9/1/04-00258

Final

Record of Decision
Site 4: Landfill D

St. Juliens Creek Annex
Chesapeake, Virginia

NAVFAC
Naval Facilities Engineering Command

Department of the Navy

Naval Facilities Engineering Command
Atlantic

September 2004

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Acronyms and Abbreviations

AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
BAF	bioaccumulation factor
BCF	bioconcentration factor
BERA	Baseline Ecological Risk Assessment
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
CSF	carcinogenic slope factor
CSM	conceptual site model
CT	central tendency
DNH	Division of Natural Heritage
DRMO	Defense Reutilization and Marketing Office
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft	foot, feet
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IAS	Initial Assessment Study
IRP	Installation Restoration Program
MCL	maximum contaminant level
MF	modification factor
mg/kg	milligrams per kilogram
NACIP	Naval Assessment and Control of Installation Pollutants
Navy	United States Department of Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PPE	personal protective equipment

ppm	parts per million
PRAP	Proposed Remedial Action Plan
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RBC	Risk-Based Concentration
RCRA	Resource Conservation Recovery Act
RD	Remedial Design
RFA	RCRA Facility Assessment
RfD	reference dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RRR	Relative Risk Ranking
SARA	Superfund Amendments and Reauthorization Act
SIMA	Shore Intermediate Maintenance Activity
SJCA	St. Juliens Creek Annex
SMP	Site Management Plan
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	to-be-considered
TCL	Target Compound list
UCL	upper confidence limit
Uf	uncertainty factor
USFWS	United States Fish and Wildlife Service
UTL	upper tolerance limit
UXO	unexploded ordnance
VDEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compound

SECTION 1

Declaration

1.1 Site Name and Location

Site 4 (Landfill D)
St. Juliens Creek Annex
Chesapeake, Virginia
EPA ID: VA5170000181

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the Selected Remedy for Site 4 (Landfill D) at the St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. The determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record file for this site.

The United States Department of the Navy (Navy) and the United States Environmental Protection Agency (EPA) (Region III) issue this ROD jointly. The Commonwealth of Virginia, Virginia Department of Environmental Quality (VDEQ), concurs with the Selected Remedy.

1.3 Assessment of the Site

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of pollutants from the site.

1.4 Description of the Selected Remedy

Site 4 is one of several Installation Restoration Program (IRP) sites being addressed under CERCLA at SJCA. The Selected Remedy for Site 4 addresses the media of concern (soil and eastern drainage ditch sediment) as identified in previous investigations, and comprises the final remedial action for the site. The annual Site Management Plan (SMP) for SJCA includes the schedule for remedial actions that will be conducted at Site 4 and all other IRP sites at SJCA.

The Selected Remedy to address human health and ecological risk associated with soil and eastern drainage ditch sediment at Site 4 is a soil cover and includes removal of the impacted eastern drainage ditch sediment. The Selected Remedy was determined based on the evaluation of site conditions, site-related risks, applicable or relevant and appropriate requirements (ARARs), and Remedial Action Objectives (RAOs). Installing a soil cover and removing impacted eastern drainage ditch sediment provides the best alternative for reducing current and future exposure pathways to on-site contaminants. The Selected Remedy includes the following major components:

- Installation of a soil cover to prevent or minimize direct contact of human and ecological receptors with landfill contents. The soil cover will also reduce any future potential risk associated with contaminants leaching into the groundwater;
- Removal of impacted sediment in the eastern drainage ditch to prevent direct contact of human and ecological receptors with the sediment. The excavated material will be disposed in an appropriately licensed and permitted off-site disposal facility; and
- Construction of an open stormwater drainage ditch along the eastern boundary and a new drainage ditch along the western boundary to prevent overland flow entering the site (surface water run-on) and control surface run-off and erosion.
- Land Use Controls (LUCs) will be implemented within the boundaries of the landfill to meet the following objectives:
  - Prohibit digging into or disturbing the soil cover or landfill contents and
  - Prohibit residential use and development of the site.

Within 90 days following the execution of this ROD, the Navy shall develop, and submit to EPA and VDEQ, in accordance with the Federal Facilities Agreement (FFA), a Remedial Design (RD) to implement the Selected Remedy and a LUC RD that shall provide for implementation and maintenance actions, including periodic inspections and reporting. The Navy will implement, maintain, monitor, and enforce the LUCs according to the RD. Within 30 days of finalizing the RD, the Navy will amend the SMP to include the schedule for RD actions.

1.5 Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with Federal and State regulations that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The remedy does not satisfy the statutory preference for treatment as a principal element of the remedy because there is no principal threat waste at Site 4 that requires treatment and treatment of the landfill contents would not be cost-effective because of the significant size of the landfill (10 acres). Additionally, there is no definable plume of groundwater contamination and no site-related groundwater risks were identified at Site 4.

Because this remedy will result in pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is protective of human health and the environment.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD (Section 2). Additional information can be found in the Administrative Record file for SJCA Site 4.

- Chemicals of concern (COCs) and their respective concentrations (Section 2.7 and associated tables);
- Baseline risk represented by the COCs (Section 2.7);
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 2.6);
- The drainage ditches at Sites 4 reflect site soil conditions and therefore, the background 95% upper tolerance limits (UTLs) for the associated soil type will be used as the cleanup levels for COCs in the eastern drainage ditch (Section 2.12.2);
- Site 4 does not contain "principal threat waste," that is, highly toxic or highly mobile waste that cannot be reliably contained or would pose a significant threat to human health or the environment if containment failed. Accordingly, this ROD does not discuss a remedy for principal threat waste (Section 2.11);
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (Section 2.12.4);
- Estimated capital costs, annual maintenance and performance costs, and total present-worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (Section 2.12.3 and Table 2-27); and
- Key factors that led to selecting the remedy (i.e., a description of how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.12.1).

1.7 Authorizing Signatures

F. F. Aucremanne
28SEP04

F. F. Aucremanne, CAPT, CEC, USN
Chief of Staff
By direction of the Commander
Navy Region Mid-Atlantic

Date

Abraham Ferdas
9/29/04

Abraham Ferdas, Director
Hazardous Site Cleanup Division
EPA (Region III)

Date

SECTION 2

Decision Summary

This ROD describes the Navy and EPA's selected remedial action for Site 4 (Landfill D) at the SJCA, Chesapeake, Virginia. VDEQ concurs with the Selected Remedy. The Navy is the lead agency and provides funding for site cleanups. Site 4 is one of several IRP sites located at the SJCA facility (EPA ID: VA5170000181).

2.1 Site Name, Location, Description, and History

The SJCA facility is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River in the City of Chesapeake in southeastern Virginia (Figure 2-1). The facility covers approximately 490 acres and includes administrative buildings, wharf areas on the Southern Branch of the Elizabeth River, a central heating plant, numerous non-operational industrial facilities, and miscellaneous structures. A list of all IRP sites can be found in the current version of the SMP, which is located in the Administrative Record. The SMP contains the location, description, contaminants of concern, and cleanup status of each site, including Site 4, at SJCA.

Site 4 (Landfill D) is located in the northeastern portion of SJCA (Figures 2-1 and 2-2). Although the areal extent of Site 4 was previously reported to be about 5 acres, the site boundary was adjusted to cover an estimated 10 acres. A review of historical aerial photographs and site reconnaissance during Phase I of the Remedial Investigation (RI) show that the extent of Site 4 is greater than previously thought. Site 4 consists of three distinct areas; an upland area (landfill), slope area, and wetland area; based on differences in surface topography and vegetation as shown on Figure 2-5. The wetland area is part of Site 4 based on the surface debris associated with landfill activities only. The wetland area sediment is being addressed separately and will not impact the remedial action for Site 4.

The disposal history at Site 4 is based on information provided in the Initial Assessment Study (IAS) conducted in 1981, the Phase II Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) conducted in 1989, and historical aerial photographs. Though SJCA has been active in ordnance related activities, there is no record of ordnance material being disposed at the site. The first indication of activity at Site 4 is a trench identified on a historical aerial photograph from 1961. The trench was approximately 1,000 feet (ft) long and was located parallel to and about 500 ft north of Blows Creek. The original trench and others were filled with trash, wet garbage, and soil from subsequent trenches. It is not known how many trenches were eventually dug, but based on a review of historical aerial photographs, there appear to be only two.

The IAS indicates that around 1970, sanitary landfill operations began at Site 4 in the marshes of Blows Creek. Disposal included primarily trash and wet garbage. Sanitary landfill operations continued until 1976, at which time trash and garbage were hauled to an off-site facility and inert construction material was then disposed of at the landfill. The RFA indicates that refuse disposal continued until 1981. The wastes managed were primarily trash, wet garbage, construction material, and out-dated civil defense materials. Although the RFA indicated that some solvents, acids, bases, and polychlorinated biphenyls (PCBs) were disposed of at Site 4, it is assumed that these materials were disposed of prior to 1976 as the IAS states that only inert material was disposed of after that date. Wastes disposed of at Site 4 were estimated at 1,500,000 cubic ft. According to Base Public Works Center personnel, the PCBs most likely came from ballast containers for fluorescent light fixtures. It is not known whether or not these ballasts were sealed units.

Sample results from the Remedial Investigation/Human Health Risk Assessment/ Ecological Risk Assessment (RI/HHRA/ERA) conducted from 1997 to 2001 do not indicate the presence of chlorinated solvents or hazardous materials in soil or groundwater at Site 4. Based on the findings of the RI/HHRA/ERA and historic disposal dates, Site 4 does not require closure as a hazardous waste landfill.

2.2 Previous Investigations and Enforcement Activities

2.2.1 Previous Investigations

2.2.1.1 Initial Assessment Study

In 1981, the Navy conducted the IAS as part of the Naval Assessment and Control of Installation Pollutants (NACIP) Program. The purpose was to qualitatively identify and assess sites that posed a potential threat to human health or the environment as a result of contamination from past handling of (and operations involving) hazardous materials. The IAS determined that Dump D (Site 4), did not pose a threat to human health and the environment, and no confirmation study was recommended.

2.2.1.2 Preliminary Assessment

In 1983, NUS Corporation, Superfund Division (NUS), conducted a PA at seven facility sites, including Site 4. Ambient air at the site was monitored for volatile organic compounds (VOCs) and radiation with an organic vapor meter and radiation meter, respectively. No readings above background were encountered, and NUS did not observe significant signs of contamination at the site. However, the PA report mentioned that various locations on the facility were contaminated with low level residues of pesticide and herbicide materials. A confirmation study was not proposed.

2.2.1.3 Phase II RCRA Facility Assessment

In 1989, A.T. Kearney, Inc. and K.W. Brown and Associates, Inc. prepared the RFA. The RFA included a preliminary review of all available relevant documents and a visual site inspection of 34 Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs), including Dump D (Site 4). No sampling was conducted during the RFA. Dump D (Site 4) was recommended for a RCRA Facility Investigation (RFI) due to the high potential for release to soil because of the unlined nature of the waste disposal area and the moderate to high potential for release to surface water via runoff and groundwater discharge due to the proximity to Blows Creek.

2.2.1.4 Relative Risk Ranking System Data Collection Report

In April 1996, CH2M HILL submitted a Relative Risk Ranking (RRR) System Data Collection Report for SJCA. Site 4 was sampled as part of the RRR System Data Collection which included two surface soil and three groundwater samples from Site 4. Analytical results were not validated. Several Pesticides, PCBs, and polycyclic aromatic hydrocarbons (PAHs) were detected in the surface soil samples. Acetone was detected in one groundwater sample collected from the northeastern corner of Site 4. No other organic compounds were detected in groundwater. Several inorganic analytes were detected in both soil and groundwater samples.

2.2.1.5 Hazard Ranking System

In 1999, Tetra Tech was assigned by the EPA to prepare an HRS sampling plan for SJCA. The purpose of the plan was to identify additional sampling locations and sample analysis necessary to complete the HRS evaluation (Tetra Tech, 1999). Twelve potential sources that may have released contaminants were identified, including Site 4. Sediment samples were collected from Blows Creek and the Southern Branch of the Elizabeth River adjacent to Site 4 in February 1999 and analyzed for Target Analyte List (TAL) and Target Compound List (TCL) constituents.

The data were presented in the *Hazard Ranking System Documentation Record for St. Juliens Creek Annex* (Tetra Tech, 2000). The HRS document identified sample locations adjacent to Site 4 as containing organic and inorganic concentrations that met the criteria for observed releases.

2.2.1.6 Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment

The RI/HHRA/ERA was completed by CH2M HILL in March 2003 at Site 4 to define the nature and extent of soil, groundwater, sediment, and surface water contamination to an extent sufficient for a Feasibility Study (FS), evaluate the geologic and hydrogeologic systems at the site to further understand contaminant distribution, and potential contaminant migration pathways, and determine if Site 4 poses unacceptable human and ecological risks.

Elevated chemical concentrations (primarily inorganics and PAHs) were identified in soil and sediment at Site 4. In general, potential site contaminants were restricted to the soils located within the limits of the waste. In sediment, a significant concentration of mercury was found in the eastern drainage ditch.

Although several inorganic concentrations were elevated in shallow and deep groundwater, the highest concentrations occurred upgradient from Site 4. Based on low constituent concentrations detected in deep groundwater, the presence of similar concentrations upgradient of the site, and the existence of a laterally extensive hydraulic aquitard (Yorktown Confining Unit), deep groundwater has not been impacted at Site 4. There was no definable plume of groundwater contamination identified.

Primary fate and contaminant migration pathways at Site 4 include surface runoff and erosion of soil to the drainage ditches at Site 4 and the wetland marsh area in the southwest portion of the site and infiltration and leaching of precipitation through the vadose zone from soil to the groundwater system.

The RI/HHRA/ERA concluded that there is potential risk to human and ecological receptors from exposure to chemicals at Site 4 (details included in Section 2.7). An FS was recommended to evaluate remedial alternatives for Site 4. A separate Baseline Ecological Risk Assessment (BERA) for Blows Creek was also recommended to identify potential risk associated with possible historical contributions to Blows Creek from upland Navy IRP sites.

2.2.1.7 Baseline Ecological Risk Assessment for Blows Creek

A BERA for Blows Creek is currently being conducted. The purpose of the BERA is to assess potential ecological risk in Blows Creek associated with adverse effects from Navy IRP sites, including Site 4, as well as other potential non-Navy sources. The results will be used to assess the impact to the Blows Creek, recommend further action, and develop remedial goals, if necessary. The results of the ongoing Blows Creek BERA will only potentially impact wetland area sediment adjacent to the Site 4 landfill and will not impact the selection of a remedy for Site 4.

2.2.1.8 Feasibility Study

An FS was completed for Site 4 in March 2004 to present the development and evaluation of remedial action alternatives. RAOs were developed and four alternatives were evaluated. Based on a comparative analysis, a soil cover was selected as the recommended remedial alternative for Site 4.

2.2.1.9 Proposed Remedial Action Plan

In accordance with the NCP, the Navy issued a Proposed Remedial Action Plan (PRAP) for Site 4 in May 2004. The PRAP identified the Preferred Alternative for addressing potential contamination at Site 4. As required by Sections 113 and 117 of CERCLA, the Navy provided a public comment period from May 12 through June 12, 2004, for the PRAP. In addition, a public meeting to present the PRAP was held on May 17, 2004, at the Major Hillard Library. Public notice of the meeting and availability of documents was placed in *The Virginian Pilot* newspaper on April 29, 2004. No significant changes were made to the preferred remedial action alternative identified in the PRAP as a result of the public meeting and comment period. The Responsiveness Summary is included in Section 3 of this ROD.

2.2.2 Enforcement Activities

SJCA was placed on the National Priorities List (NPL) in August 2000 (VA5170000181). No enforcement activities have been recorded to date at Site 4. The FFA provides for CERCLA-directed enforcement activities at the sites.

2.3 Community Participation

The SJCA Restoration Advisory Board (RAB) was formed in 1999. Meetings continue to be held to provide an information exchange among community members, the EPA, the Commonwealth of Virginia, and the Navy. These meetings are open to the public to provide opportunity for public comment and input, including the assumptions about reasonably anticipated future land use and potential beneficial uses of groundwater. A community relations program is being conducted through the IRP process and public input is considered a key element in the decision-making process.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from May 12 through June 12, 2004, for the PRAP for Site 4. A public meeting to present the PRAP for Site 4 was held on May 17, 2004, at the Major Hillard Library. Public notice of the meeting and availability of documents was placed in *The Virginian Pilot* newspaper on April 29, 2004.

The PRAP and the RI/HHRA/ERA for Site 4 are available to the public in the Administrative Record and information repository maintained at:

Major Hillard Library
824 Old George Washington Hwy. N
Chesapeake, Virginia 23323
(757) 382-3600

2.4 Scope and Role of Response Action

Site 4 is one of several IRP sites being addressed under CERCLA at SJCA. The annual SMP for SJCA includes the schedule for future remedial actions that will be conducted at Site 4 and all other IRP sites at SJCA.

Site 4 consists of three distinct areas; an upland area (landfill), slope area, and wetland area; based on differences in surface topography and vegetation as shown on Figure 2-5. Previous waste disposal activities at Site 4 have impacted soil and eastern drainage ditch sediment. The Selected Remedy in this ROD addresses the impacted soil and eastern drainage ditch sediment at Site 4, as identified in previous investigations and comprises the final remedial action for the site. The soil cover and removal of impacted eastern drainage ditch sediment will minimize human health and ecological exposure to contaminants at Site 4 and the potential transport of contaminants to Blows Creek. The soil cover will also reduce infiltration through contaminated soil and landfill contents, thereby reducing the potential contribution to groundwater. Pending the results of the Blows Creek BERA, wetland area sediment adjacent to Blows Creek, will be remediated, if necessary, separate from the remedial action for Site 4. The results of the BERA will not impact the selection of a remedy for Site 4.

The Selected Remedy will be designed and implemented to meet State requirements. Within 90 days following the execution of this ROD, the Navy shall develop, and submit to EPA and VDEQ, in accordance with the FFA, an RD that contains the Selected Remedy design and a LUC RD that shall provide for implementation and maintenance actions, including periodic inspections and reporting. The Navy will implement, maintain, monitor, and enforce the LUCs according to the RD. Actual construction of the soil cover is planned to begin in 2005.

2.5 Site Characteristics

2.5.1 Conceptual Site Model

The conceptual site models (CSMs) shown in Figures 2-3 and 2-4 show transport pathways, exposure media, exposure routes, and potential human health and ecological receptors for

Site 4, respectively. The human health and ecological risk assessments and the subsequent RAOs for Site 4 were based on these CSMs.

2.5.2 Site Overview

Site 4 covers an estimated 10 acres in the northeastern portion of SJCA (Figure 2-2). Surrounding water bodies include the Southern Branch of the Elizabeth River to the southeast and Blows Creek to the south. Site 4 consists of three distinct areas; an upland area (landfill), slope area, and wetland area; based on differences in surface topography and vegetation as shown on Figure 2-5.

There are no surface or subsurface features (i.e., tanks, structures) or areas of archaeological or historical importance at Site 4.

2.5.3 Sampling Strategy

Surface and subsurface soil, groundwater, sediment, and surface water samples were collected and analyzed to characterize the nature and extent of contamination and potential risk to human health and the environment as part of the RI/HHRA/ERA. Additionally, a geophysical investigation was conducted to determine the horizontal extent of waste and tidal studies were conducted to assess tidal influences of Blows Creek on the Columbia and Yorktown Aquifers. The field activities were conducted in three phases; the first and second phases were conducted from June to November 1997 and from April to October 1999, respectively and the third phase was conducted from June to August 2001, details are provided on Table 2-1.

2.5.4 Sources of Contamination

The source of contamination at Site 4 is the estimated 1,500,000 cubic ft of solid waste disposed of at the site. The results of the geophysical survey conducted at Site 4 indicated typical landfill materials (for example, buried metal). Similar materials were also visually observed on the ground surface during the geophysical survey. Numerous buried objects, most likely concrete blocks, metal pipes, drums, or other reflective materials, were reported in the northeast portion of the landfill. A 30x80-ft long swath adjacent to Blows Creek contains the highest density of surface debris in the area. Surface debris extends along the edge of Blows Creek for most of the site.

2.5.5 Types of Contamination

The types of contamination at Site 4 addressed by the Selected Remedy include the soil and eastern drainage ditch sediment at Site 4. The soils at Site 4 contained several PAHs, pesticides/PCBs, and inorganics identified as human health and ecological COCs (Tables 2-2 and 2-3, respectively). In general, the potential risk posed by soil was identified based on elevated COCs found within the limits of the waste. In soil located peripheral to the waste, only a few inorganics were found at concentrations posing a potential risk to human health and ecological receptors. The SJCA Project Management Team (Navy, EPA, VDEQ) determined that based on a comparison with background values and the physical separation of these samples from the limits of the waste, potential risks posed by surface soil outside the waste at Site 4 were acceptable and would not be included as part of the Selected Remedy.

Several PAHs, pesticides/PCBs, and inorganics were identified as ecological and human health COCs in the sediment (eastern drainage ditch and wetland sediment) at Site 4 (Tables 2-3 and 2-4, respectively). Of ecological significance in sediment was an elevated mercury concentration found in the eastern drainage ditch. A BERA for Blows Creek is currently being conducted to assess the impact of adjacent IRP sites (including Site 4) to the watershed. Pending the results of the BERA, remedial actions for wetland sediment adjacent to Blows Creek will be addressed separate from the remedial action for Site 4.The results of the BERA will not impact the selection of a remedy for Site 4.

2.5.6 Location of Contamination and Routes of Migration

2.5.6.1 Lateral and Vertical Extent of Contamination

The estimated 1,500,000 cubic ft of solid waste associated with Site 4 laterally extends over about 10 acres. The vertical extent of contamination is unknown; however, buried wastes are not believed to be present below the water table, locally measured at 5 ft below ground surface.

2.5.6.2 Current and Potential Future Surface and Subsurface Routes of Exposure and Receptors

Site 4 is currently not being actively used by the base at this time except to contain the existing landfill; however, the grassy upland area is regularly mowed and the adjacent patrol road is accessible and occasionally utilized as an exercise path by base personnel. Because the area is not fenced, there is the opportunity for base employees and trespassers/ visitors to have access to Site 4 and contact with the surface soil. However, this exposure would be similar to or less than exposure by people who perform work at the site or use the patrol rode for recreation. LUCs will be implemented within the boundaries of the landfill to meet the following objectives:

- Prohibit digging into or disturbing the soil cover or landfill contents
- Prohibit residential use and development of the site

Primary fate and contaminant migration pathways at Site 4 include surface runoff and erosion of soil to the drainage ditches at Site 4 and the wetland marsh area in the southwest portion of the site and infiltration and leaching of precipitation through the vadose zone from soil to the groundwater system.

2.5.6.3 Aquifer Characteristics

Site 4 is located within the Coastal Plain physiographic division, which is underlain by a thick wedge of unconsolidated deposits dipping southward toward the Atlantic Ocean, reaching a thickness of 2,000 feet along the shore. The three most shallow hydrostratigraphic units (Columbia Aquifer, Yorktown Confining Unit, and Yorktown Aquifer) were studied during the RI activities, because only these three are likely to be affected by SJCA operations.

The shallow Columbia Aquifer is generally unconfined and generally consists of clay, silty sand, and sand with intermittent lenses of coarse sand and gravel and shell fragments. The formation includes any fill material.

Underlying the Columbia Aquifer is the Yorktown Confining Unit, consisting of very fine sandy to silty clays that are highly variable in color, varying from multicolored to dark gray. The clays were deposited on a shallow, marine shelf in broad lagoonal and bay areas. Regionally, the Yorktown Confining Unit varies in thickness, in the Chesapeake vicinity (within the Elizabeth River drainage basin), the clay is reportedly approximately 25 to 38 ft thick.

The Yorktown Aquifer underlies the Yorktown Confining Unit. In the area around SJCA, this aquifer is approximately 40 to 60 ft thick and is confined to semi-confined. The formation represents a marine depositional sequence. It consists of basal coarse sand and gravel through a fine to medium, shelly sand, and capped by fine silty clay.

The groundwater ranges seasonally between 3 and 9 ft below ground surface and flows in the direction of the nearby surface water bodies (Blows Creek to the south and the Southern Branch of the Elizabeth River to the southeast). Contaminants from Site 4 may migrate in groundwater toward the surface water bodies; however, based on the expected dilution of groundwater as it discharges to the Southern Branch of the Elizabeth River and Blows Creek, aquatic organisms are not expected to be adversely affected by the landfill. A BERA for Blows Creek, a receiving body for Site 4 groundwater and surface water, is currently being conducted and the results will be used to assess the impact to the Blows Creek watershed, recommend further action, and develop remedial goals, if necessary.

2.6 Current and Potential Future Site and Resource Uses

2.6.1 Land Uses

Site 4 is currently not being actively used by the base at this time except to contain the existing landfill; however, the grassy upland area is regularly mowed and the adjacent patrol road is accessible and occasionally utilized as an exercise path by base personnel. The perimeter of the Site 4 landfill is bounded by the Southern Branch of the Elizabeth River to the east, Blows Creek to the south, and other IRP sites to the west and north. There is a base perimeter fence at SJCA. Activities that take place to the west and south of Site 4 include administrative activities, an active Defense Reutilization and Marketing Office (DRMO), a Shore Intermediate Maintenance Activity (SIMA), and storage. The Navy does not intend to build on Site 4, and current land uses are anticipated to continue indefinitely.

LUCs will be implemented within the boundaries of the landfill to meet the following objectives:

- Prohibit digging into or disturbing the soil cover or landfill contents
- Prohibit residential use and development of the site

2.6.2 Groundwater and Surface Water Uses

Groundwater from beneath Site 4 or downgradient of Site 4 is not currently used. The City of Chesapeake supplies water to SJCA and surrounding communities. Private deep wells exist locally, at least 1.5 miles upgradient of SJCA within the cities of Chesapeake and Portsmouth, that are permitted for irrigation only.

Shallow groundwater (Columbia Aquifer) is not considered a potable water source at or in the vicinity of SJCA due to its poor quality and low yield. Additionally, the HHRA results indicated acceptable risks based on exposure to shallow groundwater (Section 2.7.1.4).

The underlying confined Yorktown Aquifer is not used as a potable water supply. The groundwater is not likely a potential future water supply based on proximity to a contaminant source (Landfill D). As required by the Commonwealth of Virginia State Board of Health's Private Well Regulations, all wells must be at least 50 to 100 feet in distance from a contaminant source depending on the well class.

Any potential groundwater contribution from Site 4 discharges to the adjacent, downgradient surface water bodies. Therefore, any future use of shallow or deep groundwater at SJCA would be upgradient from Site 4.

LUCs will be implemented within the boundaries of the landfill to meet the following objectives:

- Prohibit digging into or disturbing the soil cover or landfill contents and
- Prohibit residential use and development of the site.

There are no surface water bodies within the boundaries of Site 4. However, the Southern Branch of the Elizabeth River and Blows Creek border Site 4. The nearby surface water is not used for swimming as it is shallow and the base is secured; however, future trespassers may potentially wade in these areas and contact both surface water and sediment.

2.7 Summary of Site Risks

The human health and ecological risks associated with exposure to contaminated media at Site 4 were evaluated in the RI/HHRA/ERA for Site 4 (CH2M HILL, 2003b) and summaries are provided in the following subsections.

2.7.1 Human Health Risk Assessment Summary

The baseline HHRA estimates the human health risks the site poses if no remedial actions are taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this site.

The HHRA was prepared using conservative assumptions designed to ensure that risks are not understated. Exposure pathways were evaluated for current and potential future site use based on current site conditions. The CSM presents an overview of site conditions, potential contaminant migration pathways, and exposure pathways to potential receptors. Figure 2-3 presents the CSM for Site 4. The CSM identifies the potential contaminant source and migration pathways, and the potential pathways by which a human receptor may contact site-related material.

2.7.1.1 Chemicals of Concern

Tables 2-2, 2-4, 2-5, and 2-6 show the range of detected concentrations and the frequency of detection for each COC for each media at Site 4. All human health COCs are listed in these tables and summarized in Section 2.7.1.4.

The exposure point concentration (EPC) used to estimate the risk for COCs were based on the 95-percent upper confidence limit (UCL) of the mean for media in which five or more samples were collected. The maximum detected concentration was used in place of the 95-percent UCL when the calculated 95-percent UCL was greater than the maximum detected value or less than five samples were collected. For each medium, a statistical test was used to determine if the data fit a lognormal or normal distribution. The Shapiro-Wilk W-test was used for media in which 50 samples or less were collected. The D'Agostino test was used for media in which 50 samples were collected. The 95-percent UCL from the distribution the data best fit was chosen as the EPC. If the W-test or D'Agostino's test was inconclusive, the larger of the 95-percent UCL from the lognormal or normal distribution was selected. The EPC used to estimate the risk for each COC and the type of statistical measure it represents is presented in Tables 2-7 through 2-10.

2.7.1.2 Exposure Assessment

An exposure assessment evaluates potential human exposure to the COCs present at or migrating from the site. Potential receptors include current and future trespassers, current and future residents, future construction workers, and future other workers. These potential receptors may have contact with any contamination in soil, sediment (eastern drainage ditch and wetland sediment), and/or groundwater through ingestion, dermal absorption, or inhalation. Conservative assumptions included evaluating the risk to current and future residents even though there are not plans for residential use or development at the site, and LUCs will be in place to prohibit such development. A detailed discussion of exposure assessment is provided in Section 7.3 of the RI/HHRA/ERA (CH2M HILL, 2003b).

Table 2-11 and Figure 2-3 present an evaluation of the potential exposure pathways and scenarios and identifies the pathways that were chosen for evaluation in the risk assessment, and the rationale for these choices. Some of the scenarios listed had no unacceptable risks, and hence no COCs and are therefore not included in the other HHRA tables in this ROD.

Many of the exposure parameters used to estimate intake (exposure) have default values that were used for the risk assessment. These assumptions, based on estimates of body weights, media intake levels, and exposure frequencies and duration, are provided in EPA guidance. Other assumptions (i.e., for the construction worker scenarios) were selected based on consideration of location-specific information. The reasonable maximum exposure (RME) parameters and central tendency (CT) exposure parameters used for the risk assessment are included in Tables 2-12 and 2-13, respectively. CTs were calculated and used throughout the risk assessment to provide a more realistic, site-specific risk evaluation. Some of the receptors included do not have unacceptable risks, and are therefore not included in this ROD.

2.7.1.3 Toxicity Assessment

The toxicity assessment weighs the available evidence regarding the potential for a particular chemical to adversely affect exposed individuals and provides a numerical estimate of the relationship between the extent of exposure and possible severity of adverse effects.

Toxicity Information for Noncarcinogenic Effects. Noncarcinogenic health effects include a variety of toxic effects on body systems, ranging from renal toxicity (toxicity to the kidneys) to central nervous system disorders.

EPA-derived oral, dermal, and inhalation chronic and subchronic reference doses (RfDs), associated uncertainty factors (Ufs), and modification factors (MFs) are presented in Appendix A, Table A-1. These data provide noncarcinogenic risk information that is relevant to the COCs for combined surface and subsurface soil, sediment, and deep groundwater.

Toxicity Information for Carcinogenic Effects. Potential carcinogenic effects from human exposure to chemicals are estimated quantitatively using oral carcinogenic slope factors (CSFs) or inhalation CSFs. EPA-derived oral, dermal, and inhalation CSFs for the COCs are presented in Appendix A, Table A-2. These data provide carcinogenic risk information that is relevant to the COCs for combined surface and subsurface soil, sediment, and deep groundwater.

2.7.1.4 Risk Characterization

Risks were evaluated for exposure to Site 4 surface and subsurface soil, sediment, and groundwater. For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated using the following equation:

Risk = CDI x CSF

where:

Risk = a unitless probability (i.e., 2×10^{-5}) of an individual's developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

CSF = carcinogenic slope factor, expressed as $(mg/kg\text{-}day)^{-1}$

These risks are probabilities that usually are expressed in scientific notation (i.e., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (i.e., life-time) with a RfD derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs that affect the same target organ (i.e., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI > 1 indicates that site-related exposures may present a risk to human health. The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

The risk characterization for each media are described in the following subsections. Appendix A, Tables A-3 through A-14 provide a summary of receptor risks and hazards for the COCs at Site 4.

Surface Soil. RME risk estimates for exposure to surface soil were calculated for current/ future adult and adolescent trespassers. Exposure to surface soil via incidental ingestion, dermal contact, and inhalation of fugitive dust from the surface soil was evaluated.

The noncarcinogenic hazards associated with exposure to surface soil via incidental ingestion, dermal contact, and inhalation for all receptors are below EPA's target HI of 1. The carcinogenic risks associated with exposure to surface soil via incidental ingestion, dermal contact, and inhalation by current/future adult and adolescent trespassers are within EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$. Since the calculated risks and hazards are within the target risk range and HI of 1, there are no COCs for surface soil and the risks are not included in the ROD.

Combined Surface and Subsurface Soil. RME risk and hazard estimates for exposure to soil were calculated for future adult and child residents, construction workers, and other workers. Exposure to soil via incidental ingestion and dermal contact was evaluated for all receptors. For the construction worker, exposure to soil via inhalation of fugitive dust was also evaluated.

The noncarcinogenic hazard associated with exposure to soil by future child residents is 5, which exceeds EPA's target HI of 1. The hazard to the child resident is primarily attributable to arsenic and iron through the ingestion route. Aluminum, antimony, manganese, and thallium via ingestion and manganese via dermal contact also contribute to the hazard, although their individual HQs are below 1. The noncarcinogenic hazards associated with exposure to the remaining receptors are at or below EPA's target HI of 1.

The carcinogenic risk associated with exposure to soil for all receptors, except the future lifetime resident, are within or below EPA's acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. The carcinogenic risk to the future lifetime resident is $1.3x10^{-4}$, and is primarily associated with arsenic.

Since the lifetime residential exposure pathway exceeds the carcinogenic risk of $1x10^{-5}$ and the child residential exposure pathway exceeds the target HI of 1, CT risk estimates for exposure to soil were calculated to provide a more realistic, site-specific risk evaluation.

The CT noncarcinogenic hazard associated with exposure to soil by future child residents is equal to EPA's target HI of 1. The CT carcinogenic risk associated with exposure to soil by future lifetime residents and future other workers are within or below EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Surface Water. RME risk estimates for exposure to surface water were calculated for current/future adult and adolescent trespassers, as well as future adult and child residents. Exposure to surface water via dermal contact was evaluated for all receptors.

The noncarcinogenic hazards for all receptors are below EPA's target hazard of 1. The carcinogenic risks for all receptors are below EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$. There are no COCs for surface water and the risks are not included in the ROD.

Sediment. RME risk and hazard estimates for exposure to sediment were not calculated for current/future adult and adolescent trespassers because there were no COCs retained for quantitative evaluation. However, RME risk and hazard estimates for exposure to sediment were calculated for future adult and child residents. Exposure to sediment via incidental ingestion and dermal contact was evaluated.

The noncarcinogenic hazard associated with exposure to sediment by future adult residents is below EPA's target HI of 1. The noncarcinogenic hazard of 3 associated with exposure by child residents exceeds EPA's target HI. The hazard to the child resident is primarily associated with dermal contact with iron in the sediment.

The carcinogenic risk associated with exposure to sediment by future lifetime residents is within EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Since the lifetime residential exposure pathway fell within the carcinogenic risk range ($1x10^{-5}$) and the child residential scenario exceeded the HI of 1, CT risk estimates for exposure to sediment were calculated for lifetime and child scenarios. The CT noncarcinogenic hazard associated with exposure to sediment by a child resident is below EPA's target HI of 1. The CT carcinogenic risk associated with exposure to sediment by future lifetime residents is within EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Shallow Groundwater. RME risk estimates for exposure to shallow groundwater via dermal contact were calculated for future adult construction workers. The noncarcinogenic hazard is below EPA's target HI of 1 and the carcinogenic risk is below EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Deep Groundwater. RME risk estimates for exposure to deep groundwater were calculated for current/future adult and child residents. Exposure to deep groundwater via incidental ingestion, dermal contact, and inhalation through showering (adults only) was also evaluated.

The noncarcinogenic hazard associated with exposure to deep groundwater via incidental ingestion and dermal contact by current/future adult residents is 26, which is above EPA's target HI of 1. The risk to the adult is primarily attributable to ingestion of iron and manganese in the groundwater. Arsenic also contributes an HI above 1. Several arsenic concentrations were above the associated background UTLs but below the maximum contaminant level (MCL). Iron concentrations were all below the background UTL and only one manganese concentration was above the background UTL.

The noncarcinogenic hazard associated with exposure to deep groundwater via inhalation through showering by current/future adult residents is equal to the EPA's target HI of 1, associated with inhalation of chloroform. Chloroform was only detected in the July 1997 samples at concentrations below the MCL and was not detected in subsequent sampling events. Additionally, chloroform is a known potential lab contaminant and it is suspected that the samples reflect artifacts of the analysis process.

The noncarcinogenic hazard associated with exposure to deep groundwater via incidental ingestion and dermal contact by current/future child residents is 60, which exceeds EPA's target HI of 1. The hazard to the child resident is primarily attributable to manganese and iron with a small contribution attributable to arsenic. The ingestion pathway contributes over 98 percent of the total HI.

The carcinogenic risk associated with exposure to deep groundwater via incidental ingestion and dermal contact by current/future adult and child residents and via inhalation through showering by current/future adult residents exceeds the upper bound of EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$. The risk is primarily associated with ingestion of arsenic.

Since both adult and child resident exposure pathways exceed a HI of 1, and the lifetime resident scenario exceeds a carcinogenic risk of $1x10^{-5}$, CT risk estimates for exposure to deep groundwater were calculated. The CT noncarcinogenic hazards associated with exposure to deep groundwater via ingestion and dermal contact by current/future adult and child receptors are 5 and 16, respectively, and exceed EPA's target HI of 1. The hazard to both the adult and child residents is primarily attributable to iron and manganese through the ingestion pathway.

The CT carcinogenic risk associated with exposure to deep groundwater for the lifetime resident is within EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Summary of Total Risks Across Pathways and Media. Total potential risks were summarized for current/future adult and adolescent trespassers; current adult, child, and lifetime residents; future adult, child, and lifetime residents; future adult construction worker; and future adult other worker for Site 4.

The following Site 4 receptors had total RME noncarcinogenic hazards or carcinogenic risks that exceeded EPA's target levels:

Combined Surface and Subsurface Soil

- Future child resident
  (ingestion of arsenic and iron)
- Future lifetime resident
  (ingestion of arsenic)

Sediment (eastern drainage ditch and wetland sediment)

- Future child resident
  (dermal absorption of iron)

Deep Groundwater

- Current/Future adult resident
  (ingestion of arsenic, iron, and manganese along with inhalation of chloroform)
- Current/Future child resident

(ingestion of arsenic, iron, and manganese)
- Current/Future lifetime resident
  (ingestion of arsenic)

Although human health risk drivers were identified for the deeper Yorktown Aquifer, based on the low concentrations of COC compounds, background UTL and MCL comparisons, and the presence of similar concentrations upgradient of the site, the SJCA Project Management Team (Navy, EPA, VDEQ) determined the deep groundwater risks at Site 4 to be acceptable for all pathways and receptors. Therefore, there are no site-related groundwater concerns at Site 4.

2.7.1.5 Uncertainty

The risk measures used in risk assessments are not fully probabilistic estimates of risk but are conditional estimates given that a set of assumptions about exposure and toxicity are realized. Thus it is important to specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective. A detailed discussion of the uncertainties associated with the risk assessment is included in the RI/HHRA/ERA (CH2M HILL, 2003b).

2.7.2 Ecological Risk Summary

The following subsections present a summary and the conclusions of the ERA for the Site 4 from the RI/HHRA/ERA (CH2M HILL, 2003b).

2.7.2.1 Chemicals of Concern

Summaries of the chemical concentrations detected in Site 4 surface soil, sediment (eastern drainage ditch and wetland sediment), and surface water are provided in Tables 2-14 through 2-16, respectively. Table 2-17 lists the ecological toxicity values that were used to initially screen chemicals within each of these media. Tables 2-18 through 2-20 compare the maximum concentrations of chemicals detected in surface soil, sediment, and surface water to the ecological screening values. Tables 2-21 through 2-23 compare the mean concentrations of chemicals detected in surface soil, sediment, and surface water to the ecological screening values. A comparison of the COCs to background concentrations in surface soil is presented in Table 2-24. Background concentrations have not been established for sediment or surface water at SJCA.

2.7.2.2 Exposure Assessment and Effects Assessment

Environmental Setting

Scrub/shrub community and mixed forest comprises approximately 55 percent of the total Site 4 habitat area. This habitat type is located mostly in the central to western portion of the site. Mowed grassland occurs in the north/northeastern portion of the site and comprises approximately 25 percent of the total Site 4 habitat area. Wetland habitats comprise approximately 20 percent of the remaining Site 4 habitat area. These wetlands consist mostly of isolated, seasonally flooded depressions (freshwater) that are located adjacent to Blows Creek, which is a tidally-influenced brackish water tributary to the Southern Branch of the Elizabeth River. Most of the habitats on Site 4 represent portions of larger communities that extend to areas outside the bounds of this site.

A drainage ditch along the eastern side of Site 4 transports surficial runoff from the Site 4 area to Blows Creek. This drainage contains water for limited time periods following storm events and provides habitat for a limited number of opportunistic aquatic species (i.e., tolerant and transient aquatic species).

Rare, Threatened, and Endangered Species

Rare, threatened, and endangered species information was obtained from the Virginia Department of Conservation and Recreation, Division of Natural Heritage (DNH), the Commonwealth of Virginia Department of Game and Inland Fisheries, Office of Plant and Pest Services, and the United States Fish and Wildlife Service (USFWS). These results were updated and verified by checking the DNH, Virginia Department of Game and Inland Fisheries, and USFWS web sites for rare and endangered species (http://www.dcr.state.va.us/dnh/rare.htm, http://www.dgif.state.va.us/wildlife/index.cfm, and http://endangered.fws.gov/). The reports and updated information indicate that no rare, threatened, or endangered wildlife species are known to occur at the Annex, with the possible exception of occasional transient species.

The following three listed species reside or migrate through southeastern Virginia and could periodically occur at the SJCA on which Site 4 is located:

- **Peregrine falcon (*Falco peregrinus*)—** Listed as endangered in the Commonwealth of Virginia, the peregrine falcon can be found in coastal areas during migration, particularly in September and October. In addition, hacking stations (release areas) have been established for the peregrine falcon on the Eastern Shore and in Back Bay National Wildlife Refuge;

- **Bald eagle (*Haliaeetus leucocephalus*)—**This species is listed as endangered in the Commonwealth of Virginia and threatened in portions of the lower 48 United States. The bald eagle was proposed for removal from the federal list in July 1999. Virginia provides prime habitat for the bald eagle. In 1978, 37 active nests were located in the state. There are currently no known bald eagles nesting within the Annex. Some eagles, however, do winter along area beaches or pass through the region during migration; and

- **Swainson's warbler (*Limnothlypis swainsonii*)—**This species is known to inhabit areas with abundant giant cane. However, this habitat does not occur at the Annex, limiting the potential for this species to occur on-site.

According to the DNH report, no natural heritage resources have been documented within a 2-mile radius of SJCA.

Transport and Exposure Pathways

A summary of the exposure pathways/routes by which ecological receptors could be exposed to chemicals originating from Site 4 is presented in the following section and is shown on Figure 2-4.

Based on available historic site information, chemicals are likely to have entered Site 4 surface soils via direct release. Viable terrestrial habitats occur throughout the site and terrestrial life, including terrestrial plants, soil invertebrates, and terrestrial wildlife could be exposed to chemicals in surface soil.

Chemicals could reach subsurface soil through infiltration and as a result of historic site activities. Once in subsurface soils, chemicals have potential to infiltrate into groundwater. Chemicals in groundwater are inaccessible to wildlife. There is, however, the potential for chemicals in groundwater to discharge to Blows Creek surface water, where they would once again be accessible to wildlife.

Surficial runoff has the potential to enter the Site 4 drainage where it could be transported to Blows Creek. The upland drainage associated with the southern portions of Site 4 contains adequate water to support ephemeral aquatic life, while Blows Creek is expected to support a broad diversity of aquatic species.

Once in these water bodies, chemicals could partition to sediment. The water velocity is expected to slow in the ditches/marshes immediately downgradient from Site 4 and these areas are expected to represent depositional sinks where chemicals could adsorb and precipitate to sediment. Once in sediment, chemicals could be remobilized and transported by various physical events and chemical processes (i.e., storm events, tidal forces). Aquatic life occurring in these habitats could be exposed to chemicals originating from Site 4.

An exposure pathway links a source of chemicals with one or more receptors. Exposure (and potential risk) can only occur if complete exposure pathways exist.

Terrestrial plants may be exposed to chemicals in soil through their root surfaces during water and nutrient uptake, while soil invertebrates may be exposed to chemicals in soil via direct contact and through the ingestion of chemicals in soils. Aquatic life may be exposed to chemicals by direct contact, through the ingestion of chemicals in sediment and surface water, and via the respiration of chemicals in surface water. Unrooted, floating aquatic plants, and rooted submerged vascular aquatic plants and algae, may be directly exposed to chemicals in surface water, while rooted aquatic plants may be directly exposed to chemicals in sediment via root uptake.

Wildlife at Site 4 would be primarily exposed to chemicals by the following pathways: (1) the incidental ingestion of chemicals in abiotic media (i.e., soil or sediment) during feeding activities; (2) the ingestion of chemicals in surface water; and (3) the ingestion of chemicals that have accumulated in plant and/or animal prey.

Assessment and Measurement Endpoints

Assessment and measurement endpoints were selected for evaluation following the identification of transport and exposure pathways and potentially-impacted ecological receptors. A summary of the assessment and measurement endpoints evaluated in the ERA is summarized in Table 2-25.

Because of the complexity of natural systems, it is generally not possible to directly assess the potential impacts to all ecological receptors present within an area. Therefore, specific receptor species (i.e., deer mouse) or species groups (i.e., fish) were selected as surrogates to evaluate potential risks to wildlife.

Lower trophic-level receptors were evaluated in the ERA based on the taxonomic groupings. The lower trophic-level receptor groups selected for evaluation in the Site 4 ERA consist of the following:

- Terrestrial plants and soil invertebrates;
- Water column-dwelling aquatic life; and
- Benthic-dwelling aquatic life.

The evaluation of risks for these receptors involved the direct comparison of maximum and mean chemical concentrations in soil (terrestrial plants and soil invertebrates), sediment (benthic-dwelling aquatic life), and surface water (water column-dwelling aquatic life) to literature-based ecological screening values.

Results for direct comparison to maximum concentrations are presented in Table 2-18 for surface soil, Table 2-19 for sediment, and Table 2-20 for surface water. Results for direct comparison to mean concentrations are presented in Table 2-21 for surface soil, Table 2-22 for sediment, and Table 2-23 for surface water.

Food web models were used to evaluate potential risks to higher trophic-level wildlife. The following representative higher trophic level species were selected for evaluation:

- Short-tailed shrew (*Blarina brevicauda*)—terrestrial mammalian insectivore;
- Deer mouse (*Peromyscus maniculatus*)—terrestrial mammalian omnivore;
- Raccoon (*Procyon lotor*)—semi-aquatic mammalian omnivore;
- Muskrat (*Ondatra zibethicus*)—aquatic mammalian herbivore;
- Mink (*Mustela vison*)—aquatic mammalian piscivore;
- Red fox (*Vulpes vulpes*)—terrestrial mammalian carnivore;
- American robin (*Turdus migratorius*)—terrestrial avian insectivore/omnivore;
- Red-tailed hawk (*Buteo jamaicensis*)—terrestrial avian carnivore;
- Belted kingfisher (*Ceryle alcyon*)—wetland/aquatic avian piscivore/omnivore; and,
- American Woodcock (*Scolopax minor*)—wetland/terrestrial avian insectivore.

Risks to lower trophic-level receptors were evaluated by comparing chemical concentrations in environmental media (soil, sediment, and surface water) to ecological screening values. Both maximum and mean concentrations were compared to ecological screening values to evaluate both worst case and more realistic exposure scenarios.

