromium	
	Aluminum	Chromium	Lead	Iron	
	Antimony	Iron		Lead	
	Arsenic	Lead		Manganese	
	Chromium	Manganese		Thallium	
	Copper			Vanadium	
	Iron				
	Lead				
	Manganese				
	Nickel				
	Thallium				
	Vanadium				
	Zinc				

* COPCs for Current/Future were determined using an industrial RBC screen. COPCs for Future scenario were determined using a residential RBC screen.

Summary of RME Risks for Site 2

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways
	Inhalation		Ingestion		Dermal			
	Risk	HI	Risk	HI	Risk	HI		
Surface Soil								
Current/Future Trespasser Adult	2E-10	NA	2E-06	0.03	4E-07	0.01	**2E-06**	**0.04**
Current/Future Trespasser Adolescent	5E-11	NA	4E-07	0.03	4E-08	0.01	**4E-07**	**0.04**
Shallow Groundwater								
Future Construction Worker	NA	NA	NA	NA	2E-09	0.2	**2E-09**	**0.2**
Deep Groundwater								
Current/Future Residential Adult	5E-06	2	4E-05	0.8	1E-07	0.01	**4E-05**	**3**
Current/Future Residential Child	NA	NA	2E-05	2	6E-08	0.02	**2E-05**	**2**
Current/Future Age-adjusted Resident	5E-06	NA	6E-05	NA	2E-07	NA	**6E-05**	**NA**
Soil								
Future Residential Adult	NA	NA	1E-05	0.3	8E-06	0.6	**2E-05**	**0.9**
Future Residential Child	NA	NA	3E-05	3	4E-06	1	**3E-05**	**4**
Future Construction Worker	2E-10	NA	8E-07	0.7	1E-07	0.1	**9E-07**	**0.9**
Future Other Worker	NA	NA	4E-06	0.1	2E-06	0.04	**6E-06**	**0.1**
Surface Water								
Current/Future Trespasser Adult	NA	NA	NA	NA	2E-06	0.1	**2E-06**	**0.1**
Current/Future Trespasser Adolescent	NA	NA	NA	NA	3E-07	0.02	**3E-07**	**0.02**
Future Residential Adult	NA	NA	NA	NA	3E-06	0.1	**3E-06**	**0.1**
Future Residential Child	NA	NA	NA	NA	2E-06	0.1	**2E-06**	**0.1**
Sediment								
Future Residential Adult	NA	NA	2E-06	0.2	6E-07	2	**3E-06**	**2**
Future Residential Child	NA	NA	5E-06	0.6	2E-05	32	**2E-05**	**32**

Risk = carcinogenic risk as determined by the risk calculations in Appendix.
HI = Hazard index as determined by the risk calculation in Appendix
N/A - not calculated.

Summary of CT Risks for Site 2

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways
	Inhalation		Ingestion		Dermal			
	Risk	HI	Risk	HI	Risk	HI		
Soil								
Future Residential Adult	NA	NA	7E-07	0.1	1E-07	0.04	9E-07	0.1
Future Residential Child	NA	NA	4E-06	0.5	2E-07	0.1	5E-06	0.6
Sediment								
Future Residential Adult	NA	NA	9E-08	0.01	9E-09	0.1	1E-07	0.1
Future Residential Child	NA	NA	6E-07	0.04	9E-07	0.3	1E-06	0.4

Risk = carcinogenic risk as determined by the risk calculations in Appendix.

HI = Hazard index as determined by the risk calculation in Appendix.

RME Risk Drivers for Site 2

Media: Deep Groundwater

	Current/Future Residential Adult								Current/Future Residential Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Chloroform	2	0.01	0.0003	2	5E-06	2E-07	5E-09	5E-06	NA	0.03	0.001	0.03	NA	1E-07	3E-09	1E-07
Totals	2	0.01	0.0003	2	5E-06	2E-07	5E-09	5E-06	NA	0.03	0.001	0.03	NA	1E-07	3E-09	1E-07

Media: Soil

	Future Residential Adult								Future Residential Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
4,4'-DDT	NA	0.1	0.1	0.2	NA	5E-06	5E-06	9E-06	NA	0.7	0.2	0.9	NA	1E-05	2E-06	1E-05
Aluminum	NA	0.01	0.005	0.02	NA	NA	NA	NA	NA	0.1	0.5	0.6	NA	NA	NA	NA
Arsenic	NA	0.03	0.01	0.04	NA	5E-06	1E-06	6E-06	NA	0.3	0.02	0.3	NA	1E-05	7E-07	1E-05
Iron	NA	0.1	0.05	0.2	NA	NA	NA	NA	NA	1	0.10	1.1	NA	NA	NA	NA
Manganese	NA	0.02	0.1	0.2	NA	NA	NA	NA	NA	0.2	0.3	0.4	NA	NA	NA	NA
Totals	NA	0.2	0.3	0.5	NA	9E-06	6E-06	2E-05	NA	2	1	3	NA	2E-05	3E-06	2E-05

