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Final

Remedial Investigation Report for Site 21

St. Juliens Creek Annex
Chesapeake, Virginia

Contract Task Order 0057

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Acronyms and Abbreviations

amsl	above mean sea level
AOC	Area of Concern
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
C	Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action— Navy
COC	constituent of concern
COPC	constituent of potential concern
CSF	carcinogenic slope factor
CSM	conceptual site model
CTE	central tendency exposure
CTO	Contract Task Order
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DHC	dehalococcoides
DNA	deoxyribonucleic acid
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct-push technology
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
ECD	electron capture detector
ELCR	excess lifetime carcinogenic risk
EPC	exposure point concentration
ERS	ecological risk screening
ESS	Explosive Safety Submission
F	Fahrenheit
f_{oc}	fraction of organic carbon
FFA	Federal Facilities Agreement
FID	flame-ionization detector
ft	foot, feet
gm/cm^3	grams per cubic centimeter
gpd	gallons per day
HHRA	Human Health Risk Assessment

HHRS	human health risk screening
HI	hazard index
HQ	hazard quotient
ID	inside diameter
IDW	investigation-derived waste
IR	Installation Restoration
IRIS	Integrated Risk Information System
K	hydraulic conductivity
µg/kg	micrograms per kilograms
µg/L	micrograms per liter
MARMC	Mid-Atlantic Regional Maintenance Center
MCL	maximum contaminant level
MEC	munitions and explosives of concern
MEK	methyl ethyl ketone
MF	modifying factor
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mgd	million gallons per day
MIP	membrane interface probe
MS/MSD	matrix spike/matrix spike duplicate
MVUE	minimum variance unbiased estimate
n_e	estimated effective porosity
NAPL	non-aqueous phase liquid
NAVFAC	Naval Facilities Engineering Command
NCEA	National Center for Environmental Assessment
NFA	no further action
NOSSA	Naval Ordnance Safety and Security Activity
NOD	natural oxidant demand
ORP	oxidation reduction potential
p_b	bulk density
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDB	passive diffusion bag
PID	photoionization detector
PPRTV	Provisional Peer Reviewed Toxicity Value
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
R	retardation coefficient
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylenetrinitramine

RFA	RCRA Facility Assessment
RfD	reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure
RPD	relative percent difference
RRR	Relative Risk Ranking
SI	Site Investigation
SIMA	Shore Intermediate Maintenance Activity
SJCA	St. Juliens Creek Annex
SSA	Site Screening Assessment
SPAWAR	Space and Naval Warfare Systems Command
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TAL	target analyte list
TCA	trichloroethane
TCLP	toxicity characteristic leaching procedure
TCE	trichloroethene
TCL	target compound list
TOC	total organic carbon
TPH	total petroleum hydrocrabons
USEPA	United States Environmental Protection Agency
UCL	upper confidence limit
UF	uncertainty factor
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
VC	vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
yr	year

SECTION 1

Introduction

This report presents the activities, results, and conclusions of the remedial investigation (RI) conducted at Installation Restoration (IR) Site 21, St. Juliens Creek Annex (SJCA) in Chesapeake, Virginia. This RI report was prepared under the United States Navy, Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-term Environmental Action Navy (CLEAN) III, Contract N62470-02-D-3052, Contract Task Order (CTO) 0057. The investigations summarized in this report were completed to determine the nature and extent of contaminant releases and assess long term site risks in response to recommendations included in *Site Investigation Report for Sites 8, 19, 21, and Area of Concern 1* (CH2M HILL, 2004a).

The field activities were completed in several phases between March 2005 and February 2007. Field activities were conducted in accordance with the following work plans:

- Work Plan for the Expanded Remedial Investigation at Site 2 and Site 5 (CH2M HILL, 2003b)[1]
- Supplemental Site Investigation of Sites 19 and 21 (CH2M HILL, 2005a)
- Work Plan for Additional Groundwater Delineation Activities at Site 21 (CH2M HILL, 2005b)
- Addendum to Work Plan for Additional Groundwater Delineation Activities at Site 21 (CH2M HILL, 2006)
- Phase II Addendum to Work Plan for Additional Groundwater Delineation Activities at Site 21 (CH2M HILL, 2007).

The technical approach for and specific objectives of each event were jointly scoped by the SJCA Tier I Partnering Team, consisting of representatives from the Navy, United States Environmental Protection Agency (USEPA) Region III, and Virginia Department of Environmental Quality (VDEQ).

1.1 Objectives and Approach

In order to achieve the purpose of this RI, the following objectives were identified:

- Define the boundary of the shallow groundwater chlorinated volatile organic compound (CVOC) plume, define physical and geochemical characteristics of the shallow aquifer, and evaluate contaminant fate and transport mechanisms to develop a conceptual site model (CSM).
- Determine if the site poses unacceptable human health and ecological risks.

[1] Storm water sampling analysis within Site 21 storm sewer system was conducted during the investigation of Site 2.

To aid in the development of a comprehensive CSM and risk evaluation based on all available information, data from the Site Investigation (SI) Report (CH2M HILL, 2004a) are also included in this report.

1.2 Report Organization

The RI report following this introduction section comprises the following sections:

- Section 2—Site Background
- Section 3—Field Investigation Activities and Data Evaluation
- Section 4—Physical Characteristics
- Section 5—Nature and Extent of Contamination
- Section 6—Contaminant Fate and Transport
- Section 7—Human Health Risk Assessment
- Section 8—Ecological Risk Assessment
- Section 9—Conclusions and Recommendations
- Section 10—References

Tables are provided within the text or at the end of each respective section. Figures are provided at the end of each respective section. Appendixes are provided after Section 10.

SECTION 2

Site Background

2.1 SJCA Description and History

The SJCA facility is approximately 490 acres and is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River in the City of Chesapeake, southeastern Virginia (**Figure 2-1**). Most surrounding areas are developed and include residences, schools, recreational areas, and shipping facilities for several large industries.

SJCA began operations as a naval ammunition facility in 1849. The annex was one of the largest ammunition depots in the United States involving wartime transfer of ammunitions to various other naval facilities. After ordnance operations ceased at SJCA in 1977, decontamination was performed in, around, and under ordnance-handling facilities by flushing the areas with chemical solutions and water. The SJCA facility has also been involved in non-ordnance operations, including degreasing operations, paint shops, machine shops, vehicle and locomotive maintenance shops, pest control shops, battery shops, print shops, electrical shops, boiler plant operations, wash rack operations, potable water and salt water fire-protection systems, fire-fighter training operations, and storage of oil and chemicals.

Activity at SJCA has decreased in recent years and many of the aging structures are being demolished. The current primary mission of SJCA is to provide a radar-testing range and various administrative and warehousing facilities for nearby Norfolk Naval Shipyard and other local naval activities. SJCA also provides administrative offices, light industrial shops, and storage facilities for several tenant commands; including Defense Reutilization and Marketing Office (DRMO) storage, Space and Naval Warfare Systems Command (SPAWAR), Mid-Atlantic Regional Maintenance Center (MARMC), and a cryogenics school.

2.2 Site 21 Description and History

Site 21 is located in a former industrial area in the south-central portion of SJCA (**Figure 2-2**). The site vicinity, including the boundary, existing and demolished buildings, and other site features, are shown on **Figure 2-3**. Although the site was initially identified as Building 187 the Site 21 boundary has been expanded, based on investigation data, to encompass the CVOC groundwater plume that underlies a number of nearby industrial buildings. The original Site 21 boundary is shown on **Figure 2-3**. The actual plume boundary is discussed in detail in Section 5.

2.2.1 Historical Land Use

Buildings at Site 21 were historically used as machine, vehicle, and locomotive maintenance shops; electrical shops; and munitions loading facilities. Outdoor areas were used for equipment and chemical storage. Several of these buildings and/or their surrounding areas were designated as former IR sites (Sites 9, 10, 11, 12, 13, 14, 18, and Area of Concern [AOC]

E). Additionally, a fuel service station was previously located just south of Building 187. Two abandoned underground storage tanks (USTs) at the former service station had a history of leakage. Following removal of the USTs and remediation of the associated groundwater, the UST site was closed under the state UST program (Baker, 1994). Descriptions of each building or industrial area (Navy Engineering and Environmental Support Activity [NEESA], 1981) and corresponding historical activities and contaminant sources are described in **Table 2-1**.

2.2.2 Existing Land Use

The existing buildings and the Site 21 area are currently used for storage and maintenance activities. Building 1556 was constructed in 1992 and is currently used as the MARMC warehouse. Many of the older buildings at the site have been demolished. A storm sewer system runs through the site and drains to a downstream inlet (IR Site 2) to St. Juliens Creek (**Figure 2-3**).

2.3 Previous Removal Activities and Investigations

Several investigations were conducted at Site 21 and at Sites 9, 10, 11, and 18, which are now included within the expanded Site 21 boundary. The results are detailed in the following sections.

2.3.1 Resource Conservation and Recovery Act Facility Assessment (A.T. Kearney, 1989)

The Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) was conducted to identify solid waste management units (SWMUs) and AOCs and included a preliminary review of all available relevant documents and a visual site inspection. Seven of the SWMUs and one of the AOCs identified and recommended for further action were located within the current Site 21 boundary (SWMUs 13, 14, 15, 16, 20, 23, and 25, and AOC E).

2.3.2 Shore Intermediate Maintenance Activity Building Construction Soil Removals (1992 through 1993)

Construction of the Shore Intermediate Maintenance Activity (SIMA) Building (Building 1556) began in 1992. Several IR sites were located within the footprint of the SIMA building: Site 9 (SWMUs 13, 23, and 25), Site 12 (SWMU 16), Site 13 (SWMU 20/AOC E), and Site 14. Soil removals were conducted at those sites prior to construction of the SIMA building. Interviews of SJCA staff who oversaw the construction activities indicated confirmation samples were collected, and that the extent of the removal areas increased based on the results of the confirmation sample results. However, only the report of the confirmation sample results for SMWUs 16 and 20 could be located (Baker, 1993). To confirm the extent of removal at SWMUs 16 and 20 was sufficient, five sidewall samples (collected at 1 to 3 feet [ft] below the initial ground surface), one 14-point floor composite sample (collected at approximately 2 ft below the initial ground surface), and one 14-point floor composite sample (collected at approximately 4 to 5 ft below the initial ground surface) were collected. The samples were analyzed for toxicity characteristic leaching procedure (TCLP) volatile

organic compounds (VOCs); TCLP semivolatile organic compounds (SVOCs); TCLP metals; benzene, toluene, ethylbenzene, and xylene (BTEX); and total petroleum hydrocarbons (TPH) analysis. All results were below regulatory limits and met Virginia requirements for cleanup of petroleum-contaminated soil. A human health risk screening (HHRS) was conducted on the remaining soil to confirm no risks to construction workers. The sites were closed as no further action (NFA) in the Federal Facilities Agreement (FFA) (Department of Defense [DoD], 2004).

2.3.3 Relative Risk Ranking System Data Collection Report (CH2M HILL, 1996)

The Relative Risk Ranking (RRR) was conducted to determine and prioritize sites requiring possible further investigation. It based the ranking on the results of the RFA and focused on the areas of greatest concern (e.g., visible contamination) to serve as a conservative screen to determine whether or not additional investigation is necessary. Although the number of samples seems low in relation to the current site size, the site boundary has expanded to encompass the groundwater plume. The RRR included investigation of 21 sites at SJCA; however, only the sites located within the current Site 21 boundary are discussed in this document. Groundwater samples were collected at Site 21 and Sites 9 (SWMUs 13, 23, and 25) 10 (SWMU 14), and 11 (SWMU 15) and surface soil samples were collected at Site 21 and at Sites 10, 11, and 18 (**Figure 2-4**). **Table 2-2** summarizes the data collected at each site. Analyses were selected based on a review of historical records of disposal or release and field observations, but did not extend to all chemicals stored or used in the vicinity (e.g., pesticides that were used at the wash rack but not disposed).

Groundwater samples were collected using direct push technology (DPT) from a 3-ft screened interval at a depth of approximately 1 to 2 ft below the water table; however, the specific depth was not recorded. Surface samples were collected at a depth of 0 to 1 ft below ground surface (bgs). The soil samples were collected with a stainless-steel trowel.

As indicated in **Table 2-2**, the samples were analyzed for target compound list (TCL) VOCs, TCL SVOCs, TCL pesticides/polychlorinated biphenyls (PCBs), and target analyte list (TAL) metals and cyanide. The results, which were not validated because they were collected for use as a screening tool, indicated the presence of VOCs, SVOCs, and metals in groundwater (**Table 2-3**) and VOCs, SVOCs, pesticides/PCBs, and metals in soil (**Table 2-4**).

2.3.4 Site Screening Assessment (CH2M HILL, 2002)

In association with the Site Screening Assessment (SSA), the partnering team conducted a site visit during the July 2001 partnering meeting to aid in determining the appropriate path forward for the sites identified in the RFA, including the necessity to collect additional samples for the inclusion into the SSA. Based on a review of the information gathered during the site visit, no additional samples were recommended.

During the SSA, the unvalidated analytical data from the RRR were evaluated and human health and ecological risk screenings were conducted to evaluate whether sites required additional investigation, removal action, or no further action. The following sections summarize the findings for each of the sites within the current Site 21 boundary. **Table 2-3** presents the constituents detected in groundwater and **Table 2-4** presents the constituents detected in surface soil.

Site 9 – Pest Control, Oil/Water Separator, and Washrack at Building 249

During construction of Building 1556, and prior to the SSA, surface spills of petroleum fuels and used oil from vehicle maintenance at Buildings 249 and 323 were identified. Approximately 2,000 cubic yards (cy) of petroleum contaminated soil were removed during the building construction. Following the soil excavation and disposal, NFA consensus was reached for the site. Although several metals and VOCs were detected in groundwater, the RRR data were not evaluated during the SSA. Based on the proximity of Site 9 to Site 21, VOCs in groundwater at Site 9 are being addressed under further investigation of groundwater at Site 21. Site 9 was closed with no further action as documented in the FFA (DoD, 2004).

Site 10 – Waste Disposal at Railroad Tracks/Swale Beneath Building 18

Several metals and VOCs were detected in groundwater and several metals, SVOCs, and one VOC were detected in surface soil at Site 10.

The HHRS concluded that groundwater should not be considered for further evaluation and that surface soil does not pose a concern to human health. The ecological risk screening (ERS) concluded that because Site 10 is paved, it does not provide habitat for potential ecological receptors. Furthermore, no pathways (e.g., surface water drainages) exist by which site-related chemicals (if present) could be transported offsite to viable ecological habitats. Therefore, there is no complete exposure pathway and no further evaluation of potential ecological effects was recommended.

Because no human health or ecological risks were identified in groundwater or soil, no further action was recommended for groundwater or soil. Consensus for no further action for Site 10 was recommended during a July 2001 Partnering Team site visit and documented through team signature of the SSA report.

Site 11 – Waste Disposal at Building 53

Several metals and VOCs were detected in groundwater and several metals, pesticides, PCBs, SVOCs, and VOCs were detected in surface soil at Site 11.

The HHRS identified potential risk in shallow groundwater from VOCs associated with use of shallow groundwater as a potable source. In addition, VOCs were identified above the maximum contaminant levels (MCLs). The HHRS concluded that surface soil does not pose a concern to human health. An ERS was conducted and concluded that because Site 11 is paved, it does not provide habitat for potential ecological receptors. Furthermore, no pathways (e.g., surface water drainages) exist by which site-related chemicals (if present) could be transported offsite to viable ecological habitats. Therefore, there is no complete exposure pathway and no further evaluation of potential ecological effects was recommended.

Based on the proximity of Site 11 to Site 21, VOCs in groundwater at Site 11 are being addressed under further investigation of groundwater at Site 21. Because no human health or ecological risks were identified in soil, no further action was recommended for soil. Consensus for no further action at Site 11 was recommended during a July 2001 Partnering Team site visit and documented through team signature of the SSA report.

Site 18 – Blasting Grit and Air Compressor at Building 47

Several metals, SVOCs, and VOCs were detected in surface soil at Site 18. No groundwater samples were collected.

The HHRS concluded that surface soil does not pose a concern to human health. An ERS was conducted and concluded that because Site 18 is a mowed lawn area in a highly developed area, it provides minimal habitat for ecological receptors. Furthermore, no pathways (e.g., surface water drainages) exist by which site-related chemicals (if present) could be transported offsite to viable ecological habitats. Therefore, there is no complete exposure pathway and no further evaluation of potential ecological effects was recommended.

Because no human health or ecological risks were identified in soil, no further action was recommended for soil. Consensus for no further action at Site 18 was recommended during a July 2001 Partnering Team site visit and documented through team signature of the SSA report.

Site 21 – Soil Staining at Building 187

Several metals, one SVOC, and several VOCs were detected in groundwater and several metals, pesticides, PCBs, and SVOCs were detected in surface soil at Site 21.

The HHRS identified potential human health risk from VOCs in shallow groundwater at Site 21 if used as a potable source. Additionally, VOCs were detected at concentrations exceeding MCLs. The HHRS concluded that surface soil does not pose a concern to human health. An ERS was conducted and concluded that because Site 21 is paved, it does not provide habitat for potential ecological receptors. Furthermore, no pathways (e.g., surface water drainages) exist by which site-related chemicals (if present) could be transported offsite to viable ecological habitats. Therefore, there is no complete exposure pathway and no further evaluation of potential ecological effects was recommended.

Because no human health or ecological risks were identified in soil, no further action was recommended for soil. VOCs in shallow groundwater were recommended for further investigation at Site 21.

2.3.5 Site Investigation (CH2M HILL, 2004)

Based on the results of the SSA, an SI was conducted to further characterize potential contamination in groundwater. Specifically, the investigation aimed to identify the highest TCE concentrations in shallow groundwater, identify areas of highest CVOC concentrations, and determine if site activities had impacted the deep aquifer. Field activities consisted of a membrane interface probe (MIP) investigation followed by shallow and deep groundwater monitoring well installation and sampling. No additional investigation of soil was conducted based on the recommendations of the SSA.

A total of 16 MIP pushes were advanced, and speciation data collected during trapping indicated the presence of a CVOC plume in shallow groundwater (**Appendix A**). Based on the electron capture detector (ECD) log, CVOC concentrations increased significantly between 15 and 19 ft bgs, coinciding with the depth of the Yorktown confining unit, as indicated by the conductivity logs.

Six shallow groundwater monitoring wells (SJS21-MW01S through MW06S) were installed based on the MIP results. One deep groundwater monitoring well (SJS21-MW01D) was also installed. The shallow monitoring wells were installed with 10-ft screens just above the Yorktown confining unit and the deep well was screened over 10 ft just below the Yorktown confining unit. Groundwater samples were collected from the wells and analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals and cyanide, and explosives. The sample locations and MIP results are shown in **Figure 2-4**.

A HHRS was performed and identified potential human health risks from CVOCs and cyclotrimethylenetrinitramine (RDX) in shallow groundwater, and chloroform, arsenic, and vanadium in deep groundwater. Although Site 21 provides little habitat for potential ecological receptors, there may be some potential for chemicals in groundwater to be transported and discharge to St. Juliens Creek and/or its tributaries. Therefore, an ERS was performed, and chemical concentrations in groundwater were accordingly screened to determine if they are present in groundwater at concentrations that could represent a potential risk to aquatic life. Only TCE was detected at concentrations exceeding its ecological screening value, indicating a potential risk. However; based on the transport distance before discharging to surface water, and the potential for mixing and dilution; there is minimal potential for adverse effects to aquatic life from the presence of TCE in groundwater. Therefore it was concluded that TCE concentrations are unlikely to pose risk to ecological receptors and no further ecological evaluation was recommended.

The SI recommended further evaluation of shallow and deep groundwater; including further delineation of the CVOC plume in shallow groundwater through the installation and sampling of additional groundwater monitoring wells, and re-sampling of select existing groundwater monitoring wells to confirm or deny elevated concentrations of metals and RDX posing potential risks to human health in deep groundwater.

2.4 Basis for Further Investigation

Based on the findings of the RRR, SSA, and SI, additional investigation of groundwater at Site 21 was necessary. Because no human health or ecological risks were identified in soil at Site 21, no further investigation or action for soil was necessary. The investigation activities were jointly scoped by the SJCA Tier I Partnering Team and are described in the following sections.

TABLE 2-1
Historical Activities
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Historical Activity	Description
Former Building 13 (IR Site 10)	**Painting Activities**: Building 13 was used for tank renovation and painting. No releases of paint products have been documented.
	Degreasing Activities: Alodine (a caustic detergent), MEK, and acetone were used for degreasing within the building. Prior to 1949, waste fluids were dumped into an engineered drainage swale that ran under Buildings 47 and 13 and eventually fed to St. Juliens Creek.
	Sand Blasting Activities: Sand blasting for paint removal was conducted in a 10-ft long by 18-ft wide by 8-ft high pit. Waste products included spent blast grit mixed with metal and paint chips removed from the blasted items.
Building 46	**Cartridge Cleaning Activities**: Canisters were cleaned with detergents prior to return to the manufacturer.
	Reloading Activities: Smokeless powder was loaded into cartridges. Related chemicals included explosives.
	Pump Maintenance: Hydraulic Fluid was reportedly used for maintenance of pumps in the machine shop and later dumped outside of the building for the purpose of weed and dust control.
Building 47 (IR Site 18)	**Degreasing Activities**: The building was used as the Inert Component Renovation Plant. Cartridge cases were cleaned and degreased with carbon tetrachloride or acid wash. The acid waste was then taken to the burning ground (IR Site 5) for disposal. Prior to 1949, rinsate was reportedly dumped into a drainage swale that ultimately fed to St. Juliens Creek. In addition, about 2 gallons per day of MEK and acetone were used in the building for degreasing and the waste was usually dumped along the adjacent railroad tracks.
	Sandblasting Activities: Sandblasting activities were conducted to remove paint from cartridge cases. Waste blast grit containing metals particulate and paint chips was reportedly dumped along the south side of the building.
	Leaking Petroleum: Building 47 housed an air compressor which reportedly leaked oil.
	Pump Maintenance: Hydraulic Fluid was reportedly used for maintenance of pumps in the machine shop and later dumped outside of the building for the purpose of weed and dust control.
Building 53 (IR Site 11)	**Degreasing Activities**: Building 53 was an Electrical Shop where station electricians used about 5 gallons per month of TCE. TCE was reportedly disposed of beside the building and on the railroad tracks. Based on proximity of the site to Site 21, VOCs in groundwater at the site are to be addressed as part of Site 21, and Site 11 was closed under CERCLA.
Building 187 (IR Site 21)	**Locomotive Maintenance Activities**: Oils and degreasers were used for locomotive maintenance. Waste fluids, including TCE, were reportedly dumped outside of the building for the purpose of dust control. During the IAS (1981), the ground around the building was saturated with oil.

TABLE 2-1
Historical Activities
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Historical Activity	Description
Former Building 201 (UST Site)	**Vehicle Maintenance Activities**: Oils and degreasers were used for vehicle maintenance. Waste fluids, including TCE, were reportedly dumped outside of the building for the purpose of dust control.
	Fuel Servicing Activities: A service station was located north of the building. The site consisted of two tanks, a pump island and associated underground piping. The fuel tanks leaked resulting in concentrations of BTEX constituents in groundwater. Although this site has been closed under the UST Program because free product is no longer present on the water table, benzene is still present in groundwater in this area.
	Pump Maintenance: Hydraulic fluid was reportedly used for maintenance of pumps in the machine shop and later dumped outside of the building for the purpose of weed and dust control.
Former Building 247	**Vehicle Maintenance Activities**: Oils and degreasers were used for vehicle maintenance. Waste fluids were reportedly dumped outside of the building for the purpose of dust control.
Former Building 249 (IR Site 9/14).	**Pesticide Handling**: Building 249 was utilized for storage and mixing of pesticides from the mid 1960s until 1976. Chemicals included Abate, rodent baits, Bromacil, Carbaryl, Chlordane, Dalapon, Diazinon, Diquat, Gardona, Malathion, Naled, Tandex, and other combinations of pesticide chemicals. Herbicide tanks were rinsed in the adjacent wash pad which drained to the storm sewer adjacent to the building, ultimately feeding to St. Juliens Creek.
	Equipment Maintenance Activities: The wash pad was also used for general cleaning and degreasing with TCE for the purpose of equipment maintenance.
	Oil/Water Separation: A former OWS on the southeast side of the building received a wide mix of chemicals including petroleum chemicals and solvents. Stained soils in this area were removed prior to construction of Building 1556. The SJCA Partnering Team reached consensus for NFA closure based on the soils removal action.
Former Building 323	**Sandblasting Activities**: Paint was removed using blast grit. Wastes consisting of blast grit and metal and paint particulates removed from the items being blasted were observed on the ground surrounding the building. This material was removed prior to construction of Building 1556. The SJCA Partnering Team reached consensus for NFA closure based on this removal action.
Former Chemical and Pump Storage Yards (IR Site 13/AOC E)	**Chemical Storage**: Battery acid, lacquer thinner, antifreeze, and lube oils were stored on a concrete pad prior to being transported to the waste accumulation area. Stained soil was removed prior to construction of Building 1556. The SJCA Partnering Team reached consensus for NFA closure based on this removal action.
	Equipment Storage: Heavy equipment, pumps, and generators were stored. Stained soils in this area were excavated prior to construction of Building 1556. The SJCA Partnering Team reached consensus for NFA closure based on this removal action.

Notes:
BTEX = benzene, toluene, ethylbenzene, and xylene; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; ft = foot/feet; MEK = methyl ethyl ketone; NFA = no further action; OWS = oil-water separator; TCE = trichloroethene; UST = underground storage tank; VOC = volatile organic compound

For buildings not included in this table, no historical use is documented in the Initial Assessment Study (IAS) (NEESA, 1981) and Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (A.T. Kearney Inc., 1989).

Table 2-2
Sample Summary
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

		Analytical Parameters																		
Station ID	Sample ID	TCL VOCs (OLM04)	TCL VOCs (OLC03)	TCL SVOCs (OLM04)	TCL Pesticides/ PCBs (OLM04)	TAL Total Metals & Cyanide (ILM04)	TAL Dissolved Metals (ILM04)	TAL Total Metals & Cyanide (ILM05)	TAL Dissolved Metals (ILM05)	Total Arsenic (ILM05 ICP/MS)	Dissolved Arsenic (ILM05 ICP/MS)	Explosives (SW846 8330)	Alkalinity (310.1)	Ferrous Iron (SM 3500)	Nitrate/ Nitrite (353.2)	Sulfate (375.4)	TOC (9060)	NOD (SiRem MOD-48)	DHC DNA (functional genes: BAV1, 195, FL2)	OilScreenSoil (Indigo Blue®)
RRR (April 1996)[1]																				
Groundwater Sampling																				
09GW01	09GW01	X		X	X	X	X													
09GW02	09GW02	X		X	X	X	X													
09GW03	09GW03	X		X	X	X	X													
10GW01	10GW01	X		X		X	X													
10GW02	10GW02	X		X		X	X													
11GW01	11GW01	X		X	X	X	X													
21GW01	21GW01	X		X	X	X	X													
21GW02	21GW02	X		X	X	X	X													
Surface Soil Sampling																				
10SS01	10SS01 (0-1')	X		X		X														
10SS02	10SS02 (0-1')	X		X		X														
11SS01	11SS01 (0-1')	X		X	X	X														
18SS01	18SS01 (0-1')	X		X		X														
21SS01	21SS01 (0-1')	X		X	X	X														
21SS02	21SS02 (0-1')	X		X	X	X														
SI (August 2003)																				
MIP Investigation																				
MIP01	MIP01																			
MIP02	MIP02																			
MIP03	MIP03																			
MIP04	MIP04																			
MIP05	MIP05																			
MIP06	MIP06																			
MIP07	MIP07																			
MIP08	MIP08																			
MIP09	MIP09																			
MIP10	MIP10																			
MIP11	MIP11																			
MIP12	MIP12																			
MIP13	MIP13																			
MIP14	MIP14																			
MIP15	MIP15																			
MIP16	MIP16																			
Shallow Groundwater Sampling																				
SJS21-MW01S	SJS21-MW01S-03C	X		X	X	X	X					X								
SJS21-MW02S	SJS21-MW02S-03C	X		X	X	X	X					X								
SJS21-MW03S	SJS21-MW03S-03C	X		X	X	X	X					X								
SJS21-MW04S	SJS21-MW04S-03C	X		X	X	X	X					X								
SJS21-MW05S	SJS21-MW05S-03C	X		X	X	X	X					X								
SJS21-MW06S	SJS21-MW06S-03C	X		X	X	X	X					X								
Deep Groundwater Sampling																				
SJS21-MW01D	SJS21-MW01D-03C	X		X	X	X	X					X								
RI (December 2003)																				
Storm Water Sampling																				
SJS02-ST01	SJS02-ST01-03D		X																	
SJS02-ST02	SJS02-ST02-03D		X																	
SJS02-ST03	SJS02-ST03-03D		X																	
SJS02-ST04	SJS02-ST04-03D		X																	
SJS02-ST05	SJS02-ST05-03D		X																	
SJS02-ST06	SJS02-ST06-03D		X																	
SJS02-ST07	SJS02-ST07-03D		X																	
Surface Water Sampling																				
SJS02-SW10	SJS02-SW10-03D		X																	
RI (November through December 2004)																				
MIP Investigation																				
MIP17	MIP17																			
MIP18	MIP18																			
MIP19	MIP19																			
Shallow Groundwater Sampling																				
SJS21-MW01S	SJS21-MW01S-04D		X										X	X	X	X	X			
SJS21-MW02S	SJS21-MW02S-04D		X										X		X	X	X			
SJS21-MW03S	SJS21-MW03S-04D		X										X		X	X	X			
SJS21-MW04S	SJS21-MW04S-04D		X									X	X		X	X	X			
SJS21-MW05S	SJS21-MW05S-04D		X										X	X	X	X	X			
SJS21-MW06S	SJS21-MW06S-04D		X										X	X	X	X	X			
SJS21-MW07S	SJS21-MW07S-04D		X	X	X	X	X					X	X	X	X	X	X			
SJS21-MW08S	SJS21-MW08S-04D		X	X	X	X	X					X	X		X	X	X			
SJS21-MW09S	SJS21-MW09S-04D		X	X	X	X	X					X	X		X	X	X			
SJS21-MW10S	SJS21-MW10S-04D		X	X	X	X	X					X	X	X	X	X	X			
SJS21-MW11S	SJS21-MW11S-04D		X	X	X	X	X					X	X	X	X	X	X			
Deep Groundwater Sampling																				
SJS21-MW01D	SJS21-MW01D-04D					X	X													

		Analytical Parameters																		
Station ID	**Sample ID**	**TCL VOCs (OLM04)**	**TCL VOCs (OLC03)**	**TCL SVOCs (OLM04)**	**TCL Pesticides/ PCBs (OLM04)**	**TAL Total Metals & Cyanide (ILM04)**	**TAL Dissolved Metals (ILM04)**	**TAL Total Metals & Cyanide (ILM05)**	**TAL Dissolved Metals (ILM05)**	**Total Arsenic (ILM05 ICP/MS)**	**Dissolved Arsenic (ILM05 ICP/MS)**	**Explosives (SW846 8330)**	**Alkalinity (310.1)**	**Ferrous Iron (SM 3500)**	**Nitrate/ Nitrite (353.2)**	**Sulfate (375.4)**	**TOC (9060)**	**NOD (SiRem MOD-48)**	**DHC DNA (functional genes: BAV1, 195, FL2)**	**OilScreenSoil (Indigo Blue®)**
Subsurface Soil Sampling																				
SJS21-MW02S	SJS21-SB02A-05 (5-7')																	X		
SJS21-MW02S	SJS21-SB02A-10 (6-8')																	X		
SJS21-MW02S	SJS21-SB02A-14 (14-16')																	X		
SJS21-MW02S	SJS21-SB02B-06 (6-8')																	X		
SJS21-MW02S	SJS21-SB02B-10 (10-12')																	X		
SJS21-MW02S	SJS21-SB02B-12 (12-14')																	X		
SJS21-MW04S	SJS21-SB04-05 (5-7')																	X		
SJS21-MW04S	SJS21-SB04-09 (9-11')																	X		
SJS21-MW04S	SJS21-SB04-12 (12-14')																	X		
RI (March 2005)																				
Shallow Groundwater Sampling																				
SJS21-MW07S	SJS21-MW07S-05A[2]		X			X	X													
RI (October through November 2005)																				
Shallow Groundwater Sampling																				
SJS21-TW101	SJS21-TW101-05D	X																		
SJS21-TW102	SJS21-TW102-05D	X	X																	
SJS21-TW103	SJS21-TW103-05D	X																		
SJS21-TW104	SJS21-TW104-05D	X	X																	
SJS21-TW106	SJS21-TW106-05D	X																		
SJS21-TW107	SJS21-TW107-05D	X																		
SJS21-TW108	SJS21-TW108-05D	X																		
SJS21-TW109	SJS21-TW109-05D	X																		
SJS21-TW110	SJS21-TW110-05D	X																		
SJS21-TW111	SJS21-TW111-05D	X																		
SJS21-TW112	SJS21-TW112-05D	X																		
SJS21-TW113	SJS21-TW113-05D	X																		
SJS21-TW114	SJS21-TW114-05D	X																		
SJS21-TW115	SJS21-TW115-05D	X																		
SJS21-TW116	SJS21-TW116-05D	X																		
SJS21-TW117	SJS21-TW117-05D	X																		
SJS21-TW118	SJS21-TW118-05D	X	X																	
SJS21-TW119	SJS21-TW119-05D	X	X																	
SJS21-TW120	SJS21-TW120-05D	X	X																	
SJS21-TW121	SJS21-TW121-05D	X	X																	
SJS21-TW122	SJS21-TW122-05D	X																		
SJS21-TW123	SJS21-TW123-05D	X	X																	
SJS21-TW124	SJS21-TW124-05D	X	X																	
SJS21-TW125	SJS21-TW125-05D	X	X																	
SJS21-TW126	SJS21-TW126-05D	X	X																	
SJS21-TW127	SJS21-TW127-05D	X	X																	
SJS21-MW01S	SJS21-MW01S-05D		X											X						
SJS21-MW02S	SJS21-MW02S-05D	X												X						
SJS21-MW03S	SJS21-MW03S-05D		X											X						
SJS21-MW04S	SJS21-MW04S-05D	X												X						
SJS21-MW05S	SJS21-MW05S-05D		X											X						
SJS21-MW06S	SJS21-MW06S-05D		X											X						
SJS21-MW07S	SJS21-MW07S-05D	X																		
SJS21-MW08S	SJS21-MW08S-05D	X												X						
SJS21-MW09S	SJS21-MW09S-05D	X												X						
SJS21-MW10S	SJS21-MW10S-05D		X																	
SJS21-MW11S	SJS21-MW11S-05D		X																	
SJS21-MW12S	SJS21-MW12S-05D	X		X	X			X	X			X	X	X	X	X	X			
SJS21-MW13S	SJS21-MW13S-05D	X		X	X			X	X			X	X	X	X	X	X			
Deep Groundwater Sampling																				
SJS21-MW01D	SJS21-MW01D-05D									X	X									
Depth-Specific Subsurface Soil Sampling																				
SJS21-MW12S	SJS21-SB05-00 (5-7')	X																		
SJS21-MW12S	SJS21-SB05-01 (12.5-14.5')	X																		
SJS21-MW12S	SJS21-SB05-02 (14.5-16')	X																		
SJS21-MW13S	SJS21-SB06-00 (9-11')	X																		
SJS21-MW13S	SJS21-SB06-01 (14-16')	X																		
SJS21-MW13S	SJS21-SB06-02 (16-18')	X																		

		Analytical Parameters																		
Station ID	**Sample ID**	**TCL VOCs (OLM04)**	**TCL VOCs (OLC03)**	**TCL SVOCs (OLM04)**	**TCL Pesticides/ PCBs (OLM04)**	**TAL Total Metals & Cyanide (ILM04)**	**TAL Dissolved Metals (ILM04)**	**TAL Total Metals & Cyanide (ILM05)**	**TAL Dissolved Metals (ILM05)**	**Total Arsenic (ILM05 ICP/MS)**	**Dissolved Arsenic (ILM05 ICP/MS)**	**Explosives (SW846 8330)**	**Alkalinity (310.1)**	**Ferrous Iron (SM 3500)**	**Nitrate/ Nitrite (353.2)**	**Sulfate (375.4)**	**TOC (9060)**	**NOD (SiRem MOD-48)**	**DHC DNA (functional genes: BAV1, 195, FL2)**	**OilScreenSoil (Indigo Blue®)**
RI (October through November 2006)																				
Shallow Groundwater Sampling																				
SJS21-TW201	SJS21-TW201-06D	X																		
SJS21-TW202	SJS21-TW202-06D		X																	
SJS21-TW203	SJS21-TW203-06D		X																	
SJS21-TW204	SJS21-TW204-06D		X																	
SJS21-GW101	SJS21-GW101-13-06D	X																		
SJS21-GW102	SJS21-GW102-13-06D		X																	
SJS21-GW103	SJS21-GW103-13-06D	X																		
SJS21-GW104	SJS21-GW104-13-06D	X																		
SJS21-GW105	SJS21-GW105-13-06D	X																		
SJS21-MW02S	SJS21-MW02S-06D																		X	
SJS21-MW07S	SJS21-MW07S-06D																		X	
SJS21-MW12S	SJS21-MW12S-06D																		X	
SJS21-MW13S	SJS21-MW13S-06D																		X	
SJS21-MW14S	SJS21-MW14S-06D	X																		X (15-16.5')
SJS21-MW15S	SJS21-MW15S-06D	X																		X (15.5-17')
SJS21-MW16S	SJS21-MW16S-06D	X																		X (14.5-15.5')
Depth-Specific Groundwater Sampling																				
SJS21-MW07S	SJS21-DW101-13-06D	X																		
SJS21-MW12S	SJS21-DW102-14-06D	X																		
SJS21-MW13S	SJS21-DW103-06D	X																		
SJS21-MW13S	SJS21-DW104-06D (Bailer)	X																		
SJS21-MW13S	SJS21-DW105-06D (PDB)	X																		
Depth-Specific Subsurface Soil Sampling																				
SJS21-MW16S	SJS21-SB09-15-06D (15-16')	X																		
RI (February 2007)																				
Shallow Groundwater Sampling																				
SJS21-TW205	SJS21-TW205-07A	X																		
SJS21-TW206	SJS21-TW206-07A	X																		
SJS21-TW207	SJS21-TW207-07A	X																		
SJS21-TW208	SJS21-TW208-07A	X																		
SJS21-TW209	SJS21-TW209-07A	X																		
SJS21-TW210	SJS21-TW210-07A	X																		
SJS21-TW211	SJS21-TW211-07A	X																		
SJS21-TW212	SJS21-TW212-07A	X																		
SJS21-TW213	SJS21-TW213-07A	X																		
SJS21-TW214	SJS21-TW214-07A	X																		
SJS21-TW215	SJS21-TW215-07A	X																		
SJS21-TW216	SJS21-TW216-07A	X																		
SJS21-TW217	SJS21-TW217-07A	X																		
SJS21-MW17S	SJS21-MW17S-07A	X																		
SJS21-MW18S	SJS21-MW18S-07A	X																		
SJS21-MW19S	SJS21-MW19S-07A	X																		

Notes:
[1] CLP method used for sample analysis, method version unknown.
[2] An additional groundwater sample was collected from SJS21-MW07S because the initial November 2004 sample collected following well installation, indicated TCE concentrations that were "B" qualified for possible blank contamination.
All groundwater samples were collected using low flow purging techniques unless otherwise noted.
DHC - *Dehalococoides*
DNA - Deoxyribonucleic Acid
PCBs - Polychlorinated Biphenyls
PDB - Passive Diffusion Bag
NOD - Natural Oxidant Demand
SVOCs - Semivolatile Organic Compounds
TAL - Target Analyte List
TCL - Target Compound List
TOC - Total Organic Carbon
VOCs - Volatile Organic Compounds

Table 2-3
Groundwater Detects from Relative Risk Ranking
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	09GW01	09GW02	09GW03	10GW01	10GW02	11GW01	21GW01	21GW02
Sample ID	09GW01	09GW02	09GW03	10GW01	10GW02	11GW01	21GW01	21GW02
Sample Date	04/04/96	04/04/96	04/04/96	04/04/96	04/04/96	04/04/96	04/04/96	04/04/96
Chemical Name								
Volatile Organic Compounds (UG/L)								
1,1-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	3 J	10 U
1,1-Dichloroethene	10 U	8 J	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene (total)	3 J	550 D	10 U	10 U	10 U	110	2 J	10 U
1,2-Dichloropropane	10 U	10 U	10 U	10 U	10 U	10 U	2 J	10 U
Acetone	6 J	5 J	10 U	7 BJ	10 U	10 U	13	5 J
Carbon tetrachloride	10 U	10 U	10 U	10 U	10 U	10 U	10	30
Chloroform	10 U	10 U	10 U	10 U	10 U	10 U	2 J	1 J
Methylene chloride	15 B	14	4 BJ	6 BJ	8 BJ	11	12	11
Tetrachloroethene	10 U	2 J	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	18	5,200 D	10 U	3 J	1 J	46	10	2,400 D
Xylene, total	10 U	1 J	10 U	10 U	10 U	10 U	10 U	10 U
Semi-volatile Organic Compounds (UG/L)								
2,4,5-Trichlorophenol	25 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4-Dinitrophenol	25 U	50 U	50 U	50 U	50 U	20 U	50 U	50 U
2-Nitroaniline	25 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
3-Nitroaniline	25 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4,6-Dinitro-2-methylphenol	25 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-Nitroaniline	25 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-Nitrophenol	25 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
bis(2-Ethylhexyl)phthalate	10 U	20 U	20 U	20 U	20 U	20 U	20 U	2 J
Total Metals (UG/L)								
Aluminum	107 B	25.9 B	19 U	401	305	120 B	147 B	19 U
Calcium	14,600	7,830	13,300	19,400	14,500	19,500	3,620 B	5,880
Cyanide	5.6 B	5 U	5 U	5 U	5 U	5 U	15.8	5 U
Iron	410	2,220	8,200	14,700	2,350	19.2 B	110	687
Magnesium	2,670 B	3,830 B	8,310	12,500	8,640	11,700	4,280 B	3,610 B
Manganese	253	484	1,980	2,650	1,400	1,440	433	602
Sodium	15,100	32,200	10,700	33,600	35,600	10,600	21,600	13,000
Zinc	35.6	30.9	18.1 B	39.6	57	10.6 B	31.5	36.1

Notes:

Shaded cells represent detected compounds

B - analyte not detected above associated blank

D - Result came from a diluted sample

J - estimated value

U - analyte not detected

Table 2-4
Surface Soil Detects from Relative Risk Ranking
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	10SS01	10SS02	11SS01	18SS01	21SS01	21SS02
Sample ID	10SS01	10SS02	11SS01	18SS01	21SS01	21SS02
Sample Date	04/05/96	04/04/96	04/05/96	04/02/96	04/08/96	04/08/96
Chemical Name						
Volatile Organic Compounds (UG/KG)						
Methylene chloride	5 J	5 BJ	6 J	4 J	1 BJ	1 BJ
Trichloroethene	11 U	11 U	6 J	4 J	11 U	12 U
Semi-volatile Organic Compounds (UG/KG)						
Anthracene	1,800 U	3,700 U	210 J	65 J	1,700 U	3,800 U
Benzo(a)anthracene	1,800 U	510 J	790 J	250 J	1,700 U	3,800 U
Benzo(a)pyrene	1,800 U	520 J	570 J	470	1,700 U	3,800 U
Benzo(b)fluoranthene	1,800 U	730 J	870 J	240 J	1,700 U	3,800 U
Benzo(g,h,i)perylene	1,800 U	420 J	320 J	360 U	1,700 U	540 J
Benzo(k)fluoranthene	1,800 U	3,700 U	380 J	290 J	1,700 U	3,800 U
Butylbenzylphthalate	1,800 U	3,700 U	1,800 U	150 J	1,700 U	3,800 U
Carbazole	1,800 U	3,700 U	1,800 U	51 J	1,700 U	3,800 U
Chrysene	1,800 U	440 J	820 J	330 J	1,700 U	3,800 U
Dimethyl phthalate	1,800 U	3,700 U	1,800 J	NA	1,700 U	3,800 U
Fluoranthene	210 J	910 J	1,800 U	450	1,700 U	430 J
Indeno(1,2,3-cd)pyrene	1,800 U	400 J	330 J	290 J	1,700 U	3,800 U
Naphthalene	1,800 U	3,700 U	1,800 U	47 J	1,700 U	3,800 U
Phenanthrene	1,800 U	3,700 U	1,500 J	370 J	1,700 U	3,800 U
Phenol	1,800 U	3,700 U	1,800 U	77 J	1,700 U	3,800 U
Pyrene	210 J	850 J	1,700 J	780	1,700 U	3,800 U
bis(2-Ethylhexyl)phthalate	1,800 U	3,700 U	1,800 U	630	1,700 U	3,800 U
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDD	NA	NA	37 U	NA	72 PD	3.8 U
4,4'-DDE	NA	NA	56	NA	170 D	3.8 U
4,4'-DDT	NA	NA	74	NA	88 D	3.8 U
Aroclor-1260	NA	NA	6,100 E	NA	4.9 JP	13 JP
Dieldrin	NA	NA	63	NA	3.5 U	3.8 U
Endrin	NA	NA	170	NA	3.5 U	3.8 U
Total Metals (MG/KG)						
Aluminum	6,610	6,150	7,400	4,520	6,460	4,350
Antimony	7.2 U	9.6 BJ	7.4 U	8.9 U	7.5	8.2 U
Arsenic	10.6	4.1	3.3	3.9	1.7	2.6
Barium	47.4	108	148	130	44.4	94.8
Beryllium	0.41 B	0.29 BJ	0.29 B	0.25 B	1.2	0.18 B
Cadmium	0.31 U	1.2	2.1	32.2	5.2	2.2
Calcium	1,040	3,380	1,040	754 B	7,660	2,650
Chromium	12	53.3	32.3	111	8.3	11.6
Copper	9.4	121	362	589	34.2	79.4
Cyanide	0.54 U	1.4	0.56 U	0.59 U	0.52 U	0.54 U
Iron	6,250	14,000	9,780	9,870	11,800	10,800
Lead	37.4	309	1,040	907	87.6	144
Magnesium	385 B	1,480	507 B	394 B	3,040	1,720
Manganese	79.5	125	61.6	49.6	405	342
Mercury	0.27	0.55	0.73	0.15	0.04 U	0.09 B
Nickel	5.5 B	24.1	10.4	12.7	5 B	6.7 B
Potassium	412 B	434 BJ	410 B	309 B	840	1,520
Silver	0.78 U	0.97 U	0.81 U	2.7	0.81 U	0.89 U
Vanadium	11.2	44.7	24.3	34	20.9	13.4
Zinc	49.8	405	461	554	60	137

Notes:

Shaded cells represent detected compounds

B - analyte not detected above associated blank

D - Result came from a diluted sample

E - exceeds calibration range

J - estimated value

P - analyte present, greater than 25% difference between the two GC columns

U - analyte not detected

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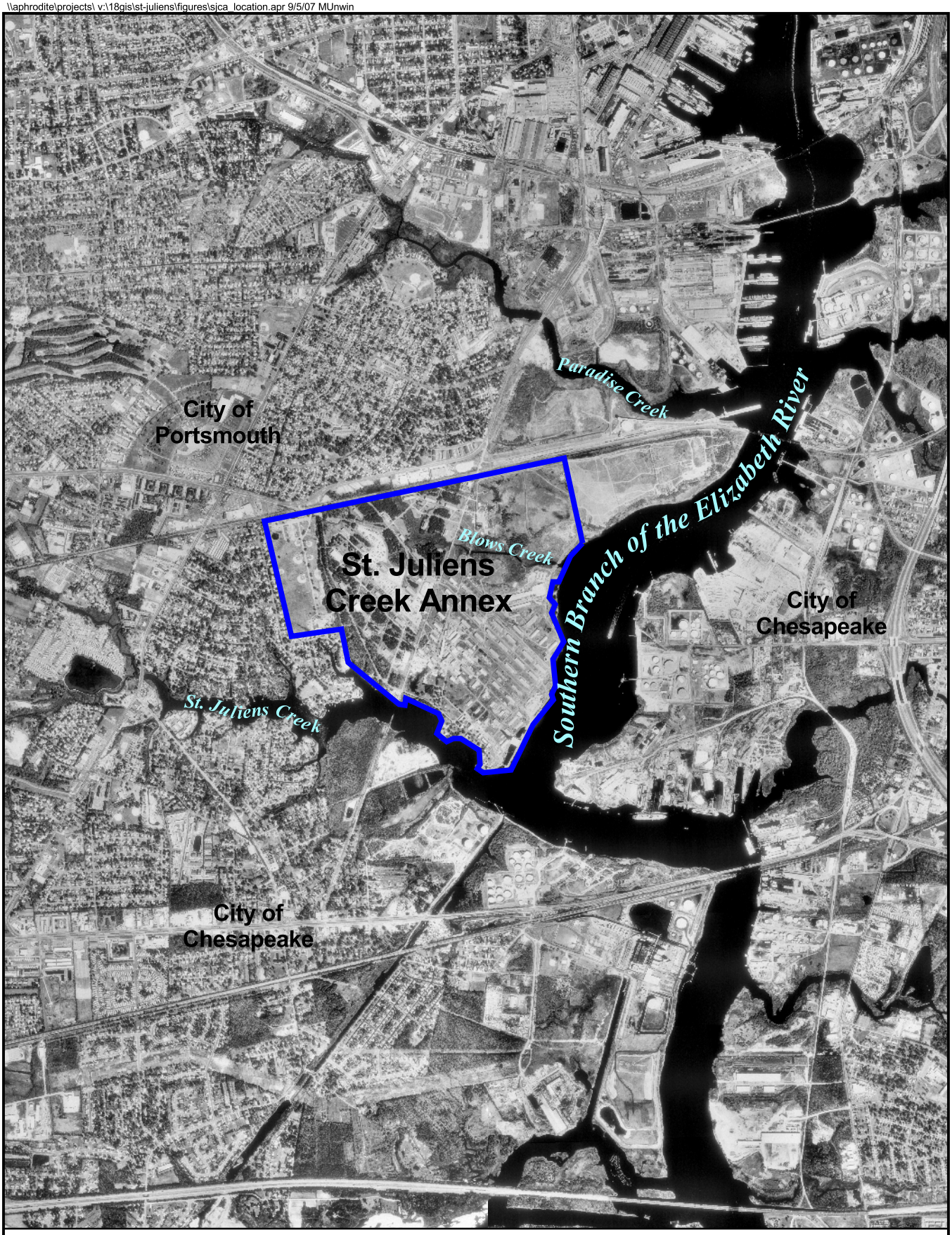

LEGEND

St. Juliens Creek Annex

N

0 1250 2500 Feet

Figure 2-1
Location of St. Juliens Creek Annex
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

LEGEND

- St. Juliens Creek Annex
- Site 21

N

0 500 1000 Feet

Figure 2-2
Site 21 Location Map
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

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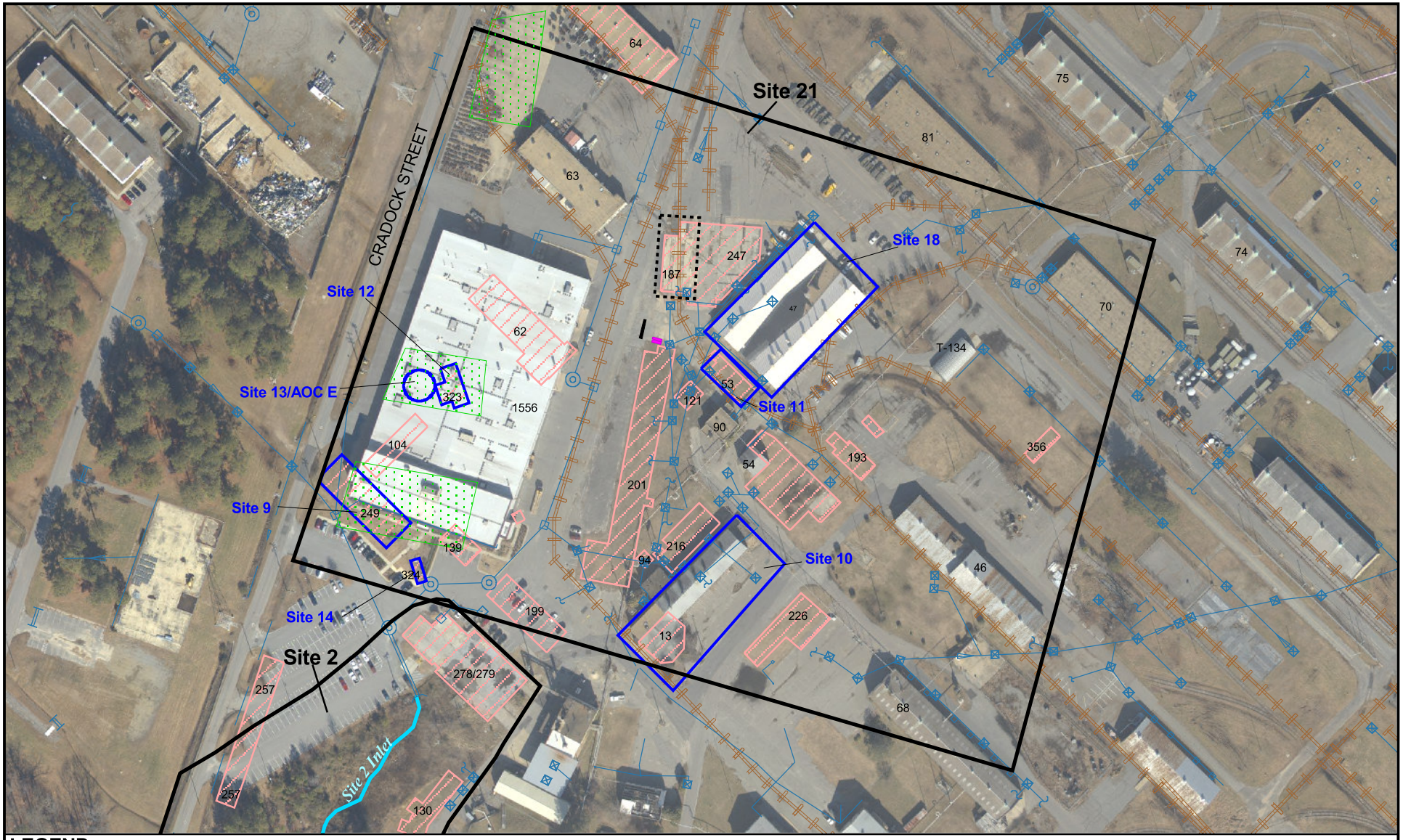

LEGEND

- Active IR Sites
- No Further Action IR Sites
- Demolished Buildings
- Original Site 21 Boundary
- Approx. Areas of TPH Contaminated Soil Removal (1993)
- Approx. Locations of Former USTs
- Former Service Station
- Former Railroad Tracks
- Stormwater Sewer System

N

0 100 200 Feet

Figure 2-3
Site 21 Vicinity
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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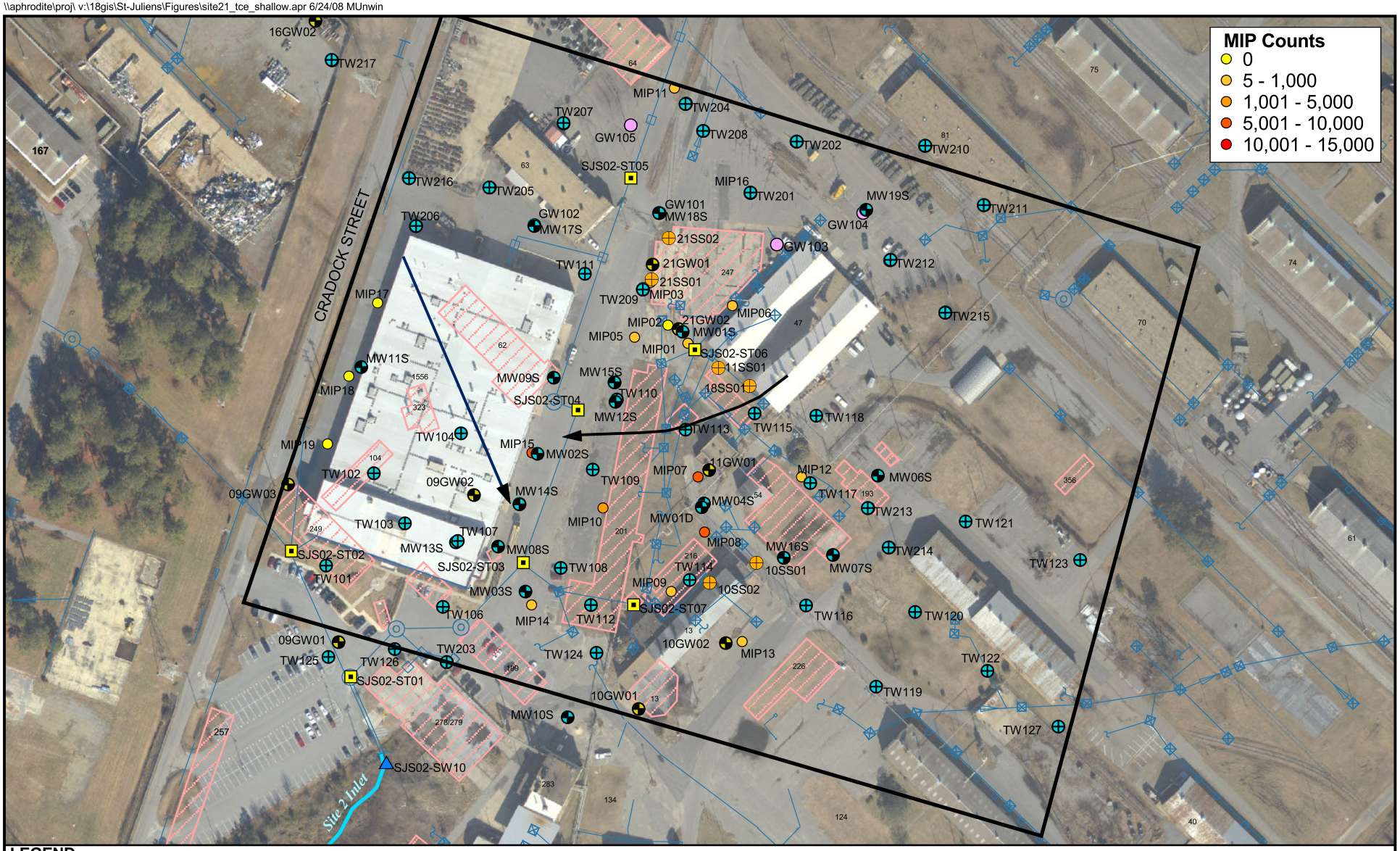

LEGEND

- Site 21 Boundary
- Shallow Monitoring Well Location
- Deep Monitoring Well Location
- Surface Water Sample Location
- Stormwater Sample Location
- Temporary Monitoring Well Location
- Grab Groundwater Sample Location
- RRR Groundwater Sample Location
- RRR Soil Sample Location
- Demolished Buildings
- Storm Sewer System
- Estimated Groundwater Flow Direction

Figure 2-4
Site 21 Sample Locations
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 3

Field Investigation Activities and Data Evaluation

The field activities reported in this RI, listed below, were initially conducted as a Supplemental Site Investigation. After the latest field investigation phase was completed, the SJCA Partnering Team agreed that sufficient data have been collected to fully characterize the site and the data should be reported in a RI report. The field activities described below were conducted in accordance with the work plans identified in Section 1.

December 2003

- Storm Water sampling and analysis

November through December 2004

- MIP
- Permanent shallow groundwater monitoring well installation
- Groundwater and subsurface soil sampling and analysis
- Aquifer Slug Testing

March 2005

- Groundwater sampling and analysis

October through November 2005

- Temporary and permanent shallow groundwater monitoring well installation
- Groundwater and subsurface soil sampling and analysis

October 2006 through January 2007

- Temporary and permanent shallow groundwater monitoring well installation
- Groundwater and subsurface soil sampling and analysis
- Storm sewer system video survey

February 2007

- Temporary and permanent shallow groundwater monitoring well installation
- Groundwater and subsurface soil sampling and analysis

Details of the field activities are provided in the sections below and the results are provided in Section 5, with the exception of the performance and evaluation of the hydraulic conductivity testing, which is included in Section 4.3.2. **Table 2-2** summarizes the data collected during each investigation phase.

3.1 Investigation Protocol

Prior to initiating intrusive activities, all sampling locations were cleared for utilities by third-party subcontractors. Potential munitions and explosives of concern (MEC) hazards were cleared as necessary in accordance with the Explosives Safety Submissions (ESS) Waiver (Naval Ordnance Safety and Security Activity [NOSSA], 2004) and ESS

Determination (NOSSA, 2006). No MEC hazards were encountered during any of the field activities. The summary reports from the MEC subcontractors are provided as **Appendix B**.

Samples collected during the investigations were submitted to pre-approved subcontracted laboratories. Off-site laboratories were used for all analyses, with the exception of the February 2007 field event, during which an on-site laboratory was used for analysis of temporary well groundwater samples to provide real-time data.

Appropriate quality assurance/quality control (QA/QC) sampling was performed in accordance with Navy CLEAN and CH2M HILL protocols, including field blanks, equipment blanks, duplicates, and matrix spike/matrix spike duplicates (MS/MSDs). The QA/QC data collected are provided in **Appendix C**.

3.2 Investigation Activities

The following sections summarize the sampling activities and analyses. Copies of the field logs are included in **Appendix D**. Groundwater samples collected during the initial sampling event were analyzed for VOCs, SVOCs, pesticides, PCBs, and total and dissolved metals. Based on those results, follow-up events focused on CVOC analysis for shallow groundwater plume delineation. **Table 2-2** provides a summary of all samples collected at Site 21 and their analytical parameters. The sample locations are identified on **Figure 2-4**. Results of the investigation activities are discussed in Section 5.

3.2.1 Storm Water and Surface Water Sampling

Seven storm water samples (SJS02-ST01 through ST07) were collected from drop inlets in the storm sewer system to determine if VOCs in groundwater are discharging to the storm sewer system and being transported to the Site 2 inlet. The samples were collected using a peristaltic pump with disposable tubing. A surface water sample (SJS02-SW10) was also collected at the storm sewer system outlet in the Site 2 inlet to St. Juliens Creek by submersing the sampling container directly into the surface water at the culvert outfall.

Water quality parameters (dissolved oxygen [DO], oxidation reduction potential [ORP], pH, temperature, salinity, and conductivity) were field measured *in situ* using a Horiba U-22 prior to sample collection and recorded in the field notebook. The storm water and surface water samples were analyzed for TCL VOCs.

3.2.2 Storm Sewer System Video Inspection

A video inspection of the storm sewer system was conducted to evaluate the potential for transport and release of contaminants from shallow groundwater through the adjacent storm sewer system and to ensure existing damage to the storm sewer system will not adversely affect future remediation activities. A technical memorandum detailing the video inspection of the storm sewer system is provided as **Appendix E**.

3.2.3 MIP Investigation

A limited MIP investigation was performed to help determine appropriate placement of a permanent groundwater monitoring well on the western side of Building 1556. Three MIP locations (17, 18, and 19) were advanced by DPT and extended from the ground surface to

the Yorktown confining unit, approximately 17 ft bgs. The ECD, photoionization detector (PID), and flame-ionization detector (FID) readings were used to assist in determining the presence of VOCs in groundwater (**Appendix A**). Additionally, conductivity and temperature data collected from the MIP were utilized to approximate depth to water and depth to the confining unit.

3.2.4 Aquifer Hydraulic Conductivity Testing

In situ hydraulic conductivity ("slug") testing was conducted to determine horizontal hydraulic conductivity. Rising head slug tests were performed at five shallow groundwater monitoring wells (SJS21-MW01S, MW04S, MW06S, MW10S, and MW11S) and one deep groundwater monitoring well (SJS21-MW01D). Slug tests were performed using solid polyvinyl chloride (PVC) slugs with clean bailer rope. A pressure transducer (MiniTroll) was used in combination with an electronic recording device (Hermit) to obtain water level readings during the slug testing activities. The test results were used to calculate the hydraulic conductivities (*K*) of the Columbia and Yorktown aquifers. The test data were evaluated using AQTESOLV software by HydroSOLVE, Inc. Test data were analyzed using the Bouwer-Rice (1976, 1989) method for unconfined and confined aquifers. The slug test results are incorporated in Section 4.3.2.

3.2.5 Temporary Monitoring Well Installation and Sampling

Forty-three temporary shallow groundwater monitoring wells (SJS21-TW101 through TW104, TW106 through TW127, and TW201 through TW217) were installed to refine the boundaries of the CVOC shallow groundwater plume and to aid in determining appropriate locations for permanent shallow groundwater monitoring wells. During installation of SJS21-TW05 in the northern portion of Building 1556, an abandoned utility was encountered and installation was not completed.

The temporary wells were installed using a DPT rig. Two-inch diameter casings with disposable end points were driven to the top of the Yorktown confining unit, depths ranging from 17- to 22-ft bgs. The wells were constructed with 5 ft of 1-inch diameter PVC casing and 10 to 15-ft of 1-inch diameter PVC screen was set through the 2-inch casings. After the wells were set, the casings were removed, leaving only the well and disposable end point in the ground. The formation was allowed to cave in around the temporary monitoring wells. Any remaining annular space was filled with #1 silica pack sand.

Groundwater samples were collected from the temporary wells using a peristaltic pump following a low-flow sampling protocol (USEPA, 1996). All samples were collected by placing the sample tubing intake approximately 2-ft above the bottom of the well. Water quality parameters—DO, ORP, pH, temperature, conductivity, and turbidity—were field measured with a Horiba U-22 and flow-through cell to ensure aquifer stability prior to sample collection and recorded in the field notebook. Measurements indicated stabilization of most water quality parameters prior to sample collection. All samples were analyzed for TCL VOCs.

The temporary wells were abandoned immediately following sampling. The PVC portion of the well was removed and the remaining void filled with bentonite chips. At locations paved with asphalt, the top 6 inches were patched to match the existing ground surface.

Prior to temporary monitoring well installation in Building 1556, 3-inch diameter cores were drilled into the concrete floor using diamond encrusted coring equipment. The cores were used to facilitate proper reconstruction of the floor once the temporary monitoring wells were removed.

3.2.6 Permanent Monitoring Well Installation and Sampling

Thirteen permanent shallow groundwater monitoring wells (SJS21-MW07S through MW19S) were installed to further define the nature and extent of contamination, determine the groundwater flow direction, aid remedial alternative evaluation, and support shallow groundwater monitoring in association with future remedial activities. Wells were installed using hollow stem augers. During drilling, 2- to 4-ft split spoon samples were collected continuously for the purpose of lithologic characterization. Soils were logged according to the Unified Soil Classification System (USCS). Grain size, color, moisture content, consistency, and other observations such as evidence of contamination were recorded in a field notebook. Boring logs are included in **Appendix F**.

Each new groundwater monitoring well was constructed with 2–inch inside diameter (ID) Schedule 40 PVC screen and riser. Screens were 10 ft in length and were set at bottom depths ranging from 13.5 to 21 ft bgs. Annular space surrounding the 0.01-inch machine slotted well screens was filled with #1 filter sand. The groundwater monitoring wells were completed flush to ground surface with a watertight steel cover. A watertight cap was placed on the PVC pipe and the wells were clearly marked. Well construction diagrams are provided in **Appendix F**. Following installation, each groundwater monitoring well was developed using a submersible Whale® pump. Conductivity, pH, turbidity, and flow rate were monitored during development.

Groundwater samples were collected from the new and existing shallow monitoring wells and an existing deep monitoring well, although not all wells were sampled during each investigation phase. Prior to sample collection, depth to groundwater was measured and recorded at each well. All shallow groundwater samples were analyzed for TCL VOCs, as well as additional analytical parameters as summarized in **Table 2-2**. A deep groundwater sample was collected from SJS21-MW01D for TAL total and dissolved metals to confirm or deny previous concentrations detected during the SI.

Groundwater samples were collected using a peristaltic pump following a low-flow sampling protocol (USEPA, 1996). All samples were collected by placing the sample tubing intake approximately 2 ft above the bottom of the well. Water quality parameters (DO, ORP, pH, temperature, conductivity, turbidity, and salinity) were field measured with a Horiba U-22 and flow through cell to ensure aquifer stability prior to sample collection and recorded in the field notebook. The aquifer was considered stable after at least one well volume was purged and water quality readings collected 5 minutes apart were stabilized to within 10 percent of one another, with the exception of turbidity, which was reduced to the extent practical. Measurements indicated stabilization of most water quality parameters prior to sample collection.

Groundwater from four monitoring wells (SJS21-MW02S, MW07S, MW12S, and MW13S) within the shallow CVOC groundwater plume were sampled for *Dehalococcoides* (DHC) deoxyribonucleic acid (DNA) BAV1, 195, and FL2 functional genes analysis to evaluate the

CVOC dechlorinating capability of the indigenous microbial community and assess the potential viability of enhanced reductive dechlorination as a remedial approach for treating CVOCs in site groundwater. A peristaltic pump was used to pump groundwater through a laboratory-prepared bio-filter until little or no outflow was observed, trapping microorganisms within the bio-filter.

3.2.7 Depth-Specific Groundwater Sampling

Depth-specific groundwater samples were collected in the northern portion of the site to refine the boundaries of the CVOC shallow groundwater plume and confirm the presence or absence of an undefined source release point in the area and at three permanent monitoring well locations of known high CVOC concentrations to confirm the presence or absence of dense non-aqueous phase liquid (DNAPL).

Five grab groundwater samples (SJS21-GW101, GW102, GW103, GW104, and GW105) were collected to refine the boundaries of the CVOC shallow groundwater plume and confirm the presence or absence of an undefined source area in the northern portion of the site. The samples were collected by using DPT to advance a 4-ft retractable, stainless-steel screen to the top of the Yorktown confining unit (approximately 20 ft bgs). The groundwater was sampled directly through this screen using a peristaltic pump and low-flow purging techniques (USEPA, 1996) to minimize turbidity. The samples were initially collected in 40 milliliter (ml) unpreserved glass vials filled to 70 percent capacity and analyzed for chlorinated compounds using Color-Tec groundwater test kits. Only low concentrations of CVOCs were detected using the test kits, and based on existing knowledge of the plume, it was evident that the results were unreliable. Therefore, additional grab groundwater samples were collected using DPT, as described above. These samples were collected in 40-ml laboratory-preserved glass vials filled to capacity with zero headspace; sent to an offsite laboratory; and analyzed for TCL VOCs.

Depth-specific grab groundwater samples were collected at three permanent monitoring well locations (SJS21-MW07S, MW12S, and MW13S) to confirm the presence or absence of DNAPL. Grab groundwater samples were collected immediately adjacent to MW07S and MW12S using a DPT rig fitted with a retractable screen. The samples were collected by advancing a 4-ft retractable stainless steel screen to the top of the Yorktown confining unit then partially retracting the screen cover, resulting in exposure of only 1-ft of the screen. The groundwater was sampled directly through this screen using a peristaltic pump. Because MW13S is located within Building 1556, the depth-specific groundwater samples were collected using three methods in order to provide QC data. First, groundwater from MW13S was sampled using a double check valve Aqua Bailer. Second, polyethylene tubing was lowered into the monitoring well to the bottom of the well and approximately 0.2 gallons were purged at a rate as slow as the peristaltic pump allowed prior to groundwater sample collection. Third, a groundwater sample was collected using a polyethylene-based passive diffusion bag (PDB) sampler in accordance with the U.S. Geological Survey (USGS) Users Guide (USGS, 2001). A PDB containing deionized water was installed at the bottom of MW13S and left for 2 weeks to equilibrate prior to sample collection. All the depth-specific groundwater samples were analyzed for TCL VOCs.

3.2.8 Depth-Specific Subsurface Soil Sampling

Subsurface soil samples were collected to determine the natural oxidant demand (NOD) to assist in evaluation of *in situ* chemical oxidation as a remedial alternative, determine the presence of sorbed TCE at various depths, and to screen for the presence or absence of DNAPL.

To determine the NOD in soil, samples were collected adjacent to existing permanent monitoring wells with elevated TCE concentrations (SJS21-MW02S and MW04S) by DPT using 4-ft, disposal acetate sleeves. The samples were collected from three depths at each sample location—the water table interface, within the Columbia aquifer, and at the top of the Yorktown confining unit—and analyzed for NOD.

To determine the presence of sorbed TCE, samples were collected at monitoring well locations (SJS21-MW12S, MW13S, and MW16S) during installation. At MW12S and MW13S the soil samples were collected at three depth intervals [at the water table (unsaturated/saturated zone interface), base of the Columbia aquifer, and top of the Yorktown confining unit]. At MW16S, a soil sample was collected from the top of the Yorktown confining unit. The samples were analyzed for TCL VOCs.

To screen for the presence or absence of DNAPL, samples were collected at monitoring well locations (SJS21-MW14S, MW15S, and MW16S) during installation. Samples were collected at the base of the Columbia aquifer (approximately 13 to 16 ft bgs) and from the top of the Yorktown confining unit (approximately 20 ft bgs) at each well. Each sample was field-screened for the presence of DNAPL using OilScreenSoil (Indigo Blue®). The soil was placed into a vendor prepared field testing container bottle with potable water. A cube containing a blue water soluble dye was added to the sample bottle cap. The cap was secured and the bottle was shaken vigorously. The formation of blue beading would indicate the presence of DNAPL.

3.2.9 Investigation-derived Waste Management

Investigation-derived waste (IDW) generated during the RI included drill cuttings from the soil borings and monitoring well installations, well development and purge water, and solutions used to decontaminate non-disposable sampling equipment. IDW was containerized in approved 55-gallon drums, stored on secondary containment at the approved IDW staging location, located at IR Site 2, and properly labeled. The drums were sampled by an IDW subcontractor or CH2M HILL for disposal characterization. Based on the analytical results, both non-hazardous and hazardous wastes were identified and disposed of at an approved disposal facility.

3.3 Data Management and Evaluation

Data management and tracking, from the time of field collection to receipt of validated electronic analytical results, is of primary importance and reflects the overall quality of analytical results. Field samples and their corresponding analytical tests were recorded on executed chain-of-custody forms, which were submitted with the samples to the laboratory. Chain-of-custody entries were checked against the site-specific project instructions and work plans to verify that all designated field samples were collected and submitted for the

appropriate analysis. Upon receipt of the samples by the laboratories, a comparison to the field information to verify that each sample was analyzed for the correct parameters and appropriate QA/QC samples were collected.

3.3.1 Data Qualifiers

Analytical data reports, in hardcopy and electronic format were submitted to Navy-approved third-party data validators. Procedures used for validation were Region III Modifications to the *National Functional Guidelines for Organic Data Review, Multi-media, Multi-concentration* (USEPA, 1994), and *Region III Modifications to Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis* (USEPA, 1993b). The data validation summaries are provided in **Appendix G**.

The data validation qualifiers, or flags, used for the RI data are the following:

- A "B" flag by the data validator indicates that the analytes have also been detected in a field, equipment, or trip blank, or in a laboratory QA/QC sample. The concentration of a "B"-qualified result is less than 10 times the concentration of the constituent for an associated QA/QC result. If the sample concentration is less than ten times the associated blank concentration, the conclusion is that the parameter was not detected. The following section provides further discussion of potential sources of blank contamination.
- A "J" flag indicates that the analyte is present but the value is estimated.
- An "L" flag indicates that the analyte is present, but the reported value may be biased low and the actual value is expected to be higher.
- An "R" flag indicates an unusable result. The analyte may or may not have been present and the result was rejected.
- A "U" flag indicates that the analyte was not detected and the associated value indicates the approximate sample concentration necessary to be detected.

3.3.2 Potential Non-Site-Related Analytical Results

Some of the organic (e.g., polycyclic aromatic hydrocarbons [PAHs]) and metal constituents detected in soil and/or groundwater may be attributed to non-site-related conditions or sources such as laboratory contaminants, anthropogenic non-site release sources, and naturally occurring (background) concentrations of constituents.

Laboratory and Sample Blank Contamination

In some instances, constituents detected in samples may have been introduced during field sampling, transportation to the analytical laboratory, or during laboratory procedures. A variety of blank samples were analyzed and used in the QA/QC process to determine which of the constituents may or may not be attributed to the field sample.

Typically, a field blank is collected to account for ambient conditions during sample collection. An equipment/rinsate blank is collected to determine if the equipment used to collect the samples (e.g., augers, bailers, and sample containers) was adequately clean. Additionally, the laboratory analyzes a method blank in each batch of 20 samples to verify

instrument cleanliness and function. Common phthalate compounds can be introduced during the analytical process and are often considered laboratory contaminants.

When blank samples are found to contain common laboratory contaminants, each of the aqueous field samples associated with that blank that contain up to 10 times the concentrations in the blanks are qualified during data validation with a "B" for that compound. A "B" qualifier means that the compound may not be attributed to the site at that sample location. When a sampling or laboratory blank contains contaminants other than the common laboratory contaminants, each of the aqueous field samples associated with that blank that contain up to 5 times the concentrations is qualified during data validation with a "B" for that compound.

To determine if a "B" qualifier should be assigned to a soil sample, a unit conversion is performed whereby soil sample concentrations relative to aqueous samples or laboratory blank concentrations are determined by dividing the soil concentration by the fraction of moisture, then dividing the result by five. A "B" qualifier designation, as described above for aqueous samples, can then be applied directly to the converted soil concentrations.

Background Data

To identify constituents present in groundwater reflective of a potential site-related release, naturally occurring and anthropogenic compounds (metals, pesticides, and PAHs) detected in shallow groundwater were compared to the shallow groundwater background 95 percent upper tolerance levels (UTLs) established for SJCA. The findings of the facility-wide background groundwater investigation were presented in the *Final Background Investigation Report Addendum for Groundwater* (CH2M HILL, 2004b).

SECTION 4

Physical Characteristics

Section 4 summarizes the physical characteristics of the region, SJCA, and Site 21 in particular. Subsection 4.1 discusses the regional and facility-wide physiography, climate, and surface water hydrology and Subsection 4.2 discusses the topography, drainage, and surface features at Site 21. Subsection 4.3 describes regional and site-specific geology and hydrogeology and water usage.

4.1 Regional and Facility-wide Physiography, Climate, and Surface Water Hydrology

SJCA is located in the eastern part of the Atlantic Coastal Plain Physiographic Province in Chesapeake, Virginia, within the Tidewater Region (**Figure 4-1**). Low elevations (typically less than 25 ft above mean sea level [amsl]) and relatively flat relief, characterize this part of the Coastal Plain. SJCA lies within the Deep Creek Swale, with land surface elevations ranging from sea level to approximately 20 ft amsl in the northeastern portion of the facility (**Figure 4-2**).

The Southern Branch of the Elizabeth River defines the eastern boundary of the land occupied by SJCA. St. Juliens Creek, which is a west-to-east flowing tributary of the Southern Branch of the Elizabeth River, defines the southern boundary of SJCA. Blows Creek, also a tributary of the Southern Branch of the Elizabeth River, flows through the center of SJCA and drains into the Southern Branch of the Elizabeth River. The Southern Branch of the Elizabeth River and its tributaries (including Blows Creek and St. Juliens Creek) are part of a tidal estuary system. In the vicinity of SJCA, the mean tide range of the Elizabeth River is approximately 2.8 ft and the spring tide range is approximately 3.3 ft (National Oceanic and Atmospheric Administration [NOAA], 2005).

The Tidewater Region has a maritime climate that is characterized by long, temperate summers and mild winters. The average annual temperature is 60.7° Fahrenheit (°F) with average monthly temperatures ranging from 43.1°F in January to 78.7°F in July. Winds are generally easterly and range from 6 to 11 knots. On the average, two hurricanes a year come close enough to affect Virginia, but fewer than one per year comes ashore. Hurricanes passing close offshore may cause high, wind-set tides. Northeasters are also a cause of wind-set tides; these storms occur from late fall to spring. Precipitation averages 43 inches annually and is slightly higher from June to August because of the prevalence of conductive thunderstorms. October, November, and December are the driest months of a typical year. The average annual snowfall is 8.8 inches.

Between 50 percent and 70 percent (22 to 30 inches) of the precipitation is removed from the area via runoff along the relatively flat topography and via evapotranspiration. The remaining 30 percent to 50 percent (13 to 22 inches) of precipitation recharges the surficial aquifer system by percolation through the upper soils (Siudyala, 1981). This recharge volume is approximately equivalent to 1.5 million to 2.5 million gallons per day (mgd) per

square mile. Approximately 90 percent of recharged groundwater returns to surface water streams as baseflow.

4.2 Topography, Drainage, and Surface Features

The Site 21 ground surface is mostly asphalt-covered with small unconnected grassy areas. The ground-surface elevations at each monitoring well were surveyed by a licensed surveyor. A topographical survey has not been performed at the site; however, the topography is relatively flat, with ground-surface elevations ranging from 7 to 9 ft amsl, based on surveyed monitoring well elevations.

A storm sewer system passes through Site 21 and discharges to the tidal wetland at Site 2. The majority of precipitation runs off into the storm sewer system. Precipitation that is not collected by the storm sewer system runs off south towards Site 2, with very little infiltration to groundwater. Precipitation that does not run off to the storm sewer system or water bodies or infiltrate to the groundwater evaporates or transpires.

4.3 Geology and Hydrogeology

4.3.1 General Regional Geologic and Hydrogeologic Framework

Regional Geology

The Southeastern Virginia Coastal Plain physiographic province is underlain by an eastward thickening wedge of marine and non-marine sediments ranging in age from early Cretaceous to Holocene (**Figure 4-3**). Along the coastline, several thousands of feet of interlayered, unconsolidated sediment, consisting of gravel, sand, silt, and clay deposits, overlie pre-Cretaceous crystalline basement rock.

Differential subsidence produced a series of gently dipping regional structural highs and lows, known as arches and embayments (or basins). The Tidewater Area of Virginia is located along the axis of a regional structural feature known as the Norfolk Arch, as shown in **Figure 4-4**. The arch is an east-west structural ridge of crystalline basement rock that separates the Salisbury Embayment to the north from Albemarle Embayment to the south. Thicker accumulations of sediment, estimated to be 1,500 to 2,000 ft thick in the vicinity of Chesapeake, are present in the basins as compared to over the arches. The arches were partially responsible for characteristic depositional sequences (marine, alluvial, and lagoonal) within the different basins.

Based on the generalized regional column presented by Meng and Harsh, 1988 (**Figure 4-5**), geologic units present beneath SJCA include, from youngest to oldest:

- Holocene (Recent) deposits
- Undifferentiated Pleistocene deposits of the Columbia Group (Sand Bridge and Norfolk Formations)
- The Miocene to Pliocene Chesapeake Group of formations (including Yorktown Formation)

- The Paleocene to Eocene Pamunkey Group of formations (Nanjemoy Formation)
- Late Cretaceous undifferentiated sediments
- Early to Late Cretaceous Potomac Formation

The two geologic units of interest for the Site 21 investigation are the Columbia Group and Chesapeake Group. The Columbia Group, composed of Holocene deposits and undifferentiated Pleistocene deposits, is the uppermost geologic unit in the area and is approximately 60 ft thick. The upper 20 to 40 ft consists of unconsolidated fine sands and silts. The lower 20 to 40 ft consists of relatively impermeable silt, clay, and sandy clay. The Chesapeake Group underlies the Columbia Group. The uppermost unit in the Chesapeake Group is the Yorktown Formation. The Yorktown Formation is approximately 300 to 400 ft thick with major sand, gravel, and shell beds in the upper 50 to 100 ft of the formation.

Regional Hydrogeologic Framework

Corresponding to the regional geologic formations and groups listed above are 17 hydro-stratigraphic units: nine aquifers separated by eight aquitards or confining units. Of these regional hydrostratigraphic units, only the youngest three are likely to be affected by facility operations. The hydrostratigraphic units are, from youngest to oldest:

- Holocene to Pleistocene Columbia aquifer
- Late Pliocene Yorktown confining unit
- Late Miocene to Pliocene Yorktown-Eastover aquifer
- Miocene St. Marys confining unit and St. Marys-Choptank aquifer
- Miocene Calvert confining unit and Chickahominy-Piney Point aquifer
- Late Paleocene to Early Eocene Nanjemoy-Marlboro Clay confining unit and Aquia aquifer
- Early Paleocene Brightseat confining unit and Brightseat aquifer (not present in Portsmouth/Chesapeake region)
- Late to Early Cretaceous Upper, Middle, and Lower Potomac confining unit and Upper, Middle, and Lower Potomac aquifers

The two uppermost aquifer systems underlying SJCA are: the surficial Columbia aquifer located in the upper 20 to 40 ft of the Columbia Group and the underlying Yorktown-Eastover aquifer, referred to as the Yorktown aquifer in this report. The Columbia aquifer consists of discontinuous, heterogeneous sand and shell lenses with generally low to moderate permeability deposited under fluvial-deltaic and estuarine environments (McFarland and Bruce, 2006). The aquifer is unconfined but clayey sediments within the unit may produce localized confined or leaky confined conditions and result in areas of perched groundwater. In the Chesapeake vicinity, transmissivity of the Columbia aquifer is typically less than 3,000 gallons per day (gpd)/ft (approximately 400 ft^2/day). The Columbia aquifer is recharged primarily by infiltration of precipitation and minimally by

stream infiltration. Most groundwater in the Columbia aquifer discharges into surface water and maintains base flow.