Risks to higher trophic-level wildlife were evaluated for all potentially bioaccumulative chemicals using literature-based food web models. Dietary items for which tissue concentrations were modeled included terrestrial plants, soil invertebrates (earthworms), small mammals, aquatic plants, aquatic invertebrates and fish. The uptake of chemicals from the abiotic media into these dietary items was calculated using both conservative and more realistic (mean) exposure parameters. Default factors of 1.0 were used when data were not available for a chemical in the literature. Incidental ingestion of soil or sediment was also included when calculating total exposure. In the models it was assumed that chemicals were 100-percent bioavailable to the receptor and that each receptor spent 100 percent of its time on the site (i.e., an area use factor of 1.0 was assumed).

The methodology and models used to derive tissue concentration estimates in potential prey items are described in the following subsections.

Terrestrial Plant Tissue. Tissue concentrations in the above-ground vegetative portion of terrestrial plants were estimated by multiplying the maximum measured surface soil concentration for each chemical by chemical-specific soil-to-plant bioconcentration factor (BCFs) obtained from the scientific literature. The BCF values used were based on root uptake from soil and on the ratio between dry-weight soil and dry-weight plant tissue. Literature values based on the ratio between dry-weight soil and wet-weight plant tissue were converted to a dry-weight basis by dividing the wet-weight BCF by the estimated solids content for terrestrial plants (15 percent [0.15]; Sample et al. 1997).

For inorganic chemicals without literature based BCFs, a soil-to-plant BCF of 1.0 was assumed. For organic chemicals without literature based BCFs, soil-to-plant BCFs were estimated using the algorithm provided in Travis and Arms (1988):

$$\log B_v = 1.588 - (0.578)\ (\log K_{ow})$$

where:

B_v = Soil-to-plant BCF (unitless; dry weight basis)

K_{ow} = Octanol-water partitioning coefficient (unitless)

The log K_{ow} values used in the calculations were obtained mostly from EPA (1995; 1996a). The soil-to-plant BCFs used in the conservative (worst case) scenario are given in Appendix B, Table B-1, while those for the mean scenario are given in Table B-2.

Earthworms Tissue. Tissue concentrations in soil invertebrates (earthworms) were estimated by multiplying the maximum measured surface soil concentration for each chemical by chemical-specific BCFs or bioaccumulation factors (BAFs) obtained from the literature. BCFs are calculated by dividing the concentration of a chemical in the tissues of an organism by the concentration of that same chemical in the surrounding environmental medium (in this case, soil) without accounting for uptake via the diet. BAFs consider both direct exposure to soil and exposure via the diet. Since earthworms consume soil, BAFs are more appropriate values and are used in the food web models when available. BAFs based on depurated analyses (soil was purged from the gut of the earthworm prior to analysis) were given preference over undepurated analyses when selecting BAF values since direct ingestion of soil is accounted for separately in the food web model.

The BCF/BAF values used were based on the ratio between dry-weight soil and dry-weight earthworm tissue. Literature values based on the ratio between dry-weight soil and wet-weight earthworm tissue were converted to a dry-weight basis by dividing the wet-weight BCF/BAF by the estimated solids content for earthworms (16 percent [0.16]; EPA, 1993). For inorganic chemicals without available measured BAFs or BCFs, an earthworm BAF of 1.0 was assumed. The soil-to-invertebrate (earthworm) BCFs/BAFs used in the conservative (worst case) scenario are given in Appendix B, Table B-1 while those for the mean scenario are given in Table B-2.

Small Mammals. Whole-body tissue concentrations in small mammals (shrews, voles, and/or mice) were estimated using one of two methodologies. For chemicals with literature-based soil-to-small mammal BAFs, the small mammal tissue concentration was estimated by multiplying the maximum measured surface soil concentration for each chemical by a chemical-specific soil-to-small mammal BAFs obtained from the literature.

The BAF values used were based on the ratio between dry-weight soil and whole-body dry-weight tissue. Literature values based on the ratio between dry-weight soil and wet-weight tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for small mammals (32 percent [0.32]; EPA, 1993).

BAFs reported in Sample et al. (1998b) were used to estimate whole-body tissue concentrations. BAFs for insectivores were used for shrews (or for general small mammals if insectivore values were unavailable), BAFs for voles were used for herbivores, and BAFs for mice were used for omnivores. General BAFs for small mammals were used when BAFs for specific receptor groups were not available. The small mammal BAFs used in the conservative (worst case) scenario are given in Appendix B, Table B-3, while those for the mean scenario are given in Table B-4.

For chemicals without soil-to-small mammal BAF values, an alternate approach was used to estimate whole-body tissue concentrations. Because most chemical exposure for small mammal species is via diet, it was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF (wet-weight basis) of one was assumed. Resulting tissue concentrations (wet-weight) were then converted to dry weight using an estimated solids content of 32 percent (see above).

Aquatic Plants. Tissue concentrations in the above-ground vegetative portion of aquatic plants were estimated using the same methodologies as described above for terrestrial plants except that maximum sediment (not soil) concentrations were used in the calculation.

Aquatic Invertebrates. Tissue concentrations in aquatic invertebrates were estimated by multiplying the maximum measured sediment concentration for each chemical by chemical-specific sediment-to-invertebrate BAFs obtained from the literature. The BAF values used were based on the ratio between dry-weight sediment and dry-weight invertebrate tissue. BAFs based on depurated analyses (sediment was purged from the gut of the organism prior to analysis) were given preference over undepurated analyses when selecting BAF values since direct ingestion of sediment is accounted for separately in the food web model.

Literature values based on the ratio between dry-weight sediment and wet-weight invertebrate tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for aquatic invertebrates (21 percent [0.21]; EPA, 1993). For chemicals without literature based sediment-to-invertebrate BAFs, a BAF of 1.0 was assumed. The sediment-to-invertebrate BAFs used in the conservative (worst case) scenario are given in Appendix B, Table B-5, while those for the mean scenario are given in Table B-6.

Fish. Tissue concentrations in whole-body fish were estimated by multiplying the maximum measured sediment concentration for each chemical by chemical-specific sediment-to-fish BAFs obtained from the literature. The BAF values used were based on the ratio between dry-weight sediment and dry-weight fish tissue. Literature values based on the ratio between dry-weight sediment and wet-weight fish tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for fish (25 percent [0.25]; EPA, 1993). For chemicals without literature based sediment-to-fish BAFs, a BAF of 1.0 was assumed. The sediment-to-fish BAFs used in the conservative (worst case) scenario are given in Appendix B, Table B-5, while those for the mean scenario are given in Table B-6.

Dietary intakes were estimated following the calculation of tissue concentrations. Dietary intakes for each receptor species were calculated using the following formula (modified from EPA [1993]):

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

where:

DI_x	=	Dietary intake for chemical x (mg chemical/kg body weight/day)
FIR	=	Food ingestion rate (kg/day, dry-weight)
FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry weight)
PDF_i	=	Proportion of diet composed of food item i (dry weight basis)
SC_x	=	Concentration of chemical x in soil/sediment (mg/kg, dry weight)
PDS	=	Proportion of diet composed of soil/sediment (dry weight basis)
WIR	=	Water ingestion rate (l/day)
WC_x	=	Concentration of chemical x in water (mg/l)
BW	=	Body weight (kg, wet weight)

A summary of the receptor-specific exposure parameters used for the above equation is provided in Appendix B, Table B-7 for the conservative (worst case) scenario and Table B-8 for the mean scenario**.**

Risks to wildlife receptors were evaluated by comparing calculated chemical doses to literature-based toxicity values. Wildlife dose-based toxicity values are summarized in Appendix B, Table B-9 for mammals and in Table B-10 for avian species. Risks to wildlife were determined by comparing doses estimated with both conservative (worst case) and mean exposure estimates.

Appendix B, Table B-11 shows the results of comparisons of maximum concentrations to ingestion based screening values. Appendix B, Table B-12 shows the results of comparisons of mean concentrations to ingestion based screening values.

2.7.2.3 Risk Characterization

A summary of the ERA risk results is presented in Table 2-3. For the direct exposure scenario, chemicals were identified as a potential risk in the risk summary table if mean concentrations exceeded the ecological screening values. For the wildlife exposure scenario, chemicals were identified as a potential risk in the risk summary table if the mean exposure scenario indicated a potential risk to wildlife. These exposure scenarios were selected because they are considered to be a more realistic indication of exposure. The ERA also considered the following factors when evaluating and interpreting the risk results: inorganic and PAH concentrations in site soils compared to those in reference samples, chemical bioavailability in sediment, chemical distribution in soil and sediment, and the influence of grain size and organic carbon on chemical distribution in sediment.

The ERA for Site 4 indicated the potential for adverse effects to:

- Lower trophic-level receptors (plants and soil invertebrates) from the presence of chemicals in Site 4 surface soils. The COCs in the surface soil include the inorganic compounds chromium, copper, iron, lead, nickel, vanadium, and zinc; the PCB aroclor-1260; and the PAHs anthracene, benzo(a)anthracene, benzo(a)pyrene, fluoranthene, phenanthrene, and pyrene;
- Chemicals present in the sediment (eastern drainage ditch and wetland sediment) at Site 4 are present at concentrations that could potentially adversely affect aquatic life. The COCs in Site 4 sediment include the inorganic compounds arsenic, barium, cobalt, copper, cyanide, iron, lead, manganese, mercury, nickel, and zinc; the pesticides/PCBs DDD, DDE, DDT, dieldrin, and aroclor-1260; and the PAHs 2-methylnaphthalene, acenaphthalyne, anthracene, benzo(a)anthracene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, diethylphthalate, fluoranthene, phenanthrene, and pyrene;
- Chemicals present in surface water may also have limited potential to adversely affect aquatic life if transported to Blows Creek. The COCs in Site 4 surface water include the inorganic compounds aluminum, copper, cyanide, iron, lead, manganese, nickel, silver, and zinc and the semivolatile organic compound (SVOC) carbon disulfide; and
- Risk calculations also indicated the potential for adverse effects to avian piscivores (i.e., Great Blue Heron) from mercury in the eastern drainage ditch sediment at Site 4.

The site drainages provide very little viable habitat for aquatic species based on the limited surface water present within them. A broader range of aquatic species could be exposed to chemicals if they are transported via the site-related drainages to Blows Creek, where a variety of aquatic species could be exposed to chemicals in surface water or following deposition to sediment. A separate BERA for Blows Creek is currently being conducted to identify potential risk associated with possible historical contributions from IRP sites (including Site 4) to Blows Creek.

2.8 Remedial Action Objectives

The level of contamination and the potential exposure routes were considered in defining the site-specific RAOs for protecting public health, welfare, and the environment. The future protection of environmental resources and the means of minimizing long-term disruption to current and future facility operations were also considered. The site-specific RAOs for Site 4 are:

- Prevent or minimize direct contact of human and ecological receptors with landfill contents;
- Reduce infiltration and any resulting leaching of contaminants from the landfill into groundwater; and
- Prevent overland flow entering the site (surface water run-on) and control surface water run-off and erosion.

The human health risks driving the need for action are related to COCs in soil and eastern drainage ditch sediment. Ecological risks driving the need for action are related to the presence of chemicals in surface soils potentially effecting plants and soil invertebrates and chemicals in the drainage sediment at that could potentially adversely affect aquatic life and avian piscivores (i.e., Great Blue Heron). To address these risks, RAOs were established to prevent or minimize direct contact of human or ecological receptors with landfill contents (soil) and control surface water run-off and erosion (to reduce the source of potential contamination to surface water and sediment). Reducing infiltration and any resulting leaching of contaminants from the landfill into groundwater would prevent future potential risks and potential transport to surface water and sediment.

2.9 Description of Alternatives

Four remedial alternatives were developed to address risk associated with soil and eastern drainage ditch sediment at Site 4. The remedial alternatives are discussed in detail in the FS (CH2M HILL, 2004b). Each alternative, with the exception of the no-action alternative, was developed to meet the RAOs.

2.9.1 Alternative 1—No Action

An analysis of the no action alternative is required by the NCP and serves as the baseline alternative. All other remedial action alternatives are judged against the no action alternative. Under this alternative, no additional controls or remedial technologies would be implemented and no further site-related monitoring or maintenance would be conducted. CERCLA (Section 121(c)), as amended by SARA, requires that the site be reviewed every 5 years since contamination (i.e., landfill contents) would remain on site. It is assumed that the current level of maintenance would be maintained. Only 5-year review costs apply to this alternative.

2.9.2 Alternative 2—Soil Cover

Alternative 2 consists of installing a soil cover (minimum 24 inches thick) over the landfill contents, estimated at 1,500,000 cubic ft, at Site 4. The major components of this alternative are as follows:

- The containment components of the soil cover include:
  - Cover materials (minimum 24 inches thick) will be placed over the upland and slope areas (approximately 8.2 acres);
  - Cover materials will be certified clean, meeting regulatory requirements, and consist of a topsoil layer, a vegetative support layer, and a leveling layer; and
  - A stand of vegetation will be established on top of the final cover.
- Removal of impacted sediment in the eastern drainage ditch
- LUCs will be implemented by the Navy within the boundaries of the landfill to meet the following objectives:
  - Prohibit digging into or disturbing the soil cover or landfill contents and

   - Prohibit residential use and development of the site.

The capital costs associated with this alternative are $1,396,000, maintenance and performance costs estimated for 30 years are $650,000, and total present-worth costs are $1,825,000. It would take an estimated 4 months to implement Alternative 2.

Based on the findings of the RI/HHRA/ERA (no evidence of chlorinated solvents or hazardous materials) and historic disposal dates, Site 4 does not require closure as a hazardous waste landfill.

2.9.3 Alternative 3—RCRA Subtitle D Cap

Alternative 3 consists of installing a RCRA Subtitle D Cap over the landfill contents, estimated at 1,500,000 cubic ft, at Site 4. Based on the findings of the RI/HHRA/ERA and historic disposal dates, Site 4 does not require closure as a hazardous waste landfill and a RCRA Subtitle D Cap is presented here for comparison. Alternative 3 consists of installing a cap that incorporates the minimum landfill cover requirements specified by RCRA Subtitle D (40 CFR Part 258). The overall goals of landfill closure under the Subtitle D regulations are to minimize the infiltration of water into the landfill and to maintain the integrity of the cover during the post-closure period by minimizing cover erosion. Subtitle D Cap and closure requirements are expanded upon in the seminar publication *Design, Operation, and Closure of Municipal Solid Waste Landfills* (EPA, 1994). RCRA Subtitle D requires that post-closure care and monitoring be performed for at least 30 years. As part of landfill closure, the Navy will prepare a written post-closure care plan and a monitoring plan. The major components of Alternative 3 are as follows:

- The containment components of the soil cover for landfill closure include:
   - Cap materials will be placed over the upland and slope areas (approximately 8.2 acres);
   - Cap materials will be certified clean, meeting State requirements, and consist of a topsoil layer, a vegetative support layer, a drainage layer, a barrier layer, and a leveling layer; and
   - A stand of vegetation will be established on top of the final cover.
- Removal of impacted sediment in the eastern drainage ditch
- LUCs will be implemented by the Navy within the boundaries of the landfill to meet the following objectives:
   - Prohibit digging into or disturbing the soil cover or landfill contents and
   - Prohibit residential use and development of the site.

The capital costs associated with this alternative are $2,358,000, maintenance and performance costs estimated for 30 years are $650,000, and total present-worth costs are $2,787,000. It would take an estimated 5 months to implement Alternative 3.

2.9.4 Alternative 4—Excavation and Off-site Disposal of Landfill Materials

Alternative 4 consists of excavating soil from the landfill and disposing of the excavated material in an appropriately licensed and permitted disposal facility. The major components of this alternative are as follows:

- Soil and landfill contents will be excavated to an estimated depth of 8 ft in the upland area (3.4 acres), 5 ft in the slope area (4.8 acres), and 3 ft in the wetland area (1.9 acres). These quantities were selected based on available site data (geophysical surveys and soil sampling). It is assumed that these disposal depths will be sufficient to remove landfill contents, estimated at 1,500,000 cubic ft;
- Removal of impacted sediment in the eastern drainage ditch;
- Installation of well points for dewatering of the excavation. Groundwater will be tested and properly managed to comply with regulatory requirements;
- Excavated materials will be classified as either hazardous or nonhazardous waste based on the results of waste characterization testing;
- Following characterization, the excavated materials will be properly manifested and transported to a landfill facility located within 50 miles of Site 4; and
- The excavated area will be backfilled and graded to allow for surface drainage southward into the wetland area north of Blows Creek.

The capital/total present-worth costs associated with this alternative are $10,791,000 and there are no associated maintenance and performance costs. It would take an estimated 6 months to implement Alternative 4.

2.9.5 Common Elements and Distinguishing Features of Each Alternative

2.9.5.1 Common Elements

Several elements are common to Alternatives 2, 3, and 4 as follows:

- **Clearing and Grubbing** - Portions of the site will need to be cleared prior to the commencement of any remedial action
- **Consolidation or Removal of 7.5-Ton Weights** - Seven 7.5-ton concrete counterweights are located on top of the ground surface in the upland area. If the Alternatives 2 or 3 are selected, these counterweights will be broken up and consolidated within the cover or cap design. If Alternative 4 is selected, then the counterweights will be broken up and hauled off-site as construction debris;
- **Surface Debris Removal from Wetland Area -** A 30x80-ft long swath against Blows Creek has a high density of surface debris, including sheet metal, concrete, and railroad ties. For Alternatives 2 and 3, depending on the type of material encountered, it will be consolidated under landfill cover or cap. If Alternative 4 is selected, the debris will be tested and hauled off-site for appropriate disposal;

- **Installation of Rip-Rap Upgradient of Wetland Area -** Rip-rap will be placed along the toe of the slope adjacent to and upgradient of the wetland area minimize the erosion of the slope area during high-tide events;
- **Sediment Removal from Eastern Drainage Ditch** - Because of the ecological and human health risks associated with impacted sediment in the eastern drainage ditch, the remedial alternatives will include the removal of 1 foot of sediment from the floor and side-slopes of the drainage ditch. Confirmation sampling from the eastern drainage ditch at Site 4 will be conducted with cleanup levels based on the background 95% UTLs for the associated soil type. The excavated material will be disposed in an appropriately licensed and permitted off-site disposal facility; and
- **Stormwater Drainage Ditch Improvements and Construction -** As part of remedial Alternatives 2, 3, and 4 considered in the FS, an open stormwater drainage ditch will be constructed along the eastern boundary of Site 4. The drainage ditch will be designed to convey stormwater runoff from locations upgradient of Site 4, as well as runoff that falls within Site 4 boundaries.

2.9.5.2 Distinguishing Features

The key distinguishing features of each alternative are as follows:

- Alternative 1 does not meet all ARARs, whereas Alternatives 2, 3, and 4 meet all ARARs;
- Alternative 1 does not provide long-term reliability of remedy, whereas with sufficient maintenance and performance, the useful life of a soil cover (Alternative 2) or RCRA Subtitle D Cap (Alternative 3) can surpass 30 years. However, complete excavation (Alternative 4) provides indefinite reliability of remedy;
- Alternatives 1, 2, and 3 result in a portion of landfill materials to be managed on-site. Alternative 4 results in the estimated 1,500,000 cubic ft of landfill materials to be disposed of off-site;
- Unlike Alternative 2, a RCRA Subtitle D Cap (Alternative 3) is designed, at a minimum, to meet requirements of the *Virginia Solid Waste Management Regulation*s. A RCRA Subtitle D Cap is constructed with a low permeability barrier layer and often includes a drainage layer to more effectively divert infiltration water away from the landfill cell;
- The estimated time for design and construction is similar for Alternatives 2 and 3 and substantially longer for Alternative 4;
- If Alternatives 2, 3, or 4 were implemented, the estimated time to reach remediation goals is 2 calendar years. Alternative 1 does not meet the remediation goals; and
- The remedy costs for each alternative were projected for 30 years:

Alternative	Capital Costs	Maintenance and Performance Costs	Present-Worth Costs
1	$0	*	*
2	$1,396,000	$650,000	$1,825,000
3	$2,358,000	$650,000	$2,787,000
4	$10,791,000	$0	$10,791,000

*Only 5-year review costs apply

2.9.6 Expected Outcomes of Each Alternative

There is currently no planned alternate future land use at Site 4 and the surrounding area except to contain the existing landfill. If Alternatives 2 or 3 were implemented, exposure would be controlled through containment and LUCs. If Alternative 4 was implemented, exposure would be controlled through off-site disposal of impacted soil and landfill materials and would result in unlimited use and unrestricted exposure. As a result of the surface debris removal and drainage improvements included as part of Alternatives 2, 3, and 4, the wetland vegetation that is disturbed will be allowed to recover naturally.

The drainage ditches at Sites 4 reflect site soil conditions and therefore, the background 95% UTLs for the associated soil type (CH2M HILL, 2001) will be used as the cleanup level for COCs in the eastern drainage ditch.

2.10 Comparative Analysis of Alternatives

The NCP outlines the approach for comparing remedial alternatives. Evaluation of the alternatives uses nine evaluation criteria. These consist of "threshold," "primary balancing," and "modifying" criteria. All alternatives are evaluated against threshold and primary balancing criteria, which are technical criteria based on environmental protection, cost, and engineering feasibility. To be considered for remedy selection, an alternative must meet the two following threshold criteria:

1. Overall protection of human health and the environment and
2. Compliance with ARARs.

The primary balancing criteria are then considered to determine which alternative provides the best combination of attributes. The primary balancing criteria are:

1. Long-term effectiveness and permanence;
2. Reduction in toxicity, mobility, or volume through treatment;
3. Implementability;
4. Short-term effectiveness; and
5. Cost.

The Preferred Alternative is evaluated further against two modifying criteria:

1. Acceptance by the Commonwealth/State and
2. Acceptance by the community.

A summary of the comparative analysis of alternatives for Site 4 is discussed in the subsections below and provided in Table 2-26.

2.10.1 Threshold Criteria

2.10.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are reduced, or controlled, through treatment, and LUCs.

With the exception of Alternative 1, the Alternatives protect human health and the environment by eliminating, reducing, or controlling risks posed by the site. Therefore, Alternative 1 will not be considered further in this evaluation. Alternatives 2 and 3 would provide adequate protection from exposure due to direct contact with impacted soil and landfill materials, while removal of eastern drainage ditch sediment eliminates the associated risk. A breach in the cover/cap could potentially expose human and ecological receptors to existing levels of contamination and allow leaching to the groundwater. Therefore, the cover/cap, as constructed, and future maintenance will be required to ensure protectiveness.

Unlike Alternative 2, a RCRA Subtitle D Cap (Alternative 3) is designed, at a minimum, to meet regulatory solid-waste disposal requirements. A RCRA Subtitle D Cap is constructed with a barrier layer and often includes a drainage layer to more effectively divert infiltration water away from the landfill cell.

Alternative 4 (complete removal of contaminated soil and landfill contents) would eliminate the potential for direct human or ecological contact with the soil and landfill contents. Removal also eliminates any future potential risk associated with contaminants leaching into the groundwater.

2.10.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, requires that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as ARARs, unless waivers are obtained.

Applicable requirements are standards and other environmental protection requirements of federal or state law dealing with a hazardous substance, pollutant, contaminant, or a selected remedial action. Relevant and appropriate requirements are standards and environmental protection criteria of federal or state law that, although not “applicable” to a hazardous substance or remedial action, address situations sufficiently similar to those at the site that their use is suitable.

Alternatives 2, 3, and 4, achieve compliance with chemical-, action-, and location-specific ARARs for Site 4. Although impacted soil and landfill materials would remain in place with Alternative 2, they are not considered hazardous waste and a soil cover will meet the associated ARARs (Appendix C). The soil cover would minimize surface water run-on, surface water runoff, and erosion; protect the existing wetlands; prevent exposure to soil and landfill contents; and reduce infiltration through contaminated soil and landfill contents, thereby reducing the potential contribution to groundwater.

2.10.2 Primary Balancing Criteria

2.10.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Alternatives 2, 3, and 4 provide some degree of long-term protection. The effectiveness and permanence of Alternatives 2 and 3 are dependant on the adequacy of maintenance. Landfill contents and impacted soil would remain as a potential source of future groundwater contamination. Because of the cap design, Alternative 3 would be more effective in preventing infiltration of surface runoff through the landfill contents and, ultimately, into the groundwater. Covering the landfill with soil, however, will not remove impacted soil or debris from the site.

With effective LUC implementation and maintenance, the useful life of a soil cover or RCRA Subtitle D Cap will easily surpass 30 years. As no hazardous waste will be present at the site, no bioaccumulation of hazardous waste and no Virginia Hazardous Waste Management Regulation compliance is needed. In the case of failure, restoration of the remedy would have minimal costs and would likely be limited to isolated small repairs due to natural causes, and the reasonable maximum exposure scenario would pose minimal impacts to human health and the environment for the short duration that landfill contents would be exposed.

Alternative 4 provides the greatest degree of long-term effectiveness and permanence with the complete removal of impacted soil, landfill materials, and impacted eastern drainage ditch sediment allowing for unlimited use and unrestricted exposure at the site.

2.10.2.2 Reduction in Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. None of the alternatives include a treatment component that would reduce the toxicity, mobility, or volume of contaminants at the site due to the large volume of waste.

Alternatives 2 and 3 would reduce the mobility of and the infiltration of surface runoff through the landfill contents. The cover/cap eliminates any direct pathway of landfill contents to potential receptors. But because the RCRA Subtitle D Cap would provide a greater degree of protection from infiltrating stormwater than the soil cover prescribed under Alternative 2, Alternative 3 provides a greater reduction in contaminant mobility than Alternative 2.

Alternative 4 would reduce the volume and mobility of contaminants by excavating and removing impacted materials from Site 4 and placing them in an appropriately permitted and licensed landfill facility.

2.10.2.3 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Installation of a soil cover or RCRA Subtitle D cap, as included in Alternatives 2 and 3,are well-established technologies. Placement of soil cover material, removal of impacted eastern drainage ditch sediment, and improvements to the drainage ditches can be implemented with conventional equipment in a relatively short time using standard construction methods. Alternative 2 would take approximately 4 months to implement and Alternative 3 would take at least 1 additional month to implement due to the nature of the cap materials.

To minimize wetland disturbance during debris removal, low-pressure equipment and/or logging mats would be required. Because waste will remain in place, 5-year site reviews would be conducted at Site 4, which can be easily implemented. Alternative 4 would be the most difficult to implement and would take at least 6 months. In the upland and slope areas, soil excavation and off-site disposal can be performed using conventional construction equipment and methods. However, although there are no suspected unexploded ordnance (UXO) at the site, due to past ordnance handling activities at the base, UXO support would be required for the duration of the construction for worker safety reasons and this causes difficulty in implementation. Dewatering operations, that also include testing of discharge water, would be required for this alternative.

2.10.2.4 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to site workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

Implementation of Alternatives 2 or 3 would require typical construction activities, such as excavation, placement of fill, grading and removal and would likely take two mobilizations, each taking several months. These activities would potentially expose workers to contaminated materials and debris for 4 months if Alternative 2 was implemented and 5 months if Alternative 3 was implemented. Workers would be required to receive training and use personal protective equipment (PPE). Implementation of this alternative would result in minimal increased risk to the surrounding community and ecosystems over current conditions because landfill contents will remain in place.

Alternative 4 would require similar construction activities (i.e., excavation, grading) to those associated with Alternatives 2 and 3 but would take at least 6 months to implement. Because all of the landfill soil and debris would be excavated and hauled off-site under Alternative 4, a greater volume of off-site truck traffic would occur under this Alternative than under Alternatives 2 and 3. This increased traffic poses a slightly higher risk of exposure to communities surrounding Site 4, as compared to Alternatives 2 and 3.

2.10.2.5 Cost

The estimated present-worth cost for Alternative 2 is $1,825,000, Alternative 3 estimated present-worth cost is $962,000 more that Alternative 2, totaling $2,787,000. The present-worth cost for Alternative 4 is estimated at approximately four times the cost as $10,791,000. Alternatives 2 and 3 would have Maintenance and Performance costs ($650,000 for 30 years). Cost summaries can be found in Table 2-27.

2.10.3 Modifying Criteria

2.10.3.1 Commonwealth of Virginia Acceptance

State involvement has been solicited throughout the investigative process and through to the proposed remedy selection. The VDEQ as the designated state support agency in Virginia has reviewed this ROD and concurs with the Selected Remedy (Alternative 2 - Soil Cover) as described in Section 2.12.

2.10.3.2 Community Acceptance

A public meeting was held on May 17, 2004, to present the PRAP for Site 4 to answer any questions on the PRAP and on the documents in the information repositories. Two RAB members attended the meeting. The public expressed its support for the preferred alternative presented in the public meeting. The questions and concerns raised at the meeting were general inquiries for informational purposes only; no significant comments were received from the public. Questions and concerns received during the meeting were addressed at the meeting and are documented in the meeting minutes, included as Appendix D. No written comments, concerns, or questions were received by the Navy, the EPA, or the Commonwealth of Virginia during the public comment period for the PRAP from May 12 to June 12, 2004.

2.11 Principal Threat Wastes

The NCP establishes an expectation that the EPA will use treatment to address the principal threats posed by a site whenever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. There are no principal threat wastes present at Site 4.

2.12 Selected Remedy

Alternative 2 - Soil Cover is the remedy selected for Site 4. This Selected Remedy is the Preferred Alternative presented in the PRAP. This alternative also includes the removal of impacted eastern drainage ditch sediment and the implementation of LUCs. Based on available information and the current understanding of site conditions, this alternative provides the best balance with respect to the nine NCP criteria for Site 4.

2.12.1 Summary of the Rationale for the Selected Remedy

Based on the comparative analysis, Alternative 2 - Soil Cover was selected as the Preferred Alternative for Site 4. Alternative 2 was selected because it achieves the following:

- Substantial risk reduction preventing direct exposure to impacted soil and landfill contents and by removing impacted eastern drainage ditch sediment;
- Compliance with ARARs of Federal and Virginia environmental laws (Appendix C);
- A useful life that can easily surpass 30 years;
- Reduction in contaminant volume and the mobility of contaminants;

- A well-established technology that can be implemented with conventional equipment in a relatively short time using standard construction methods; and
- Cost effectiveness.

Other than Alternative 1 - No Action, Alternative 2 is the most cost-effective of all the alternatives considered for Site 4. Alternative 3 - RCRA Subtitle D Cap is considered as slightly more protective; however, the costs are significantly higher and the implementability is considered more difficult. Additionally, because Site 4 is not a permitted landfill subject to the Virginia Solid Waste Management Regulations, a RCRA Subtitle D Cap is not required. Although Alternative 4 is considered the most effective for the long-term and would allow unlimited use and unrestricted exposure at the site, the costs are elevated, implementability is extremely difficult, and the removal activities would pose a higher risk of exposure to communities surrounding Site 4 due to the off-site transportation involved. Therefore, based on the available information and current understanding of site conditions, Alternative 2 provides the best balance with respect to the NCP evaluation criteria.

2.12.2 Description of the Selected Remedy

Alternative 2 consists of installing a soil cover over the landfill contents, estimated at 1,500,000 cubic ft, at Site 4. A description of the components of this alternative are as follows:

- Clearing and grubbing will be conducted prior to installation of the soil cover. The slope area between the upland and wetlands areas consists of a variety of low to medium dense brush (Honeysuckle, Briars) and stands of mature hardwood and pine trees. Brush and trees cleared from the site will be transported to an off-site location for disposal. No on-site stockpiling or burning will be permitted;
- Surface debris, including the seven 7.5-ton concrete counterweights, will be removed from the ground surface in the upland area and be broken up and consolidated under the landfill cover;
- Cover materials will be placed over the upland and slope areas (approximately 8.2 acres);
- Cover material will be certified clean through analytical testing and comparison to established EPA Risk-Based Concentrations (RBCs) values;
- Cover materials will consist of the following layers (listed from top to bottom):
  - **Topsoil Layer.** The upper 6 inches of the final cover system will consist of topsoil or similar materials capable of sustaining vegetation. Acceptable topsoil is defined as native or amended soil with an organic content of at least 1.5 percent by weight, a pH in the range of 6.0 to 7.0, and a soluble salt concentration less than 500 parts per million (ppm);
  - **Vegetative Support Layer.** The vegetative support layer will consist of a minimum of 18 inches of clean soil fill with a maximum particle size of 3 inches. Since there are no on-site borrow sources for this material, it is expected that the vegetative support layer will be constructed of imported soil materials. These materials will be trucked to the site, spread, and compacted to at least 90 percent relative compaction per

American Society for Testing and Materials (ASTM) D698 (Standard Proctor) to provide a stable base for the overlying topsoil layer. Below this layer will be the compacted soil base layer, as required, to establish proper slopes for drainage and stability; and

  – **Leveling Layer.** A layer of approximately 6 in. of soil will be placed to protect the overlying layers from landfill contents and to build up the appropriate grades specified in the design basis. The leveling layer will be compacted to serve as a proper sub-base for the overlying layers.

- A stand of vegetation will be established on top of the final cover. Temperature- and drought-resistant vegetation indigenous to the area will be planted. The vegetation will have a root system that does not extend past the vegetative support layer, will require minimal maintenance, can survive in low-nutrient soil, and has sufficient density to control the rate of erosion to recommended levels (less than 2 tons/acre/year);
- The 30x80-ft long swath adjacent to Blows Creek that has a high density of surface debris will be consolidated into landfill cover or cap. The debris primarily consisted of 8x8-inch railroad ties in various stages of decay. Other debris includes corrugated panels (suspected of containing asbestos), glass, metal cylinders, pipes, and wooden boards;
- Rip-rap will be installed along the toe of the slope adjacent to and upgradient of the wetland area. The rip-rap will minimize the erosion of the slope area during high-tide events. Slope erosion could result in the premature loss of wetland area because of the settlement of fines in standing water bodies within the wetland area. The area at the toe of the slope in which rip-rap will be placed is estimated to be 10 ft wide by 600 ft long;
- Because of the ecological and human health risks associated with impacted sediment in the eastern drainage ditch, the remedial alternatives will include the removal of 1 foot of sediment from the floor and side-slopes of the drainage ditch and be hauled off-site for disposal. Confirmation sampling from the eastern drainage ditch at Site 4 will be conducted with cleanup levels based on the background 95% UTLs for the associated soil type;
- An open stormwater drainage ditch will be constructed along the eastern boundary of Site 4. The drainage ditch will be designed to convey stormwater runoff from locations upgradient of Site 4, as well as runoff that falls within Site 4 boundaries. The drainage ditch will be lined with a synthetic geotextile membrane and rip-rap in order to minimize stormwater erosion and contact with native soil. The ditch will traverse approximately 1,000 ft and discharge its load into the tidal wetlands of Blows Creek south of Site 4;
- A new drainage ditch will also be constructed along the site's western boundary. This ditch will be lined with erosion matting and graded to convey runoff from the vegetated soil cover to the wetland area adjacent to Blows Creek; and
- LUCs will be implemented within the boundaries of the landfill to meet the following objectives:
  – Prohibit digging into or disturbing the soil cover or landfill contents and

– Prohibit residential use and development of the site.

Within 90 days following the execution of this ROD, the Navy shall develop, and submit to EPA and VDEQ, in accordance with the FFA, an RD to implement the Selected Remedy and a LUC RD containing implementation and maintenance actions that shall provide for implementation and maintenance actions, including periodic inspections and reporting. The Navy will implement, maintain, monitor, and enforce the LUCs according to the RD. Within 30 days of finalizing the RD, the Navy will amend the SMP to include the schedule for RD actions.

The LUCs shall be maintained within the boundaries of the landfill indefinitely, or until all parties (Navy, EPA, VDEQ) agree that waste left in place is at such levels to allow for unlimited use and unrestricted exposure.

2.12.3 Summary of the Estimated Remedy Costs

The estimated remedy costs for Alternative 2 - Soil Cover is presented in Table 2-27. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost estimate are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes shall be documented in the form of a memorandum in the Administrative Record file. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 percent to -30 percent of the actual project costs.

2.12.4 Expected Outcomes of the Selected Remedy

There is currently no planned future land use at Site 4 and the surrounding area except to contain the existing landfill. If Alternative 2 is implemented, exposure will be controlled through containment and LUCs. The soil cover will also reduce any future potential risk associated with contaminants leaching into the groundwater. Five-year site remedy reviews will be conducted and groundwater quality will be re-assessed. Disturbed vegetation resulting from the surface debris removal from the wetland area and drainage improvements will be allowed to recover naturally.

The drainage ditches at Sites 4 reflect site soil conditions and therefore, the background 95% UTLs for the associated soil type (CH2M HILL, 2001) will be used as the cleanup level for COCs in the eastern drainage ditch.

2.13 Statutory Determinations

Remedial actions must meet the statutory requirements of Section 121 of CERCLA. Remedial actions undertaken at NPL sites must achieve adequate protection of human health and the environment, comply with ARARs of both federal and state laws and regulations, be cost-effective, and use, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, and/or mobility of hazardous waste as the principal element and a bias against off-site disposal of untreated wastes. The following discussion summarizes the statutory requirements that are met by the selected remedial alternative.

2.13.1 Protection of Human Health and the Environment

The Selected Remedy, Alternative 2, will protect human health and the environment by reducing and controlling site risks through the installation of a soil cover, removal of impacted eastern drainage ditch sediment, and the implementation of LUCs. Implementation of the Selected Remedy will eliminate the threat of human and ecological receptor exposure to the COCs via direct contact with or ingestion of impacted soil, landfill materials, and eastern drainage ditch sediment. The Selected Remedy will also minimize the potential for leachate generation and potential future contamination of groundwater.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements and To-Be-Considered Criteria

The Selected Remedy will meet all identified ARARs. Federal and state ARARs for Site 4 are summarized in Appendix C. The tables summarize the ARARs by classification. In addition, other to-be-considered (TBC) criteria are included as appropriate for each classification. The classifications of ARARs identified include chemical-specific, location-specific, and action-specific.

Although impacted soil and landfill materials would remain in place with Alternative 2, they are not considered hazardous waste and only require a soil cover. The soil cover would minimize surface water run-on, surface water runoff, and erosion; protect the existing wetlands; prevent exposure to soil and landfill contents; and reduce infiltration through contaminated soil and landfill contents, thereby reducing the potential contribution to groundwater.

The Site 4 soil cover will be maintained, and land use restrictions will be documented. If the remedy goals are not met, additional remedial actions could be implemented in the future.

2.13.3 Cost-Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." This was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria. Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to represent a reasonable value for the money to be spent.

The estimated present-worth cost of the Selected Remedy is $1,396,000. The Selected Remedy is cost-effective because it provides protection of human health and the environment. Alternative 3 - RCRA Subtitle D Cap is considered as slightly more protective; however, the costs are significantly higher and the implementability is considered more difficult. Additionally, because Site 4 is not a permitted landfill subject to the Virginia Solid Waste Management Regulations, a RCRA Subtitle D is not required.

2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The Navy, EPA, and the Commonwealth of Virginia determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at Site 4. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Navy, EPA, and the Commonwealth of Virginia determined that the Selected Remedy provides the best balance of tradeoffs in terms of the balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal, and considering state and community acceptance.

The Selected Remedy represents the maximum extent to which permanent solutions and treatment are practicable at Site 4 because:

- Existing conditions provide a level of long-term protection equivalent to the low permeability cap (Alternative 3) without additional cost;
- There is no principal threat waste at the site that requires treatment;
- Treatment of the landfill contents is not practicable in a cost-effective manner because of the large volume of waste; and
- There is no definable plume of groundwater contamination.

2.13.5 Preference for Treatment as a Principal Element

The Selected Remedy does not use treatment for the reasons given above. It therefore does not satisfy the statutory preference for treatment as a principal element. Note that the EPA generally expects to use treatment to address principal threat waste and that no principal threat waste exists at Site 4.

2.13.6 Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants (i.e., landfill contents) remaining on-site above levels that allow for unlimited use and unrestricted exposure, the Navy will conduct a statutory remedy review within 5 years after initiating remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

2.14 Documentation of Significant Changes

The Selected Remedy was the Preferred Alternative in the PRAP and was presented at the public meeting held on May 17, 2004. No significant changes were made to the preferred remedial action alternative identified in the PRAP.

Table 2-1
Summary of RI Field Activities at Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Field Investigation Acivity	**Site 4**	
Geophysical Surveys		
Electronmagnetic	X	
Magnetometer	X	
Ground Penetrating Radar	X	
Monitoring Well Installation		
Phase 1 Monitoring Wells Installed	4 shallow and 2 deep wells	
Surface Soil Sampling	**Samples**	**Duplicates**
Phase 1 Samples	10	1
Phase 2 Samples	8	1
Total RI Samples	18	2
Subsurface Soil Sampling		
Phase 1 Samples	3	0
Phase 2 Samples	5	1
Total RI Samples	8	1
Monitoring Well Groundwater Sampling		
Phase 1 Sampling - July 1997	4 shallow and 2 deep wells	
Phase 1 Sampling - November 1997	4 shallow and 2 deep wells	
Phase 2 Sampling - May 1999	4 shallow and 2 deep wells	
Surface Water Sampling	**Samples**	**Duplicates**
Phase 1 Samples	1	1
Phase 2 Samples	7	2
Total RI Samples	8	3
Sediment Sampling		
Phase 1 Samples	4	0
Phase 2 Samples	5	1
Total RI Samples	9	1
Groundwater Elevation Monitoring Events		
Phase 2 Monitoring Events	17-May-99	
Phase 3 Monitoring Events	16-Aug-01	
Tidal Survey	1 deep well (May 1-4, 1999) and 1 shallow (May 5-8, 1999)	
Slug Tests	4 shallow, 2 deep wells	

TABLE 2-2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH COCS IN SOIL
St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: At Site 4

CAS Number	Chemical	(1) Minimum Concentration	Minimum Qualifier	(1) Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	(2) Background Value	(3) Screening Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	(4) Rationale for Contaminant Deletion or Selection
	Inorganic															
7440382	Arsenic	1.9		236		mg/kg	SB06	26 / 26	0.42 - 1.1	236	14	0.43 C	NA	NA	yes	ASL
7439896	Iron	2920		65100		mg/kg	SS11	26 / 26	2.56 - 16.6	65100	36585	2300 N	NA	NA	yes	ASL

* Surface soil & subsurface soil combined

(1) Minimum/maximum detected concentration.

(2) Background data is UCL for dredge-fill background soil type from St. Julliens Creek Background Investigation.

(3) Tier I screening: With the exception of lead, all compounds are screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, October 9, 2002 for residential soil (cancer benchmark value = 1e-06; HQ = 0.1). Lead is screened against the EPA screening value of a value of 400 mg/kg.

(4) Rationale Codes

Selection Reason: Above Screening Level (ASL)
No Toxicity Information (NTX)

Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)

Surface and Subsurface Soil Samples: Phase I - SS01 to SS10, SB01, SB02, and SB03; Phase II - SS11 to SS18, SB04 to SB08

Definitions:
NA = Not Applicable
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated Value
L = Estimated Value - Biased Low

Table 2-3
Summary of Mean Concentration Ecological COCs
St. Juliens Creek Annex - Site 4

	Direct Exposure			Food Web									
				Mammals						Birds			
Chemical	Surface Soil	Sediment	Surface Water	Short-tailed Shrew	Deer Mouse	Raccoon	Red Fox	Muskrat	Mink	American Robin	American Woodcock	Red-tailed Hawk	Belted Kingfisher
Inorganics													
Aluminum	X		X										
Antimony													
Arsenic		**X**											
Barium		**X**											
Beryllium		**X**											
Cadmium													
Chromium	X												
Cobalt		**X**											
Copper	X	X	X										
Cyanide		X	X										
Iron	X		**X**										
Lead	X	X	X										
Manganese		X	X										
Mercury	X	**X**											X
Nickel	X	X	X										
Selenium													
Silver			X										
Thallium		**X**											
Vanadium	X												
Zinc	X	X	X										
Pesticides/PCBs													
4,4'-DDD		X											
4,4'-DDT		X											
4,4'-DDT		X											
Aldrin													
Aroclor-1016													
Aroclor-1221													
Aroclor-1232													
Aroclor-1242													
Aroclor-1248													
Aroclor-1254													
Aroclor-1260	X	X											
Dieldrin		X											
Endosulfan I													
Endosulfan II													
Endosulfan sulfate													
Endrin													
Endrin aldehyde													
Endrin ketone													
Heptachlor													
Heptachlor epoxide													
Methoxychlor													
Toxaphene													
alpha-BHC													
alpha-Chlordane													
beta-BHC													
delta-BHC													

Table 2-3
Summary of Mean Concentration Ecological COCs
St. Juliens Creek Annex - Site 4

Chemical	Direct Exposure			Food Web									
				Mammals						Birds			
	Surface Soil	Sediment	Surface Water	Short-tailed Shrew	Deer Mouse	Raccoon	Red Fox	Muskrat	Mink	American Robin	American Woodcock	Red-tailed Hawk	Belted Kingfisher
gamma-BHC (Lindane)													
gamma-Chlordane													
Semivolatile Organic Compounds													
1,2,4-Trichlorobenzene													
1,2-Dichlorobenzene													
1,4-Dichlorobenzene													
2,4,5-Trichlorophenol													
2,4,6-Trichlorophenol													
2,4-Dichlorophenol													
2,4-Dimethylphenol													
2,4-Dinitrophenol													
2-Chloronaphthalene													
2-Chlorophenol													
2-Methylnaphthalene	X	**X**											
2-Methylphenol													
4,6-Dinitro-2-methylphenol													
4-Bromophenyl-phenylether													
4-Methylphenol													
4-Nitrophenol													
4-Chloro-3-methylphenol													
Acenaphthene													
Acenaphthylene	X	**X**											
Anthracene	X	X											
Benzo(a)anthracene	X	X											
Benzo(a)pyrene	X												
Benzo(b)fluoranthene	X												
Benzo(g,h,i)perylene	X												
Benzo(k)fluoranthene	X	**X**											
Butylbenzylphthalate	X												
Carbazole	X												
Chrysene	X	**X**											
Dibenz(a,h)anthracene	X	**X**											
Dibenzofuran	X												
Diethylphthalate		X											
Dimethyl phthalate													
Di-n-butylphthalate													
Di-n-octylphthalate													
Fluoranthene	X	**X**											
Fluorene													
Hexachlorobenzene													
Hexachlorobutadiene													
Hexachlorocyclopentadiene													
Indeno(1,2,3-cd)pyrene	X												
Naphthalene	X												
Nitrobenzene													
Pentachlorophenol													
Phenanthrene	X	X											
Phenol													

Table 2-3
Summary of Mean Concentration Ecological COCs
St. Juliens Creek Annex - Site 4

Chemical	Direct Exposure			Food Web									
				Mammals						Birds			
	Surface Soil	Sediment	Surface Water	Short-tailed Shrew	Deer Mouse	Raccoon	Red Fox	Muskrat	Mink	American Robin	American Woodcock	Red-tailed Hawk	Belted Kingfisher
Pyrene	X	**X**											
bis(2-Ethylhexyl)phthalate	X												
n-Nitrosodiphenylamine													
Volatile Organic Compounds													
1,1,1-Trichloroethane													
1,1,2-Trichloroethane													
2-Butanone	X												
Acetone	X	**X**											
Carbon disulfide		X	X										
Ethylbenzene													
Toluene		**X**											

Note:
A blank cell denotes a chemical determined not to be a COC
An "X" in a cell denotes a chemical that is a COC
Shaded cells indicate COCs

TABLE 2-4
OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH COCS IN SEDIMENT
St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Drainage Features

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	Inorganic															
7439896	Iron	10500		56000		mg/kg	SD01	9 / 9	3.38 - 14.1	56000	NA	23000 N	NA	NA	yes	ASL

(1) Minimum/maximum detected concentration.

(2) No background study has been completed for the St. Juliens Creek Annex sediment.

(3) Tier I screening: With the exception of lead, all compounds are screened against 10 times the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, October 9, 2002 for residential soil (10 times the cancer benchmark value = 1e-06; 10 times the HQ = 0.1). Lead is screened against the EPA screening value of 400 mg/kg.

(4) Rationale Codes

Selection Reason: Above Screening Level (ASL)
No Toxicity Information (NTX)

Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)

Sediment Samples: SD01 to SD04 - Phase I; SD05 to SD09 - Phase II

Definitions:
NA = Not Applicable
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated Value
K = Estimated Value - Biased High
L = Estimated Value - Biased Low

TABLE 2-5
OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH COCS IN DEEP GROUNDWATER
St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Deep Groundwater
Exposure Point: Tap Water

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	Inorganic															
7440382	Arsenic	3.8	J	6.5	J	ug/l	GW3D	3 / 5	2 - 3.2	6.5	ND	0.045 C	50	MCL	yes	ASL
7439896	Iron	9120	K	68500		ug/l	GW1D	5 / 5	5 - 30.8	68500	2035	1100 N	300	SMCL	yes	ASL
7439965	Manganese	1900		12500		ug/l	GW1D	5 / 5	0.3 - 1	12500	271	73 N	50	SMCL	yes	ASL

(1) Minimum/maximum detected concentration.