Media: Sediment

	Future Resident Adult								Future Resident Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Chromium	NA	0.2	2	2	NA	NA	NA	NA	NA	0.2	30	30	NA	NA	NA	NA
Iron	NA	0.02	0.01	0.03	NA	NA	NA	NA	NA	0.2	1	1.4	NA	NA	NA	NA
Totals	NA	0.2	2	2	NA	0E+00	0E+00	0E+00	NA	4E-01	31	32	NA	0E+00	0E+00	0E+00

Information on RME Risk Drivers for Site 2

	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration
Deep Groundwater (ug/l)				
Chloroform	2/7	0.6	6	GW2D
Soil (mg/kg)				
4,4'-DDT	28/28	6.90E-04	2.90E+02	SB08
Aluminum	29/29	1.96E+03	2.17E+04	SB07
Arsenic	28/29	1.20E+00	1.80E+01	SS13
Iron	29/29	1.85E+03	1.06E+05	SS03/SS06
Manganese	29/29	5.90E+00	6.88E+02	SS03
Sediment (mg/kg)				
Chromium	9/9	6.5	2,630	SD03
Iron	9/9	2,050	31,100	SD03

Exposure Scenarios for Site 3

Media	Exposure Route	Current/Future				Future			
		Trespasser		Offsite Resident		Construction Worker	Other Worker	Onsite Resident	
		Adult	Adolescent	Adult	Child			Adult	Child
Surface Soil	Ingestion	X	X						
	Dermal	X	X						
	Inhalation	X	X						
Groundwater (Deep)	Ingestion			X	X				
	Dermal			X	X				
	Inhalation			X					
Shallow Groundwater	Ingestion								
	Dermal					X			
	Inhalation								
Surface Water[1]	Ingestion								
	Dermal	X	X					X	X
	Inhalation								
Sediment[1]	Ingestion	X	X					X	X
	Dermal	X	X					X	X
	Inhalation								
Soil[2]	Ingestion					X	X	X	X
	Dermal					X	X	X	X
	Inhalation					X			

X Quantitative evaluation.
[1] Surface water and sediment exposure scenarios are for waders.
[2] Includes both surface soil and subsurface soil.

COPCs for Site 3

Surface Soil	Surface and Subsurface Soil	Surface Water	Sediment	Shallow Groundwater	Deep Groundwater
			*Current/Future***		
Benzo(a)Pyrene	Benzo(a)Anthracene	Phosphorus	Phosphorus	Heptachlor	Chloroform
Phosphorus	Benzo(a)Pyrene*	Aluminum	Lead	Bis(2-ethylhexyl)Phthalate	Phosphorus
Antimony	Benzo(b)Fluoranthene	Arsenic		Dibenzofuran	Arsenic
Arsenic	Dibenz(a,h)Anthracene	Iron	*Future***	Naphthalene	Thallium
Iron	Indeno(1,2,3-cd)Pyrene	Lead	Phosphorus	Phosphorus	Manganese
Lead	Phosphorus*	Manganese	Antimony	Aluminum	
	Aluminum		Arsenic	Antimony	
	Antimony*		Iron	Arsenic	
	Arsenic*		Lead	Chromium	
	Barium			Iron	
	Cadmium			Manganese	
	Chromium			Nickel	
	Copper			Vanadium	
	Iron*				
	Lead*				
	Manganese				
	Thallium				
	Vanadium				
	Zinc				

* All COPCs for residential screen and indicated COPCs for both residential and industrial scenarios.

** COPCs for Current/Future were determined using an industrial RBC screen. COPCs for Future scenario were determined using a residential RBC screen.

Exposure Scenarios for Site 4

Media	Exposure Route	Current/Future				Future			
		Trespasser		Offsite Resident		Construction Worker	Other Worker	Onsite Resident	
		Adult	Adolescent	Adult	Child			Adult	Child
Surface Soil									
	Ingestion	X	X						
	Dermal	X	X						
	Inhalation	X	X						
Groundwater									
	Ingestion			X	X				
	Dermal			X	X				
	Inhalation			X					
Shallow Groundwater	Ingestion								
	Dermal					X			
	Inhalation								
Surface Water[1]									
	Ingestion								
	Dermal	X	X					X	X
	Inhalation								
Sediment[1]									
	Ingestion	X	X					X	X
	Dermal	X	X					X	X
	Inhalation								
Soil[2]									
	Ingestion					X	X	X	X
	Dermal					X	X	X	X
	Inhalation					X			

X Quantitative evaluation.

[1] Surface water and sediment exposure scenarios are for waders.

[2] Includes both surface soil and subsurface soil.