The Yorktown confining unit consists predominantly of relatively impermeable silt and clay layers interbedded with quartz sands of the lower Columbia Group and the upper Yorktown Formation. Locally the Yorktown confining unit consists of a blue/green gray, plastic clay with shell fragments common. Regionally, this unit varies in thickness from less than 50 ft to a maximum thickness of approximately 100 ft in northeastern Virginia. In the Chesapeake vicinity, the clay is approximately 20 to 40 ft thick. Across the facility, the thickness of the clay ranges from 15.3 to 38.7 ft (**Figure 4-6**). The low hydraulic conductivity of the silt and clay layers in the approximately 30-ft thick confining unit results in minimal leakage from the Columbia aquifer through the confining unit into the Yorktown aquifer from above. However, there is a potential for downward seepage where the confining unit thins or is discontinuous.

The Yorktown aquifer is semi-confined beneath the clay and silt layers of the Yorktown confining unit. The aquifer is heterogeneous. Water-bearing zones in the Yorktown aquifer consist of fine to coarse sand, gravel, and shells. This aquifer is approximately 200 ft thick in the Chesapeake area with transmissivity values ranging from approximately 1,500 gpd/ft to 65,000 gpd/ft (200 to 8,700 ft^2/day).

4.3.2 Site-Specific Geologic and Hydrogeologic Framework

The subsurface geology at Site 21 consists of the fine to coarse silty and clayey sands of the Columbia aquifer underlain by the high plasticity clay of the Yorktown confining unit. The Columbia aquifer extends to a depth of between 13.5 to 20 ft bgs. Only one deep permanent monitoring well has been installed at Site 21. The Yorktown confining unit is 17 ft thick at that location. At Site 2, just south of Site 21, four deep permanent monitoring wells have been installed, at which the thickness of the Yorktown confining unit ranges from 23 to 38 ft thick. The confining unit lies above the fine to coarse shelly sands of the Yorktown aquifer. The location of the hydrostratigraphic cross section depicting the subsurface environment at Site 21 is shown in **Figure 4-7**, and a cross section is presented as **Figure 4-8**. To evaluate hydrogeologic conditions and groundwater flow directions in each aquifer unit, an analysis was conducted to relate the screened interval of each well to each hydrostratigraphic unit. This analysis is presented in **Table 4-1**.

Groundwater levels were collected from Site 21 permanent monitoring wells during the field activities, with the exception of SJS21-MW04S during the February 2007 event (**Table 4-2**). A vehicle was parked atop of SJS21-MW04S, rendering the well inaccessible and preventing a groundwater level from being collected. Based on these data, shallow groundwater is generally encountered from 2 to 7 ft bgs and flows southwest in the eastern portions of the site and southeast in the western portions of the site toward the storm sewer system east of Building 1556. **Figure 4-9** depicts the potentiometric surface of groundwater observed in February 2007. It is not clear whether leaks in the storm sewer line or the increased permeability of the gravel around the line cause this preferential flow pathway. The storm sewer system eventually outlets in a downstream inlet (IR Site 2) to St. Juliens Creek (**Figure 4-9**). The horizontal hydraulic gradient in the shallow Columbia aquifer is between 0.004 and 0.01 ft/ft.

The slug test data, provided in **Appendix H,** were used to determine horizontal hydraulic conductivity (K) for the site. For the Columbia aquifer, the geometric mean K was interpreted to be about 7 ft/day and the standard deviation was interpreted to be about 4 ft/day (**Table 4-3**). These values are consistent with expected K values for a clean to silty sand. The K for the Yorktown aquifer was calculated to be about 4 ft/day (**Table 4-3**), also consistent with expected values for a clean to silty sand.

Groundwater flow velocity can be estimated using the following equation, based on Darcy's law:

$$v = Ki/n_e$$

Where:

v = estimated groundwater flow velocity
K = hydraulic conductivity
i = horizontal groundwater gradient
n_e = estimated effective porosity

For the shallow groundwater at SJCA Site 21, assuming K = 7 ft/day, i = 0.007 ft/ft, and n_e = 0.25 (typical for silty sand), v = 0.196 ft/day (72 ft/year).

The equation above is used to estimate groundwater flow under typical conditions. Since flow at Site 21 is heavily influenced by the position of the storm sewer system, it is likely that the actual velocity is higher than calculated.

4.3.3 Regional Water Usage

In southeastern Virginia, the Columbia aquifer may be utilized for watering lawns or filling swimming pools. However, groundwater in the Columbia aquifer is generally not utilized as a potable or industrial water supply in the area because it typically has a poorer quality and lower yield than underlying aquifers.

Throughout the eastern portion of the Coastal Plain, the Yorktown aquifer is used extensively for domestic and public water supply, as well as for industrial purposes. There is only one commercial/industrial permitted groundwater withdrawal in the vicinity of SJCA from the Yorktown aquifer: northwest of SJCA, the Elizabeth Manor Golf Club is permitted for groundwater withdrawals for golf course maintenance. The only permitted municipal groundwater usage of significance (i.e., several mgd or more) is located approximately 10 miles to the southeast of SJCA on the east (opposite) side of the Southern Branch of the Elizabeth River. These permitted groundwater withdrawals should not be affected by past or current operations at SJCA given the depth and location of the permitted wells and groundwater barriers formed by the Southern Branch of the Elizabeth River on the east boundary of SJCA and St. Juliens Creek on the south.

The groundwater at Site 21, and throughout SJCA, is not currently and is not expected to be used as a potable water supply. The SJCA drinking and industrial water is supplied by the City of Chesapeake.

Table 4-1
Monitoring Well Construction Summary
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Monitoring Well	Installation Date	Ground Elevation (ft msl)	Top of PVC Elevation (ft msl)	Total Well Depth (ft bgs)	Depth of Surface Casing (ft bgs)	Length of Screen (ft)	Depth of Top of Screen (ft bgs)	Depth of Bottom of Screen (ft bgs)	Depth to Base of Columbia Aquifer (ft bgs)	Depth to Base of Yorktown Confining Unit (ft bgs)	Thickness of Yorktown Confining Unit (ft)	Hydrogeologic Unit of Screened Interval	Description of Screened Lithology	Elevation of Top of Screen (ft msl)	Elevation of Bottom of Screen (ft msl)	Elevation of Base of Borehole (ft msl)	Elevation of Base of Columbia Aquifer (ft msl)	Elevation of Base of Yorktown Confining Unit (ft msl)
Shallow																		
SJS21-MW01S	08/07/03	8.9	8.53	18	NA	10	8	18	16	NA	NA	Columbia Aquifer	Columbia - fine sand with some silt and clay at 12-15', greenish gray silty clay 15-18', 8 ppm on PID in sample at 4-6'	0.9	-9.1	-9.1	-7.1	NA
SJS21-MW02S	08/07/03	8.5	8.03	18	NA	10	8	18	15	NA	NA	Columbia Aquifer	Columbia - fine to coarse sand; silty greenish gray clay 15-16'	0.5	-9.5	-9.5	-6.5	NA
SJS21-MW03S	08/08/03	8	7.64	18	NA	10	8	18	14.5	NA	NA	Columbia Aquifer	Columbia - fine to coarse sand; silty greenish gray clay 14.5- 16'	0	-10	-10	-6.5	NA
SJS21-MW04S	08/11/03	7.7	7.34	18	NA	10	8	18	16	NA	NA	Columbia Aquifer	Columbia - fine silty sand, fine to coarse from 12 14', greenish gray clay 14-16'	-0.3	-10.3	-10.3	-8.3	NA
SJS21-MW05S	08/12/03	7.7	7.53	18	NA	10	8	18	16	NA	NA	Columbia Aquifer	Columbia - fine to medium silty sand from 8-13.5'; medium to coarse sand with some silt 13.5-15.5'; sandy clay 15.5-16', greenish gray clay with trace silt and sand, some organic material at 16'	-0.3	-10.3	-10.3	-8.3	NA
SJS21-MW06S	08/12/03	8	7.63	18	NA	10	8	18	15	NA	NA	Columbia Aquifer	Columbia - silty fine to medium sand becoming medium to coarse at 12'; greenish gray clay at 15.5'	0	-10	-10	-7	NA
SJS21-MW07S	11/10/04	8.2	8.08	13.5	NA	10	3.5	13.5	13.5	NA	NA	Columbia Aquifer	Columbia - fine silty sand becoming medium sand at 11.5'; 13.5' clay	4.7	-5.3	-5.3	-5.3	NA
SJS21-MW08S	11/11/04	8.7	8.45	16	NA	10	4	14	15.5	NA	NA	Columbia Aquifer	Columbia - clay from 5-6'; fine sand with silt, becoming medium sand with clay at 14.5', then silty clay at 15'; clay at 15.5'	4.7	-5.3	-7.3	-6.8	NA
SJS21-MW09S	11/11/04	9.05	8.69	14	NA	10	4	14	14.5	NA	NA	Columbia Aquifer	Columbia - silty sand, gray becoming brownish tan; fine sand; slight odor from 11-12'	5.05	-4.95	-4.95	-5.45	NA
SJS21-MW10S	11/11/04	8.32	8.03	14	NA	10	4	14	14.5	NA	NA	Columbia Aquifer	Columbia - silty sand with clay lenses; fine sand; slight petroleum odor from 6-7'	4.32	-5.68	-5.68	-6.18	NA
SJS21-MW11S	11/16/04	9.16	8.91	17	NA	10	6.5	16.5	16.8	NA	NA	Columbia Aquifer	Columbia - fill to 7.25'; sandy clay, becoming fine silty sand with small amounts of clay and then silty to coarse sand	2.66	-7.34	-7.84	-7.64	NA
SJS21-MW12S	11/07/05	8.39	8.13	15.5	NA	10	5	15	14.5	NA	NA	Columbia Aquifer	Columbia - fine light gray sand to silty fine dark gray sand; trace mottling from 10-12'	3.39	-6.61	-7.11	-6.11	NA
SJS21-MW13S	11/07/05	9.82	9.31	15.5	NA	10	5	15	16	NA	NA	Columbia Aquifer	Columbia - silty fine sand changing to medium sand and fine sand with some silt at 14.5'	4.82	-5.18	-5.68	-6.18	NA
SJS21-MW14S	10/24/06	8.49	8.20	16.5	NA	10	6	16	16	NA	NA	Columbia Aquifer	Columbia - medium fine to fine sand , organics at 13.5-14.5', some clay from 12-16'	2.49	-7.51	-8.01	-7.51	NA
SJS21-MW15S	10/23/06	8.27	8.02	17.5	NA	10	7	17	16.5	NA	NA	Columbia Aquifer	Columbia - medium to fine sand with some silt, some clay from 14.9 - 16.5'	1.27	-8.73	-9.23	-8.23	NA
SJS21-MW16S	10/25/06	7.69	7.39	15.5	NA	10	5	15	14.5	NA	NA	Columbia Aquifer	Columbia - fine to medium sand with some silt and clay, clay at 14.5'	2.69	-7.31	-7.81	-6.81	NA
SJS21-MW17S	02/23/07	8.49	8.17	17	NA	10	7	17	16	NA	NA	Columbia Aquifer	Columbia - silty sand, clay with fine sand at 14', clay at 17'	1.49	-8.51	-8.51	-7.51	NA
SJS21-MW18S	02/22/07	8.40	8.17	21	NA	10	11	21	17	NA	NA	Columbia Aquifer	Columbia - fine silty sand becoming clayey at 15.25', silty clay at 17', clayey fine sand lense from 20-21'	-2.6	-12.6	-12.6	-8.6	NA
SJS21-MW19S	02/23/07	7.85	7.52	18	NA	10	8	18	17	NA	NA	Columbia Aquifer	Columbia - silty sand becoming clayey at 13', silty clay at 18'	-0.15	-10.15	-10.15	-9.15	NA
Deep																		
SJS21-MW01D	08/11/03	7.7	7.37	43	22	10	33	43	16	33	17	Yorktown Aquifer	YCU - silty sand, medium to coarse sand, sandy clay; some gravel and pebbles at 42'; greenish gray	-25.3	-35.3	-35.3	-8.3	-25.3

NA - Not Available or Not Applicable
OVM - Organic Vapor Meter
YCU - Yorktown Confining Unit
YF - Yorktown Formation

Table 4-2
Groundwater Elevations
Site 21 Remedial Investigation
St. Juliens Creek Annex, Chesapeake, Virginia

Monitoring Well	Top of PVC Elevation (ft msl)	October 2003		December 2004		March 2005		November 2005		October 2006		February 2007	
		Depth to Water (ft)	Water Elevation (ft msl)	Depth to Water (ft)	Water Elevation (ft msl)	Depth to Water (ft)	Water Elevation (ft msl)	Depth to Water (ft)	Water Elevation (ft msl)	Depth to Water (ft)	Water Elevation (ft msl)	Depth to Water (ft)	Water Elevation (ft msl)
Shallow													
SJS21-MW01S	8.53	3.14	5.39	3.43	5.1	-----	-----	4.15	4.38	-----	-----	2.6	5.93
SJS21-MW02S	8.03	4.73	3.3	5.02	3.01	-----	-----	5.3	2.73	-----	-----	4.9	3.13
SJS21-MW03S	7.64	4.74	2.9	5.4	2.24	-----	-----	5.43	2.21	-----	-----	4.98	2.66
SJS21-MW04S	7.34	1.75	5.59	2.25	5.09	-----	-----	2.79	4.55	-----	-----	-----	-----
SJS21-MW05S	7.53	1.56	5.97	2.25	5.28	-----	-----	3.03	4.5	-----	-----	1.72	5.81
SJS21-MW06S	7.63	1.98	5.65	1.75	5.88	-----	-----	2.39	5.24	-----	-----	1.52	6.11
SJS21-MW07S	8.07	-----	-----	2.54	5.53	1.36	6.71	3.33	4.74	-----	-----	1.54	6.53
SJS21-MW08S	8.45	-----	-----	6.08	2.37	-----	-----	6.12	2.33	-----	-----	5.95	2.5
SJS21-MW09S	8.69	-----	-----	5.74	2.95	-----	-----	5.76	2.93	-----	-----	5.61	3.08
SJS21-MW10S	8.03	-----	-----	3.87	4.16	-----	-----	4.25	3.78	-----	-----	3.19	4.84
SJS21-MW11S	8.91	-----	-----	5.69	3.22	-----	-----	5.63	3.28	-----	-----	5.13	3.78
SJS21-MW12S	8.13	-----	-----	-----	-----	-----	-----	4.5	3.63	-----	-----	3.68	4.45
SJS21-MW13S	9.31	-----	-----	-----	-----	-----	-----	6.95	2.36	-----	-----	6.72	2.59
SJS21-MW14S	8.2	-----	-----	-----	-----	-----	-----	-----	-----	5.35	2.85	5.33	2.87
SJS21-MW15S	8.02	-----	-----	-----	-----	-----	-----	-----	-----	3.77	4.25	3.71	4.31
SJS21-MW16S	7.39	-----	-----	-----	-----	-----	-----	-----	-----	1.42	5.97	1.59	5.8
SJS21-MW17S	8.17	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.11	4.06
SJS21-MW18S	8.17	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.05	5.12
SJS21-MW19S	7.52	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.21	6.31
Deep													
SJS21-MW01D	7.37	4.88	2.49	5.45	1.92	-----	-----	5.31	2.06	-----	-----	-----	-----

----- depth to water not measured

Table 4-3
Slug Test Results
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Monitoring Well	Slug Test Type	Slug Test Analytical Method	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (feet/day)	Saturated Thickness (feet)	Transmissivity (cm^2/sec)	Transmissivity ($feet^2$/day)
Columbia Aquifer - Unconfined Aquifer							
SJS21-MW01S	Rising Head	Bouwer-Rice	2.94E-03	8.33	11.36	1.02	94.6
SJS21-MW04S	Rising Head	Bouwer-Rice	2.73E-03	7.73	14.63	1.22	113.1
SJS21-MW06S	Rising Head	Bouwer-Rice	1.97E-03	5.58	9.89	0.59	55.1
SJS21-MW10S	Rising Head	Bouwer-Rice	4.75E-03	13.45	10	1.45	134.5
SJS21-MW11S	Rising Head	Bouwer-Rice	1.07E-03	3.04	11	0.36	33.4
Columbia Aquifer Geometric Mean:			**2.40E-03**	**7**		**0.82**	**77**
Columbia Aquifer Standard Deviation:			**1.36E-03**	**4**		**0.45**	**41**
Yorktown Aquifer (Bouwer-Rice)							
SJS21-MW01D	Rising Head	Bouwer-Rice	1.55E-03	4.39	12	0.57	52.7

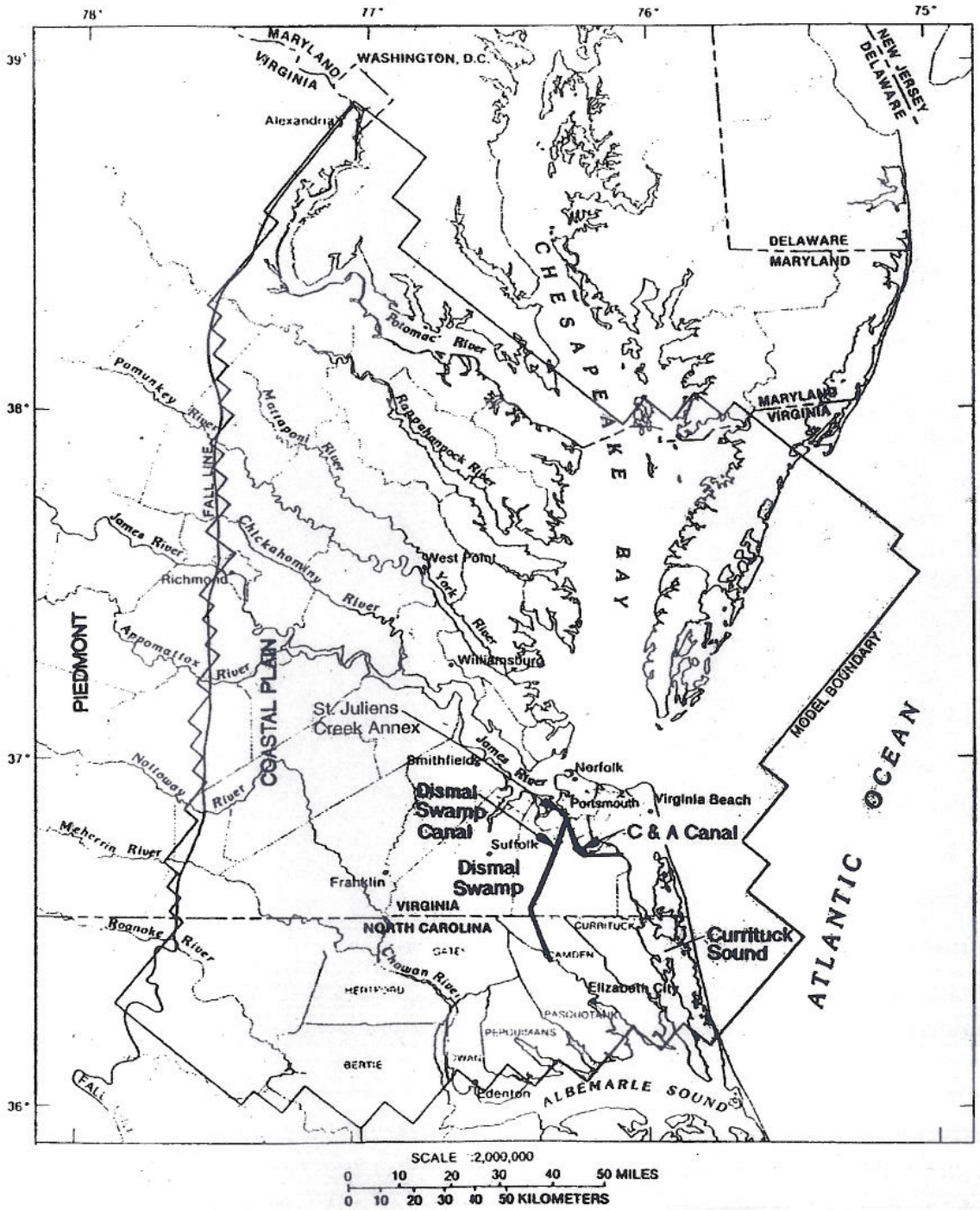

FIGURE 4-1

PHYSIOGRAPHIC PROVINCES
OF SOUTHERN VIRGINIA
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

SOURCES:

BASE FROM U.S. GEOLOGICAL SURVEY
STATE BASE MAPS 1:1,000,000 AND USGS
SURVEY PROFESSIONAL PAPER 1404-F.

CH2MHILL

8802f004.dlv

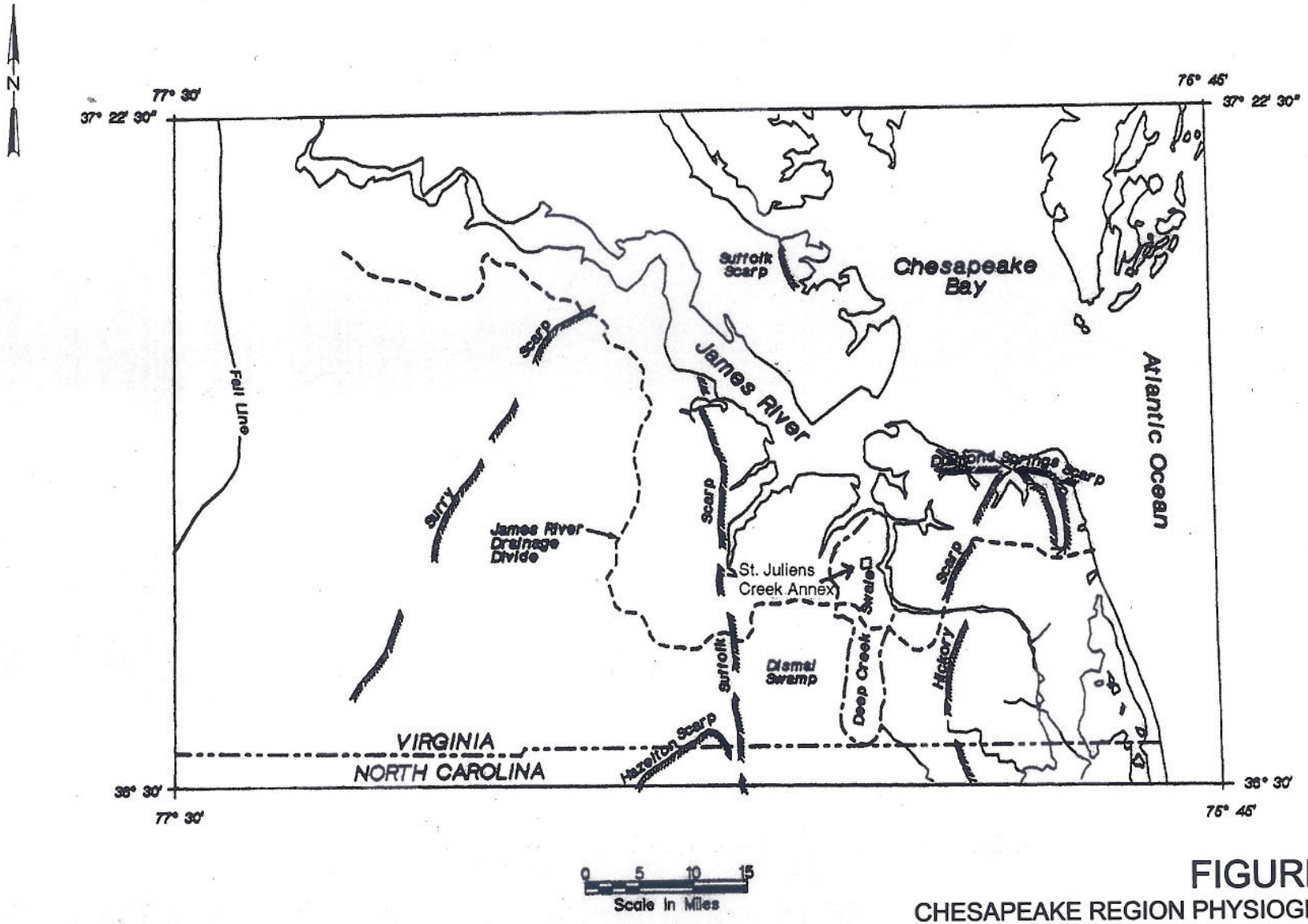

FIGURE 4-2

CHESAPEAKE REGION PHYSIOGRAPHY
AND HYDROLOGY FEATURES
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

SOURCE:

FIGURE 6" OF POST-MIOCENE STRATIGRAPHIC AND MORPHOLOGY, SOUTHERN VIRGINIA, BULLETIN 82, DATED 1973.

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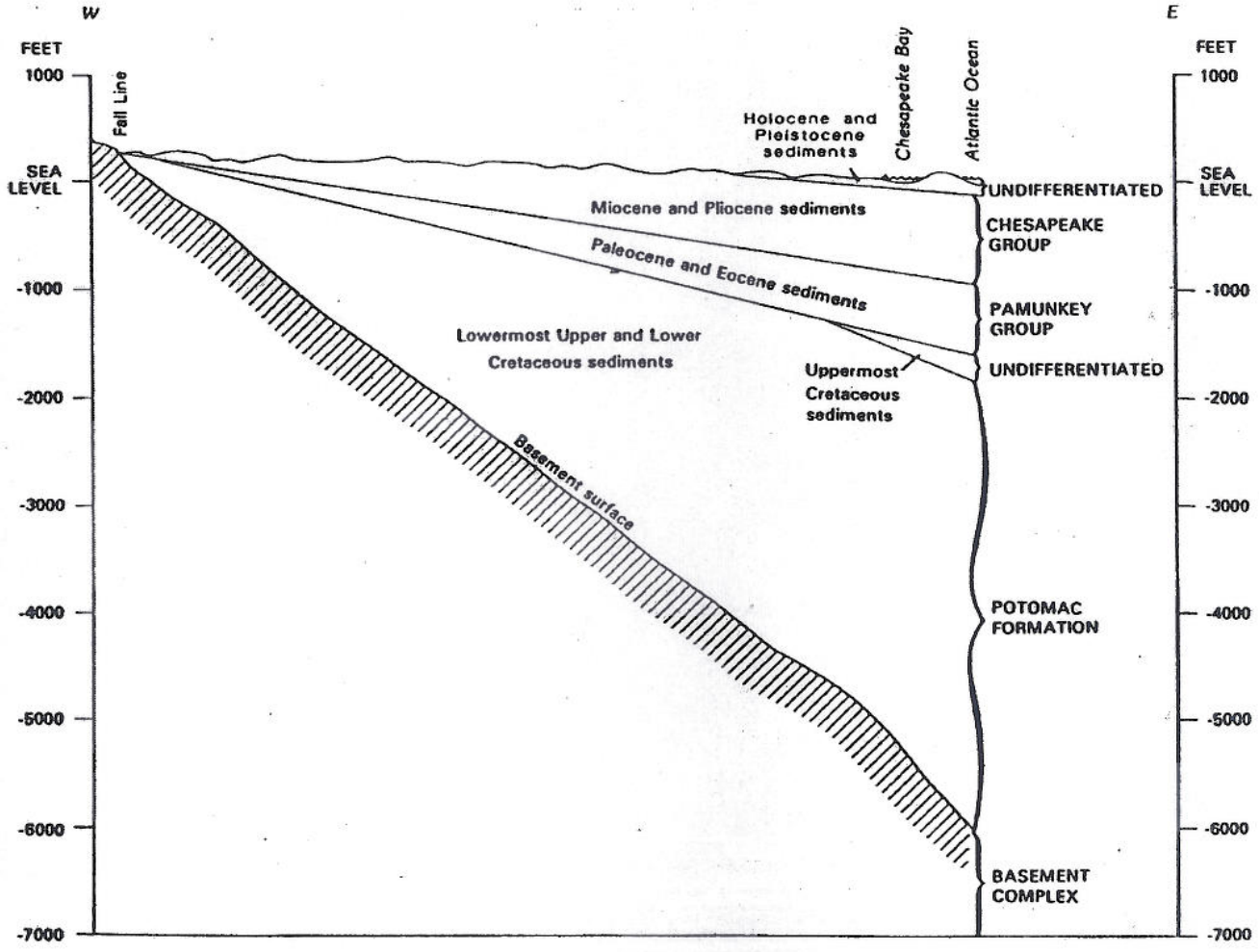

FIGURE 4-3

GENERALIZED GEOLOGIC SECTION
SHOWING EASTWARD-THICKENING SEDIMENTARY
WEDGE OF VIRGINIA COSTAL PLAIN
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

SOURCE:

FIGURE 5 OF REGIONAL AQUIFER-SYSTEM ANAYLSIS
USGS SURVEY PROFESSIONAL PAPER 1404-C.

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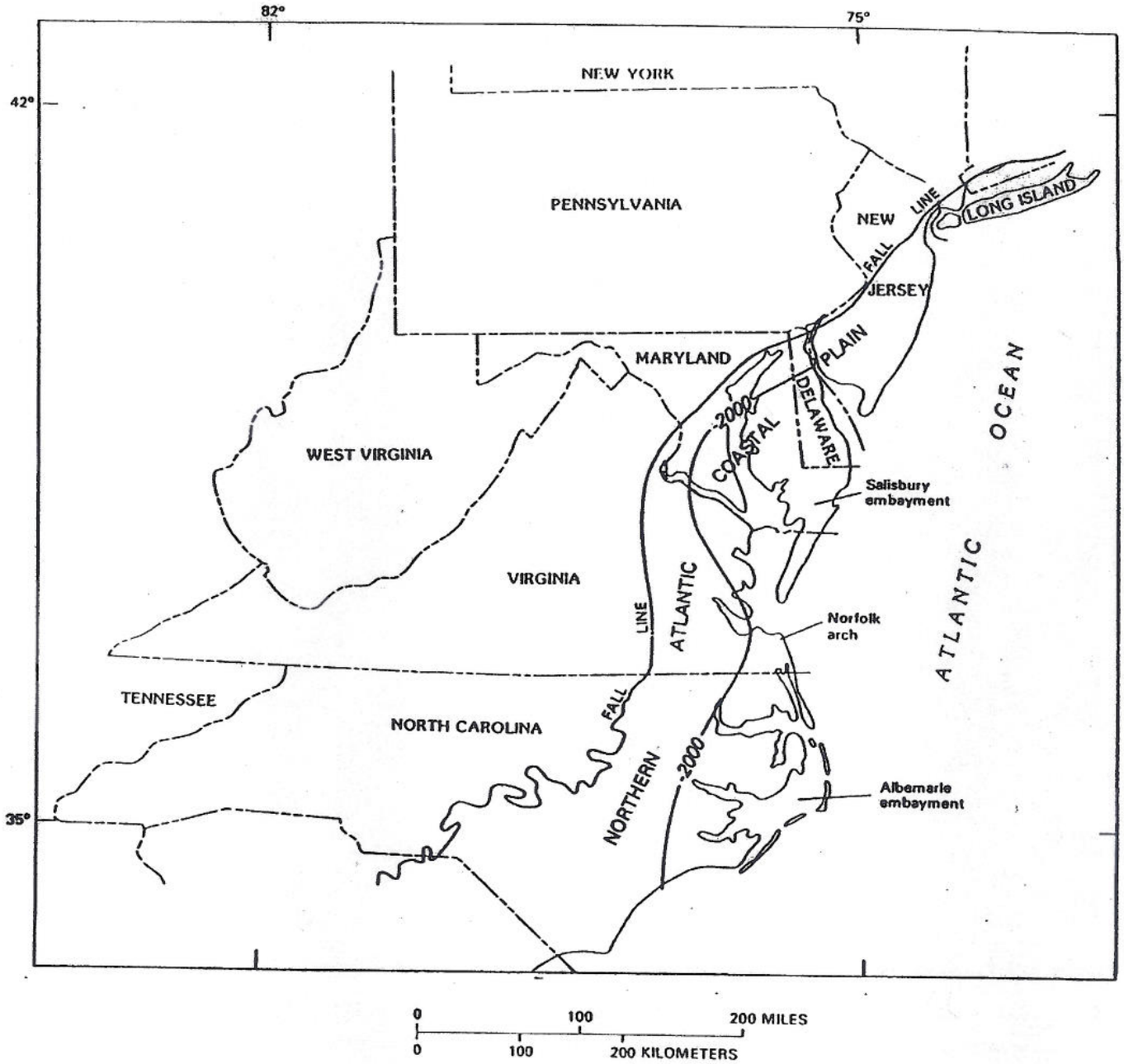

EXPLANATION

—-2000— STRUCTURE CONTOUR-Shows altitude of top of basement surface, in feet. Datum is sea level

FIGURE 4-4

MAJOR STRUCTURAL BASEMENT-DEFORMATION FEATURES OF THE VIRGINIA COASTAL PLAIN AND ADJOINING AREAS
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

SOURCE:

FIGURE 6* OF REGIONAL AQUIFER-SYSTEM ANALYSIS
USGS SURVEY PROFESSIONAL PAPER 1404-C.

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SYSTEM	SERIES		Geological units this report			Hydrogeologic units: Meng and Harsh (1988)	Virginia RASA model unit	Laczniak and Meng (1988)	Brockman and others (1997): Lackey Plain	Brockman and others (1997): Croaker Flat
QUATERNARY	Holocene		Alluvium, swamp, + beach			Columbia aquifer	AQ10	Columbia aquifer	Columbia aquifer	Columbia aquifer
	Pleistocene	U	Tabb Formation							
		M	Shirley Formation							
			Chuckatuck Formation							
		L	Charles City Formation						Columbia aquifer	Yorktown confining unit[2]
			Windsor Formation							
TERTIARY	Pliocene	U	Bacons Castle Formation			Yorktown confining unit	CU9	Yorktown confining unit	Cornwallis Cave confining unit	
			CHESAPEAKE GROUP	Yorktown Formation	Moore House Member	Yorktown-Eastover aquifer	AQ9		Cornwallis Cave aquifer	
					Mogarts Beach Member				Yorktown confining unit	
					Rushmere Member			Yorktown-Eastover aquifer	Yorktown confining unit	
		L			Sunken Meadow Member				Yorktown-Eastover aquifer	
	Miocene	U		Eastover Formation	Unnamed beds[1] ?					
					Cobham Bay Member					
					Claremont Manor Member	St. Marys confining unit	CU8	St. Marys confining unit	Eastover-Calvert confining unit	
				St. Marys Formation						
				Calvert Formation	Choptank Formation (not present in study area)	St. Marys-Choptank aquifer	AQ8	Calvert confining unit		
		M			Calvert Beach Member	Calvert confining unit	CU7			
					Plum Point Member					
					Fairhaven Member					
		L			Newport News unit	Chickahominy-Piney Point aquifer	AQ7	Chickahominy-Piney Point aquifer	Not covered in report	
	Oligocene	U	Old Church Formation							

York County shallow aquifer system

[1]Unpublished data D.S. Powars and T. Cronin (1995).
[2]Yorktown-Eastover aquifer.

FIGURE 4-5

SIGNIFICANT STRATIGRAPHIC NOMENCLATURE
IN RELATION TO HYDROGEOLOGIC FRAMEWORK
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

NOTE:

TABLE COPIED FROM THE EFFECTS OF THE CHESAPEAKE BAY IMPACT CRATER ON THE GEOLOGICAL FRAMEWORK AND CORRELATION OF THE HYDROGEOLOGIC UNIT OF THE LOWER YORK-JAMES PENINSULA, VIRGINIA, BY: DAVID S. POWARS AND T. SCOTT BRUCE, U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1612.

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\\aphrodite\proj\18GIS\St-Juliens\Figures\Site21\Figure4-6_deep_mw_yorktown.mxd 7/1/08 MUnwin

Legend

- Activity Boundary
- Deep Monitoring Well Location

N
W E
S

0 325 650
Feet

Figure 4-6
Deep Monitoring Well Locations and Thickness of the Yorktown Confining Unit Across SJCA
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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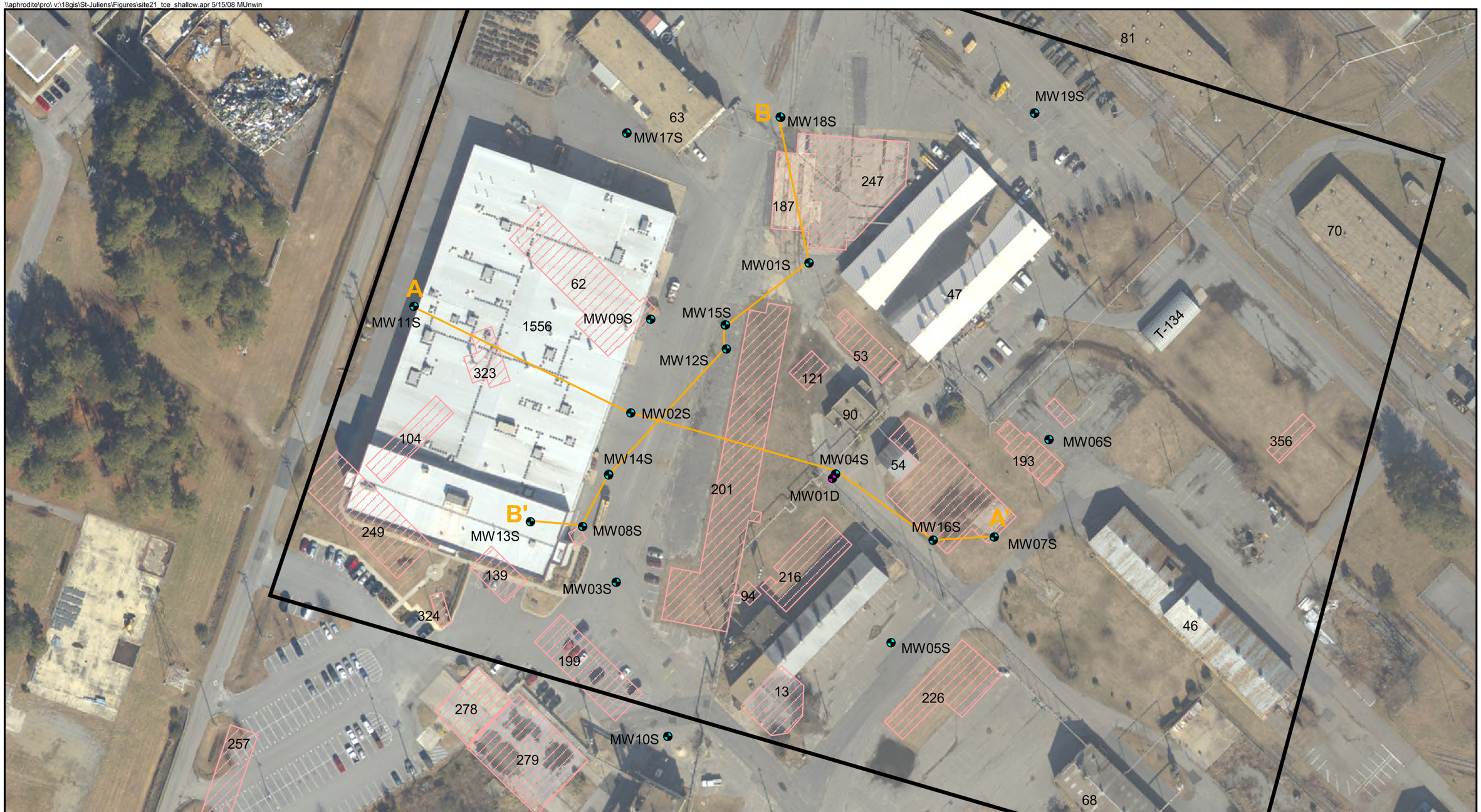

LEGEND

- Site 21 Boundary
- Shallow Monitoring Well Location
- Deep Monitoring Well Location
- Cross Section Location
- Demolished Buildings

N

0 100 200 Feet

Figure 4-7
Hydrostratigraphic Cross Section Locations
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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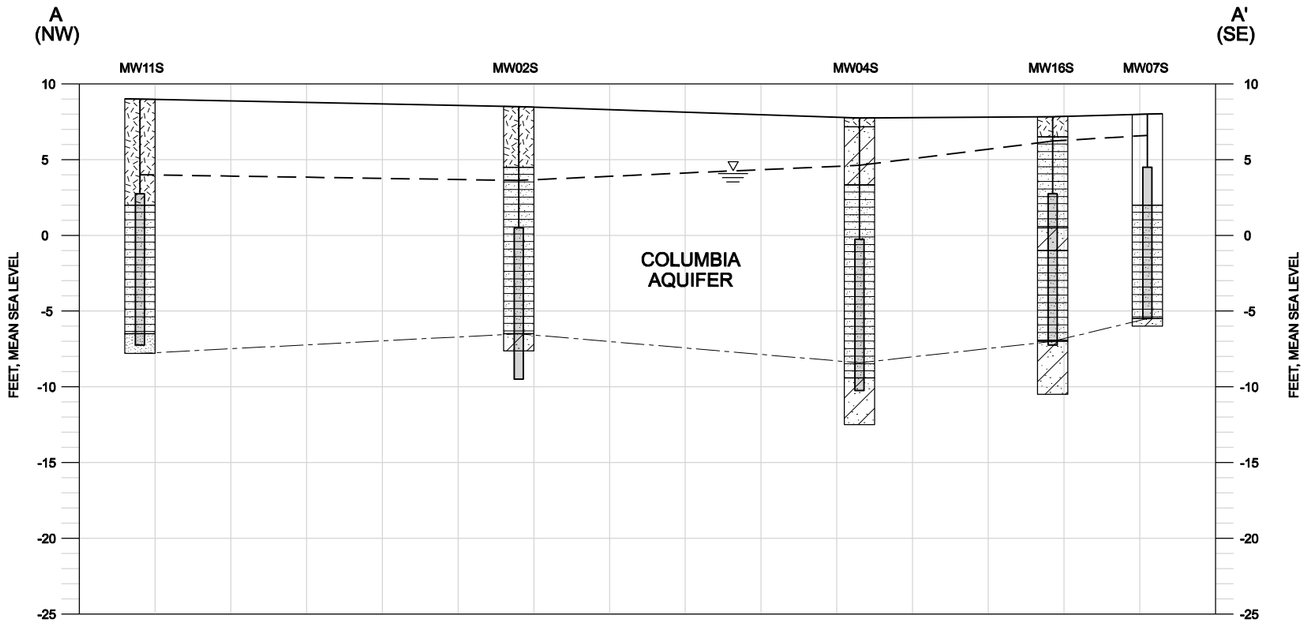
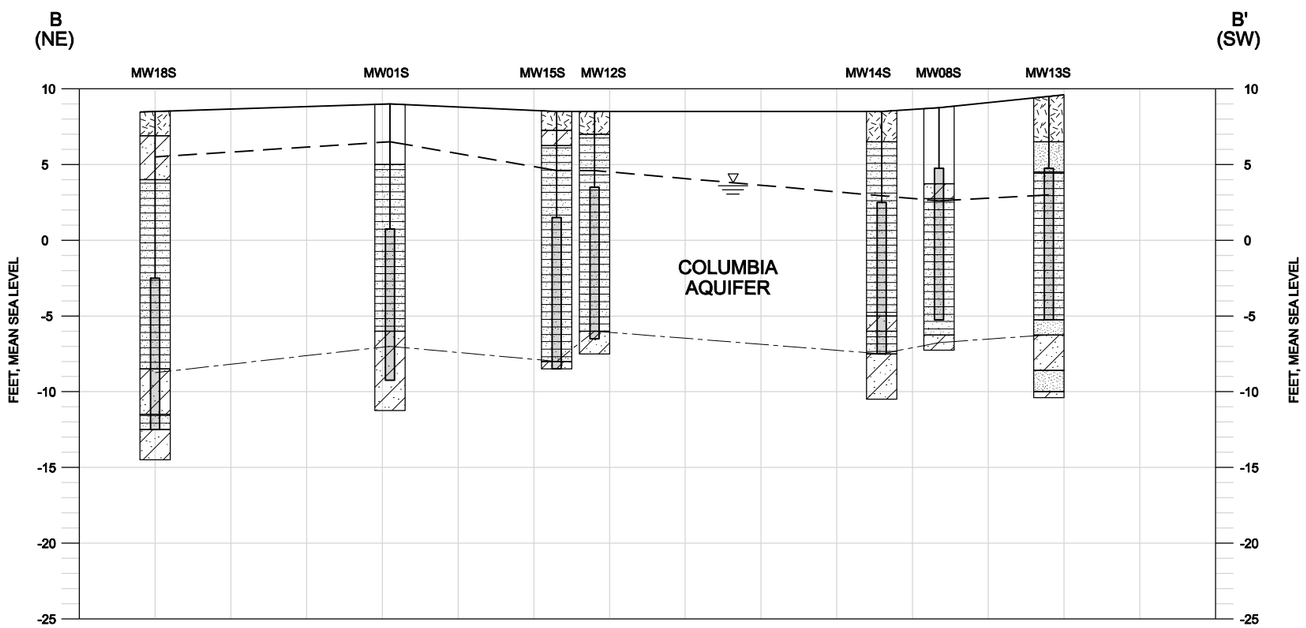




LEGEND

MONITORING WELL SCREENED INTERVAL

WATER TABLE

STRATIGRAPHY

GROUND SURFACE

HYDROSTRATIGRAPHIC CONTACT

INTERPOLATED WATER TABLE

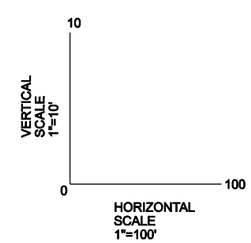
LITHOLOGY/USCS DESCRIPTION

FILL MATERIAL: ASPHALT

WELL GRADED SAND

FINE TO MEDIUM SAND

SILTY CLAY



NOTE:

1. THIS CROSS SECTION IS INTERPRETIVE AND WAS PREPARED BY INTERPOLATION BETWEEN BORING LOCATIONS. ACTUAL CONDITIONS BETWEEN BORINGS MAY DIFFER FROM THOSE SHOWN HERE.