(2) Background data is UCL for Yorktown Aquifer from St. Julliens Creek Background Investigation.

(3) Tier I screening: With the exception of lead, all compounds are screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, October 9, 2002 for tap water (cancer benchmark value = 1e-06; HQ = 0.1). Lead is screened against the MCL value of 15 ug/l.
When no RBC available, surrogate RBC used as follows:

(4) Rationale Codes
Selection Reason: Above Screening Level (ASL)
No Toxicity Information (NTX)
Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)

Deep Groundwater Samples: GW1D and GW3D - Phase I, Rounds 1 and 2 and Phase II

Definitions:
N/A = Not Applicable
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
K = Estimated Value - Biased High
L = Estimated Value - Biased Low

TABLE 2-6
OCCURRENCE, DISTRIBUTION, AND SELECTION OF HUMAN HEALTH COCS IN AIR
St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Air
Exposure Point: Deep Groundwater - Water Vapor at Showerhead

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	<u>Organic</u>															
67663	Chloroform	0.6	J	9		ug/l	GW3D	2 / 6	1 - 1	9	ND	0.063 N	100	MCL	yes	ASL

(1) Minimum/maximum detected concentration.
(2) Background data is UCL for Yorktown Aquifer from St. Julliens Creek Background Investigation.
(3) Tier I screening: With the exception of lead, all compounds are screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, October 9, 2002 for tap water (cancer benchmark value = 1e-06; HQ = 0.1). Lead is screened against the MCL value of 15 ug/l.
(4) Rationale Codes
Selection Reason: Above Screening Level (ASL)
No Toxicity Information (NTX)
Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)

Deep Groundwater Samples: GW1D and GW3D - Phase I, Rounds 1 and 2 and Phase II

Definitions:
N/A = Not Applicable
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
K = Estimated Value - Biased High
L = Estimated Value - Biased Low

TABLE 2-7

HUMAN HEALTH MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SOIL

St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: At Site 4

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Arsenic	mg/kg	19	34	236	-	mg/kg	34	95% UCL-N	W - Test (4)	19	Mean-N	W - Test (4)
Iron	mg/kg	24014	32512	65100	-	mg/kg	32512	95% UCL-T	W - Test (4)	24014	Mean-N	W - Test (4)

*Surface soil and subsurface soil combined.

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T);
Mean of Normal Data (Mean-N).

J = Estimated Value

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(2) Shapiro-Wilk W Test indicates data are lognormally distributed.

(3) Shapiro-Wilk W Test indicates data are normally distributed.

(4) Shapiro-Wilk W Test inconclusive. Higher of UCL for normally and lognormally distributed data used for the RME EPC. Higher of mean value for normally and lognormally distributed data used for CT EPC.

(5) Mean exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

Note: The arithmetic mean is calculated using one-half the sample quantitation limit for non-detects and is normally distributed. When calculated in this way, it is possible for the mean to exceed the maximum detected value. In such cases, the maximum det

TABLE 2-8
HUMAN HEALTH MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR DEEP GROUNDWATER
St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Deep Groundwater
Exposure Point: Tap Water

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Arsenic	ug/L	3.6	19.1	6.5	J	ug/L	19.1	95% UCL-T	W - Test (4)	3.6	Mean-N	W - Test (4)
Iron	ug/L	31624	188881	68500	-	ug/L	68500	Max	W - Test (4,1)	31624	Mean-N	W - Test (4)
Manganese	ug/L	6052	33449	12500	-	ug/L	12500	Max	W - Test (4,1)	6052	Mean-N	W - Test (4)

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

J = Estimated Value

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(2) Shapiro-Wilk W Test indicates data are lognormally distributed.
(3) Shapiro-Wilk W Test indicates data are normally distributed.
(4) Shapiro-Wilk W Test inconclusive. Higher of UCL for normally and lognormally distributed data used for the RME EPC. Higher of mean value for normally and lognormally distributed data used for CT EPC.

Note: The arithmetic mean is calculated using one-half the sample quantitation limit for non-detects and is normally distributed. When calculated in this way, it is possible for the mean to exceed the maximum detected value. In such cases, the maximum det

TABLE 2-9
HUMAN HEALTH MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR AIR
St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Air
Exposure Point: Deep Groundwater - Water Vapor at Showerhead

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Chloroform	ug/L	1.9	21.5	9	-	ug/L	9	Max	W - Test (4,1)	1.9	Mean-N	W - Test (4)

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T);
Mean of Normal Data (Mean-N).

J = Estimated Value

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(2) Shapiro-Wilk W Test indicates data are lognormally distributed.
(3) Shapiro-Wilk W Test indicates data are normally distributed.
(4) Shapiro-Wilk W Test inconclusive. Higher of UCL for normally and lognormally distributed data used for the RME EPC. Higher of mean value for normally and lognormally distributed data used for CT EPC.

Note: The arithmetic mean is calculated using one-half the sample quantitation limit for non-detects and is normally distributed. When calculated in this way, it is possible for the mean to exceed the maximum detected value. In such cases, the maximum det

TABLE 2-10

HUMAN HEALTH MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY FOR SEDIMENT

St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Drainage Features

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Iron	mg/kg	30388	53013	56000	-	mg/kg	53013	95% UCL-T	W - Test (4)	30388	Mean-N	W - Test (4)

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).

J = Estimated Value

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(2) Shapiro-Wilk W Test indicates data are lognormally distributed.

(3) Shapiro-Wilk W Test indicates data are normally distributed.

(4) Shapiro-Wilk W Test inconclusive. Higher of UCL for normally and lognormally distributed data used for the RME EPC. Higher of mean value for normally and lognormally distributed data used for CT EPC.

Note: The arithmetic mean is calculated using one-half the sample quantitation limit for non-detects and is normally distributed. When calculated in this way, it is possible for the mean to exceed the maximum detected value.
In such cases, the maximum det

TABLE 2-11

SELECTION OF HUMAN HEALTH EXPOSURE PATHWAYS

St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current / Future	Surface Soil	Surface Soil	At Site 4	Trespasser	Adult	Dermal	On-Site	Quant	Trespassers may have exposed skin surfaces come into contact with soil
						Ingestion	On-Site	Quant	Trespassers may incidentally ingest soil
					Adolescent	Dermal	On-Site	Quant	Trespassers may have exposed skin surfaces come into contact with soil
						Ingestion	On-Site	Quant	Trespassers may incidentally ingest soil
		Air	Emissions from Surface Soil at Site 4	Trespasser	Adult	Inhalation	On-Site	Quant	Trespassers may inhale volatiles/particulates
					Adolescent	Inhalation	On-Site	Quant	Trespassers may inhale volatiles/particulates
	Groundwater	Deep Groundwater	Tap Water	Resident	Adult	Dermal	Off-Site	Quant	Local municipality currently has some uses for groundwater from deep aquifer
						Ingestion	Off-Site	Quant	Local municipality currently has some uses for groundwater from deep aquifer
					Child	Dermal	Off-Site	Quant	Local municipality currently has some uses for groundwater from deep aquifer
						Ingestion	Off-Site	Quant	Local municipality currently has some uses for groundwater from deep aquifer
					Adult/Child	Dermal	Off-Site	Quant	Local municipality currently has some uses for groundwater from deep aquifer
						Ingestion	Off-Site	Quant	Local municipality currently has some uses for groundwater from deep aquifer
		Air	Deep Groundwater - Water Vapors at Showerhead	Resident	Adult	Inhalation	Off-Site	Quant	Local municipality currently has some uses for groundwater from deep aquifer
	Surface Water [2]	Surface Water [2]	Drainage Features	Trespasser	Adult	Dermal	On-Site	Quant	Trespassers may have exposed skin surfaces come into contact with surface water
						Ingestion	On-Site	None	Ingestion of surface water not expected to be a significant exposure pathway during wading
					Adolescent	Dermal	On-Site	Quant	Trespassers may have exposed skin surfaces come into contact with surface water
						Ingestion	On-Site	None	Ingestion of surface water not expected to be a significant exposure pathway during wading
	Sediment [2]	Sediment [2]	Drainage Features	Trespasser	Adult	Dermal	On-Site	Quant	Trespassers may have exposed skin surfaces come into contact with sediment
						Ingestion	On-Site	Quant	Trespassers may incidentally ingest sediment that had adhered to their hands
					Adolescent	Dermal	On-Site	Quant	Trespassers may have exposed skin surfaces come into contact with sediment
						Ingestion	On-Site	Quant	Trespassers may incidentally ingest sediment that has adhered to their hands

TABLE 2-11

SELECTION OF HUMAN HEALTH EXPOSURE PATHWAYS

St. Juliens Creek Annex - Site 4 (Landfill D)

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil[1]	Soil[1]	At Site 4	Resident	Adult	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with soil
						Ingestion	On-Site	Quant	Residents may incidentally ingest soil
					Child	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with soil
						Ingestion	On-Site	Quant	Residents may incidentally ingest soil
					Adult/Child	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with soil
						Ingestion	On-Site	Quant	Residents may incidentally ingest soil
				Construction Worker	Adult	Dermal	On-Site	Quant	Workers may have exposed skin surfaces come into contact with soil
						Ingestion	On-Site	Quant	Workers may incidentally ingest soil
				Other Worker	Adult	Dermal	On-Site	Quant	Workers may have exposed skin surfaces come into contact with soil
						Ingestion	On-Site	Quant	Workers may incidentally ingest soil
		Air	Emissions from Soil at Site 4	Construction Worker	Adult	Inhalation	On-Site	Quant	Workers may inhale volatiles/particulates
	Surface Water [2]	Surface Water [2]	Drainage Features	Resident	Adult	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with surface water
						Ingestion	On-Site	None	Ingestion of surface water not expected to be a significant exposure pathway during wading
					Child	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with surface water
						Ingestion	On-Site	None	Ingestion of surface water not expected to be a significant exposure pathway during wading
					Adult/Child	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with surface water
						Ingestion	On-Site	None	Ingestion of surface water not expected to be a significant exposure pathway during wading
	Sediment [2]	Sediment [2]	Drainage Features	Resident	Adult	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with sediment
						Ingestion	On-Site	Quant	Residents may incidentally ingest sediment that has adhered to their hands
					Child	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with sediment
						Ingestion	On-Site	Quant	Residents may incidentally ingest sediment that has adhered to their hands
					Adult/Child	Dermal	On-Site	Quant	Residents may have exposed skin surfaces come into contact with sediment
						Ingestion	On-Site	Quant	Residents may incidentally ingest sediment that has adhered to their hands
	Groundwater	Shallow Groundwater	Water Table	Construction Worker	Adult	Dermal	On-Site	Quant	Workers may have exposed skin surfaces come into contact with groundwater

[1] Includes both surface soil and subsurface soil.

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

Table 2-12
Reasonable Maximum Exposure Parameters for Human Health Risk Assessment
St. Juliens Creek Annex - Site 4 (Landfill D)

	Industrial		**Residential**			**Trespasser**	
	Other Worker	**Construction Worker**	**Child** (age 1-6)	**Adult**	**Lifetime**	**Adult**	**Adolescent** (age 12-17)
General Receptor Factors							
Body Weight (kg)	70	70	15	70		70	56
Media-Specific Factors							
Soil							
Ingestion Rate (mg/day)	50	480	200	100	114.29	100[a]	100[a]
Inhalation Rate (m^3/hour)		2.5				1.6	1.4
Skin Surface Area[1] (cm^2)	5,000	5,000	3,600	5,000	3,600, 5,000	5,000	4000
Soil Adherence Factor (mg/cm^2-day)	.071	0.24	0.11	0.19	.11,.19	.19	.11
Dermal Absorption Factor Solids[2]	Chemical Specific		Chemical Specific			Chemical Specific	
Exposure Frequency[3] (days/year)	250	250	350	350	350	52[a]	52[a]
Exposure Duration (years)	25	0.5	6	24	30	30[a]	6[a]
Groundwater							
Ingestion Rate (L/day)			1	2			
Ingestion Rate (mg-year/kg-day)					1.09		
Inhalation Rate (m^3/day)				0.83			
Skin Surface Area[4] (cm^2)		5,000	7,200	20,000	7,200, 20,000		
Permeability Constant (cm/hour)	Chemical Specific		Chemical Specific				
Exposure Time (hours/day)		2[c]	0.33	0.25	0.33, 0.25		
Exposure Frequency (days/year)		63[c]	350	350	350		
Exposure Duration (years)		.5	6	24	30		
Surface Water							
Ingestion Rate (L/day)							
Ingestion Rate (mg-year/kg-day)							
Inhalation Rate (m^3/day)							
Skin Surface Area[4] (cm^2)			3,600	5,000	3,600, 5,000	5,000	4,000
Permeability Constant (cm/hour)			Chemical Specific				
Exposure Time (hours/day)			2	2	2	1[a]	1[a]
Exposure Frequency (days/year)			52	52	52	52[a]	52[a]
Exposure Duration (years)			6	24	30	30	6
Sediment							
Ingestion Rate (L/day)			200	100		100	100
Ingestion Rate (mg-year/kg-day)					1.14.29		
Inhalation Rate (m^3/day)							
Skin Surface Area[4] (cm^2)			3,600	5,000	3,600, 5,000	5,000	4,000
Permeability Constant (cm/hour)			Chemical Specific				
Exposure Time (hours/day)							
Exposure Frequency (days/year)			52[b]	52[b]	52[b]	52[a]	52a
Exposure Duration (years)			6	24	30	30[a]	6[a]

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim F

EPA, 1993: Superfund Standard Default Exposure Factors for Central Tendency and Reasonable Maximum Exposures.

EPA, 1995: Assessing Dermal Exposure from Soil, Technical Guidance manual, Region III, EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook, Vol. 1. EPA/600/P-95/002Fa.

Notes:

a. For RME values, assumes trespassing one hour per day, one day per week for 52 weeks per year. For CT values, assumes one-half of RME values.

b. For RME values, assumes residents recreate two hours per day, one day per week for 52 weeks per year. For CT value, assumes one-half of RME values.

Table 2-13
Central Tendency Exposure Parameters for Human Health Risk Assessment
St. Juliens Creek Annex - Site 4 (Landfill D)

	Industrial		Residential			Trespasser	
	Site Worker	**Construction Worker**	**Child** (age 1-6)	**Adult**	**Lifetime**	**Adult**	**Adolescent** (age 12-17)
General Receptor Factors							
Body Weight (kg)	70	70	15	70		70	56
Media-Specific Factors							
Soil							
Ingestion Rate (mg/day)	25	240[b]	100	50	46.43	50	50
Inhalation Rate (m^3/hour)		1.5				1	1
Skin Surface Area[1] (cm^2)	1,000[c]	1,000	864	1,000	864, 1,000	1,000	2,000
Soil Adherence Factor (mg/cm^2-day)	0.071	0.24	0.11	0.19	.11,.19	0.19	0.11
Dermal Absorption Factor Solids[2]	Chemical Specific		Chemical Specific			Chemical Specific	
Exposure Frequency (days/year)	219	219	234	234	234	26[a]	26[a]
Exposure Duration (years)	5	.25[b]	6	9	30	15[a]	6[a]
Groundwater							
Ingestion Rate (L/day)			.87	1.4			
Ingestion Rate (mg-year/kg-day)					0.58		
Inhalation Rate (m^3/day)							
Skin Surface Area[4] (cm^2)		1,000	7,200	17,000			
Permeability Constant (cm/hour)	Chemical Specific		Chemical Specific				
Exposure Time (hours/day)		1[d]	0.25	0.17			
Exposure Frequency (days/year)		51[d]	234	234			
Exposure Duration (years)		.25[d]	6	9			
Surface Water							
Ingestion Rate (L/day)							
Ingestion Rate (mg-year/kg-day)							
Inhalation Rate (m^3/day)							
Skin Surface Area[4] (cm^2)			864	1,000	864, 1,000	1,000	2,000
Permeability Constant (cm/hour)			Chemical Specific				
Exposure Time (hours/day)			1	1	1	0.5[a]	0.5[a]
Exposure Frequency (days/year)			26	26	26	26[a]	26[a]
Exposure Duration (years)			6	9	15	15	6
Sediment							
Ingestion Rate (L/day)			100	50		50	50
Ingestion Rate (mg-year/kg-day)					46.43		
Inhalation Rate (m^3/day)							
Skin Surface Area[4] (cm^2)			864	1,000	864, 1,000	1,000	2,000
Permeability Constant (cm/hour)			Chemical Specific				
Exposure Time (hours/day)			0.33	0.2			
Exposure Frequency (days/year)			26[c]	26[c]	26[c]	26[a]	26a
Exposure Duration (years)			6	9	15	15[a]	6[a]

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factc

EPA, 1993: Superfund Standard Default Exposure Factors for Central Tendency and Reasonable Maximum Exposures.

EPA, 1995: Assessing Dermal Exposure from Soil, Technical Guidance manual, Region III, EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook, Vol. 1. EPA/600/P-95/002Fa.

a. For RME values, assumes trespassing one hour per day, one day per week for 52 weeks per year. For CT values, assumes one-half of RME values.

b. CT value assumes one-half the RME value.

c. For RME values, assumes residents recreate two hours per day, one day per week for 52 weeks per year. For CT value, assumes one-half of RME values.

d. For EME values, assumes workers spend two hours per day exposed to shallow groundwater during excavation and construction activities (I.e.basement o

Table 2-14
Ecological Summary Statistics - Surface Soil
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	6.75 - 12.5	18 / 18	17,800	SJS04-SS01-000	8,558	4,706
Antimony	0.31 - 0.88	11 / 17	18.5	SJS04-SS11-000	2.47	4.63
Arsenic	0.42 - 0.65	18 / 18	22.9	SJS04-SS14-000	9.97	7.06
Barium	0.040 - 0.43	18 / 18	991	SJS04-SS11-000	137	222
Beryllium	0.020 - 0.22	15 / 18	5.50	SJS04-SS11-000	0.83	1.23
Cadmium	0.060 - 0.11	12 / 18	9.70	SJS04-SS11-000	0.80	2.24
Calcium	12.2 - 18.9	18 / 18	49,100	SJS04-SS11-000	5,927	11,116
Chromium	0.23 - 1.52	18 / 18	680	SJS04-SS05-000	65.8	154
Cobalt	0.11 - 1.74	17 / 18	12.0	SJS04-SS11-000	5.77	2.92
Copper	0.23 - 1.30	18 / 18	874	SJS04-SS11-000	189	235
Cyanide	0.26 - 0.63	0 / 18	--	--	0.21	0.056
Iron	2.61 - 10.1	18 / 18	65,100	SJS04-SS11-000	22,059	14,196
Lead	0.15 - 0.33	18 / 18	1,110	SJS04-SS11-000	204	235
Magnesium	5.10 - 39.3	18 / 18	3,210	SJS04-SS18-000	1,771	861
Manganese	0.060 - 0.43	18 / 18	883	SJS04-SS11-000	209	199
Mercury	0.0100 - 0.060	17 / 18	1.30	SJS04-SS06-000	0.60	0.37
Nickel	0.19 - 1.52	18 / 18	546	SJS04-SS05-000	61.9	127
Potassium	2.80 - 48.2	18 / 18	3,470	SJS04-SS18-000	1,407	933
Selenium	0.46 - 0.85	6 / 18	1.30	SJS04-SS11-000	0.57	0.44
Silver	0.15 - 0.29	3 / 18	2.20	SJS04-SS11-000	0.42	0.57
Sodium	8.90 - 48.4	9 / 18	954	SJS04-SS11-000	168	220
Thallium	0.31 - 1.00	3 / 18	3.40	SJS04-SS01-000	0.64	0.71
Vanadium	0.13 - 1.95	18 / 18	354	SJS04-SS04-000	64.6	76.9
Zinc	0.40 - 1.09	18 / 18	3,880	SJS04-SS11-000	468	872
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDD	3.30 - 21.0	6 / 18	15.0	SJS04-SS05-000	3.96	3.57
4,4'-DDE	3.30 - 21.0	10 / 18	37.0	SJS04-SS05-000	5.32	8.31
4,4'-DDT	3.30 - 21.0	13 / 18	40.0	SJS04-SS05-000	12.1	12.0
Aldrin	1.70 - 11.0	0 / 18	--	--	1.51	1.30
Aroclor-1016	33.0 - 210	0 / 18	--	--	29.5	24.5
Aroclor-1221	67.0 - 430	0 / 18	--	--	59.7	50.4
Aroclor-1232	33.0 - 210	0 / 18	--	--	29.5	24.5
Aroclor-1242	33.0 - 210	0 / 18	--	--	29.5	24.5
Aroclor-1248	33.0 - 210	0 / 18	--	--	29.5	24.5
Aroclor-1254	33.0 - 210	3 / 18	12.0	SJS04-SS16-000	27.7	25.4
Aroclor-1260	33.0 - 1,700	6 / 18	6,300	SJS04-SS08-000	386	1,477
Dieldrin	3.30 - 21.0	6 / 18	72.0	SJS04-SS08-000	8.95	17.3
Endosulfan I	1.70 - 11.0	0 / 18	--	--	1.51	1.30
Endosulfan II	3.30 - 21.0	0 / 18	--	--	2.95	2.45
Endosulfan sulfate	3.30 - 21.0	0 / 18	--	--	2.95	2.45
Endrin	3.30 - 21.0	1 / 18	3.90	SJS04-SS10-000	3.07	2.44
Endrin aldehyde	3.30 - 21.0	1 / 18	160	SJS04-SS08-000	11.4	37.1
Endrin ketone	3.30 - 21.0	1 / 18	83.0	SJS04-SS08-000	7.09	19.1
Heptachlor	1.70 - 11.0	0 / 18	--	--	1.51	1.30
Heptachlor epoxide	1.70 - 11.0	0 / 18	--	--	1.51	1.30
Methoxychlor	17.0 - 110	0 / 18	--	--	15.1	13.0
Toxaphene	170 - 1,100	0 / 18	--	--	151	130
alpha-BHC	1.70 - 11.0	0 / 18	--	--	1.51	1.30
alpha-Chlordane	1.70 - 11.0	4 / 18	42.0	SJS04-SS08-000	4.46	9.81
beta-BHC	1.70 - 11.0	0 / 18	--	--	1.51	1.30
delta-BHC	1.70 - 11.0	0 / 18	--	--	1.51	1.30
gamma-BHC (Lindane)	1.70 - 11.0	0 / 18	--	--	1.51	1.30
gamma-Chlordane	1.70 - 11.0	5 / 18	33.0	SJS04-SS08-000	3.90	7.71
Semivolatile Organic Compounds (UG/KG)						
1,2,4-Trichlorobenzene	340 - 40,000	0 / 18	--	--	1,548	4,616
1,2-Dichlorobenzene	340 - 40,000	0 / 18	--	--	1,548	4,616
1,3-Dichlorobenzene	340 - 40,000	0 / 18	--	--	1,548	4,616
1,4-Dichlorobenzene	340 - 40,000	0 / 18	--	--	1,548	4,616
2,2'-Oxybis(1-chloropropane)	340 - 40,000	0 / 18	--	--	1,548	4,616
2,4,5-Trichlorophenol	840 - 100,000	0 / 18	--	--	3,875	11,539
2,4,6-Trichlorophenol	340 - 40,000	0 / 18	--	--	1,548	4,616
2,4-Dichlorophenol	340 - 40,000	0 / 18	--	--	1,548	4,616

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-14
Ecological Summary Statistics - Surface Soil
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
2,4-Dimethylphenol	340 - 40,000	0 / 18	--	--	1,548	4,616
2,4-Dinitrophenol	840 - 100,000	0 / 15	--	--	4,220	12,685
2,4-Dinitrotoluene	340 - 40,000	0 / 18	--	--	1,548	4,616
2,6-Dinitrotoluene	340 - 40,000	0 / 18	--	--	1,548	4,616
2-Chloronaphthalene	340 - 40,000	0 / 18	--	--	1,548	4,616
2-Chlorophenol	340 - 40,000	0 / 18	--	--	1,548	4,616
2-Methylnaphthalene	340 - 40,000	1 / 18	200	SJS04-SS11-000	1,540	4,618
2-Methylphenol	340 - 40,000	0 / 18	--	--	1,548	4,616
2-Nitroaniline	840 - 100,000	0 / 18	--	--	3,875	11,539
2-Nitrophenol	340 - 40,000	0 / 18	--	--	1,548	4,616
3,3'-Dichlorobenzidine	340 - 40,000	0 / 18	--	--	1,548	4,616
3-Nitroaniline	840 - 100,000	0 / 18	--	--	3,875	11,539
4,6-Dinitro-2-methylphenol	840 - 100,000	0 / 18	--	--	3,875	11,539
4-Bromophenyl-phenylether	340 - 40,000	0 / 18	--	--	1,548	4,616
4-Chloro-3-methylphenol	340 - 40,000	0 / 18	--	--	1,548	4,616
4-Chloroaniline	340 - 40,000	0 / 18	--	--	1,548	4,616
4-Chlorophenyl-phenylether	340 - 40,000	0 / 18	--	--	1,548	4,616
4-Methylphenol	340 - 40,000	0 / 18	--	--	1,548	4,616
4-Nitroaniline	840 - 100,000	0 / 18	--	--	3,875	11,539
4-Nitrophenol	840 - 100,000	0 / 18	--	--	3,875	11,539
Acenaphthene	340 - 40,000	2 / 18	670	SJS04-SS11-000	1,560	4,614
Acenaphthylene	340 - 40,000	5 / 18	130	SJS04-SS18-000	1,508	4,628
Anthracene	340 - 40,000	9 / 18	950	SJS04-SS11-000	1,493	4,634
Benzo(a)anthracene	340 - 40,000	17 / 18	3,000	SJS04-SS11-000	1,659	4,632
Benzo(a)pyrene	340 - 40,000	17 / 18	2,300	SJS04-SS11-000	1,551	4,637
Benzo(b)fluoranthene	340 - 40,000	17 / 18	3,000	SJS04-SS11-000	1,969	4,569
Benzo(g,h,i)perylene	340 - 40,000	15 / 18	1,400	SJS04-SS11-000	1,547	4,619
Benzo(k)fluoranthene	340 - 40,000	14 / 18	820	SJS04-SS01-000	1,518	4,621
Butylbenzylphthalate	340 - 40,000	1 / 18	35.0	SJS04-SS07-000	1,540	4,618
Carbazole	340 - 40,000	3 / 18	300	SJS04-SS05-000	1,494	4,628
Chrysene	340 - 40,000	16 / 18	2,900	SJS04-SS11-000	1,802	4,597
Di-n-butylphthalate	340 - 40,000	1 / 18	200	SJS04-SS16-000	1,544	4,617
Di-n-octylphthalate	340 - 40,000	0 / 18	--	--	1,548	4,616
Dibenz(a,h)anthracene	340 - 40,000	2 / 18	320	SJS04-SS11-000	1,548	4,616
Dibenzofuran	340 - 40,000	2 / 18	190	SJS04-SS11-000	1,530	4,622
Diethylphthalate	340 - 40,000	3 / 18	620	SJS04-SS09-000	1,494	4,626
Dimethyl phthalate	340 - 40,000	0 / 18	--	--	1,548	4,616
Fluoranthene	340 - 40,000	17 / 18	4,000	SJS04-SS11-000	1,983	4,631
Fluorene	340 - 40,000	2 / 18	570	SJS04-SS11-000	1,554	4,615
Hexachlorobenzene	340 - 40,000	0 / 18	--	--	1,548	4,616
Hexachlorobutadiene	340 - 40,000	0 / 18	--	--	1,548	4,616
Hexachlorocyclopentadiene	340 - 40,000	0 / 18	--	--	1,548	4,616
Hexachloroethane	340 - 40,000	0 / 18	--	--	1,548	4,616
Indeno(1,2,3-cd)pyrene	340 - 40,000	15 / 18	1,100	SJS04-SS11-000	1,536	4,619
Isophorone	340 - 40,000	0 / 18	--	--	1,548	4,616
Naphthalene	340 - 40,000	2 / 18	250	SJS04-SS11-000	1,535	4,620
Nitrobenzene	340 - 40,000	0 / 18	--	--	1,548	4,616
Pentachlorophenol	840 - 100,000	0 / 18	--	--	3,875	11,539
Phenanthrene	340 - 40,000	15 / 18	6,300	SJS04-SS11-000	1,838	4,768
Phenol	340 - 40,000	0 / 18	--	--	1,548	4,616
Pyrene	340 - 40,000	16 / 18	7,500	SJS04-SS11-000	2,119	4,795
bis(2-Chloroethoxy)methane	340 - 40,000	0 / 18	--	--	1,548	4,616
bis(2-Chloroethyl)ether	340 - 40,000	0 / 18	--	--	1,548	4,616
bis(2-Ethylhexyl)phthalate	340 - 40,000	3 / 18	110	SJS04-SS11-000	4,503	17,597
n-Nitroso-di-n-propylamine	340 - 40,000	0 / 18	--	--	1,548	4,616
n-Nitrosodiphenylamine	340 - 40,000	0 / 18	--	--	1,548	4,616
Volatile Organic Compounds (UG/KG)						
1,1,1-Trichloroethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
1,1,2,2-Tetrachloroethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
1,1,2-Trichloroethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
1,1-Dichloroethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
1,1-Dichloroethene	10.0 - 17.0	0 / 18	--	--	6.28	1.29
1,2-Dichloroethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-14
Ecological Summary Statistics - Surface Soil
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
1,2-Dichloroethene (total)	10.0 - 17.0	0 / 18	--	--	6.28	1.29
1,2-Dichloropropane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
2-Butanone	10.0 - 17.0	2 / 18	28.0	SJS04-SS04-000	8.14	5.34
2-Hexanone	10.0 - 17.0	0 / 18	--	--	6.28	1.29
4-Methyl-2-pentanone	10.0 - 17.0	1 / 18	2.00	SJS04-SS03-000	6.11	1.61
Acetone	10.0 - 17.0	12 / 18	79.0	SJS04-SS08-000	19.6	20.9
Benzene	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Bromodichloromethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Bromoform	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Bromomethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Carbon disulfide	10.0 - 17.0	0 / 18	--	--	6.06	1.63
Carbon tetrachloride	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Chlorobenzene	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Chloroethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Chloroform	10.0 - 17.0	1 / 18	2.00	SJS04-SS11-000	5.92	1.52
Chloromethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Dibromochloromethane	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Ethylbenzene	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Methylene chloride	10.0 - 17.0	0 / 18	--	--	17.8	13.1
Styrene	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Tetrachloroethene	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Toluene	10.0 - 17.0	2 / 18	2.00	SJS04-SS10-000	5.89	2.00
Trichloroethene	10.0 - 17.0	0 / 18	--	--	5.97	1.79
Vinyl chloride	10.0 - 17.0	0 / 18	--	--	6.28	1.29
Xylene, total	10.0 - 17.0	0 / 18	--	--	6.28	1.29
cis-1,3-Dichloropropene	10.0 - 17.0	0 / 18	--	--	6.28	1.29
trans-1,3-Dichloropropene	10.0 - 17.0	0 / 18	--	--	6.28	1.29

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-15
Ecological Summary Statistics - Sediment
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (MG/KG)						
Aluminum	5.30 - 29.4	9 / 9	22,100	SJS04-SD04-000	13,664	5,535
Antimony	0.40 - 1.34	1 / 9	2.10	SJS04-SD02-000	0.77	0.54
Arsenic	0.60 - 2.01	9 / 9	33.1	SJS04-SD03-000	14.1	8.23
Barium	0.060 - 1.34	9 / 9	903	SJS04-SD07-001	198	282
Beryllium	0.030 - 0.67	9 / 9	3.90	SJS04-SD01-000	1.74	1.23
Cadmium	0.080 - 0.33	7 / 9	2.00	SJS04-SD08-001	0.76	0.67
Calcium	8.8 - 58.2	9 / 9	18,300	SJS04-SD03-000	6,106	5,622
Chromium	0.17 - 4.68	9 / 9	38.8	SJS04-SD04-000	25.2	8.04
Cobalt	0.16 - 5.35	9 / 9	32.7	SJS04-SD05-001	14.5	9.62
Copper	0.23 - 4.01	9 / 9	387	SJS04-SD03-000	111	114
Cyanide	0.40 - 1.70	1 / 9	2.90	SJS04-SD08-001	0.64	0.87
Iron	3.38 - 14.1	9 / 9	56,000	SJS04-SD01-000	29,167	15,104
Lead	0.20 - 0.67	9 / 9	441	SJS04-SD03-000	171	153
Magnesium	7.40 - 121	9 / 9	6,740	SJS04-SD04-000	3,243	2,017
Manganese	0.10 - 1.34	9 / 9	877	SJS04-SD03-000	297	234
Mercury	0.030 - 0.15	9 / 9	6.40	SJS04-SD03-000	1.23	2.02
Nickel	0.25 - 4.68	9 / 9	43.9	SJS04-SD03-000	25.1	12.4
Potassium	4.30 - 149	9 / 9	3,850	SJS04-SD04-000	1,898	1,052
Selenium	0.60 - 2.01	5 / 9	1.60	SJS04-SD07-001	0.97	0.49
Silver	0.20 - 0.67	4 / 9	1.00	SJS04-SD03-000	0.38	0.31
Sodium	11.5 - 67.9	7 / 9	11,000	SJS04-SD08-001	3,844	4,011
Thallium	0.40 - 1.50	1 / 9	0.46	SJS04-SD02-000	0.54	0.18
Vanadium	0.19 - 6.02	9 / 9	88.5	SJS04-SD03-000	39.2	21.9
Zinc	0.20 - 3.34	9 / 9	624	SJS04-SD03-000	354	149
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDD	4.00 - 42.0	7 / 9	220	SJS04-SD01-000	33.7	72.4
4,4'-DDE	4.00 - 10.0	7 / 9	31.0	SJS04-SD01-000	9.39	9.86
4,4'-DDT	4.00 - 10.0	3 / 9	38.0	SJS04-SD01-000	7.78	11.5
Aldrin	2.10 - 5.00	0 / 8	--	--	1.60	0.48
Aroclor-1016	40.0 - 100	0 / 8	--	--	31.5	9.90
Aroclor-1221	82.0 - 200	0 / 8	--	--	63.6	19.6
Aroclor-1232	40.0 - 100	0 / 8	--	--	31.5	9.90
Aroclor-1242	40.0 - 100	0 / 8	--	--	31.5	9.90
Aroclor-1248	40.0 - 100	0 / 8	--	--	31.5	9.90
Aroclor-1254	40.0 - 100	0 / 8	--	--	31.5	9.90
Aroclor-1260	40.0 - 100	4 / 8	90.0	SJS04-SD02-000	47.4	22.2
Dieldrin	4.00 - 10.0	3 / 9	23.0	SJS04-SD02-000	5.55	6.73
Endosulfan I	2.10 - 5.00	0 / 8	--	--	1.60	0.48
Endosulfan II	4.00 - 10.0	0 / 8	--	--	3.15	0.99
Endosulfan sulfate	4.00 - 10.0	0 / 8	--	--	3.15	0.99
Endrin	4.00 - 10.0	0 / 8	--	--	3.15	0.99
Endrin aldehyde	4.00 - 10.0	0 / 8	--	--	3.15	0.99
Endrin ketone	4.00 - 10.0	0 / 8	--	--	3.15	0.99
Heptachlor	2.10 - 5.00	0 / 8	--	--	1.60	0.48
Heptachlor epoxide	2.10 - 5.00	0 / 8	--	--	1.60	0.48
Methoxychlor	21.0 - 50.0	0 / 8	--	--	16.0	4.75
Toxaphene	210 - 500	0 / 8	--	--	160	47.5
alpha-BHC	2.10 - 5.00	0 / 8	--	--	1.60	0.48
alpha-Chlordane	2.10 - 5.00	0 / 8	--	--	1.60	0.48
beta-BHC	2.10 - 5.00	0 / 8	--	--	1.60	0.48
delta-BHC	2.10 - 5.00	0 / 8	--	--	1.60	0.48
gamma-BHC (Lindane)	2.10 - 5.00	0 / 8	--	--	1.60	0.48
gamma-Chlordane	2.10 - 5.00	0 / 8	--	--	1.60	0.48
Semivolatile Organic Compounds (UG/KG)						
1,2,4-Trichlorobenzene	420 - 2,000	0 / 8	--	--	416	251
1,2-Dichlorobenzene	420 - 2,000	0 / 8	--	--	416	251
1,3-Dichlorobenzene	420 - 2,000	0 / 8	--	--	416	251
1,4-Dichlorobenzene	420 - 2,000	0 / 8	--	--	416	251
2,2'-Oxybis(1-chloropropane)	420 - 2,000	0 / 8	--	--	416	251
2,4,5-Trichlorophenol	1,000 - 5,100	0 / 8	--	--	1,038	651
2,4,6-Trichlorophenol	420 - 2,000	0 / 8	--	--	416	251
2,4-Dichlorophenol	420 - 2,000	0 / 8	--	--	416	251

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-15
Ecological Summary Statistics - Sediment
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
2,4-Dimethylphenol	420 - 2,000	0 / 8	--	--	416	251
2,4-Dinitrophenol	1,000 - 5,100	0 / 8	--	--	1,038	651
2,4-Dinitrotoluene	420 - 2,000	0 / 8	--	--	416	251
2,6-Dinitrotoluene	420 - 2,000	0 / 8	--	--	416	251
2-Chloronaphthalene	420 - 2,000	0 / 8	--	--	416	251
2-Chlorophenol	420 - 2,000	0 / 8	--	--	416	251
2-Methylnaphthalene	420 - 2,000	2 / 8	140	SJS04-SD03-000	377	288
2-Methylphenol	420 - 2,000	0 / 8	--	--	416	251
2-Nitroaniline	1,000 - 5,100	0 / 8	--	--	1,038	651
2-Nitrophenol	420 - 2,000	0 / 8	--	--	416	251
3,3'-Dichlorobenzidine	420 - 2,000	0 / 8	--	--	416	251
3-Nitroaniline	1,000 - 5,100	0 / 8	--	--	1,038	651
4,6-Dinitro-2-methylphenol	1,000 - 5,100	0 / 8	--	--	1,038	651
4-Bromophenyl-phenylether	420 - 2,000	0 / 8	--	--	416	251
4-Chloro-3-methylphenol	420 - 2,000	0 / 8	--	--	416	251
4-Chloroaniline	420 - 2,000	0 / 8	--	--	416	251
4-Chlorophenyl-phenylether	420 - 2,000	0 / 8	--	--	416	251
4-Methylphenol	420 - 2,000	0 / 8	--	--	416	251
4-Nitroaniline	1,000 - 5,100	0 / 8	--	--	1,038	651
4-Nitrophenol	1,000 - 5,100	0 / 8	--	--	1,038	651
Acenaphthene	420 - 2,000	0 / 8	--	--	416	251
Acenaphthylene	420 - 2,000	2 / 8	70.0	SJS04-SD04-000	369	297
Anthracene	420 - 2,000	3 / 9	200	SJS04-SD04-000	355	278
Benzo(a)anthracene	420 - 2,000	8 / 9	1,300	SJS04-SD04-000	449	354
Benzo(a)pyrene	420 - 2,000	8 / 9	1,200	SJS04-SD04-000	407	322
Benzo(b)fluoranthene	420 - 2,000	8 / 9	1,900	SJS04-SD04-000	671	518
Benzo(g,h,i)perylene	420 - 2,000	7 / 9	340	SJS04-SD06-001	256	95.6
Benzo(k)fluoranthene	420 - 2,000	7 / 9	1,100	SJS04-SD04-000	384	274
Butylbenzylphthalate	420 - 2,000	1 / 8	58.0	SJS04-SD04-000	387	279
Carbazole	420 - 2,000	0 / 8	--	--	416	251
Chrysene	420 - 2,000	8 / 9	1,200	SJS04-SD04-000	496	304
Di-n-butylphthalate	420 - 2,000	2 / 8	67.0	SJS04-SD03-000	369	296
Di-n-octylphthalate	420 - 2,000	1 / 9	120	SJS04-SD09-001	383	255
Dibenz(a,h)anthracene	420 - 2,000	4 / 9	150	SJS04-SD04-000	293	280
Dibenzofuran	420 - 2,000	1 / 8	63.0	SJS04-SD03-000	388	279
Diethylphthalate	420 - 2,000	1 / 8	300	SJS04-SD02-000	328	87.0
Dimethyl phthalate	420 - 2,000	0 / 8	--	--	416	251
Fluoranthene	420 - 2,000	8 / 9	2,800	SJS04-SD04-000	708	814
Fluorene	420 - 2,000	0 / 8	--	--	416	251
Hexachlorobenzene	420 - 2,000	0 / 8	--	--	416	251
Hexachlorobutadiene	420 - 2,000	0 / 8	--	--	416	251
Hexachlorocyclopentadiene	420 - 2,000	0 / 8	--	--	416	251
Hexachloroethane	420 - 2,000	0 / 8	--	--	416	251
Indeno(1,2,3-cd)pyrene	420 - 2,000	7 / 9	370	SJS04-SD04-000	271	94.4
Isophorone	420 - 2,000	0 / 8	--	--	416	251
Naphthalene	420 - 2,000	3 / 8	100	SJS04-SD03-000	350	307
Nitrobenzene	420 - 2,000	0 / 8	--	--	416	251
Pentachlorophenol	1,000 - 5,100	0 / 8	--	--	1,038	651
Phenanthrene	420 - 2,000	7 / 9	400	SJS04-SD02-000	251	120
Phenol	420 - 2,000	0 / 8	--	--	416	251
Pyrene	420 - 2,000	8 / 9	2,800	SJS04-SD04-000	708	809
bis(2-Chloroethoxy)methane	420 - 2,000	0 / 8	--	--	416	251
bis(2-Chloroethyl)ether	420 - 2,000	0 / 8	--	--	416	251
bis(2-Ethylhexyl)phthalate	160 - 2,000	1 / 9	140	SJS04-SD09-001	270	174
n-Nitroso-di-n-propylamine	420 - 2,000	0 / 8	--	--	416	251
n-Nitrosodiphenylamine	420 - 2,000	0 / 8	--	--	416	251

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-15
Ecological Summary Statistics - Sediment
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Volatile Organic Compounds (UG/KG)						
1,1,1-Trichloroethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
1,1,2,2-Tetrachloroethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
1,1,2-Trichloroethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
1,1-Dichloroethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
1,1-Dichloroethene	10.0 - 31.0	0 / 9	--	--	10.0	3.69
1,2-Dichloroethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
1,2-Dichloroethene (total)	10.0 - 31.0	0 / 9	--	--	10.0	3.69
1,2-Dichloropropane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
2-Butanone	10.0 - 31.0	0 / 9	--	--	11.7	4.90
2-Hexanone	10.0 - 31.0	0 / 9	--	--	10.0	3.69
4-Methyl-2-pentanone	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Acetone	10.0 - 31.0	5 / 9	140	SJS04-SD04-000	32.0	43.6
Benzene	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Bromodichloromethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Bromoform	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Bromomethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Carbon disulfide	10.0 - 31.0	4 / 9	19.0	SJS04-SD04-000	9.11	4.18
Carbon tetrachloride	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Chlorobenzene	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Chloroethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Chloroform	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Chloromethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Dibromochloromethane	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Ethylbenzene	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Methylene chloride	10.0 - 31.0	0 / 9	--	--	23.8	30.6
Styrene	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Tetrachloroethene	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Toluene	10.0 - 31.0	2 / 9	15.0	SJS04-SD08-001	9.33	3.82
Trichloroethene	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Vinyl chloride	10.0 - 31.0	0 / 9	--	--	10.0	3.69
Xylene, total	10.0 - 31.0	0 / 9	--	--	10.0	3.69
cis-1,3-Dichloropropene	10.0 - 31.0	0 / 9	--	--	10.0	3.69
trans-1,3-Dichloropropene	10.0 - 31.0	0 / 9	--	--	10.0	3.69

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-16
Ecological Summary Statistics - Surface Water
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
Inorganics (UG/L)						
Aluminum	18.7 - 38.2	7 / 7	2,180	SJS04-SW08-001	790	686
Antimony	2.70 - 2.80	1 / 7	3.00	SJS04-SW09-001	1.76	0.71
Arsenic	2.00 - 3.60	4 / 7	9.00	SJS04-SW03-001	4.23	3.45
Barium	0.20 - 0.30	7 / 7	356	SJS04-SW07-001	117	123
Beryllium	0.10 - 0.20	3 / 7	0.58	SJS04-SW01-001	0.16	0.19
Cadmium	0.30 - 0.30	4 / 7	1.00	SJS04-SW07-001	0.37	0.30
Calcium	31.1 - 57.9	7 / 7	317,000	SJS04-SW07-001	198,714	70,393
Chromium	0.60 - 1.10	3 / 7	3.00	SJS04-SW08-001	1.12	0.95
Cobalt	0.50 - 0.80	6 / 7	22.9	SJS04-SW01-001	6.23	8.84
Copper	0.80 - 1.10	6 / 7	65.3	SJS04-SW07-001	23.1	22.5
Cyanide	5.00 - 5.00	4 / 7	29.3	SJS04-SW02-001	11.5	11.0
Iron	17.2 - 30.8	7 / 7	12,800	SJS04-SW07-001	3,359	4,376
Lead	1.00 - 1.40	6 / 7	51.9	SJS04-SW07-001	13.2	17.5
Magnesium	24.3 - 243	7 / 7	545,000	SJS04-SW06-001	176,643	198,632
Manganese	0.30 - 0.40	7 / 7	2,310	SJS04-SW01-001	703	806
Mercury	0.10 - 0.10	2 / 7	0.37	SJS04-SW07-001	0.11	0.12
Nickel	0.90 - 0.90	7 / 7	34.8	SJS04-SW01-001	9.79	12.1
Potassium	13.5 - 167	7 / 7	202,000	SJS04-SW06-001	66,857	70,081
Selenium	2.60 - 3.10	0 / 7	--	--	1.34	0.094
Silver	0.70 - 0.90	1 / 7	1.10	SJS04-SW09-001	0.54	0.25
Sodium	148 - 2,040	7 / 7	4,620,000	SJS04-SW06-001	1,322,814	1,796,822
Thallium	3.20 - 5.20	0 / 7	--	--	1.74	0.38
Vanadium	0.60 - 0.70	5 / 7	10.1	SJS04-SW03-001	4.05	3.12
Zinc	0.70 - 1.90	7 / 7	224	SJS04-SW07-001	104	76.3
Pesticide/Polychlorinated Biphenyls (UG/L)						
4,4'-DDD	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
4,4'-DDE	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
4,4'-DDT	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
Aldrin	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
Aroclor-1016	1.10 - 1.20	0 / 7	--	--	0.56	0.019
Aroclor-1221	2.20 - 2.40	0 / 7	--	--	1.12	0.039
Aroclor-1232	1.10 - 1.20	0 / 7	--	--	0.56	0.019
Aroclor-1242	1.10 - 1.20	0 / 7	--	--	0.56	0.019
Aroclor-1248	1.10 - 1.20	0 / 7	--	--	0.56	0.019
Aroclor-1254	1.10 - 1.20	0 / 7	--	--	0.56	0.019
Aroclor-1260	1.10 - 1.20	0 / 7	--	--	0.56	0.019
Dieldrin	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
Endosulfan I	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
Endosulfan II	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
Endosulfan sulfate	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
Endrin	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
Endrin aldehyde	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
Endrin ketone	0.11 - 0.12	0 / 7	--	--	0.056	0.0019
Heptachlor	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
Heptachlor epoxide	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
Methoxychlor	0.54 - 0.60	0 / 7	--	--	0.28	0.0091
Toxaphene	5.40 - 6.00	0 / 7	--	--	2.82	0.091
alpha-BHC	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
alpha-Chlordane	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
beta-BHC	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
delta-BHC	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
gamma-BHC (Lindane)	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
gamma-Chlordane	0.054 - 0.060	0 / 7	--	--	0.028	9.06E-04
Semivolatile Organic Compounds (UG/L)						
1,2,4-Trichlorobenzene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
1,2-Dichlorobenzene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
1,3-Dichlorobenzene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
1,4-Dichlorobenzene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2,2'-Oxybis(1-chloropropane)	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2,4,5-Trichlorophenol	26.0 - 29.0	0 / 7	--	--	13.9	0.69
2,4,6-Trichlorophenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2,4-Dichlorophenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-16 Ecological Summary Statistics - Surface Water *St. Juliens Creek Annex - Site 4*						
Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
2,4-Dimethylphenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2,4-Dinitrophenol	26.0 - 29.0	0 / 7	--	--	13.9	0.69
2,4-Dinitrotoluene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2,6-Dinitrotoluene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2-Chloronaphthalene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2-Chlorophenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2-Methylnaphthalene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2-Methylphenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29
2-Nitroaniline	26.0 - 29.0	0 / 7	--	--	13.9	0.69
2-Nitrophenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29
3,3'-Dichlorobenzidine	10.0 - 12.0	0 / 7	--	--	5.50	0.29
3-Nitroaniline	26.0 - 29.0	0 / 7	--	--	13.9	0.69
4,6-Dinitro-2-methylphenol	26.0 - 29.0	0 / 7	--	--	13.9	0.69
4-Bromophenyl-phenylether	10.0 - 12.0	0 / 7	--	--	5.50	0.29
4-Chloro-3-methylphenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29
4-Chloroaniline	10.0 - 12.0	0 / 7	--	--	5.50	0.29
4-Chlorophenyl-phenylether	10.0 - 12.0	0 / 7	--	--	5.50	0.29
4-Methylphenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29
4-Nitroaniline	26.0 - 29.0	0 / 7	--	--	13.9	0.69
4-Nitrophenol	26.0 - 29.0	0 / 7	--	--	13.9	0.69
Acenaphthene	10.0 - 12.0	1 / 7	2.00	SJS04-SW07-001	5.00	1.35
Acenaphthylene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Anthracene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Benzo(a)anthracene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Benzo(a)pyrene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Benzo(b)fluoranthene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Benzo(g,h,i)perylene	10.0 - 12.0	1 / 7	3.00	SJS04-SW09-001	5.14	0.99
Benzo(k)fluoranthene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Butylbenzylphthalate	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Carbazole	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Chrysene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Di-n-butylphthalate	10.0 - 12.0	0 / 7	--	--	5.07	1.17
Di-n-octylphthalate	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Dibenz(a,h)anthracene	10.0 - 12.0	1 / 7	3.00	SJS04-SW09-001	5.14	0.99
Dibenzofuran	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Diethylphthalate	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Dimethyl phthalate	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Fluoranthene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Fluorene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Hexachlorobenzene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Hexachlorobutadiene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Hexachlorocyclopentadiene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Hexachloroethane	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Indeno(1,2,3-cd)pyrene	10.0 - 12.0	1 / 7	2.00	SJS04-SW09-001	5.00	1.35
Isophorone	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Naphthalene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Nitrobenzene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Pentachlorophenol	26.0 - 29.0	0 / 7	--	--	13.9	0.69
Phenanthrene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Phenol	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Pyrene	10.0 - 12.0	0 / 7	--	--	5.50	0.29
bis(2-Chloroethoxy)methane	10.0 - 12.0	0 / 7	--	--	5.50	0.29
bis(2-Chloroethyl)ether	10.0 - 12.0	0 / 7	--	--	5.50	0.29
bis(2-Ethylhexyl)phthalate	10.0 - 12.0	0 / 7	--	--	5.50	0.29
n-Nitroso-di-n-propylamine	10.0 - 12.0	0 / 7	--	--	5.50	0.29
n-Nitrosodiphenylamine	10.0 - 12.0	0 / 7	--	--	5.50	0.29
Volatile Organic Compounds (UG/L)						
1,1,1-Trichloroethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,1,2,2-Tetrachloroethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,1,2-Trichloroethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,1-Dichloroethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,1-Dichloroethene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,2,4-Trichlorobenzene	1.00 - 1.00	0 / 7	--	--	0.50	0.0

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-16
Ecological Summary Statistics - Surface Water
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean[1]	Standard Deviation of Mean
1,2-Dibromo-3-chloropropane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,2-Dibromoethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,2-Dichlorobenzene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,2-Dichloroethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,2-Dichloropropane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,3-Dichlorobenzene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
1,4-Dichlorobenzene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
2-Butanone	5.00 - 5.00	0 / 6	--	--	2.50	0.0
2-Hexanone	5.00 - 5.00	0 / 7	--	--	2.50	0.0
4-Methyl-2-pentanone	5.00 - 5.00	0 / 7	--	--	2.50	0.0
Acetone	5.00 - 5.00	0 / 6	--	--	2.50	0.0
Benzene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Bromochloromethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Bromodichloromethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Bromoform	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Bromomethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Carbon disulfide	1.00 - 1.00	3 / 7	13.5	SJS04-SW01-001	4.93	6.01
Carbon tetrachloride	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Chlorobenzene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Chloroethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Chloroform	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Chloromethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Dibromochloromethane	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Ethylbenzene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Methylene chloride	2.00 - 2.00	0 / 7	--	--	0.61	0.37
Styrene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Tetrachloroethene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Toluene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Trichloroethene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Vinyl chloride	1.00 - 1.00	0 / 7	--	--	0.50	0.0
Xylene, total	1.00 - 1.00	0 / 7	--	--	0.50	0.0
cis-1,2-Dichloroethene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
cis-1,3-Dichloropropene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
trans-1,2-Dichloroethene	1.00 - 1.00	0 / 7	--	--	0.50	0.0
trans-1,3-Dichloropropene	1.00 - 1.00	0 / 7	--	--	0.50	0.0

1 - One-half of the reporting limit was used for non-detected samples when calculating the mean.