COPCs for Site 4

Surface Soil	Surface and Subsurface Soil	Surface Water	Sediment	Shallow Groundwater	Deep Groundwater
			*Current/Future**		
Aroclor-1260	Aroclor-1260	Dibenz(a,h)anthracene	Phosphorus	bis(2-Ethylhexyl)phthalate	bis(2-Ethylhexyl)phthalate
Benzo(a)Pyrene	Dieldrin	Indeno(1,2,3-cd)pyrene		Phosphorus	Chloroform
Phosphorus	Benzo(a)Anthracene	Phosphorus	*Future**	Aluminum	Phosphorus
Arsenic	Benzo(a)Pyrene	Aluminum	Benzo(a)Pyrene	Antimony	Arsenic
Chromium	Benzo(b)Fluoranthene	Arsenic	Phosphorus	Arsenic	Barium
Iron	Dibenz(a,h)Anthracene	Iron	Arsenic	Barium	Iron
Lead	Indeno(1,2,3-cd)Pyrene	Lead	Iron	Cadmium	Manganese
	Phosphorus	Manganese	Lead	Chromium	
	Aluminum			Iron	
	Antimony			Lead	
	Arsenic			Manganese	
	Barium			Nickel	
	Cadmium			Silver	
	Chromium			Thallium	
	Copper			Vanadium	
	Iron				
	Lead				
	Manganese				
	Nickel				
	Thallium				
	Vanadium				
	Zinc				

* COPCs for Current/Future were determined using an industrial RBC screen. COPCs for Future scenario were determined using a residential RBC screen.

Summary of RME Risks for Site 4

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways
	Inhalation		Ingestion		Dermal			
	Risk	HI	Risk	HI	Risk	HI		
Surface Soil								
Current/Future Trespasser Adult	6E-09	0.00001	4E-06	0.04	8E-07	0.1	5E-06	0.1
Current/Future Trespasser Adolescents	1E-09	0.000001	9E-07	0.04	9E-08	0.02	1E-06	0.06
Shallow Groundwater								
Future Construction Worker	NA	NA	NA	NA	4E-09	0.08	4E-09	0.08
Deep Groundwater								
Future Residential Adult	1E-05	5	9E-05	24	4E-07	0.2	1E-04	29
Future Residential Child	NA	NA	5E-05	56	2E-07	0.5	5E-05	57
Future Residential Age-Adjusted	1E-05	NA	1E-04	NA	5E-07	NA	2E-04	--
Soil								
Future Residential Adult	NA	NA	4E-05	0.5	8E-06	0.9	4E-05	1
Future Residential Child	NA	NA	8E-05	4	4E-06	1	9E-05	5
Future Residential Age-Adjusted	NA	NA	1E-04	NA	1E-05	NA	1E-04	--
Future Construction Worker	5E-09	0.00005	2E-06	1	2E-07	0.2	2E-06	1
Future Other Worker	NA	NA	1E-05	0.1	2E-06	0.1	1E-06	0.3
Surface Water								
Current/Future Trespasser Adult	NA	NA	NA	NA	2E-07	0.02	2E-07	0.02
Current/Future Trespasser Adolescents	NA	NA	NA	NA	4E-08	0.02	4E-08	0.02
Future Resident Adult	NA	NA	NA	NA	3E-07	0.04	3E-07	0.04
Future Resident Child	NA	NA	NA	NA	2E-07	0.1	2E-07	0.1
Sediment								
Current/Future Trespasser Adult	NA	NA	NA	NA	NA	NA	--	--
Current/Future Trespasser Adolescents	NA	NA	NA	NA	NA	NA	--	--
Future Resident Adult	NA	NA	3E-06	0.05	8E-07	0.02	4E-06	0.07
Future Resident Child	NA	NA	7E-06	0.4	2E-05	2	3E-05	3

Risk = carcinogenic risk as determined by the risk calculations in Appendix.
HI = Hazard index as determined by the risk calculation in Appendix.
N/A - could not be calculated because incomplete exposure pathway or no toxicity values for COPCs.

Summary of CT Risks for Site 4

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways
	Inhalation		Ingestion		Dermal			
	Risk	HI	Risk	HI	Risk	HI		
Deep Groundwater								
Future Residential Adult	5E-07	1	7E-06	5	3E-08	0.04	8E-06	6
Future Residential Child	NA	NA	1E-05	16	6E-08	0.1	1E-05	16
Future Residential Age-Adjusted	5E-07	NA	2E-05	NA	9E-08	NA	2E-05	--
Soil								
Future Residential Adult	NA	NA	2E-06	0.1	2E-07	0.07	3E-06	0.2
Future Residential Child	NA	NA	2E-05	0.9	4E-07	0.1	2E-05	1
Future Residential Age-Adjusted	NA	NA	2E-05	NA	6E-07	NA	2E-05	--
Future Construction Worker	2E-07	0.00004	3E-07	0.3	7E-09	0.0	5E-07	0.3
Future Other Worker	NA	NA	6E-07	0.03	4E-08	0.005	6E-07	0.04
Sediment								
Future Resident Child	NA	NA	1E-06	0.07	2E-06	0.2	3E-06	0.2

Risk = carcinogenic risk as determined by the risk calculations in Appendix.

HI = Hazard index as determined by the risk calculation in Appendix.

NA - could not be calculated because incomplete exposure pathway or no toxicity values for COPCs.