FIGURE 4-8
HYDROSTRATIGRAPHIC CROSS-SECTIONS
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VA

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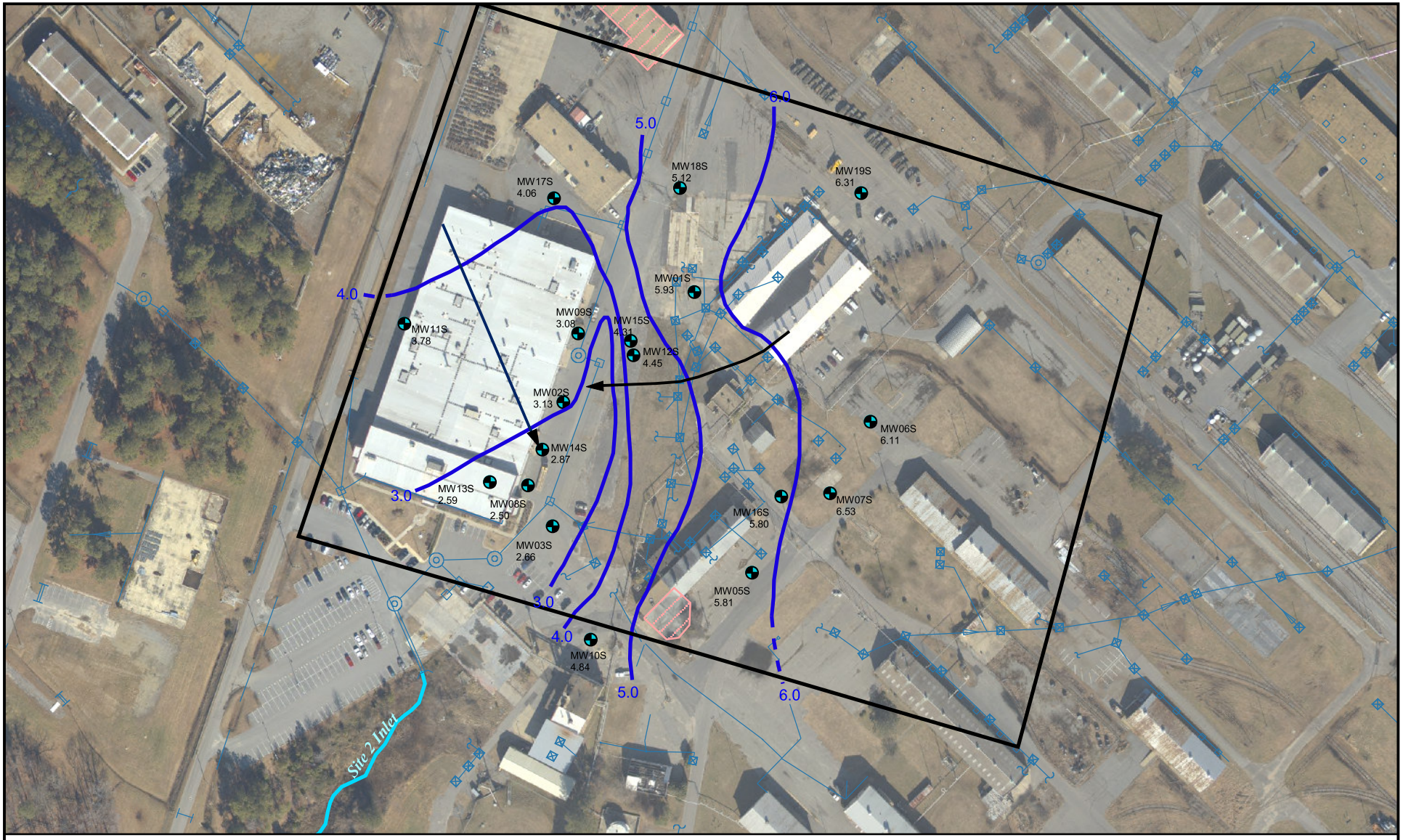

LEGEND

- Site 21 Boundary
- Shallow Monitoring Well Location
- Estimated Groundwater Flow Direction
- Demolished Buildings
- Potentiometric Contour Lines (dashed where inferred)
- 3.28 Groundwater Elevation (feet above mean sea level)
- Storm Sewer System

N

0 100 200 Feet

Figure 4-9
Potentiometric Surface Map of the Columbia Aquifer
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 5

Nature and Extent of Contamination

5.1 Investigation Results

This subsection presents the results of the MIP investigations, storm sewer system video inspection, and the field results and laboratory analytical results for storm water, surface water, groundwater, and soil samples collected during the Site 21 SI and RI. The discussion of the analytical results focuses on detections, which presents a level of uncertainty. In many instances, the reporting limits for VOCs were elevated above the MCLs. For this project, reporting limits were dictated by the CLP analytical method. Because of the elevated contaminant concentration for some analytes, the lab was not able to analyze the samples using a low concentration method without risking instrumentation damage. Therefore, the extent of the contaminants may be greater than indicated in this section. The complete analytical results are provided in **Appendix C** and the sample locations are shown on **Figure 2-4**.

5.1.1 Storm Water and Surface Water Sampling Results

Water Quality Field Parameters

Temperature, turbidity, conductivity, pH, DO, and ORP were monitored in the field prior to sampling. Water quality parameter results for the storm water and surface water are included in **Table 5-1**.

Volatile Organic Compounds

Seven VOCs, including TCE and its degradation products, were detected in the storm water and surface water samples (**Table 5-2** and **Figure 5-1**). TCE was detected at concentrations ranging from 1.3 to 150 micrograms per liter (µg/L). Cis-1,2- dichloroethene (DCE) was detected at concentrations ranging from 0.74 L to 32 µg/L. Vinyl chloride (VC) was detected at concentrations ranging from 0.47 J to 1.5 µg/L. The highest TCE, cis-1,2-DCE, and VC concentrations were detected in the storm sewer system east and south of Building 1556, and in the surface water at the outlet of the drainage culvert in the Site 2 inlet.

5.1.2 Storm Sewer System Video Inspection Results

The video inspection indicated that the storm sewer system is in fair condition with light to moderate signs of infiltration at cracks and joints. Details of the inspection results are provided in a technical memorandum, which is included as **Appendix E**. Based on these findings, it is likely that the VOC concentrations detected in the storm water (Section 5.1.1) are likely reflective of groundwater concentrations that have infiltrated into the storm sewer system.

5.1.3 MIP Results

The results of the MIP investigation are shown on **Figure 2-4**. Sixteen MIP pushes were advanced during the SI and three MIP pushes were advanced during the RI. VOC speciation, or trapping, data was collected at 14 of the SI locations by trapping the gas stream directly into the analytical column of a gas chromatograph for analysis. The column was temperature programmed to separate analytes, and a PID, FID, and dry electrolytic conductivity detector (DELCD) were used to identify compounds based on the placement of peaks within established retention-time windows.

The MIP results generally show response beginning at a depth consistent with the water table, where concentrations are relatively low to a depth of approximately 15 ft bgs and then increase substantially from 15 to 19 ft bgs (**Appendix A**). The depth at which the VOCs increase coincides with the depth the Yorktown confining unit is encountered, as indicated by the MIP conductivity logs. The MIP results are consistent with the shallow groundwater results, which are discussed in Section 5.1.4.

The MIP screening logs, trap results, and cross-sectional plume diagrams showing vertical contaminant distribution were generated by Columbia Technologies during the SI activities; these documents are included in **Appendix A**. MIP screening logs from RI activities are also included in **Appendix A**. The MIP results were used to determine the placement of monitoring wells.

5.1.4 Shallow Groundwater Results

This section presents the results for field and laboratory analysis of geochemical parameters, VOCs, SVOCs, pesticides/PCBs, explosives, and metals in the shallow groundwater samples collected during the SI and RI.

Water Quality Field Parameters

Temperature, turbidity, specific conductivity, pH, DO, and ORP were monitored in the field to ensure aquifer stabilization prior to sampling and to provide information about the conditions of the aquifer. Water quality parameter results for permanent and temporary monitoring wells are included in **Table 5-3**.

Temperature variability in shallow groundwater is low, with temperatures consistently around 20º Celsius (C) to 25ºC. Turbidity values were highly variable; higher turbidity can potentially result in higher measured concentrations of total metals and hydrophobic organics because of their tendency to sorb to particulates. The shallow groundwater was characterized by neutral to slightly acidic pH. DO and ORP values generally indicate that the Columbia aquifer at Site 21 is generally anoxic and exhibits reducing to slightly oxidizing conditions. DO and ORP were slightly lower in the area surrounding and downgradient of the former UST site, and just downgradient of the area of excavated petroleum-contaminated soil adjacent to former IR Sites 9 and 14 (**Figure 2-3**).

Geochemical Parameters

Geochemical parameters (other than the field parameters) analyzed in groundwater samples from the Columbia aquifer included ferrous iron, total organic carbon (TOC), sulfate,

alkalinity, and nitrate/nitrite. These geochemical (wet chemistry) results are shown in **Table 5-4**.

TOC concentrations were generally low, indicating low biological substrate (electron donor) availability. Most wells exhibited low sulfate concentrations when compared to the monitoring wells located outside of the plume, SJS21-MW06S and SJS21-MW11S, which serve as background locations. This suggests that some sulfate-reducing metabolism has occurred, which is indicative of strongly reducing conditions. If SJS21-MW06S represents background groundwater conditions (where alkalinity was 21 milligrams per liter [mg/L] as $CaCO_3$), several other wells exhibit higher alkalinity concentrations suggesting elevated levels of microbial metabolism. SJS21-MW11S, which also serves as a background location, has the highest concentration of alkalinity as $CaCO_3$ (120 mg/L) indicating elevated levels of microbial metabolism in background on the western boundary of the site. Ferrous iron was generally detected at concentrations less than 8 mg/L, indicating iron-reducing metabolism. At SJS21-MW09 the ferrous iron concentration was 18.4 mg/L indicating more reducing conditions, consistent with DO and ORP results, in the area of this well, which is downgradient from the former UST site. Nitrate/nitrite was not detected in groundwater collected from either background or in-plume monitoring wells.

Microbial Parameters

Four monitoring wells (SJS21-MW02S, MW07S, MW12S and MW13S) were tested for the presence of *DHC*. Results indicate the presence of these anaerobic dechlorinating bacteria at SJS21-MW02S, MW12S, and MW13S, but not at MW07S (**Appendix C**). The presence of these organisms increases the likelihood that natural degradation of CVOCs is occurring.

Volatile Organic Compounds

Thirty-one VOCs were detected above the reporting limits in the shallow groundwater (**Table 5-4**). Six VOCs (benzene; 1,2-dibromo-3-chloropropane; 1,1-DCE; TCE; cis-1,2-DCE; and VC) were detected at concentrations above their respective MCLs (**Figure 5-2**).

Benzene was detected (89 J µg/L) above the MCL (5 µg/L) at SJS21-MW09S in 2004 and at the MCL (5 µg/L) in 2005. There were no other detections of benzene above screening criteria. Detections of benzene in groundwater are most likely associated with the former UST site upgradient of this well.

1,2-dibromo-3-chloropropane was detected (1 J µg/L) once above the MCL (0.2 µg/L) at SJS21-TW209 in 2007; however because the exceedance is isolated, the constituent is not considered to be site-related.

TCE and its degradation products (cis-1,2-DCE and VC) were detected at varying concentrations across the site. TCE was detected at concentrations ranging from 0.1 J to 16,000 µg/L. Cis-1,2-DCE was detected at concentrations ranging from 0.19 J to 2,600 µg/L. VC was detected at concentrations ranging from 0.19 J to 390 µg/L. 1,1-DCE, which is a theoretical breakdown product of TCE but is more commonly observed due to abiotic breakdown of 1,1,1-trichloroethane (TCA), was detected seldomly, at concentrations ranging from 0.8 J to 11 µg/L.

TCE concentrations appear to follow groundwater flow, moving from apparent source release points to the southeast and southwest toward the storm sewer system and the Site 2 inlet (**Figure 4-8**). Based on the analytical results and the corresponding potential source areas, the TCE plume at Site 21 has an areal extent of approximately 8 acres, and extends laterally within the Columbia aquifer from the parking lot south of Building 64 (north) to the south side of Building 201 (south) and from the southwest side of Building 1556 (west) to Building 46 (east) (**Figure 5-3**). The most recent results from each sample location were used to delineate the plumes. Because the depth-specific DPT samples collected at the bottom of the Columbia aquifer represent conditions within a specific depth interval, they were not used to delineate the TCE plume. The orientation of the plume for cis-1,2-DCE (**Figure 5-4**) closely resembles that of the TCE plume and extends over 8.1 acres. The orientation of the VC plume (**Figure 5-5**) also resembles that of the TCE plume, although it is of lesser extent (2.7 acres) than the TCE plume. Building 54 serves as the eastern boundary of the VC plume. There is some uncertainty associated with the VC plume boundary due to reporting limits above the MCL for several wells. Because TCE concentrations in these samples were elevated, the samples were diluted by the laboratory, which resulted in raised reporting limits for VC.

Semivolatile Organic Compounds

Six SVOCs were detected in shallow groundwater (**Table 5-5**). There are no MCLs or background UTLs for comparison to the detected SVOCs, with the exception of bis(2-ethyl-hexyl)phthalate, which has an MCL. Bis(2-ethylhexyl)phthalate was detected at a concentration of 73 µg/L at SJS21-MW13S at a concentration above its corresponding MCL of 6 µg/L (**Figure 5-6**). However, because this detection is isolated, it is not likely related to a site release.

Pesticides/PCBs

Two pesticides, beta-BHC, and heptachlor epoxide, were detected in shallow groundwater (**Table 5-5**). Beta-BHC does not have a MCL for comparison, and heptachlor epoxide was below its MCL. Neither beta-BHC or heptachlor epoxide have background UTLs for comparison. These low detections were likely associated with routine application during landscaping operations. No PCBs were detected in shallow groundwater.

Explosives

One explosive was detected in shallow groundwater (**Table 5-5**). RDX was detected at an estimated concentration (5.3 J µg/L) below the reporting limit in one sample collected from SJS21-MW04S following well installation (August 2003), and was not detected in the subsequent sample (December 2004) collected to verify the initial result (**Figure 5-6**).

Metals

Sixteen total and 15 dissolved metals were detected in the shallow groundwater (**Table 5-5**). Antimony, arsenic, and cobalt were detected at concentrations above corresponding background UTLs in samples from one or more of the 13 permanent monitoring wells sampled. Arsenic was the only constituent detected at a concentration exceeding both the background UTL (8 µg/L total and 2.4 µg/L dissolved) and the corresponding MCL (10 g/L) at SJS21-MW09S with total and dissolved concentrations of 47.3 µg/L and

48.6 µg/L, respectively (**Figure 5-6**). These detections are likely the result of mobilization of naturally occurring arsenic in this area due to the reducing conditions created by the degradation of petroleum compounds from the former leaking USTs.

5.1.5 Deep Groundwater Sampling Results

One deep groundwater permanent monitoring well (SJS21-MW01D), screened in the Yorktown aquifer, exists at Site 21. Detected constituents and MCL exceedances in deep groundwater are presented in **Table 5-6**. The MCL exceedances in deep groundwater are shown on **Figure 5-7**. Screening criteria do not exist for explosives results; therefore, all explosives detections are shown in **Figure 5-7**.

General Water Quality Parameters

Temperature, turbidity, conductivity, pH, DO, and ORP were monitored in the field to ensure aquifer stabilization prior to sampling and to provide information about the conditions of the aquifer. Water quality parameter results for groundwater are included in **Table 5-3**.

Temperature variability in deep groundwater is low with temperatures at approximately 20 °C. Turbidity values were highly variable, and higher turbidity can potentially result in higher measured concentrations of total metals and hydrophobic organics, because of their tendency to sorb to particulates. Measurements of pH indicate that the Yorktown aquifer is basic, favoring precipitation of cationic metals as carbonates and hydroxides, where present. DO and ORP values indicate reducing conditions.

Volatile Organic Compounds

One VOC, chloroform, was detected in deep groundwater; however, its concentration was below the corresponding MCL. Chloroform is a common laboratory contaminant and its detection is not likely to be related to a site release.

Semivolatile Organic Compounds

One SVOC, di-n-butylphthalate, was detected in deep groundwater at an estimated concentration of 0.7 J µg/L. This compound is a common laboratory contaminant and is not likely to be site related. There is no MCL established for this constituent.

Pesticides/PCBs

No pesticides or PCBs were detected in deep groundwater.

Explosives

One explosive, 1,3-dinitrobenzene, was detected in deep groundwater at an estimated concentration of 1.1 J µg/L. There is no MCL established for this constituent.

Metals

Thirteen total and 11 dissolved metals were detected in deep groundwater. The only constituent detected at a concentration exceeding the corresponding MCL (10 µg/L) was arsenic. Arsenic concentrations of 72.8 µg/L total and 72 µg/L dissolved were detected in the initial sample (August 2003) following well installation. During subsequent sampling

events (December 2004 and November 2005), arsenic concentrations did not exceed the MCL (**Table 5-6**).

5.1.6 Soil Sampling Results

Because the nature and extent of contamination in soil was defined and evaluated during previous investigations in the Site 21 vicinity, and no human health or ecological risks were identified, no further investigation or action for soil was necessary (Sections 2.3 and 2.4). However, to assist in evaluation of remedial alternatives, determine the presence of sorbed TCE at various depths, and to screen for the presence or absence of DNAPL, additional subsurface data was collected.

Natural Oxidant Demand

NOD test results indicate a relatively low level of oxidant demand in the soils tested, and that the demand does not vary appreciably with depth or between sampling locations (**Table 5-7**). The NOD test employed uses potassium permanganate ($KMnO_4$) as the oxidant and measures the NOD of the soil exerted over 48 hours. These data provide a preliminary indication of the amount of oxidant chemical required for implementation of *in situ* chemical oxidation.

DNAPL Field Screening

The results of all of the samples field-screened for DNAPL using the OilScreenSoil (Indigo Blue®), collected at SJS21-MW14S, MW15S, and MW16S, were negative. The samples were collected at the base of the Columbia aquifer at locations coinciding with areas of the highest CVOC concentrations in groundwater, where DNAPL would most likely be present. Although it wasn't detected, due to its nature of DNAPL, it is difficult to identify its exact location and the negative field screening results do not definitively confirm that it is not present at the site.

Volatile Organic Compounds

Four VOCs were detected in subsurface soil samples collected during installation of permanent monitoring wells MW12S (soil sample ID SJS21-SB05), MW13S (soil sample ID SJS21-SB06), and MW16S (soil sample ID SJS21-SB09) (**Table 5-8**). The results indicate elevated sorbed-phase TCE at the top of the Yorktown confining unit at MW12S (45,000 micrograms per kilogram [µg/kg]) and MW16S (32,000 µg/kg). Moderate concentrations were observed for TCE at the base of the Columbia aquifer at MW12S (320 µg/kg) and the top of the Yorktown confining unit at MW13S (190 µg/kg), and for cis-1,2-DCE at the top of the Yorktown confining unit at both MW12S (270 µg/kg) and MW13S (280 µg/kg).

In addition to TCE and cis-1,2-DCE, acetone and carbon disulfide were detected in site soil samples. Acetone is a common laboratory contaminant and carbon disulfide is naturally occurring; therefore, the presence of these constituents in soil may not be related to a site release.

5.2 Refinement of Potential TCE Source Release Points

The investigation results have been combined with the historical data and activities presented in Section 2 to refine potential source release points. These areas are described below. Other source release points may exist, but are not specifically definable based on existing data. **Figure 2-3** shows the building locations.

- **West of Demolished Building 201—**TCE was reportedly disposed of on railroad tracks and roads in this area and groundwater concentrations of TCE in this area were detected as high as 16,000 µg/L. Concentrations in subsurface soil collected at the base of the Columbia aquifer and top of the Yorktown confining unit were 320 µg/kg and 45,000 µg/kg, respectively.
- **West of Demolished Building 187—**TCE was reportedly disposed on railroad tracks and roads in this area, and TCE was detected in groundwater at concentrations in this area as high as 420 µg/L.
- **Area between Building 47 and Demolished Building 53—**TCE was reportedly disposed of around Building 53. The maximum TCE concentration detected in groundwater sampled in this area was 190 µg/L.
- **North of Building 47—**Although there are no historical records indicating use of TCE within Building 47, TCE was detected at concentrations as high as 150 µg/L in groundwater north of the building. The concentration data is spatially inconsistent with historically documented sources, suggesting an undocumented release.
- **Northeast of Demolished Building 249—**TCE was used for degreasing in Building 249. Much of this area was excavated prior to the construction of Building 1556. However, concentrations of TCE in groundwater samples collected just east of the excavated area were as high as 4,800 µg/L, which is greater than upgradient concentrations. TCE was also detected in a soil sample from the Yorktown confining unit at a concentration of 190 µg/kg.
- **South of Demolished Building 54—**Although there are no historical records indicating use of TCE within Building 54, TCE was detected at concentrations as high as 13,000 µg/L in a groundwater sample collected south of the building. This concentration is higher than concentrations detected immediately upgradient and downgradient of the location. The concentration data is spatially inconsistent with historically documented sources, suggesting an undocumented release.
- **Building 46 Area—**There are also no historical records indicating use of TCE within Building 46. However, TCE was detected at a concentration of 27 µg/L in groundwater collected just south of the building. TCE was not detected in samples upgradient of this location or immediately downgradient of this location. Since data is spatially inconsistent with historically documented sources, an undocumented release is likely.

Table 5-1
General Storm Water and Surface Water Quality Field Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS02-ST01	SJS02-ST02	SJS02-ST03	SJS02-ST04	SJS02-ST05
Sample Date	12/9/2003	12/9/2003	12/9/2003	12/9/2003	12/9/2003
Dissolved Oxygen (mg/L)*	9.34	5.44	11.9	12.77	13.1
Depth to Water (ft)	3.55	5.54	5.35	5.2	4.95
Oxidation Reduction Potential (mV)	142	127	76	169	33
Salinity (%)	0	0	0	0	0
pH	6.47	6.24	6.93	6.81	6.33
Specific Conductance (ms/cm)	0.47	0.71	0.33	0.33	0.3
Temperature (C)	15.3	15.2	15	14.8	13.3
Turbidity (NTU)	12	25	0	0	52

Station ID	SJS02-ST06	SJS02-ST07	SJS02-SW10
Sample Date	12/9/2003	12/9/2003	12/9/2003
Dissolved Oxygen (mg/L)*	9.94	14.2	9.03
Depth to Water (ft)	1.02	1.01	NA
Oxidation Reduction Potential (mV)	9	314	161
Salinity (%)	0	0	0
pH	6.69	6.9	6.34
Specific Conductance (ms/cm)	0.21	0.37	0.44
Temperature (C)	12.7	11.2	13.8
Turbidity (NTU)	19	0.7	11

Notes:
NA- Not analyzed
Dissolved Oxygen concentrations above 10 mg/l are may be a result of instrumention error

Table 5-2
Storm Water and Surface Water Detections
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS02-ST01	SJS02-ST02	SJS02-ST03	SJS02-ST04	SJS02-ST05	SJS02-ST06	SJS02-ST07	SJS02-SW10
Sample ID	SJS02-ST01-03D[1]	SJS02-ST02-03D	SJS02-ST03-03D	SJS02-ST04-03D	SJS02-ST05-03D	SJS02-ST06-03D	SJS02-ST07-03D	SJS02-SW10-03D
Sample Date	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03
Chemical Name								
Volatile Organic Compounds (UG/L)								
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	0.5 U	0.5 U	1.1	0.5 U	0.5 U	0.5 U
Bromodichloromethane	4.4	0.5 U	4.1	5.2	0.5 U	0.75	8.7	4.2
Chloroform	13	0.5 U	12	15	0.34 J	3.4	28	12
Dibromochloromethane	0.6	0.5 U	0.6	0.7	0.5 U	0.5 U	1.2	0.5 U
Trichloroethene	150	0.5 U	140	84	1.3	1.3	0.5 U	140
Vinyl chloride	1.5	0.5 U	1.4	0.47 J	0.5 U	0.5 U	0.5 U	1.4
cis-1,2-Dichloroethene	32	0.5 U	32	20	0.74 L	0.5 U	0.5 U	31

Notes:
[1] A duplicate sample was collected at this location; the most conservative result is shown.
Shaded cells represent detections
J- Reported value is estimated
L - Reported value is biased low
U- Not detected

Table 5-3
General Groundwater Water Quality Field Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

	pH (pH units)						Specific Conductance (mS/cm)						Turbidity (NTU)					
Station ID	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**Feb-2007**	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**2/1/2007[1]**	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**Feb-2007**
Shallow Groundwater Permanent Monitoring Wells																		
SJS21-MW01S	6.03	6	--	6.5	--	--	0.17	0.15	--	0.144	--	--	NA	0	--	23.9	--	--
SJS21-MW02S	5.94	5.75	--	5.98	5.81	--	0.31	0.3	--	0.23	0.488	--	NA	76	--	226	27	--
SJS21-MW03S	6.4	6.4	--	6.64	--	--	0.33	0.359	--	0.276	--	--	NA	1.2	--	125	--	--
SJS21-MW04S	5.61	5.72	--	6.12	--	--	0.229	0.286	--	0.225	--	--	NA	33.2	--	15.2	--	--
SJS21-MW05S	5.26	5.26	--	5.4	--	--	0.303	0.374	--	0.303	--	--	NA	0	--	43.1	--	--
SJS21-MW06S	5.39	4.44	--	5.47	--	--	0.391	0	--	0.309	--	--	NA	201	--	181	--	--
SJS21-MW07S	--	4.56	5.77	6.05	5.98	--	--	0	0.175	0.137	0.185	--	--	231	21.9	113	328	--
SJS21-MW08S	--	5.79	--	6.3	--	--	--	0.431	--	0.336	--	--	--	5.2	--	83.7	--	--
SJS21-MW09S	--	6.44	--	6.7	--	--	--	0.333	--	0.251	--	--	--	26.7	--	418	--	--
SJS21-MW10S	--	4.23	--	5.36	--	--	--	0	--	0.218	--	--	--	221	--	88	--	--
SJS21-MW11S	--	6.24	--	6.96	--	--	--	0.471	--	0.472	--	--	--	0	--	158	--	--
SJS21-MW12S	--	--	--	6.45	5.96	--	--	--	--	0.253	0.528	--	--	--	--	-7	141	--
SJS21-MW13S	--	--	--	6.52	5.85	--	--	--	--	0.452	0.716	--	--	--	--	88.3	0	--
SJS21-MW14S	--	--	--	--	5.75	--	--	--	--	--	0.442	--	--	--	--	--	0	--
SJS21-MW15S	--	--	--	--	7.07	--	--	--	--	--	0.291	--	--	--	--	--	75.7	--
SJS21-MW16S	--	--	--	--	5.34	--	--	--	--	--	0.277	--	--	--	--	--	0	--
SJS21-MW17S	--	--	--	--	--	5.73	--	--	--	--	--	3.69	--	--	--	--	--	64
SJS21-MW18S	--	--	--	--	--	5.81	--	--	--	--	--	8.19	--	--	--	--	--	89
SJS21-MW19S	--	--	--	--	--	5.45	--	--	--	--	--	41.3	--	--	--	--	--	42
Shallow Groundwater Temporary Monitoring Wells																		
SJS21-TW101	--	--	--	6.85	--	--	--	--	--	0.724	--	--	--	--	--	>999	--	--
SJS21-TW102	--	--	--	6.64	--	--	--	--	--	0.245	--	--	--	--	--	561	--	--
SJS21-TW103	--	--	--	6.47	--	--	--	--	--	0.29	--	--	--	--	--	>990	--	--
SJS21-TW104	--	--	--	6.43	--	--	--	--	--	0.167	--	--	--	--	--	>999	--	--
SJS21-TW106	--	--	--	6.97	--	--	--	--	--	0.379	--	--	--	--	--	126	--	--
SJS21-TW107	--	--	--	6.64	--	--	--	--	--	0.467	--	--	--	--	--	155	--	--
SJS21-TW108	--	--	--	7.12	--	--	--	--	--	0.606	--	--	--	--	--	115	--	--
SJS21-TW109	--	--	--	6.7	--	--	--	--	--	0.271	--	--	--	--	--	677	--	--
SJS21-TW110	--	--	--	6.74	--	--	--	--	--	0.2	--	--	--	--	--	20.7	--	--
SJS21-TW111	--	--	--	7.02	--	--	--	--	--	0.2	--	--	--	--	--	581	--	--
SJS21-TW112	--	--	--	7.61	--	--	--	--	--	0.457	--	--	--	--	--	494	--	--
SJS21-TW113	--	--	--	6.99	--	--	--	--	--	0.257	--	--	--	--	--	199	--	--
SJS21-TW114	--	--	--	6.97	--	--	--	--	--	0.416	--	--	--	--	--	>999	--	--
SJS21-TW115	--	--	--	6.49	--	--	--	--	--	0.137	--	--	--	--	--	648	--	--
SJS21-TW116	--	--	--	6.07	--	--	--	--	--	0.223	--	--	--	--	--	342	--	--
SJS21-TW117	--	--	--	5.99	--	--	--	--	--	0.234	--	--	--	--	--	>999	--	--
SJS21-TW118	--	--	--	5.92	--	--	--	--	--	0.251	--	--	--	--	--	123	--	--
SJS21-TW119	--	--	--	6.05	--	--	--	--	--	0.216	--	--	--	--	--	623	--	--
SJS21-TW120	--	--	--	5.99	--	--	--	--	--	0.361	--	--	--	--	--	>999	--	--
SJS21-TW121	--	--	--	6.07	--	--	--	--	--	0.244	--	--	--	--	--	927	--	--
SJS21-TW122	--	--	--	6.1	--	--	--	--	--	0.365	--	--	--	--	--	171	--	--
SJS21-TW123	--	--	--	5.92	--	--	--	--	--	0.219	--	--	--	--	--	>999	--	--
SJS21-TW124	--	--	--	7.2	--	--	--	--	--	0.202	--	--	--	--	--	>999	--	--
SJS21-TW125	--	--	--	8.6	--	--	--	--	--	2.04	--	--	--	--	--	>999	--	--
SJS21-TW126	--	--	--	7.27	--	--	--	--	--	0.386	--	--	--	--	--	>999	--	--
SJS21-TW127	--	--	--	6.28	--	--	--	--	--	0.814	--	--	--	--	--	>999	--	--
SJS21-TW201	--	--	--	--	5.69	--	--	--	--	--	0.432	--	--	--	--	--	355	--
SJS21-TW202	--	--	--	--	5.71	--	--	--	--	--	0.261	--	--	--	--	--	802	--
SJS21-TW203	--	--	--	--	6.43	--	--	--	--	--	0.604	--	--	--	--	--	339	--
SJS21-TW204	--	--	--	--	5.71	--	--	--	--	--	0.325	--	--	--	--	--	831	--
SJS21-TW205	--	--	--	--	--	5.45	--	--	--	--	--	4.89	--	--	--	--	--	280
SJS21-TW206	--	--	--	--	--	5.64	--	--	--	--	--	6.59	--	--	--	--	--	230
SJS21-TW207	--	--	--	--	--	5.84	--	--	--	--	--	6.13	--	--	--	--	--	350
SJS21-TW208	--	--	--	--	--	7.32	--	--	--	--	--	4.84	--	--	--	--	--	25
SJS21-TW209	--	--	--	--	--	5.86	--	--	--	--	--	4.25	--	--	--	--	--	0
SJS21-TW210	--	--	--	--	--	5.5	--	--	--	--	--	5.56	--	--	--	--	--	60

Table 5-3
General Groundwater Water Quality Field Parameters
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	pH (pH units)						Specific Conductance (mS/cm)						Turbidity (NTU)					
Station ID	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**Feb-2007**	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**2/1/2007[1]**	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**Feb-2007**
SJS21-TW211	--	--	--	--	--	5.21	--	--	--	--	--	5.47	--	--	--	--	--	999
SJS21-TW212	--	--	--	--	--	5.64	--	--	--	--	--	5.39	--	--	--	--	--	130
SJS21-TW213	--	--	--	--	--	5.57	--	--	--	--	--	5.39	--	--	--	--	--	999
SJS21-TW214	--	--	--	--	--	5.82	--	--	--	--	--	5.61	--	--	--	--	--	0
SJS21-TW215	--	--	--	--	--	5.46	--	--	--	--	--	4.62	--	--	--	--	--	-5
SJS21-TW216	--	--	--	--	--	5.27	--	--	--	--	--	3.72	--	--	--	--	--	180
SJS21-TW217	--	--	--	--	--	5.55	--	--	--	--	--	8.6	--	--	--	--	--	
Grab Groundwater Samples																		
SJS21-GW101	--	--	--	--	5.87	--	--	--	--	--	0.458	--	--	--	--	--	-5	--
SJS21-GW102	--	--	--	--	5.85	--	--	--	--	--	0.366	--	--	--	--	--	751	--
SJS21-GW103	--	--	--	--	5.74	--	--	--	--	--	0.611	--	--	--	--	--	109	--
SJS21-GW104	--	--	--	--	5.58	--	--	--	--	--	0.352	--	--	--	--	--	999	--
SJS21-GW105	--	--	--	--	6.05	--	--	--	--	--	0.436	--	--	--	--	--	415	--
Deep Groundwater Permanent Monitoring Wells																		
SJS21-MW01D	10.7	8.7	--	9.25	--	--	1.14	0.369	--	0.318	--	--	NA	37.7	--	152	--	--

*Dissolved Oxygen measured using Chemets test kits

[1] The equipment was malfunctioning during measurement of specific conductance during this field event.