Table 2-17
Ecological Medium-Specific Screening Values
St. Juliens Creek Annex - Site 4

Chemical	Screening Value	Units	Reference
Sediment			
1,1,1-Trichloroethane	31	ug/kg	USEPA 1995
1,1,2-Trichloroethane	31	ug/kg	USEPA 1995
1,2,4-Trichlorobenzene	40	ug/kg	USEPA 1995
1,2-Dichlorobenzene	35	ug/kg	USEPA 1995
1,4-Dichlorobenzene	110	ug/kg	USEPA 1995
2,4-Dimethylphenol	29	ug/kg	USEPA 1995
2-Methylnaphthalene	70	ug/kg	USEPA 1995
2-Methylphenol	63	ug/kg	USEPA 1995
4-Methylphenol	670	ug/kg	USEPA 1995
Acenaphthene	16	ug/kg	USEPA 1995
Acenaphthylene	44	ug/kg	USEPA 1995
Aldrin	2	ug/kg	Ontario Ministry of the Environment 1993
alpha-BHC	6	ug/kg	Ontario Ministry of the Environment 1993
alpha-Chlordane	0.5	ug/kg	Long and Morgan 1990
Aluminum	18000	mg/kg	Buchman 1999
Anthracene	85.3	ug/kg	USEPA 1995
Antimony	150	mg/kg	USEPA 1995
Aroclor-1016	22.7	ug/kg	USEPA 1995
Aroclor-1221	22.7	ug/kg	USEPA 1995
Aroclor-1232	22.7	ug/kg	USEPA 1995
Aroclor-1242	22.7	ug/kg	USEPA 1995
Aroclor-1248	22.7	ug/kg	USEPA 1995
Aroclor-1254	22.7	ug/kg	USEPA 1995
Aroclor-1260	22.7	ug/kg	USEPA 1995
Arsenic	8.2	mg/kg	USEPA 1995
Barium	48	mg/kg	Buchman 1999
Benzo(a)anthracene	261	ug/kg	USEPA 1995
Benzo(a)pyrene	430	ug/kg	USEPA 1995
Benzo(b)fluoranthene	3200	ug/kg	USEPA 1995
Benzo(g,h,i)perylene	670	ug/kg	USEPA 1995
Benzo(k)fluoranthene	240	ug/kg	Ontario Ministry of the Environment 1993
beta-BHC	5	ug/kg	Ontario Ministry of the Environment 1993
bis(2-Ethylhexyl)phthalate	1300	ug/kg	USEPA 1995
Butylbenzylphthalate	63	ug/kg	USEPA 1995
Cadmium	1.2	mg/kg	USEPA 1995
Chromium	81	mg/kg	Long et al. 1995
Chrysene	384	ug/kg	USEPA 1995
Cobalt	10	mg/kg	Buchman 1999
2,4,5-Trichlorophenol	3	ug/kg	Buchman 1999
2,4,6-Trichlorophenol	6	ug/kg	Buchman 1999
2,4-Dichlorophenol	5	ug/kg	Buchman 1999
Copper	34	mg/kg	USEPA 1995
Cyanide	0.1	mg/kg	Ontario Ministry of the Environment 1993
Dibenz(a,h)anthracene	63.4	ug/kg	USEPA 1995
Dibenzofuran	540	ug/kg	USEPA 1995
Dieldrin	0.715	ug/kg	Buchman 1999
Diethylphthalate	200	ug/kg	USEPA 1995
Dimethyl phthalate	71	ug/kg	USEPA 1995
Di-n-butylphthalate	1400	ug/kg	USEPA 1995
Di-n-octyl phthalate	6200	ug/kg	USEPA 1995
Endrin	0.02	ug/kg	Long and Morgan 1990
Ethylbenzene	10	ug/kg	USEPA 1995
Fluoranthene	600	ug/kg	USEPA 1995
Fluorene	19	ug/kg	USEPA 1995
gamma-BHC (Lindane)	0.32	ug/kg	Buchman 1999
gamma-Chlordane	0.5	ug/kg	Long and Morgan 1990
Heptachlor	0.3	ug/kg	Buchman 1999
Heptachlor epoxide	5	ug/kg	Ontario Ministry of the Environment 1993
Hexachlorobenzene	22	ug/kg	USEPA 1995
Hexachlorobutadiene	11	ug/kg	USEPA 1995
Indeno(1,2,3-cd)pyrene	600	ug/kg	USEPA 1995
Iron	188400	mg/kg	Buchman 1999
Lead	46.7	mg/kg	USEPA 1995
Manganese	260	mg/kg	Buchman 1999
Mercury	0.15	mg/kg	USEPA 1995

Table 2-17 Ecological Medium-Specific Screening Values *St. Juliens Creek Annex - Site 4*			
Chemical	**Screening Value**	**Units**	**Reference**
Naphthalene	160	ug/kg	USEPA 1995
Nickel	20.9	mg/kg	USEPA 1995
n-Nitrosodiphenylamine	28	ug/kg	USEPA 1995
Pentachlorophenol	360	ug/kg	USEPA 1995
Phenanthrene	240	ug/kg	USEPA 1995
Phenol	420	ug/kg	USEPA 1995
Pyrene	665	ug/kg	USEPA 1995
Selenium	1	mg/kg	Buchman 1999
Silver	1	mg/kg	USEPA 1995
Tetrachloroethene	57	ug/kg	USEPA 1995
Trichloroethene	41	ug/kg	Buchman 1999
Vanadium	57	mg/kg	Buchman 1999
Xylene, total	40	ug/kg	USEPA 1995
Zinc	150	mg/kg	USEPA 1995
Surface Water			
1,1,1-Trichloroethane	3,120	ug/L	derived from USEPA 1995
1,1,2,2-Tetrachloroethane	623	ug/L	derived from USEPA 1995
1,1,2-Trichloroethane	3,120	ug/L	derived from USEPA 1995
1,1-Dichloroethene	1,160	ug/L	derived from USEPA 1995
1,2,4-Trichlorobenzene	50.0	ug/L	USEPA 1995
1,2-Dibromoethane	180	ug/L	derived from USEPA 1995
1,2-Dichlorobenzene	129	ug/L	USEPA 1995
1,2-Dichloroethane	1,130	ug/L	derived from USEPA 1995
1,2-Dichloropropane	3,040	ug/L	USEPA 1995
1,3-Dichlorobenzene	28.5	ug/L	USEPA Region IV 1999
1,4-Dichlorobenzene	129	ug/L	USEPA 1995
2,4,5-Trichlorophenol	11.0	ug/L	USEPA 1995
2,4,6-Trichlorophenol	970	ug/L	USEPA 1995
2,4-Dichlorophenol	365	ug/L	USEPA 1995
2,4-Dimethylphenol	110	ug/L	Federal Register 59:3762 (1994)
2,4-Dinitrophenol	150	ug/L	USEPA 1995
2,4-Dinitrotoluene	230	ug/L	USEPA 1995
2-Butanone	14,000	ug/L	Suter and Tsao 1996
2-Chloronaphthalene	0.75	ug/L	derived from USEPA 1995
2-Chlorophenol	97.0	ug/L	derived from USEPA 1995
2-Hexanone	4,280	ug/L	derived from USEPA 1995
2-Methylnaphthalene	30.0	ug/L	derived from USEPA 1995
2-Methylphenol	13.0	ug/L	Suter and Tsao 1996
2-Nitrophenol	150	ug/L	USEPA 1994
4,4'-DDD	0.025	ug/L	USEPA Region IV 1999
4,4'-DDE	1.40	ug/L	derived from USEPA 1995
4,4'-DDT	0.0010	ug/L	USEPA 1995
4,6-Dinitro-2-methylphenol	2.30	ug/L	USEPA Region IV 1999
4-Bromophenyl-phenylether	1.50	ug/L	USEPA 1996
4-Chloro-3-methylphenol	0.30	ug/L	USEPA Region IV 1999
4-Chloroaniline	50.0	ug/L	Buchman 1999
4-Methyl-2-pentanone	4,600	ug/L	derived from USEPA 1995
4-Nitrophenol	150	ug/L	USEPA 1995
Acenaphthene	520	ug/L	USEPA 1995
Acenaphthylene	30.0	ug/L	derived from USEPA 1995
Acetone	90,000	ug/L	derived from USEPA 1995
Aldrin	0.13	ug/L	derived from USEPA 1995
alpha-BHC	0.034	ug/L	derived from USEPA 1995
alpha-Chlordane	0.0040	ug/L	USEPA 1995
Aluminum	87.0	ug/L	USEPA 1999
Anthracene	0.73	ug/L	Suter and Tsao 1996
Antimony	30.0	ug/L	USEPA 1995
Aroclor-1016	0.014	ug/L	USEPA 1995
Aroclor-1221	0.030	ug/L	USEPA 1995
Aroclor-1232	0.030	ug/L	USEPA 1995
Aroclor-1242	0.030	ug/L	USEPA 1995
Aroclor-1248	0.030	ug/L	USEPA 1995
Aroclor-1254	0.030	ug/L	USEPA 1995
Aroclor-1260	0.030	ug/L	USEPA 1995
Arsenic	36.0	ug/L	USEPA 1999
Barium	1,000	ug/L	derived from USEPA 1995

Table 2-17
Ecological Medium-Specific Screening Values
St. Juliens Creek Annex - Site 4

Chemical	Screening Value	Units	Reference
Benzene	530	ug/L	USEPA 1995
Benzo(a)anthracene	6.30	ug/L	derived from USEPA 1995
Benzo(a)pyrene	0.014	ug/L	Suter and Tsao 1996
Benzo(b)fluoranthene	30.0	ug/L	derived from USEPA 1995
Benzo(g,h,i)perylene	30.0	ug/L	derived from USEPA 1995
Benzo(k)fluoranthene	30.0	ug/L	derived from USEPA 1995
Beryllium	5.30	ug/L	USEPA 1995
beta-BHC	0.034	ug/L	derived from USEPA 1995
bis(2-Chloroethoxy)methane	1,100	ug/L	derived from USEPA 1995
bis(2-Chloroethyl)ether	2,380	ug/L	USEPA Region IV 1999
bis(2-Ethylhexyl)phthalate	30.0	ug/L	USEPA 1995
Bromochloromethane	1,100	ug/L	derived from USEPA 1995
Bromodichloromethane	1,100	ug/L	derived from USEPA 1995
Bromoform	320	ug/L	derived from USEPA 1995
Bromomethane	110	ug/L	derived from USEPA 1995
Butylbenzylphthalate	22.0	ug/L	USEPA Region IV 1999
Cadmium	0.83	ug/L	USEPA 1999a
Carbon disulfide	2.00	ug/L	USEPA 1995
Carbon tetrachloride	3,520	ug/L	derived from USEPA 1995
Chlorobenzene	105	ug/L	USEPA Region IV 1999
Chloroform	815	ug/L	USEPA Region IV 1999
Chloromethane	2,700	ug/L	USEPA Region IV 1999
Chromium	11.4	ug/L	USEPA 1999a
Chrysene	30.0	ug/L	derived from USEPA 1995
cis-1,2-Dichloroethene	1,160	ug/L	derived from USEPA 1995
cis-1,3-Dichloropropene	79.0	ug/L	derived from USEPA 1995
Cobalt	23.0	ug/L	Suter and Tsao 1996
Copper	2.85	ug/L	USEPA 1995
Cyanide	1.00	ug/L	USEPA 1995
delta-BHC	0.034	ug/L	derived from USEPA 1995
Dibenz(a,h)anthracene	30.0	ug/L	derived from USEPA 1995
Dibenzofuran	20.0	ug/L	USEPA 1996
Dibromochloromethane	1,100	ug/L	derived from USEPA 1995
Dieldrin	0.0019	ug/L	USEPA 1995
Diethylphthalate	75.9	ug/L	USEPA Region IV 1999
Dimethyl phthalate	330	ug/L	USEPA Region IV 1999
Di-n-butylphthalate	3.40	ug/L	USEPA 1995
Di-n-octylphthalate	3.00	ug/L	Buchman 1999
Endosulfan I	0.0087	ug/L	USEPA 1995
Endosulfan II	0.0087	ug/L	USEPA 1995
Endosulfan sulfate	0.0087	ug/L	USEPA 1995
Endrin	0.0023	ug/L	USEPA 1995
Endrin aldehyde	0.0023	ug/L	USEPA 1995
Endrin ketone	0.0023	ug/L	USEPA 1995
Ethylbenzene	43.0	ug/L	derived from USEPA 1995
Fluoranthene	16.0	ug/L	USEPA 1995
Fluorene	30.0	ug/L	derived from USEPA 1995
gamma-BHC (Lindane)	0.016	ug/L	derived from USEPA 1995
gamma-Chlordane	0.0040	ug/L	USEPA 1995
Heptachlor	0.0036	ug/L	USEPA 1995
Heptachlor epoxide	0.0036	ug/L	USEPA 1995
Hexachlorobenzene	3.68	ug/L	USEPA 1995
Hexachlorobutadiene	3.20	ug/L	derived from USEPA 1995
Hexachlorocyclopentadiene	0.70	ug/L	derived from USEPA 1995
Hexachloroethane	94.0	ug/L	derived from USEPA 1995
Indeno(1,2,3-cd)pyrene	30.0	ug/L	derived from USEPA 1995
Iron	320	ug/L	USEPA 1995
Isophorone	1,290	ug/L	derived from USEPA 1995
Lead	0.54	ug/L	USEPA 1999
Manganese	10.0	ug/L	USEPA 1995
Mercury	0.91	ug/L	USEPA 1999a
Methoxychlor	0.030	ug/L	USEPA 1995
Methylene chloride	2,200	ug/L	Suter and Tsao 1996
Naphthalene	100	ug/L	USEPA 1995
Nickel	8.30	ug/L	USEPA 1995
Nitrobenzene	668	ug/L	derived from USEPA 1995

Table 2-17 Ecological Medium-Specific Screening Values *St. Juliens Creek Annex - Site 4*			
Chemical	**Screening Value**	**Units**	**Reference**
n-Nitrosodiphenylamine	585	ug/L	derived from USEPA 1995
Pentachlorophenol	6.69	ug/L	derived from USEPA 1995
Phenanthrene	4.60	ug/L	USEPA 1995
Phenol	256	ug/L	USEPA Region IV 1999
Pyrene	30.0	ug/L	derived from USEPA 1995
Selenium	5.00	ug/L	USEPA 1995
Silver	0.23	ug/L	USEPA Region IV 1999
Tetrachloroethene	450	ug/L	USEPA 1995
Thallium	40.0	ug/L	USEPA 1995
Toluene	37.0	ug/L	USEPA Region IV 1999
Toxaphene	0.011	ug/L	USEPA 1996
trans-1,2-Dichloroethene	1,160	ug/L	derived from USEPA 1995
trans-1,3-Dichloropropene	79.0	ug/L	derived from USEPA 1995
Trichloroethene	200	ug/L	derived from USEPA 1995
Vanadium	10,000	ug/L	USEPA 1995
Vinyl chloride	1,160	ug/L	derived from USEPA 1995
Xylene, total	130	ug/L	USEPA 1995
Zinc	37.0	ug/L	USEPA 1999a
Surface Soil			
1,1,1-Trichloroethane	300	ug/kg	USEPA 1995
1,1,2,2-Tetrachloroethane	300	ug/kg	USEPA 1995
1,1,2-Trichloroethane	300	ug/kg	USEPA 1995
1,1-Dichloroethane	300	ug/kg	USEPA 1995
1,2,4-Trichlorobenzene	1,270	ug/kg	Efroymson et al. 1997b
1,2-Dichlorobenzene	100	ug/kg	USEPA 1995
1,2-Dichloroethane	401	ug/kg	USEPA Region IV 1999
1,2-Dichloroethene (total)	300	ug/kg	USEPA 1995
1,2-Dichloropropane	38,800	ug/kg	Efroymson et al. 1997b
1,4-Dichlorobenzene	1,280	ug/kg	Efroymson et al. 1997b
2,4,5-Trichlorophenol	430	ug/kg	Efroymson et al. 1997a
2,4,6-Trichlorophenol	580	ug/kg	Efroymson et al. 1997b
2,4-Dichlorophenol	13,400	ug/kg	Efroymson et al. 1997b
2,4-Dimethylphenol	100	ug/kg	USEPA 1995
2,4-Dinitrophenol	20,000	ug/kg	Efroymson et al. 1997a
2-Chloronaphthalene	1,033	ug/kg	USEPA Region IV 1999
2-Chlorophenol	100	ug/kg	USEPA 1995
2-Methylphenol	100	ug/kg	USEPA 1995
4,4'-DDD	100	ug/kg	USEPA 1995
4,4'-DDE	100	ug/kg	USEPA 1995
4,4'-DDT	100	ug/kg	USEPA 1995
4-Methyl-2-pentanone	10,000	ug/kg	derived from USEPA 1995
4-Methylphenol	100	ug/kg	USEPA 1995
4-Nitrophenol	380	ug/kg	Efroymson et al. 1997b
Acenaphthene	2,500	ug/kg	Efroymson et al. 1997a
Acenaphthylene	100	ug/kg	USEPA 1995
Aldrin	100	ug/kg	USEPA 1995
alpha-BHC	100,000	ug/kg	USEPA 1995
alpha-Chlordane	100	ug/kg	USEPA 1995
Aluminum	50.0	mg/kg	Efroymson et al. 1997a
Anthracene	100	ug/kg	USEPA 1995
Antimony	5.00	mg/kg	Efroymson et al. 1997a
Aroclor-1016	100	ug/kg	USEPA 1995
Aroclor-1221	100	ug/kg	USEPA 1995
Aroclor-1232	100	ug/kg	USEPA 1995
Aroclor-1242	100	ug/kg	USEPA 1995
Aroclor-1248	100	ug/kg	USEPA 1995
Aroclor-1254	100	ug/kg	USEPA 1995
Aroclor-1260	100	ug/kg	USEPA 1995
Arsenic	60.0	mg/kg	Efroymson et al. 1997b
Barium	500	mg/kg	Efroymson et al. 1997a
Benzene	105	ug/kg	USEPA 1995
Benzo(a)anthracene	100	ug/kg	USEPA 1995
Benzo(a)pyrene	100	ug/kg	USEPA 1995
Benzo(b)fluoranthene	100	ug/kg	USEPA 1995
Benzo(g,h,i)perylene	100	ug/kg	USEPA 1995
Benzo(k)fluoranthene	100	ug/kg	USEPA 1995

Table 2-17
Ecological Medium-Specific Screening Values
St. Juliens Creek Annex - Site 4

Chemical	Screening Value	Units	Reference
Beryllium	10.0	mg/kg	Efroymson et al. 1997a
beta-BHC	100,000	ug/kg	USEPA 1995
Bromodichloromethane	45,000	ug/kg	derived from USEPA 1995
Bromoform	114,700	ug/kg	derived from USEPA 1995
Cadmium	4.00	mg/kg	Efroymson et al. 1997a
Carbon tetrachloride	1,000,000	ug/kg	derived from USEPA 1995
Chlorobenzene	2,400	ug/kg	Efroymson et al. 1997b
Chloroform	1,000	ug/kg	derived from USEPA 1995
Chromium	0.40	mg/kg	Efroymson et al. 1997b
Chrysene	100	ug/kg	USEPA 1995
cis-1,3-Dichloropropene	300	ug/kg	USEPA 1995
Cobalt	100	mg/kg	USEPA 1995
Copper	50.0	mg/kg	Efroymson et al. 1997b
Cyanide	0.060	mg/kg	Eisler 1991
delta-BHC	100,000	ug/kg	USEPA 1995
Dibenz(a,h)anthracene	100	ug/kg	USEPA 1995
Dieldrin	100	ug/kg	USEPA 1995
Diethylphthalate	13,400	ug/kg	Efroymson et al. 1997a
Dimethyl phthalate	10,640	ug/kg	Efroymson et al. 1997b
Di-n-butylphthalate	200,000	ug/kg	Efroymson et al. 1997a
Endrin	100	ug/kg	USEPA 1995
Endrin aldehyde	100	ug/kg	USEPA 1995
Endrin ketone	100	ug/kg	derived from USEPA 1995
Ethylbenzene	5,005	ug/kg	derived from USEPA 1995
Fluoranthene	100	ug/kg	USEPA 1995
Fluorene	1,700	ug/kg	Efroymson et al. 1997b
gamma-BHC (Lindane)	100	ug/kg	USEPA 1995
gamma-Chlordane	100	ug/kg	USEPA 1995
Heptachlor epoxide	100	ug/kg	USEPA 1995
Hexachlorocyclopentadiene	1,000	ug/kg	Efroymson et al. 1997a
Indeno(1,2,3-cd)pyrene	100	ug/kg	USEPA 1995
Iron	200	mg/kg	Efroymson et al. 1997b
Lead	50.0	mg/kg	Efroymson et al. 1997a
Magnesium [2]	4,400	mg/kg	USEPA 1995
Manganese	330	mg/kg	USEPA 1995
Mercury	0.10	mg/kg	Efroymson et al. 1997b
Methoxychlor	100	ug/kg	USEPA 1995
Methylene chloride	1,001	ug/kg	derived from USEPA 1995
Naphthalene	100	ug/kg	USEPA 1995
Nickel	30.0	mg/kg	Efroymson et al. 1997a
Nitrobenzene	2,260	ug/kg	Efroymson et al. 1997b
n-Nitrosodiphenylamine	1,090	ug/kg	Efroymson et al. 1997b
Pentachlorophenol	3,000	ug/kg	Efroymson et al. 1997a
Phenanthrene	100	ug/kg	USEPA 1995
Phenol	1,880	ug/kg	Efroymson et al. 1997b
Pyrene	100	ug/kg	USEPA 1995
Selenium	1.80	mg/kg	USEPA 1995
Silver	2.00	mg/kg	Efroymson et al. 1997a
Styrene	10,010	ug/kg	derived from USEPA 1995
Tetrachloroethene	401	ug/kg	derived from USEPA 1995
Thallium	1.00	mg/kg	Efroymson et al. 1997a
Toluene	13,005	ug/kg	derived from USEPA 1995
trans-1,3-Dichloropropene	300	ug/kg	USEPA 1995
Trichloroethene	6,000	ug/kg	derived from USEPA 1995
Vanadium	2.00	mg/kg	Efroymson et al. 1997a
Vinyl chloride	300	ug/kg	USEPA 1995
Xylene, total	2,505	ug/kg	derived from USEPA 1995
Zinc	50.0	mg/kg	Efroymson et al. 1997a