RME Risk Drivers for Site 4

Media: Deep Groundwater

	Current/Future Residential Adult								Current/Future Residential Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Chloroform	5	0.02	0.0005	4.6	1E-05	3E-07	1E-08	1E-05	NA	0.06	0.001	0.06	NA	3E-07	5E-09	3E-07
Arsenic	NA	0.6	0.002	0.6	NA	9E-05	2E-07	9E-05	NA	1	0.003	1	NA	5E-05	1E-07	5E-05
Barium	NA	0.2	0.0005	0.2	NA	NA	NA	NA	NA	0.4	0.001	0.4	NA	NA	NA	NA
Iron	NA	8	0.08	8	NA	NA	NA	NA	NA	15	0.2	15	NA	NA	NA	NA
Manganese	NA	17	0.1	17	NA	NA	NA	NA	NA	40	0.3	40	NA	NA	NA	NA
Totals	5	24	0.2	29	1E-05	9E-05	3E-07	1E-04	NA	56	0.5	57	NA	5E-05	1E-07	5E-05

Media: Soil

	Future Residential Adult								Future Residential Child							
	HQ				CR				HQ				CR			
Chemical	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Aroclor-1260	NA	NA	NA	NA	NA	6E-07	4E-07	1E-06	NA	NA	NA	NA	NA	2E-06	2E-07	2E-06
Benzo(a)Anthracene	NA	NA	NA	NA	NA	7E-07	NA	7E-07	NA	NA	NA	NA	NA	3E-06	NA	2E-06
Benzo(a)Pyrene	NA	NA	NA	NA	NA	8E-06	NA	8E-06	NA	NA	NA	NA	NA	2E-05	NA	2E-05
Benzo(b)Fluoranthene	NA	NA	NA	NA	NA	9E-07	NA	9E-07	NA	NA	NA	NA	NA	2E-06	NA	2E-06
Dibenz(a,h)Anthracene	NA	NA	NA	NA	NA	1E-06	NA	1E-06	NA	NA	NA	NA	NA	3E-06	NA	3E-06
Aluminum	NA	0.02	0.009	0.03	NA	NA	NA	NA	NA	0.2	0.02	0.2	NA	NA	NA	NA
Antimony	NA	0.02	0.02	0.05	NA	NA	NA	NA	NA	0.2	0.04	0.3	NA	NA	NA	NA
Arsenic	NA	0.2	0.05	0.2	NA	2E-05	8E-08	3E-05	NA	1	0	2	NA	6E-05	4E-06	6E-05
Chromium	NA	0.04	0.4	0.5	NA	NA	NA	NA	NA	0.06	0.1	0.2	NA	NA	NA	NA
Copper	NA	0.01	0.002	0.01	NA	NA	NA	NA	NA	0.1	0.003	0.1	NA	NA	NA	NA
Iron	NA	0.1	0.07	0.2	NA	NA	NA	NA	NA	1	0.1	2	NA	NA	NA	NA
Manganese	NA	0.02	0.2	0.2	NA	NA	NA	NA	NA	0.2	0.3	0.5	NA	NA	NA	NA
Nickel	NA	0.006	0.06	0.06	NA	NA	NA	NA	NA	0.06	0.1	0.2	NA	NA	NA	NA
Thallium	NA	0.02	0.002	0.02	NA	NA	NA	NA	NA	0.2	0.004	0.2	NA	NA	NA	NA
Vanadium	NA	0.02	0.07	0.09	NA	NA	NA	NA	NA	0.1	0.1	0.3	NA	NA	NA	NA
Totals	NA	0.5	0.9	1	NA	4E-05	8E-08	4E-05	NA	4	1	5	NA	8E-05	4E-06	9E-05

RME Risk Drivers for Site 4 (continued)

Media: Soil

Chemical	Future Construction Worker								Future Other Worker							
	HQ				CR				HQ				CR			
	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Benzo(a)Pyrene	NA	NA	NA	NA	4E-10	6E-07	NA	6E-07	NA	NA	NA	NA	NA	3E-06	NA	3E-06
Arsenic	NA	0.5	0.05	0.6	5E-10	2E-06	1E-07	2E-06	NA	0.06	0.01	0.07	NA	9E-06	2E-06	1E-05
Chromium	0.00005	0.02	0.06	0.08	4E-09	NA	NA	4E-09	NA	0.02	0.1	0.1	NA	NA	NA	NA
Iron	NA	0.5	0.06	0.6	NA	NA	NA	NA	NA	0.05	0.02	0.07	NA	NA	NA	NA
Totals	0.00005	1.1	0.2	1.2	5E-09	2E-06	1E-07	2E-06	NA	0.1	0.1	0.3	NA	1E-05	2E-06	1E-05

Media: Sediment

Chemical	Future Resident Child							
	HQ				CR			
	Inh	Ing	Der	Total	Inh	Ing	Der	Total
Benzo(a)Pyrene	NA	NA	NA	NA	NA	1E-06	NA	1E-06
Arsenic	NA	0.2	0.6	0.8	NA	6E-06	2E-05	3E-05
Iron	NA	0.3	1.7	2.0	NA	NA	NA	NA
Totals	NA	0.4	2.3	2.8	NA	7E-06	2E-05	3E-05