Table 5-3
General Groundwater Water Quality Field Parameters
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St. Juliens Creek Annex
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	Dissolved Oxygen (mg/L)						Temperature (^{0}C)						Oxidation Reduction Potential (mV)					
Station ID	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**Feb-2007**	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**Feb-2007**	**Aug-04**	**Nov-Dec-2004**	**Mar-2005**	**Oct-Nov-2005**	**Oct-Nov-2006**	**Feb-2007**
Shallow Groundwater P																		
SJS21-MW01S	0.19	0.33	--	0.79	--	--	25.3	22	--	23.52	--	--	18	-38	--	-30	--	--
SJS21-MW02S	0.39	0.43	--	0.96	--	--	25.9	23	--	24.99	27.55	--	31	78	--	43	18	--
SJS21-MW03S	0.44	0.28	--	0.75	--	--	24.8	22.4	--	23.4	--	--	9	1	--	-42	--	--
SJS21-MW04S	0.12	0.45	--	0.79	--	--	25.1	21.6	--	22.07	--	--	75	43	--	30	--	--
SJS21-MW05S	0	0.4	--	0.85	--	--	26.8	22.6	--	22.57	--	--	148	162	--	174	--	--
SJS21-MW06S	0.08	8.65	--	1.11	--	--	24.8	21	--	22.87	--	--	85	309	--	132	--	--
SJS21-MW07S	--	9.75	0	1.17	--	--	--	21.6	13.9	20.8	23.64	--	--	304	81	69	103	--
SJS21-MW08S	--	0.42	--	0.8	--	--	--	22.8	--	24.17	--	--	--	83	--	0	--	--
SJS21-MW09S	--	0.51	--	0.28	--	--	--	22	--	23.68	--	--	--	-105	--	-113	--	--
SJS21-MW10S	--	8.5	--	0.84	--	--	--	22.5	--	23.65	--	--	--	291	--	151	--	--
SJS21-MW11S	--	0.32	--	0.77	--	--	--	21.5	--	22.2	--	--	--	1	--	-129	--	--
SJS21-MW12S	--	--	--	1.71	--	--	--	--	--	21.87	25.22	--	--	--	--	53	-23	--
SJS21-MW13S	--	--	--	1.04	--	--	--	--	--	23.57	26.37	--	--	--	--	19	23	--
SJS21-MW14S	--	--	--	--	1*	--	--	--	--	--	27.04	--	--	--	--	--	90	--
SJS21-MW15S	--	--	--	--	2*	--	--	--	--	--	25.65	--	--	--	--	--	108	--
SJS21-MW16S	--	--	--	--	1*	--	--	--	--	--	23.84	--	--	--	--	--	106	--
SJS21-MW17S	--	--	--	--	--	0.5*	--	--	--	--	--	17.99	--	--	--	--	--	66
SJS21-MW18S	--	--	--	--	--	0.6*	--	--	--	--	--	18.15	--	--	--	--	--	24
SJS21-MW19S	--	--	--	--	--	0.6*	--	--	--	--	--	18.72	--	--	--	--	--	25
Shallow Groundwater T																		
SJS21-TW101	--	--	--	0.4*	--	--	--	--	--	21.98	--	--	--	--	--	-152	--	--
SJS21-TW102	--	--	--	0.6*	--	--	--	--	--	23.95	--	--	--	--	--	-118	--	--
SJS21-TW103	--	--	--	0.4*	--	--	--	--	--	23.54	--	--	--	--	--	-82	--	--
SJS21-TW104	--	--	--	0.6*	--	--	--	--	--	24	--	--	--	--	--	-96	--	--
SJS21-TW106	--	--	--	2*	--	--	--	--	--	24.8	--	--	--	--	--	-73	--	--
SJS21-TW107	--	--	--	1*	--	--	--	--	--	24.19	--	--	--	--	--	-90	--	--
SJS21-TW108	--	--	--	2*	--	--	--	--	--	22.69	--	--	--	--	--	-114	--	--
SJS21-TW109	--	--	--	1*	--	--	--	--	--	22.93	--	--	--	--	--	-80	--	--
SJS21-TW110	--	--	--	0.8*	--	--	--	--	--	22.26	--	--	--	--	--	-127	--	--
SJS21-TW111	--	--	--	0.8*	--	--	--	--	--	23.73	--	--	--	--	--	-140	--	--
SJS21-TW112	--	--	--	0*	--	--	--	--	--	19.5	--	--	--	--	--	-214	--	--
SJS21-TW113	--	--	--	0.3*	--	--	--	--	--	20.62	--	--	--	--	--	-154	--	--
SJS21-TW114	--	--	--	0.8*	--	--	--	--	--	19.39	--	--	--	--	--	-115	--	--
SJS21-TW115	--	--	--	1*	--	--	--	--	--	21.34	--	--	--	--	--	-84	--	--
SJS21-TW116	--	--	--	1*	--	--	--	--	--	22.75	--	--	--	--	--	13	--	--
SJS21-TW117	--	--	--	0.6*	--	--	--	--	--	20.39	--	--	--	--	--	-17	--	--
SJS21-TW118	--	--	--	0.8*	--	--	--	--	--	24	--	--	--	--	--	-39	--	--
SJS21-TW119	--	--	--	0.8*	--	--	--	--	--	24.15	--	--	--	--	--	-51	--	--
SJS21-TW120	--	--	--	0.8*	--	--	--	--	--	20.26	--	--	--	--	--	-36	--	--
SJS21-TW121	--	--	--	0.3*	--	--	--	--	--	23.81	--	--	--	--	--	-52	--	--
SJS21-TW122	--	--	--	0.6*	--	--	--	--	--	19.89	--	--	--	--	--	-65	--	--
SJS21-TW123	--	--	--	0.7*	--	--	--	--	--	23.29	--	--	--	--	--	-63	--	--
SJS21-TW124	--	--	--	2*	--	--	--	--	--	21.86	--	--	--	--	--	-90	--	--
SJS21-TW125	--	--	--	0.8*	--	--	--	--	--	22.32	--	--	--	--	--	-256	--	--
SJS21-TW126	--	--	--	1*	--	--	--	--	--	22.67	--	--	--	--	--	-116	--	--
SJS21-TW127	--	--	--	0.4*	--	--	--	--	--	20.89	--	--	--	--	--	-33	--	--
SJS21-TW201	--	--	--	--	0.5*	--	--	--	--	--	27.39	--	--	--	--	--	-55	--
SJS21-TW202	--	--	--	--	0.5*	--	--	--	--	--	26.26	--	--	--	--	--	-40	--
SJS21-TW203	--	--	--	--	0.3*	--	--	--	--	--	24.59	--	--	--	--	--	-81	--
SJS21-TW204	--	--	--	--	0.5*	--	--	--	--	--	25.4	--	--	--	--	--	-21	--
SJS21-TW205	--	--	--	--	--	0.8*	--	--	--	--	--	19.48	--	--	--	--	--	19.48
SJS21-TW206	--	--	--	--	--	--	--	--	--	--	--	18.46	--	--	--	--	--	18.46
SJS21-TW207	--	--	--	--	--	0.7*	--	--	--	--	--	17.53	--	--	--	--	--	17.53
SJS21-TW208	--	--	--	--	--	0*	--	--	--	--	--	14.22	--	--	--	--	--	14.22
SJS21-TW209	--	--	--	--	--	0.7*	--	--	--	--	--	17.68	--	--	--	--	--	17.68
SJS21-TW210	--	--	--	--	--	--	--	--	--	--	--	17.22	--	--	--	--	--	17.22

Table 5-3
General Groundwater Water Quality Field Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
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Station ID	Dissolved Oxygen (mg/L)						Temperature (^{0}C)						Oxidation Reduction Potential (mV)					
	Aug-04	Nov-Dec-2004	Mar-2005	Oct-Nov-2005	Oct-Nov-2006	Feb-2007	Aug-04	Nov-Dec-2004	Mar-2005	Oct-Nov-2005	Oct-Nov-2006	Feb-2007	Aug-04	Nov-Dec-2004	Mar-2005	Oct-Nov-2005	Oct-Nov-2006	Feb-2007
SJS21-TW211	--	--	--	--	--	--	--	--	--	--	--	17.66	--	--	--	--	--	17.66
SJS21-TW212	--	--	--	--	--	0.5*	--	--	--	--	--	18.4	--	--	--	--	--	18.4
SJS21-TW213	--	--	--	--	--	--	--	--	--	--	--	16.31	--	--	--	--	--	16.31
SJS21-TW214	--	--	--	--	--	0.25*	--	--	--	--	--	16.9	--	--	--	--	--	16.9
SJS21-TW215	--	--	--	--	--	1*	--	--	--	--	--	15.75	--	--	--	--	--	15.75
SJS21-TW216	--	--	--	--	--	--	--	--	--	--	--	18.11	--	--	--	--	--	18.11
SJS21-TW217	--	--	--	--	--	--	--	--	--	--	--	15.51	--	--	--	--	--	15.51
Grab Groundwater Sam																		
SJS21-GW101	--	--	--	--	0.6*	--	--	--	--	--	25.74	--	--	--	--	--	0	--
SJS21-GW102	--	--	--	--	0.3*	--	--	--	--	--	26.79	--	--	--	--	--	1	--
SJS21-GW103	--	--	--	--	0.1*	--	--	--	--	--	26.1	--	--	--	--	--	24	--
SJS21-GW104	--	--	--	--	0.5*	--	--	--	--	--	25.44	--	--	--	--	--	20	--
SJS21-GW105	--	--	--	--	0.6*	--	--	--	--	--	25.76	--	--	--	--	--	-27	--
Deep Groundwater Perm																		
SJS21-MW01D	0.02	0.26	--	0.83	--	--	23.2	20.6	--	19.62	--	--	-203	-206	--	-163	--	--

*Dissolved Oxygen measured

[1] The equipment was malfunc

Table 5-4
Shallow Groundwater Detections and Exceedances of Screening Criteria
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

				Permanent Monitoring Wells											
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-MW01S			SJS21-MW02S			SJS21-MW03S			SJS21-MW04S		
Sample ID				SJS21-MW01S-03C	SJS21-MW01S-04D	SJS21-MW01S-05D	SJS21-MW02S-03C	SJS21-MW02S-04D[2]	SJS21-MW02S-05D	SJS21-MW03S-03C	SJS21-MW03S-04D	SJS21-MW03S-05D	SJS21-MW04S-03C	SJS21-MW04S-04D	SJS21-MW04S-05D
Sample Date				08/21/03	11/30/04	11/07/05	08/21/03	12/01/04	11/04/05	08/21/03	12/01/04	11/03/05	08/20/03	12/01/04	11/09/05
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	10 U	0.5 UJ	0.5 U	10 U	0.5 J	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
1,1-Dichloroethane	--	3	SJS21-TW211-07A	10 U	0.39 J	0.45 J	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	10 U	0.5 UJ	0.5 U	**8 J**	5	5 J	10 U	0.5 U	0.5 U	10 U	1.5	50 U
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	10 UJ	0.5 UJ	0.5 U	10 UJ	0.5 U	10 U	10 UJ	0.5 U	0.5 U	10 UJ	0.5 U	50 U
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	10 U	0.5 UJ	0.41 J	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	10 U	0.5 UJ	0.5 U	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	10 U	0.5 UJ	0.5 U	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Acetone	--	20	SJS21-MW03S-05D	10 UJ	5 R	5 U	10 UJ	500 R	10 U	10 UJ	5 R	20	10 UJ	4 J	50 U
Benzene	5	89	SJS21-MW09S-04D	10 U	0.5 UJ	0.28 J	10 U	0.5 U	10 U	10 U	0.5 U	0.1 J	10 U	0.5 U	50 U
Bromoform	80	0.13	SJS21-TW118-05D	10 U	0.5 UJ	0.5 U	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Carbon disulfide	--	0.59	SJS21-MW02S-04D	10 UJ	0.5 UJ	0.5 U	10 UJ	0.59	10 U	10 UJ	0.5 U	0.5 U	10 UJ	0.5 U	50 U
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	10 U	0.5 UJ	0.16 J	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Chlorobenzene	100	14	SJS21-TW113-05D	10 U	0.5 UJ	0.5 U	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Chloroform	80	2.1	SJS21-MW11S-04D	10 U	0.5 UJ	0.24 J	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Chloromethane	--	0.77	SJS21-MW11S-04D	10 UJ	0.5 UJ	0.5 U	10 UJ	0.5 U	10 U	10 UJ	0.5 U	0.5 U	10 UJ	0.5 U	50 U
Cyclohexane	--	8.1	SJS21-MW09S-04D	10 U	0.5 UJ	0.78	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	10 U	0.5 UJ	0.5 UJ	10 U	0.4 J	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Ethylbenzene	700	0.8	SJS21-TW205-07A	10 U	0.5 UJ	0.5 U	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Isopropylbenzene	--	2	SJS21-MW01S-03C	2 J	0.61 J	0.21 J	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Methyl acetate	--	19	SJS21-MW11S-04D	10 U	0.5 R	0.5 U	10 U	50 R	10 U	10 U	0.5 R	0.5 U	10 U	13 R	50 U
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	10 U	0.5 UJ	0.5 U	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	10 U	3.7 J	2	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Methylene chloride	5	1.8	SJS21-MW11S-04D	1 B	0.5 UJ	0.2 B	2 B	0.5 U	10 U	2 B	0.5 U	0.5 U	2 B	0.5 U	50 U
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	10 U	0.5 UJ	0.5 U	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
Toluene	1,000	15	SJS21-TW206-07A	10 UJ	0.5 UJ	0.5 U	2 B	0.5 U	10 U	1 B	0.5 U	0.5 U	1 B	0.5 U	50 U
Trichloroethene	5	16,000	SJS21-MW15SP-06D	2 B	0.81 B	1.3	**2,500 J**	**1,400**	**1,500**	2 B	1.5	2.6	**460**	**120**	**6 J**
Vinyl chloride	2	390	SJS21-TW115-05D	10 U	0.66 J	**2.4**	**12**	**5**	**9 J**	10 U	0.5 U	0.5 U	10 U	1.5	50 U
Xylene, total	10,000	0.69	SJS21-TW126-05D	10 U	0.5 UJ	0.1 J	10 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	10 U	1.6 J	1.4	**410 J**	**540**	**530**	10 U	1.2	2 J	**190**	**350**	**540**
o-Xylene	--	0.8	SJS21-TW209-07A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	10 U	0.5 UJ	0.5 U	9 J	5.9	9 J	10 U	0.5 U	0.5 UJ	5 J	7.7	6 J
Wet Chemistry (MG/L)															
Alkalinity	--	120	SJS21-MW11S-04D	NA	10	NA	NA	51 B	NA	NA	120 B	NA	NA	25 B	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	2.8	6.7 L	NA	NA	3.86 L	NA	NA	1.99 L	NA	NA	7.35 L
Sulfate	--	110	SJS21-MW01S-04D	NA	110	NA	NA	65	NA	NA	1.1	NA	NA	90	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	NA	1.5	NA	NA	3.2	NA	NA	1 U	NA	NA	2.9	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

Bold blue text represents MCL exceedance

B- Possible blank contamination
J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
R- Unreliable result
U- Not detected

Table 5-4
Shallow Groundwater Detections and Exceedances of Screening Criteria
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

				Permanent Monitoring Wells											
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-MW05S			SJS21-MW06S			SJS21-MW07S				SJS21-MW08S	
Sample ID				SJS21-MW05S-03C	SJS21-MW05S-04D	SJS21-MW05S-05D	SJS21-MW06S-03C	SJS21-MW06S-04D	SJS21-MW06S-05D	SJS21-MW07S-04D	SJS21-MW07S-05A	SJS21-MW07S-05D	SJS21-DW101-13-06D	SJS21-MW08S-04D	SJS21-MW08S-05D
Sample Date				08/20/03	11/30/04	11/07/05	08/21/03	11/30/04	11/04/05	11/30/04	03/28/05	11/07/05	10/24/06	12/01/04	11/04/05
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
1,1-Dichloroethane	--	3	SJS21-TW211-07A	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	1 J	500 U	**8 J**	5.6	4 J
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	10 UJ	0.5 UL	0.5 U	10 UJ	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Acetone	--	20	SJS21-MW03S-05D	10 UJ	5 R	5 U	10 UJ	5 R	5 U	25,000 R	10 U	500 U	5 B	500 R	10 U
Benzene	5	89	SJS21-MW09S-04D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Bromoform	80	0.13	SJS21-TW118-05D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Carbon disulfide	--	0.59	SJS21-MW02S-04D	10 UJ	0.39 J	0.5 U	10 UJ	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Chlorobenzene	100	14	SJS21-TW113-05D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Chloroform	80	2.1	SJS21-MW11S-04D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Chloromethane	--	0.77	SJS21-MW11S-04D	10 UJ	0.5 UL	0.5 U	10 UJ	0.54 J	0.5 U	2,400 UJ	10 U	500 U	10 U	0.5 U	10 U
Cyclohexane	--	8.1	SJS21-MW09S-04D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	10 U	0.5 UL	0.5 UJ	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Ethylbenzene	700	0.8	SJS21-TW205-07A	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Isopropylbenzene	--	2	SJS21-MW01S-03C	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Methyl acetate	--	19	SJS21-MW11S-04D	10 U	0.5 R	0.5 UJ	10 U	0.5 R	0.5 U	2,500 R	10 U	500 U	10 U	50 R	10 U
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
Methylene chloride	5	1.8	SJS21-MW11S-04D	10 U	0.5 UL	0.16 B	2 B	0.5 U	0.5 U	2,500 UJ	10 U	500 U	3 B	0.5 U	10 U
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	1 J	0.5 U	10 U
Toluene	1,000	15	SJS21-TW206-07A	10 UJ	0.5 UL	0.5 U	1 B	0.5 U	0.5 U	2,500 UJ	10 UJ	500 U	0.9 B	0.5 U	10 U
Trichloroethene	5	16,000	SJS21-MW15SP-06D	10 U	2.6 B	**8.1**	10 U	0.8 B	0.5 U	7,100 B	**1,800**	**3,600**	**8,200**	**1,000 J**	**830**
Vinyl chloride	2	390	SJS21-TW115-05D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	**4 J**	**7.3**	**33**
Xylene, total	10,000	0.69	SJS21-TW126-05D	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	10 U	0.54 L	0.69	10 U	0.5 U	0.5 U	2,500 UJ	**71**	500 U	**350 J**	**710 J**	**560**
o-Xylene	--	0.8	SJS21-TW209-07A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	10 U	0.5 UL	0.5 U	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	4 J	5.8	5 J
Wet Chemistry (MG/L)															
Alkalinity	--	120	SJS21-MW11S-04D	NA	52	NA	NA	21	NA	20	NA	NA		52 B	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	5.9	1.26 L	NA	3.4	1.45 L	3.6	NA	NA		NA	4.15 L
Sulfate	--	110	SJS21-MW01S-04D	NA	20	NA	NA	110	NA	37	NA	NA		79	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	NA	3.1	NA	NA	3	NA	1.9	NA	NA		4.6	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

Bold blue text represents MCL exceedance

B- Possible blank contamination
J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
R- Unreliable result
U- Not detected

Table 5-4
Shallow Groundwater Detections and Exceedances of Screening Criteria
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

				Permanent Monitoring Wells											
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-MW09S		SJS21-MW10S		SJS21-MW11S		SJS21-MW12S		SJS21-MW13S			
Sample ID				SJS21-MW09S-04D[2]	SJS21-MW09S-05D	SJS21-MW10S-04D	SJS21-MW10S-05D	SJS21-MW11S-04D	SJS21-MW11S-05D[2]	SJS21-MW12S-05D	SJS21-DW102-14-06D	SJS21-MW13S-05D[2]	SJS21-DW103-06D	SJS21-DW104-06D	SJS21-DW105-06D[2]
Sample Date				12/01/04	11/04/05	11/30/04	11/03/05	11/30/04	11/04/05	11/09/05	10/24/06	11/09/05	10/26/06	10/27/06	11/20/06
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	0.5 U	10 U	0.5 UL	0.5 U	0.27 L	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	--	3	SJS21-TW211-07A	0.47 J	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	2 J	**17**	**11**	4 J	5 J	1 J
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	--	20	SJS21-MW03S-05D	50 R	10 U	5 R	5 U	5 R	3.7 B	10 U	3 B	10 U	10 U	10 U	20 B
Benzene	5	89	SJS21-MW09S-04D	**89 J**	5 J	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	80	0.13	SJS21-TW118-05D	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon disulfide	--	0.59	SJS21-MW02S-04D	0.5 U	10 U	0.5 UL	0.5 U	0.5 L	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	100	14	SJS21-TW113-05D	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroform	80	2.1	SJS21-MW11S-04D	0.5 U	10 U	0.5 UL	0.5 U	2.1 L	0.5 U	10 U	10 U	10 U	10 U	10 U	0.8 B
Chloromethane	--	0.77	SJS21-MW11S-04D	0.5 U	10 U	0.5 UL	0.5 U	0.77 L	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	--	8.1	SJS21-MW09S-04D	8.1	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	1 J
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	0.5 U	10 U	0.5 UL	0.11 J	0.54 L	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	700	0.8	SJS21-TW205-07A	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Isopropylbenzene	--	2	SJS21-MW01S-03C	1.7	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl acetate	--	19	SJS21-MW11S-04D	5 R	10 U	0.5 R	0.5 U	19 J	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	0.5 U	1 J	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	1.2	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene chloride	5	1.8	SJS21-MW11S-04D	0.5 U	10 U	0.5 UL	0.5 U	1.8 J	0.14 B	10 U	3 B	10 U	1 B	10 U	4 B
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	1,000	15	SJS21-TW206-07A	1.2	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	0.9 J	1 B	10 U	1 B
Trichloroethene	5	16,000	SJS21-MW15SP-06D	0.38 J	10 U	0.39 B	0.39 J	0.4 B	0.5 U	**1,400**	**9,600**	**4,800**	**1,300**	**1,800**	**200**
Vinyl chloride	2	390	SJS21-TW115-05D	**2.3**	**6 J**	0.5 UL	0.5 U	0.5 UL	0.5 U	**9 J**	**13**	**86**	**110**	**170**	**130**
Xylene, total	10,000	0.69	SJS21-TW126-05D	0.58	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	8.5	17	0.5 UL	0.19 J	0.5 UL	0.5 U	**370**	**3,500**	**1,800**	**600**	**950**	**400**
o-Xylene	--	0.8	SJS21-TW209-07A	NA	NA	NA	NA	NA	NA	NA	10 U	NA	NA	NA	NA
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	0.73	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	2 J	15	8 J	3 J	4 J	2 J
Wet Chemistry (MG/L)															
Alkalinity	--	120	SJS21-MW11S-04D	120 B	NA	19	NA	120	NA	52.9	NA	58.4	NA	NA	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	18.4 L	0.2 U	NA	6	NA	2.8 L	NA	1.26 L	NA	NA	NA
Sulfate	--	110	SJS21-MW01S-04D	2.7	NA	71	NA	100	NA	55.5	NA	51	NA	NA	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	11	NA	1.1	NA	7.6	NA	4.68 J	NA	4.65 J	NA	NA	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

Bold blue text represents MCL exceedance

B- Possible blank contamination
J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
R- Unreliable result
U- Not detected

				Permanent Monitoring Wells					
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-MW14S	SJS21-MW15S	SJS21-MW16S	SJS21-MW17S	SJS21-MW18S	SJS21-MW19S
Sample ID				SJS21-MW14S-06D	SJS21-MW15S-06D[2]	SJS21-MW16S-06D	SJS21-MW17S-07A	SJS21-MW18S-07A[2]	SJS21-MW19S-07A
Sample Date				10/30/06	10/30/06	10/30/06	02/26/07	02/26/07	02/26/07
Chemical Name									
Volatile Organic Compounds (UG/L)									
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	130 U	2,000 U	670 U	10 U	10 U	2.2 J
1,1-Dichloroethane	--	3	SJS21-TW211-07A	130 U	2,000 U	670 U	10 U	10 U	10 U
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	130 U	2,000 U	670 U	5 U	5 U	1.6 J
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	130 U	2,000 U	670 U	1 U	1 U	1 U
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	130 U	2,000 U	670 U	5 U	5 U	5 U
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	130 U	2,000 U	670 U	10 U	10 U	10 U
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	130 U	2,000 U	670 U	10 U	10 U	10 U
Acetone	--	20	SJS21-MW03S-05D	130 U	2,000 U	670 U	10 U	10 U	10 U
Benzene	5	89	SJS21-MW09S-04D	130 U	2,000 U	670 U	5 U	5 U	5 U
Bromoform	80	0.13	SJS21-TW118-05D	130 U	2,000 U	670 U	10 U	10 U	10 U
Carbon disulfide	--	0.59	SJS21-MW02S-04D	130 U	2,000 U	670 U	10 U	10 U	10 U
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	130 U	2,000 U	670 U	5 U	5 U	5 U
Chlorobenzene	100	14	SJS21-TW113-05D	130 U	2,000 U	670 U	10 U	10 U	10 U
Chloroform	80	2.1	SJS21-MW11S-04D	130 U	2,000 U	670 U	10 U	10 U	10 U
Chloromethane	--	0.77	SJS21-MW11S-04D	130 U	2,000 U	670 U	10 U	10 U	10 U
Cyclohexane	--	8.1	SJS21-MW09S-04D	130 U	2,000 U	670 U	10 U	10 U	10 U
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	130 U	2,000 U	670 U	10 U	10 U	10 U
Ethylbenzene	700	0.8	SJS21-TW205-07A	130 U	2,000 U	670 U	10 U	10 U	10 U
Isopropylbenzene	--	2	SJS21-MW01S-03C	130 U	2,000 U	670 U	10 U	10 U	10 U
Methyl acetate	--	19	SJS21-MW11S-04D	130 U	2,000 U	670 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	130 U	2,000 U	670 U	10 U	10 U	10 U
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	130 U	2,000 U	670 U	10 U	10 U	10 U
Methylene chloride	5	1.8	SJS21-MW11S-04D	130 U	2,000 U	670 U	5 U	5 U	5 U
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	130 U	2,000 U	670 U	5 U	5 U	5 U
Toluene	1,000	15	SJS21-TW206-07A	130 U	2,000 U	670 U	10 U	10 U	10 U
Trichloroethene	5	16,000	SJS21-MW15SP-06D	**650**	**16,000**	**13,000**	**29**	**180**	**150**
Vinyl chloride	2	390	SJS21-TW115-05D	130 U	2,000 U	670 U	1 U	**16**	**25**
Xylene, total	10,000	0.69	SJS21-TW126-05D	130 U	2,000 U	670 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	**880**	**2,600 J**	**460 J**	22	49	**140**
o-Xylene	--	0.8	SJS21-TW209-07A	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	130 U	2,000 U	670 U	10 U	10 U	10 U
Wet Chemistry (MG/L)									
Alkalinity	--	120	SJS21-MW11S-04D	NA	NA	NA	NA	NA	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	NA	NA	NA	NA	NA
Sulfate	--	110	SJS21-MW01S-04D	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	NA	NA	NA	NA	NA	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

Bold blue text represents MCL exceedance

B- Possible blank contamination
J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
R- Unreliable result
U- Not detected

Table 5-4
Shallow Groundwater Detections and Exceedances of Screening Criteria
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

				Temporary Monitoring Wells											
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-TW101	SJS21-TW102	SJS21-TW103	SJS21-TW104	SJS21-TW106	SJS21-TW107	SJS21-TW108	SJS21-TW109	SJS21-TW110	SJS21-TW111	SJS21-TW112	SJS21-TW113
Sample ID				SJS21-TW101-05D	SJS21-TW102-05D[2]	SJS21-TW103-05D	SJS21-TW104-05D	SJS21-TW106-05D	SJS21-TW107-05D	SJS21-TW108-05D	SJS21-TW109-05D	SJS21-TW110-05D[2]	SJS21-TW111-05D	SJS21-TW112-05D	SJS21-TW113-05D
Sample Date				11/03/05	10/31/05	11/01/05	10/31/05	11/02/05	10/31/05	11/02/05	11/01/05	11/02/05	11/01/05	11/02/05	11/02/05
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	--	3	SJS21-TW211-07A	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	0.5 U	0.5 U	10 U	0.5 U	1 J	500 U	10 U	2 J	4 J	10 U	10 U	10 U
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	--	20	SJS21-MW03S-05D	9.4 B	5.6	10 U	8.8 B	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzene	5	89	SJS21-MW09S-04D	0.13 J	0.5 U	10 U	0.14 J	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	80	0.13	SJS21-TW118-05D	0.12 J	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon disulfide	--	0.59	SJS21-MW02S-04D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	100	14	SJS21-TW113-05D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	14
Chloroform	80	2.1	SJS21-MW11S-04D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	--	0.77	SJS21-MW11S-04D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	--	8.1	SJS21-MW09S-04D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	0.5 UJ	0.5 U	10 U	0.5 UJ	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	700	0.8	SJS21-TW205-07A	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Isopropylbenzene	--	2	SJS21-MW01S-03C	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl acetate	--	19	SJS21-MW11S-04D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene chloride	5	1.8	SJS21-MW11S-04D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	1,000	15	SJS21-TW206-07A	0.18 J	0.11 J	10 U	0.11 J	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	5	16,000	SJS21-MW15SP-06D	0.5 U	0.1 J	4 J	0.29 J	**500**	**3,000**	1 J	**1,600**	**2,900**	**10**	1 J	**78**
Vinyl chloride	2	390	SJS21-TW115-05D	0.5 U	0.5 U	10 U	0.5 U	**4 J**	500 U	10 U	**6 J**	**6 J**	10 U	10 U	**5 J**
Xylene, total	10,000	0.69	SJS21-TW126-05D	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	0.26 J	0.5 UJ	9 J	2.3 J	**730**	**1,300**	10 U	**450**	**1,300**	18	10 U	28
o-Xylene	--	0.8	SJS21-TW209-07A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	0.5 U	0.5 UJ	10 U	0.5 UJ	2 J	500 U	10 U	5 J	3 J	10 U	10 U	10 U
Wet Chemistry (MG/L)															
Alkalinity	--	120	SJS21-MW11S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	--	110	SJS21-MW01S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

Bold blue text represents MCL exceedance

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J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
R- Unreliable result
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VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

				Temporary Monitoring Wells											
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-TW114	SJS21-TW115	SJS21-TW116	SJS21-TW117	SJS21-TW118	SJS21-TW119	SJS21-TW120	SJS21-TW121	SJS21-TW122	SJS21-TW123	SJS21-TW124	SJS21-TW125
Sample ID				SJS21-TW114-05D	SJS21-TW115-05D	SJS21-TW116-05D	SJS21-TW117-05D	SJS21-TW118-05D	SJS21-TW119-05D	SJS21-TW120-05D	SJS21-TW121-05D	SJS21-TW122-05D	SJS21-TW123-05D	SJS21-TW124-05D	SJS21-TW125-05D
Sample Date				11/01/05	11/01/05	11/02/05	11/03/05	11/01/05	11/01/05	11/01/05	10/31/05	10/31/05	10/31/05	11/02/05	11/07/05
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	10 U	15	10 U	10 U	4.6	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
1,1-Dichloroethane	--	3	SJS21-TW211-07A	10 U	10 U	10 U	10 U	0.28 J	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	10 U	10 U	10 U	10 U	0.27 J	0.5 U	0.5 U	4.6	10 U	2.5	0.5 U	0.5 UJ
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Acetone	--	20	SJS21-MW03S-05D	10 U	10 U	10 U	7 B	5 U	3.9 J	3.1 B	2.7 J	10 U	2.3 J	6.1 B	2.2 B
Benzene	5	89	SJS21-MW09S-04D	10 U	10 U	10 U	10 U	0.13 J	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.33 J
Bromoform	80	0.13	SJS21-TW118-05D	10 U	10 U	10 U	10 U	0.13 J	0.5 U	0.12 J	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Carbon disulfide	--	0.59	SJS21-MW02S-04D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.1 J	10 U	0.5 U	0.5 U	0.5 UJ
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Chlorobenzene	100	14	SJS21-TW113-05D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Chloroform	80	2.1	SJS21-MW11S-04D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	1.2	0.5 UJ
Chloromethane	--	0.77	SJS21-MW11S-04D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Cyclohexane	--	8.1	SJS21-MW09S-04D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	1.2 J
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	10 U	21	10 U	10 U	0.3 J	0.5 U	0.5 UJ	5	10 U	0.5 U	0.5 UJ	0.5 UJ
Ethylbenzene	700	0.8	SJS21-TW205-07A	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.2 J
Isopropylbenzene	--	2	SJS21-MW01S-03C	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.47 J
Methyl acetate	--	19	SJS21-MW11S-04D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	10 U	10 U	10 U	10 U	11	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	2.3 J
Methylene chloride	5	1.8	SJS21-MW11S-04D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.58 B
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Toluene	1,000	15	SJS21-TW206-07A	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.68 J
Trichloroethene	5	16,000	SJS21-MW15SP-06D	**50**	**190**	1 J	**14**	1	0.5 U	1.2	0.5 U	**27**	0.5 U	0.55	0.5 UJ
Vinyl chloride	2	390	SJS21-TW115-05D	10 U	**390**	10 U	10 U	0.65	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ
Xylene, total	10,000	0.69	SJS21-TW126-05D	10 U	10 U	10 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.63 J
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	3 J	**140**	10 U	2 J	1.1 J	0.5 UJ	0.69 J	0.5 UJ	2 J	0.5 UJ	0.73 J	0.5 UJ
o-Xylene	--	0.8	SJS21-TW209-07A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	10 U	2 J	10 U	10 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	10 U	0.5 UJ	0.5 UJ	0.5 UJ
Wet Chemistry (MG/L)															
Alkalinity	--	120	SJS21-MW11S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	--	110	SJS21-MW01S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

Bold blue text represents MCL exceedance

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VOCs and Geochemical Parameters
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St. Juliens Creek Annex
Chesapeake, Virginia

				Temporary Monitoring Wells											
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-TW126	SJS21-TW127	SJS21-TW201	SJS21-TW202	SJS21-TW203	SJS21-TW204	SJS21-TW205	SJS21-TW206	SJS21-TW207	SJS21-TW208	SJS21-TW209	SJS21-TW210
Sample ID				SJS21-TW126-05D	SJS21-TW127-05D	SJS21-TW201-06D[2]	SJS21-TW202-06D	SJS21-TW203-06D	SJS21-TW204-06D	SJS21-TW205-07A	SJS21-TW206-07A	SJS21-TW207-07A[2]	SJS21-TW208-07A	SJS21-TW209-07A	SJS21-TW210-07A
Sample Date				11/07/05	11/07/05	10/25/06	10/25/06	10/26/06	10/26/06	02/20/07	02/20/07	02/20/07	02/21/07	02/22/07	02/20/07
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	0.5 UJ	0.5 UJ	200	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	--	3	SJS21-TW211-07A	0.5 UJ	0.5 UJ	2 J	0.28 J	0.5 U	0.5 U	10 U	10 U	10 U	10 U	2 J	10 U
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	**1 J**	10 U
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	0.5 UJ	0.21 J	10 U	0.5 U	0.5 U	0.5 U	5 U	5 U	0.8 J	0.8 B	5 U	0.7 J
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	0.9 J	10 U
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	0.9 J	10 U
Acetone	--	20	SJS21-MW03S-05D	5 UJ	2.7 B	10 U	5.7 B	3.1 B	8.2 B	NA	NA	NA	NA	NA	NA
Benzene	5	89	SJS21-MW09S-04D	0.16 J	0.5 UJ	10 U	0.5 U	0.5 U	0.19 J	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	80	0.13	SJS21-TW118-05D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
Carbon disulfide	--	0.59	SJS21-MW02S-04D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	100	14	SJS21-TW113-05D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	0.9 B	10 U	10 U	10 U	0.9 J	10 U
Chloroform	80	2.1	SJS21-MW11S-04D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	--	0.77	SJS21-MW11S-04D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	--	8.1	SJS21-MW09S-04D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.25 B	0.11 B	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	700	0.8	SJS21-TW205-07A	0.3 J	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	0.8 J	15 U	15 U	15 U	0.9 B	15 U
Isopropylbenzene	--	2	SJS21-MW01S-03C	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
Methyl acetate	--	19	SJS21-MW11S-04D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	0.5 UJ	0.5 UJ	1 J	0.5 U	0.5 U	0.32 J	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
Methylene chloride	5	1.8	SJS21-MW11S-04D	0.55 B	0.96 B	1 B	0.13 B	0.5 U	0.5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	1 B	5 U	5 U	5 U	2 B	5 U
Toluene	1,000	15	SJS21-TW206-07A	11 J	0.96 UJ	10 U	0.5 U	0.5 U	0.1 B	6 B	15	7 J	4 J	0.8 B	1 B
Trichloroethene	5	16,000	SJS21-MW15SP-06D	0.13 J	0.5 UJ	1 B	0.5 U	0.17 J	1.5	**8**	**14**	5 U	5 U	**11**	5 U
Vinyl chloride	2	390	SJS21-TW115-05D	0.5 UJ	0.5 UJ	**10**	0.5 U	0.19 J	0.5 U	2 U	0.8 J	2 U	2 U	2 U	2 U
Xylene, total	10,000	0.69	SJS21-TW126-05D	0.69 J	0.5 UJ	10 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	0.35 J	0.5 UJ	18	0.5 U	2.2	2.4	5 J	9 J	10 U	10 U	2 J	10 U
o-Xylene	--	0.8	SJS21-TW209-07A	NA	NA	NA	NA	NA	NA	10 U	10 U	10 U	10 U	0.8 J	10 U
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	0.5 UJ	0.5 UJ	10 U	0.5 U	0.5 U	0.34 J	10 U	10 U	10 U	10 U	10 U	10 U
Wet Chemistry (MG/L)															
Alkalinity	--	120	SJS21-MW11S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	--	110	SJS21-MW01S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

Bold blue text represents MCL exceedance

B- Possible blank contamination
J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
R- Unreliable result
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Table 5-4
Shallow Groundwater Detections and Exceedances of Screening Criteria
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

				Temporary Monitoring Wells						
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-TW211	SJS21-TW212	SJS21-TW213	SJS21-TW214	SJS21-TW215	SJS21-TW216	SJS21-TW217
Sample ID				SJS21-TW211-07A	SJS21-TW212-07A	SJS21-TW213-07A	SJS21-TW214-07A	SJS21-TW215-07A	SJS21-TW216-07A	SJS21-TW217-07A
Sample Date				02/21/07	02/21/07	02/21/07	02/21/07	02/21/07	02/22/07	02/23/07
Chemical Name										
Volatile Organic Compounds (UG/L)										
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	--	3	SJS21-TW211-07A	3 J	10 U	10 U	10 U	10 U	10 U	1 J
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	1 J	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	0.7 B	0.8 B	5 U	0.7 B	0.7 B	5 U	0.7 J
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	--	20	SJS21-MW03S-05D	NA	NA	NA	NA	NA	NA	NA
Benzene	5	89	SJS21-MW09S-04D	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	80	0.13	SJS21-TW118-05D	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	--	0.59	SJS21-MW02S-04D	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	100	14	SJS21-TW113-05D	10 U	10 U	10 U	10 U	10 U	10 U	0.7 B
Chloroform	80	2.1	SJS21-MW11S-04D	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	--	0.77	SJS21-MW11S-04D	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	--	8.1	SJS21-MW09S-04D	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	10 U	1 J	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	700	0.8	SJS21-TW205-07A	15 U	15 U	15 U	15 U	15 U	15 U	15 U
Isopropylbenzene	--	2	SJS21-MW01S-03C	NA	NA	NA	NA	NA	NA	NA
Methyl acetate	--	19	SJS21-MW11S-04D	NA	NA	NA	NA	NA	NA	NA
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	5	1.8	SJS21-MW11S-04D	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	5 U	5 U	5 U	5 U	5 U	0.7 B	5 U
Toluene	1,000	15	SJS21-TW206-07A	1 J	3 J	1 J	15	1 J	0.8 B	5 J
Trichloroethene	5	16,000	SJS21-MW15SP-06D	5 U	**9**	5	5 U	5 U	**11**	5 U
Vinyl chloride	2	390	SJS21-TW115-05D	2 U	0.9 J	2 U	2 U	2 U	2 J	2 U
Xylene, total	10,000	0.69	SJS21-TW126-05D	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	10 U	9 J	10 U	10 U	10 U	12	10 U
o-Xylene	--	0.8	SJS21-TW209-07A	10 U	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Wet Chemistry (MG/L)										
Alkalinity	--	120	SJS21-MW11S-04D	NA	NA	NA	NA	NA	NA	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	NA	NA	NA	NA	NA	NA
Sulfate	--	110	SJS21-MW01S-04D	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	NA	NA	NA	NA	NA	NA	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

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B- Possible blank contamination
J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
R- Unreliable result
U- Not detected

Table 5-4
Shallow Groundwater Detections and Exceedances of Screening Criteria
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

				Grab Groundwater Samples				
Station ID	**MCL[1]**	**Maximum Detected Concentration**	**Sample ID of Maximum Detected Value**	SJS21-GW101	SJS21-GW102	SJS21-GW103	SJS21-GW104	SJS21-GW105
Sample ID				SJS21-GW101-13-06D	SJS21-GW102-13-06D	SJS21-GW103-13-06D	SJS21-GW104-13-06D	SJS21-GW105-13-06D
Sample Date				10/26/06	10/26/06	10/26/06	10/27/06	10/27/06
Chemical Name								
Volatile Organic Compounds (UG/L)								
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	200	SJS21-TW201-06D	10 U	0.5 U	10 U	10 U	10 U
1,1-Dichloroethane	--	3	SJS21-TW211-07A	2 J	0.5 U	10 U	10 U	10 U
1,1-Dichloroethene	7	11	SJS21-MW13S-05D	2 J	1 J	10 U	0.8 J	10 U
1,2-Dibromo-3-chloropropane	0.2	1	SJS21-TW209-07A	10 U	0.5 U	10 U	10 U	10 U
1,2-Dichloroethane	5	4.6	SJS21-TW121-05D	10 U	0.5 U	10 U	10 U	10 U
1,3-Dichlorobenzene	--	0.9	SJS21-TW209-07A	10 U	0.5 U	10 U	10 U	10 U
1,4-Dichlorobenzene	75	0.9	SJS21-TW209-07A	10 U	0.5 U	10 U	10 U	10 U
Acetone	--	20	SJS21-MW03S-05D	10 U	7.5 B	10 U	10 U	10 U
Benzene	5	89	SJS21-MW09S-04D	10 U	0.43 J	10 U	10 U	10 U
Bromoform	80	0.13	SJS21-TW118-05D	10 U	0.5 U	10 U	10 U	10 U
Carbon disulfide	--	0.59	SJS21-MW02S-04D	10 U	0.12 B	10 U	10 U	10 U
Carbon tetrachloride	5	0.16	SJS21-MW01S-05D	10 U	0.5 U	10 U	10 U	10 U
Chlorobenzene	100	14	SJS21-TW113-05D	10 U	0.5 U	10 U	10 U	10 U
Chloroform	80	2.1	SJS21-MW11S-04D	10 U	0.5 U	10 U	10 U	10 U
Chloromethane	--	0.77	SJS21-MW11S-04D	10 U	0.5 U	10 U	10 U	10 U
Cyclohexane	--	8.1	SJS21-MW09S-04D	10 U	0.16 B	10 U	10 U	10 U
Dichlorodifluoromethane (Freon-12)	--	21	SJS21-TW115-05D	10 U	0.5 U	10 U	10 U	10 U
Ethylbenzene	700	0.8	SJS21-TW205-07A	10 U	0.5 U	10 U	10 U	10 U
Isopropylbenzene	--	2	SJS21-MW01S-03C	10 U	0.5 U	10 U	10 U	10 U
Methyl acetate	--	19	SJS21-MW11S-04D	10 U	0.5 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	--	11	SJS21-TW118-05D	10 U	0.5 U	10 U	10 U	10 U
Methylcyclohexane	--	3.7	SJS21-MW01S-04D	10 U	0.5 U	10 U	10 U	10 U
Methylene chloride	5	1.8	SJS21-MW11S-04D	1 B	0.5 U	10 U	10 U	10 U
Tetrachloroethene	5	1.3	SJS21-GW102-13-06D	10 U	1.3	10 U	10 U	10 U
Toluene	1,000	15	SJS21-TW206-07A	10 U	0.5 U	10 U	10 U	10 U
Trichloroethene	5	16,000	SJS21-MW15SP-06D	**420**	**100**	10 B	**83**	10 U
Vinyl chloride	2	390	SJS21-TW115-05D	**25**	**3.1**	10 U	**16**	10 U
Xylene, total	10,000	0.69	SJS21-TW126-05D	10 U	0.5 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	70	2,600	SJS21-MW15SP-06D	**120**	**72**	10 J	**110**	10 U
o-Xylene	--	0.8	SJS21-TW209-07A	NA	NA	10	NA	NA
trans-1,2-Dichloroethene	100	9	SJS21-MW02S-03C	2 J	2.4 J	10 U	1 J	10 U
Wet Chemistry (MG/L)								
Alkalinity	--	120	SJS21-MW11S-04D	NA	NA	NA	NA	NA
Ferrous iron	--	18.4	SJS21-MW09S-05D	NA	NA	NA	NA	NA
Sulfate	--	110	SJS21-MW01S-04D	NA	NA	NA	NA	NA
Total organic carbon (TOC)	--	11	SJS21-MW09S-04D	NA	NA	NA	NA	NA

Notes:
[1]June 2003 MCLs
[2]Duplicate sample collected at this location; the most conservative result is shown

Bold blue text represents MCL exceedance

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J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
R- Unreliable result
U- Not detected