Table 2-18
Ecological Screening Statistics - Surface Soil - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
Inorganics (MG/KG)								
Aluminum	6.75 - 12.5	18 / 18	17,800	SJS04-SS01-000	50.0	18 / 18	356	YES
Antimony	0.31 - 0.88	11 / 17	18.5	SJS04-SS11-000	5.00	2 / 17	3.70	YES
Arsenic	0.42 - 0.65	18 / 18	22.9	SJS04-SS14-000	60.0	0 / 18	0.38	NO
Barium	0.040 - 0.43	18 / 18	991	SJS04-SS11-000	500	1 / 18	1.98	YES
Beryllium	0.020 - 0.22	15 / 18	5.50	SJS04-SS11-000	10.0	0 / 18	0.55	NO
Cadmium	0.060 - 0.11	12 / 18	9.70	SJS04-SS11-000	4.00	1 / 18	2.42	YES
Calcium [2]	12.2 - 18.9	18 / 18	49,100	SJS04-SS11-000	NSV	-- / --	NSV	NO
Chromium	0.23 - 1.52	18 / 18	680	SJS04-SS05-000	0.40	18 / 18	1,700	YES
Cobalt	0.11 - 1.74	17 / 18	12.0	SJS04-SS11-000	100	0 / 18	0.12	NO
Copper	0.23 - 1.30	18 / 18	874	SJS04-SS11-000	50.0	12 / 18	17.5	YES
Cyanide	0.26 - 0.63	0 / 18	--	--	0.060	-- / --	10.5	YES
Iron	2.61 - 10.1	18 / 18	65,100	SJS04-SS11-000	200	18 / 18	326	YES
Lead	0.15 - 0.33	18 / 18	1,110	SJS04-SS11-000	50.0	17 / 18	22.2	YES
Magnesium [2]	5.10 - 39.3	18 / 18	3,210	SJS04-SS18-000	4,400	0 / 18	0.73	NO
Manganese	0.060 - 0.43	18 / 18	883	SJS04-SS11-000	330	3 / 18	2.68	YES
Mercury	0.0100 - 0.060	17 / 18	1.30	SJS04-SS06-000	0.10	16 / 18	13.0	YES
Nickel	0.19 - 1.52	18 / 18	546	SJS04-SS05-000	30.0	5 / 18	18.2	YES
Potassium [2]	2.80 - 48.2	18 / 18	3,470	SJS04-SS18-000	NSV	-- / --	NSV	NO
Selenium	0.46 - 0.85	6 / 18	1.30	SJS04-SS11-000	1.80	0 / 18	0.72	NO
Silver	0.15 - 0.29	3 / 18	2.20	SJS04-SS11-000	2.00	1 / 18	1.10	YES
Sodium [2]	8.90 - 48.4	9 / 18	954	SJS04-SS11-000	NSV	-- / --	NSV	NO
Thallium	0.31 - 1.00	3 / 18	3.40	SJS04-SS01-000	1.00	1 / 18	3.40	YES
Vanadium	0.13 - 1.95	18 / 18	354	SJS04-SS04-000	2.00	18 / 18	177	YES
Zinc	0.40 - 1.09	18 / 18	3,880	SJS04-SS11-000	50.0	17 / 18	77.6	YES
Pesticide/Polychlorinated Biphenyls (UG/KG)								
4,4'-DDD	3.30 - 21.0	6 / 18	15.0	SJS04-SS05-000	100	0 / 18	0.15	NO
4,4'-DDE	3.30 - 21.0	10 / 18	37.0	SJS04-SS05-000	100	0 / 18	0.37	NO
4,4'-DDT	3.30 - 21.0	13 / 18	40.0	SJS04-SS05-000	100	0 / 18	0.40	NO
Aldrin	1.70 - 11.0	0 / 18	--	--	100	-- / --	0.11	NO
Aroclor-1016	33.0 - 210	0 / 18	--	--	100	-- / --	2.10	YES
Aroclor-1221	67.0 - 430	0 / 18	--	--	100	-- / --	4.30	YES
Aroclor-1232	33.0 - 210	0 / 18	--	--	100	-- / --	2.10	YES
Aroclor-1242	33.0 - 210	0 / 18	--	--	100	-- / --	2.10	YES
Aroclor-1248	33.0 - 210	0 / 18	--	--	100	-- / --	2.10	YES
Aroclor-1254	33.0 - 210	3 / 18	12.0	SJS04-SS16-000	100	0 / 18	0.12	NO
Aroclor-1260	33.0 - 1,700	6 / 18	6,300	SJS04-SS08-000	100	2 / 18	63.0	YES
Dieldrin	3.30 - 21.0	6 / 18	72.0	SJS04-SS08-000	100	0 / 18	0.72	NO
Endosulfan I	1.70 - 11.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Endosulfan II	3.30 - 21.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Endosulfan sulfate	3.30 - 21.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Endrin	3.30 - 21.0	1 / 18	3.90	SJS04-SS10-000	100	0 / 18	0.039	NO
Endrin aldehyde	3.30 - 21.0	1 / 18	160	SJS04-SS08-000	100	1 / 18	1.60	YES
Endrin ketone	3.30 - 21.0	1 / 18	83.0	SJS04-SS08-000	100	0 / 18	0.83	NO
Heptachlor	1.70 - 11.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Heptachlor epoxide	1.70 - 11.0	0 / 18	--	--	100	-- / --	0.11	NO
Methoxychlor	17.0 - 110	0 / 18	--	--	100	-- / --	1.10	YES
Toxaphene	170 - 1,100	0 / 18	--	--	NSV	-- / --	NSV	YES
alpha-BHC	1.70 - 11.0	0 / 18	--	--	100,000	-- / --	1.10E-04	NO
alpha-Chlordane	1.70 - 11.0	4 / 18	42.0	SJS04-SS08-000	100	0 / 18	0.42	NO
beta-BHC	1.70 - 11.0	0 / 18	--	--	100,000	-- / --	1.10E-04	NO
delta-BHC	1.70 - 11.0	0 / 18	--	--	100,000	-- / --	1.10E-04	NO
gamma-BHC (Lindane)	1.70 - 11.0	0 / 18	--	--	100	-- / --	0.11	NO
gamma-Chlordane	1.70 - 11.0	5 / 18	33.0	SJS04-SS08-000	100	0 / 18	0.33	NO
Semivolatile Organic Compounds (UG/KG)								
1,2,4-Trichlorobenzene	340 - 40,000	0 / 18	--	--	1,270	-- / --	31.5	YES
1,2-Dichlorobenzene	340 - 40,000	0 / 18	--	--	100	-- / --	400	YES
1,3-Dichlorobenzene	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
1,4-Dichlorobenzene	340 - 40,000	0 / 18	--	--	1,280	-- / --	31.3	YES
2,2'-Oxybis(1-chloropropane)	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
2,4,5-Trichlorophenol	840 - 100,000	0 / 18	--	--	430	-- / --	233	YES
2,4,6-Trichlorophenol	340 - 40,000	0 / 18	--	--	580	-- / --	69.0	YES
2,4-Dichlorophenol	340 - 40,000	0 / 18	--	--	13,400	-- / --	2.99	YES
2,4-Dimethylphenol	340 - 40,000	0 / 18	--	--	100	-- / --	400	YES
2,4-Dinitrophenol	840 - 100,000	0 / 15	--	--	20,000	-- / --	5.00	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-18
Ecological Screening Statistics - Surface Soil - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
2-Chloronaphthalene	340 - 40,000	0 / 18	--	--	1,033	-- / --	38.7	YES
2-Chlorophenol	340 - 40,000	0 / 18	--	--	100	-- / --	400	YES
2-Methylnaphthalene	340 - 40,000	1 / 18	200	SJS04-SS11-000	NSV	-- / --	NSV	YES
2-Methylphenol	340 - 40,000	0 / 18	--	--	100	-- / --	400	YES
2-Nitroaniline	840 - 100,000	0 / 18	--	--	NSV	-- / --	NSV	YES
2-Nitrophenol	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
3,3'-Dichlorobenzidine	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
3-Nitroaniline	840 - 100,000	0 / 18	--	--	NSV	-- / --	NSV	YES
4,6-Dinitro-2-methylphenol	840 - 100,000	0 / 18	--	--	NSV	-- / --	NSV	YES
4-Bromophenyl-phenylether	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
4-Chloro-3-methylphenol	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
4-Chloroaniline	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
4-Chlorophenyl-phenylether	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
4-Methylphenol	340 - 40,000	0 / 18	--	--	100	-- / --	400	YES
4-Nitroaniline	840 - 100,000	0 / 18	--	--	NSV	-- / --	NSV	YES
4-Nitrophenol	840 - 100,000	0 / 18	--	--	380	-- / --	263	YES
Acenaphthene	340 - 40,000	2 / 18	670	SJS04-SS11-000	2,500	0 / 18	0.27	NO
Acenaphthylene	340 - 40,000	5 / 18	130	SJS04-SS18-000	100	1 / 18	1.30	YES
Anthracene	340 - 40,000	9 / 18	950	SJS04-SS11-000	100	4 / 18	9.50	YES
Benzo(a)anthracene	340 - 40,000	17 / 18	3,000	SJS04-SS11-000	100	15 / 18	30.0	YES
Benzo(a)pyrene	340 - 40,000	17 / 18	2,300	SJS04-SS11-000	100	15 / 18	23.0	YES
Benzo(b)fluoranthene	340 - 40,000	17 / 18	3,000	SJS04-SS11-000	100	15 / 18	30.0	YES
Benzo(g,h,i)perylene	340 - 40,000	15 / 18	1,400	SJS04-SS11-000	100	12 / 18	14.0	YES
Benzo(k)fluoranthene	340 - 40,000	14 / 18	820	SJS04-SS01-000	100	12 / 18	8.20	YES
Butylbenzylphthalate	340 - 40,000	1 / 18	35.0	SJS04-SS07-000	NSV	-- / --	NSV	YES
Carbazole	340 - 40,000	3 / 18	300	SJS04-SS05-000	NSV	-- / --	NSV	YES
Chrysene	340 - 40,000	16 / 18	2,900	SJS04-SS11-000	100	15 / 18	29.0	YES
Di-n-butylphthalate	340 - 40,000	1 / 18	200	SJS04-SS16-000	200,000	0 / 18	0.0010	NO
Di-n-octylphthalate	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
Dibenz(a,h)anthracene	340 - 40,000	2 / 18	320	SJS04-SS11-000	100	2 / 18	3.20	YES
Dibenzofuran	340 - 40,000	2 / 18	190	SJS04-SS11-000	NSV	-- / --	NSV	YES
Diethylphthalate	340 - 40,000	3 / 18	620	SJS04-SS09-000	13,400	0 / 18	0.046	NO
Dimethyl phthalate	340 - 40,000	0 / 18	--	--	10,640	-- / --	3.76	YES
Fluoranthene	340 - 40,000	17 / 18	4,000	SJS04-SS11-000	100	15 / 18	40.0	YES
Fluorene	340 - 40,000	2 / 18	570	SJS04-SS11-000	1,700	0 / 18	0.34	NO
Hexachlorobenzene	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
Hexachlorobutadiene	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
Hexachlorocyclopentadiene	340 - 40,000	0 / 18	--	--	1,000	-- / --	40.0	YES
Hexachloroethane	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
Indeno(1,2,3-cd)pyrene	340 - 40,000	15 / 18	1,100	SJS04-SS11-000	100	12 / 18	11.0	YES
Isophorone	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
Naphthalene	340 - 40,000	2 / 18	250	SJS04-SS11-000	100	1 / 18	2.50	YES
Pentachlorophenol	840 - 100,000	0 / 18	--	--	3,000	-- / --	33.3	YES
Phenanthrene	340 - 40,000	15 / 18	6,300	SJS04-SS11-000	100	11 / 18	63.0	YES
Phenol	340 - 40,000	0 / 18	--	--	1,880	-- / --	21.3	YES
Pyrene	340 - 40,000	16 / 18	7,500	SJS04-SS11-000	100	14 / 18	75.0	YES
bis(2-Chloroethoxy)methane	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
bis(2-Chloroethyl)ether	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
bis(2-Ethylhexyl)phthalate	340 - 40,000	3 / 18	110	SJS04-SS11-000	NSV	-- / --	NSV	YES
n-Nitroso-di-n-propylamine	340 - 40,000	0 / 18	--	--	NSV	-- / --	NSV	YES
n-Nitrosodiphenylamine	340 - 40,000	0 / 18	--	--	1,090	-- / --	36.7	YES
Volatile Organic Compounds (UG/KG)								
1,1,1-Trichloroethane	10.0 - 17.0	0 / 18	--	--	300	-- / --	0.057	NO
1,1,2,2-Tetrachloroethane	10.0 - 17.0	0 / 18	--	--	300	-- / --	0.057	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-18
Ecological Screening Statistics - Surface Soil - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
1,1,2-Trichloroethane	10.0 - 17.0	0 / 18	--	--	300	-- / --	0.057	NO
1,1-Dichloroethane	10.0 - 17.0	0 / 18	--	--	300	-- / --	0.057	NO
1,1-Dichloroethene	10.0 - 17.0	0 / 18	--	--	NSV	-- / --	NSV	YES
1,2-Dichloroethane	10.0 - 17.0	0 / 18	--	--	401	-- / --	0.042	NO
1,2-Dichloroethene (total)	10.0 - 17.0	0 / 18	--	--	300	-- / --	0.057	NO
1,2-Dichloropropane	10.0 - 17.0	0 / 18	--	--	38,800	-- / --	4.38E-04	NO
2-Butanone	10.0 - 17.0	2 / 18	28.0	SJS04-SS04-000	NSV	-- / --	NSV	YES
2-Hexanone	10.0 - 17.0	0 / 18	--	--	NSV	-- / --	NSV	YES
4-Methyl-2-pentanone	10.0 - 17.0	1 / 18	2.00	SJS04-SS03-000	10,000	0 / 18	2.00E-04	NO
Acetone	10.0 - 17.0	12 / 18	79.0	SJS04-SS08-000	NSV	-- / --	NSV	YES
Benzene	10.0 - 17.0	0 / 18	--	--	105	-- / --	0.16	NO
Bromodichloromethane	10.0 - 17.0	0 / 18	--	--	45,000	-- / --	3.78E-04	NO
Bromoform	10.0 - 17.0	0 / 18	--	--	114,700	-- / --	1.48E-04	NO
Bromomethane	10.0 - 17.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Carbon disulfide	10.0 - 17.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Carbon tetrachloride	10.0 - 17.0	0 / 18	--	--	1,000,000	-- / --	1.70E-05	NO
Chlorobenzene	10.0 - 17.0	0 / 18	--	--	2,400	-- / --	0.0071	NO
Chloroethane	10.0 - 17.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Chloroform	10.0 - 17.0	1 / 18	2.00	SJS04-SS11-000	1,000	0 / 18	0.0020	NO
Chloromethane	10.0 - 17.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Dibromochloromethane	10.0 - 17.0	0 / 18	--	--	NSV	-- / --	NSV	YES
Ethylbenzene	10.0 - 17.0	0 / 18	--	--	5,005	-- / --	0.0034	NO
Methylene chloride	10.0 - 17.0	0 / 18	--	--	1,001	-- / --	0.017	NO
Styrene	10.0 - 17.0	0 / 18	--	--	10,010	-- / --	0.0017	NO
Tetrachloroethene	10.0 - 17.0	0 / 18	--	--	401	-- / --	0.042	NO
Toluene	10.0 - 17.0	2 / 18	2.00	SJS04-SS10-000	13,005	0 / 18	1.54E-04	NO
Trichloroethene	10.0 - 17.0	0 / 18	--	--	6,000	-- / --	0.0028	NO
Vinyl chloride	10.0 - 17.0	0 / 18	--	--	300	-- / --	0.057	NO
Xylene, total	10.0 - 17.0	0 / 18	--	--	2,505	-- / --	0.0068	NO
cis-1,3-Dichloropropene	10.0 - 17.0	0 / 18	--	--	300	-- / --	0.057	NO
trans-1,3-Dichloropropene	10.0 - 17.0	0 / 18	--	--	300	-- / --	0.057	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-19
Ecological Screening Statistics - Sediment - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
Inorganics (MG/KG)								
Aluminum	5.30 - 29.4	9 / 9	22,100	SJS04-SD04-000	18,000	2 / 9	1.23	YES
Antimony	0.40 - 1.34	1 / 9	2.10	SJS04-SD02-000	150	0 / 9	0.014	NO
Arsenic	0.60 - 2.01	9 / 9	33.1	SJS04-SD03-000	8.20	7 / 9	4.04	YES
Barium	0.060 - 1.34	9 / 9	903	SJS04-SD07-001	48.0	7 / 9	18.8	YES
Beryllium	0.030 - 0.67	9 / 9	3.90	SJS04-SD01-000	NSV	-- / --	NSV	YES
Cadmium	0.080 - 0.33	7 / 9	2.00	SJS04-SD08-001	1.20	3 / 9	1.67	YES
Calcium [2]	8.8 - 58.2	9 / 9	18,300	SJS04-SD03-000	NSV	-- / --	NSV	NO
Chromium	0.17 - 4.68	9 / 9	38.8	SJS04-SD04-000	81.0	0 / 9	0.48	NO
Cobalt	0.16 - 5.35	9 / 9	32.7	SJS04-SD05-001	10.0	5 / 9	3.27	YES
Copper	0.23 - 4.01	9 / 9	387	SJS04-SD03-000	34.0	8 / 9	11.4	YES
Cyanide	0.40 - 1.70	1 / 9	2.90	SJS04-SD08-001	0.10	1 / 9	29.0	YES
Iron	3.38 - 14.1	9 / 9	56,000	SJS04-SD01-000	188,400	0 / 9	0.30	NO
Lead	0.20 - 0.67	9 / 9	441	SJS04-SD03-000	46.7	8 / 9	9.44	YES
Magnesium [2]	7.40 - 121	9 / 9	6,740	SJS04-SD04-000	NSV	-- / --	NSV	NO
Manganese	0.10 - 1.34	9 / 9	877	SJS04-SD03-000	260	3 / 9	3.37	YES
Mercury	0.030 - 0.15	9 / 9	6.40	SJS04-SD03-000	0.15	8 / 9	42.7	YES
Nickel	0.25 - 4.68	9 / 9	43.9	SJS04-SD03-000	20.9	4 / 9	2.10	YES
Potassium [2]	4.30 - 149	9 / 9	3,850	SJS04-SD04-000	NSV	-- / --	NSV	NO
Selenium	0.60 - 2.01	5 / 9	1.60	SJS04-SD07-001	1.00	4 / 9	1.60	YES
Silver	0.20 - 0.67	4 / 9	1.00	SJS04-SD03-000	1.00	0 / 9	1.00	YES
Sodium [2]	11.5 - 67.9	7 / 9	11,000	SJS04-SD08-001	NSV	-- / --	NSV	NO
Thallium	0.40 - 1.50	1 / 9	0.46	SJS04-SD02-000	NSV	-- / --	NSV	YES
Vanadium	0.19 - 6.02	9 / 9	88.5	SJS04-SD03-000	57.0	1 / 9	1.55	YES
Zinc	0.20 - 3.34	9 / 9	624	SJS04-SD03-000	150	8 / 9	4.16	YES
Pesticide/Polychlorinated Biphenyls (UG/KG)								
4,4'-DDD	4.00 - 42.0	7 / 9	220	SJS04-SD01-000	16.0	2 / 9	13.8	YES
4,4'-DDE	4.00 - 10.0	7 / 9	31.0	SJS04-SD01-000	2.20	5 / 9	14.1	YES
4,4'-DDT	4.00 - 10.0	3 / 9	38.0	SJS04-SD01-000	1.58	3 / 9	24.1	YES
Aldrin	2.10 - 5.00	0 / 8	--	--	2.00	-- / --	2.50	YES
Aroclor-1016	40.0 - 100	0 / 8	--	--	22.7	-- / --	4.41	YES
Aroclor-1221	82.0 - 200	0 / 8	--	--	22.7	-- / --	8.81	YES
Aroclor-1232	40.0 - 100	0 / 8	--	--	22.7	-- / --	4.41	YES
Aroclor-1242	40.0 - 100	0 / 8	--	--	22.7	-- / --	4.41	YES
Aroclor-1248	40.0 - 100	0 / 8	--	--	22.7	-- / --	4.41	YES
Aroclor-1254	40.0 - 100	0 / 8	--	--	22.7	-- / --	4.41	YES
Aroclor-1260	40.0 - 100	4 / 8	90.0	SJS04-SD02-000	22.7	4 / 8	3.96	YES
Dieldrin	4.00 - 10.0	3 / 9	23.0	SJS04-SD02-000	0.72	2 / 9	32.2	YES
Endosulfan I	2.10 - 5.00	0 / 8	--	--	NSV	-- / --	NSV	YES
Endosulfan II	4.00 - 10.0	0 / 8	--	--	NSV	-- / --	NSV	YES
Endosulfan sulfate	4.00 - 10.0	0 / 8	--	--	NSV	-- / --	NSV	YES
Endrin	4.00 - 10.0	0 / 8	--	--	0.020	-- / --	500	YES
Endrin aldehyde	4.00 - 10.0	0 / 8	--	--	NSV	-- / --	NSV	YES
Endrin ketone	4.00 - 10.0	0 / 8	--	--	NSV	-- / --	NSV	YES
Heptachlor	2.10 - 5.00	0 / 8	--	--	0.30	-- / --	16.7	YES
Heptachlor epoxide	2.10 - 5.00	0 / 8	--	--	5.00	-- / --	1.00	YES
Methoxychlor	21.0 - 50.0	0 / 8	--	--	NSV	-- / --	NSV	YES
Toxaphene	210 - 500	0 / 8	--	--	NSV	-- / --	NSV	YES
alpha-BHC	2.10 - 5.00	0 / 8	--	--	6.00	-- / --	0.83	NO
alpha-Chlordane	2.10 - 5.00	0 / 8	--	--	0.50	-- / --	10.0	YES
beta-BHC	2.10 - 5.00	0 / 8	--	--	5.00	-- / --	1.00	YES
delta-BHC	2.10 - 5.00	0 / 8	--	--	NSV	-- / --	NSV	YES
gamma-BHC (Lindane)	2.10 - 5.00	0 / 8	--	--	0.32	-- / --	15.6	YES
gamma-Chlordane	2.10 - 5.00	0 / 8	--	--	0.50	-- / --	10.0	YES
Semivolatile Organic Compounds (UG/KG)								
1,2,4-Trichlorobenzene	420 - 2,000	0 / 8	--	--	40.0	-- / --	50.0	YES
1,2-Dichlorobenzene	420 - 2,000	0 / 8	--	--	35.0	-- / --	57.1	YES
1,3-Dichlorobenzene	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
1,4-Dichlorobenzene	420 - 2,000	0 / 8	--	--	110	-- / --	18.2	YES
2,2'-Oxybis(1-chloropropane)	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
2,4,5-Trichlorophenol	1,000 - 5,100	0 / 8	--	--	NSV	-- / --	NSV	YES
2,4,6-Trichlorophenol	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
2,4-Dichlorophenol	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
2,4-Dimethylphenol	420 - 2,000	0 / 8	--	--	29.0	-- / --	69.0	YES
2,4-Dinitrophenol	1,000 - 5,100	0 / 8	--	--	NSV	-- / --	NSV	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-19
Ecological Screening Statistics - Sediment - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
2,4-Dinitrotoluene	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
2,6-Dinitrotoluene	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
2-Chloronaphthalene	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
2-Chlorophenol	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
2-Methylnaphthalene	420 - 2,000	2 / 8	140	SJS04-SD03-000	70.0	1 / 8	2.00	YES
2-Methylphenol	420 - 2,000	0 / 8	--	--	63.0	-- / --	31.7	YES
2-Nitroaniline	1,000 - 5,100	0 / 8	--	--	NSV	-- / --	NSV	YES
2-Nitrophenol	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
3,3'-Dichlorobenzidine	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
3-Nitroaniline	1,000 - 5,100	0 / 8	--	--	NSV	-- / --	NSV	YES
4,6-Dinitro-2-methylphenol	1,000 - 5,100	0 / 8	--	--	NSV	-- / --	NSV	YES
4-Bromophenyl-phenylether	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
4-Chloro-3-methylphenol	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
4-Chloroaniline	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
4-Chlorophenyl-phenylether	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
4-Methylphenol	420 - 2,000	0 / 8	--	--	670	-- / --	2.99	YES
4-Nitroaniline	1,000 - 5,100	0 / 8	--	--	NSV	-- / --	NSV	YES
4-Nitrophenol	1,000 - 5,100	0 / 8	--	--	NSV	-- / --	NSV	YES
Acenaphthene	420 - 2,000	0 / 8	--	--	16.0	-- / --	125	YES
Acenaphthylene	420 - 2,000	2 / 8	70.0	SJS04-SD04-000	44.0	2 / 8	1.59	YES
Anthracene	420 - 2,000	3 / 9	200	SJS04-SD04-000	85.3	2 / 9	2.34	YES
Benzo(a)anthracene	420 - 2,000	8 / 9	1,300	SJS04-SD04-000	261	6 / 9	4.98	YES
Benzo(a)pyrene	420 - 2,000	8 / 9	1,200	SJS04-SD04-000	430	2 / 9	2.79	YES
Benzo(b)fluoranthene	420 - 2,000	8 / 9	1,900	SJS04-SD04-000	3,200	0 / 9	0.59	NO
Benzo(g,h,i)perylene	420 - 2,000	7 / 9	340	SJS04-SD06-001	670	0 / 9	0.51	NO
Benzo(k)fluoranthene	420 - 2,000	7 / 9	1,100	SJS04-SD04-000	240	5 / 9	4.58	YES
Butylbenzylphthalate	420 - 2,000	1 / 8	58.0	SJS04-SD04-000	63.0	0 / 8	0.92	NO
Carbazole	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
Chrysene	420 - 2,000	8 / 9	1,200	SJS04-SD04-000	384	6 / 9	3.13	YES
Di-n-butylphthalate	420 - 2,000	2 / 8	67.0	SJS04-SD03-000	1,400	0 / 8	0.048	NO
Di-n-octylphthalate	420 - 2,000	1 / 9	120	SJS04-SD09-001	6,200	0 / 9	0.019	NO
Dibenz(a,h)anthracene	420 - 2,000	4 / 9	150	SJS04-SD04-000	63.4	4 / 9	2.37	YES
Dibenzofuran	420 - 2,000	1 / 8	63.0	SJS04-SD03-000	540	0 / 8	0.12	NO
Diethylphthalate	420 - 2,000	1 / 8	300	SJS04-SD02-000	200	1 / 8	1.50	YES
Dimethyl phthalate	420 - 2,000	0 / 8	--	--	71.0	-- / --	28.2	YES
Fluoranthene	420 - 2,000	8 / 9	2,800	SJS04-SD04-000	600	3 / 9	4.67	YES
Fluorene	420 - 2,000	0 / 8	--	--	19.0	-- / --	105	YES
Hexachlorobenzene	420 - 2,000	0 / 8	--	--	22.0	-- / --	90.9	YES
Hexachlorobutadiene	420 - 2,000	0 / 8	--	--	11.0	-- / --	182	YES
Hexachlorocyclopentadiene	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
Hexachloroethane	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
Indeno(1,2,3-cd)pyrene	420 - 2,000	7 / 9	370	SJS04-SD04-000	600	0 / 9	0.62	NO
Isophorone	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
Naphthalene	420 - 2,000	3 / 8	100	SJS04-SD03-000	160	0 / 8	0.63	NO
Nitrobenzene	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
Pentachlorophenol	1,000 - 5,100	0 / 8	--	--	360	-- / --	14.2	YES
Phenanthrene	420 - 2,000	7 / 9	400	SJS04-SD02-000	240	3 / 9	1.67	YES
Phenol	420 - 2,000	0 / 8	--	--	420	-- / --	4.76	YES
Pyrene	420 - 2,000	8 / 9	2,800	SJS04-SD04-000	665	2 / 9	4.21	YES
bis(2-Chloroethoxy)methane	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
bis(2-Chloroethyl)ether	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
bis(2-Ethylhexyl)phthalate	160 - 2,000	1 / 9	140	SJS04-SD09-001	1,300	0 / 9	0.11	NO
n-Nitroso-di-n-propylamine	420 - 2,000	0 / 8	--	--	NSV	-- / --	NSV	YES
n-Nitrosodiphenylamine	420 - 2,000	0 / 8	--	--	28.0	-- / --	71.4	YES
Volatile Organic Compounds (UG/KG)					0	0		
1,1,1-Trichloroethane	10.0 - 31.0	0 / 9	--	--	31.0	-- / --	1.00	YES
1,1,2,2-Tetrachloroethane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
1,1,2-Trichloroethane	10.0 - 31.0	0 / 9	--	--	31.0	-- / --	1.00	YES
1,1-Dichloroethane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
1,1-Dichloroethene	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
1,2-Dichloroethane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
1,2-Dichloroethene (total)	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
1,2-Dichloropropane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
2-Butanone	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
2-Hexanone	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
4-Methyl-2-pentanone	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-19
Ecological Screening Statistics - Sediment - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
Acetone	10.0 - 31.0	5 / 9	140	SJS04-SD04-000	NSV	-- / --	NSV	YES
Benzene	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Bromodichloromethane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Bromoform	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Bromomethane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Carbon disulfide	10.0 - 31.0	4 / 9	19.0	SJS04-SD04-000	NSV	-- / --	NSV	YES
Carbon tetrachloride	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Chlorobenzene	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Chloroethane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Chloroform	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Chloromethane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Dibromochloromethane	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Ethylbenzene	10.0 - 31.0	0 / 9	--	--	10.0	-- / --	3.10	YES
Methylene chloride	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Styrene	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Tetrachloroethene	10.0 - 31.0	0 / 9	--	--	57.0	-- / --	0.54	NO
Toluene	10.0 - 31.0	2 / 9	15.0	SJS04-SD08-001	NSV	-- / --	NSV	YES
Trichloroethene	10.0 - 31.0	0 / 9	--	--	41.0	-- / --	0.76	NO
Vinyl chloride	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
Xylene, total	10.0 - 31.0	0 / 9	--	--	40.0	-- / --	0.78	NO
cis-1,3-Dichloropropene	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES
trans-1,3-Dichloropropene	10.0 - 31.0	0 / 9	--	--	NSV	-- / --	NSV	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-20
Ecological Screening Statistics - Surface Water - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
Inorganics (UG/L)								
Aluminum	18.7 - 38.2	7 / 7	2,180	SJS04-SW08-001	87.0	7 / 7	25.1	YES
Antimony	2.70 - 2.80	1 / 7	3.00	SJS04-SW09-001	30.0	0 / 7	0.10	NO
Arsenic	2.00 - 3.60	4 / 7	9.00	SJS04-SW03-001	36.0	0 / 7	0.25	NO
Barium	0.20 - 0.30	7 / 7	356	SJS04-SW07-001	1,000	0 / 7	0.36	NO
Beryllium	0.10 - 0.20	3 / 7	0.58	SJS04-SW01-001	5.30	0 / 7	0.11	NO
Cadmium	0.30 - 0.30	4 / 7	1.00	SJS04-SW07-001	0.83	1 / 7	1.21	YES
Calcium [2]	31.1 - 57.9	7 / 7	317,000	SJS04-SW07-001	NSV	-- / --	NSV	NO
Chromium	0.60 - 1.10	3 / 7	3.00	SJS04-SW08-001	11.4	0 / 7	0.26	NO
Cobalt	0.50 - 0.80	6 / 7	22.9	SJS04-SW01-001	23.0	0 / 7	0.996	NO
Copper	0.80 - 1.10	6 / 7	65.3	SJS04-SW07-001	2.85	6 / 7	22.9	YES
Cyanide	5.00 - 5.00	4 / 7	29.3	SJS04-SW02-001	1.00	4 / 7	29.3	YES
Iron	17.2 - 30.8	7 / 7	12,800	SJS04-SW07-001	320	7 / 7	40.0	YES
Lead	1.00 - 1.40	6 / 7	51.9	SJS04-SW07-001	0.54	6 / 7	95.3	YES
Magnesium [2]	24.3 - 243	7 / 7	545,000	SJS04-SW06-001	NSV	-- / --	NSV	NO
Manganese	0.30 - 0.40	7 / 7	2,310	SJS04-SW01-001	10.0	7 / 7	231	YES
Mercury	0.10 - 0.10	2 / 7	0.37	SJS04-SW07-001	0.91	0 / 7	0.41	NO
Nickel	0.90 - 0.90	7 / 7	34.8	SJS04-SW01-001	8.30	2 / 7	4.19	YES
Potassium [2]	13.5 - 167	7 / 7	202,000	SJS04-SW06-001	NSV	-- / --	NSV	NO
Selenium	2.60 - 3.10	0 / 7	--	--	5.00	-- / --	0.62	NO
Silver	0.70 - 0.90	1 / 7	1.10	SJS04-SW09-001	0.23	1 / 7	4.78	YES
Sodium [2]	148 - 2,040	7 / 7	4,620,000	SJS04-SW06-001	NSV	-- / --	NSV	NO
Thallium	3.20 - 5.20	0 / 7	--	--	40.0	-- / --	0.13	NO
Vanadium	0.60 - 0.70	5 / 7	10.1	SJS04-SW03-001	10,000	0 / 7	0.001	NO
Zinc	0.70 - 1.90	7 / 7	224	SJS04-SW07-001	37.0	4 / 7	6.05	YES
Pesticide/Polychlorinated Biphenyls (UG/L)								
4,4'-DDD	0.11 - 0.12	0 / 7	--	--	0.025	-- / --	4.80	YES
4,4'-DDE	0.11 - 0.12	0 / 7	--	--	1.40	-- / --	0.09	NO
4,4'-DDT	0.11 - 0.12	0 / 7	--	--	0.0010	-- / --	120	YES
Aldrin	0.054 - 0.060	0 / 7	--	--	0.13	-- / --	0.46	NO
Aroclor-1016	1.10 - 1.20	0 / 7	--	--	0.014	-- / --	85.7	YES
Aroclor-1221	2.20 - 2.40	0 / 7	--	--	0.030	-- / --	80.0	YES
Aroclor-1232	1.10 - 1.20	0 / 7	--	--	0.030	-- / --	40.0	YES
Aroclor-1242	1.10 - 1.20	0 / 7	--	--	0.030	-- / --	40.0	YES
Aroclor-1248	1.10 - 1.20	0 / 7	--	--	0.030	-- / --	40.0	YES
Aroclor-1254	1.10 - 1.20	0 / 7	--	--	0.030	-- / --	40.0	YES
Aroclor-1260	1.10 - 1.20	0 / 7	--	--	0.030	-- / --	40.0	YES
Dieldrin	0.11 - 0.12	0 / 7	--	--	0.0019	-- / --	63.2	YES
Endosulfan I	0.054 - 0.060	0 / 7	--	--	0.0087	-- / --	6.90	YES
Endosulfan II	0.11 - 0.12	0 / 7	--	--	0.0087	-- / --	13.8	YES
Endosulfan sulfate	0.11 - 0.12	0 / 7	--	--	0.0087	-- / --	13.8	YES
Endrin	0.11 - 0.12	0 / 7	--	--	0.0023	-- / --	52.2	YES
Endrin aldehyde	0.11 - 0.12	0 / 7	--	--	0.0023	-- / --	52.2	YES
Endrin ketone	0.11 - 0.12	0 / 7	--	--	0.0023	-- / --	52.2	YES
Heptachlor	0.054 - 0.060	0 / 7	--	--	0.0036	-- / --	16.7	YES
Heptachlor epoxide	0.054 - 0.060	0 / 7	--	--	0.0036	-- / --	16.7	YES
Methoxychlor	0.54 - 0.60	0 / 7	--	--	0.030	-- / --	20.0	YES
Toxaphene	5.40 - 6.00	0 / 7	--	--	0.011	-- / --	545	YES
alpha-BHC	0.054 - 0.060	0 / 7	--	--	0.034	-- / --	1.76	YES
alpha-Chlordane	0.054 - 0.060	0 / 7	--	--	0.0040	-- / --	15.0	YES
beta-BHC	0.054 - 0.060	0 / 7	--	--	0.034	-- / --	1.76	YES
delta-BHC	0.054 - 0.060	0 / 7	--	--	0.034	-- / --	1.76	YES
gamma-BHC (Lindane)	0.054 - 0.060	0 / 7	--	--	0.016	-- / --	3.75	YES
gamma-Chlordane	0.054 - 0.060	0 / 7	--	--	0.0040	-- / --	15.0	YES
Semivolatile Organic Compounds (UG/L)								
1,2,4-Trichlorobenzene	10.0 - 12.0	0 / 7	--	--	50.0	-- / --	0.24	NO
1,2-Dichlorobenzene	10.0 - 12.0	0 / 7	--	--	129	-- / --	0.09	NO
1,3-Dichlorobenzene	10.0 - 12.0	0 / 7	--	--	28.5	-- / --	0.42	NO
1,4-Dichlorobenzene	10.0 - 12.0	0 / 7	--	--	129	-- / --	0.09	NO
2,2'-Oxybis(1-chloropropane)	10.0 - 12.0	0 / 7	--	--	NSV	-- / --	NSV	YES
2,4,5-Trichlorophenol	26.0 - 29.0	0 / 7	--	--	11.0	-- / --	2.64	YES
2,4,6-Trichlorophenol	10.0 - 12.0	0 / 7	--	--	970	-- / --	0.012	NO
2,4-Dichlorophenol	10.0 - 12.0	0 / 7	--	--	365	-- / --	0.033	NO
2,4-Dimethylphenol	10.0 - 12.0	0 / 7	--	--	110	-- / --	0.11	NO
2,4-Dinitrophenol	26.0 - 29.0	0 / 7	--	--	150	-- / --	0.19	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-20
Ecological Screening Statistics - Surface Water - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
2,4-Dinitrotoluene	10.0 - 12.0	0 / 7	--	--	230	-- / --	0.052	NO
2,6-Dinitrotoluene	10.0 - 12.0	0 / 7	--	--	NSV	-- / --	NSV	YES
2-Chloronaphthalene	10.0 - 12.0	0 / 7	--	--	0.75	-- / --	16.0	YES
2-Chlorophenol	10.0 - 12.0	0 / 7	--	--	97.0	-- / --	0.12	NO
2-Methylnaphthalene	10.0 - 12.0	0 / 7	--	--	30.0	-- / --	0.40	NO
2-Methylphenol	10.0 - 12.0	0 / 7	--	--	13.0	-- / --	0.92	NO
2-Nitroaniline	26.0 - 29.0	0 / 7	--	--	NSV	-- / --	NSV	YES
2-Nitrophenol	10.0 - 12.0	0 / 7	--	--	150	-- / --	0.080	NO
3,3'-Dichlorobenzidine	10.0 - 12.0	0 / 7	--	--	NSV	-- / --	NSV	YES
3-Nitroaniline	26.0 - 29.0	0 / 7	--	--	NSV	-- / --	NSV	YES
4,6-Dinitro-2-methylphenol	26.0 - 29.0	0 / 7	--	--	2.30	-- / --	12.6	YES
4-Bromophenyl-phenylether	10.0 - 12.0	0 / 7	--	--	1.50	-- / --	8.00	YES
4-Chloro-3-methylphenol	10.0 - 12.0	0 / 7	--	--	0.30	-- / --	40.0	YES
4-Chloroaniline	10.0 - 12.0	0 / 7	--	--	50.0	-- / --	0.24	NO
4-Chlorophenyl-phenylether	10.0 - 12.0	0 / 7	--	--	NSV	-- / --	NSV	YES
4-Methylphenol	10.0 - 12.0	0 / 7	--	--	NSV	-- / --	NSV	YES
4-Nitroaniline	26.0 - 29.0	0 / 7	--	--	NSV	-- / --	NSV	YES
4-Nitrophenol	26.0 - 29.0	0 / 7	--	--	150	-- / --	0.19	NO
Acenaphthene	10.0 - 12.0	1 / 7	2.00	SJS04-SW07-001	520	0 / 7	0.0038	NO
Acenaphthylene	10.0 - 12.0	0 / 7	--	--	30.0	-- / --	0.40	NO
Anthracene	10.0 - 12.0	0 / 7	--	--	0.73	-- / --	16.4	YES
Benzo(a)anthracene	10.0 - 12.0	0 / 7	--	--	6.30	-- / --	1.90	YES
Benzo(a)pyrene	10.0 - 12.0	0 / 7	--	--	0.014	-- / --	857	YES
Benzo(b)fluoranthene	10.0 - 12.0	0 / 7	--	--	30.0	-- / --	0.40	NO
Benzo(g,h,i)perylene	10.0 - 12.0	1 / 7	3.00	SJS04-SW09-001	30.0	0 / 7	0.10	NO
Benzo(k)fluoranthene	10.0 - 12.0	0 / 7	--	--	30.0	-- / --	0.40	NO
Butylbenzylphthalate	10.0 - 12.0	0 / 7	--	--	22.0	-- / --	0.55	NO
Carbazole	10.0 - 12.0	0 / 7	--	--	NSV	-- / --	NSV	YES
Chrysene	10.0 - 12.0	0 / 7	--	--	30.0	-- / --	0.40	NO
Di-n-butylphthalate	10.0 - 12.0	0 / 7	--	--	3.40	-- / --	3.53	YES
Di-n-octylphthalate	10.0 - 12.0	0 / 7	--	--	3.00	-- / --	4.00	YES
Dibenz(a,h)anthracene	10.0 - 12.0	1 / 7	3.00	SJS04-SW09-001	30.0	0 / 7	0.10	NO
Dibenzofuran	10.0 - 12.0	0 / 7	--	--	20.0	-- / --	0.60	NO
Diethylphthalate	10.0 - 12.0	0 / 7	--	--	75.9	-- / --	0.16	NO
Dimethyl phthalate	10.0 - 12.0	0 / 7	--	--	330	-- / --	0.04	NO
Fluoranthene	10.0 - 12.0	0 / 7	--	--	16.0	-- / --	0.75	NO
Fluorene	10.0 - 12.0	0 / 7	--	--	30.0	-- / --	0.40	NO
Hexachlorobenzene	10.0 - 12.0	0 / 7	--	--	3.68	-- / --	3.26	YES
Hexachlorobutadiene	10.0 - 12.0	0 / 7	--	--	3.20	-- / --	3.75	YES
Hexachlorocyclopentadiene	10.0 - 12.0	0 / 7	--	--	0.70	-- / --	17.1	YES
Hexachloroethane	10.0 - 12.0	0 / 7	--	--	94.0	-- / --	0.13	NO
Indeno(1,2,3-cd)pyrene	10.0 - 12.0	1 / 7	2.00	SJS04-SW09-001	30.0	0 / 7	0.07	NO
Isophorone	10.0 - 12.0	0 / 7	--	--	1,290	-- / --	0.01	NO
Naphthalene	10.0 - 12.0	0 / 7	--	--	100	-- / --	0.12	NO
Nitrobenzene	10.0 - 12.0	0 / 7	--	--	668	-- / --	0.02	NO
Pentachlorophenol	26.0 - 29.0	0 / 7	--	--	6.69	-- / --	4.33	YES
Phenanthrene	10.0 - 12.0	0 / 7	--	--	4.60	-- / --	2.61	YES
Phenol	10.0 - 12.0	0 / 7	--	--	256	-- / --	0.05	NO
Pyrene	10.0 - 12.0	0 / 7	--	--	30.0	-- / --	0.40	NO
bis(2-Chloroethoxy)methane	10.0 - 12.0	0 / 7	--	--	1,100	-- / --	0.01	NO
bis(2-Chloroethyl)ether	10.0 - 12.0	0 / 7	--	--	2,380	-- / --	0.01	NO
bis(2-Ethylhexyl)phthalate	10.0 - 12.0	0 / 7	--	--	30.0	-- / --	0.40	NO
n-Nitroso-di-n-propylamine	10.0 - 12.0	0 / 7	--	--	NSV	-- / --	NSV	YES
n-Nitrosodiphenylamine	10.0 - 12.0	0 / 7	--	--	585	-- / --	0.02	NO
Volatile Organic Compounds (UG/L)								
1,1,1-Trichloroethane	1.00 - 1.00	0 / 7	--	--	3,120	-- / --	3.21E-04	NO
1,1,2,2-Tetrachloroethane	1.00 - 1.00	0 / 7	--	--	623	-- / --	0.002	NO
1,1,2-Trichloroethane	1.00 - 1.00	0 / 7	--	--	3,120	-- / --	3.21E-04	NO
1,1-Dichloroethane	1.00 - 1.00	0 / 7	--	--	1,600	-- / --	6.25E-04	NO
1,1-Dichloroethene	1.00 - 1.00	0 / 7	--	--	1,160	-- / --	8.62E-04	NO
1,2,4-Trichlorobenzene	1.00 - 1.00	0 / 7	--	--	50.0	-- / --	0.02	NO
1,2-Dibromo-3-chloropropane	1.00 - 1.00	0 / 7	--	--	NSV	-- / --	NSV	YES
1,2-Dibromoethane	1.00 - 1.00	0 / 7	--	--	180	-- / --	0.01	NO
1,2-Dichlorobenzene	1.00 - 1.00	0 / 7	--	--	129	-- / --	0.01	NO
1,2-Dichloroethane	1.00 - 1.00	0 / 7	--	--	1,130	-- / --	8.85E-04	NO
1,2-Dichloropropane	1.00 - 1.00	0 / 7	--	--	3,040	-- / --	3.29E-04	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-20
Ecological Screening Statistics - Surface Water - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient[1]	HQ>1?
1,3-Dichlorobenzene	1.00 - 1.00	0 / 7	--	--	28.5	-- / --	0.04	NO
1,4-Dichlorobenzene	1.00 - 1.00	0 / 7	--	--	129	-- / --	0.01	NO
2-Butanone	5.00 - 5.00	0 / 6	--	--	14,000	-- / --	3.57E-04	NO
2-Hexanone	5.00 - 5.00	0 / 7	--	--	4,280	-- / --	0.001	NO
4-Methyl-2-pentanone	5.00 - 5.00	0 / 7	--	--	4,600	-- / --	0.001	NO
Acetone	5.00 - 5.00	0 / 6	--	--	90,000	-- / --	5.56E-05	NO
Benzene	1.00 - 1.00	0 / 7	--	--	530	-- / --	0.002	NO
Bromochloromethane	1.00 - 1.00	0 / 7	--	--	1,100	-- / --	9.09E-04	NO
Bromodichloromethane	1.00 - 1.00	0 / 7	--	--	1,100	-- / --	9.09E-04	NO
Bromoform	1.00 - 1.00	0 / 7	--	--	320	-- / --	0.003	NO
Bromomethane	1.00 - 1.00	0 / 7	--	--	110	-- / --	0.01	NO
Carbon disulfide	1.00 - 1.00	3 / 7	13.5	SJS04-SW01-001	2.00	2 / 7	6.75	YES
Carbon tetrachloride	1.00 - 1.00	0 / 7	--	--	3,520	-- / --	2.84E-04	NO
Chlorobenzene	1.00 - 1.00	0 / 7	--	--	105	-- / --	0.01	NO
Chloroethane	1.00 - 1.00	0 / 7	--	--	NSV	-- / --	NSV	YES
Chloroform	1.00 - 1.00	0 / 7	--	--	815	-- / --	0.001	NO
Chloromethane	1.00 - 1.00	0 / 7	--	--	2,700	-- / --	3.70E-04	NO
Dibromochloromethane	1.00 - 1.00	0 / 7	--	--	1,100	-- / --	9.09E-04	NO
Ethylbenzene	1.00 - 1.00	0 / 7	--	--	43.0	-- / --	0.02	NO
Methylene chloride	2.00 - 2.00	0 / 7	--	--	2,200	-- / --	9.09E-04	NO
Styrene	1.00 - 1.00	0 / 7	--	--	NSV	-- / --	NSV	YES
Tetrachloroethene	1.00 - 1.00	0 / 7	--	--	450	-- / --	0.002	NO
Toluene	1.00 - 1.00	0 / 7	--	--	37.0	-- / --	0.03	NO
Trichloroethene	1.00 - 1.00	0 / 7	--	--	200	-- / --	0.01	NO
Vinyl chloride	1.00 - 1.00	0 / 7	--	--	1,160	-- / --	8.62E-04	NO
Xylene, total	1.00 - 1.00	0 / 7	--	--	130	-- / --	0.01	NO
cis-1,2-Dichloroethene	1.00 - 1.00	0 / 7	--	--	1,160	-- / --	8.62E-04	NO
cis-1,3-Dichloropropene	1.00 - 1.00	0 / 7	--	--	79.0	-- / --	0.01	NO
trans-1,2-Dichloroethene	1.00 - 1.00	0 / 7	--	--	1,160	-- / --	8.62E-04	NO
trans-1,3-Dichloropropene	1.00 - 1.00	0 / 7	--	--	79.0	-- / --	0.01	NO

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits
2 - Macronutrient - Not considered to be a COPC

Table 2-21
Ecological Screening Statistics - Surface Soil - Mean Concentration
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Mean Hazard Quotient[1]	HQ>1?
Inorganics (MG/KG)									
Aluminum	6.75 - 12.5	18 / 18	17,800	SJS04-SS01-000	8,558	50.0	18 / 18	171	YES
Antimony	0.31 - 0.88	11 / 17	18.5	SJS04-SS11-000	2.47	5.00	2 / 17	0.49	NO
Barium	0.040 - 0.43	18 / 18	991	SJS04-SS11-000	137	500	1 / 18	0.27	NO
Cadmium	0.060 - 0.11	12 / 18	9.70	SJS04-SS11-000	0.80	4.00	1 / 18	0.20	NO
Chromium	0.23 - 1.52	18 / 18	680	SJS04-SS05-000	65.8	0.40	18 / 18	164	YES
Copper	0.23 - 1.30	18 / 18	874	SJS04-SS11-000	189	50.0	12 / 18	3.79	YES
Cyanide	0.26 - 0.63	0 / 18	--	--	0.21	0.060	-- / --	3.57	(YES)
Iron	2.61 - 10.1	18 / 18	65,100	SJS04-SS11-000	22,059	200	18 / 18	110	YES
Lead	0.15 - 0.33	18 / 18	1,110	SJS04-SS11-000	204	50.0	17 / 18	4.07	YES
Manganese	0.060 - 0.43	18 / 18	883	SJS04-SS11-000	209	330	3 / 18	0.63	NO
Mercury	0.0100 - 0.060	17 / 18	1.30	SJS04-SS06-000	0.60	0.10	16 / 18	6.01	YES
Nickel	0.19 - 1.52	18 / 18	546	SJS04-SS05-000	61.9	30.0	5 / 18	2.06	YES
Silver	0.15 - 0.29	3 / 18	2.20	SJS04-SS11-000	0.42	2.00	1 / 18	0.21	NO
Thallium	0.31 - 1.00	3 / 18	3.40	SJS04-SS01-000	0.64	1.00	1 / 18	0.64	NO
Vanadium	0.13 - 1.95	18 / 18	354	SJS04-SS04-000	64.6	2.00	18 / 18	32.3	YES
Zinc	0.40 - 1.09	18 / 18	3,880	SJS04-SS11-000	468	50.0	17 / 18	9.37	YES
Pesticide/Polychlorinated Biphenyls (UG/KG)									
Aroclor-1016	33.0 - 210	0 / 18	--	--	29.5	100	-- / --	0.29	NO
Aroclor-1221	67.0 - 430	0 / 18	--	--	59.7	100	-- / --	0.60	NO
Aroclor-1232	33.0 - 210	0 / 18	--	--	29.5	100	-- / --	0.29	NO
Aroclor-1242	33.0 - 210	0 / 18	--	--	29.5	100	-- / --	0.29	NO
Aroclor-1248	33.0 - 210	0 / 18	--	--	29.5	100	-- / --	0.29	NO
Aroclor-1260	33.0 - 1,700	6 / 18	6,300	SJS04-SS08-000	386	100	2 / 18	3.86	YES
Endrin aldehyde	3.30 - 21.0	1 / 18	160	SJS04-SS08-000	11.4	100	1 / 18	0.11	NO
Methoxychlor	17.0 - 110	0 / 18	--	--	15.1	100	-- / --	0.15	NO
Semivolatile Organic Compounds (UG/KG)									
1,2,4-Trichlorobenzene	340 - 40,000	0 / 18	--	--	1,548	1,270	-- / --	1.22	(YES)
1,2-Dichlorobenzene	340 - 40,000	0 / 18	--	--	1,548	100	-- / --	15.5	(YES)
1,4-Dichlorobenzene	340 - 40,000	0 / 18	--	--	1,548	1,280	-- / --	1.21	(YES)
2,4,5-Trichlorophenol	840 - 100,000	0 / 18	--	--	3,875	430	-- / --	9.01	(YES)
2,4,6-Trichlorophenol	340 - 40,000	0 / 18	--	--	1,548	580	-- / --	2.67	(YES)
2,4-Dichlorophenol	340 - 40,000	0 / 18	--	--	1,548	13,400	-- / --	0.12	NO
2,4-Dimethylphenol	340 - 40,000	0 / 18	--	--	1,548	100	-- / --	15.5	(YES)
2,4-Dinitrophenol	840 - 100,000	0 / 15	--	--	4,220	20,000	-- / --	0.21	NO
2-Chloronaphthalene	340 - 40,000	0 / 18	--	--	1,548	1,033	-- / --	1.50	(YES)
2-Chlorophenol	340 - 40,000	0 / 18	--	--	1,548	100	-- / --	15.5	(YES)
2-Methylnaphthalene	340 - 40,000	1 / 18	200	SJS04-SS11-000	1,540	NSV	-- / --	NSV	YES
2-Methylphenol	340 - 40,000	0 / 18	--	--	1,548	100	-- / --	15.5	(YES)
4-Methylphenol	340 - 40,000	0 / 18	--	--	1,548	100	-- / --	15.5	(YES)
4-Nitrophenol	840 - 100,000	0 / 18	--	--	3,875	380	-- / --	10.2	(YES)
Acenaphthylene	340 - 40,000	5 / 18	130	SJS04-SS18-000	1,508	100	1 / 18	1.30	YES
Anthracene	340 - 40,000	9 / 18	950	SJS04-SS11-000	1,493	100	4 / 18	9.50	YES
Benzo(a)anthracene	340 - 40,000	17 / 18	3,000	SJS04-SS11-000	1,659	100	15 / 18	16.6	YES
Benzo(a)pyrene	340 - 40,000	17 / 18	2,300	SJS04-SS11-000	1,551	100	15 / 18	15.5	YES
Benzo(b)fluoranthene	340 - 40,000	17 / 18	3,000	SJS04-SS11-000	1,969	100	15 / 18	19.7	YES
Benzo(g,h,i)perylene	340 - 40,000	15 / 18	1,400	SJS04-SS11-000	1,547	100	12 / 18	14.0	YES
Benzo(k)fluoranthene	340 - 40,000	14 / 18	820	SJS04-SS01-000	1,518	100	12 / 18	8.20	YES
Butylbenzylphthalate	340 - 40,000	1 / 18	35.0	SJS04-SS07-000	1,540	NSV	-- / --	NSV	YES
Carbazole	340 - 40,000	3 / 18	300	SJS04-SS05-000	1,494	NSV	-- / --	NSV	YES
Chrysene	340 - 40,000	16 / 18	2,900	SJS04-SS11-000	1,802	100	15 / 18	18.0	YES
Dibenz(a,h)anthracene	340 - 40,000	2 / 18	320	SJS04-SS11-000	1,548	100	2 / 18	3.20	YES
Dibenzofuran	340 - 40,000	2 / 18	190	SJS04-SS11-000	1,530	NSV	-- / --	NSV	YES
Dimethyl phthalate	340 - 40,000	0 / 18	--	--	1,548	10,640	-- / --	0.15	NO
Fluoranthene	340 - 40,000	17 / 18	4,000	SJS04-SS11-000	1,983	100	15 / 18	19.8	YES
Hexachlorocyclopentadiene	340 - 40,000	0 / 18	--	--	1,548	1,000	-- / --	1.55	(YES)
Indeno(1,2,3-cd)pyrene	340 - 40,000	15 / 18	1,100	SJS04-SS11-000	1,536	100	12 / 18	11.0	YES
Naphthalene	340 - 40,000	2 / 18	250	SJS04-SS11-000	1,535	100	1 / 18	2.50	YES
Nitrobenzene	340 - 40,000	0 / 18	--	--	1,548	2,260	-- / --	0.68	NO
Pentachlorophenol	840 - 100,000	0 / 18	--	--	3,875	3,000	-- / --	1.29	(YES)
Phenanthrene	340 - 40,000	15 / 18	6,300	SJS04-SS11-000	1,838	100	11 / 18	18.4	YES
Phenol	340 - 40,000	0 / 18	--	--	1,548	1,880	-- / --	0.82	NO
Pyrene	340 - 40,000	16 / 18	7,500	SJS04-SS11-000	2,119	100	14 / 18	21.2	YES
bis(2-Ethylhexyl)phthalate	340 - 40,000	3 / 18	110	SJS04-SS11-000	4,503	NSV	-- / --	NSV	YES
n-Nitrosodiphenylamine	340 - 40,000	0 / 18	--	--	1,548	1,090	-- / --	1.42	(YES)
Volatile Organic Compounds (UG/KG)									
2-Butanone	10.0 - 17.0	2 / 18	28.0	SJS04-SS04-000	8.14	NSV	-- / --	NSV	YES
Acetone	10.0 - 17.0	12 / 18	79.0	SJS04-SS08-000	19.6	NSV	-- / --	NSV	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits

Table 2-22
Ecological Screening Statistics - Sediment - Mean Concentration
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Mean Hazard Quotient[1]	HQ>1?
Inorganics (MG/KG)									
Aluminum	5.30 - 29.4	9 / 9	22,100	SJS04-SD04-000	13,664	18,000	2 / 9	0.76	NO
Arsenic	0.60 - 2.01	9 / 9	33.1	SJS04-SD03-000	14.1	8.20	7 / 9	1.72	YES
Barium	0.060 - 1.34	9 / 9	903	SJS04-SD07-001	198	48.0	7 / 9	4.12	YES
Beryllium	0.030 - 0.67	9 / 9	3.90	SJS04-SD01-000	1.74	NSV	-- / --	NSV	YES
Cadmium	0.080 - 0.33	7 / 9	2.00	SJS04-SD08-001	0.76	1.20	3 / 9	0.64	NO
Cobalt	0.16 - 5.35	9 / 9	32.7	SJS04-SD05-001	14.5	10.0	5 / 9	1.45	YES
Copper	0.23 - 4.01	9 / 9	387	SJS04-SD03-000	111	34.0	8 / 9	3.26	YES
Cyanide	0.40 - 1.70	1 / 9	2.90	SJS04-SD08-001	0.64	0.10	1 / 9	6.38	YES
Lead	0.20 - 0.67	9 / 9	441	SJS04-SD03-000	171	46.7	8 / 9	3.65	YES
Manganese	0.10 - 1.34	9 / 9	877	SJS04-SD03-000	297	260	3 / 9	1.14	YES
Mercury	0.030 - 0.15	9 / 9	6.40	SJS04-SD03-000	1.23	0.15	8 / 9	8.23	YES
Nickel	0.25 - 4.68	9 / 9	43.9	SJS04-SD03-000	25.1	20.9	4 / 9	1.20	YES
Selenium	0.60 - 2.01	5 / 9	1.60	SJS04-SD07-001	0.97	1.00	4 / 9	0.97	NO
Silver	0.20 - 0.67	4 / 9	1.00	SJS04-SD03-000	0.38	1.00	0 / 9	0.38	NO
Thallium	0.40 - 1.50	1 / 9	0.46	SJS04-SD02-000	0.54	NSV	-- / --	NSV	YES
Vanadium	0.19 - 6.02	9 / 9	88.5	SJS04-SD03-000	39.2	57.0	1 / 9	0.69	NO
Zinc	0.20 - 3.34	9 / 9	624	SJS04-SD03-000	354	150	8 / 9	2.36	YES
Pesticide/Polychlorinated Biphenyls (UG/KG)									
4,4'-DDD	4.00 - 42.0	7 / 9	220	SJS04-SD01-000	33.7	16.0	2 / 9	2.11	YES
4,4'-DDE	4.00 - 10.0	7 / 9	31.0	SJS04-SD01-000	9.39	2.20	5 / 9	4.27	YES
4,4'-DDT	4.00 - 10.0	3 / 9	38.0	SJS04-SD01-000	7.78	1.58	3 / 9	4.92	YES
Aldrin	2.10 - 5.00	0 / 8	--	--	1.60	2.00	-- / --	0.80	NO
Aroclor-1016	40.0 - 100	0 / 8	--	--	31.5	22.7	-- / --	1.39	(YES)
Aroclor-1221	82.0 - 200	0 / 8	--	--	63.6	22.7	-- / --	2.80	(YES)
Aroclor-1232	40.0 - 100	0 / 8	--	--	31.5	22.7	-- / --	1.39	(YES)
Aroclor-1242	40.0 - 100	0 / 8	--	--	31.5	22.7	-- / --	1.39	(YES)
Aroclor-1248	40.0 - 100	0 / 8	--	--	31.5	22.7	-- / --	1.39	(YES)
Aroclor-1254	40.0 - 100	0 / 8	--	--	31.5	22.7	-- / --	1.39	(YES)
Aroclor-1260	40.0 - 100	4 / 8	90.0	SJS04-SD02-000	47.4	22.7	4 / 8	2.09	YES
Dieldrin	4.00 - 10.0	3 / 9	23.0	SJS04-SD02-000	5.55	0.72	2 / 9	7.77	YES
Endrin	4.00 - 10.0	0 / 8	--	--	3.15	0.020	-- / --	158	(YES)
Heptachlor	2.10 - 5.00	0 / 8	--	--	1.60	0.30	-- / --	5.33	(YES)
Heptachlor epoxide	2.10 - 5.00	0 / 8	--	--	1.60	5.00	-- / --	0.32	NO
alpha-Chlordane	2.10 - 5.00	0 / 8	--	--	1.60	0.50	-- / --	3.20	(YES)
beta-BHC	2.10 - 5.00	0 / 8	--	--	1.60	5.00	-- / --	0.32	NO
gamma-BHC (Lindane)	2.10 - 5.00	0 / 8	--	--	1.60	0.32	-- / --	5.00	(YES)
gamma-Chlordane	2.10 - 5.00	0 / 8	--	--	1.60	0.50	-- / --	3.20	(YES)
Semivolatile Organic Compounds (UG/KG)									
1,2,4-Trichlorobenzene	420 - 2,000	0 / 8	--	--	416	40.0	-- / --	10.4	(YES)
1,2-Dichlorobenzene	420 - 2,000	0 / 8	--	--	416	35.0	-- / --	11.9	(YES)
1,4-Dichlorobenzene	420 - 2,000	0 / 8	--	--	416	110	-- / --	3.78	(YES)
2,4-Dimethylphenol	420 - 2,000	0 / 8	--	--	416	29.0	-- / --	14.3	(YES)
2-Methylnaphthalene	420 - 2,000	2 / 8	140	SJS04-SD03-000	377	70.0	1 / 8	2.00	YES
2-Methylphenol	420 - 2,000	0 / 8	--	--	416	63.0	-- / --	6.60	(YES)
4-Methylphenol	420 - 2,000	0 / 8	--	--	416	670	-- / --	0.62	NO
Acenaphthene	420 - 2,000	0 / 8	--	--	416	16.0	-- / --	26.0	(YES)
Acenaphthylene	420 - 2,000	2 / 8	70.0	SJS04-SD04-000	369	44.0	2 / 8	1.59	YES
Anthracene	420 - 2,000	3 / 9	200	SJS04-SD04-000	355	85.3	2 / 9	2.34	YES
Benzo(a)anthracene	420 - 2,000	8 / 9	1,300	SJS04-SD04-000	449	261	6 / 9	1.72	YES
Benzo(a)pyrene	420 - 2,000	8 / 9	1,200	SJS04-SD04-000	407	430	2 / 9	0.95	NO
Benzo(k)fluoranthene	420 - 2,000	7 / 9	1,100	SJS04-SD04-000	384	240	5 / 9	1.60	YES
Chrysene	420 - 2,000	8 / 9	1,200	SJS04-SD04-000	496	384	6 / 9	1.29	YES
Dibenz(a,h)anthracene	420 - 2,000	4 / 9	150	SJS04-SD04-000	293	63.4	4 / 9	2.37	YES
Diethylphthalate	420 - 2,000	1 / 8	300	SJS04-SD02-000	328	200	1 / 8	1.50	YES
Dimethyl phthalate	420 - 2,000	0 / 8	--	--	416	71.0	-- / --	5.85	(YES)
Fluoranthene	420 - 2,000	8 / 9	2,800	SJS04-SD04-000	708	600	3 / 9	1.18	YES
Fluorene	420 - 2,000	0 / 8	--	--	416	19.0	-- / --	21.9	(YES)
Hexachlorobenzene	420 - 2,000	0 / 8	--	--	416	22.0	-- / --	18.9	(YES)
Hexachlorobutadiene	420 - 2,000	0 / 8	--	--	416	11.0	-- / --	37.8	(YES)
Pentachlorophenol	1,000 - 5,100	0 / 8	--	--	1,038	360	-- / --	2.88	(YES)
Phenanthrene	420 - 2,000	7 / 9	400	SJS04-SD02-000	251	240	3 / 9	1.05	YES
Phenol	420 - 2,000	0 / 8	--	--	416	420	-- / --	0.99	NO
Pyrene	420 - 2,000	8 / 9	2,800	SJS04-SD04-000	708	665	2 / 9	1.06	YES
n-Nitrosodiphenylamine	420 - 2,000	0 / 8	--	--	416	28.0	-- / --	14.8	(YES)
Volatile Organic Compounds (UG/KG)									
1,1,1-Trichloroethane	10.0 - 31.0	0 / 9	--	--	10.0	31.0	-- / --	0.32	NO
1,1,2-Trichloroethane	10.0 - 31.0	0 / 9	--	--	10.0	31.0	-- / --	0.32	NO
Acetone	10.0 - 31.0	5 / 9	140	SJS04-SD04-000	32.0	NSV	-- / --	NSV	YES
Carbon disulfide	10.0 - 31.0	4 / 9	19.0	SJS04-SD04-000	9.11	NSV	-- / --	NSV	YES
Ethylbenzene	10.0 - 31.0	0 / 9	--	--	10.0	10.0	-- / --	1.00	(YES)
Toluene	10.0 - 31.0	2 / 9	15.0	SJS04-SD08-001	9.33	NSV	-- / --	NSV	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits

Table 2-23
Ecological Screening Statistics - Surface Water - Mean Concentration
St. Juliens Creek Annex - Site 4