Information on RME Risk Drivers for Site 4

	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Concentration
Deep Groundwater (ug/l)				
Chloroform*	2/8	6.00E-01	9.00E+00	GW3D
Arsenic*	3/5	3.80E+00	6.50E+00	GW3D
Barium	5/5	6.50E+01	4.89E+02	GW1D
Iron*	5/5	9.12E+03	6.85E+04	GW1D
Manganese*	5/5	1.90E+03	1.25E+04	GW1D
Soil (mg/kg)				
Aroclor-1260	6/26	2.20E-02	6.30E+00	SS08
Benzo(a)Anthracene	23/26	3.90E-02	3.00E+00	SS11
Benzo(a)Pyrene	23/26	3.50E-02	2.30E+00	SS11
Benzo(b)Fluoranthene	23/26	7.90E-02	3.00E+00	SS11
Dibenz(a,h)Anthracene	3/26	1.00E-01	3.20E-01	SS11
Aluminum	26/26	3.91E+03	1.81E+04	SB01
Antimony	13/23	8.70E-01	5.35E+01	SB06
Arsenic*	26/26	1.90E+00	2.36E+02	SB06
Chromium	26/26	7.20E+00	6.80E+02	SS05
Copper	26/26	7.00E+00	8.74E+02	SS11
Iron	26/26	2.92E+03	6.51E+04	SS11
Manganese	26/26	3.86E+01	8.83E+02	SS11
Nickel	24/24	3.70E+00	5.46E+02	SS05
Thallium	6/26	5.00E-01	3.40E+00	SS01
Vanadium	26/26	1.12E+01	3.54E+02	SS04
Sediment (mg/kg)				
Benzo(a)Pyrene	8/9	7.10E-02	1.20E+00	SD04
Arsenic	9/9	3.90E+00	3.31E+01	SD03
Iron	9/9	1.05E+04	5.60E+04	SD01

*Constituent is also a risk driver for CT risk

Exposure Scenarios for Site 5

Media	Exposure Route	Current/Future				Future			
		Trespasser		Offsite Resident		Construction Worker	Other Worker	Onsite Resident	
		Adult	Adolescent	Adult	Child			Adult	Child
Surface Soil									
	Ingestion	X	X						
	Dermal	X	X						
	Inhalation	X	X						
Groundwater									
	Ingestion			X	X				
	Dermal			X	X				
	Inhalation			X					
Shallow Groundwater	Ingestion								
	Dermal					X			
	Inhalation								
Surface Water[1]									
	Ingestion								
	Dermal	X	X					X	X
	Inhalation								
Sediment[1]									
	Ingestion	X	X					X	X
	Dermal	X	X					X	X
	Inhalation								
Soil[2]									
	Ingestion					X	X	X	X
	Dermal					X	X	X	X
	Inhalation					X			

X Quantitative evaluation.

[1] Surface water and sediment exposure scenarios are for wadders.

[2] Includes both surface soil and subsurface soil

COPCs for Site 5

Surface Soil	Surface and Subsurface Soil	Surface Water	Sediment	Shallow Groundwater	Deep Groundwater
			*Current/Future***		
Benzo(a)Pyrene	Dioxin TEQ	Phosphorus	Phosphorus	Phosphorus	RDX
Phosphorus	4,4-DDT	Arsenic		Aluminum	Heptachlor
Arsenic	4,4-DDE	Iron		Antimony	Chloroform
Chromium	Benzo(a)Anthracene	Lead	*Future***	Arsenic	Phosphorus
Iron	Benzo(a)Pyrene*	Manganese	Phosphorus	Barium	Antimony
Lead	Benzo(b)Fluoranthene		Arsenic	Beryllium	Arsenic
	Dibenz(a,h)Anthracene		Iron	Cadmium	Iron
	Phosphorus*		Thallium	Chromium	Manganese
	Aluminum			Cobalt	
	Antimony			Iron	
	Arsenic*			Lead	
	Barium			Manganese	
	Cadmium			Nickel	
	Chromium*			Thallium	
	Copper			Vanadium	
	Iron*			Zinc	
	Lead*				
	Manganese				
	Thallium				
	Vanadium				
	Zinc				

* COPCs for both industrial and residential scenarios based on industrial RBC and residential RBCs, respectively.

** COPCs for Current/Future were determined using an industrial RBC screen. COPCs for Future scenario were determined using a residential RBC screen.

AGENDA
RESTORATION ADVISORY BOARD (RAB)
St. Juliens Creek Annex
Chesapeake, Virginia

SPAWAR Conference Room, Building 68
St. Juliens Creek Annex
Thursday, September 14, 2000, 6:30 PM

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ROUNDTABLE / Q&As Comments Schedule site visit & next meeting	Jeff Harlow/Bob Mann

COMMENTS/ANNOUNCEMENT OF FUTURE MEETINGS:
RAB MEETINGS Thursday, 14 December 2000
Thursday, 08 March 2001.