Table 5-5
Shallow Groundwater Detections and Exceedances of Screening Criteria
SVOCs, Pesticides, Explosives, and Metals
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	MCL[1]	Background UTL	Maximum Detected Concentration	Sample ID of Maximum Detected Value	SJS21-MW01S	SJS21-MW02S	SJS21-MW03S	SJS21-MW04S		SJS21-MW05S	SJS21-MW06S	SJS21-MW07S	SJS21-MW08S	SJS21-MW09S	SJS21-MW10S	SJS21-MW11S	SJS21-MW12S	SJS21-MW13S
Sample ID					SJS21-MW01S-03C	SJS21-MW02S-03C	SJS21-MW03S-03C	SJS21-MW04S-03C	SJS21-MW04S-04D	SJS21-MW05S-03C	SJS21-MW06S-03C	SJS21-MW07S-04D	SJS21-MW08S-04D	SJS21-MW09S-04D[2]	SJS21-MW10S-04D	SJS21-MW11S-04D	SJS21-MW12S-05D	SJS21-MW13S-05D[2]
Sample Date					08/21/03	08/21/03	08/21/03	08/20/03	12/01/04	08/20/03	08/21/03	11/30/04	12/01/04	12/01/04	11/30/04	11/30/04	11/09/05	11/09/05
Chemical Name																		
Semi-volatile Organic Compounds (UG/L)																		
2-Methylnaphthalene	--	--	0.6	SJS21-MW01S-03C	0.6 J	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	11 U	11 U	10 U	11 U
Acenaphthene	--	15	0.9	SJS21-MW01S-03C	0.9 J	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	11 U	11 U	10 U	11 U
Caprolactam	--	ND	3.7	SJS21-MW08S-04D	10 U	1 J	10 U	1 J	NA	0.8 J	11 U	11 U	3.7 J	12 U	11 U	3.6 J	10 U	11 U
Di-n-butylphthalate	--	ND	0.8	SJS21-MW06S-03C	10 U	10 U	10 U	0.5 J	NA	10 U	0.8 J	3.5 B	1.1 B	1.9 B	2.4 B	3.2 B	10 U	11 U
Phenol	--	ND	4.1	SJS21-MW09S-04D	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	4.1 J	11 U	11 U	10 U	11 U
bis(2-Ethylhexyl)phthalate	6	1	73	SJS21-MW13S-05D	10 U	10 U	0.8 B	10 U	NA	10 U	11 U	1.5 B	3 B	2.6 B	1.7 B	4.6 B	10 U	**73**
Pesticides (UG/L)																		
Heptachlor epoxide	0.2	--	0.059	SJS21-MW12S-05D	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 U	0.05 U	0.059	0.029 J
beta-BHC	--	--	0.043	SJS21-MW13S-05D	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.019 J	0.012 J	0.05 U	0.05 UJ	0.06 U	0.06 U	0.05 U	0.036 J	0.043 J
Explosives (UG/L)																		
RDX	--	--	5.3	SJS21-MW04S-03C	5.4 U	3 U	5.4 U	5.3 J	0.52 U	4.8 U	4.2 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	2.5 U	2.5 U
Total Metals (UG/L)																		
Aluminum	--	1,710	324	SJS21-MW10S-04D	26.7 U	26.7 U	26.7 U	26.7 U	NA	56.3 B	26.7 U	61.4 B	37.7 B	17.9 U	324	178 J	17.9 B	61.8 B
Arsenic	10	8	47.3	SJS21-MW09S-04D	2.2 U	2.2 U	2.2 U	2.2 U	NA	2.2 U	2.2 U	5.3 U	5.3 U	**47.3**	5.3 U	5.3 U	10 U	10 U
Barium	2,000	77.1	51.1	SJS21-MW11S-04D	37.1 J	34.2 J	32.9 J	29.8 J	NA	50 J	34 J	34.5 J	37.5 J	21.2 J	47.3 J	51.1 J	40 J	30.4 J
Boron	--	NA	252	SJS21-MW11S-04D	NA	NA	NA	NA	NA	NA	NA	93.5	83	44.9	191	252	NA	NA
Calcium	--	531,000	48,000	SJS21-MW11S-04D	25,000	15,400	20,400	12,600	NA	11,900	11,100	7,390	20,100	32,300	9,770	48,000	29,900	33,400
Chromium	100	3.2	0.86	SJS21-MW13S-05D	1.1 U	1.1 U	1.1 U	1.1 U	NA	1.1 U	1.1 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	10 U	0.86 J
Cobalt	--	15.8	35.9	SJS21-MW11S-04D	4.5 B	4.2 B	7.1 B	3.5 B	NA	14.6 J	12.1 J	3.8 J	11.2 J	2 J	19.2 J	35.9 J	4.5 J	6.1 J
Iron	--	107,000	26,100	SJS21-MW09S-04D	3,810	2,260	770	7,260	NA	3,370	6,080	4,630	2,310 L	26,100 L	634	6,050	2,980 J	3,680 J
Magnesium	--	296,000	12,700	SJS21-MW11S-04D	3,270 J	5,360	11,500	4,950 J	NA	6,630	9,770	5,550	6,490	4,790 J	10,300	12,700	5,650	7,820
Manganese	--	13,700	3,040	SJS21-MW11S-04D	285	452	1,510	328	NA	926	479	366	983	404	1,160	3,040	311	672
Molybdenum	--	NA	18.9	SJS21-MW09S-04D	NA	NA	NA	NA	NA	NA	NA	1.8 J	1.6 U	18.9	1.6 U	1.7 J	NA	NA
Nickel	--	20.1	5.8	SJS21-MW12S-05D	4.2 B	2.6 B	1.7 B	3.9 B	NA	5.2 B	8.6 B	4.4 J	4 J	1.1 U	4 J	3.2 J	5.8 J	2.7 B
Potassium	--	85,400	4,210	SJS21-MW11S-04D	2,470 J	3,440 J	3,830 J	1,940 J	NA	2,650 J	2,370 J	1,270 J	2,030 J	1,770 J	2,590 J	4,210 J	2,600 J	2,240 J
Sodium	--	810,000	63,100	SJS21-MW13S-05D	11,000	49,200	38,800	23,700	NA	35,500	54,800	28,000	56,000	17,100	30,000	28,100	18,500	63,100
Vanadium	--	13.7	0.98	SJS21-MW13S-05D	2.7 B	1.2 B	0.65 B	0.6 U	NA	1 B	0.6 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	50 U	0.98 J
Zinc	--	241	26.5	SJS21-MW11S-04D	10.2 U	10.2 U	10.2 U	10.2 U	NA	19.2 J	16.9 J	12 J	10.6 B	3.3 B	12.1 J	26.5	60 U	60 U
Dissolved Metals (UG/L)																		
Antimony	6	3.8	5.5	SJS21-MW02S-03C	4 U	5.5 J	4 U	4 U	NA	4 U	4 U	6.4 U	6.4 U	6.4 U	6.4 U	6.4 U	60 U	60 U
Arsenic	10	2.4	48.6	SJS21-MW09S-04D	5 J	2.6 U	2.6 U	2.6 U	NA	2.6 U	2.6 U	5.3 U	5.3 U	**48.6**	5.3 U	5.3 U	10 U	10 U
Barium	2,000	93.3	49	SJS21-MW11S-04D	27 J	43.8 J	29.2 J	26.4 J	NA	47.5 J	32.7 J	34 J	36.5 J	21.4 J	46.3 J	49 J	36.2 J	34.6 J
Boron	--	NA	243	SJS21-MW11S-04D	NA	NA	NA	NA	NA	NA	NA	88	82.9	44.4	190	243	NA	NA
Calcium	--	464,000	45,400	SJS21-MW11S-04D	24,400	14,400	18,800	11,500	NA	11,300	10,700	7,630	20,300	33,200	9,980	45,400	26,900	33,500
Cobalt	--	15	37.6	SJS21-MW11S-04D	2.4 B	8 B	7 B	3.7 B	NA	14 J	12.6 J	4 J	11.3 J	2.1 J	18.3 J	37.6 J	5.2 J	6.1 J
Iron	--	94,000	25,400	SJS21-MW09S-04D	3,580	2,110	767	6,790	NA	3,310	5,960	3,920	2,340	25,400 L	287	5,750	3,260	2,460
Magnesium	--	256,000	12,600	SJS21-MW11S-04D	3,310 J	5,380	10,900	4,770 J	NA	6,530	9,730	5,470	6,510	4,920 J	10,100	12,600	5,450	8,110
Manganese	--	11,800	3,050	SJS21-MW11S-04D	290	446	1,450	323	NA	905	490	354	971	416	1,140	3,050	338	672
Molybdenum	--	NA	17.6	SJS21-MW09S-04D	NA	NA	NA	NA	NA	NA	NA	1.6 U	1.6 U	17.6	1.6 U	1.6 U	NA	NA
Nickel	--	13.2	6.1	SJS21-MW12S-05D	4 B	6.6 B	2.7 B	3.9 B	NA	6 B	9.6 B	5 J	4.7 J	1.1 U	4.4 J	3.2 J	6.1 J	3.4 J
Potassium	--	73,300	4,050	SJS21-MW11S-04D	1,740 J	2,600 J	2,710 J	1,340 J	NA	1,930 J	1,800 J	1,240 J	1,960 J	1,860 J	2,600 J	4,050 J	2,430 J	2,430 J
Sodium	--	582,000	63,800	SJS21-MW13S-05D	12,800	48,000	37,500	24,300	NA	35,700	54,600	27,000	54,700	17,400	31,300	26,600	17,500	63,800
Vanadium	--	7.1	1	SJS21-MW12S-05D	1.4 U	4.2 B	1.4 U	1.4 U	NA	1.4 U	1.4 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1 J	0.94 J
Zinc	--	109	25.9	SJS21-MW11S-04D	0.9 U	4.2 J	0.9 U	3.3 J	NA	15.3 J	21.4	9.5 J	12.3 B	4.4 B	11.2 J	25.9	60 U	60 U

Notes:
[1]June 2003 MCLs
[2] A duplicate sample was collected at this location; the most conservative result is shown.

Bold blue text represents MCL exceedance

Exceedances of UTLs, established only for PAHs and metals, are represented by shaded cells

B- Possible blank contamination
J- Reported value is estimated
L- Reported value is biased low
NA- Not analyzed
ND- Compound not detected in background
U- Not detected

Table 5-6
Deep Groundwater Detections and Exceedances of Screening Criteria
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	**MCL[1]**	SJS21-MW01D		
Sample ID		SJS21-MW01D-03C	SJS21-MW01D-04D	SJS21-MW01D-05D[2]
Sample Date		08/20/03	12/01/04	11/07/05
Chemical Name				
Volatile Organic Compounds (UG/L)				
Chloroform	80	3 J	NA	NA
Semi-volatile Organic Compounds (UG/L)				
Di-n-butylphthalate	--	0.7 J	NA	NA
Pesticide/Polychlorinated Biphenyls (UG/L)				
No Detections				
Explosives (UG/L)				
1,3-Dinitrobenzene	--	1.1 J	NA	NA
Total Metals (UG/L)				
Arsenic	10	**72.8**	5.3 U	3.1
Barium	2,000	18.3 B	14.3 J	NA
Boron	--	NA	75.5	NA
Calcium	--	48,600	53,300	NA
Chromium	100	47.2	1.8 J	NA
Cyanide	200	1.8 J	5 U	NA
Iron	--	266	124 B	NA
Magnesium	--	552 B	1,360 J	NA
Manganese	--	5.3 B	30.5	NA
Potassium	--	50,800	11,100 J	NA
Selenium	50	3.8 J	3.9 U	NA
Sodium	--	64,300	24,100	NA
Vanadium	--	35.9 J	1.7 U	NA
Dissolved Metals (UG/L)				
Arsenic	10	**72**	5.3 U	3.2
Barium	2,000	15.3 B	13.4 J	NA
Boron	--	NA	73.3	NA
Calcium	--	47,100	52,300	NA
Chromium	100	48.5	1.5 U	NA
Magnesium	--	588 J	1,340 J	NA
Manganese	--	3.4 B	31.4	NA
Potassium	--	48,600	10,700 J	NA
Sodium	--	64,000	24,300	NA
Vanadium	--	36.3 J	2.6 J	NA
Zinc	--	2.8 J	1.9 B	NA

Notes:
[1]June 2003 MCLs
[2] A duplicate sample was collected at this location;
the most conservative result is shown.
Bold blue text represents MCL exceedance
B- Possible blank contamination
J- Reported value is estimated
NA- Not analyzed
U- Not detected

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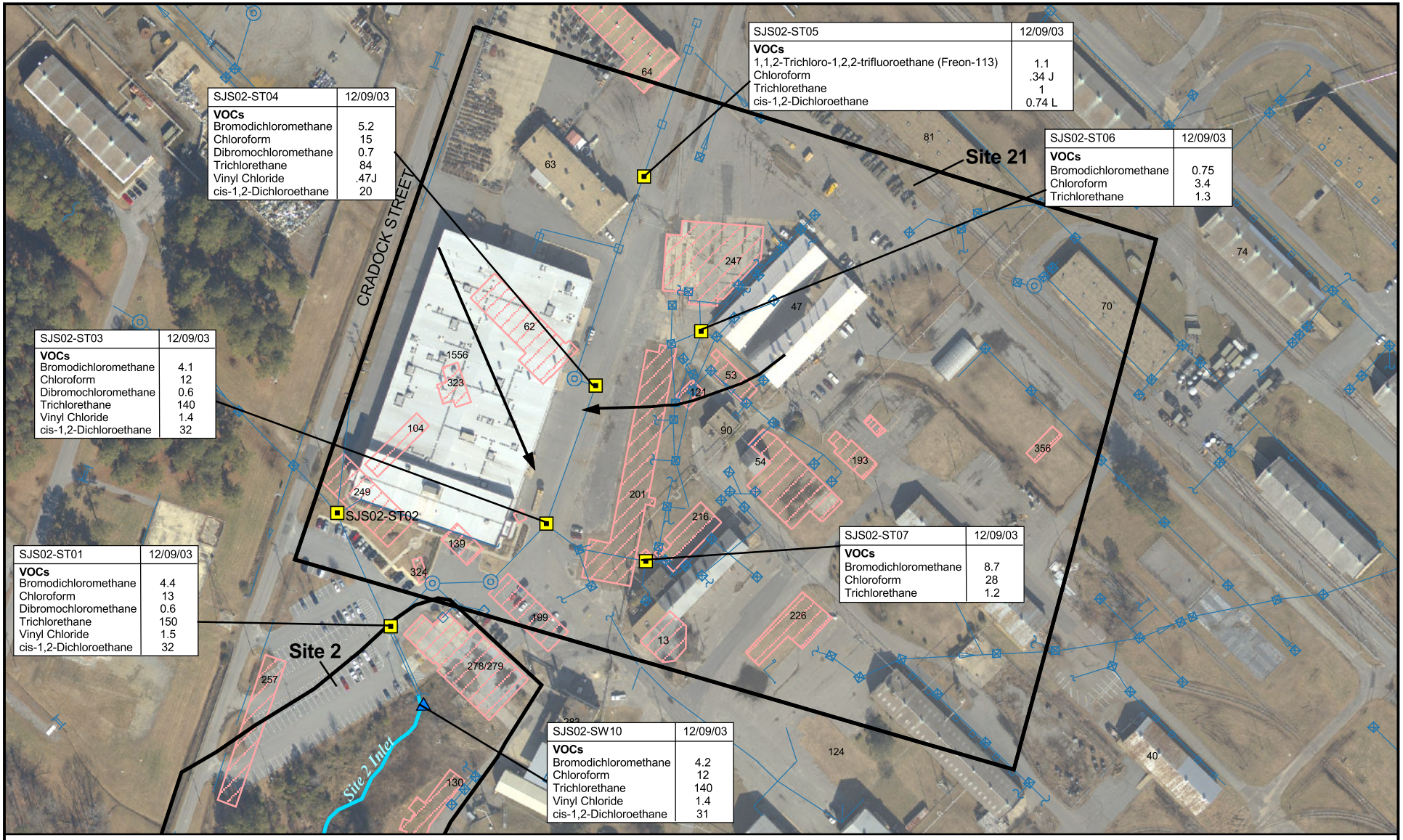

LEGEND

- Active IR Sites
- Surface Water Sample Location
- Storm Water Sample Location
- Demolished Buildings
- Storm Sewer System
- Estimated Groundwater Flow Direction

L - Analyte present. Reported value is biased low.
J - Analyte present. Reported value is estimated.
All results are reported in µg/L.

N

0 100 200 Feet

Figure 5-1
Storm Water and Surface Water Detections
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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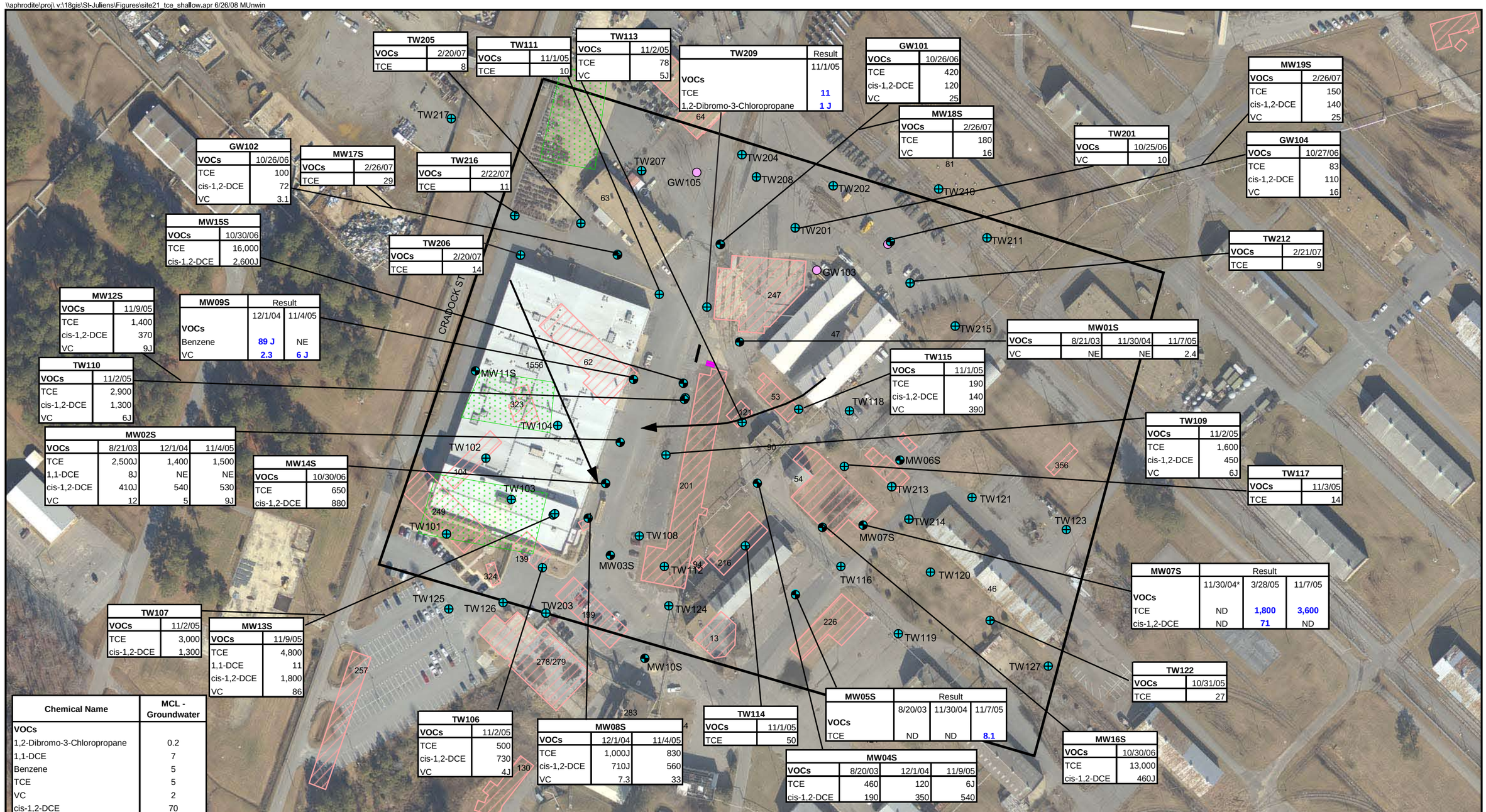

TW205	
VOCs	2/20/07
TCE	8

TW111	
VOCs	11/1/05
TCE	10

TW113	
VOCs	11/2/05
TCE	78
VC	5J

TW209	Result
	11/1/05
VOCs	
TCE	11
1,2-Dibromo-3-Chloropropane	1 J

GW101	
VOCs	10/26/06
TCE	420
cis-1,2-DCE	120
VC	25

MW19S	
VOCs	2/26/07
TCE	150
cis-1,2-DCE	140
VC	25

MW18S	
VOCs	2/26/07
TCE	180
VC	16

TW201	
VOCs	10/25/06
VC	10

GW104	
VOCs	10/27/06
TCE	83
cis-1,2-DCE	110
VC	16

GW102	
VOCs	10/26/06
TCE	100
cis-1,2-DCE	72
VC	3.1

MW17S	
VOCs	2/26/07
TCE	29

TW216	
VOCs	2/22/07
TCE	11

MW15S	
VOCs	10/30/06
TCE	16,000
cis-1,2-DCE	2,600J

TW206	
VOCs	2/20/07
TCE	14

TW212	
VOCs	2/21/07
TCE	9

MW12S	
VOCs	11/9/05
TCE	1,400
cis-1,2-DCE	370
VC	9J

MW09S	Result	
	12/1/04	11/4/05
VOCs		
Benzene	89 J	NE
VC	2.3	6 J

MW01S			
VOCs	8/21/03	11/30/04	11/7/05
VC	NE	NE	2.4

TW115	
VOCs	11/1/05
TCE	190
cis-1,2-DCE	140
VC	390

TW110	
VOCs	11/2/05
TCE	2,900
cis-1,2-DCE	1,300
VC	6J

TW109	
VOCs	11/2/05
TCE	1,600
cis-1,2-DCE	450
VC	6J

MW02S			
VOCs	8/21/03	12/1/04	11/4/05
TCE	2,500J	1,400	1,500
1,1-DCE	8J	NE	NE
cis-1,2-DCE	410J	540	530
VC	12	5	9J

MW14S	
VOCs	10/30/06
TCE	650
cis-1,2-DCE	880

TW117	
VOCs	11/3/05
TCE	14

MW07S	Result		
	11/30/04*	3/28/05	11/7/05
VOCs			
TCE	ND	1,800	3,600
cis-1,2-DCE	ND	71	ND

TW107	
VOCs	11/2/05
TCE	3,000
cis-1,2-DCE	1,300

MW13S	
VOCs	11/9/05
TCE	4,800
1,1-DCE	11
cis-1,2-DCE	1,800
VC	86

TW122	
VOCs	10/31/05
TCE	27

Chemical Name	MCL - Groundwater
VOCs	
1,2-Dibromo-3-Chloropropane	0.2
1,1-DCE	7
Benzene	5
TCE	5
VC	2
cis-1,2-DCE	70

TW106	
VOCs	11/2/05
TCE	500
cis-1,2-DCE	730
VC	4J

MW08S		
VOCs	12/1/04	11/4/05
TCE	1,000J	830
cis-1,2-DCE	710J	560
VC	7.3	33

TW114	
VOCs	11/1/05
TCE	50

MW05S	Result		
	8/20/03	11/30/04	11/7/05
VOCs			
TCE	ND	ND	8.1

MW04S			
VOCs	8/20/03	12/1/04	11/9/05
TCE	460	120	6J
cis-1,2-DCE	190	350	540

MW16S	
VOCs	10/30/06
TCE	13,000
cis-1,2-DCE	460J

LEGEND

- Site 21 Boundary
- Shallow Monitoring Well Location
- Temporary Monitoring Well Location
- Grab Groundwater Sample Location
- Demolished Buildings
- Estimated Groundwater Flow Direction
- Approx. Areas of TPH Contaminated Soil Removal (1993)
- Approx. Locations of Former USTs
- Former Service Station

Bold blue values represent MCL exceedances.
ND - Not detected
NE - Screening criteria not exceeded
DCE - dichloroethene
TCE - trichloroethene
VC - vinyl chloride
J - Reported value is estimated
All results are reported in µg/L.

N

0 150 300 Feet

Figure 5-2
Shallow Groundwater Exceedances
VOCs
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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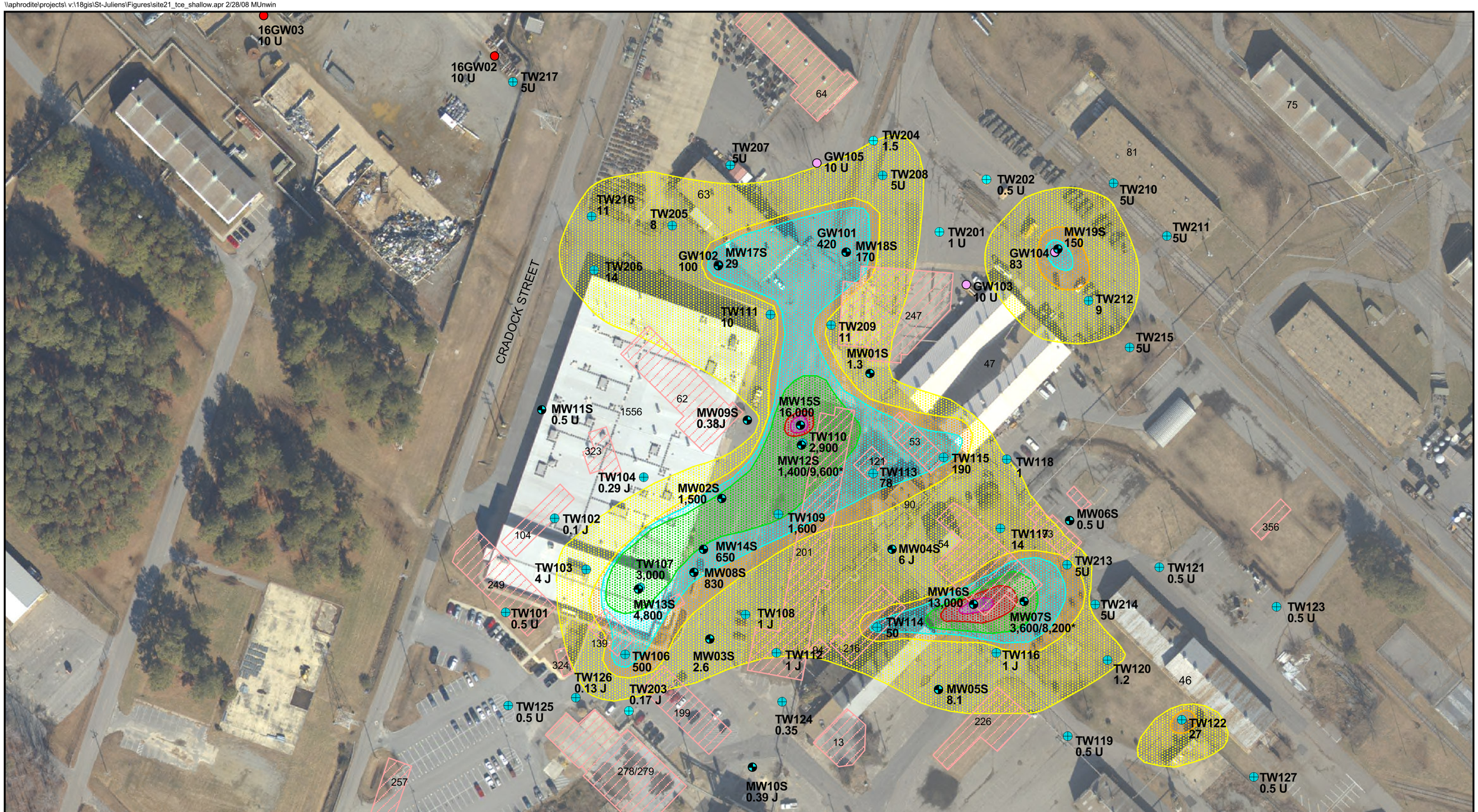

LEGEND

- Permanent Monitoring Well Location
- Temporary Monitoring Well Location
- Grab Groundwater Sample Location
- RRR Groundwater Sample Location
- Demolished Buildings
- Estimated Groundwater Flow Direction

TCE Concentrations in µg/L
J = Analyte detected, result is estimated
U = No Detect
Concentrations shown are the most recent results, with the exception of MW09S, at which a previous result was used because the most recent detection limit was above the MCL.
* = Concentrations from depth specific DPT GW surplus collected at the bottom of the aquifer, not used to delineate the plume

- TCE Concentration 1 - 25
- TCE Concentration 26 - 49
- TCE Concentration 50 - 999
- TCE Concentration 1,000 - 4,999
- TCE Concentration 5,000 - 9,999
- TCE Concentration >= 10,000

N

0 120 240 Feet

Figure 5-3
Shallow Groundwater TCE Plume
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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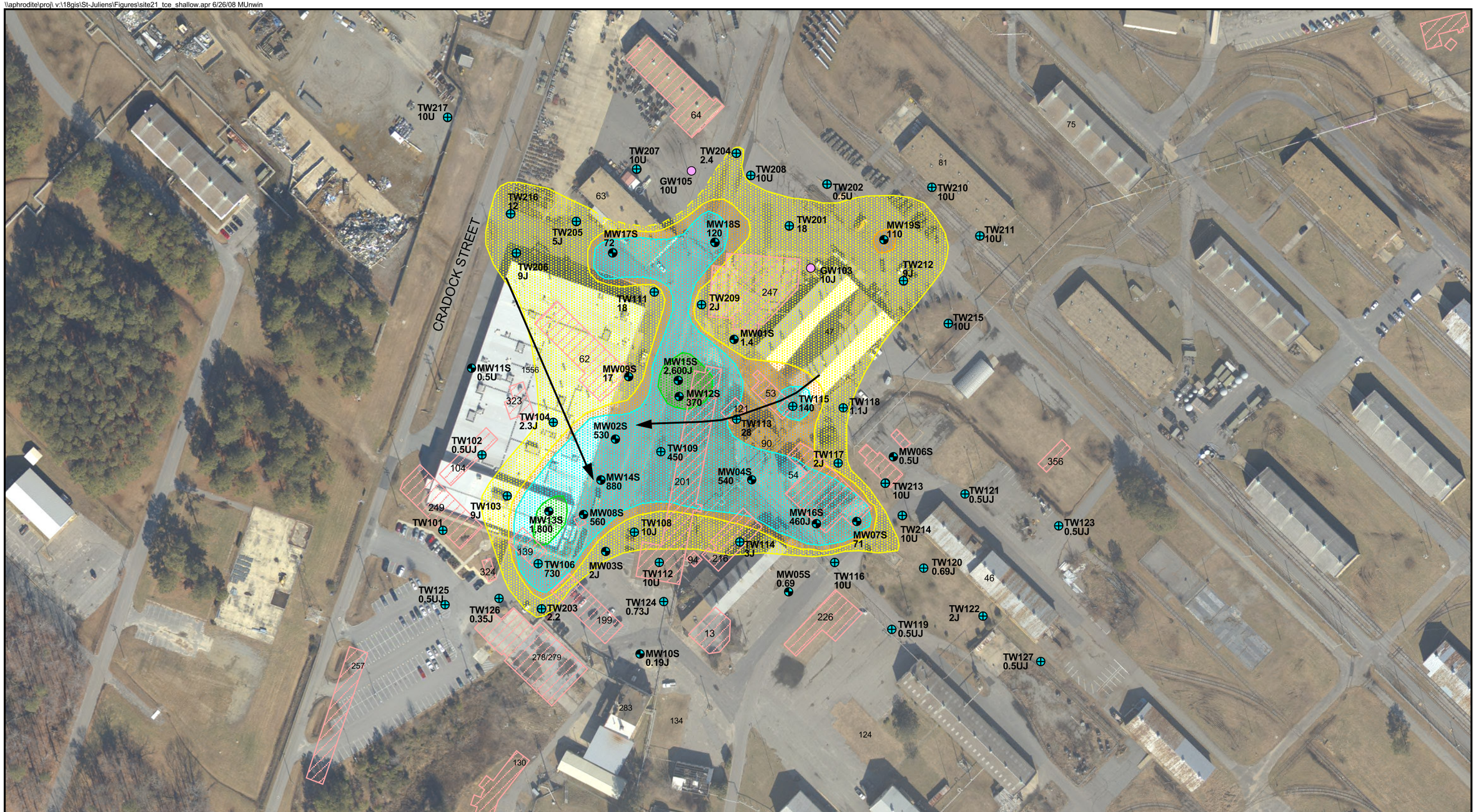

LEGEND

- Shallow Monitoring Well Location
- Temporary Monitoring Well Location
- Grab Groundwater Sample Location
- Demolished Buildings
- Estimated Groundwater Flow Direction

DCE - dichloroethene
U - no detect
J - Reported value is estimated
All results are reported in µg/L.
Concentrations shown are the most recent results.

- Cis-1,2-DCE Concentration 1-25
- Cis-1,2-DCE Concentration 26-49
- Cis-1,2-DCE Concentration 50-999
- Cis-1,2-DCE Concentration >=1,000

N

0 150 300 Feet

Figure 5-4
Shallow Groundwater Cis-1,2-DCE Plume
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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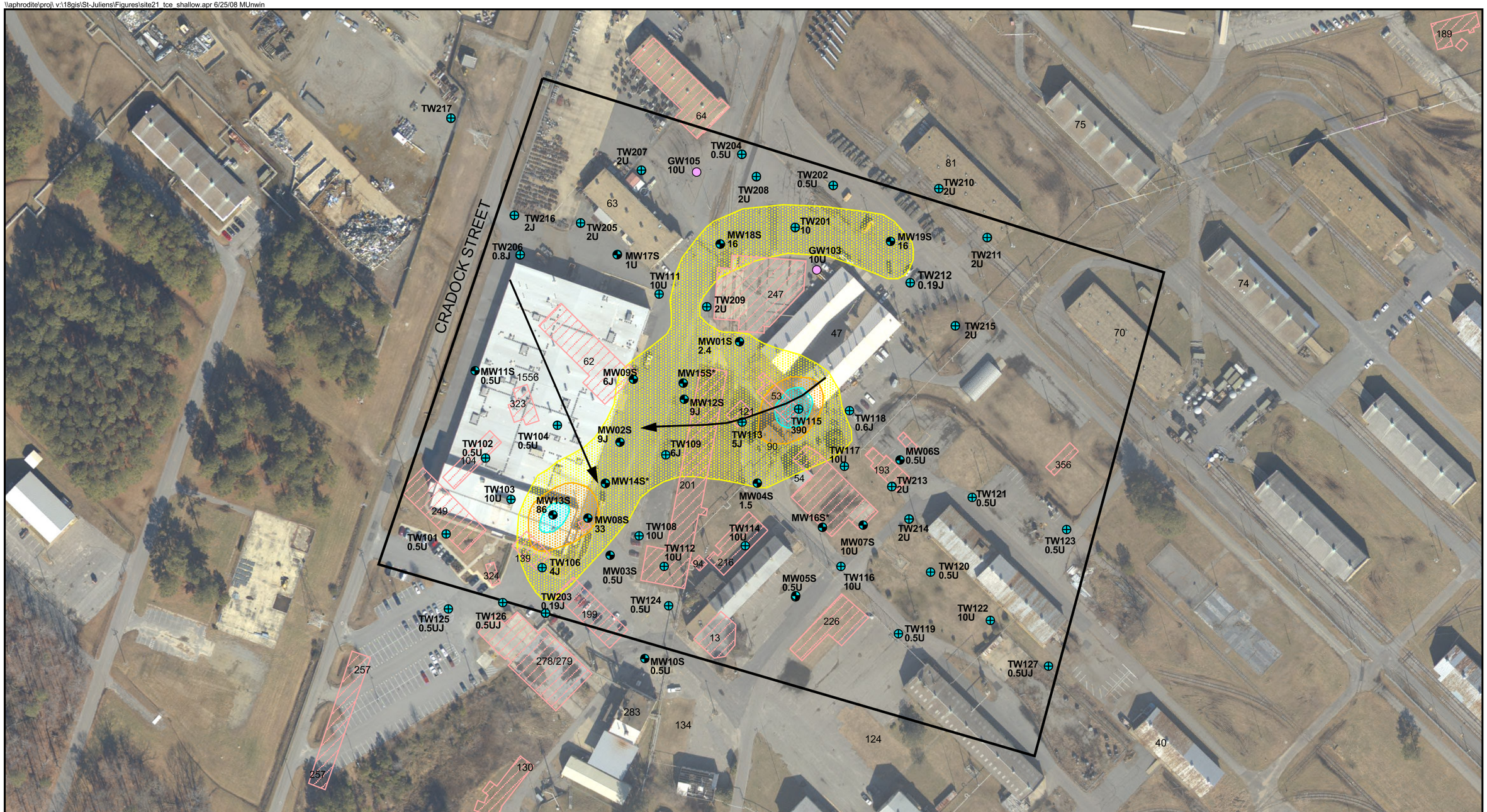

LEGEND

- Site 21 Boundary
- Shallow Monitoring Well Location
- Temporary Monitoring Well Location
- Grab Groundwater Sample Location
- Demolished Buildings
- Estimated Groundwater Flow Direction

VC - vinyl chloride
J - Reported value is estimated
U - No detect
All results are reported in µg/L.
Concentrations shown are the most recent results, with the exception of MW04S, at which a previous result was used because the most recent detection was above the MCL.
*Results not used to delineate plume due to elevated detection limits from sample dilutions.

- VC Concentration 1-25
- VC Concentration 26-49
- VC Concentration >=50

N

0 150 300 Feet

Figure 5-5
VC Plume
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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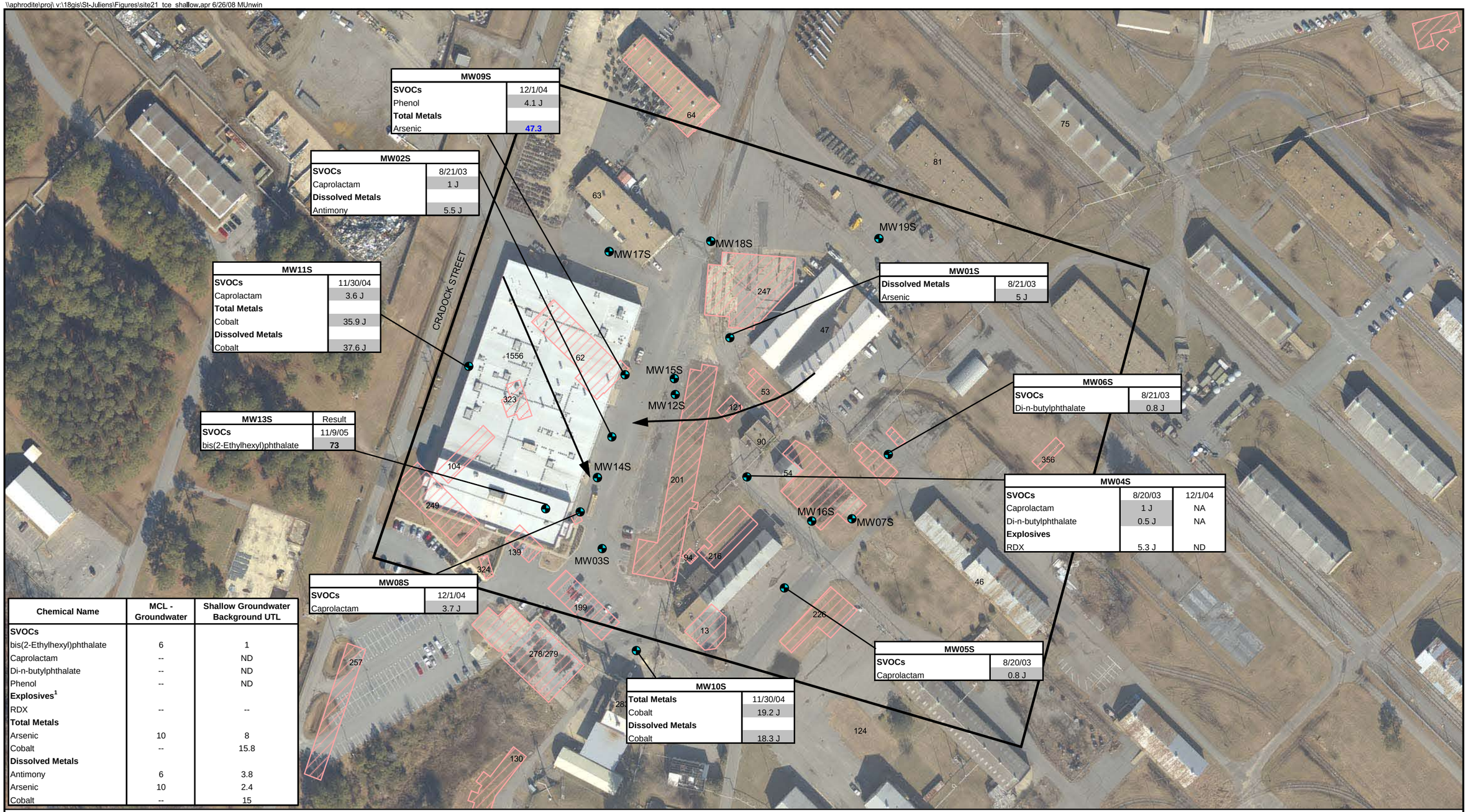

Chemical Name	MCL - Groundwater	Shallow Groundwater Background UTL
SVOCs		
bis(2-Ethylhexyl)phthalate	6	1
Caprolactam	--	ND
Di-n-butylphthalate	--	ND
Phenol	--	ND
Explosives[1]		
RDX	--	--
Total Metals		
Arsenic	10	8
Cobalt	--	15.8
Dissolved Metals		
Antimony	6	3.8
Arsenic	10	2.4
Cobalt	--	15

LEGEND

- Site 21 Boundary
- Shallow Monitoring Well Location
- Demolished Buildings
- Estimated Groundwater Flow Direction

- no criteria established
NA - Not analyzed
ND - Not detected
J - Reported value is estimated
All results are reported in µg/L.
[1]No explosives screening criteria exist; therefore all detections are shown.
[2]PAHs not detected during Background Investigation but detected during subsequent sampling events are considered UTL exceedances.
Bold blue text indicates MCL Exceedances
Shaded indicate Background UTL Exceedances

N

0 150 300 Feet

Figure 5-6
Shallow Groundwater Exceedances
SVOCs, Pesticides, Explosives, and Metals
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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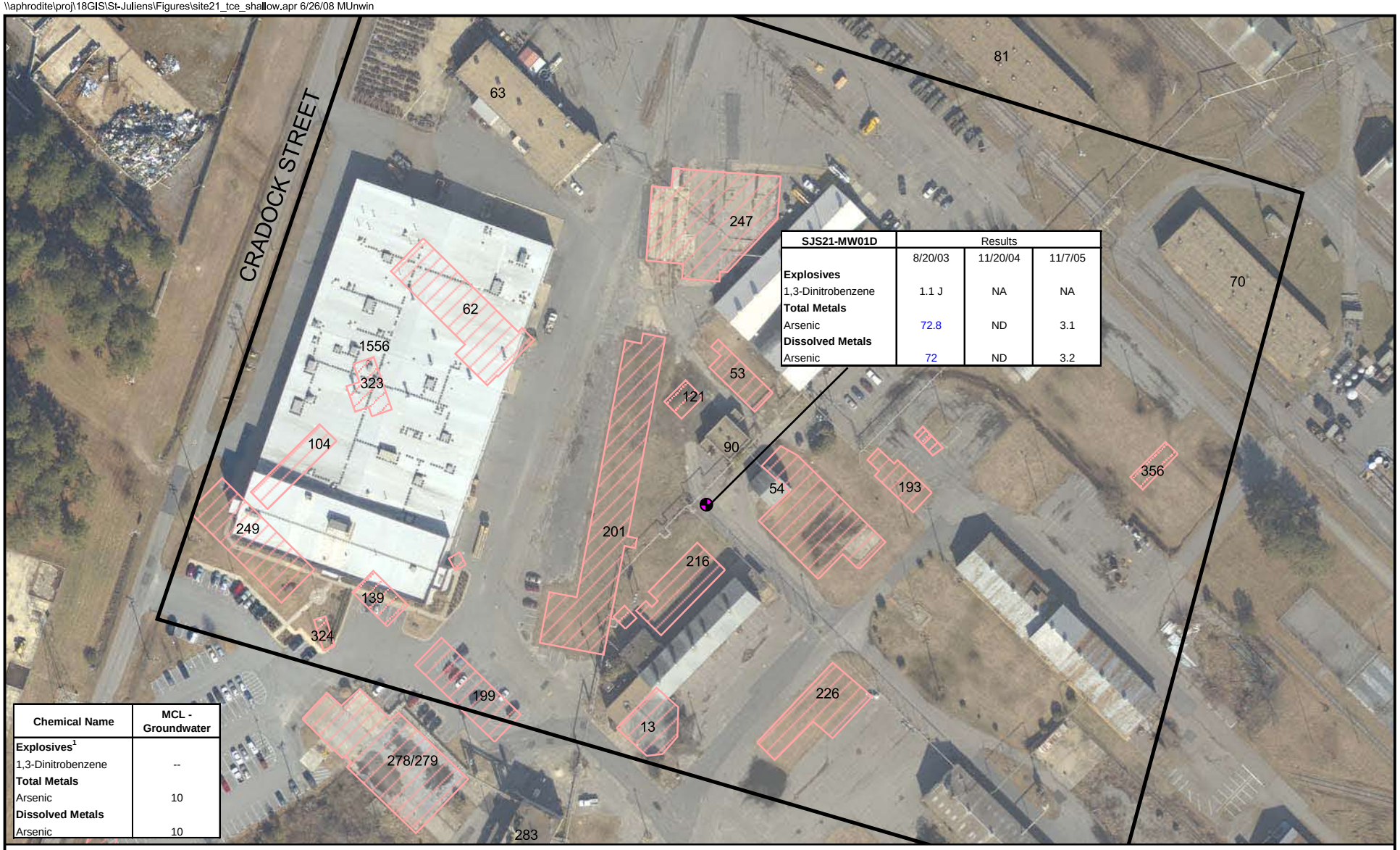

SJS21-MW01D	Results		
	8/20/03	11/20/04	11/7/05
Explosives			
1,3-Dinitrobenzene	1.1 J	NA	NA
Total Metals			
Arsenic	**72.8**	ND	3.1
Dissolved Metals			
Arsenic	**72**	ND	3.2

Chemical Name	MCL - Groundwater
Explosives[1]	
1,3-Dinitrobenzene	--
Total Metals	
Arsenic	10
Dissolved Metals	
Arsenic	10

LEGEND

- Site 21 Boundary
- Deep Monitoring Well Location
- Demolished Buildings

- no criteria established
ND - Not detected
NA - Not Analyzed
J - Analyte Present, reported value is estimated.
All results are reported in µg/L.
All explosives detections are shown because no screening criteria exist.
Bold blue text indicates MCL Exceedances

N

0 75 150 Feet

Figure 5-7
Deep Groundwater Detections and Exceedances
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 6

Contaminant Fate and Transport

This section discusses the fate and transport of representative contaminants identified at Site 21 and their interactions with the soil, groundwater, and surface water. Fate and transport consists of identification of theoretical contaminant phases and migration and degradation pathways. The representative contaminants are TCE, cis-1,2 DCE, VC, benzene, and arsenic in shallow groundwater. Selection of the representative contaminants was based on the exceedance of MCLs in groundwater, which is discussed in Section 5. 1,1-DCE was not selected as a representative contaminant because it was only detected twice above the MCL, each time at a different location. Neither 1,2-dibromo-3-chloropropane and bis(2-ethylhexyl)phthalate were selected as representative contaminants because they were each only detected once. Soils are only being considered in this section in relation to fate and transport; based on previous investigation activities, soil is not a media of concern.