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Screening Value	Frequency of Exceedance	Mean Hazard Quotient[1]	HQ>1?
Inorganics (UG/L)									
Aluminum	18.7 - 38.2	7 / 7	2,180	SJS04-SW08-001	790	87.0	7 / 7	9.09	YES
Cadmium	0.30 - 0.30	4 / 7	1.00	SJS04-SW07-001	0.37	0.83	1 / 7	0.45	NO
Copper	0.80 - 1.10	6 / 7	65.3	SJS04-SW07-001	23.1	2.85	6 / 7	8.11	YES
Cyanide	5.00 - 5.00	4 / 7	29.3	SJS04-SW02-001	11.5	1.00	4 / 7	11.5	YES
Iron	17.2 - 30.8	7 / 7	12,800	SJS04-SW07-001	3,359	320	7 / 7	10.5	YES
Lead	1.00 - 1.40	6 / 7	51.9	SJS04-SW07-001	13.2	0.54	6 / 7	24.2	YES
Manganese	0.30 - 0.40	7 / 7	2,310	SJS04-SW01-001	703	10.0	7 / 7	70.3	YES
Nickel	0.90 - 0.90	7 / 7	34.8	SJS04-SW01-001	9.79	8.30	2 / 7	1.18	YES
Silver	0.70 - 0.90	1 / 7	1.10	SJS04-SW09-001	0.54	0.23	1 / 7	2.36	YES
Zinc	0.70 - 1.90	7 / 7	224	SJS04-SW07-001	104	37.0	4 / 7	2.80	YES
Pesticide/Polychlorinated Biphenyls (UG/L)									
4,4'-DDD	0.11 - 0.12	0 / 7	--	--	0.056	0.025	-- / --	2.23	(YES)
4,4'-DDT	0.11 - 0.12	0 / 7	--	--	0.056	0.0010	-- / --	55.7	(YES)
Aroclor-1016	1.10 - 1.20	0 / 7	--	--	0.56	0.014	-- / --	39.8	(YES)
Aroclor-1221	2.20 - 2.40	0 / 7	--	--	1.12	0.030	-- / --	37.4	(YES)
Aroclor-1232	1.10 - 1.20	0 / 7	--	--	0.56	0.030	-- / --	18.6	(YES)
Aroclor-1242	1.10 - 1.20	0 / 7	--	--	0.56	0.030	-- / --	18.6	(YES)
Aroclor-1248	1.10 - 1.20	0 / 7	--	--	0.56	0.030	-- / --	18.6	(YES)
Aroclor-1254	1.10 - 1.20	0 / 7	--	--	0.56	0.030	-- / --	18.6	(YES)
Aroclor-1260	1.10 - 1.20	0 / 7	--	--	0.56	0.030	-- / --	18.6	(YES)
Dieldrin	0.11 - 0.12	0 / 7	--	--	0.056	0.0019	-- / --	29.3	(YES)
Endosulfan I	0.054 - 0.060	0 / 7	--	--	0.028	0.0087	-- / --	3.24	(YES)
Endosulfan II	0.11 - 0.12	0 / 7	--	--	0.056	0.0087	-- / --	6.40	(YES)
Endosulfan sulfate	0.11 - 0.12	0 / 7	--	--	0.056	0.0087	-- / --	6.40	(YES)
Endrin	0.11 - 0.12	0 / 7	--	--	0.056	0.0023	-- / --	24.2	(YES)
Endrin aldehyde	0.11 - 0.12	0 / 7	--	--	0.056	0.0023	-- / --	24.2	(YES)
Endrin ketone	0.11 - 0.12	0 / 7	--	--	0.056	0.0023	-- / --	24.2	(YES)
Heptachlor	0.054 - 0.060	0 / 7	--	--	0.028	0.0036	-- / --	7.84	(YES)
Heptachlor epoxide	0.054 - 0.060	0 / 7	--	--	0.028	0.0036	-- / --	7.84	(YES)
Methoxychlor	0.54 - 0.60	0 / 7	--	--	0.28	0.030	-- / --	9.40	(YES)
Toxaphene	5.40 - 6.00	0 / 7	--	--	2.82	0.011	-- / --	256	(YES)
alpha-BHC	0.054 - 0.060	0 / 7	--	--	0.028	0.034	-- / --	0.83	NO
alpha-Chlordane	0.054 - 0.060	0 / 7	--	--	0.028	0.0040	-- / --	7.05	(YES)
beta-BHC	0.054 - 0.060	0 / 7	--	--	0.028	0.034	-- / --	0.83	NO
delta-BHC	0.054 - 0.060	0 / 7	--	--	0.028	0.034	-- / --	0.83	NO
gamma-BHC (Lindane)	0.054 - 0.060	0 / 7	--	--	0.028	0.016	-- / --	1.76	(YES)
gamma-Chlordane	0.054 - 0.060	0 / 7	--	--	0.028	0.0040	-- / --	7.05	(YES)
Semivolatile Organic Compounds (UG/L)									
2,4,5-Trichlorophenol	26.0 - 29.0	0 / 7	--	--	13.9	11.0	-- / --	1.26	(YES)
2-Chloronaphthalene	10.0 - 12.0	0 / 7	--	--	5.50	0.75	-- / --	7.33	(YES)
4,6-Dinitro-2-methylphenol	26.0 - 29.0	0 / 7	--	--	13.9	2.30	-- / --	6.02	(YES)
4-Bromophenyl-phenylether	10.0 - 12.0	0 / 7	--	--	5.50	1.50	-- / --	3.67	(YES)
4-Chloro-3-methylphenol	10.0 - 12.0	0 / 7	--	--	5.50	0.30	-- / --	18.3	(YES)
Anthracene	10.0 - 12.0	0 / 7	--	--	5.50	0.73	-- / --	7.53	(YES)
Benzo(a)anthracene	10.0 - 12.0	0 / 7	--	--	5.50	6.30	-- / --	0.87	NO
Benzo(a)pyrene	10.0 - 12.0	0 / 7	--	--	5.50	0.014	-- / --	393	(YES)
Di-n-butylphthalate	10.0 - 12.0	0 / 7	--	--	5.07	3.40	-- / --	1.49	(YES)
Di-n-octylphthalate	10.0 - 12.0	0 / 7	--	--	5.50	3.00	-- / --	1.83	(YES)
Hexachlorobenzene	10.0 - 12.0	0 / 7	--	--	5.50	3.68	-- / --	1.49	(YES)
Hexachlorobutadiene	10.0 - 12.0	0 / 7	--	--	5.50	3.20	-- / --	1.72	(YES)
Hexachlorocyclopentadiene	10.0 - 12.0	0 / 7	--	--	5.50	0.70	-- / --	7.86	(YES)
Pentachlorophenol	26.0 - 29.0	0 / 7	--	--	13.9	6.69	-- / --	2.07	(YES)
Phenanthrene	10.0 - 12.0	0 / 7	--	--	5.50	4.60	-- / --	1.20	(YES)
Volatile Organic Compounds (UG/L)									
Carbon disulfide	1.00 - 1.00	3 / 7	13.5	SJS04-SW01-001	4.93	2.00	2 / 7	2.46	YES

NSV - No Screening Value
1 - Shaded cells indicate hazard quotient based on reporting limits

Table 2-24
Comparison of Ecological COC Concentrations in Site Soil to Background
St. Juliens Creek Annex - Site 4

Chemical	Frequency of Detection	Maximum Site Concentration	Sample ID of Maximum Site Concentration	Soil Type	Maximum Background Concentration	Site Exceeds Background?
Inorganics (MG/KG)						
Aluminum	18 / 18	17,800	SJS04-SS01-000	Dredge Fill	21,900	NO
Chromium	18 / 18	680	SJS04-SS05-000	Dredge Fill	45	YES
Copper	18 / 18	874	SJS04-SS11-000	Dredge Fill	57.8	YES
Iron	18 / 18	65,100	SJS04-SS11-000	Dredge Fill	42,800	YES
Lead	18 / 18	1,110	SJS04-SS11-000	Dredge Fill	137	YES
Mercury	17 / 18	1.30	SJS04-SS06-000	Dredge Fill	1.2	YES
Nickel	18 / 18	546	SJS04-SS05-000	Dredge Fill	23.9	YES
Vanadium	18 / 18	354	SJS04-SS04-000	Dredge Fill	65.6	YES
Zinc	18 / 18	3,880	SJS04-SS11-000	Dredge Fill	162	YES
Semivolatile Organic Compounds (UG/KG)						
2-Methylnaphthalene	1 / 18	200	SJS04-SS11-000	Dredge Fill	NA	--
Acenaphthylene	5 / 18	130	SJS04-SS18-000	Dredge Fill	250	NO
Anthracene	9 / 18	950	SJS04-SS11-000	Dredge Fill	360	YES
Benzo(a)anthracene	17 / 18	3,000	SJS04-SS11-000	Dredge Fill	1,400	YES
Benzo(a)pyrene	17 / 18	2,300	SJS04-SS11-000	Dredge Fill	1,200	YES
Benzo(b)fluoranthene	17 / 18	3,000	SJS04-SS11-000	Dredge Fill	3,300	NO
Benzo(g,h,i)perylene	15 / 18	1,400	SJS04-SS11-000	Dredge Fill	1,600	NO
Benzo(k)fluoranthene	14 / 18	820	SJS04-SS01-000	Dredge Fill	1,500	NO
Butylbenzylphthalate	1 / 18	35.0	SJS04-SS07-000	Dredge Fill	NA	--
Carbazole	3 / 18	300	SJS04-SS05-000	Dredge Fill	NA	--
Chrysene	16 / 18	2,900	SJS04-SS11-000	Dredge Fill	2,700	YES
Dibenz(a,h)anthracene	2 / 18	320	SJS04-SS11-000	Dredge Fill	630	NO
Dibenzofuran	2 / 18	190	SJS04-SS11-000	Dredge Fill	NA	--
Fluoranthene	17 / 18	4,000	SJS04-SS11-000	Dredge Fill	1,100	YES
Indeno(1,2,3-cd)pyrene	15 / 18	1,100	SJS04-SS11-000	Dredge Fill	1,800	NO
Naphthalene	2 / 18	250	SJS04-SS11-000	Dredge Fill	480	NO
Phenanthrene	15 / 18	6,300	SJS04-SS11-000	Dredge Fill	260	YES
Pyrene	16 / 18	7,500	SJS04-SS11-000	Dredge Fill	1,100	YES

NA - Background values were not established for these parameters

Table 2-25
Preliminary Ecological Assessment Endpoints, Risk Hypotheses, Measurement Endpoints, and Receptors
St. Juliens Creek Annex - Site 4

Assessment Endpoints	Risk Hypothesis	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 the sediment and surface water.	Are levels of site-related chemicals present in the 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 piscivorous, sometimes omnivorous, 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 piscivorous 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.	Belted Kingfisher
Protection of carnivorous 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.	Hawk

Table 2-25
Preliminary Ecological Assessment Endpoints, Risk Hypotheses, Measurement Endpoints, and Receptors
St. Juliens Creek Annex - Site 4

Assessment Endpoints	Risk Hypothesis	Measurement Endpoint	Receptor Species
Protection of 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 insectivorous bird 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.	Woodcock
Protection of omnivorous mammals 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 soil sufficient to cause adverse effects on the growth, survival, and reproductive success of omnivorous 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.	Raccoon
Protection of piscivorous mammals 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 soil sufficient to cause adverse effects on the growth, survival, and reproductive success of piscivorous 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.	Mink
Protection of carnivorous 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 carnivorous 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.	Red fox
Protection of omnivorous mammals 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 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.	Mouse

Table 2-26 Comparative Analyses of Alternatives Site 4 St. Juliens Creek Annex Chesapeake, Virginia				
Evaluation Criteria	**Alternative No. 1 No Action**	**Alternative No. 2 Soil Cover**	**Alternative No. 3 RCRA Subtitle D Cap***	**Alternative No. 4 Excavation and Offsite Disposal of Landfill Materials**
Compliance with ARARs				
Chemical-Specific ARARs	Does not meet Chemical-Specific ARARs. Impacted soil, landfill contents, and sediment would remain in place. Additionally, the potential for contaminants leaching into groundwater would remain.	Meets Chemical-Specific ARARs. Although impacted soil and landfill materials would remain in place, they are not considered hazardous waste and only require a soil cover. The soil cover would minimize surface water run-on, surface water runoff, and erosion; protect the existing wetlands; prevent exposure to soil and landfill contents; and reduce infiltration through contaminated soil and landfill contents, thereby reducing the potential contribution to groundwater. Impacted drainage ditch sediment would also be addressed.	Meets Chemical-Specific ARARs. Impacted soil and landfill materials would remain in place. Unlike Alternative 2, a RCRA Subtitle D cap is designed, at a minimum, to meet regulatory solid-waste disposal requirements. A RCRA Subtitle D cap is constructed with a barrier layer and often includes a drainage layer to more effectively divert infiltration water away from the landfill cell. This would reduce the potential of water penetrating the landfill materials and leaching contaminants to the groundwater. Impacted drainage ditch sediment would also be addressed.	Meets Chemical-Specific ARARs. By removing the landfill materials, the risk associated with impacted soil, the landfill materials, and sediment would be eliminated. In addition, removal eliminates any future potential risk associated with contaminants leaching into the groundwater.
Action-Specific ARARs	Not applicable.	Meets Action-Specific ARARs.	Meets Action-Specific ARARs.	Meets Action-Specific ARARs.
Location-Specific ARARs	Not applicable.	Meets Location-Specific ARARs.	Meets Location-Specific ARARs.	Meets Location-Specific ARARs.
Need for Five Year Review	Impacted soil, landfill materials, and sediment remain on site. Therefore, a five-year review would be required.	Impacted soil, landfill materials, and sediment remain on site. Therefore, a five-year review would be required.	Impacted soil, landfill materials, and sediment remain on site. Therefore, a five-year review would be required.	Not required.

Table 2-26
Comparative Analyses of Alternatives
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

Evaluation Criteria	Alternative No. 1 No Action	Alternative No. 2 Soil Cover	Alternative No. 3 RCRA Subtitle D Cap*	Alternative No. 4 Excavation and Offsite Disposal of Landfill Materials
Reduction of Toxicity, Mobility, or Volume				
Groundwater	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.
Soil/Sediment	Impacted soil and sediment would remain onsite.	Impacted sediment would be removed from the site. Although impacted soil and landfill materials would remain in place, they are not considered hazardous waste and only require a soil cover. The soil cover would minimize surface water run-on, surface water runoff, and erosion; protect the existing wetlands; prevent exposure to soil and landfill contents; and reduce infiltration through contaminated soil and landfill contents, thereby reducing the potential contribution to groundwater.	Impacted sediment would be removed from the site. Impacted soil and landfill materials would remain in place. Unlike Alternative 2, a RCRA Subtitle D cap is designed, at a minimum, to meet regulatory solid-waste disposal requirements. A RCRA Subtitle D cap is constructed with a barrier layer and often includes a drainage layer to more effectively divert infiltration water away from the landfill cell. This would reduce the potential of water penetrating the landfill materials and leaching contaminants to the groundwater.	Impacted soil, landfill materials, and sediment would be removed.
Type and Quantity of Residuals Remaining After Remediation	Impacted soil and sediment would remain onsite.	Impacted soil would remain onsite.	Impacted soil would remain onsite.	Not Applicable.
Time Until Action is Complete	Not Applicable.	The exposure pathways (and therefore risks) associated with impacted soil and landfill materials would be eliminated immediately after construction of soil cover. Risks posed by sediment would be eliminated immediately after impacted sediment is removed and disposed offsite.	The exposure pathways (and therefore risks) associated with impacted soil and landfill materials would be eliminated immediately after construction of the RCRA Subtitle D cap. Risks posed by sediment would be eliminated immediately after impacted sediment is removed and disposed offsite.	Risks posed by impacted soil and sediment would be eliminated immediately after removal and offsite disposal.

Table 2-26
Comparative Analyses of Alternatives
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

Evaluation Criteria	Alternative No. 1 No Action	Alternative No. 2 Soil Cover	Alternative No. 3 RCRA Subtitle D Cap*	Alternative No. 4 Excavation and Offsite Disposal of Landfill Materials
Implementability				
Ability to Construct and Operate	Not Applicable.	Installation of soil cover is a well-established technology. Placement of soil cover material can be done with conventional equipment in a relatively short time. Waste handling, hauling, and disposal are routine operations for waste management contractors. Construction and improvements of drainage ditches are implementable using standard construction methods. To minimize wetland disturbance, low-pressure equipment and/or logging mats would be required to remove debris from the wetlands area of Site 4.	Although the design of a RCRA Subtitle D cap is more sophisticated than the soil cover prescribed under Alternative 2, capping is a proven technology that could be constructed with conventional equipment in a relatively short timeframe using conventional construction equipment and methods.	Implementation of this alternative would be the most difficult of the four alternatives. In the upland and slope areas, soil excavation and offsite disposal can be performed using conventional construction equipment and methods. However, the soil removal will be difficult to implement because UXO would be required during construction. Dewatering operations, that also include testing of discharge water, would also be required for this alternative. Low-pressure equipment and/or logging mats would be required to remove debris from the wetlands area of Site 4. Drainage ditch construction and improvements are implementable using standard construction methods.
Ease of Implementing Additional Action if needed	Very Easy	Easy	Moderate	Difficult
Ability to Monitor Effectiveness	Not Applicable.	Effectiveness can be monitored through annual inspections of soil cover.	Effectiveness can be monitored through annual inspections of RCRA Subtitle D cap.	Not Applicable.
Cost				
Capital Cost	$0	$1,396,000	$2,358,000	$10,791,000
O&M Cost	$0	$650,000	$650,000	$0
Present-Worth	**$0**	**$1,825,000**	**$2,787,000**	**$10,791,000**

*A RCRA Subtitle D Cap is not required but included for comparison.

Table 2-27
Cost Estimate for Alternative 2 - Soil Cover
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Site: Site 4
Location: St. Juliens Creek Annex, Chesapeake, Virginia
Phase: Feasibility Study
Date: 10-Sep-03

Description: Installation of soil cover over landfill contents at Site 4. Also consists of surface debris removal from wetlands area, installing rip-rap upgradient of wetland area, improving the stormwater drainage ditches surrounding the landfill, and long term groundwater monitoring.

CALCULATIONS

Lanfill Cap Placement
Upland Area = 149,100 sq. ft
Slope Area = 207,490 sq. ft
Upland and Slope Area = 356,590 sq. ft
Cap thickness in upland and slope areas = 2.0 ft

Cap volume = 713,180 cu ft (26,414 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Total Cap Material Required = 39,621 tons

Sediment Removal from Wetland Area
Wetland Area - 81,303 sq. ft
Sediment removal depth in wetland area = 3.0 ft

Removal volume = 243,909 cu ft (9,034 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Sediment Removed from Wetland Area = 13,551 tons

Soil Removal During Excavation of Drainage Ditch
Slope length = 5 ft
Floor width = 5 ft
Length of ditch = 1,000 ft

Removal volume = 15,000 cu ft (555 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Soil Removed for Drainage Ditch = 832 tons

ASSUMPTIONS

1) Clearing and Grubbing
* Area w/ trees < 40 yrs old: 3.6 acres
* Area w/ trees > 40 yrs old: 1.2 acres
* No trees/brush will be removed from wetland area
* All brush/trees will be hauled at no cost by logging/mulching company

2) Landfill Cap
* 2 ft of clay compacted by weight of heavy equipment only (no tamping)
* Clay installed in 6-inch lifts
* No nuclear density testing
* Clay fill source located within 20 mile radius of Site 4
* Assume 20 trucks/day @ 10 cu yds/truck x 2 trips to fill source = 400 cu yd/day (600 tons/day)

3) UXO Support
* 2 UXO technicians will be present during the removal of wetland sediment and site preparation
* Assume $53/hr per UXO technician
* Assume $76/day for UXO equipment/materials

4) Drainage Ditch
* Existing piping on east side of landfill will be removed and ditch will be excavated
* Dimensions: 5 ft floor width; 5 ft vertical height; 15 ft distance across ditch at ground surface; 1,000 ft length; 3:1 slope
* Ditch lined with geotextile membrane and 1 ft of rip-rap
* Excavated soil/sediment will be disposed at a landfill as non-hazardous waste

5) Wetland Protection
* Rip-rap placed at toe of slope area to protect slope from erosion
* Dimensions: 10 ft wide, 0.5 ft thick, 600 ft long
* Wetland will be allowed to naturally restore itself, no enhancement

6) Groundwater Sampling
* Assume 2 field technicians at $55/hr
* Assume 2 hours per well, 4 hours mob/demob
* Assume cost for total/dissolved TAL metals at $135/sample
* Assume 8 groundwater samples including QA/QC samples
* QA/QC samples include 1 equipment blank, 1 field duplicate, 1 MS/MSD

7) Cap Maintenance
* Assume that cap and ditch vegetation will be mowed on a monthly basis from May through September. No mowing October through April.
* Assume annual cost for potential cap repairs

Table 2-27
Cost Estimate for Alternative 2 - Soil Cover
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Site: Site 4
Location: St. Juliens Creek Annex, Chesapeake, Virginia
Phase: Feasibility Study
Date: 10-Sep-03

Description: Installation of soil cover over landfill contents at Site 4. Also consists of surface debris removal from wetlands area, installing rip-rap upgradient of wetland area, improving the stormwater drainage ditches surrounding the landfill, and long term groundwater monitoring.

CAPITAL COSTS

Description	Qty	Unit	Unit Cost	Total Cost	Notes
Clearing and Grubbing					
Removal of brush, trees, stumps, w/in landfill area	3.6	ACRE	$2,514.00	$9,050	RS Means 02230-200-0160
Removal of larger trees and stumps w/in landfill area and on slopes	1.2	ACRE	$2,115.00	$2,538	RS Means 02230-200-0200
SUBTOTAL				$11,588	
Site Preparation					
Surface preparation for cap placement	39,621	SY	$0.29	$11,490	RS Means 02310-440-0100
SUBTOTAL				$11,490	
Sediment Excavation					
Excavate and load sediment material	13,551	TON	$10.00	$135,510	Subcontractor Estimate
SUBTOTAL				$135,510	
Landfill Cap Construction					
Cap material (includes haul, spread, compact)	26,414	CY	$25.00	$660,350	Subcontractor Estimate
Stone on south slope for wetland erosion control	112	CY	$27.45	$3,074	RS Means 02370-300-0100
Seeding	357	MSF	$34.44	$12,295	RS Means 02920-510-4600
SUBTOTAL				$675,719	
Clearing/Grading/Excavation Support					
UXO Technician II/III for UXO scanning (2 UXO technicians)	15	DAYS	$848.00	$12,720	Engineer's Estimate
UXO Equipment/Materials	15	DAYS	$76.00	$1,140	Engineer's Estimate
Per Diem (2 UXO technicians)	15	DAYS	$302.00	$4,530	Engineer's Estimate
SUBTOTAL				$18,390	
Drainage Construction					
Excavate/load soil/sediment from stormwater ditch NE/SE of landfill area	832	TONS	$10.00	$8,320	Subcontractor Estimate
Transportation and disposal of non-hazardous waste (local)	832	TONS	$35.00	$29,120	Subcontractor Estimate
Placement of geotextile membrane along floor/slopes of ditch	555	SY	$1.22	$677	RS Means 02620-400-0100
Placement of stone for erosion control	700	CY	$22.55	$15,785	RS Means 02370-300-0100
SUBTOTAL				$53,902	
Disposal Characterization					
TCLP Analysis	1	UNIT	$700.00	$700	Engineer's Estimate
SUBTOTAL				$700	
Long Term Groundwater Monitoring					
Monitoring well construction	4	WELLS	$1,500.00	$6,000	Engineer's estimate
SUBTOTAL				$6,000	
Institutional Controls					
Establish institutional controls (fencing, signs, deed restrictions)	1	UNIT	$10,000.00	$10,000	Engineer's estimate
SUBTOTAL				$10,000	
SUBTOTAL				$923,300	
Contingency	20%			$184,660	Engineer's estimate
SUBTOTAL				$1,107,960	
Project Management	6%			$66,478	Source: A Guide to Developing and
Remedial Design	12%			$132,955	Documenting Cost Estimates During the
Construction Management	8%			$88,637	Feasibility Study - USEPA/USACE, July 2000
TOTAL CAPITAL COST				**$1,396,030**	

Table 2-27
Cost Estimate for Alternative 2 - Soil Cover
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Site: Site 4
Location: St. Juliens Creek Annex, Chesapeake, Virginia
Phase: Feasibility Study
Date: 10-Sep-03

Description: Installation of soil cover over landfill contents at Site 4. Also consists of surface debris removal from wetlands area, installing rip-rap upgradient of wetland area, improving the stormwater drainage ditches surrounding the landfill, and long term groundwater monitoring.

OPERATION AND MAINTENANCE COSTS (Year 1)					
Long Term Groundwater Monitoring					
Groundwater sampling (labor/equipment/materials)	4	EVENT	$1,600.00	$6,400	Engineer's estimate, 4 MW's, quarterly
Laboratory analysis (Total/dissovled TAL metals), includes QA/QC	4	EVENT	$1,080.00	$4,320	Engineer's estimate
Annual Report	1	UNIT	$2,500.00	$2,500	Engineer's estimate
SUBTOTAL				$13,220	
Cap Monitoring					
Mowing cap and ditch vegetation	5	MONTH	$1,000.00	$5,000	Engineer's Estimate
Erosion repair to cap	1	UNIT	$2,000.00	$2,000	Engineer's Estimate
Annual cap inspection and report	1	UNIT	$2,000.00	$2,000	Engineer's Estimate
SUBTOTAL				$9,000	
SUBTOTAL				$22,220	
Contingency	20%			$4,444	
SUBTOTAL				$26,664	
Project Management	6%			$1,600	
TOTAL ANNUAL OPERATION AND MAINTENANCE COST (Year 1)				$28,264	
OPERATION AND MAINTENANCE COSTS (Years 2-30)					
Long Term Groundwater Monitoring					
Groundwater sampling/data validation	2	EVENT	$1,600.00	$3,200	Engineer's estimate, 4 MW's, semiannual
Laboratory analysis (Total/dissovled TAL metals), includes QA/QC	2	EVENT	$1,080.00	$2,160	Engineer's estimate, 4 MW's, semiannual
Annual Report	1	UNIT	$2,500.00	$2,500	Engineer's estimate
SUBTOTAL				$7,860	
Cap Monitoring					
Mowing cap and ditch vegetation	5	MONTH	$1,000.00	$5,000	Engineer's Estimate
Erosion repair to cap	1	UNIT	$2,000.00	$2,000	Engineer's Estimate
Annual cap inspection and report	1	UNIT	$2,000.00	$2,000	Engineer's estimate
SUBTOTAL				$9,000	
SUBTOTAL				$16,860	
Contingency	20%			$3,372	Engineer's estimate
SUBTOTAL				$20,232	
Project Management	6%			$1,213.92	
TOTAL ANNUAL OPERATION AND MAINTENANCE COST (Years 2-30)				$21,446	

PRESENT VALUE ANALYSIS

i = 0.032
t = 1
t = 29

Cost Type	Year	Total Cost	Total Cost Per Year	Discount Factor (7%)	Present Value
Capital	0	$1,396,030	$1,396,030	1.000	$1,396,030
O&M	1	$28,264	$28,264	0.969	$27,387
O&M	2-30	$621,932	$21,446	18.715	$401,351
		$2,046,225			$1,824,769
TOTAL PRESENT VALUE OF ALTERNATIVE					**$1,825,000**

*Discount factor established per "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis", OSWER Directive No. 9355.3-20, June 25, 1993.

Table 2-27
Cost Estimate for Alternative 3 - RCRA Subtitle D Cap
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Site: Site 4
Location: St. Juliens Creek Annex, Chesapeake, Virginia
Phase: Feasibility Study
Date: 10-Sep-03

Description: Installation of a RCRA Subtitle D cap over landfill contents at Site 4. Also consists of surface debris removal from wetlands area, installing rip-rap upgradient of wetland area, and improving the stormwater drainage ditches surrounding the landfill.

CALCULATIONS

Lanfill Cap Placement
Upland Area = 149,100 sq. ft
Slope Area = 207,490 sq. ft
Upland and Slope Area = 356,590 sq. ft
Cap thickness in upland and slope areas = 4.0 ft

Cap volume = 1,426,360 cu ft (52,828 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Total Cap Material Required = 79,242 tons

Sediment Removal from Wetland Area
Wetland Area - 81,303 sq. ft
Sediment removal depth in wetland area = 3.0 ft

Removal volume = 243,909 cu ft (9,034 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Sediment Removed from Wetland Area = 13,551 tons

Soil Removal During Excavation of Drainage Ditch
Slope length = 5 ft
Floor width = 5 ft
Length of ditch = 1,000 ft

Removal volume = 15,000 cu ft (555 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Soil Removed for Drainage Ditch = 832 tons

ASSUMPTIONS

1) Clearing and Grubbing
* Area w/ trees < 40 yrs old: 3.6 acres
* Area w/ trees > 40 yrs old: 1.2 acres
* No trees/brush will be removed from wetland area
* All brush/trees will be hauled at no cost by logging/mulching company

2) Subtitle D Landfill Cap Design (from bottom to top)
* 6 in. grading/leveling layer, compacted
* 18 in. low permeability soil layer (K<10E-05 cm/sec), imported from borrow source, compacted
* Geocomposite drainage net
* 18 in. vegetative support layer, consists of native soil, compacted
* 6 in. topsoil layer, imported or native soil, compacted, hydroseeded

3) UXO Support
* 2 UXO technicians will be present during the removal of wetland sediment and site preparation
* Assume $53/hr per UXO technician
* Assume $76/day for UXO equipment/materials

4) Drainage Ditch
* Existing piping on east side of landfill will be removed and ditch will be excavated
* Dimensions: 5 ft floor width; 5 ft vertical height; 15 ft distance across ditch at ground surface; 1,000 ft length; 3:1 slope
* Ditch lined with geotextile membrane and 1 ft of rip-rap
* Excavated soil/sediment will be disposed at a landfill as non-hazardous waste

5) Wetland Protection
* Rip-rap placed at toe of slope area to protect slope from erosion
* Dimensions: 10 ft wide, 0.5 ft thick, 600 ft long
* Wetland will be allowed to naturally restore itself, no enhancement

6) Groundwater Sampling
* Assume 2 field technicians at $55/hr
* Assume 2 hours per well, 4 hours mob/demob
* Assume cost for total/dissolved TAL metals at $135/sample
* Assume 8 groundwater samples including QA/QC samples
* QA/QC samples include 1 equipment blank, 1 field duplicate, 1 MS/MSD

7) Cap Maintenance
* Assume that cap and ditch vegetation will be mowed on a monthly basis from May through September. No mowing October through April.
* Assume annual cost for potential cap repairs

Table 2-27
Cost Estimate for Alternative 3 - RCRA Subtitle D Cap
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Site: Site 4
Location: St. Juliens Creek Annex, Chesapeake, Virginia
Phase: Feasibility Study
Date: 10-Sep-03

Description: Installation of a RCRA Subtitle D cap over landfill contents at Site 4. Also consists of surface debris removal from wetlands area, installing rip-rap upgradient of wetland area, and improving the stormwater drainage ditches surrounding the landfill.

CAPITAL COSTS

Description	Qty	Unit	Unit Cost	Total Cost	Notes
Clearing and Grubbing					
Removal of brush, trees, stumps, w/in landfill area	3.6	ACRE	$2,514.00	$9,050	RS Means 02230-200-0160
Removal of larger trees and stumps w/in landfill area and on slopes	1.2	ACRE	$2,115.00	$2,538	RS Means 02230-200-0200
SUBTOTAL				$11,588	
Site Preparation					
Surface preparation for cap placement	39,621	SY	$0.29	$11,490	RS Means 02310-440-0100
SUBTOTAL				$11,490	
Sediment Excavation					
Excavate and load sediment material	13,551	TON	$10.00	$135,510	Subcontractor Estimate
SUBTOTAL				$135,510	
Subtitle D Landfill Cap Construction					
6" grading/leveling layer below low permeability layer	6,604	CY	$25.00	$165,100	Subcontractor Estimate
18" low permeability soil layer (K<10E-05 cm/sec)	19,811	CY	$25.00	$495,275	Subcontractor Estimate
Compaction of low permeability soil	19,811	CY	$0.55	$10,896	RS Means 02315-300-5620
Composite drainage net	39,621	SY	$4.95	$196,124	Engineer's Estimate
18" vegetative support layer	19,811	CY	$15.00	$297,165	Subcontractor Estimate
6" topsoil layer	6,604	CY	$20.00	$132,080	Engineer's Estimate
Stone on south side slope for wetland erosion control	112	CY	$27.45	$3,074	RS Means 02370-300-0100
Seeding	357	MSF	$34.44	$12,302	RS Means 02920-510-4600
SUBTOTAL				$1,312,016	
Clearing/Grading/Excavation Support					
UXO Technician II/III for UXO scanning (2 UXO technicians)	15	DAYS	$848.00	$12,720	Engineer's Estimate
UXO Equipment/Materials	15	DAYS	$76.00	$1,140	Engineer's Estimate
Per Diem (2 UXO technicians)	15	DAYS	$302.00	$4,530	Engineer's Estimate
SUBTOTAL				$18,390	
Drainage Construction					
Excavate/load soil/sediment from stormwater ditch NE/SE of landfill area	832	TONS	$10.00	$8,320	Subcontractor Estimate
Transportation and disposal of non-hazardous waste (local)	832	TONS	$35.00	$29,120	Subcontractor Estimate
Placement of geotextile membrane along floor/slopes of ditch	555	SY	$1.22	$677	RS Means 02620-400-0100
Placement of stone for erosion control	700	CY	$22.55	$15,785	RS Means 02370-300-0100
SUBTOTAL				$53,902	
Disposal Characterization					
TCLP Analysis	1	UNIT	$700.00	$700	Engineer's Estimate
SUBTOTAL				$700	
Long Term Groundwater Monitoring					
Monitoring well construction	4	WELLS	$1,500.00	$6,000	Engineer's Estimate
SUBTOTAL				$6,000	
Institutional Controls					
Establish institutional controls (fencing, signs, deed restrictions)	1	UNIT	$10,000.00	$10,000	Engineer's Estimate
SUBTOTAL				$10,000	
SUBTOTAL				$1,559,597	
Contingency	20%			$311,919	Engineer's Estimate
SUBTOTAL				$1,871,516	
Project Management	6%			$112,291	Source: A Guide to Developing and
Remedial Design	12%			$224,582	Documenting Cost Estimates During the
Construction Management	8%			$149,721	Feasibility Study - USEPA/USACE, July 2000
TOTAL CAPITAL COST				**$2,358,111**	

Table 2-27
Cost Estimate for Alternative 3 - RCRA Subtitle D Cap
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Site: Site 4
Location: St. Juliens Creek Annex, Chesapeake, Virginia
Phase: Feasibility Study
Date: 10-Sep-03

Description: Installation of a RCRA Subtitle D cap over landfill contents at Site 4. Also consists of surface debris removal from wetlands area, installing rip-rap upgradient of wetland area, and improving the stormwater drainage ditches surrounding the landfill.

OPERATION AND MAINTENANCE COSTS (Year 1)					
Long Term Groundwater Monitoring					
Groundwater sampling (labor/equipment/materials)	4	EVENT	$1,600.00	$6,400	Engineer's estimate, 4 MW's, quarterly
Laboratory analysis (Total/dissovled TAL metals), includes QA/QC	4	EVENT	$1,080.00	$4,320	Engineer's estimate, 4 MW's, quarterly
Annual Report	1	UNIT	$2,500.00	$2,500	Engineer's estimate
SUBTOTAL				$13,220	
Cap Monitoring					
Mowing cap and ditch vegetation	5	MONTH	$1,000.00	$5,000	Engineer's Estimate
Erosion repair to cap	1	UNIT	$2,000.00	$2,000	Engineer's Estimate
Annual cap inspection and report	1	UNIT	$2,000.00	$2,000	Engineer's estimate
SUBTOTAL				$9,000	
SUBTOTAL				$22,220	
Contingency	20%			$4,444	
SUBTOTAL				$26,664	
Project Management	6%			$1,600	
TOTAL ANNUAL OPERATION AND MAINTENANCE COST (Year 1)				$28,264	
OPERATION AND MAINTENANCE COSTS (Years 2-30)					
Long Term Groundwater Monitoring					
Groundwater sampling/data validation	2	EVENT	$1,600.00	$3,200	Engineer's estimate, 4 MW's, semiannual
Laboratory analysis (Total/dissovled TAL metals), includes QA/QC	2	EVENT	$1,080.00	$2,160	Engineer's estimate, 4 MW's, semiannual
Annual Report	1	UNIT	$2,500.00	$2,500	Engineer's estimate
SUBTOTAL				$7,860	
Cap Monitoring					
Mowing cap and ditch vegetation	5	MONTH	$1,000.00	$5,000	Engineer's Estimate
Erosion repair to cap	1	UNIT	$2,000.00	$2,000	Engineer's Estimate
Annual cap inspection and report	1	UNIT	$2,000.00	$2,000	Engineer's estimate
SUBTOTAL				$9,000	
SUBTOTAL				$16,860	
Contingency	20%			$3,372	Engineer's estimate
SUBTOTAL				$20,232	
Project Management	6%			$1,214	
TOTAL ANNUAL OPERATION AND MAINTENANCE COST (Years 2-30)				$21,446	

PRESENT VALUE ANALYSIS

i = 0.032
t = 1
t = 29

Cost Type	Year	Total Cost	Total Cost Per Year	Discount Factor (7%)	Present Value
Capital	0	$2,358,111	2,358,111	1.000	$2,358,111
O&M	1	$28,264	28,264	0.969	$27,387
O&M	2-30	$621,932	21,446	18.715	$401,351
		$3,008,306			$2,786,849
TOTAL PRESENT VALUE OF ALTERNATIVE					**$2,787,000**

*Discount factor established per "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis", OSWER Directive No. 9355.3-20, June 25, 1993.

Table 2-27
Cost Estimate for Alternative 4 - Excavation and Offsite Disposal of Landfill Materials
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Site: Site 4
Location: St. Juliens Creek Annex, Chesapeake, Virginia
Phase: Feasibility Study
Date: 10-Sep-03

Description: Excavation of soil from the landfill and disposing of the excavated material at an appropriate disposal facility. Also consists of surface debris removal from wetlands area, installing rip-rap upgradient of wetland area, and improving the stormwater drainage ditches surrounding the landfill.

CALCULATIONS

Soil/Waste Removal from Landfill
Upland Area = 149,100 sq. ft
Slope Area = 207,490 sq. ft
Soil/waste depth in upland area = 8 ft
Soil/waste depth in slope area = 5 ft

Soil/waste volume = 2,230,250 cu ft (82,602 cu yd)

Assumed soil weight = 1.5 tons/cu yd

Total Soil/Waste Material to be Excavated = 123,903 tons

Sediment Removal from Wetland Area
Wetland Area - 81,303 sq. ft
Sediment removal depth in wetland area = 3.0 ft

Removal volume = 243,909 cu ft (9,034 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Sediment Removed from Wetland Area = 13,551 tons

Soil Removal During Excavation of Drainage Ditch
Slope length = 5 ft
Floor width = 5 ft
Length of ditch = 1,000 ft

Removal volume = 15,000 cu ft (555 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Soil Removed for Drainage Ditch = 832 tons

Fill Material
Upland Area = 149,100 sq. ft
Slope Area = 207,490 sq. ft
Fill depth in upland area = 8 ft
Fill depth in slope area = 5 ft

Fill volume = 2,230,250 cu ft (82,602 cu yd)
Assumed soil weight = 1.5 tons/cu yd

Fill Material = 123,903 tons

ASSUMPTIONS

1) Clearing and Grubbing
 * Area w/ trees < 40 yrs old: 3.6 acres
 * Area w/ trees > 40 yrs old: 1.2 acres
 * No trees/brush will be removed from wetland area
 * All brush/trees will be hauled at no cost by logging/mulching company
2) Excavation of Soil/Waste Material
 * Assume 8 ft of material will be excavated from upland area
 * Assume 5 ft of material will be excavated from slope area
 * Excavated materials disposed at offsite landfill as non-hazardous waste
 * Landfill located within 50 miles of site
 * Assume: 20 trucks/day @ 10 cu yds/truck x 2 trips to fill source = 400 cu yds/day (600 tons/day)
3) Excavation Dewatering
 * 120 Well points allong northern perimeter.
4) UXO Support
 * 2 UXO technicians will be present during the removal of wetland sediment and landfill soil and waste materials
 * Assume $53/hr per UXO technician
 * Assume $76/day for UXO equipment/materials
5) Drainage Ditch
 * Existing piping on east side of landfill will be removed and ditch will be excavated
 * Dimensions: 5 ft floor width; 5 ft vertical height; 15 ft distance across ditch at ground surface; 1,000 ft length; 3:1 slope
 * Ditch lined with geotextile membrane and 1 ft of rip-rap
 * Excavated soil/sediment will be disposed at a landfill as non-hazardous waste
6) Wetland Protection
 * Rip-rap placed at toe of slope area to protect slope from erosion
 * Dimensions: 10 ft wide, 0.5 ft thick, 600 ft long
 * Wetland will be allowed to naturally restore itself, no enhancement
7) Fill Material
 * Backfill material will come from an offsite borrow source
 * Assume complete backfill of material removed, restoring original grade
8) Confirmation Sampling
 * Assume 4 confirmation composite soil samples collected per acre
 * Actual number of confirmation soil samples will be negotiated with agency
 * Samples analyzed for SVOCs and metals
 * Assume $125/sample for metals
 * Assume $250/sample for SVOCs
 * Assume 32 confirmation samples, does not include QA/QC samples

Table 2-27
Cost Estimate for Alternative 4 - Excavation and Offsite Disposal of Landfill Materials
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Site: Site 4
Location: St. Juliens Creek Annex, Chesapeake, Virginia
Phase: Feasibility Study
Date: 10-Sep-03

Description: Excavation of soil from the landfill and disposing of the excavated material at an appropriate disposal facility. Also consists of surface debris removal from wetlands area, installing rip-rap upgradient of wetland area, and improving the stormwater drainage ditches surrounding the landfill.

CAPITAL COSTS

Description	Qty	Unit	Unit Cost	Total Cost	Notes
Clearing and Grubbing					
Removal of brush, trees, stumps, w/in landfill area	3.6	ACRE	$2,514.00	$9,050	RS Means 02230-200-0160
Removal of larger trees and stumps w/in landfill area and on slopes	1.2	ACRE	$2,115.00	$2,538	RS Means 02230-200-0200
SUBTOTAL				$11,588	
Soil/Waste & Wetland Sediment Excavation					
Excavate and load soil/waste/sediment material	137,454	TON	$10.00	$1,374,540	Subcontractor Estimate
SUBTOTAL				$1,374,540	
Excavation Support					
UXO Technician II/III for UXO scanning (2 UXO technicians)	104	DAYS	$848.00	$88,192	Engineer's Estimate
UXO Equipment/Materials	104	DAYS	$76.00	$7,904	Engineer's Estimate
Per Diem (2 UXO technicians)	104	DAYS	$302.00	$31,408	Engineer's Estimate
SUBTOTAL				$127,504	
Confirmation Sampling					
Laboratory analysis (metals)	32	UNIT	$125.00	$4,000	Engineer's Estimate
Laboratory analysis (SVOCs)	32	UNIT	$250.00	$8,000	Engineer's Estimate
SUBTOTAL				$12,000	
Disposal Characterization					
TCLP Analysis	15	UNIT	$700.00	$10,500	Engineer's Estimate
SUBTOTAL				$10,500	
Transportation and Disposal (Nonhazardous Waste)					
Transportation and disposal (local)	137,454	TON	$35.00	$4,810,890	Subcontractor Estimate
SUBTOTAL				$4,810,890	
Excavation Dewatering					
Pumping groundwater/surface water from excavations					
SUBTOTAL				$562,031	
Clean Fill (Haul, Dump, Spread, Compact)					
Placement of fill in former landfill footprint (6" lifts)	82,602	CY	$7.00	$578,214	Subcontractor Estimate
SUBTOTAL				$578,214	
Site Restoration					
Stone for wetland erosion control	112	CY	$27.45	$3,074	RS Means 02620-400-0100
Seeding	357	MSF	$34.44	$12,302	RS Means 02370-300-0100
SUBTOTAL				$15,376	
Drainage Construction					
Excavate/load soil/sediment from stormwater ditch NE/SE of landfill area	832	TONS	$10.00	$8,320	Subcontractor Estimate
Transportation and disposal of non-hazardous waste (local)	832	TONS	$35.00	$29,120	Subcontractor Estimate
Placement of geotextile membrane along floor/slopes of ditch	555	SY	$1.22	$677	RS Means 02620-400-0100
Placement of stone for erosion control	700	CY	$22.55	$15,785	RS Means 02370-300-0100
SUBTOTAL				$53,902	
SUBTOTAL				$7,556,546	
Contingency	20%			$1,511,309	Engineer's estimate
SUBTOTAL				$9,067,855	
Project Management	5%			$453,393	Source: A Guide to Developing and
Remedial Design	8%			$725,428	Documenting Cost Estimates During the
Construction Management	6%			$544,071	Feasibility Study - USEPA/USACE, July 2000
TOTAL CAPITAL COST				**$10,790,747**	

PRESENT VALUE ANALYSIS

Cost Type	Year	Total Cost	Total Cost Per Year	Discount Factor (1.6%)	Present Value
Capital	0	$10,790,747	$10,790,747	1.000	$10,790,747
TOTAL PRESENT VALUE OF ALTERNATIVE					**$10,791,000**

Table 2-27
Cost Estimate for Alternative 4 - Dewatering Cost
Site 4
St. Juliens Creek Annex, Chesapeake, Virginia

Well Point Installation	
Upgradient perimeter of Site 3 (upland area only), ft	600
Assumed well point spacing (ft)	5
Required number of well points	120

	Unit	Quantity	Cost/Unit	Total Cost	Adjusted Cost[2]
Complete Installation, operation, equipment rental, fuel & removal of system with 2" well points 5' on center[*, a]	L.F.	600			
Cost per linear foot of header, first month	L.F.		175	$105,000	$112,350
Cost per linear foot of header, each add'l month	L.F.		100	$240,000	$256,800
Construction Duration, working days	Day	104			
Construction Duration, months (22 days per month)	Month	5			
			Total Cost		$369,150

[*] cost includes pumping 168 hours per week and include pump operator and one stand-by pump

[2] Adjusted 7% to account for 3.5% inflation over each of 2 years

Direct Pumping from Excavation Areas	Unit	Quantity	Cost/Unit	Total Cost	Adjusted Cost[2]
4" diaphragm pump[b]	Day	104	610	$63,440	$67,881
			Total Cost		$67,881

Water Treatment Prior to Discharge	Unit	Quantity	Cost/Unit	Total Cost	Adjusted Cost[3]
20,000 gallon storage tanks in series Sand filter to reduce turbidy	Lump Sum	1	$125,000	$125,000	$125,000
Carbon filtration, as necessary	Lump Sum	1	$125,000	$125,000	$125,000
			Total Cost		$125,000

Total Dewatering Cost	**$562,031**

SOURCES:

[1] RS Means Heavy Construction Cost Data, 2001

[a] 02240 900 1300/1700

[b] 02240 500 1000

[3] Engineer's Estimate

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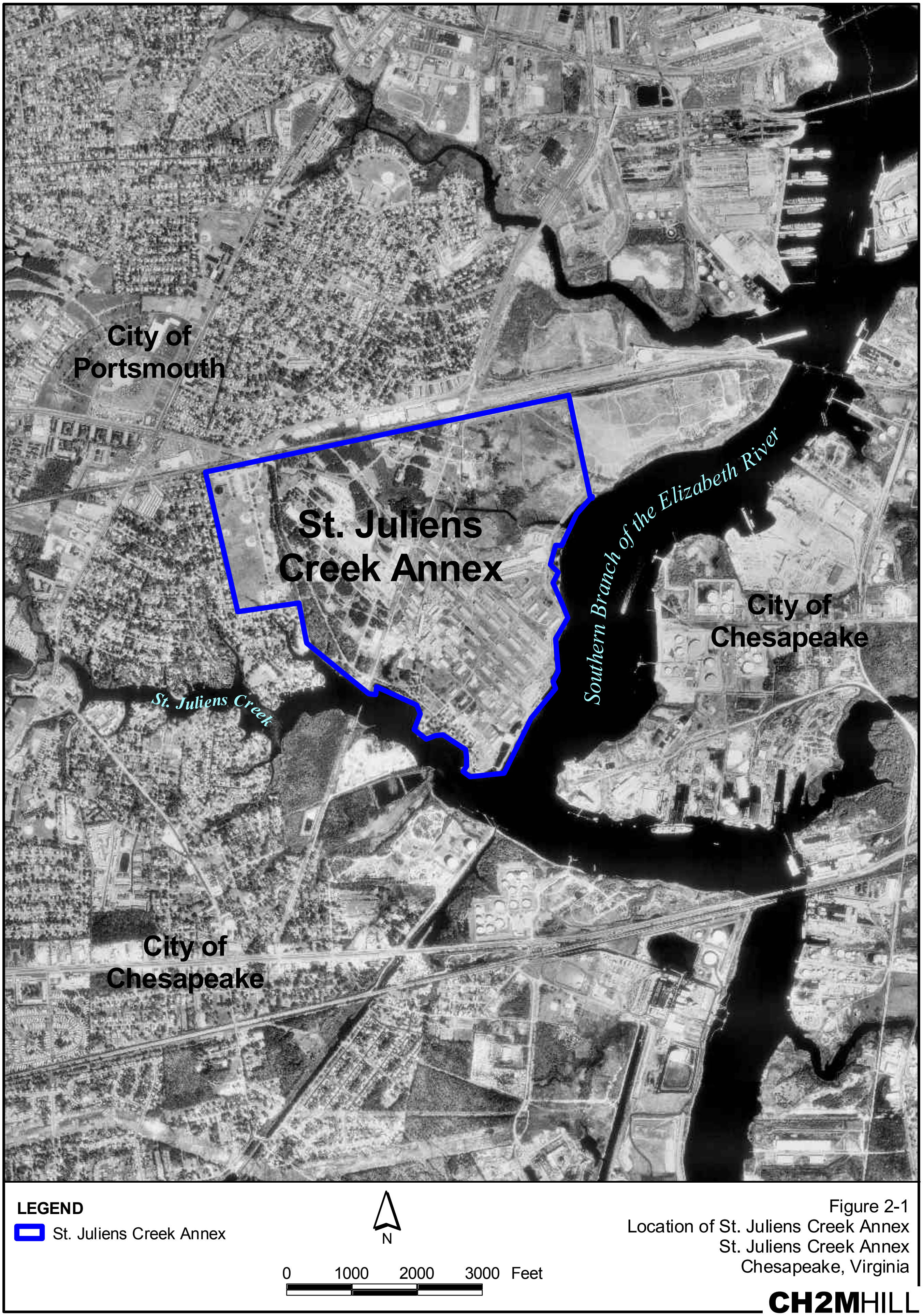

Figure 2-1
Location of St. Juliens Creek Annex
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

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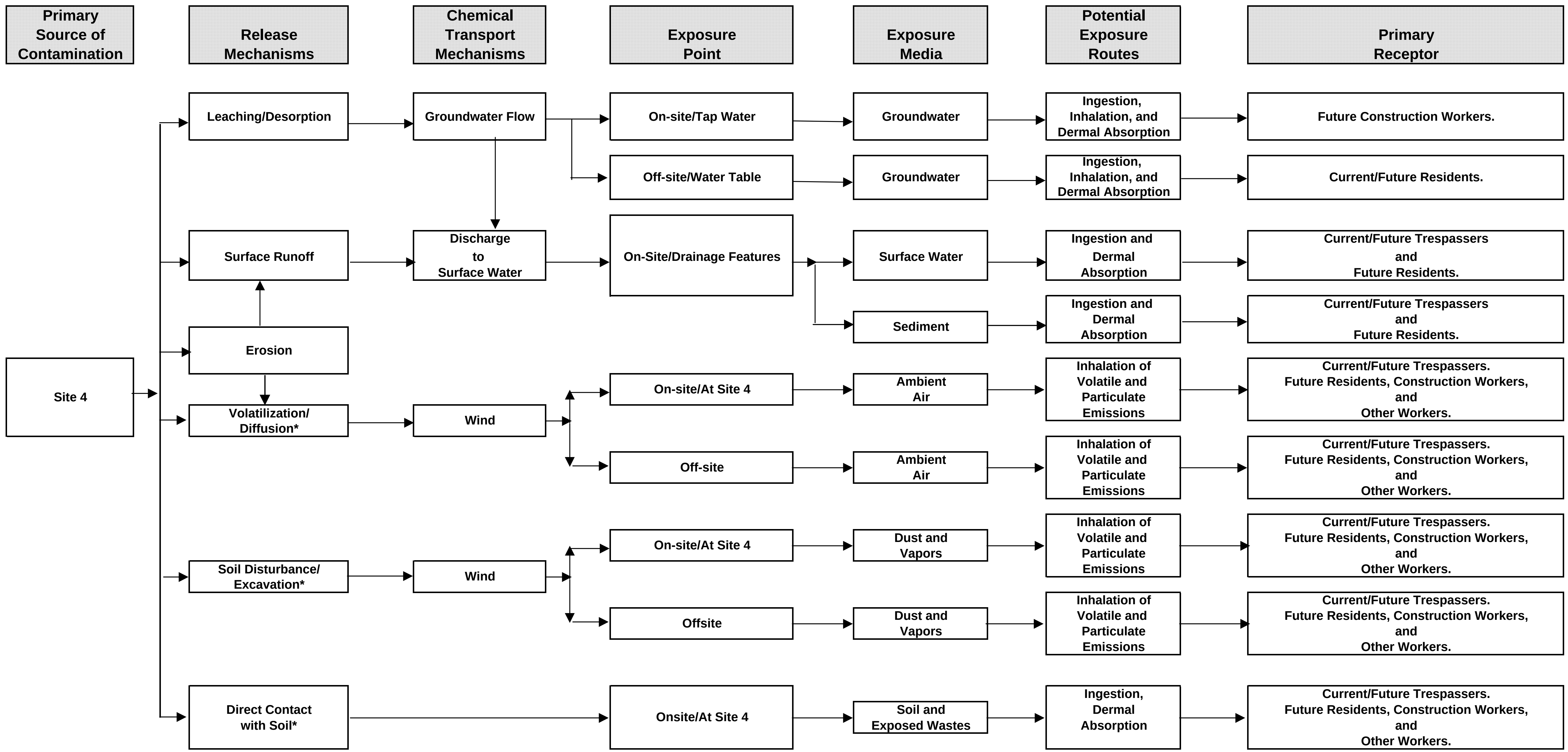
LEGEND
Site Boundary
Activity Boundary

N

0 500 1000 Feet

Figure 2-2
Site Location Map
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL



* Surface soil for current/future trespasser; combined surface and subsurface soil for future resident, construction worker, and other worker.