CLOSING REMARKS & ADJOURN

St. Juliens Creek

Sites 2 and 4
Screening-Level Ecological Risk Assessment (SERA) and Refinement of SERA

St. Juliens Creek
Sites 2 and 4 SERA

- Overview
- Site 2 Landfill B
- Site 4 Landfill D
- Conclusions

Presentation of Each Site

- Overview
- Screening-level ERA (SERA)Problem Formulation
- Screening-level ERA COPC Identification
- Conclusions from SERA
- Realistic Refinement Step; Step 3a of the Baseline Ecological Risk Assessment (BERA)

Presentation of Each Site

- Conclusion Based on Refinement Step 3a
  - COPCs-Screening
  - Food Chain Exposure

St. Juliens Creek

Site 2 Landfill B

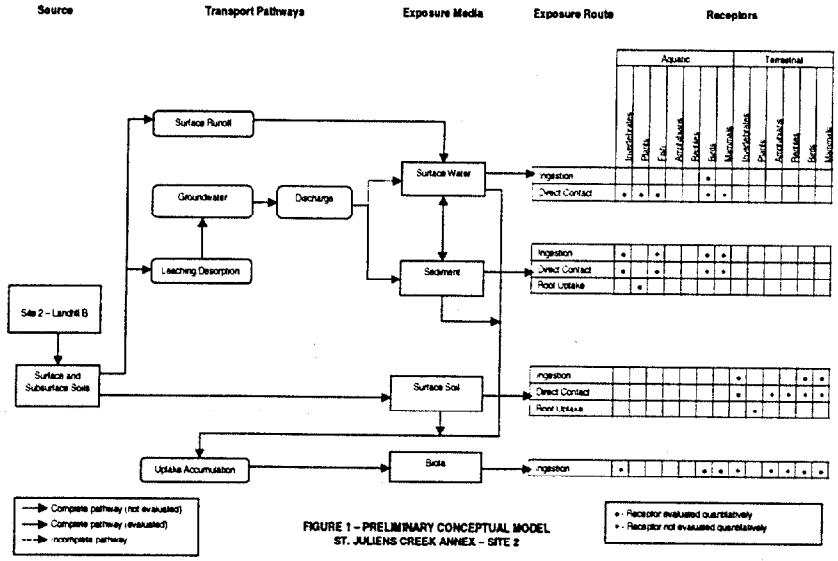

FIGURE 1 – PRELIMINARY CONCEPTUAL MODEL
ST. JULIENS CREEK ANNEX – SITE 2

Site 2 Landfill B

Assessment Endpoints, Risk Hypotheses, Measurement Endpoints, and Receptor Species

Assessment Endpoints	Risk Hypotheses	Measurement Endpoint	Receptor Species
Protection of soil invertebrate communities from the toxic effects (on survival and growth) of site-related chemicals present in surface soil	Are levels of site-related chemicals present in surface soils sufficient to cause adverse effects on the survival and growth of soil invertebrates at the site?	Comparison of exposure HQs to a reference HQ of 1.0. Exposure HQs are calculated for individual chemicals by dividing the soil concentrations by an invertebrate-based soil screening values. A reference HQ of 1.0 represents a condition where the soil concentration is equal to the screening values	Soil invertebrates
Protection of aquatic receptors (invertebrates and fish) communities from the toxic effects (on survival and growth) of site-related chemicals present in sediment and surface waters	Are levels of site-related chemicals present in sediment and surface water sufficient to cause adverse effects on the survival and growth of aquatic receptors at the site?	Comparison of exposure HQs to a reference HQ of 1.0. Exposure HQs are calculated for individual chemicals by dividing the sediment and surface water concentrations by an invertebrate-based sediment and surface water screening values. A reference HQ of 1.0 represents a condition where the sediment and surface water concentration is equal to the screening values	Aquatic receptors (invertebrates, and fish)
Protection of semiaquatic herbivorous, sometimes omnivorous, mammals to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of herbivorous mammals using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Muskrat
Protection of insectivorous mammals to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of insectivorous mammals using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Short-tailed shrew
Protection of omnivorous birds to ensure that ingestion of contaminants in soil, prey, and forage does not have negative impacts on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of omnivorous birds using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Robin
Protection of carnivorous, sometimes insectivorous, birds to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of carnivorous birds using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Heron

Site 2 Landfill B Screening-level COPC

- Surface Water (15 Total)
  - Conc > SV -- 9 Inorganics, 1 VOC, 1 Pesticide
  - No SV -- 3 Inorganics, 1 VOC
- Sediment (40 Total)
  - Conc > SV -- 14 Inorganics, 11 SVOCs, 6 Pesticides, 1 PCB
  - No SV -- 2 Inorganics, 6 VOCs