The fate and transport, in addition to data presented in the previous sections, are used to develop a CSM (**Figure 6-1**). The CSM is used to support potential risk management decisions and aid in defining the effectiveness of potential remedial alternatives in the Feasibility Study.

6.1 Contaminant Fate Processes

The primary mechanisms responsible for the fate of contaminants include sorption of contamination to soil surfaces, volatilization from groundwater into the gas phase, natural degradation through different pathways, and metal transformation. **Table 6-1** summarizes several physical and chemical properties for the representative contaminants.

6.1.1 Sorption

Sorption occurs when a compound adheres to and becomes associated with solid particles in the formation (sorbed phase). The subsurface materials likely to sorb chemicals typically are clays and organic matter. In addition, inorganic compounds, such as arsenic species, can sorb to iron, manganese, and oxyhydroxide or oxide coatings on soil and sediment grains. The extent of clays and organic matter in the Columbia Formation at Site 21 is limited. Well-sorted clean sand composing the majority of the Columbia Formation would be less likely to sorb chemicals. The Yorktown confining unit, however, is composed of very fine-grained materials including clay, silt, and very fine sand and organic matter, and would be likely to have a strong affinity for many of the representative contaminants.

The conventional measure of sorption is the distribution coefficient (K_d). The K_d for organic chemicals is the product of the soil organic carbon partition coefficient (K_{oc}) of the chemical and the fraction of organic carbon (f_{oc}) in the soil. In general, higher K_{oc} values indicate a greater degree of sorption and lower chemical mobility. The K_d for inorganic chemicals is a complex function of pH, organic content, oxide coatings, and other factors; therefore, K_d is not easily estimated by methods other than site-specific testing. The migration rates of

different dissolved contaminants vary depending on the K_d and the rate of groundwater flow. The average groundwater flow velocity, as discussed in Section 4.3.2, is estimated at 72 ft/yr in the Columbia aquifer.

Typically, contaminants will not move as rapidly as the groundwater because of adsorption of the contaminant to the solid media. For each contaminant detected at the site, it is theoretically possible to calculate a retardation coefficient, which is an estimate of the degree to which the contaminant is slowed by adsorption in relation to the groundwater flow velocity. The retardation coefficient is calculated according to the following equation:

$$R = 1 + p_b \times K_d/n_e$$

where R = Retardation coefficient (dimensionless)

p_b = Bulk density (grams per cubic centimeter [gm/ml])

K_d = Distribution coefficient (milliliters per gram [ml/gm])

The effect of retardation is estimated by dividing the groundwater flow velocity by R, which provides a value of migration that is either equal to (in the case of no retardation) or less than (in the presence of retardation) the groundwater flow velocity.

In order to estimate the K_d of the soil for a particular organic chemical, it is necessary to have an estimate of the f_{oc} in the soil. In the absence of site-specific data on f_{oc}, a default value of 0.006 (USEPA, 2004) was used as an estimate. The K_d for each organic chemical was estimated by multiplying the f_{oc} by the K_{oc} (from **Table 6-1**) for the particular chemical. A bulk density of 1.85 grams per cubic centimeter (typical of silty sand) and an effective porosity of 0.25 were assumed. The resulting retardation coefficients are listed in **Table 6-2**.

The retardation coefficients for the representative VOCs range from 6.6 for TCE to 1.4 for benzene, resulting in contaminant flow velocities ranging from 11 ft/yr for TCE to 52 ft/yr for benzene. Of all the representative VOCs, TCE has the highest log K_{oc}, thus a greater tendency for sorption followed by cis-1,2 DCE, VC, and benzene. The three CVOCs have essentially the same log K_{oc} and are considered to have a medium to high mobility in soil. Benzene has a lower K_{oc} and is estimated to have higher mobility.

6.1.2 Volatilization

Volatilization occurs when a compound transfers from the aqueous phase to the gas phase. A conventional measure of volatility is Henry's Law Constant (K_h). Values of K_h for the representative chemicals are provided in **Table 6-1**. Compounds with higher K_h values volatilize more readily from water. Most inorganic compounds, including arsenic species, are not volatile under normal temperature and pressure conditions.

The relatively high K_h values for the representative VOCs suggest that volatilization could be an important fate mechanism for VOCs in groundwater. However, volatilization only occurs at the air/water interface between the saturated and unsaturated zones, and movement of aqueous-phase contaminants from the bulk groundwater to the interface is largely diffusion-limited.

6.1.3 Degradation

Degradation is the transformation of a compound either biologically (biodegradation) or abiotically through such processes as hydrolysis and photolysis. Biodegradation occurs when microorganisms transforms a chemical as part of their metabolic processes. Hydrolysis is the reaction of a chemical with water and photolysis is the result of exposing the chemical to light.

VOCs can undergo biodegradation through three different pathways; use as an electron acceptor (reductive dechlorination), use as an electron donor (oxidation), or co-metabolism (a fortuitous transformation that provides no direct benefit to the organism).

Biodegradation via reductive dechlorination is often the principal attenuation mechanism for TCE and other chlorinated ethenes in groundwater. Furthermore, it is usually the only naturally-occurring destructive fate mechanism for these compounds. Biological reductive dechlorination is a microbially-mediated process in which CVOCs serve as the electron acceptor for metabolism, coupled with oxidation of an available electron donor. Anthropogenic (i.e., fuel hydrocarbons, landfill leachate, etc.) or natural organic carbon sources can serve as electron donors. Reductive dechlorination results in the sequential replacement of a chlorine atom on the CVOC molecule with hydrogen (see reaction pathway below), and can ultimately lead to complete dechlorination to innocuous end-products, such as chloride and ethene.

$$\text{TCE} \rightarrow \text{cis-1,2-DCE} \rightarrow \text{VC} \rightarrow \text{ethene}$$

The rate of reductive dechlorination tends to decrease as the degree of chlorination decreases. Thus, TCE tends to degrade more rapidly than cis-1,2-DCE, and VC, resulting in accumulation of daughter products, at least temporarily. However, whereas biodegradation of TCE is largely limited to occurring via reductive dechlorination under deeply anaerobic conditions, the less chlorinated products have been found to biodegrade by either anaerobic reductive dechlorination or aerobic direct oxidation. The importance of this is that biodegradation of daughter products is possible if they migrate to an area of aerobic conditions, such as sometimes occurs at the edge of a plume or after the electron donor supply has been exhausted. Concentrations of parent contaminants (TCE) and degradation products (cis-1,2-DCE, VC, ethene/ethane) in conjunction with concentrations of natural attenuation indicator parameters are used to determine whether reductive dechlorination is occurring at a site (USEPA, 1998). Geochemical data from many locations at Site 21 indicate that conditions are favorable for naturally-occurring reductive dechlorination (e.g., low DO and nitrate, negative ORP, elevated ferrous iron, moderate temperature, and near-neutral pH).

More importantly, the abundance of cis-1,2-DCE and VC in the groundwater, and the general similarity on the areal extent of those compounds to that of TCE, provide strong evidence that reductive dechlorination is occurring at the site. The highest detected cis-1,2-DCE concentrations have been identified in the area of SJS21-MW12S and SJS21-MW15S as shown in **Figure 5-4.** The pattern of cis-1,2 DCE shows a correlation with TCE, which is indicative of natural degradation across most of the plume. The presence of VC in many of the wells indicates further dechlorination. The highest detected concentrations of VC occur east of SJS21-MW15S at 390 μg/L. VC has also been detected at lower concentrations in the

north and southwest areas of the site as shown in **Figure 5-5**. In these areas results of DHC analysis indicated the presence of dechlorinating bacteria. Evidence of degradation is not as strong in the southeast portion of the plume (east of SJS21-MW07S), where only low concentrations of cis-1,2-DCE were detected, VC was not detected, and the results of DHC analysis did not indicate the presence of reducing bacteria.

Benzene degradation occurs most rapidly under aerobic conditions, but can also be biodegraded under anaerobic conditions. The only location where benzene has been detected (SJS21-MW09S) is downgradient of the former USTs. It is likely that benzene biodegradation has occurred over time and is limiting its extent of migration.

6.1.4 Metals Transformation

Transformation of metals occurs when the valence state and/or species is changed due to changes in redox potential or pH. Transformation may have a significant effect on the mobility of metals.

Arsenic in soil/groundwater systems usually occurs as either arsenate (As[V]) or arsenite (As[III]). Under aerobic/oxidizing conditions, arsenate predominates, and tends to be relatively immobile because of sorption to solid particles. Under anaerobic/reducing conditions, arsenate can be reduced to arsenite, which is generally more mobile and toxic. Arsenic in the Columbia aquifer has only been detected above the MCL at one shallow monitoring well (SJS21-MW09S). The presence of arsenic here can be attributed to the former UST releasing petroleum, and the strongly reducing conditions produced by biodegradation of the fuel constituents.

6.2 Contaminant Transport

Although the exact flow pathways of contaminants transported in the subsurface can not be determined definitively, the following sections present a generalized description of theoretical contaminant flow pathways at Site 21 that may have resulted in the distribution of contaminants.

Contaminants are transported in the subsurface through a variety of ways depending on the phase of the contaminant. There are four main phases that can exist in the subsurface: aqueous, sorbed, non-aqueous phase liquid (NAPL), and gas (vadose zone only).

Aqueous Phase

Contaminants existing in the aqueous phase will have dissolved into the groundwater and are moved through advection and dispersion. Advection is the transport of dissolved contaminants by the bulk motion of flowing groundwater. It is the primary transport mechanism for dissolved contamination along the hydraulic gradient. Advective contaminant transport is a function of the groundwater flow as it has been modified by the retardation factor of the specific contaminant. Dispersion is the spreading of dissolved contaminants from the path they would be expected to follow during advection. It results from the spatial variation in aquifer permeability, fluid mixing, and molecular diffusion. Dispersion primarily controls the concentration of the contaminant at any point in the flow system.

Sorbed Phase

For contaminants to be present in the sorbed phase they must first have the affinity to bind to a solid surface. This ability differs between contaminants as discussed above. Sorbed contaminants tend to be stationary, staying with the soil and not being transported. Although in some cases if soil is transported by the groundwater, a contaminant sorbed to that surface can be transported as well.

Non-Aqueous Phase Liquids

Because of their relatively low solubility, CVOCs can occur in aquifers as DNAPL or free product. They are referred to as dense because they are denser than water when present in free-phase and will therefore migrate downward through the aquifer. DNAPL will slowly partition (dissolve) into the surrounding groundwater at a rate dependent on the solubility of the constituent compounds, composition of the DNAPL, temperature, chemical characteristics of the groundwater, and other factors, thereby continuing to act as a source of contamination. Therefore, determination of its presence and approximate quantity can be very important for evaluating process requirements and effectiveness of remedial alternatives.

DNAPL is often difficult to detect, especially if it occurs as dispersed droplets (residual DNAPL) as opposed to a continuous pool (mobile DNAPL). As a general rule-of-thumb, dissolved concentrations of CVOCs in groundwater in excess of approximately 1 percent of a compound's solubility suggest that DNAPL may be present. For TCE, with a water solubility of 1,100 mg/L, a concentration of 11,000 µg/L is typically used as an indicator for potential DNAPL.

The maximum concentrations of TCE detected in shallow groundwater at Site 21 are 16,000 µg/L at SJS21-MW15S and 13,000 µg/L at SJS21-MW16S, likely indicating the presence of DNAPL. Monitoring wells from which groundwater samples were collected are screened across the entire Columbia aquifer, potentially resulting in dilution of higher-concentration groundwater from areas containing DNAPL during sampling. To determine if CVOC concentrations were higher at the base of the aquifer, depth-specific groundwater samples were collected at the bottom of the Columbia aquifer at select monitoring wells (SJS21-MW07S, SJS21-MW12S, and SJS21-MW13S). The previous CVOC concentrations at the selected locations from samples collected from the entire screened interval were not indicative of DNAPL. The depth-specific CVOC concentrations were 2 to 7 times higher, indicating that CVOC concentrations at the base of the aquifer at MW15S and MW16S may also be higher and further support the conclusion that DNAPL is likely present.

Gas Phase

A contaminant can only exist in the gas phase in the vadose zone, which is the unsaturated layer of soil between the surface and the saturated zone. Contaminants enter the gas phase through volatilization of aqueous phase contaminants. They tend to remain trapped in the pore space between grains of soil but can migrate out of the soil to the atmosphere.

6.2.1 Unsaturated Zone Migration

Releases of concentrated TCE in a DNAPL form and releases of wastewater and other waste stream solutions containing dissolved TCE occurred at Site 21. Following surface releases or subsurface releases above the water table (such as from storm sewer lines), contaminants most likely moved downward by gravity as porous media flow through the unsaturated

zone above the water table. Movement through the unsaturated zone may have been aided by preferential flow areas around structures like storm sewers or structural pilings for buildings. Some CVOCs and benzene most likely volatilized in the unsaturated zone before reaching the water table. Percolation of precipitation, both rainfall and snowmelt, through the unsaturated soil can aid in the transport of contaminants through the unsaturated zone to the underlying groundwater. Infiltrating precipitation and contaminants eventually reach the top of the shallow water table.

6.2.2 Saturated Zone Migration

CVOCs that reached the top of the saturated zone at the water table most likely followed a flow path determined by the phase and density of the contaminant stream.

CVOCs dissolved within an aqueous waste stream most likely flowed via advection in the direction of groundwater flow. At Site 21, shallow groundwater flows to the south, southeast, and southwest toward a leaking storm sewer and St. Juliens Creek (**Figure 2-4**). Transport mechanisms for flow though porous media that also may have influenced CVOC migration include hydrodynamic dispersion and retardation.

The predominant direction of DNAPL flow was most likely downward, directed by gravity. As contaminants migrated downward, some of the DNAPL most likely remained in the pore spaces of the aquifer material as residual contamination. Some DNAPL would have dissolved in the groundwater and sorbed to the soil, contributing to aqueous-phase and sorbed-phase contamination. If the volume of any of the releases at Site 21 was sufficient to provide enough mass of DNAPL to reach the Yorktown confining unit, as is suspected due to the highest concentrations of CVOCs detected at the base of the Columbia aquifer, the DNAPL most likely collected on the Yorktown clay and possibly continued to move under the force of gravity down the slope of the aquitard. Some CVOCs that collected on the Yorktown clay may also have migrated into the clay of the confining unit as residual phase contamination; however, the competence and low permeability of the confining unit indicate this is not likely a significant migration pathway.

Migration of CVOCs or benzene from the Columbia aquifer through the Yorktown confining unit and into the Yorktown aquifer is not likely to occur at Site 21. Evidence of this includes the presence of a laterally extensive hydraulic aquitard (Yorktown confining unit), in which there is very low vertical permeability in clay.

6.3 Summary of Current Migration Pathways

As depicted in the CSM (**Figure 6-1**), the current primary migration pathways of CVOCs in the shallow aquifer at Site 21 are:

- Dissolved plume migration downgradient with groundwater flow (advection)
- Groundwater discharge to the leaking storm sewer system and to the south toward St. Juliens Creek
- DNAPL desorbing from the top of the Yorktown confining unit into shallow groundwater

Additionally, vapor intrusion into indoor air (volatilization) is a potential migration pathway, which will be further evaluated.

Table 6-1
Constituents of Interest
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical	Molecular Weight (g/mole)	Specific Gravity (unitless)	Water Solubility (mg/L)	Vapor Pressure (mm Hg)	K_h (atm-m^3/ mole)	K_d (mL/g)	Log K_{ow}
Volatile Organic Compounds							
Benzene	78.1 (2)	0.88 (2)	1,780 (2)	95 (2)	0.0055 (2)	83.2	2.13 (2)
Trichloroethene	131.39	1.46 (1)	1,100 (1)	57.8 (1)	0.00892 (3)	125.9	2.42 (3)
Cis-1,2-Dichloroethene	96.94 (1)	1.28 (3)	3,500 (3)	200 (3)	0.0075 (3)	72.4	1.86 (3)
Vinyl Chloride	62.5 (2)	0.91 (2)	90 (2)	2,584 (2)	2.4 (2)	8.51	1.27 (2)

K_{oc} = Organic carbon partition coefficient

K_{ow} = Octanol-water partition coefficient

K_h= Henry's Law Constant

Data sources:

(1) Montgomery and Welkom. 1989. Groundwater Chemicals Desk Reference. Volume 1.

(2) Schnoor, J. L. 1996. *Environmental Modeling Fate and Transport of Pollutants in water, air, and soil*

(3) United States Environmental Protection Agency. October 1990. *Subsurface Contamination Reference Guide.*

Table 6-2
Retardation Coefficients
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemicals	Log K_{oc}	K_d	R	Contaminant Flow Velocity (ft/yr)
Volatile Organic Compounds				
Benzene	0.93	0.05	1.4	52
Trichloroethene	2.1	0.76	6.6	11
Cis-1,2-Dichloroethene	1.86	0.43	4.2	17
Vinyl Chloride	1.75	0.34	3.5	21

K_{oc} = Organic carbon partition coefficient

K_d = Distribution coefficient

R = Retardation coefficient = $1 + K_d \times p_b / n_e$

p_b = Soil bulk density = 1.85 grams per cubic centimeter

n_e = Effective porosity = 0.35

For organics, $K_d = K_{oc}$ x fraction of organic carbon, estimated to be 0.006 for soil based on EPA guidelines

Users' Guide and Background technical Document for USEPA Region 9's
Preliminary Remediation Goals (PRG) Table, USEPA, 2004.

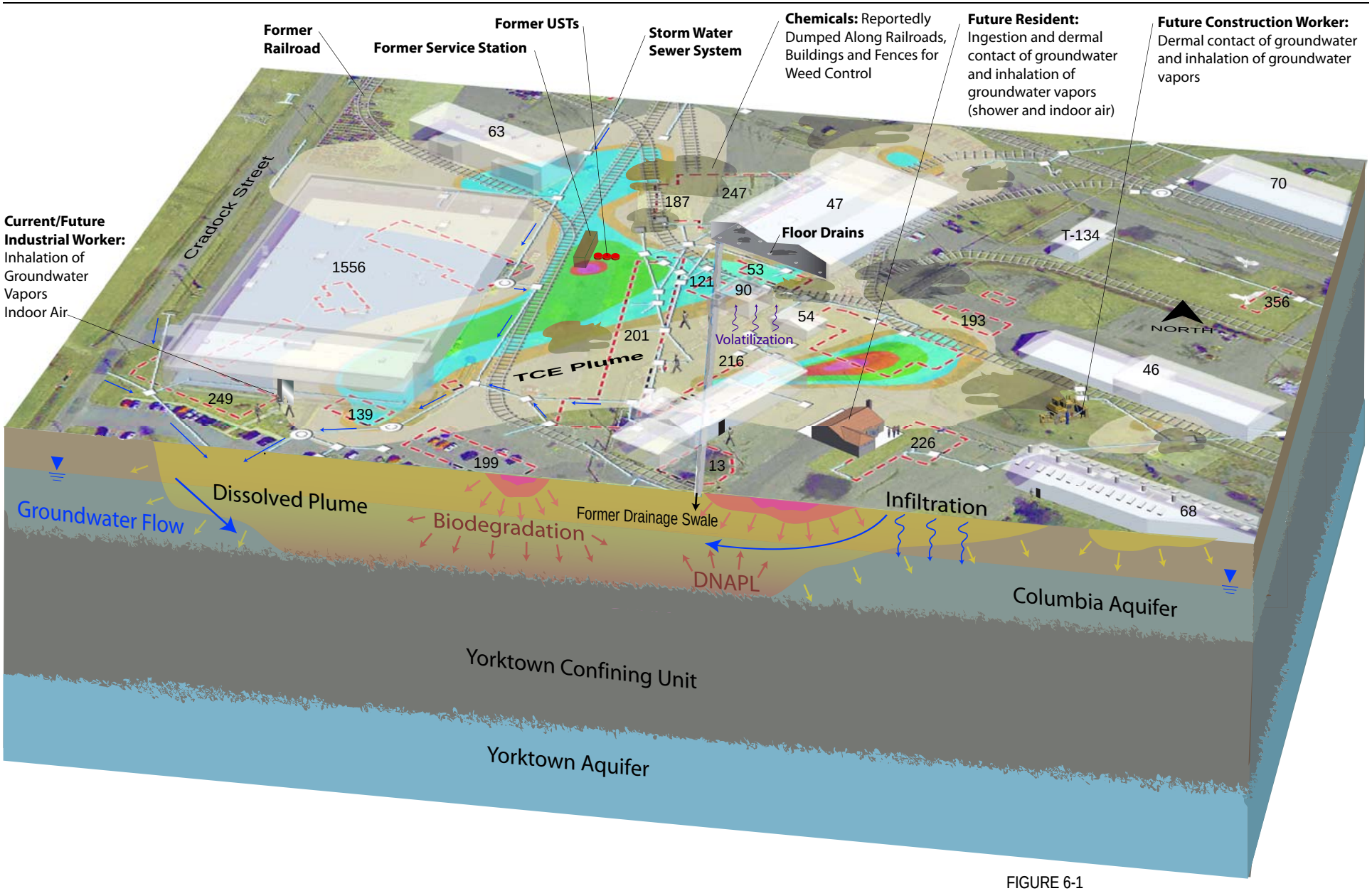

FIGURE 6-1
Site 21 Conceptual Site Model
Site 21 Remedial Investigation Report
St. Juliens Creek Annex,
Chesapeake, Virginia

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SECTION 7

Human Health Risk Assessment

This section presents the Human Health Risk Assessment (HHRA) for groundwater at Site 21. This baseline risk assessment was conducted to assess the potential human health impacts associated with groundwater from the site under current conditions, as well as to determine if any further actions are needed at the site to be sufficiently protective of human health. As indicated in Section 2, no potential risk was identified in other site media during the HHRSs performed during the SSA and SI; therefore, soil is not evaluated in this HHRA.

This risk assessment has been prepared using conservative assumptions, and exposure pathways based on current site conditions and current and potential future site use were evaluated. The risk assessment incorporates the general methodology described in *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual, Part A* (USEPA, 1989); *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual, Part D* (USEPA, 2001); and USEPA Region III Technical Guidance Manuals for Risk Assessment.

The results of the Site 21 baseline HHRA will be used to document the potential for endangerment to human health, and to provide a basis to select action levels, if necessary.

The HHRA is comprised of the following components:

- Identification of chemicals of potential concern (COPCs)
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty assessment

These components are described briefly in the following sections. Spreadsheets prepared in accordance with *RAGS, Volume 1, Human Health Evaluation Manual, Part D* (USEPA, 2001) were used to screen for COPCs, and to calculate estimated exposures and health risks associated with the COPCs. These spreadsheets (Tables 1 through 10) are presented in **Appendix I**.

7.1 Identification of Chemicals of Potential Concern

The identification of COPCs is performed through data evaluation and screening as described below.

7.1.1 Data Evaluation and Selection

Groundwater data collected from permanent monitoring wells at Site 21 during the SI and RI were evaluated in the risk assessment; groundwater data from the temporary wells and grab samples were not used because turbidity present in those samples is not representative of drinking water concentrations that would result in a developed potable supply well. For

the vapor intrusion evaluation, because turbidity does not impact the validity of the chemical properties of the volatile chemicals associated with volatilization and vapor intrusion into indoor air, groundwater data from temporary monitoring wells and grab samples were used in addition to the groundwater data from the permanent monitoring wells.

The environmental sampling and analysis conducted at Site 21 was designed to cover the range of potential site contaminants associated with historical site activities. The CSM, which was continuously updated to incorporate new data as it was collected, was used as a tool to identify data gaps and support the selection of sample locations as discussed in Section 3. Detailed results of the sampling program for Site 21 are presented in Section 5 of this report.

Available data and the data qualifiers were reviewed and used, as follows, for the quantitative risk assessment.

- Estimated values flagged with a J, K, or L qualifier were treated as unqualified detected concentrations.
- Data qualified with an R (rejected) were not used in the risk assessment.
- Data qualified with a B (blank contamination) were used in the risk assessment as if they were nondetects. One-half of the blank-related concentration was used to calculate exposure point concentrations in the risk assessment for cases where the constituent was detected in other samples from the same medium.
- One-half of the sample quantitation limit was used in the risk assessment to calculate exposure point concentrations for cases where no detectable contaminant concentrations were found in a sample, but the contaminant was detected in other samples collected from the same medium.
- For duplicate samples, the higher of the two concentrations was used as the sample concentration.

Data Summary

Groundwater data collected at Site 21 were evaluated in the HHRA. Section 3 text and associated figures provide a summary of the samples collected during field activities. Discussions of the nature and extent of COPCs in groundwater can be found in Section 5.

Table 7-1 lists the groundwater samples used in the risk assessment and the corresponding analyses. Groundwater data were grouped into two exposure units for evaluation in the risk assessment, the shallow groundwater and the deep groundwater. The shallow groundwater data are from wells screened in the Columbia aquifer. The deep groundwater data are from the well screened in the Yorktown aquifer. **Appendix C** presents the analytical results for all of the samples collected at the site. All data used in the risk assessment were validated following USEPA Region III data validation procedures (USEPA, 1993b, 1994).

In accordance with the USEPA Region III *Draft Guidance on the Selection of Analytical Metal Results from Monitoring Well Samples for Use in the Quantitative Assessment of Risk* (USEPA, 1992), unfiltered groundwater samples were used to determine inorganic constituent exposure concentrations for deep and shallow groundwater because a review of the

groundwater data determined that the results from the filtered samples were similar to the results from the unfiltered groundwater samples.

Background data have been collected for Columbia aquifer groundwater and are presented in the Final Background Investigation Report Addendum for Groundwater (CH2M HILL, 2004b). The background UTLs are included in the RAGS Part D Tables 2s (**Appendix I**) for shallow groundwater. A comparison of site data to background data was not used to select the COPCs.

7.1.2 Selection of Chemicals of Potential Concern

All of the detected constituents were screened following the procedures described below. The selection of COPCs was based on the criteria presented in a USEPA Region III technical guidance manual (USEPA, 1993a) and USEPA's *RAGS Part D* (USEPA, 2001). The maximum detected concentration of each constituent in each data grouping was compared to the criteria discussed below to select the COPCs. If the maximum concentration exceeded the criteria, the constituent was selected as a COPC. Constituents that were not detected in any of the samples or were detected at concentrations less than the screening criteria were not retained as COPCs. The resulting COPCs are presented in **Appendix I**, Tables 2.1 through 2.5.

- **Comparison with Health-based Criteria for Groundwater:** Groundwater data were compared to the USEPA Region III risk-based concentrations (RBCs) for tap water (USEPA, 2007). RBCs that are based on non-carcinogenic effects were divided by 10 to account for exposure to multiple constituents. RBCs based on carcinogenic effects were used as presented in the RBC table. Groundwater data were also compared to the National Primary Drinking Water Regulations MCLs; however, this comparison was not used to select the groundwater COPCs.

  Tables 2.2 and 2.3, **Appendix I,** present the screening for the deep groundwater direct contact with water, and volatilization to air from groundwater and subsequent inhalation of air, respectively. Tables 2.4 and 2.5, **Appendix I,** present the screening for the shallow groundwater direct contact with water, and volatilization to air from groundwater and subsequent inhalation of air, respectively.

- Appropriate constituents were chosen as surrogates for constituents not included in the USEPA Region III RBC table (USEPA, 2007) and their RBCs were used as the screening value. These constituents and their surrogates are identified on Tables 2.1 through 2.5, in **Appendix I**.

- **Comparison with Health-based Criteria for Vapor Intrusion from Shallow Groundwater to Indoor Air:** All of the shallow groundwater data were compared to the generic target groundwater concentrations based on a risk of $1x10^{-6}$ from Table 2c of the Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), (USEPA, 2002). Target groundwater concentrations based on non-carcinogenic effects were divided by 10 to account for exposure to multiple constituents. Target groundwater concentrations based on carcinogenic effects were used as presented in the screening value table. Table 2.1, Appendix I, presents this screening.

  As discussed in Section 7.2.3, potential current exposure to indoor air was estimated

individually for the buildings currently on site, and potential future residential exposure to indoor air was estimated using the most contaminated data across the site. The wells used for these assessments are identified on Table 3.1, Appendix I, and Table 7-1. Any of the constituents that were retained as COPCs were evaluated quantitatively for each building if they were detected in the well(s) associated with that building.

- **Essential Human Nutrients:** Constituents that are considered essential nutrients, present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and toxic only at very high doses were eliminated from the quantitative risk analysis. These constituents include calcium, magnesium, potassium, and sodium. Although iron is also considered an essential nutrient and is only toxic at very high doses, iron was included in the HHRA since a provisional toxicity value is available.

7.1.3 Chemicals of Potential Concern

Table 7-2 lists the chemicals that were selected as COPCs based on the screening methodology for all media. The screening process is shown in Tables 2.1 through 2.5 in **Appendix I**.

7.2 Exposure Assessment

Exposure refers to the potential contact of an individual with a constituent. The exposure assessment identifies pathways and routes by which an individual may be exposed to the COPCs, and estimates the magnitude, frequency, and duration of potential exposure. Constituent intakes and associated health risks are only quantified for complete exposure pathways.

A conceptual exposure model showing potential exposure scenarios identified for current and potential future site-use conditions is presented in **Figure 7-1**. The following sections discuss the components of exposure assessment:

- Conceptual exposure model for human health (characterization of exposure setting, identification of exposure pathways)
- Exposure point concentrations
- Exposure assumptions for potentially complete exposure pathways
- Calculation of intakes

7.2.1 Characterization of Exposure Setting

Characterizing an exposure setting consists of two parts: (1) identifying the physical characteristics of the site as they relate to exposure, and (2) characterizing human populations on or near the site.

Physical Characteristics

Basic site characteristics such as physical setting, climate, and groundwater hydrology are summarized in Section 4.

Potentially Exposed Populations

Potentially exposed populations are identified based on their locations relative to the site, their activity patterns, and the presence of potential sensitive subpopulations. Table 1 in **Appendix I** details the potentially exposed populations evaluated in this risk assessment. The pathways evaluated in the risk assessment are also shown in **Table 7-3** and on the conceptual exposure model (**Figure 7-1**).

Current Land Use. Site 21 is located in a former industrial area in the central portion of SJCA. The existing buildings and the Site 21 area are currently used for storage (Buildings 13, 46, and 63) and maintenance activities (Buildings 47, 54, and 1556). Building 90 is abandoned with no access or current use. Many older buildings have been demolished. Exposure to vapors that may migrate from shallow groundwater into indoor air of on-site buildings (evaluated for Buildings 13, 46, 47, 54, 63, 90, and 1556) by workers in the buildings may occur.

Groundwater is not currently used at or near the site, and therefore, direct exposures to shallow or deep groundwater are not evaluated under current land use.

Potential Future Land Use. Future land use at the site is expected to be either industrial or commercial. Future residential development of the site is unlikely; however, it is evaluated as the most conservative future use of the site. Deep groundwater is evaluated under the future residential scenario because if the site is used for future development, the deep aquifer could be used as a potable water supply. Near SJCA, no wells reportedly utilize the Columbia aquifer (shallow groundwater) as a domestic potable supply due to its poor quality and low yield (Fluor Daniel GTI, 1997). Groundwater from the shallow aquifer at the SJCA is not used or intended to be used as a potable supply; however, it is evaluated for exposure through potable use (ingestion and bathing with the water). Shallow groundwater is also evaluated for the construction worker since the depth to groundwater ranges seasonally from 2 to 7 ft bgs, and construction workers could contact this water during excavation activities.

Under an unlikely future residential use of the site scenario, exposure to vapors that may migrate from shallow groundwater into indoor air of future residential dwellings could occur. Exposure to vapors that may migrate from shallow groundwater into indoor air of industrial building was evaluated under the current land use scenarios.

7.2.2 Identification of Exposure Pathways

An exposure pathway can be described as a mechanism that moves a COPC from its source to an exposed population or individual, referred to as a receptor. An exposure pathway must be complete or exposure cannot occur. A complete exposure pathway has five elements:

- A source (e.g., chemical residues in groundwater)
- A mechanism for release and migration of chemical (e.g., leaching)
- An environmental transport medium (e.g., groundwater)
- A point or site of potential human contact (exposure point, e.g., drinking water)
- A route of intake (e.g., ingestion of groundwater used as a drinking water source)

All five elements must be present for a pathway to be considered complete. If one or more elements are not present, then the pathway is incomplete and there is no possibility of exposure. The following subsections discuss the elements as they pertain to Site 21.

Contaminant Sources

Contaminant sources at Site 21 are associated with the past uses of the site, and now include the contaminated groundwater associated with these past uses. The past site uses and their contaminant sources are discussed in Section 2. They include machine, vehicle, and locomotive maintenance shops, electric shops, munitions loading facilities, and equipment and chemical storage.

Release and Transport Mechanisms

The fate and transport of chemicals in groundwater are determined by physical characteristics of the site as well as by the chemical and physical properties of the chemicals. A detailed description of the fate and transport of the site contamination is included in Section 6 and summarized here.

Contaminants placed on the surface and in the ground at the site may have migrated from the surface, through the soil, and into the groundwater. Organic and inorganic constituents were detected more often and at higher concentrations in the shallow aquifer groundwater than in the deep aquifer groundwater. Additionally, CVOC concentrations were higher at bottom of the Columbia aquifer than at its top. DNAPL is suspected in the areas of highest concentrations, though its presence has not been confirmed. Contaminants may be transported downgradient from the site in the groundwater. Contaminants in shallow groundwater may also volatilize and be transported into the indoor air in buildings above the groundwater.

Potential Exposure Points and Exposure Routes

Exposure points are locations where humans could come in contact with contamination. Exposure points for Site 21 include shallow groundwater, deep groundwater, and indoor air.

Potential exposure routes are evaluated for current site use and potential future site use. The potentially complete pathways of exposure evaluated in this risk assessment are presented in Table 1 in **Appendix I** and in **Table 7-3**.

Current Exposure Routes. Groundwater is not currently used as a source of potable water either at the site or downgradient of the site, and direct exposure to deep or shallow aquifer groundwater is not a currently complete exposure pathway. Vapor intrusion from shallow groundwater to indoor air of buildings currently on-site, and exposure to the indoor air by industrial site workers is the only potentially complete current exposure scenario.

In summary, the current exposure routes include:

- Industrial Worker: inhalation of indoor air (vapor intrusion from shallow groundwater into current site building)

Future Exposure Routes. Potential future site use is unlikely to change from current use, but for a conservative evaluation of potential risks, both residential and industrial uses were

evaluated. In the unlikely event the site is used for future residential development, future onsite residential receptors could use the shallow or deep aquifer groundwater beneath the site as a potable water supply. Future onsite residential receptors could also inhale vapors in indoor air that may migrate from the shallow groundwater into future onsite residences. Exposure to shallow aquifer groundwater by construction workers during excavation activities is a potential exposure scenario under future residential or commercial/industrial site use.

In summary, the potential future exposure routes include the current exposure routes, and the following:

- Resident (adult): ingestion of deep aquifer groundwater, and dermal contact with, and inhalation of volatiles from deep aquifer groundwater while showering.
- Resident (child): ingestion of deep aquifer groundwater and dermal contact with deep aquifer groundwater while bathing.
- Resident (adult and child): inhalation of indoor air (vapor intrusion from shallow groundwater into future residential house)
- Construction Worker: dermal contact with and inhalation of volatile emissions from shallow groundwater
- Resident (adult): ingestion of shallow aquifer groundwater, and dermal contact with, and inhalation of volatiles from shallow aquifer groundwater while showering
- Resident (child): ingestion of shallow aquifer groundwater and dermal contact with shallow aquifer groundwater while bathing

7.2.3 Estimation of Exposure Point Concentrations

Exposure point concentrations (EPCs) are estimated constituent concentrations that a receptor may contact and are specific to each exposure medium. Exposure is quantified by estimating the EPCs of COPCs in environmental media and constituent intake by the receptor. EPCs may be directly monitored or estimated using environmental models. Constituent concentrations in shallow and deep groundwater were measured for this assessment. Concentrations of volatile constituents in indoor air due to vapor emissions from shallow groundwater through building foundations, in bathroom air from volatilization from shallow and deep groundwater during showering, and in outside air due to volatilization from shallow groundwater during excavation activities were modeled using the methods described below.

The reasonable maximum exposure (RME) EPC for each COPC was calculated as a 95 percent upper confidence limit (UCL) of the arithmetic mean of the data set, using ProUCL Version 3.0 (Singh, Singh, and Miachle, 2004). First, the distribution of each data set was determined (normal, lognormal, and/or gamma; or non-parametric if data fit none of these distributions) using the Shapiro-Wilks test to test for a normal or lognormal distribution, and the Anderson-Darling and Kolmogorov-Smirnov Tests to test for a gamma distribution. Based on the distribution and the skewness of the data, ProUCL recommended a 95 percent UCL that was used as the RME EPC for the data set. In cases where there were less than five samples in the data set (i.e., for the deep groundwater), or the recommended

UCL exceeded the maximum detected concentration, the maximum concentration was used as the EPC.

The arithmetic mean of the dataset was used as the central tendency exposure (CTE) EPC regardless of distribution, except in cases where the data set was lognormally distributed. In this case, the minimum variance unbiased estimate (MVUE) of the mean was used as the CTE EPC.

Appendix I, Tables 3.1 through 3.5 present the EPCs for the COPCs, and the rationale for the selected EPC.

Indoor Air Concentrations - Vapor Intrusion Modeling

Two different scenarios were evaluated for vapor intrusion, a current industrial exposure scenario and a future residential exposure scenario. The Johnson and Ettinger model (USEPA, 2002) was used to calculate indoor air concentrations in a number of the buildings currently onsite, and indoor air concentrations in a potential future residence (using the most contaminated data as a future residence could be placed anywhere). For each COPC identified for the vapor intrusion scenario, the maximum detected concentrations in shallow groundwater within 100 ft of the buildings evaluated (Buildings 13, 46, 47, 54, 63, 90, and 1556) were conservatively used to estimate the indoor air concentrations. These concentrations are included in **Appendix I**, Table 3.1. Building-specific information (e.g., building length and width, ceiling height, access/usage), site-specific groundwater data (e.g., depth to groundwater, water temperature), and site-specific soils data collected during monitoring well installation, along with standard default model parameters, were used in the Johnson and Ettinger model for the current/future industrial worker scenario. A summary of the building-specific information is provided in **Appendix I**, Attachment 1, Table 1. Summaries of the model inputs for each building and their basis is provided in **Appendix I**, Attachment 1, Tables 2 through 8.

In addition to calculated indoor air concentrations for buildings currently onsite, the Johnson and Ettinger model was used to estimate indoor air concentrations in a future residential building. Site-specific information and standard default model parameters for a residential dwelling were used to evaluate vapor intrusion into a future residence (USEPA, 2003a). Parameter values used in the model are shown in **Appendix I**, Attachment 1, Table 9.

The Johnson and Ettinger model incorporates the following conceptual assumptions/:

- Contaminant vapors enter the structure primarily through cracks and openings in the walls and foundation.
- Convective transport occurs primarily within the building zone of influence and vapor velocities decrease rapidly with increasing distance from the structure.
- Diffusion dominates vapor transport between the source of contamination and the building zone of influence.
- All vapors originating from below the building will enter the building unless the floors and walls are perfect vapor barriers.

- All soil properties in stratum are homogeneous (up to three strata with different properties can be simulated in the model).
- The contaminant is homogeneously distributed within the zone of contamination.
- The areal extent of contamination is greater than that of the building floor in contact with the soil.
- Vapor transport occurs in the absence of convective water movement within the soil column (i.e., evaporation or infiltration), and in the absence of mechanical dispersion.
- The model does not account for transformation processes (e.g., biodegradation, hydrolysis)
- The soil layer in contact with the structure floor and walls is isotropic with respect to permeability.
- Both the building ventilation rate and the difference in dynamic pre pressure between the interior of the structure and the soil surface are constant values.

Volatilization While Showering

Volatilization while showering was estimated using the Foster and Chrostowski shower model (Foster and Chrostowski, 1987). The deep aquifer groundwater concentrations and shallow aquifer groundwater concentrations used in the model are shown in Tables 3.3 and 3.5, **Appendix I**. The model parameters and the Foster and Chrostowski shower model calculations are presented in Table 7.2.RME Supplement C and 7.6.RME Supplement B in **Appendix I**.

Volatilization from Shallow Groundwater During Construction Activities

Concentrations of VOCs in air resulting from volatilization of constituents in shallow groundwater in an open excavation were calculated using a two-film volatilization model, in conjunction with USEPA's SCREEN 3 model. The groundwater concentrations used in the model are shown in Table 3.5 in **Appendix I**. The two-film volatilization model calculations are shown in Table 7.5.RME Supplement B in **Appendix I**.