Complete Pathway
Incomplete Pathway

Figure 2-3
Conceptual Site Model for Potential Human Exposures
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia

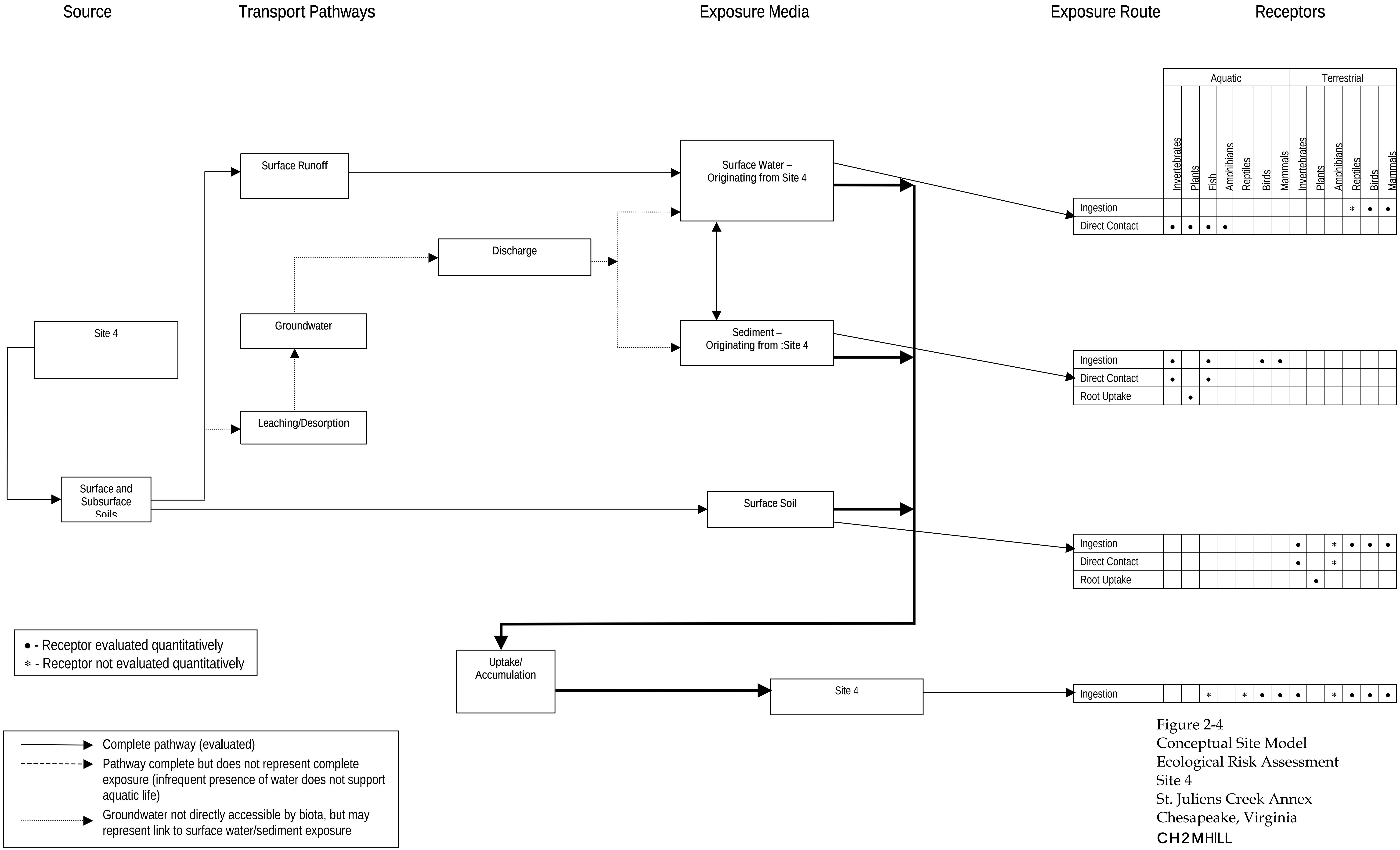


Figure 2-4
Conceptual Site Model
Ecological Risk Assessment
Site 4
St. Juliens Creek Annex
Chesapeake, Virginia
CH2MHILL

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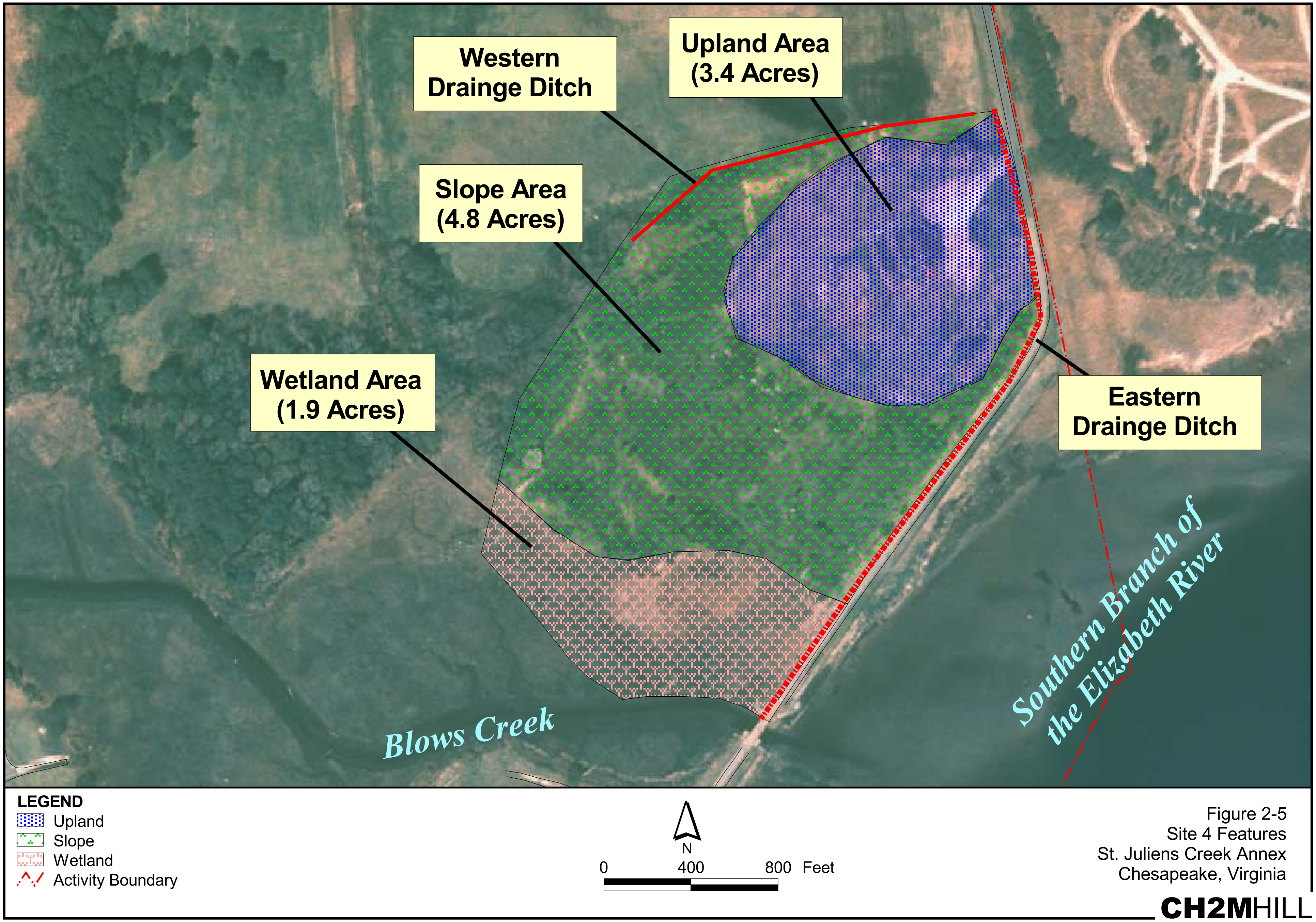

Figure 2-5
Site 4 Features
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 3

Responsiveness Summary

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from May 12 through June 12, 2004, for the proposed remedial action described in the FS and PRAP for Site 4. A public meeting to present the PRAP was held at the Major Hillard Library, located in Chesapeake, Virginia, on May 17, 2004. Public notice of the meeting and availability of documents was placed in *The Virginian-Pilot* newspaper on April 29, 2004.

The participants in the Public Meeting, held on May 17, 2004, included two RAB members and representatives of the Navy, EPA, and the Commonwealth of Virginia. Questions and concerns received during the meeting were addressed at the meeting and are documented in the meeting minutes, included as Appendix D. No additional written comments, concerns, or questions were received by the Navy, EPA, or the Commonwealth of Virginia during the public comment period.

SECTION 4
References

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Appendix A
Human Health Risk Assessment Tables

TABLE A-1

NON-CANCER TOXICITY DATA

St. Juliens Creek Annex - Site 4 (Landfill D)

ORAL/DERMAL

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (MM/DD/YY)
	Subchronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000	HEAST	07/01/97
Arsenic	Chronic	3.0E-04	mg/kg/day	0.95	2.9E-04	mg/kg/day	Skin	3	IRIS	05/04/01
	Subchronic	3.0E-04	mg/kg/day	0.95	2.9E-04	mg/kg/day	Skin	3	HEAST	07/01/97
Iron	Chronic	3.0E-01	mg/kg/day	0.20	6.0E-02	mg/kg/day	Gastrointestinal	1	NCEA	07/23/96
Manganese (nonfood)	Chronic	2.0E-02	mg/kg/day	0.35	7.0E-03	mg/kg/day	Central Nervous System	1	IRIS	05/04/01
Manganese(food)	Chronic	1.4E-01	mg/kg/day	0.05	2.0E-04	mg/kg/day	Central Nervous System	1	IRIS	05/04/01

INHALATION

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (3)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (MM/DD/YY)
Chloroform	Chronic	3.0E-04	mg/m3	8.6E-05	mg/kg/day	Nasal	1000	NCEA	12/01/97

NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Tables, July 1997

RBC = Region III Risk-Based Concentration Table, October 9, 2002

NCEA = National Center for Environmental Assessment

(1) Oral to Dermal Adjustment Factor from oral ABS values for oral to dermal extrapolation per RAGS Appendix A, USEPA Update, April 8, 1999

(2) Adjusted Dermal RfD (mg/kg/day) = Oral RfD (mg/kg/day)x Oral to Dermal Adjustment Factor

(3) Adjusted Inhalation RfD (mg/kg/day) = Inhalation RfC (mg/m^3) x 20 (m^3/day) / 70 (kg)

TABLE A-2

CANCER TOXICITY DATA

St. Juliens Creek Annex - Site 4 (Landfill D)

ORAL/DERMAL

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (MM/DD/YY)
Arsenic	1.5E+00	0.95	1.6E+00	1/mg/kg/day	A	IRIS	05/04/01
Iron	NA	NA	NA	NA	NA	NA	NA
Manganese (food)	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	NA	NA	NA	NA	NA	NA	NA

INHALATION

Chemical of Potential Concern	Unit Risk	Units	Adjustment	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description
Chloroform	2.3E-05	$1/ug/m^3$	(3)	8.1E-02	1/mg/kg/day	B2

(1) Oral to Dermal Adjustment Factor from oral ABS values for oral to dermal extrapolation per
RAGS Appendix A, USEPA Update, April 8, 1999

(2) Adjusted Dermal Cancer Slope Factor (1/mg/kg/day) = Oral Cancer Slope Factor (1/mg/kg/day)
/ Oral to Dermal Adjustment Factor

(3) Inhalation Cancer Slope Factor (1/mg/kg/day) = Unit Risk ($1/ug/m^3$)
x 70 kg / 20 m^3/day x 1000 ug/mg

NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Tables, July 1997

RBC = Region III Risk-Based Concentration Table, April 13, 2000

NCEA = National Center for Environmental Assessment

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human d

B2 - Probable human carcinogen - indicates sufficient evidence ir

inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

Weight of Evidence:

Known/Likely

Cannot be Determined

Not Likely

TABLE A-3
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
REASONABLE MAXIMUM EXPOSURE
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water						Arsenic	Skin	1.7	NA	0.005	1.7
								Iron	Gastrointestinal	6	NA	0.08	6
								Manganese	CNS	17	NA	0.1	17
			(Total)					(Total)		25	NA	0.2	26
			Total Risk Across Tap water				0.0E+00	Total Hazard Index Across Tap water					26
	Air	Deep Groundwater - Water Vapors at Showerhead	Chloroform	NA	1.3E-05	NA	1.3E-05	Chloroform	Nasal	NA	1.0	NA	1.0
			(Total)	NA	1.3E-05	NA	1.3E-05	(Total)		NA	1	NA	1.0
			Total Risk Across Vapors at Showerhead				1.3E-05	Total Hazard Index Across Vapors at Showerhead					1.0
Total Risk Across All Media and All Exposure Routes							1.3E-05	Total Hazard Index Across All Media and All Exposure Routes					27

Note: Total Hazard Index and Target Organ sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

Total Liver HI =	0.042
Total Skin HI =	1.7
Total Heart HI =	0.2
Total Gastronintestinal HI =	6
Total CNS HI =	17
Total Nasal HI =	1.0

TABLE A-4
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
REASONABLE MAXIMUM EXPOSURE
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water						Arsenic	Skin	4.1	NA	0.010	4.1
								Iron	Gastrointestinal	15	NA	0.17	15
								Manganese	CNS	40	NA	0.3	40
			(Total)					(Total)		59	NA	0.5	60
			Total Risk Across Tap water				0.0E+00	Total Hazard Index Across Tap water					60
			Total Risk Across All Media and All Exposure Routes				0E+00	Total Hazard Index Across All Media and All Exposure Routes					60

Note: Total Hazard Index and Target Organ sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

Total Liver HI =	0.093
Total Skin HI =	4.1
Total Heart HI =	0.4
Total Gastronintestinal HI =	15
Total CNS HI =	40

TABLE A-5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
REASONABLE MAXIMUM EXPOSURE
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water	Arsenic	4.3E-04	NA	1.1E-06	4.3E-04						
			(Total)	4.3E-04	1.3E-05	2.4E-06	4.4E-04	(Total)					
			Total Risk Across Tap water				4.4E-04	Total Hazard Index Across Tap water					0
			Total Risk Across All Media and All Exposure Routes				4.4E-04	Total Hazard Index Across All Media and All Exposure Routes					0

Note: Total Risk sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

TABLE A-6
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
REASONABLE MAXIMUM EXPOSURE
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water						Arsenic	Skin	1.7	NA	0.005	1.7
								Iron	Gastrointestinal	6	NA	0.08	6
								Manganese	CNS	17	NA	0.1	17
			(Total)					(Total)		25	NA	0.2	26
			Total Risk Across Tap water				0.0E+00	Total Hazard Index Across Tap water					26
	Air	Deep Groundwater - Water Vapors at Showerhead	Chloroform	NA	1.3E-05	NA	1.3E-05	Chloroform	Nasal	NA	1.0	NA	1.0
			(Total)	NA	1.3E-05	NA	1.3E-05	(Total)		NA	1	NA	1.0
			Total Risk Across Vapors at Showerhead				1.3E-05	Total Hazard Index Across Vapors at Showerhead					1.0
			Total Risk Across All Media and All Exposure Routes				1.3E-05	Total Hazard Index Across All Media and All Exposure Routes					28.0

* Includes both surface and subsurface soil.

Note: Total Hazard Index and Target Organ sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

Total CNS HI =	17.5
Total Longevity HI =	0.06
Total Blood HI =	0.06
Total Skin HI =	2.0
Total Heart HI =	0.196
Total Kidney HI =	0.01
Total NOAEL HI =	0.5
Total Gastrointestinal HI =	6.7
Total Body Weight HI =	0.1
Total Nasal HI =	1.0

TABLE A-7
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
REASONABLE MAXIMUM EXPOSURE
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water						Arsenic	Skin	4.1	NA	0.010	4.1
								Iron	Gastrointestinal	15	NA	0.17	15
								Manganese	CNS	40	NA	0.3	40
			(Total)					(Total)		59	NA	0.5	60
			Total Risk Across Tap water				0.0E+00	Total Hazard Index Across Tap water					60
Soil*	Soil*	At Site 4						Aluminum	CNS	0.15	NA	0.01	0.16
								Antimony	Longevity, Blood	0.27	NA	0.05	0.32
								Arsenic	Skin	1.46	NA	0.1	1.56
								Iron	Gastrointestinal	1.39	NA	0.1	1.52
								Manganese	CNS	0.22	NA	0.3	0.53
								Thallium	Liver	0.19	NA	0.004	0.20
			(Total)				0.0E+00	(Total)		4	NA	1	5
			Total Risk Across Soil* at Site 4				0.0E+00	Total Hazard Index Across Soil* at Site 4					5
Sediment	Sediment	Drainage features						Iron	Gastrointestinal	0.3	NA	2.0	2
			(Total)					(Total)		0.5	NA	2.0	3.2
			Total Risk Across Sediment				0.0E+00	Total Hazard Index Across Sediment					3.2
			Total Risk Across All Media and All Exposure Routes				0.0E+00	Total Hazard Index Across All Media and All Exposure Routes					68

Total Liver HI =	0.30
Total CNS HI =	41.0
Total Longevity HI =	0.32
Total Blood HI =	0.35
Total Skin HI =	6.5
Total Heart HI =	0.480
Total Kidney HI =	0.03
Total NOAEL HI =	0.2
Total Gastrointestinal HI =	18.9
Total Body Weight HI =	0.2

* Includes both surface and subsurface soil.

Note: Total Hazard Index and Target Organ sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

TABLE A-8
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
REASONABLE MAXIMUM EXPOSURE
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water	Arsenic	4.3E-04	NA	1.1E-06	4.3E-04						
			(Total)	4.3E-04	NA	2.4E-06	4.3E-04	(Total)					
			Total Risk Across Tap water				4.3E-04	Total Hazard Index Across Tap water					0
Soil*	Soil*	At Site 4	Arsenic	8.0E-05	NA	1.1E-05	9.2E-05						
			(Total)	1.2E-04	NA	1.2E-05	1.3E-04	(Total)					0
			Total Risk Across Soil* at Site 4				1.3E-04	Total Hazard Index Across Soil* at Site 4					0
			Total Risk Across All Media and All Exposure Routes				6.0E-04	Total Hazard Index Across All Media and All Exposure Routes					0

* Includes both surface and subsurface soil.
Note: Total Risk sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

TABLE A-9
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
CENTRAL TENDENCY
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water						Arsenic	Skin	0.2	NA	0.0003	0.2
								Iron	Gastrointestinal	1	NA	0.01	1
								Manganese	CNS	4	NA	0.02	4
			(Total)					(Total)		5	NA	0.04	5
						Total Risk Across Tap water	0.0E+00				Total Hazard Index Across Tap water		5
						Total Risk Across All Media and All Exposure Routes	0.0E+00				Total Hazard Index Across All Media and All Exposure Routes		5

Note: Total Hazard Index and Target Organ sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

Total Liver HI =	0.007
Total Skin HI =	0.2
Total Heart HI =	0.04
Total Gastronintestinal HI =	1
Total CNS HI =	4

TABLE A-10
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
CENTRAL TENDENCY
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water						Arsenic	Skin	0.44	NA	0.001	0.4
								Iron	Gastrointestinal	3.9	NA	0.04	4
								Manganese	CNS	11	NA	0.1	11
			(Total)					(Total)		16	NA	0.1	16
			Total Risk Across Tap water				0.0E+00	Total Hazard Index Across Tap water					16
			Total Risk Across All Media and All Exposure Routes				0E+00	Total Hazard Index Across All Media and All Exposure Routes					16

Note: Total Hazard Index and Target Organ sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

Total Liver HI =	0.020
Total Skin HI =	0.4
Total Heart HI =	0.12
Total Gastronintestinal HI =	4
Total CNS HI =	11

TABLE A-11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
CENTRAL TENDENCY
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water	Arsenic	2.8E-05	NA	7.7E-08	2.8E-05						
			(Total)	2.9E-05	NA	3.5E-07	2.9E-05	(Total)					0
			Total Risk Across Tap water				2.9E-05	Total Hazard Index Across Tap water					0
			Total Risk Across All Media and All Exposure Routes				2.9E-05	Total Hazard Index Across All Media and All Exposure Routes					0

Note: Total Risk sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

TABLE A-12
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
CENTRAL TENDENCY
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water						Arsenic	Skin	0.2	NA	0.0003	0.2
								Iron	Gastrointestinal	1	NA	0.01	1
								Manganese	CNS	4	NA	0.02	4
			(Total)					(Total)		5	NA	0.04	5
			Total Risk Across Tap water				0.0E+00	Total Hazard Index Across Tap water					5
Total Risk Across All Media and All Exposure Routes							0.0E+00	Total Hazard Index Across All Media and All Exposure Routes					5

Total Liver HI =	0.007
Total CNS HI =	4
Total Skin HI =	0.2
Total Heart HI =	0.04
Total Gastrointestinal HI =	1

* Includes both surface and subsurface soil.

Note: Total Hazard Index and Target Organ sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

TABLE A-13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
CENTRAL TENDENCY

s Creek - Landfil St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water						Arsenic	Skin	0.4	NA	0.001	0.4
								Iron	Gastrointestinal	4	NA	0.04	4
								Manganese	CNS	11	NA	0.1	11
			(Total)					(Total)		16	NA	0.1	16
			Total Risk Across Tap water				0.0E+00	Total Hazard Index Across Tap water					16
Soil*	Soil*	At Site 4						Arsenic	Skin	0.27	NA	0.009	0.3
								Iron	Gastrointestinal	0.34	NA	0.02	0.4
			(Total)				0E+00	(Total)		0.9	NA	0.1	1.0
			Total Risk Across Soil* at Site 4				0E+00	Total Hazard Index Across Soil* at Site 4					1.0
Sediment	Sediment	Drainage features						Iron	Gastrointestinal	0.05	NA	0.14	0.19
			(Total)					(Total)		0.07	NA	0.14	0.3
			Total Risk Across Sediment				0.0E+00	Total Hazard Index Across Sediment					0.3
			Total Risk Across All Media and All Exposure Routes				0E+00	Total Hazard Index Across All Media and All Exposure Routes					17

Total Liver HI =	0.07
Total CNS HI =	11.5
Total Longevity HI =	0.05
Total Blood HI =	0.05
Total Skin HI =	0.8
Total Heart HI =	0.124
Total Kidney HI =	0.004
Total NOAEL HI =	0.02
Total Gastrointestinal HI =	4.5
Total Body Weight HI =	0.02

* Includes both surface and subsurface soil.

Note: Total Hazard Index and Target Organ sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

TABLE A-14
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COCs
CENTRAL TENDENCY
St. Juliens Creek Annex- Site 4 (Landfill D)

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water	Arsenic	2.8E-05	NA	7.7E-08	2.8E-05						
			(Total)	2.9E-05	NA	3.5E-07	2.9E-05	(Total)					0
			Total Risk Across Tap water				2.9E-05	Total Hazard Index Across Tap water					0
Soil*	Soil*	At Site 4	Arsenic	1.2E-05	NA	5.6E-07	1.3E-05						
			(Total)	1.8E-05	NA	5.9E-07	1.9E-05	(Total)					0
			Total Risk Across Soil* at Site 4				1.9E-05	Total Hazard Index Across Soil* at Site 4					0
			Total Risk Across All Media and All Exposure Routes				5.1E-05	Total Hazard Index Across All Media and All Exposure Routes					0

* Includes both surface and subsurface soil.

Note: Total Risk sums include all Chemicals of Potential Concern (COPCs) for all media although chemicals listed are narrowed to only Chemicals of Concern (COCs).

Appendix B
Ecological Risk Assessment Tables

Table B-1

Soil Bioconcentration and Bioaccumulation Factors Used For Plants and Soil Invertebrates - Maximum Concentration (Worst Case Scenario)

St. Juliens Creek Annex - Site 4

Chemical	Soil-Plant BCF (dry weight)		Soil-Invertebrate BAF (dry weight)	
	Value	Reference	Value	Reference
Inorganics				
Arsenic	1.10	Bechtel Jacobs 1998a	0.52	Sample et al. 1998a
Cadmium	3.25	Bechtel Jacobs 1998a	40.69	Sample et al. 1998a
Chromium	0.01	Baes et al. 1984	3.16	Sample et al. 1998a
Copper	0.63	Bechtel Jacobs 1998a	1.53	Sample et al. 1998a
Lead	0.47	Bechtel Jacobs 1998a	1.52	Sample et al. 1998a
Mercury	5	Bechtel Jacobs 1998a	20.63	Sample et al. 1998a
Nickel	1.41	Bechtel Jacobs 1998a	4.73	Sample et al. 1998a
Selenium	3.01	Bechtel Jacobs 1998a	1.34	Sample et al. 1998a
Silver	0.40	Baes et al. 1984	1	--
Zinc	1.82	Bechtel Jacobs 1998a	12.89	Sample et al. 1998a
Pesticides/PCBs				
4,4'-DDD	0.01	Travis and Arms 1988	2	Menzie et al. 1992
4,4'-DDE	0.00	Travis and Arms 1988	10.6	Menzie et al. 1992
4,4'-DDT	0.01	Travis and Arms 1988	0.7	Menzie et al. 1992
Aldrin	0.01	Travis and Arms 1988	1	--
alpha-BHC	0.25	Travis and Arms 1988	1	--
Aroclor-1016	0.02	Travis and Arms 1988	15.91	Sample et al. 1998a
Aroclor-1221	0.07	Travis and Arms 1988	15.91	Sample et al. 1998a
Aroclor-1232	0.04	Travis and Arms 1988	15.91	Sample et al. 1998a
Aroclor-1242	0.02	Travis and Arms 1988	15.91	Sample et al. 1998a
Aroclor-1248	0.01	Travis and Arms 1988	15.91	Sample et al. 1998a
Aroclor-1254	0.01	Travis and Arms 1988	15.91	Sample et al. 1998a
Aroclor-1260	0.01	Travis and Arms 1988	15.91	Sample et al. 1998a
beta-BHC	0.24	Travis and Arms 1988	1	--
delta-BHC	0.17	Travis and Arms 1988	1	--
Dieldrin	0.03	Travis and Arms 1988	8	Beyer and Gish 1980
Endosulfan I	0.24	Travis and Arms 1988	1	--
Endosulfan II	0.09	Travis and Arms 1988	1	--
Endrin	0.05	Travis and Arms 1988	1	--
Gamma-BHC (Lindane)	0.27	Travis and Arms 1988	1	--
Heptachlor	0.01	Travis and Arms 1988	10	Roberts and Dorough 1985
Heptachlor Epoxide	0.05	Travis and Arms 1988	10	Roberts and Dorough 1985
Methoxychlor	0.04	Travis and Arms 1988	1	--
Toxaphene	0.03	Travis and Arms 1988	1	--
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	0.19	Travis and Arms 1988	0.56	Beyer 1996
1,2-Dichlorobenzene	0.40	Travis and Arms 1988	1	--
1,3-Dichlorobenzene	0.37	Travis and Arms 1988	1	--
1,4-Dichlorobenzene	0.41	Travis and Arms 1988	1	--
4-Bromophenyl-Phenylether	0.05	Travis and Arms 1988	1	--
4-Chlorophenyl-Phenylether	0.05	Travis and Arms 1988	1	--
Acenaphthene	0.21	Travis and Arms 1988	0.3	Beyer and Stafford 1993
Acenaphthylene	0.17	Travis and Arms 1988	0.22	Beyer and Stafford 1993
Anthracene	0.09	Travis and Arms 1988	0.32	Beyer and Stafford 1993
Benzo(a)anthracene	0.02	Travis and Arms 1988	0.27	Beyer and Stafford 1993
Benzo(a)pyrene	0.01	Travis and Arms 1988	0.34	Beyer and Stafford 1993
Benzo(b)fluoranthene	0.01	Travis and Arms 1988	0.21	Beyer and Stafford 1993
Benzo(g,h,i)perylene	0.01	Travis and Arms 1988	0.15	Beyer and Stafford 1993
Benzo(k)fluoranthene	0.01	Travis and Arms 1988	0.21	Beyer and Stafford 1993
Chrysene	0.02	Travis and Arms 1988	0.44	Beyer and Stafford 1993
Dibenz(a,h)anthracene	0.01	Travis and Arms 1988	0.49	Beyer and Stafford 1993
Fluoranthene	0.04	Travis and Arms 1988	0.37	Beyer and Stafford 1993
Fluorene	0.14	Travis and Arms 1988	0.2	Beyer and Stafford 1993
Hexachlorobutadiene	0.06	Travis and Arms 1988	1	--
Hexachlorobenzene	0.02	Travis and Arms 1988	1.69	Beyer 1996
Hexachlorocyclopentadiene	0.03	Travis and Arms 1988	1	--
Hexachloroethane	0.19	Travis and Arms 1988	1	--
Indeno(1,2,3-cd)pyrene	0.01	Travis and Arms 1988	0.41	Beyer and Stafford 1993
Pentachlorophenol	0.04	Travis and Arms 1988	8	van Gestel and Ma 1988
Phenanthrene	0.09	Travis and Arms 1988	0.28	Beyer and Stafford 1993
Pyrene	0.04	Travis and Arms 1988	0.39	Beyer and Stafford 1993

Table B-2
Soil Bioconcentration Factors Used For Plants and Soil Invertebrates - Mean Concentration
St. Juliens Creek Annex - Site 4

Chemical	Soil-Plant BCF (dry weight)		Soil-Invertebrate BAF (dry weight)	
	Value	Reference	Value	Reference
Inorganics				
Arsenic	0.04	Bechtel Jacobs 1998a	0.26	Sample et al. 1998a
Cadmium	0.51	Bechtel Jacobs 1998a	7.66	Sample et al. 1998a
Chromium	0.01	Baes et al. 1984	0.32	Sample et al. 1998a
Copper	0.12	Bechtel Jacobs 1998a	0.47	Sample et al. 1998a
Lead	0.04	Bechtel Jacobs 1998a	0.31	Sample et al. 1998a
Mercury	0.34	Bechtel Jacobs 1998a	1.19	Sample et al. 1998a
Nickel	0.03	Bechtel Jacobs 1998a	1.66	Sample et al. 1998a
Selenium	0.57	Bechtel Jacobs 1998a	0.98	Sample et al. 1998a
Silver	0.4	Baes et al. 1984	1	--
Zinc	0.36	Bechtel Jacobs 1998a	2.48	Sample et al. 1998a
Pesticides/PCBs				
4,4'-DDD	0.01	Travis and Arms 1988	2	Menzie et al. 1992
4,4'-DDE	0.00	Travis and Arms 1988	10.6	Menzie et al. 1992
4,4'-DDT	0.01	Travis and Arms 1988	0.7	Menzie et al. 1992
Aldrin	0.01	Travis and Arms 1988	1	--
alpha-BHC	0.25	Travis and Arms 1988	1	--
Aroclor-1016	0.02	Travis and Arms 1988	4.30	Sample et al. 1998a
Aroclor-1221	0.07	Travis and Arms 1988	4.30	Sample et al. 1998a
Aroclor-1232	0.04	Travis and Arms 1988	4.30	Sample et al. 1998a
Aroclor-1242	0.02	Travis and Arms 1988	4.30	Sample et al. 1998a
Aroclor-1248	0.01	Travis and Arms 1988	4.30	Sample et al. 1998a
Aroclor-1254	0.01	Travis and Arms 1988	4.30	Sample et al. 1998a
Aroclor-1260	0.00	Travis and Arms 1988	4.30	Sample et al. 1998a
beta-BHC	0.24	Travis and Arms 1988	1	--
delta-BHC	0.17	Travis and Arms 1988	1	--
Dieldrin	0.03	Travis and Arms 1988	8	Beyer and Gish 1980
Endosulfan I	0.24	Travis and Arms 1988	1	--
Endosulfan II	0.09	Travis and Arms 1988	1	--
Endrin	0.05	Travis and Arms 1988	1	--
Gamma-BHC (Lindane)	0.27	Travis and Arms 1988	1	--
Heptachlor	0.01	Travis and Arms 1988	10	Roberts and Dorough 1985
Heptachlor Epoxide	0.05	Travis and Arms 1988	10	Roberts and Dorough 1985
Methoxychlor	0.04	Travis and Arms 1988	1	--
Toxaphene	0.03	Travis and Arms 1988	1	--
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	0.19	Travis and Arms 1988	0.56	Beyer 1996
1,2-Dichlorobenzene	0.40	Travis and Arms 1988	1	--
1,3-Dichlorobenzene	0.37	Travis and Arms 1988	1	--
1,4-Dichlorobenzene	0.41	Travis and Arms 1988	1	--
4-Bromophenyl-Phenylether	0.05	Travis and Arms 1988	1	--
4-Chlorophenyl-Phenylether	0.05	Travis and Arms 1988	1	--
Acenaphthene	0.21	Travis and Arms 1988	0.3	Beyer and Stafford 1993
Acenaphthylene	0.17	Travis and Arms 1988	0.22	Beyer and Stafford 1993
Anthracene	0.09	Travis and Arms 1988	0.32	Beyer and Stafford 1993
Benzo(a)anthracene	0.02	Travis and Arms 1988	0.27	Beyer and Stafford 1993
Benzo(a)pyrene	0.01	Travis and Arms 1988	0.34	Beyer and Stafford 1993
Benzo(b)fluoranthene	0.01	Travis and Arms 1988	0.21	Beyer and Stafford 1993
Benzo(g,h,i)perylene	0.01	Travis and Arms 1988	0.15	Beyer and Stafford 1993
Benzo(k)fluoranthene	0.01	Travis and Arms 1988	0.21	Beyer and Stafford 1993
Chrysene	0.02	Travis and Arms 1988	0.44	Beyer and Stafford 1993
Dibenz(a,h)anthracene	0.01	Travis and Arms 1988	0.49	Beyer and Stafford 1993
Fluoranthene	0.04	Travis and Arms 1988	0.37	Beyer and Stafford 1993
Fluorene	0.14	Travis and Arms 1988	0.2	Beyer and Stafford 1993
Hexachlorobutadiene	0.06	Travis and Arms 1988	1	--
Hexachlorobenzene	0.02	Travis and Arms 1988	1.69	Beyer 1996
Hexachlorocyclopentadiene	0.03	Travis and Arms 1988	1	--
Hexachloroethane	0.19	Travis and Arms 1988	1	--
Indeno(1,2,3-cd)pyrene	0.01	Travis and Arms 1988	0.41	Beyer and Stafford 1993
Pentachlorophenol	0.04	Travis and Arms 1988	5.18	van Gestel and Ma 1988
Phenanthrene	0.09	Travis and Arms 1988	0.28	Beyer and Stafford 1993
Pyrene	0.04	Travis and Arms 1988	0.39	Beyer and Stafford 1993

Table B-3
Soil Bioaccumulation Factors Used For Small Mammals - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Soil-Mouse BAF (dry weight)		Soil-Vole BAF (dry weight)		Soil-Shrew BAF (dry weight)	
	Value	Reference	Value	Reference	Value	Reference
Inorganics						
Arsenic	0.01	Sample et al. 1998b	0.02	Sample et al. 1998b	0.01	Sample et al. 1998b
Cadmium	0.46	Sample et al. 1998b	0.45	Sample et al. 1998b	7.02	Sample et al. 1998b
Chromium	0.35	Sample et al. 1998b	0.31	Sample et al. 1998b	0.33	Sample et al. 1998b
Copper	0.55	Sample et al. 1998b	1.29	Sample et al. 1998b	1.12	Sample et al. 1998b
Lead	0.29	Sample et al. 1998b	0.19	Sample et al. 1998b	0.34	Sample et al. 1998b
Mercury	0.13	Sample et al. 1998b	0.19	Sample et al. 1998b	0.19	Sample et al. 1998b
Nickel	0.59	Sample et al. 1998b	0.90	Sample et al. 1998b	0.58	Sample et al. 1998b
Selenium	1.26	Sample et al. 1998b	0.16	Sample et al. 1998b	1.19	Sample et al. 1998b
Silver	1	--	1	--	1	--
Zinc	2.78	Sample et al. 1998b	2.32	Sample et al. 1998b	2.90	Sample et al. 1998b
Pesticides/PCBs						
4,4'-DDD	1	--	1	--	1	--
4,4'-DDE	1	--	1	--	1	--
4,4'-DDT	1	--	1	--	1	--
Aldrin	1	--	1	--	1	--
alpha-BHC	1	--	1	--	1	--
Aroclor-1016	1	--	1	--	1	--
Aroclor-1221	1	--	1	--	1	--
Aroclor-1232	1	--	1	--	1	--
Aroclor-1242	1	--	1	--	1	--
Aroclor-1248	1	--	1	--	1	--
Aroclor-1254	1	--	1	--	1	--
Aroclor-1260	1	--	1	--	1	--
beta-BHC	1	--	1	--	1	--
delta-BHC	1	--	1	--	1	--
Dieldrin	1	--	1	--	1	--
Endosulfan I	1	--	1	--	1	--
Endosulfan II	1	--	1	--	1	--
Endrin	1	--	1	--	1	--
Gamma-BHC (Lindane)	1	--	1	--	1	--
Heptachlor	1	--	1	--	1	--
Heptachlor Epoxide	1	--	1	--	1	--
Methoxychlor	1	--	1	--	1	--
Toxaphene	1	--	1	--	1	--
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	1	--	1	--	1	--
1,2-Dichlorobenzene	1	--	1	--	1	--
1,3-Dichlorobenzene	1	--	1	--	1	--
1,4-Dichlorobenzene	1	--	1	--	1	--
4-Bromophenyl-Phenylether	1	--	1	--	1	--
4-Chlorophenyl-Phenylether	1	--	1	--	1	--
Acenaphthene	1	--	1	--	1	--
Acenaphthylene	1	--	1	--	1	--
Anthracene	1	--	1	--	1	--
Benzo(a)anthracene	1	--	1	--	1	--
Benzo(a)pyrene	1	--	1	--	1	--
Benzo(b)fluoranthene	1	--	1	--	1	--
Benzo(g,h,i)perylene	1	--	1	--	1	--
Benzo(k)fluoranthene	1	--	1	--	1	--
Chrysene	1	--	1	--	1	--
Dibenz(a,h)anthracene	1	--	1	--	1	--
Fluoranthene	1	--	1	--	1	--
Fluorene	1	--	1	--	1	--
Hexachlorobutadiene	1	--	1	--	1	--
Hexachlorobenzene	1	--	1	--	1	--
Hexachlorocyclopentadiene	1	--	1	--	1	--
Hexachloroethane	1	--	1	--	1	--
Indeno(1,2,3-cd)pyrene	1	--	1	--	1	--
Pentachlorophenol	1	--	1	--	1	--
Phenanthrene	1	--	1	--	1	--
Pyrene	1	--	1	--	1	--

Table B-4
Soil Bioaccumulation Factors Used For Small Mammals - Mean Concentration
St. Juliens Creek Annex - Site 4

Chemical	Soil-Mouse BAF (dry weight)		Soil-Vole BAF (dry weight)		Soil-Shrew BAF (dry weight)	
	Value	Reference	Value	Reference	Value	Reference
Inorganics						
Arsenic	0.003	Sample et al. 1998b	0.01	Sample et al. 1998b	0.004	Sample et al. 1998b
Cadmium	0.14	Sample et al. 1998b	0.13	Sample et al. 1998b	2.21	Sample et al. 1998b
Chromium	0.09	Sample et al. 1998b	0.12	Sample et al. 1998b	0.09	Sample et al. 1998b
Copper	0.11	Sample et al. 1998b	0.11	Sample et al. 1998b	0.50	Sample et al. 1998b
Lead	0.05	Sample et al. 1998b	0.04	Sample et al. 1998b	0.15	Sample et al. 1998b
Mercury	0.07	Sample et al. 1998b	0.07	Sample et al. 1998b	0.07	Sample et al. 1998b
Nickel	0.26	Sample et al. 1998b	0.26	Sample et al. 1998b	0.35	Sample et al. 1998b
Selenium	0.26	Sample et al. 1998b	0.02	Sample et al. 1998b	0.27	Sample et al. 1998b
Silver	1	--	1	--	1	--
Zinc	0.51	Sample et al. 1998b	0.29	Sample et al. 1998b	0.86	Sample et al. 1998b
Pesticides/PCBs						
4,4'-DDD	1	--	1	--	1	--
4,4'-DDE	1	--	1	--	1	--
4,4'-DDT	1	--	1	--	1	--
Aldrin	1	--	1	--	1	--
alpha-BHC	1	--	1	--	1	--
Aroclor-1016	1	--	1	--	1	--
Aroclor-1221	1	--	1	--	1	--
Aroclor-1232	1	--	1	--	1	--
Aroclor-1242	1	--	1	--	1	--
Aroclor-1248	1	--	1	--	1	--
Aroclor-1254	1	--	1	--	1	--
Aroclor-1260	1	--	1	--	1	--
beta-BHC	1	--	1	--	1	--
delta-BHC	1	--	1	--	1	--
Dieldrin	1	--	1	--	1	--
Endosulfan I	1	--	1	--	1	--
Endosulfan II	1	--	1	--	1	--
Endrin	1	--	1	--	1	--
Gamma-BHC (Lindane)	1	--	1	--	1	--
Heptachlor	1	--	1	--	1	--
Heptachlor Epoxide	1	--	1	--	1	--
Methoxychlor	1	--	1	--	1	--
Toxaphene	1	--	1	--	1	--
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	1	--	1	--	1	--
1,2-Dichlorobenzene	1	--	1	--	1	--
1,3-Dichlorobenzene	1	--	1	--	1	--
1,4-Dichlorobenzene	1	--	1	--	1	--
4-Bromophenyl-Phenylether	1	--	1	--	1	--
4-Chlorophenyl-Phenylether	1	--	1	--	1	--
Acenaphthene	1	--	1	--	1	--
Acenaphthylene	1	--	1	--	1	--
Anthracene	1	--	1	--	1	--
Benzo(a)anthracene	1	--	1	--	1	--
Benzo(a)pyrene	1	--	1	--	1	--
Benzo(b)fluoranthene	1	--	1	--	1	--
Benzo(g,h,i)perylene	1	--	1	--	1	--
Benzo(k)fluoranthene	1	--	1	--	1	--
Chrysene	1	--	1	--	1	--
Dibenz(a,h)anthracene	1	--	1	--	1	--
Fluoranthene	1	--	1	--	1	--
Fluorene	1	--	1	--	1	--
Hexachlorobutadiene	1	--	1	--	1	--
Hexachlorobenzene	1	--	1	--	1	--
Hexachlorocyclopentadiene	1	--	1	--	1	--
Hexachloroethane	1	--	1	--	1	--
Indeno(1,2,3-cd)pyrene	1	--	1	--	1	--
Pentachlorophenol	1	--	1	--	1	--
Phenanthrene	1	--	1	--	1	--
Pyrene	1	--	1	--	1	--