Site 2 Landfill B Screening-level COPC

- Soil (42 Total)
  - Conc > SV -- 15 Inorganics, 14 SVOCs, 1 PCB, 3 Pesticides
  - No SV -- 6 SVOCs, 2 VOCs, 1 Pesticide
- Food Web (40 Total)
  - 17 Inorganics, 15 SVOCs, 1 PCB, 7 pesticides

Site 2 Landfill B Screening-level ERA

- Conclusion
  - One or more COPCs were identified in each of the media, thus additional evaluation in Step 3 is recommended

Site 2 Landfill B
Step 3a--Realistic Refinement Steps

- Used average chemical concentrations instead of maximum detected values when completing the media screening and the Food Chain Exposure models.
- Used average receptor species, body weights, and food ingestion rates instead of minimum body weights and maximum ingestion rates.
- Calculated realistic site use factors based upon actual home range or territory size instead of the conservative assumption that the receptor species home range was equal to the area of the site.

Site 2 Landfill B
Step 3a—Refined COPC

- Surface Water (13 Total)
  - Conc > SV -- 7 Inorganics, 1 VOC, 1 Pesticide
  - No SV -- 3 Inorganics, 1 VOC
- Sediment (32 Total)
  - Conc > SV -- 10 Inorganics, 7 SVOCs, 6 Pesticides, 1 PCB
  - No SV -- 2 Inorganics, 6 VOCs

Site 2 Landfill B
Step 3a—Refined COPC

- Soil (34 Total)
  - Conc > SV -- 10 Inorganics, 12 SVOCs, 3 Pesticides
  - No SV -- 6 SVOCs, 2 VOCs, 1 Pesticide
- Food Web (27 Total)
  - 11 Inorganics, 10 SVOCs, 1 PCB, 5 Pesticides

Site 2 Landfill B
Realistic Refinements, Step 3a of the Baseline ERA

- Conclusions
  - Using average concentrations instead of maximum values one or more COPCs were identified in each of the media thus additional evaluation under Step 3 (BERA) is recommended.
  - Using realistic exposure assumptions, risk due to exposure via the food chain was indicated for the muskrat, shrew, robin, woodcock, raccoon, and deer mouse. Further evaluation of the risk to these receptors will be made under Step 3 (completion of the BERA).

St. Juliens Creek

Site 4 Landfill D

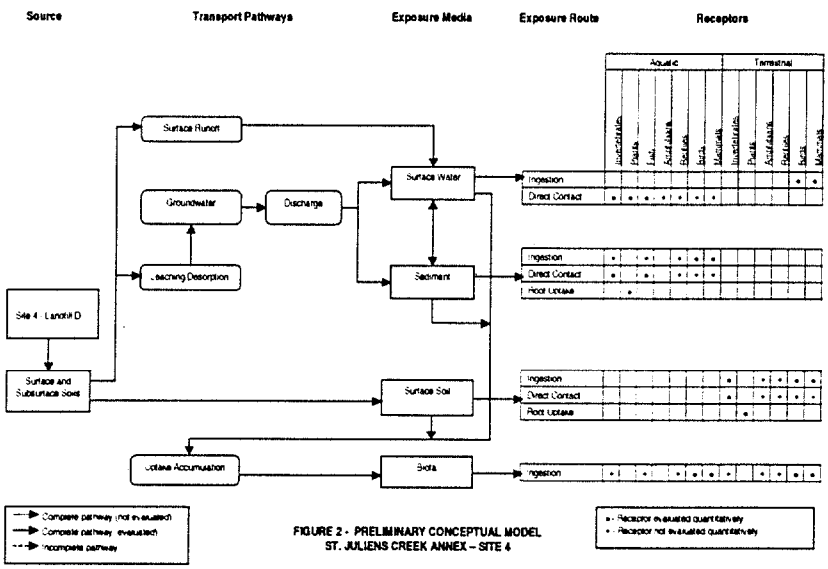

FIGURE 2 - PRELIMINARY CONCEPTUAL MODEL
ST. JULIENS CREEK ANNEX – SITE 4

Site 4 Landfill D

Assessment Endpoints, Risk Hypotheses, Measurement Endpoints, and Receptor Species

Assessment Endpoints	Risk Hypotheses	Measurement Endpoints	Receptor Species
Protection of soil invertebrate communities from the toxic effects (on survival and growth) of site-related chemicals present in surface soil	Are levels of site-related chemicals present in surface soils sufficient to cause adverse effects on the survival and growth of soil invertebrates at the site?	Comparison of exposure HQs to a reference HQ of 1.0. Exposure HQs are calculated for individual chemicals by dividing the soil concentrations by an invertebrate-based soil screening values. A reference HQ of 1.0 represents a condition where the soil concentration is equal to the screening values	Soil invertebrates
Protection of aquatic receptors (invertebrates and fish) communities from the toxic effects (on survival and growth) of site-related chemicals present in sediment and surface water	Are levels of site-related chemicals present in sediment and surface water sufficient to cause adverse effects on the survival and growth of aquatic receptors at the site?	Comparison of exposure HQs to a reference HQ of 1.0. Exposure HQs are calculated for individual chemicals by dividing the sediment and surface water concentrations by an invertebrate-based sediment and surface water screening values. A reference HQ of 1.0 represents a condition where the sediment and surface water concentration is equal to the screening values	Aquatic receptors (invertibrates and fish)
Protection of semiaquatic herbivorous, sometimes omnivorous, mammals to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of herbivorous mammals using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Muskrat
Protection of insectivorous mammals to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of insectivorous mammals using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Short-tailed shrew
Protection of omnivorous birds to ensure that ingestion of contaminants in soil, prey, and forage does not have negative impacts on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of omnivorous birds using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Robin
Protection of carnivorous, sometimes insectivorous, birds to ensure that ingestion of contaminants in soil and prey does not have a negative impact on growth, survival, and reproduction	Are levels of site contaminants in soils sufficient to cause adverse effects on the growth, survival, and reproductive success of carnivorous birds using the site?	Comparison of dietary HQs to a reference of 1.0. Dietary HQs are calculated for individual chemicals by dividing an estimated level of exposure by an ecotoxicity value that is associated with a NOAEL. A reference HQ of 1.0 represents a dietary dose that is equal to the NOAEL ecotoxicity value	Heron

Site 4 Landfill D Screening-level COPC

- Surface Water (25 Total for Both Marine and Freshwater)
  - Marine
    - Conc > SV -- 8 Inorganics
    - No SV -- 2 Inorganics
  - Freshwater
    - Conc > SV -- 13 Inorganics, 1 VOC
    - No SV -- 1 SVOC

Site 4 Landfill D Screening-level COPC

- Sediment (57 Total Both Marine and Freshwater)
  - Marine
    - Conc > SV -- 12 Inorganics, 8 SVOCs, 1 Pesticide
    - No SV -- 3 VOCs
  - Freshwater
    - Conc > SV -- 12 Inorganics, 12 SVOCs, 1 PCB, 4 Pesticides
    - No SV -- 2 Inorganics, 2 VOCs

Site 4 Landfill D Screening-level COPC

- Soil (37 Total)
  - Conc > SV -- 14 Inorganics, 12 SVOCs, 1 PCB, 1 Pesticide
  - No SV -- 7 SVOCs, 2 VOCs
- Food Web (38 Total)
  - 17 Inorganics, 15 SVOCs, 1 PCB, 5 Pesticides

Site 4 Landfill D
Screening-level ERA

- Conclusion
  - One or more COPCs were identified in each of the media, thus additional evaluation in Step 3 is recommended

Site 4 Landfill D
Step 3a--Realistic Refinement Steps

- Used average chemical concentrations instead of maximum detected values when completing the media screening and the Food Chain Exposure models.
- Used average receptor species, body weights, and food ingestion rates instead of minimum body weights and maximum ingestion rates.
- Calculated realistic site use factors based upon actual home range or territory size instead of the conservative assumption that the receptor species home range was equal to the area of the site.

Site 4 Landfill D
Step 3a—Refined COPC

- Surface Water (21 Total for Both Marine and Freshwater)
  - Marine
    - Conc > SV -- 6 Inorganics
    - No SV -- 2 Inorganics
  - Freshwater
    - Conc > SV -- 11 Inorganics, 1 VOC
    - No SV -- 1 SVOC

Site 4 Landfill D
Step 3a—Refined COPC

- Sediment (44 Total for Both Marine and Freshwater)
  - Marine
    - Conc > SV -- 8 Inorganics, 5 SVOCs, 1 Pesticide
    - No SV -- 3 VOCs
  - Freshwater
    - Conc > SV -- 6 Inorganics, 12 SVOCs, 1 PCB, 4 Pesticides
    - No SV -- 2 Inorganics, 2 VOCs

Site 4 Landfill D
Step 3a—Refined COPC

- Soil (31 Total)
  - Conc > SV -- 9 Inorganics, 11 SVOCs, 1 PCB, 1 Pesticide
  - No SV -- 7 SVOCs, 2 VOCs
- Food Web (26 Total)
  - 12 Inorganics, 11 SVOCs, 1 PCB, 2 Pesticides

Site 2 Landfill B
Realistic Refinements, Step 3a of the Baseline ERA

- Conclusion
  - Using average concentrations instead of maximum concentrations one or more COPCs were identified in each media thus additional evaluation under Step 3 (BERA) is recommended.
  - Using realistic exposure assumptions, risk due to exposure via the food chain was indicated for the muskrat, shrew, robin, hawk, woodcock, raccoon, fox, and mouse. Further evaluation of the risk to these receptors will be made under Step 3 (completion of the BERA).

St. Juliens Creek

Uncertainty

Screening-Level ERA and Baseline ERA Uncertainty

- Detection limits
- No screening values (SVs)
- Total vs. dissolved metals in water
- No site-specific bioavailability
- Lack of species-specific toxicities, life history parameters, bioaccumulation factors
- Chemical Mixtures

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Chesapeake, Virginia

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