Table B-5
Sediment Bioaccumulation Factors Used For Aquatic Invertebrates and Fish - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Chemical	Sediment-Invertebrate BAF (dry weight)		Sediment-Fish BAF (dry weight)	
	Value	Reference	Value	Reference
Inorganics				
Arsenic	0.68	Bechtel Jacobs 1998b	0.13	Pascoe et al. 1996
Cadmium	3.07	Bechtel Jacobs 1998b	0.16	Pascoe et al. 1996
Chromium	0.19	Bechtel Jacobs 1998b	0.04	Krantzberg and Boyd 1992
Copper	7.96	Bechtel Jacobs 1998b	0.1	Krantzberg and Boyd 1992
Lead	0.33	Bechtel Jacobs 1998b	0.07	Krantzberg and Boyd 1992
Mercury	1.74	Bechtel Jacobs 1998b	4.58	Cope et al. 1990
Nickel	0.21	Bechtel Jacobs 1998b	1	--
Selenium	1	--	1	--
Silver	0.18	Hirsch 1998	1	--
Zinc	4.76	Bechtel Jacobs 1998b	0.15	Pascoe et al. 1996
Pesticides/PCBs				
4,4'-DDD	0.5	Oliver 1987	2.61	Oliver and Niimi 1988
4,4'-DDE	4.3	Oliver 1987	20.39	Oliver and Niimi 1988
4,4'-DDT	0.5	Oliver 1987	9.11	Oliver and Niimi 1988
Aldrin	1	--	1	--
alpha-BHC	1	--	1	--
Aroclor-1016	21.89	Bechtel Jacobs 1998b	11.24	Oliver and Niimi 1988
Aroclor-1221	21.89	Bechtel Jacobs 1998b	11.24	Oliver and Niimi 1988
Aroclor-1232	21.89	Bechtel Jacobs 1998b	11.24	Oliver and Niimi 1988
Aroclor-1242	21.89	Bechtel Jacobs 1998b	11.24	Oliver and Niimi 1988
Aroclor-1248	21.89	Bechtel Jacobs 1998b	11.24	Oliver and Niimi 1988
Aroclor-1254	21.89	Bechtel Jacobs 1998b	11.24	Oliver and Niimi 1988
Aroclor-1260	21.89	Bechtel Jacobs 1998b	11.24	Oliver and Niimi 1988
beta-BHC	1	--	1	--
delta-BHC	1	--	1	--
Dieldrin	1	--	1	--
Endosulfan I	1	--	1	--
Endosulfan II	1	--	1	--
Endrin	1	--	1	--
Gamma-BHC (Lindane)	1	--	1	--
Heptachlor	1	--	1	--
Heptachlor Epoxide	1	--	1	--
Methoxychlor	1	--	1	--
Toxaphene	1	--	1	--
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	1	--	1	--
1,2-Dichlorobenzene	1	--	1	--
1,3-Dichlorobenzene	1	--	1	--
1,4-Dichlorobenzene	1	--	1	--
4-Bromophenyl-Phenylether	1	--	1	--
4-Chlorophenyl-Phenylether	1	--	1	--
Acenaphthene	2.04	Maruya et al. 1997	1	--
Acenaphthylene	1	--	1	--
Anthracene	0.27	Maruya et al. 1997	1	--
Benzo(a)anthracene	1.4	Maruya et al. 1997	1	--
Benzo(a)pyrene	0.19	Maruya et al. 1997	1	--
Benzo(b)fluoranthene	0.16	Maruya et al. 1997	1	--
Benzo(g,h,i)perylene	0.30	Maruya et al. 1997	1	--
Benzo(k)fluoranthene	0.42	Maruya et al. 1997	1	--
Chrysene	0.34	Maruya et al. 1997	1	--
Dibenz(a,h)anthracene	1	--	1	--
Fluoranthene	0.31	Maruya et al. 1997	1	--
Fluorene	1.13	Maruya et al. 1997	1	--
Hexachlorobutadiene	1	--	1	--
Hexachlorobenzene	1	--	1	--
Hexachlorocyclopentadiene	1	--	1	--
Hexachloroethane	1	--	1	--
Indeno(1,2,3-cd)pyrene	0.36	Maruya et al. 1997	1	--
Pentachlorophenol	1	--	1	--
Phenanthrene	0.65	Maruya et al. 1997	1	--
Pyrene	0.80	Maruya et al. 1997	1	--

Table B-6
Sediment Bioaccumulation Factors Used For Aquatic Invertebrates and Fish - Mean Concentration
St. Juliens Creek Annex - Site 4

Chemical	Sediment-Invertebrate BAF (dry weight)		Sediment-Fish BAF (dry weight)	
	Value	Reference	Value	Reference
Inorganics				
Arsenic	0.44	Bechtel Jacobs 1998b	0.13	Pascoe et al. 1996
Cadmium	0.68	Bechtel Jacobs 1998b	0.16	Pascoe et al. 1996
Chromium	0.09	Bechtel Jacobs 1998b	0.04	Krantzberg and Boyd 1992
Copper	0.92	Bechtel Jacobs 1998b	0.1	Krantzberg and Boyd 1992
Lead	0.34	Bechtel Jacobs 1998b	0.07	Krantzberg and Boyd 1992
Mercury	1.02	Bechtel Jacobs 1998b	3.25	Cope et al. 1990
Nickel	0.13	Bechtel Jacobs 1998b	1	--
Selenium	1	--	1	--
Silver	0.18	Hirsch 1998	1	--
Zinc	0.95	Bechtel Jacobs 1998b	0.15	Pascoe et al. 1996
Pesticides/PCBs				
4,4'-DDD	0.5	Oliver 1987	1.66	Oliver and Niimi 1988
4,4'-DDE	4.3	Oliver 1987	15.88	Oliver and Niimi 1988
4,4'-DDT	0.5	Oliver 1987	6.56	Oliver and Niimi 1988
Aldrin	1	--	1	--
alpha-BHC	1	--	1	--
Aroclor-1016	1.92	Bechtel Jacobs 1998b	8.64	Oliver and Niimi 1988
Aroclor-1221	1.92	Bechtel Jacobs 1998b	8.64	Oliver and Niimi 1988
Aroclor-1232	1.92	Bechtel Jacobs 1998b	8.64	Oliver and Niimi 1988
Aroclor-1242	1.92	Bechtel Jacobs 1998b	8.64	Oliver and Niimi 1988
Aroclor-1248	1.92	Bechtel Jacobs 1998b	8.64	Oliver and Niimi 1988
Aroclor-1254	1.92	Bechtel Jacobs 1998b	8.64	Oliver and Niimi 1988
Aroclor-1260	1.92	Bechtel Jacobs 1998b	8.64	Oliver and Niimi 1988
beta-BHC	1	--	1	--
delta-BHC	1	--	1	--
Dieldrin	1	--	1	--
Endosulfan I	1	--	1	--
Endosulfan II	1	--	1	--
Endrin	1	--	1	--
Gamma-BHC (Lindane)	1	--	1	--
Heptachlor	1	--	1	--
Heptachlor Epoxide	1	--	1	--
Methoxychlor	1	--	1	--
Toxaphene	1	--	1	--
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	1	--	1	--
1,2-Dichlorobenzene	1	--	1	--
1,3-Dichlorobenzene	1	--	1	--
1,4-Dichlorobenzene	1	--	1	--
4-Bromophenyl-Phenylether	1	--	1	--
4-Chlorophenyl-Phenylether	1	--	1	--
Acenaphthene	2.04	Maruya et al. 1997	1	--
Acenaphthylene	1	--	1	--
Anthracene	0.19	Maruya et al. 1997	1	--
Benzo(a)anthracene	0.36	Maruya et al. 1997	1	--
Benzo(a)pyrene	0.13	Maruya et al. 1997	1	--
Benzo(b)fluoranthene	0.15	Maruya et al. 1997	1	--
Benzo(g,h,i)perylene	0.22	Maruya et al. 1997	1	--
Benzo(k)fluoranthene	0.23	Maruya et al. 1997	1	--
Chrysene	0.20	Maruya et al. 1997	1	--
Dibenz(a,h)anthracene	1	--	1	--
Fluoranthene	0.21	Maruya et al. 1997	1	--
Fluorene	0.48	Maruya et al. 1997	1	--
Hexachlorobutadiene	1	--	1	--
Hexachlorobenzene	1	--	1	--
Hexachlorocyclopentadiene	1	--	1	--
Hexachloroethane	1	--	1	--
Indeno(1,2,3-cd)pyrene	0.17	Maruya et al. 1997	1	--
Pentachlorophenol	1	--	1	--
Phenanthrene	0.29	Maruya et al. 1997	1	--
Pyrene	0.44	Maruya et al. 1997	1	--

Table B-7
Exposure Parameters for Upper Trophic Level Ecological Receptors - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek Annex - Site 4

Receptor	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)	
	Value	Reference	Value	Reference	Value	Reference
Birds						
American robin	0.06	USEPA 1993a	0.01	allometric equation	0.01	Levey and Karasov 1989
American woodcock	0.15	USEPA 1993a	0.02	allometric equation	0.03	USEPA 1993a
Belted kingfisher	0.13	Dunning 1993	0.02	allometric equation	0.02	USEPA 1993a
Red-tailed hawk	0.96	USEPA 1993a	0.07	allometric equation	0.04	Sample and Suter 1994
Mammals						
Deer mouse	0.01	Silva and Downing 1995	0.00	USEPA 1993	0.00	USEPA 1993a
Mink	0.73	Silva and Downing 1995	0.03	USEPA 1993	0.03	USEPA 1993a
Muskrat	0.75	USEPA 1993a	0.14	allometric equation	0.08	USEPA 1993a
Raccoon	4.23	Silva and Downing 1995	0.61	allometric equation	0.13	Conover 1989
Red fox	3.17	Silva and Downing 1995	0.41	allometric equation	0.15	Sample and Suter 1994
Short-tailed shrew	0.013	USEPA 1993a	0.005	USEPA 1993	0.002	USEPA 1993a

Table B-7
Exposure Parameters for Upper Trophic Level Ecological Receptors - Maximum Concentration (Worst Case Scenario)
St. Juliens Creek - Site 4

Receptor	Dietary Composition (percent)							Soil/ Sediment Ingestion (percent)	
	Terr. Plants	Soil Invert.	Small Mammals	Fish/ Frogs	Aquatic Plants	Aquatic Invert./Amphibians	Reference	Value	Reference
Birds									
American robin	51.6	43.6	0	0	0	0	Martin et al. 1951	4.8	Sample and Suter 1994
American woodcock	0	89.6	0	0	0	0	USEPA 1993a	10.4	Beyer et al. 1994
Belted kingfisher	0	0	0	84	0	16	USEPA 1993a	0	Sample and Suter 1994
Red-tailed hawk	0	0	100	0	0	0	USEPA 1993a; Sample and Suter 1994	0	Sample and Suter 1994
Mammals									
Deer mouse	53	45	0	0	0	0	Martin et al. 1951	2	Beyer et al. 1994
Mink	0	0	0	94	1	5	USEPA 1993a	0	Sample and Suter 1994
Muskrat	0	0	0	0	90.6	0	USEPA 1993a	9.4	Beyer et al. 1994 (raccoon)
Raccoon	0	0	0	7	40	43.6	USEPA 1993a	9.4	Beyer et al. 1994
Red fox	7	2.8	87.4	0	0	0	USEPA 1993a	2.8	Beyer et al. 1994
Short-tailed shrew	4.7	82.3	0	0	0	0	USEPA 1993a; Sample and Suter 1994	13	Sample and Suter 1994

Table B-8
Exposure Parameters for Upper Trophic Level Ecological Receptors - Mean Concentration
St. Juliens Creek Annex - Site 4

Receptor	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)	
	Value	Reference	Value	Reference	Value	Reference
Birds						
American robin	0.08	USEPA 1993a	0.01	allometric equation	0.01	Levey and Karasov 1989
American woodcock	0.20	Dunning 1993	0.02	allometric equation	0.02	USEPA 1993a
Belted kingfisher	0.15	Dunning 1993	0.02	allometric equation	0.02	USEPA 1993a
Red-tailed hawk	1.13	Sample and Suter 1994	0.06	allometric equation	0.04	Sample and Suter 1994
Mammals						
Deer mouse	0.02	Silva and Downing 1995	0.00	USEPA 1993a	0.00	USEPA 1993a
Mink	0.78	Silva and Downing 1995	0.02	USEPA 1993a	0.03	USEPA 1993a
Muskrat	1.17	Silva and Downing 1995	0.11	allometric equation	0.06	USEPA 1993a
Raccoon	5.94	Silva and Downing 1995	0.49	allometric equation	0.10	Conover 1989
Red fox	4.06	Silva and Downing 1995	0.35	allometric equation	0.12	Sample and Suter 1994
Short-tailed shrew	0.02	USEPA 1993a	0.00	USEPA 1993a	0.00	USEPA 1993a

Table B-8
Exposure Parameters for Upper Trophic Level Ecological Receptors - Mean Concentration
St. Juliens Creek Annex - Site 4

Receptor	Dietary Composition (percent)							Soil/ Sediment Ingestion (percent)	
	Terr. Plants	Soil Invert.	Small Mammals	Fish/ Frogs	Aquatic Plants	Aquatic Invert./Amphibians	Reference	Value	Reference
Birds									
American robin	51.6	43.6	0	0	0	0	Martin et al. 1951	4.8	Sample and Suter 1994
American woodcock	0	89.6	0	0	0	0	USEPA 1993a	10.4	Beyer et al. 1994
Belted kingfisher	0	0	0	84	0	16	USEPA 1993a	0	Sample and Suter 1994
Red-tailed hawk	0	0	100	0	0	0	USEPA 1993a; Sample and Suter 1994	0	Sample and Suter 1994
Mammals									
Deer mouse	53	45	0	0	0	0	Martin et al. 1951	2	Beyer et al. 1994
Mink	0	0	0	94	1	5	USEPA 1993a	0	Sample and Suter 1994
Muskrat	0	0	0	0	90.6	0	USEPA 1993a	9.4	Beyer et al. 1994 (raccoon)
Raccoon	0	0	0	7	40	43.6	USEPA 1993a	9.4	Beyer et al. 1994
Red fox	7	2.8	87.4	0	0	0	USEPA 1993a	2.8	Beyer et al. 1994
Short-tailed shrew	4.7	82.3	0	0	0	0	USEPA 1993a; Sample and Suter 1994	13	Sample and Suter 1994

Table B-9
Ingestion Screening Values for Mammals
St. Juliens Creek Annex - Site 4

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Inorganics								
Arsenic	mouse	0.03	3 generations	oral in water	reproduction	1.26	0.13	Sample et al. 1996
Cadmium	rat	0.30	6 weeks	oral (gavage)	reproduction	10	1	Sample et al. 1996
Cadmium	dog	10	3 months	oral	reproduction	7.5	0.75	ATSDR 1993
Chromium	rat	0.35	3 months	oral in water	mortality	131.4	13.14	Sample et al. 1996
Copper	mink	1	357 days	oral in diet	reproduction	15.14	11.7	Sample et al. 1996
Lead	rat	0.35	3 generations	oral in diet	reproduction	80	8	Sample et al. 1996
Mercury	rat	0.35	3 generations	oral in diet	reproduction	0.16	0.03	Sample et al. 1996
Mercury	mink	1	93 days	oral in diet	mortality/weight loss	0.25	0.15	Sample et al. 1996
Nickel	rat	0.35	3 generations	oral in diet	reproduction	80	40	Sample et al. 1996
Selenium	rat	0.35	1 year	oral in water	reproduction	0.33	0.2	Sample et al. 1996
Silver	rat	0.35	2 weeks	oral in water	mortality	181	18.1	ATSDR 1990
Zinc	rat	0.35	GD 1-16	oral in diet	reproduction	320	160	Sample et al. 1996
Zinc	mink	1	25 weeks	oral	reproduction	208	20.8	ATSDR 1992
Pesticides/PCBs								
4,4'-DDD	rat	0.35	2 years	oral in diet	reproduction	4	0.8	Sample et al. 1996
4,4'-DDD	dog	10	2 generations	oral	reproduction	5	1	ATSDR 1994
4,4'-DDE	rat	0.35	2 years	oral in diet	reproduction	4	0.8	Sample et al. 1996
4,4'-DDE	dog	10	2 generations	oral	reproduction	5	1	ATSDR 1994
4,4'-DDT	rat	0.35	2 years	oral in diet	reproduction	4	0.8	Sample et al. 1996
4,4'-DDT	dog	10	2 generations	oral	reproduction	5	1	ATSDR 1994
Aldrin	rat	0.35	3 generations	oral in diet	reproduction	1	0.2	Sample et al. 1996
alpha-BHC	rat	0.35	4 generations	oral in diet	reproduction	3.2	1.6	Sample et al. 1996
Aroclor-1016	mink	1	18 months	oral in diet	reproduction	3.43	1.37	Sample et al. 1996
Aroclor-1221	mink	1	7 months	oral in diet	reproduction	0.69	0.07	Sample et al. 1996
Aroclor-1232	mink	1	7 months	oral in diet	reproduction	0.69	0.07	Sample et al. 1996
Aroclor-1242	mink	1	7 months	oral in diet	reproduction	0.69	0.07	Sample et al. 1996
Aroclor-1248	mouse	0.03	5 weeks	oral in diet	immunological	13	1.3	ATSDR 1995
Aroclor-1248	rhesus monkey	5	14 months	oral in diet	reproduction	0.1	0.01	Sample et al. 1996
Aroclor-1254	oldfield mouse	0.01	12 months	oral in diet	reproduction	0.68	0.07	Sample et al. 1996
Aroclor-1254	mink	1	4.5 months	oral in diet	reproduction	0.69	0.14	Sample et al. 1996
Aroclor-1260	oldfield mouse	0.01	12 months	oral in diet	reproduction	0.68	0.07	Sample et al. 1996
Aroclor-1260	mink	1	4.5 months	oral in diet	reproduction	0.69	0.14	Sample et al. 1996
beta-BHC	rat	0.35	13 weeks	oral in diet	growth/systemic	20	4	Sample et al. 1996
delta-BHC	rat	0.35	4 generations	oral in diet	reproduction	3.2	1.6	Sample et al. 1996
Dieldrin	rat	0.35	3 generations	oral in diet	reproduction	0.2	0.02	Sample et al. 1996
Endosulfan I	rat	0.35	30 days	oral (intubation)	reproduction	15	1.5	Sample et al. 1996
Endosulfan II	rat	0.35	30 days	oral (intubation)	reproduction	15	1.5	Sample et al. 1996

Table B-9
Ingestion Screening Values for Mammals
St. Juliens Creek Annex - Site 4

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Endrin	mouse	0.03	120 days	oral in diet	reproduction	0.92	0.09	Sample et al. 1996
Gamma-BHC (Lindane)	rat	0.35	3 generations	oral in diet	reproduction	80	8	Sample et al. 1996
Heptachlor	mink	1	181 days	oral in diet	reproduction	1	0.1	Sample et al. 1996
Heptachlor Epoxide	mink	1	181 days	oral in diet	reproduction	1	0.1	Sample et al. 1996
Methoxychlor	rat	0.35	11 months	oral in diet	reproduction	8	4	Sample et al. 1996
Toxaphene	rat	0.35	3 generations	oral in diet	reproduction	80	8	Sample et al. 1996
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	rat	0.35	3 generations	oral in water	reproduction	106	53	Coulston and Kolbye 1994
1,2-Dichlorobenzene	rat	0.35	chronic	oral (gavage)	liver/kidney	857	85.7	Coulston and Kolbye 1994
1,3-Dichlorobenzene	rat	0.35	chronic	oral (gavage)	liver/kidney	857	85.7	Coulston and Kolbye 1994
1,4-Dichlorobenzene	rat	0.35	GD 6-15	oral (gavage)	reproduction	500	250	Coulston and Kolbye 1994
4-Bromophenyl-Phenylether	--	--	--	--	--	NA	NA	--
4-Chlorophenyl-Phenylether	--	--	--	--	--	NA	NA	--
Acenaphthene	mouse	0.03	13 weeks	oral (gavage)	reproduction	3500	350	ATSDR 1995
Acenaphthylene	mouse	0.03	13 weeks	oral (gavage)	reproduction	3500	350	ATSDR 1995
Anthracene	mouse	0.03	13 weeks	oral (gavage)	reproduction	10000	1000	ATSDR 1995
Benzo(a)anthracene	mouse	0.03	GD 7-16	oral (intubation)	reproduction	10	1	Sample et al. 1996
Benzo(a)pyrene	mouse	0.03	GD 7-16	oral (intubation)	reproduction	10	1	Sample et al. 1996
Benzo(b)fluoranthene	mouse	0.03	GD 7-16	oral (intubation)	reproduction	10	1	Sample et al. 1996
Benzo(g,h,i)perylene	mouse	0.03	19 to 29 days	oral in diet	reproduction	1330	133	ATSDR 1995
Benzo(k)fluoranthene	mouse	0.03	GD 7-16	oral (intubation)	reproduction	10	1	Sample et al. 1996
Chrysene	mouse	0.03	GD 7-16	oral (intubation)	reproduction	10	1	Sample et al. 1996
Dibenz(a,h)anthracene	mouse	0.03	GD 7-16	oral (intubation)	reproduction	10	1	Sample et al. 1996
Fluoranthene	mouse	0.03	13 weeks	oral (gavage)	hepatic	1250	125	ATSDR 1995
Fluorene	mouse	0.03	13 weeks	oral (gavage)	hematological	1250	125	ATSDR 1995
Hexachlorobutadiene	rat	0.35	90 days +	oral	reproduction	20	2	IPCS 1994
Hexachlorobenzene	rat	0.35	2 years	oral	reproduction	16	1.6	ATSDR 1989
Hexachlorocyclopentadiene	rat	0.35	GD 6-15	oral	reproduction	30	10	USEPA 1984
Hexachloroethane	--	--	--	--	--	NA	NA	--
Indeno(1,2,3-cd)pyrene	mouse	0.03	GD 7-16	oral (intubation)	reproduction	10	1	Sample et al. 1996
Pentachlorophenol	rat	0.35	up to 24 months	oral in diet	reproduction	30	3	Coulston and Kolbye 1994
Phenanthrene	mouse	0.03	19 to 29 days	oral in diet	reproduction	1330	133	ATSDR 1995
Pyrene	mouse	0.03	19 to 29 days	oral in diet	reproduction	1330	133	ATSDR 1995

Table B-10
Ingestion Screening Values for Birds
St. Juliens Creek Annex - Site 4

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Inorganics								
Arsenic	brown-headed cowbird	0.05	7 months	oral in diet	mortality	7.38	2.46	Sample et al. 1996
Arsenic	mallard	1	128 days	oral in diet	mortality	12.84	5.14	Sample et al. 1996
Cadmium	mallard	1.15	90 days	oral in diet	reproduction	20	1.45	Sample et al. 1996
Chromium	American black duck	1.25	10 months	oral in diet	reproduction	5	1	Sample et al. 1996
Copper	chicks	0.53	10 weeks	oral in diet	growth/mortality	61.7	47	Sample et al. 1996
Lead	Japanese quail	0.15	12 weeks	oral in diet	reproduction	11.3	1.13	Sample et al. 1996
Lead	American kestrel	0.13	7 months	oral in diet	reproduction	38.5	3.85	Sample et al. 1996
Mercury	Japanese quail	0.15	1 year	oral in diet	reproduction	0.9	0.45	Sample et al. 1996
Mercury	mallard	1	3 generations	oral in diet	reproduction	0.06	0.006	Sample et al. 1996
Nickel	mallard	0.78	90 days	oral in diet	growth/mortality	107	77.4	Sample et al. 1996
Selenium	mallard	1	100 days	oral in diet	reproduction	0.8	0.4	Sample et al. 1996
Selenium	screech owl	0.2	13.7 weeks	oral in diet	reproduction	1.5	0.44	Sample et al. 1996
Silver	mallard	?	14 days	oral	?	1780	178	USEPA 1999b
Zinc	chicken	1.94	44 weeks	oral in diet	reproduction	131	14.5	Sample et al. 1996
Pesticides/PCBs								
4,4'-DDD	mallard	1.13	chronic	oral	reproduction	5.2	0.52	Stickel 1973
4,4'-DDD	American kestrel	0.12	2 years	oral	reproduction	0.5	0.05	McLane and Hall 1972
4,4'-DDE	brown pelican	3.5	chronic	oral	reproduction	1.31	0.13	Beyer et al. 1996
4,4'-DDE	American kestrel	0.12	2 years	oral	reproduction	0.5	0.05	McLane and Hall 1972
4,4'-DDT	mallard	1.13	chronic	oral	reproduction	1.04	0.10	Davison and Sell 1974
4,4'-DDT	American kestrel	0.12	2 years	oral	reproduction	0.5	0.05	McLane and Hall 1972
Aldrin	mallard	1.13	chronic	oral	mortality	5	0.5	Tucker and Crabtree 1970
alpha-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
Aroclor-1016	screech owl	0.18	2 generations	oral in diet	reproduction	4.1	0.41	Sample et al. 1996
Aroclor-1221	screech owl	0.18	2 generations	oral in diet	reproduction	4.1	0.41	Sample et al. 1996
Aroclor-1232	screech owl	0.18	2 generations	oral in diet	reproduction	4.1	0.41	Sample et al. 1996
Aroclor-1242	screech owl	0.18	2 generations	oral in diet	reproduction	4.1	0.41	Sample et al. 1996
Aroclor-1248	ring-necked pheasant	1	17 weeks	oral	reproduction	1.8	0.18	Sample et al. 1996
Aroclor-1254	ring-necked pheasant	1	17 weeks	oral	reproduction	1.8	0.18	Sample et al. 1996
Aroclor-1260	ring-necked pheasant	1	17 weeks	oral	reproduction	1.8	0.18	Sample et al. 1996
beta-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
delta-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
Dieldrin	barn owl	0.47	2 years	oral in diet	reproduction	0.77	0.08	Sample et al. 1996
Endosulfan I	gray partridge	0.4	4 weeks	oral in diet	reproduction	100	10	Sample et al. 1996
Endosulfan II	gray partridge	0.4	4 weeks	oral in diet	reproduction	100	10	Sample et al. 1996
Endrin	mallard	1.15	>200 days	oral in diet	reproduction	3	0.3	Sample et al. 1996
Endrin	screech owl	0.18	>83 days	oral in diet	reproduction	0.1	0.01	Sample et al. 1996

Table B-10
Ingestion Screening Values for Birds
St. Juliens Creek Annex - Site 4

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Gamma-BHC (Lindane)	mallard	1	8 weeks	oral (intubation)	reproduction	20	2	Sample et al. 1996
Heptachlor	quail	0.19	5 days	oral in diet	mortality	4.05	0.41	Hill et al. 1975
Heptachlor Epoxide	quail	0.19	5 days	oral in diet	mortality	4.05	0.41	Hill et al. 1975
Methoxychlor	quail	0.19	5 days	oral in diet	mortality	4050	405	Hill and Camardese 1986
Toxaphene	mallard	1.04	5 days	oral in diet	mortality	3.07	0.31	Hill and Camardese 1986
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	--	--	--	--	--	NA	NA	--
1,2-Dichlorobenzene	northern bobwhite	0.16	14 days	oral (gavage)	growth/mortality	2500	250	Grimes and Jaber 1989
1,3-Dichlorobenzene	northern bobwhite	0.16	14 days	oral (gavage)	growth/mortality	2500	250	Grimes and Jaber 1989
1,4-Dichlorobenzene	northern bobwhite	0.16	14 days	oral (gavage)	growth/mortality	2500	250	Grimes and Jaber 1989
4-Bromophenyl-Phenylether	--	--	--	--	--	NA	NA	--
4-Chlorophenyl-Phenylether	--	--	--	--	--	NA	NA	--
Acenaphthene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Acenaphthylene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Anthracene	mallard	1.04	7 months	oral in diet	hepatic	228	22.8	Patton and Dieter 1980
Benzo(a)anthracene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Benzo(a)pyrene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Benzo(b)fluoranthene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Benzo(g,h,i)perylene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Benzo(k)fluoranthene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Chrysene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Dibenz(a,h)anthracene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Fluoranthene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Fluorene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Hexachlorobutadiene	Japanese quail	0.19	90 days	oral	reproduction	8	2.5	Coulston and Kolbye 1994; IPCS 1994
Hexachlorobenzene	Japanese quail	0.19	?	oral	reproduction	0.8	0.08	Coulston and Kolbye 1994
Hexachlorocyclopentadiene	--	--	--	--	--	NA	NA	--
Hexachloroethane	--	--	--	--	--	NA	NA	--
Indeno(1,2,3-cd)pyrene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Pentachlorophenol	chicken	1.5	8 weeks	oral	growth	200	100	Eisler 1989
Phenanthrene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963
Pyrene	chicken	1.5	34 days	oral in diet	reproduction	395	39.5	Rigdon and Neal 1963

Table B-11
Summary of Hazard Quotients for Food Web Exposures - Maximum Concentration (Worst Case Scenario)
Comparison to NOAEL
St. Juliens Creek Annex - Site 4

Chemical	Short-tailed shrew	Deer mouse	Raccoon	Mink	Red fox	Muskrat	American robin	American woodcock	Red-tailed hawk	Belted kingfisher
Inorganics										
Arsenic	15.79	8.44	6.61	2.01	1.13	29.31	0.91	1.07	<0.01	0.27
Cadmium	46.42	10.73	0.22	0.04	2.16	0.62	15.08	49.26	0.13	0.17
Chromium	20.04	4.13	0.02	<0.01	0.98	0.03	112.63	402.21	9.24	0.47
Copper	15.03	4.29	3.79	0.77	3.39	2.23	2.24	5.53	0.71	2.19
Lead	27.62	7.30	0.71	0.22	2.19	2.91	108.40	290.34	2.82	2.49
Mercury	99.84	26.79	4.06	8.86	0.45	94.33	3.89	10.81	0.02	807.38
Nickel	7.91	2.18	0.03	0.05	0.55	0.15	2.32	6.17	0.22	0.10
Selenium	1.27	0.80	0.44	0.38	0.31	2.31	0.75	0.78	0.09	0.78
Silver	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	37.19	9.08	2.62	0.55	24.68	0.69	204.70	627.96	28.17	7.46
Pesticides/PCBs										
4,4'-DDD	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	0.03	0.11	<0.01	0.19
4,4'-DDE	0.06	0.01	<0.01	0.03	<0.01	<0.01	0.40	1.43	0.01	0.83
4,4'-DDT	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.03	0.12	<0.01	0.55
Aldrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
alpha-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor-1016	0.29	0.06	0.02	0.04	0.02	<0.01	0.42	1.48	0.01	0.62
Aroclor-1221	11.69	2.49	0.91	1.58	0.73	0.05	0.85	3.03	0.03	1.24
Aroclor-1232	5.71	1.22	0.46	0.79	0.36	0.02	0.42	1.48	0.01	0.62
Aroclor-1242	5.71	1.21	0.46	0.79	0.35	0.02	0.42	1.48	0.01	0.62
Aroclor-1248	0.30	0.06	0.02	0.04	0.02	<0.01	0.95	3.37	0.03	1.41
Aroclor-1254	0.34	0.08	0.22	0.39	0.01	0.02	0.06	0.19	<0.01	1.41
Aroclor-1260	173.61	36.71	0.20	0.35	5.19	0.02	28.32	101.21	0.96	1.27
beta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	3.43	0.72	0.02	0.05	0.21	0.02	0.38	1.37	0.01	0.06
Endosulfan I	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.08	<0.01	<0.01
Gamma-BHC (Lindane)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	0.13	0.03	<0.01	<0.01	<0.01	<0.01	0.01	0.05	<0.01	<0.01
Heptachlor Epoxide	0.13	0.03	<0.01	<0.01	<0.01	<0.01	0.01	0.05	<0.01	<0.01
Methoxychlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.21	0.72	0.01	0.32

Table B-11
Summary of Hazard Quotients for Food Web Exposures - Maximum Concentration (Worst Case Scenario)
Comparison to NOAEL
St. Juliens Creek Annex - Site 4

Chemical	Short-tailed shrew	Deer mouse	Raccoon	Mink	Red fox	Muskrat	American robin	American woodcock	Red-tailed hawk	Belted kingfisher
Semivolatile Organic Compounds										
1,2,4-Trichlorobenzene	0.06	0.02	<0.01	<0.01	<0.01	<0.01	NA	NA	NA	NA
1,2-Dichlorobenzene	0.06	0.02	<0.01	<0.01	<0.01	<0.01	0.01	0.03	<0.01	<0.01
1,3-Dichlorobenzene	0.06	0.02	<0.01	<0.01	<0.01	<0.01	0.01	0.03	<0.01	<0.01
1,4-Dichlorobenzene	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.03	<0.01	<0.01
4-Bromophenyl-Phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-Phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.15	0.03	0.03	0.06	0.02	0.02	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.14	0.03	0.01	0.05	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.13	0.02	0.02	0.08	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.04	<0.01	0.01	0.05	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	0.21	0.04	0.01	0.05	0.02	0.02	<0.01	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Hexachlorobutadiene	2.71	0.56	0.02	0.05	0.20	0.02	0.96	3.22	0.04	0.16
Hexachlorobenzene	5.39	1.09	0.02	0.06	0.36	0.02	45.92	162.96	1.64	4.92
Hexachlorocyclopentadiene	0.54	0.11	<0.01	<0.01	0.04	<0.01	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.07	0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pentachlorophenol	31.72	6.70	0.03	0.08	1.98	0.03	0.41	1.46	0.01	0.01
Phenanthrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.01

Table B-12
Summary of Hazard Quotients for Food Web Exposures - Mean Concentration
St. Juliens Creek Annex - Site 4

Chemical	Short-tailed shrew	Deer mouse	Raccoon	Mink	Red fox	Muskrat	American robin	American woodcock	Red-tailed hawk	Belted kingfisher
Inorganics										
Arsenic	0.24	0.04	0.06	0.06	0.01	0.08	0.02	0.05	<0.01	0.02
Cadmium	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.03	<0.01	<0.01
Chromium	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.18	0.60	0.05	0.03
Copper	0.58	0.11	0.07	0.04	0.10	0.08	0.07	0.19	0.01	0.05
Lead	0.09	0.01	0.01	<0.01	<0.01	0.01	0.26	0.80	<0.01	0.06
Mercury	0.37	0.08	0.08	0.56	0.01	0.18	0.04	0.09	<0.01	6.98
Nickel	0.10	0.02	<0.01	<0.01	<0.01	<0.01	0.03	0.11	<0.01	0.02
Selenium	0.15	0.04	0.04	0.10	0.01	0.09	0.02	0.04	<0.01	0.14
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	0.28	0.06	0.02	0.01	0.04	0.02	0.34	0.97	0.05	0.09
Pesticides/PCBs										
4,4'-DDD	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4,4'-DDE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01
4,4'-DDT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aldrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
alpha-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor-1016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor-1221	0.03	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Aroclor-1232	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor-1242	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor-1248	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Aroclor-1254	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Aroclor-1260	0.18	0.03	<0.01	0.02	<0.01	<0.01	0.03	0.10	<0.01	0.02
beta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Gamma-BHC (Lindane)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor Epoxide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Semivolatile Organic Compounds										
1,2,4-Trichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	NA	NA	NA
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table B-12
Summary of Hazard Quotients for Food Web Exposures - Mean Concentration
St. Juliens Creek Annex - Site 4

Chemical	Short-tailed shrew	Deer mouse	Raccoon	Mink	Red fox	Muskrat	American robin	American woodcock	Red-tailed hawk	Belted kingfisher
4-Bromophenyl-Phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-Phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorobutadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01
Hexachlorobenzene	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.11	0.37	<0.01	0.06
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pentachlorophenol	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Phenanthrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Appendix C
ARARs Tables

Appendix C

Contents

Table C-1
Federal Chemical-Specific ARARs
Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Soil				
Chemical-specific risk-based concentration (RBC) screening levels	CERCLA site	EPA Region III RBC Tables	TBC	Site-specific clean-up goals will be used for implementing the remedy. RBCs were used to screen against site concentrations as a preliminary indicator of the presence of risk.
Groundwater				
Chemical-specific RBC screening levels	Public water system	EPA Region III RBC Tables	TBC	RBCs were used to screen against site concentrations as a preliminary indicator of the presence of risk. Although human health risk drivers were identified for the deeper Yorktown Aquifer, based on the low concentrations of COC compounds, background UTL comparison, and the presence of similar concentrations upgradient of the site, the SJCA Project Management Team (Navy, EPA, VDEQ) determined the deep groundwater risks at Site 4 to be acceptable for all pathways and receptors.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that DON accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or Relevant and Appropriate Requirement

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

TBC - To-Be-Considered Criteria

Table C-2
Virginia Chemical-Specific ARARs
Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Soil				
Virginia Hazardous Waste Management Regulations (VHWMRs)				
Definition and management of RCRA hazardous waste	Waste soil	9 VAC 20-60 et seq	Relevant and Appropriate	It is not anticipated that the remedial action at Site 4 will require disposal of hazardous wastes. However, soils shall be sampled to determine the appropriate waste characterization. Virginia has lead RCRA Subtitle C Regulatory Authority.
Virginia Solid Waste Management Regulations (VSWMRs)				
Specific regulations for the handling of “special wastes"	Waste must meet the determination of a Virginia “special waste”	9 VAC 20-80 et seq	Relevant and Appropriate	Soils shall be sampled to determine the appropriate waste characterization. Materials to be removed will be evaluated for classification as “special waste” per VSWMR.

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ARARs - Applicable or Relevant and Appropriate Requirement

RCRA - Resource Conservation and Recovery Act

VAC - Virginia Administrative Code

Table C-3 Federal Location-Specific ARARs Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia					
Location	**Requirement**	**Prerequisite**	**Citation**	**ARAR Determination**	**Comment**
Clean Water Act as Amended by the Chesapeake Bay Restoration Act of 2000*					
Within Chesapeake Bay watershed	Actions taken should expand and strengthen cooperative efforts to restore and protect the Chesapeake Bay and to achieve the goals established in the Chesapeake Bay Agreement	Applies to sites located within the Chesapeake Bay watershed	Chesapeake Restoration Act of 2000	Applicable	Activities conducted at Site 4 will comply with Chesapeake Bay Restoration Act.
Protection of Floodplain*					
Within floodplain	Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas	40 CFR Part 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Applicable	All appropriate measures shall be taken, including erosion control, to ensure floodplain protection.
Protection of Wetlands*					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands	Wetland	40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302 Clean Water Act (CWA) of 1972 Section 404	Applicable	Federal or State regulated wetlands are present at the site which could be impacted by the remedial action at the site. "Notification" of the CERCLA action and delineation of the wetlands impacted shall be provided to the USACOE. Activities undertaken entirely on a CERCLA site by authority of CERCLA as approved or required by EPA, are not required to obtain permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act.
Federal Fish and Wildlife Conservation Act					
Fish and wildlife	Requires that activities avoid, minimize, or compensate for impacts to fish and wildlife and their habitats	Applies to actions that affect fish and wildlife and their habitat	16 USC §662 et seq	Applicable	Blows Creek and the tidally influenced wetland area of Site 4 adjacent to Blows Creek will provide habitat for fish and wildlife species. Engineering controls shall address potential impacts to fish and wildlife and their habitats.

Table C-3 Federal Location-Specific ARARs Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia					
Location	**Requirement**	**Prerequisite**	**Citation**	**ARAR Determination**	**Comment**
Coastal Zone and Management Act					
Coastal zone	Requires that activities conducted within a coastal zone be consistent with an approved state management program	Applies to sites located within a coastal zone	16 USC §1451 et seq	Relevant and Appropriate	Activities will be conducted under an approved state management program.

* Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statues or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARAR - Applicable or Relevant and Appropriate Requirement

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CFR - Code of Federal Regulations

EPA - Environmental Protection Agency

USACOE - United States Army Corps of Engineers

USC - United States Code

Table C-4
Virginia Location-Specific ARARs
Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Virginia State Water Control Laws and Virginia Wetlands Regulations*					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands	Wetland as defined by Virginia statutory provision	General Provisions Relating to Marine Resources Commission, Va. Code Ann. 28.2-1300 to 1320 (1998); Wetlands Mitigation Compensation Policy, 4 VAC 20-390-10 to 50	Applicable	Federal and/or state regulated wetlands are present at the site which could be impacted by the remedial action at the site. The process of excavating in wetlands is marginally regulated at this time. Virginia Administrative Code, 9 VAC 25-210 et seq establishes excavation and related activities as a regulated activity. Although CERCLA actions do not require permits in wetlands, the VDEQ (along with the USACOE as the lead agency in CWA Section 404 actions) work with project proponents to meet the intent of the law, including compensatory mitigation.
Chesapeake Bay Preservation Act and Chesapeake Bay Preservation Area Designation and Management Regulations*					
Within Chesapeake Bay watershed	Under these requirements, certain locally designated tidal and nontidal wetlands, as well as other sensitive land areas, may be subject to limitations regarding land-disturbing activities, removal of vegetation, use of impervious cover, erosion and sediment control, stormwater management, and other aspects of land use that may have effects on water quality.	Federally owned area designated as a Chesapeake Bay preservation area	Chesapeake Bay Preservation Act, Va. Code Ann. 10.1-2100 to 2116; Chesapeake Bay Preservation Area Designation and Management Regulations, 9 VAC 10-20-10 to 280	Relevant and Appropriate	Activities conducted at Site 4 will comply with Chesapeake Bay Preservation Act.
Coastal Zone Management Act; NOAA Regulations of Federal Consistency with approved State Coastal Zone Management Programs					
Within coastal zone	Conduct activities within a coastal management zone in a manner consistent with local requirements	Activities affecting the coastal zone including lands thereunder and adjacent shore land	Section 307(c) of 16 USC 1456(c); also see 15 CFR 930 and 923.45	Relevant and Appropriate	All actions will be conducted in accordance with the State-approved erosion and sediment control plan for Site 4.

Table C-4 Virginia Location-Specific ARARs Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia					
Location	**Requirement**	**Prerequisite**	**Citation**	**ARAR Determination**	**Comment**

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARAR - Applicable or Relevant and Appropriate Requirement

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CFR - Code of Federal Regulations

CWA - Clean Water Act

NOAA - National Oceanic and Atmospheric Administration

USACOE - United States Army Corps of Engineers

USC - United States Code

VAC - Virginia Administrative Code

VDEQ - Virginia Department of Environmental Quality

Table C-5
Federal Action-Specific ARARs
Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Clean Air Act (CAA) 40 USC 7401 et seq*					
Discharge to air	National Primary and Secondary Ambient Air Quality Standards (NAAQS) - standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead)	Contamination of air affecting public health and welfare	40 CFR Sections 50.4 - 50.12	Relevant and Appropriate	No discharges to air are anticipated other than fugitive dust.

* Statutes and policies, and their citations are provided as headings to identify general categories of ARARs. Specific potential ARARs are addressed in the table below each general heading.

ARAR - Applicable or Relevant and Appropriate Requirement

CFR - Code of Federal Regulations

Table C-6
Virginia Action-Specific ARARs
Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Virginia Hazardous Waste Management Regulations (VHWMRs)					
Hazardous waste staging transport, and disposal	These regulations and laws define the requirements for the management of hazardous wastes. Any disposal facility must be properly permitted and in compliance with all operational and monitoring requirements of the permit and regulations.	Wastes must meet definition of hazardous waste	9 VAC 20-60-12 et seq	Relevant and Appropriate	It is not anticipated that the remedial action at Site 4 will require disposal of hazardous wastes. However, soils will be sampled to determine the appropriate waste characterization.
Virginia Solid Waste Management Regulations (VSWMRs)					
Solid waste staging transport, and disposal	These regulations and laws define the requirements for the management of solid wastes. Any disposal facility must be properly permitted and in compliance with all operational and monitoring requirements of the permit and regulations.	Wastes must meet definition of solid waste	9 VAC 20-80 et seq	Applicable	Applicable to management and staging, transportation, and off-site disposal of any debris classified as a solid waste.
Off-site disposal	Provides criteria for determining if solid waste disposal facility poses an adverse effect on human health or environment	Permitted solid waste / municipal waste landfill	9 VAC 20-80 et seq	Applicable	Applicable for off-site disposal of excavated drainage ditch sediment.
Virginia Air Pollution Control Regulations*					
Discharge of visible emissions and fugitive dust	Fugitive dust/emissions may not be discharged to the atmosphere at amounts in excess of standards	Any source of fugitive dust/ emissions	9 VAC 5-50-60 to 90	Applicable	Control of fugitive dust will be in accordance with this requirement.

Table C-6
Virginia Action-Specific ARARs
Site 4: Landfill D, St. Juliens Creek Annex, Chesapeake, Virginia

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Virginia Stormwater Management Regulations and Virginia Erosion and Sediment Control Regulations					
Stormwater management	Regulates stormwater management and erosion/ sedimentation control practice	Land disturbing activities	*Stormwater Management Act*, VA Code Ann. §§ 10.1-603.1 to 603.15 (1998) *Stormwater Management Regulations*, 4 VAC 3-20-10 to 251 *Erosion and Sediment Control Law,* Va. Code Ann .§§ 10.1-560 to 571 (1998); Erosion and Sediment Control Regulations, 4 VAC 50-30-10 to 110 *Virginia Storm Water Construction Activity,* 9 VAC 25-180-10 to 70	Applicable	Applicable for any site remediation activities involving surface water runoff, groundwater, infiltration, and erosion. The remedy will include erosion and sediment control for storm water; and, storage, treatment, and discharge of groundwater.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific ARARs are addressed in the table below each general heading.

ARAR - Applicable or Relevant and Appropriate Requirement

VAC - Virginia Administrative Code

Appendix D
PRAP Public Meeting Summary: May 17, 2004

St. Juliens Creek Annex (SJCA) Site 4 Proposed Remedial Action Plan (PRAP) Public Meeting Summary: May 17, 2004

RAB Members Present:

Valerie Walker	CNRMA
Bob Schirmer	LANTDIV
Debra Miller	Virginia DEQ
Todd Richardson	USEPA Region III
Kevin Lew	SPAWAR
Scott Mohr	NAVSTA PAO
Bill Friedmann	CH2M HILL
Kim Henderson	CH2M HILL

FROM: Kim Henderson/CH2M HILL

DATE: May 24, 2004

Location: Major Hillard Library, Chesapeake, Virginia

Mr. Kevin Lew arrived for the RAB at 5:00 pm and Mr. Bill Friedmann presented the Site 4 Proposed Remedial Action Plan (PRAP) presentation that was intended for the public meeting at 4:30 pm. Handouts of the presentation and Site 4 PRAP were provided. The presentation included the background information for Site 4; previous investigations conducted; purpose and contents of the PRAP; next steps including a Record of Decision (ROD), Remedial Design, and Remedial Action; and availability of the Administrative Record for St. Juliens Creek Annex (SJCA) at the Major Hillard Library. Following the presentation, a question and comment period was held.

Mr. Kevin Lew of SPAWAR asked if the cost for Alternative 2 includes the long-term operations and maintenance (O&M) cost. Mr. Friedmann indicated that 30-years of O&M costs are included.

Mr. Lew asked why the contaminated sediment was being removed. Mr. Friedmann explained that the drainage ditch adjacent to Site 4 contained elevated concentrations that indicated unacceptable risks to human and ecological receptors. Rather than covering the ditch it was more effective to remove the contaminated sediment from the drainage ditch.

Mr. Lew said that obviously the cover isn't going to be a 100% effective and asked how effective the cover will be. Mr. Friedmann stated that the cover will be very effective because it will reduce leaching of contaminants into the groundwater and prevent direct contact by humans and ecological receptors with the landfill contents. Ms. Debra Miller of the Virginia Department of Environmental Quality (VDEQ) added that groundwater monitoring will be conducted long-term to monitor the effectiveness of the cover and ensure there are no future releases.

Mr. Lew asked if signs would be placed around the site to restrict access. Mr. Friedmann stated that signs would be posted as part of the Remedial Design and land use restrictions on the property, such as fencing, will be implemented. The signs will include language indicating those restrictions and provide contact information.

Mr. Lew expressed concerns regarding the types of contamination at the site and how the vegetation is effected because he has eaten mulberries from an existing tree at Site 4. Mr. Friedmann explained that he was unsure if the types of contaminants found at the site were able to bioaccumulate into the vegetation and/or the berries themselves. Mr. Lew then stated that he no longer eats mulberries.

- Subsequent to Mr. Lew's question regarding mulberries, risk assessors from CH2M HILL, using site specific data and conservative cancer and non-cancer scenarios, determined that there was no risk to Mr. Lew in ingesting the mulberries growing at Site 4, and this information was sent to Mr. Lew on June 17, 2004.

Mr. Lew requested electronic copies of the PRAP presentation and PRAP and noted that his email address has changed: kevin.lew@navy.mil

Mr. Lew asked how does the cover differ from the cap and whether it was different material. Ms. Miller indicated that the RCRA Subtitle D Cap does include a layer of a different, more impermeable material that drains surface water before it can reach the underlying wastes and almost acts as a double liner.

Public Meeting Adjourned