7.2.4 Estimation of Chemical Intakes for Individual Pathways

Chemical intake is the amount of the chemical contaminant entering the receptor's body. Chemical intakes are generally expressed as follows:

$$I = \frac{C \ x \ CR \ x \ EF \ x \ ED}{BW \ x \ AT} = (mg/kg/day)$$

Where:

I = intake (mg/kg/day)

C = chemical concentration at exposure point (µg/L)

CR = contact rate, or amount of contaminated medium contacted per unit time or event (l/day, m^3/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

BW = body weight of exposed individual (kg)

AT = averaging time, or period over which exposure is averaged (days)

The intake equation requires specific exposure parameters for each exposure pathway. Exposure parameters are often assumed values, and their magnitude influences the estimates of potential exposure (and risk). The reliability of the values chosen can also contribute substantially to the uncertainty of the resulting risk estimates. Many of the exposure parameters have default values, which were used for this assessment. These assumptions, based on estimates of body weights, media intake levels, and exposure frequencies and duration are provided by USEPA guidance. Other assumptions required consideration of location-specific information and were determined using professional judgment. Tables 4.1 through 4.6 in **Appendix I** present the exposure factors used for different receptor scenarios at the site. RME values are presented in Tables 4.1.RME through 4.6.RME and CTE values are included in Tables 4.1.CTE through 4.6.CTE.

For the dermal contact with water scenario, skin permeability rates were obtained from *RAGS E* (USEPA, 2004). Permeability constants used in the risk assessment are presented in the supplemental tables to Tables 7s in **Appendix I**.

7.3 Toxicity Assessment

Toxicity assessment defines the relationship between the magnitude of exposure and possible severity of adverse effects, and weighs the quality of available toxicological evidence. Toxicity assessment generally consists of two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining the potential adverse effects from exposure to the chemical along with the type of health effect involved. Dose-response assessment is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the constituent administered or received and the incidence of adverse health effects in the exposed population. Toxicity criteria (e.g., reference doses and slope factors) are derived from the dose-response relationship.

Health effects are divided into two broad groups: non-carcinogenic and carcinogenic effects. This division is based on the different mechanisms of action currently associated with each category. This section discusses non-carcinogenic and carcinogenic effects separately.

The primary source of toxicity values is the USEPA's Integrated Risk Information System (IRIS) database, which contains up-to-date toxicological information. IRIS includes only reference doses (RfDs) and carcinogenic slope factors (CSFs) that have been verified by USEPA work-groups. In accordance with USEPA guidance (USEPA, 2003b), the second tier of toxicity factors is the Provisional Peer Reviewed Toxicity Value (PPRTV) database maintained by the USEPA's National Center for Environmental Assessment (NCEA) and the Superfund Health Risk Technical Support Center. Toxicity values from the PPRTV were used as appropriate. The Health Effects Assessment Summary Tables (HEAST; USEPA, 1997), which are issued by USEPA's Office of Research and Development, were consulted when data were not available in IRIS or PPRTV. If toxicity values were not available from

either of these sources, USEPA's NCEA was consulted to obtain provisional toxicity values. The use of toxicity values from sources other than IRIS in an HHRA increases the uncertainty of the quantitative risk estimate.

7.3.1 Toxicity Information for Non-carcinogenic Effects

Non-carcinogenic health effects include a variety of toxic effects on body systems, ranging from renal toxicity (toxicity to the kidneys) to central nervous system disorders. Non-carcinogenic health effects are grouped into two basic categories: acute toxicity and chronic toxicity. Acute toxicity can occur after a single exposure (usually at high doses), where the effect is most often seen immediately. Chronic toxicity generally occurs after repeated exposure (usually at low doses) and is seen weeks, months, or years after the initial exposure. The toxicity of a chemical is assessed through a review of toxic effects noted in short-term (acute) animal studies, long-term (chronic) animal studies, and epidemiological investigations.

USEPA defines the chronic RfD as a dose which is likely to be without appreciable risk of deleterious effects during a lifetime of exposure (USEPA, 1989). Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (7 years to a lifetime), and consider uncertainty in the toxicological database and sensitive receptors.

Chronic RfDs may be overly protective if used to evaluate the potential for adverse health effects resulting from short-term exposure. USEPA's NCEA develops subchronic RfDs for short-term exposure (2 weeks to 7 years). Subchronic RfDs have been peer-reviewed by Agency and outside reviewers, but they have not undergone verification by an intra-Agency workgroup, and as a result are considered interim rather than verified toxicity values. Subchronic RfDs were used for the construction worker scenario because the exposure duration is 1 year. Chronic RfDs were used for all other receptors.

In the development of RfDs, all available studies examining the toxicity of a chemical following exposure are considered based on their scientific merit. Several uncertainty factors (UFs) and modifying factors (MFs) may be applied to account for uncertainty. UFs account for uncertainties such as poor data quality, extrapolation of data from animal studies to human exposures, or the use of subchronic studies to develop chronic criteria. These UFs and MFs range between 10 and 10,000, and are based on professional judgment. Therefore, there are varying degrees of uncertainty in the toxicity criteria.

USEPA-derived oral and inhalation chronic RfDs, and associated UF and MF values, for the COPCs at Site 21 are listed in Tables 5.1 and 5.2 in **Appendix I**.

Per USEPA guidance, oral RfDs were adjusted from administered doses to absorbed doses for evaluating dermal toxicity when deemed appropriate. The RfDs were adjusted using oral absorption factors from USEPA (USEPA, 2004). The adjusted dermal RfDs are summarized in Table 5.1 in **Appendix I**.

7.3.2 Toxicity Information for Carcinogenic Effects

Potential carcinogenic effects are quantified using oral and inhalation CSFs, or unit risk factors that convert estimated exposures directly to incremental lifetime carcinogenic risks. CSFs may be derived from the results of chronic animal bioassays, human epidemiological

studies, or both. Animal bioassays are usually conducted at dose levels that are much higher than are likely to be encountered in the environment. This design detects possible adverse effects in the relatively small test populations used in the studies. The actual risks from exposure to a potential carcinogen are not likely to exceed the estimated risks, and are probably much lower or even zero. USEPA-derived oral and inhalation CSFs are listed in Tables 6.1 and 6.2 in **Appendix I**.

As was done for oral RfDs, oral CSFs were adjusted from administered dose (oral) to absorbed dose (dermal) to evaluate dermal toxicity. When appropriate, the CSF were adjusted using oral absorption factors (USEPA, 2004). The adjusted dermal CSFs are summarized in **Appendix I**, Table 6.1.

In addition to deriving a quantitative estimate of carcinogenic potency, USEPA also assigns weight-of-evidence classifications to potential carcinogens. Constituents are classified as Group A, Group B1, Group B2, Group C, Group D, or Group E carcinogens, as defined in Tables 6.1 an 6.2, **Appendix I**.

7.4 Risk Characterization

Risk characterization is the process of integrating the previous elements of the risk assessment into quantitative and semi-quantitative expressions of risk. The quantification of risk is then used as an integral component in remedial decision making and selection of potential remedies or actions, as necessary.

7.4.1 Non-carcinogenic and Carcinogenic Risk Estimation Methods

Potential human health risks are discussed independently for carcinogenic and non-carcinogenic contaminants because of the different toxicological endpoints, relevant exposure duration, and methods used to characterize risk. Some chemicals may produce both non-carcinogenic and carcinogenic effects, and were evaluated in both groups. The methodology used to estimate non-carcinogenic hazards and carcinogenic risk are described below. Following the description of the methodology, the non-carcinogenic hazards and carcinogenic risks for Site 21 are discussed.

Non-carcinogenic Hazard Estimation

Non-carcinogenic health risks are estimated by comparing the calculated exposure levels to threshold concentrations (or RfDs). The calculated intake divided by the RfD is equal to the hazard quotient (HQ):

$$HQ = Intake / RfD$$

The intake and RfD are expressed in the same units (mg/kg/day) and represent the same exposure period (i.e., chronic and subchronic). The intake and RfD also represent the same exposure route (i.e., inhalation intakes are divided by the inhalation RfDs, oral intakes are divided by the oral RfDs). An HQ that exceeds 1.0 (i.e., intake exceeds the RfD) indicates that there is a potential for adverse health effects associated with exposure to that chemical.

To assess the potential for non-carcinogenic health effects posed by exposure to multiple chemicals, a “hazard index” approach is used (USEPA, 1989). This approach assumes that

non-carcinogenic hazards associated with exposure to more than one chemical are additive. Synergistic or antagonistic interactions between chemicals are not considered. The hazard index (HI) may exceed 1.0 even if all of the individual HQs are less than one. The chemicals may then be separated by similar mechanisms of toxicity and toxicological effects, and separate HIs derived based on mechanism and target organ affected. If the HI for each target organ is not above 1, it can be assumed that there is no non-carcinogenic hazard to the receptor above USEPA's target level.

Carcinogenic Risk Estimation

The potential for carcinogenic effects due to exposure to site-related constituents is evaluated by estimating the excess lifetime carcinogenic risk (ELCR). ELCR is the incremental increase in the probability of developing cancer during one's lifetime in addition to the background probability of developing cancer.

Carcinogenic risk is calculated by multiplying the intake by the CSF:

$$ELCR = Intake \times CSF$$

The combined risk from exposure to multiple constituents was evaluated by adding the risks from individual constituents. Risks were also added across the exposure routes if an individual would be exposed through multiple routes.

When a cumulative carcinogenic risk to an individual receptor under the assumed RME exposure conditions at the site exceeds 100 in a million (i.e., 10^{-4} excess carcinogenic risk), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) generally requires remedial action to reduce risks at the site (USEPA, 1991). If the cumulative risk is less than 10^{-4}, action generally is not required, but may be warranted if a risk-based chemical-specific standard (e.g., MCL) is exceeded.

7.4.2 Risk Assessment Results

RME risks were evaluated for all exposure scenarios. RME risks were evaluated using upper-bound estimates of the exposure parameters (**Appendix I**, Tables 4.1.RME through 4.6.RME) and the RME exposure point concentrations (**Appendix I**, Tables 3.1.RME through 3.5.RME). CTE risks were calculated for those scenarios that had an RME HI greater than 1.0 and/or an RME carcinogenic risk greater than $1x10^{-4}$. CTE risks were evaluated using median estimates of the exposure parameters (**Appendix I**, Tables 4.1.CTE through 4.6.CTE) and the CTE exposure point concentrations (**Appendix I**, Tables 3.1.CTE through 3.5.CTE).

The results of the risk characterization are presented below by receptor. The risk calculations are presented in **Appendix I**, Tables 7.1.RME through 7.8.CTE. A summary of the RME risk estimates is presented in **Table 7-4**, and a summary of the CTE risk estimates is presented in **Table 7-5**.

Current/Future Industrial Worker – Shallow Groundwater

The risk assessment assumed that a current/future industrial worker could be exposed to vapors that may migrate from shallow groundwater to indoor air in current on-site buildings. Table 9.1 RME, **Appendix I**, summarizes the hazards and risks to the current/future industrial worker.

The RME non-carcinogenic hazards associated with vapor intrusion from groundwater to indoor air and inhalation of the indoor air are below USEPA's target HI of 1.0 for Buildings 13, 46, 47, 54, 63, and 90. The RME carcinogenic risks associated with indoor air are within USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$ for Buildings 13, 46, 47, 63, and 90. The RME carcinogenic risks associated with indoor air, primarily from TCE, for Building 54 ($3.0x10^{-4}$) and Building 1556 ($1.1x10^{-4}$) are above USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$. However, the modeled indoor air concentration for TCE for each building, based on RME assumptions, is less than the Agency for Toxic Substances and Disease Registry (ATSDR) acute Minimal Risk Level; which indicates there is no acute or short-term risk to building occupants from potential vapor intrusion pathways. The CTE carcinogenic risks for Building 54 ($5.9x10^{-5}$) and Building 1556 ($2.1x10^{-5}$) are within USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$(**Appendix I**, Table 9.1.CTE).

Future Adult Resident – Deep Groundwater

Table 9.2.RME, **Appendix I**, summarizes the non-carcinogenic hazards to a future adult resident for exposure to deep aquifer groundwater that is used as a potable water supply through ingestion, dermal contact, and inhalation and carcinogenic risks through inhalation while showering. The non-carcinogenic hazard from exposure to the groundwater (HI = 8.7) based on RME exceeds USEPA's target HI of 1.0. The RME non-carcinogenic hazard is primarily associated with ingestion (HI = 8.4) of arsenic. No carcinogenic risk above USEPA's target risk range from inhalation while showing was identified. The CTE non-carcinogenic hazard (HI = 2.5) is above USEPA's target HI of 1.0. The CTE non-carcinogenic hazard is primarily associated with ingestion (HI = 2.4) of arsenic (**Appendix I**, Table 9.2.CTE).

Future Child Resident – Deep Groundwater

Appendix I, Table 9.3.RME, summarizes the non-carcinogenic hazards to a future child resident for exposure to deep aquifer groundwater that is used as a potable water supply through ingestion and dermal contact. The non-carcinogenic hazard from exposure to the groundwater (HI = 21) based on RME exceeds USEPA's target HI of 1.0. The RME non-carcinogenic hazard is primarily associated with ingestion (HI = 20) of arsenic, chromium, and vanadium. The CTE non-carcinogenic hazard (8.2) is above USEPA's target HI of 1.0.The CTE non-carcinogenic hazard is primarily associated with ingestion of arsenic (HI = 8) and vanadium. (**Appendix I**, Table 9.3.CTE).

Future Lifetime Resident – Deep Groundwater

Appendix I, Table 9.4.RME, summarizes the carcinogenic risks to a future lifetime resident for exposure to deep aquifer groundwater that is used as a potable water supply through ingestion and dermal contact. The carcinogenic risk from exposure to the groundwater ($1.6x10^{-3}$) based on RME exceeds USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4}. Arsenic is the only COPC for ingestion, and therefore contributes all of the risk. The CTE carcinogenic risk ($3.1x10^{-4}$) is also above USEPA's target risk range (**Appendix I**, Table 9.4.CTE). The CTE carcinogenic risk is associated with ingestion of arsenic.

Future Construction Worker – Shallow Groundwater

Appendix I, Table 9.5.RME, summarizes the non-carcinogenic hazards and carcinogenic risks to a future construction worker. The risk assessment assumed that a future

construction worker could be exposed to shallow aquifer groundwater in an excavation during construction activities through dermal contact and inhalation of vapors. No non-carcinogenic hazard from exposure to the groundwater based on RME exceeded USEPA's target HI of 1.0. The carcinogenic risk from exposure to the groundwater is within USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4}.

Future Resident Adult – Shallow Groundwater

Appendix I, Table 9.6.RME, summarizes the non-carcinogenic hazards to a future adult resident for exposure to shallow aquifer groundwater that is used as a potable water supply through ingestion, dermal contact, inhalation while showering, and to vapors that may migrate from shallow groundwater to indoor air; and carcinogenic risks through inhalation while showering. The non-carcinogenic hazard from exposure to the groundwater (HI = 51) based on RME exceeds USEPA's target HI of 1.0. The RME non-carcinogenic hazard is primarily associated with ingestion (HI = 28) of TCE, VC, cis-1,2-DCE, and arsenic; dermal contact (HI = 3.1) with TCE; and the inhalation (indoor air) (HI = 22) of dichlorodifluoromethane, TCE, and VC (**Appendix I**, Table 9.6.RME). The carcinogenic risk from exposure based on RME and CTE from inhalation while showering (2.3×10^{-4}), primarily from TCE, exceeds USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4}. The CTE non-carcinogenic hazard (18) is above USEPA's target HI of 1.0. The CTE non-carcinogenic hazard is primarily associated with ingestion (HI = 7.8) of TCE; dermal contact (HI = 1.1) with no individual COPCs contributing an HQ above 1.0; and the inhalation (indoor air) (HI = 8.3) of TCE and VC (**Appendix I**, Table 9.6.CTE).

Future Resident Child – Shallow Groundwater

Appendix I, Table 9.7.RME, summarizes the non-carcinogenic hazards to a future child resident for exposure to shallow aquifer groundwater that is used as a potable water supply through ingestion and dermal contact and to vapors that may migrate from shallow groundwater to indoor air in a future on-site residence. The non-carcinogenic hazard from exposure to the groundwater (HI = 130) based on RME exceeds USEPA's target HI of 1.0. The RME non-carcinogenic hazard is primarily associated with ingestion (HI = 58) of TCE, VC, cis-1,2-DCE, benzene, and arsenic; dermal contact (HI = 7) with TCE; and the inhalation (indoor air) (HI = 92) of benzene, dichlorodifluoromethane, TCE, and VC (**Appendix I**, Table 9.7.RME).

The CTE non-carcinogenic hazard (90) is above USEPA's target HI of 1.0. The CTE non-carcinogenic hazard is primarily associated with ingestion (HI = 26) of TCE, VC, cis-1,2-DCE, and arsenic; dermal contact (HI = 2.2) with TCE; and the inhalation (indoor air) (HI = 62) of benzene, dichlorodifluoromethane, TCE, and VC (**Appendix I**, Table 9.7.CTE).

Future Lifetime Resident – Shallow Groundwater

Appendix I, Table 9.8.RME, summarizes the carcinogenic risks to a future lifetime resident for exposure to shallow aquifer groundwater that is used as a potable water supply through ingestion and dermal contact and to vapors that may migrate from shallow groundwater to indoor air in a future on-site residence. The carcinogenic risk from exposure to the groundwater (1.8×10^{-2}) based on RME exceeds USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4}. TCE, VC, and arsenic are the main risk drivers for ingestion, and there are no individual COPCs contributing a carcinogenic risk above 10^{-4} for dermal contact. The

carcinogenic risk from exposure based on RME from inhalation (indoor air) ($1.2x10^{-2}$), primarily from benzene, TCE and VC, exceeds USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4}. The CTE carcinogenic risk ($1.2x10^{-3}$) is also above USEPA's target risk range (**Appendix I**, Table 9.8.CTE). The CTE carcinogenic risk is associated with ingestion and inhalation (showering) of TCE and ingestion of VC.

7.5 Uncertainty Associated with Human Health Risk Assessment

The risk measures used in Superfund site 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 site-specific discussion on the uncertainties associated with the individual components of the risk assessment is presented in the following sections.

7.5.1 General Uncertainty in COPC Selection

The sampling conducted at Site 21 focused on areas of known or suspected contamination. Therefore, the uncertainty in sampling and possibility of missing a contaminated location is expected to be minimal. The uncertainty associated with the data analysis is minimal, as the data have been fully validated prior to use in the risk assessment. The general assumptions used in the COPCs selection process were conservative to ensure that the true COPCs were not eliminated from the quantitative risk assessment and that the highest possible risk was estimated.

A number of the reporting limits for constituents not detected in the sample exceeded the applicable screening level or MCL. For cases where the maximum detected concentration of the constituent exceeded the screening level, one-half the reporting limit was used as a proxy concentration in calculating the exposure concentration. This may result in an over-or under-estimation of the actual exposure point concentration, as it is possible the constituent is present in the sample at a concentration either above or below one half the reporting limit. Additionally, there were some constituents not detected in any of the samples, with reporting limits above the screening levels. These constituents were not carried through the risk assessment, which might result in an underestimation of risk. However, it should be noted this is not likely to effect the conclusions of the risk assessment, which indicate VOCs pose unacceptable risks if groundwater is used as a future potable water supply.

A comparison of site concentrations to background concentrations was not used to select the COPCs. Additionally, the COPCs were not limited to those constituents that are potentially attributed to historical activities at the site. This may result in including risks calculated for some constituents that are not necessarily site related in the total site risk. This appears to be the case for benzene and arsenic in shallow groundwater and arsenic and vanadium in deep groundwater.

Benzene was only detected above the respective MCL at one well, SJS21-MW09S, which is located downgradient of a closed former UST site. Degradation of petroleum compounds from the former leaking UST has resulted in reducing conditions at this location, as indicated by the low DO, negative ORP, and elevated ferrous iron concentrations measured. These reducing conditions have increased the mobility of naturally occurring arsenic resulting in arsenic concentrations above the MCL at SJS21-MW09S. Although potential risks were identified from exposure to benzene and arsenic at SJS21-MW09S by hypothetical future residents, these compounds are fuel-related and are not treated under CERCLA based on the petroleum exclusion.

Although the HHRA identified potential human health risks from exposure to arsenic and vanadium in deep groundwater, the deep groundwater does not appear to have been impacted by Site 21 activities. Arsenic and vanadium were detected only sporadically and were not identified in the Columbia aquifer within the same area of the site. Additionally, a laterally extensive hydraulic aquitard (Yorktown confining unit) is present in which there is very low vertical permeability in clay, preventing downward migration of COPCs.

7.5.2 Uncertainty Associated with Exposure Assessment

Uncertainty in the exposure assessment was generally treated with conservative decision rules and assumptions, and therefore the uncertainty likely overestimates actual exposure to COPCs. Several exposure pathways evaluated by this HHRA, such as residential land use, are hypothetical and are not anticipated to exist in the future. Most of the exposure factors used to quantify exposure are generally conservative and reflect worst-case, or upper-bound, assumptions for the exposure.

Site-related contamination would be expected to decrease with time. The risk assessment assumed concentrations would remain constant throughout the exposure period (30 years for the residential scenarios, 25 years for the worker, and 1 year for the construction worker). This will result in an over-estimation of risk.

7.5.3 Uncertainty Associated with Toxicity Assessment

Uncertainty associated with the non-carcinogenic toxicity factors is included in Tables 5.1 and 5.2 in **Appendix I**. UFs are applied by USEPA to extrapolate from animal studies to humans. Additional modification factors are also applied based on USEPA's professional judgment. Therefore, the non-carcinogenic toxicity factors most likely overestimate the actual toxicity.

The uncertainty associated with CSFs is mostly associated with the low dose extrapolation where carcinogenicity at low doses is assumed to be straight-line responses. This is a conservative assumption, which introduces a high uncertainty into slope factors which are from this extrapolated area of the dose-response curve. Most of the experimental studies indicate existence of a threshold for carcinogenicity, which is not accounted for in the development of the CSF.

CSFs developed by USEPA represent upper-bound estimates. Carcinogenic risks generated in this assessment should be regarded as an upper-bound estimate of the potential carcinogenic risks rather than an accurate representation of carcinogenic risk. The true carcinogenic risk is likely to be less than the predicted value (USEPA, 1989).

Additional uncertainty is in the prediction of relative sensitivities of different species of animals and the applicability of animal data to humans.

There is a large degree of uncertainty associated with the oral to dermal adjustment factors (based on chemical-specific gastrointestinal absorption) used to transform the oral RfDs and CSFs based on administered doses to dermal RfDs and CSFs based on absorbed doses. It is not known if the adjustment factors result in an underestimate or overestimate of the actual toxicity associated with dermal exposure.

The provisional toxicity values used for TCE in this assessment were obtained from the California EPA. These values are the values the DoD recommends for use in human health risk assessments performed for the DoD. However, these toxicity values are considered provisional as they have not been endorsed by EPA and published in the IRIS data base.

In August 2001, NCEA completed a draft health assessment of the health risks posed by TCE. The draft health assessment was made available for public comment and includes a disclaimer that it is a preliminary draft and "has not been formally released by USEPA and should not at this stage be construed to represent Agency policy. It is being circulated for comment on its technical merit and policy implications," (USEPA, 2001). The draft health assessment proposed a provisional oral RfD of 3.0×10^{-4} mg/kg-day based on effects to the liver, kidney, and developing fetuses. A provisional inhalation RfD of 1.1×10^{-2} mg/kg-day was also suggested based on critical effects in the central nervous system, liver, and endocrine system. Several CSFs were developed in the 2001 draft health assessment, with most slope factors falling between 2×10^{-2} and 4×10^{-1} per mg/kg-day.

Because the toxicity values in the draft 2001 health assessment are different than the current provisional toxicity values, to characterize the uncertainty associated with the quantitative estimate of risk from exposure to TCE, a parallel set of risk calculations was performed using the toxicity values in the draft 2001 health assessment. The following toxicity values were used for these calculations:

- Oral CSF = 4.0x10-1 (mg/kg-day)-1
- Inhalation CSF = 4.0x10-1 (mg/kg-day)-1
- Oral RfD = 3.0×10^{-4} mg/kg-day
- Inhalation RfD = 1.1×10^{-2} mg/kg-day

Table 7-6 shows the results of the risk assessment using these toxicity values, and compares them to the results using the pre-2001 values. The following bullets show those scenarios in which use of the draft 2001 values would result in a different conclusion than the values used in the risk assessment:

- Current/Future Industrial Worker. Exposure to indoor air based on vapor intrusion from groundwater at Buildings 13 and 47 would result in a carcinogenic risk exceeding the acceptable risk range and at Buildings 54 and 1556 would result in a hazard above USEPA's target HI. TCE alone would pose a risk above the target risk range and hazard above 1.0.

- Future Construction Worker. Exposure to groundwater during construction would result in a non-carcinogenic hazard exceeding the acceptable risk levels. TCE would pose a hazard above 1.0.

7.5.4 Uncertainty in Risk Characterization

The uncertainties identified in each component of risk assessment ultimately contribute to uncertainty in risk characterization. The addition of risks and HIs across pathways and chemicals contributes to uncertainty based on the interaction of chemicals such as additivity, synergism, potentiation, and susceptibility of exposed receptors. The simple assumption of additivity used for this assessment may or may not be accurate and may or may not over- or under-estimate risk; however, a better alternative is not available at this time.

7.5.5 Uncertainty in Modeling Indoor Air Concentrations

The assumptions used in the Johnson and Ettinger model for estimating exposure point concentrations may either result in potential exposures and risks being under- or over-stated. Uncertainties associated with the assumptions of the model developed for Site 21 include the following:

1. The model assumes the highest concentration within 100 feet of a building is present uniformly under the building footprint; concentrations in groundwater in proximity to the building may differ. Depending on the concentrations closest to the building, the indoor air concentrations used in the HHRA might have either been under- or over-stated.

2. Concentrations in indoor air were modeled from groundwater monitoring wells screened over a 10-ft interval to a minimum depth of 13.5 ft. Sampling groundwater from a well with a long screen interval, such as at Site 21, results in an average concentration that is biased by higher concentrations in deeper groundwater. Previous studies (Rivett, 1995) suggest that groundwater concentrations 1 meter (3.28 ft) below the water table are unlikely to create significant soil gas signatures in the overlying vadose zone. Though elevated groundwater concentrations (i.e. approaching 1 percent of the solubility limit) are an indication that DNAPL may be present at Site 21 at the bottom of the aquifer, the rate of diffusion of contaminants through the overlying groundwater is very slow. Overlying groundwater can greatly impede or prevent high concentrations of VOCs in deeper groundwater from reaching the unsaturated zone, thus possibly preventing or reducing the vapor intrusion pathway (Fitzpatrick & Fitzgerald 2002; McAlary et al. 2004). USEPA's draft vapor intrusion guidance (USEPA, 2002) recommends that groundwater samples be taken from wells screened (preferably over short intervals) across the top of the water table because only volatile contaminants in the uppermost portions of an aquifer, including the capillary fringe, are likely to volatilize into the vadose zone. Using groundwater concentration data from samples collected from the entire well screen in the RI to model indoor air concentrations overstates the risks presented in the HHRA.

3. USEPA's draft vapor intrusion guidance (USEPA, 2002) states that modeling should not be used at sites where the depth to groundwater is less than 5 feet below ground surface; the depth to groundwater at Site 21 ranges from 1 to 7 ft bgs across the site, indicating the model's validity may be uncertain for portions of the site. However, the USEPA's user's guide for the Johnson and Ettinger model (USEPA, 2004) does not set a specific depth to groundwater limit for use of the model, but requires that the top of the

capillary zone is always below the floor (i.e. the depth to the water table must include the capillary fringe). In addition, the user's guide cautions that the model not be used with shallow water tables that are in contact with the foundation. Available site information provides no indication that wet foundations are present at the buildings at Site 21. Finally, the user's guide recommends not using the model for sites with large fluctuations in the water table elevation. In these cases, the capillary fringe might be contaminated; whereas in the groundwater source spreadsheets, the capillary fringe is assumed to be uncontaminated. Though the water table varies considerably across Site 21, the water level at each well has generally varied less than 1 ft across the rounds of water levels that were collected. Therefore, based on the available data, contaminated capillary fringe is not expected to have significantly impacted the model, though it is possible that it may have resulted in an over- or understatement of risks.

4. An evaluation of critical parameters was conducted for the Building 54 modeling scenario of TCE in groundwater, using the methodology described in *Identification of Critical Parameters for the Johnson and Ettinger (1991) Vapor Intrusion Model* (Johnson, 2002). Based on that analysis, using the methodology shown in Figure 3 (Johnson, 2002), soil gas transport through the foundation is driven by advection, while soil gas transport through the soil is limited by diffusion. The most critical parameters in the modeling include the depth to groundwater, the effective diffusion coefficient, and the building ventilation rate. However, given the depth to groundwater, the vadose zone underlying the building might be influenced by depressurization from the building. In this case, the $Q_{soil}/Q_{building}$ might best reflect the potential for vapor intrusion into the building. The $Q_{soil}/Q_{building}$ ratio is 1.19×10^{-3}, while the modeled attenuation factor for TCE in groundwater was 8.96×10^{-5}. If advective transport, rather than diffusive transport, is a driving transport mechanism in soil gas, the modeling for Building 54 might understate vapor intrusion by a factor of 13 ($1.19 \times 10^{-3}/8.96 \times 10^{-5}$).

5. The risk to industrial workers from potential vapor intrusion identified in Buildings 54 and 1556 was modeled using the adult short term exposure for moderate activities inhalation rate of 1.6 m^3/hour from EPA's Exposure Factors Handbook (USEPA, 1997). However, the recommended average hourly inhalation rate for outdoor workers from EPA's Exposure Factors Handbook is 1.3 m3/hour. Use of this value would not result in a risk to workers inside Building 1556. Because an inhalation rate has not been established for full time indoor workers, the more conservative outdoor short term inhalation rate was used in this risk assessment and may have resulted in an overstatement of risks for a indoor workers.

7.6 Summary of the HHRA

The risk assessment was conducted to evaluate the potential human health risks associated with current and hypothetical future receptors and exposure scenarios if no remedial action is implemented for shallow and deep aquifer groundwater. A summary of the RME and CTE risks are provided in Tables 7-4 and 7-5, respectively. The following subsections provide the summary of potential human health risks related to each site media:

7.6.1 Deep Groundwater

For future land use, potable use of deep aquifer groundwater may pose non-carcinogenic hazards and carcinogenic risks above USEPA target levels. The non-carcinogenic hazard to the adult resident is associated with ingestion of arsenic and to the child resident is associated with ingestion of arsenic and vanadium. The carcinogenic risk to the hypothetical future lifetime resident is associated with ingestion of arsenic. Both RME and CTE non-carcinogenic hazards and carcinogenic risks exceed USEPA target levels.

7.6.2 Shallow Groundwater

There are no non-carcinogenic hazards or carcinogenic risks that exceed USEPA target levels for a construction worker exposed to shallow groundwater during excavation activities. Future potable use of shallow aquifer groundwater may pose non-carcinogenic hazards and carcinogenic risks above USEPA target levels for future hypothetical residents. The non-carcinogenic hazard to the adult resident based on RME is associated with ingestion of TCE, VC, cis-1,2-DCE, and arsenic; dermal contact with TCE; and inhalation (indoor air) of VC, TCE, and dichlorodifluoromethane. Based on CTE, the non-carcinogenic hazard to the adult resident is associated with ingestion of TCE and inhalation (indoor air) of TCE and VC. The non-carcinogenic hazards to the child resident based on RME are associated with ingestion of benzene, TCE, VC, cis-1,2-DCE, and arsenic; dermal contact with TCE; and inhalation (indoor air) of benzene, dichlorodifluoromethane, TCE, and VC. The non-carcinogenic hazards to the child resident based on CTE are the same as RME, with the exception of benzene, which does not pose an unacceptable hazard. The carcinogenic risk to the hypothetical future lifetime resident based on RME is associated with ingestion of TCE, VC, and arsenic; inhalation (shower) of TCE; and inhalation (indoor air) of TCE and VC. Based on CTE, the carcinogenic risk to the hypothetical future lifetime resident is associated with ingestion and inhalation (shower) of TCE and ingestion of VC.

7.6.3 Indoor Air Vapor

For current/future land use, there are no non-carcinogenic hazards that exceed the USEPA target for an industrial worker exposed to vapors that may migrate from shallow groundwater to indoor air in current on-site buildings. Carcinogenic risks slightly exceed USEPA target risk range for an industrial worker exposed to vapors, primarily from TCE, that may migrate from shallow groundwater to indoor air into Building 54 and 1556 based on RME; however there are no risks based on CTE. Risks associated with indoor air for all other buildings are below the USEPA target risk range. For future hypothetical residents, both RME and CTE risks and hazards associated with vapors that may migrate from shallow groundwater to indoor air in a future on-site residence exceed USEPA target levels. These risks and hazards are associated with TCE, VC, benzene, and dichlorodifluoromethane (Freon 12).

Due to the uncertainties associated with modeling as discussed in Section 7.5.5, a work plan is being prepared to further evaluate the vapor intrusion pathway at Site 21 buildings. The results of this evaluation will be used to refine the HHRA.

Table 7-1
Summary of Data Quantitatively Used in HHRS
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Medium	Date of Sampling	Sample Location	Sample	Parameters
Shallow Groundwater				
	8/21/2003	SJS21-MW01S	SJS21-MW01S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	8/21/2003	SJS21-MW02S	SJS21-MW02S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	8/21/2003	SJS21-MW03S	SJS21-MW03S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	8/20/2003	SJS21-MW04S	SJS21-MW04S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	8/20/2003	SJS21-MW05S	SJS21-MW05S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	8/21/2003	SJS21-MW06S	SJS21-MW06S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/30/2004	SJS21-MW01S	SJS21-MW01S-04D	VOCs
	12/1/2004	SJS21-MW02S	SJS21-MW02S-04D	VOCs
	12/1/2004	SJS21-MW02S	SJS21-MW02S-04D-P	VOCs
	12/1/2004	SJS21-MW03S	SJS21-MW03S-04D	VOCs
	12/1/2004	SJS21-MW04S	SJS21-MW04S-04D	VOCs, Explosives
	11/30/2004	SJS21-MW05S	SJS21-MW05S-04D	VOCs
	11/30/2004	SJS21-MW06S	SJS21-MW06S-04D	VOCs
	11/30/2004	SJS21-MW07S	SJS21-MW07S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW08S	SJS21-MW08S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW09S	SJS21-MW09S-04D-P	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW09S	SJS21-MW09S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/30/2004	SJS21-MW10S	SJS21-MW10S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/30/2004	SJS21-MW11S	SJS21-MW11S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	3/28/2005	SJS21-MW07S	SJS21-MW07S-05A	VOCs, total Metals, dissolved Metals, Cyanide
	11/7/2005	SJS21-MW01S	SJS21-MW01S-05D	VOCs
	11/4/2005	SJS21-MW02S	SJS21-MW02S-05D	VOCs
	11/3/2005	SJS21-MW03S	SJS21-MW03S-05D	VOCs
	11/9/2005	SJS21-MW04S	SJS21-MW04S-05D	VOCs
	11/7/2005	SJS21-MW05S	SJS21-MW05S-05D	VOCs
	11/4/2005	SJS21-MW06S	SJS21-MW06S-05D	VOCs
	11/7/2005	SJS21-MW07S	SJS21-MW07S-05D	VOCs
	11/4/2005	SJS21-MW08S	SJS21-MW08S-05D	VOCs
	11/4/2005	SJS21-MW09S	SJS21-MW09S-05D	VOCs
	11/3/2005	SJS21-MW10S	SJS21-MW10S-05D	VOCs
	11/4/2005	SJS21-MW11S	SJS21-MW11S-05D	VOCs
	11/4/2005	SJS21-MW11S	SJS21-MW11S-05D-P	VOCs
	11/9/2005	SJS21-MW12S	SJS21-MW12S-05D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/9/2005	SJS21-MW13S	SJS21-MW13S-05D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/9/2005	SJS21-MW13S	SJS21-MW13S-05D-P	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	10/30/2006	SJS21-MW14S	SJS21-MW14S-06D	VOCs
	10/30/2006	SJS21-MW15S	SJS21-MW15S-06D	VOCs
	10/30/2006	SJS21-MW15S	SJS21-MW15S-06D-P	VOCs
	10/30/2006	SJS21-MW16S	SJS21-MW16S-06D	VOCs
	10/24/2006	SJS21-MW07S	SJS21-DW101-13-06D[1]	VOCs
	10/24/2006	SJS21-MW12S	SJS21-DW102-14-06D[1]	VOCs
	10/26/2006	SJS21-MW13S	SJS21-DW103-06D[1]	VOCs
	10/27/2006	SJS21-MW13S	SJS21-DW104-06D (Bailer)[1]	VOCs
	11/20/2006	SJS21-MW13S	SJS21-DW105-06D (PDB)[1]	VOCs
	11/20/2006	SJS21-MW13S	SJS21-DW105P-06D (PDB)[1]	VOCs
	2/26/2007	SJS21-MW17S	SJS21-MW17S-07A	VOCs
	2/26/2007	SJS21-MW18S	SJS21-MW18S-07A	VOCs
	2/26/2007	SJS21-MW18S	SJS21-MW18S-07A-P	VOCs
	2/26/2007	SJS21-MW19S	SJS21-MW19S-07A	VOCs
Vapors from Shallow Groundwater (Indoor Air)				
Building 13	8/20/2003	SJS21-MW04S	SJS21-MW04S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW04S	SJS21-MW04S-04D	VOCs, Explosives
	11/9/2005	SJS21-MW04S	SJS21-MW04S-05D	VOCs
	8/20/2003	SJS21-MW05S	SJS21-MW05S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/30/2004	SJS21-MW05S	SJS21-MW05S-04D	VOCs
	11/7/2005	SJS21-MW05S	SJS21-MW05S-05D	VOCs

Table 7-1
Summary of Data Quantitatively Used in HHRS
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Medium	Date of Sampling	Sample Location	Sample	Parameters
Vapors from Shallow Groundwater (Indoor Air) - continued				
Building 13	11/30/2004	SJS21-MW10S	SJS21-MW10S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/3/2005	SJS21-MW10S	SJS21-MW10S-05D	VOCs
	10/30/2006	SJS21-MW16S	SJS21-MW16S-06D	VOCs
	11/02/05	SJS21-TW112	SJS21-TW112-05D	VOCs
	11/01/05	SJS21-TW114	SJS21-TW114-05D	VOCs
	11/02/05	SJS21-TW116	SJS21-TW116-05D	VOCs
	11/02/05	SJS21-TW124	SJS21-TW124-05D	VOCs
Building 46	11/01/05	SJS21-TW120	SJS21-TW120-05D	VOCs
	10/31/05	SJS21-TW121	SJS21-TW121-05D	VOCs
	10/31/05	SJS21-TW122	SJS21-TW122-05D	VOCs
	11/07/05	SJS21-TW127	SJS21-TW127-05D	VOCs
	02/21/07	SJS21-TW213	SJS21-TW213-07A	VOCs
	02/21/07	SJS21-TW214	SJS21-TW214-07A	VOCs
Building 47	8/21/2003	SJS21-MW01S	SJS21-MW01S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/30/2004	SJS21-MW01S	SJS21-MW01S-04D	VOCs
	11/7/2005	SJS21-MW01S	SJS21-MW01S-05D	VOCs
	2/26/2007	SJS21-MW19S	SJS21-MW19S-07A	VOCs
	11/02/05	SJS21-TW113	SJS21-TW113-05D	VOCs
	11/01/05	SJS21-TW115	SJS21-TW115-05D	VOCs
	11/01/05	SJS21-TW118	SJS21-TW118-05D	VOCs
	02/21/07	SJS21-TW212	SJS21-TW212-07A	VOCs
	10/26/06	SJS21-GW103	SJS21-GW103-13-06D	VOCs
	10/27/06	SJS21-GW104	SJS21-GW104-13-06D	VOCs
	02/21/07	SJS21-TW215	SJS21-TW215-07A	VOCs
Building 54	8/20/2003	SJS21-MW04S	SJS21-MW04S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW04S	SJS21-MW04S-04D	VOCs, Explosives
	11/9/2005	SJS21-MW04S	SJS21-MW04S-05D	VOCs
	10/30/2006	SJS21-MW16S	SJS21-MW16S-06D	VOCs
	11/02/05	SJS21-TW113	SJS21-TW113-05D	VOCs
	11/03/05	SJS21-TW117	SJS21-TW117-05D	VOCs
Building 63	2/26/2007	SJS21-MW17S	SJS21-MW17S-07A	VOCs
	2/26/2007	SJS21-MW18S	SJS21-MW18S-07A	VOCs
	2/26/2007	SJS21-MW18S	SJS21-MW18S-07A-P	VOCs
	11/01/05	SJS21-TW111	SJS21-TW111-05D	VOCs
	02/20/07	SJS21-TW205	SJS21-TW205-07A	VOCs
	02/20/07	SJS21-TW207	SJS21-TW207-07A	VOCs
	02/20/07	SJS21-TW207	SJS21-TW207P-07A	VOCs
	10/26/06	SJS21-GW101	SJS21-GW101-13-06D	VOCs
	10/26/06	SJS21-GW102	SJS21-GW102-13-06D	VOCs
	10/27/06	SJS21-GW105	SJS21-GW105-13-06D	VOCs
	02/22/07	SJS21-TW209	SJS21-TW209-07A	VOCs
Building 90	8/20/2003	SJS21-MW04S	SJS21-MW04S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW04S	SJS21-MW04S-04D	VOCs, Explosives
	11/9/2005	SJS21-MW04S	SJS21-MW04S-05D	VOCs
	11/02/05	SJS21-TW113	SJS21-TW113-05D	VOCs
	11/01/05	SJS21-TW115	SJS21-TW115-05D	VOCs
Building 1556	8/21/2003	SJS21-MW02S	SJS21-MW02S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW02S	SJS21-MW02S-04D	VOCs
	12/1/2004	SJS21-MW02S	SJS21-MW02S-04D-P	VOCs
	11/4/2005	SJS21-MW02S	SJS21-MW02S-05D	VOCs
	8/21/2003	SJS21-MW03S	SJS21-MW03S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW03S	SJS21-MW03S-04D	VOCs
	11/3/2005	SJS21-MW03S	SJS21-MW03S-05D	VOCs
	12/1/2004	SJS21-MW08S	SJS21-MW08S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/4/2005	SJS21-MW08S	SJS21-MW08S-05D	VOCs
	12/1/2004	SJS21-MW09S	SJS21-MW09S-04D-P	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW09S	SJS21-MW09S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/4/2005	SJS21-MW09S	SJS21-MW09S-05D	VOCs

Table 7-1
Summary of Data Quantitatively Used in HHRS
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Medium	Date of Sampling	Sample Location	Sample	Parameters
Vapors from Shallow Groundwater (Indoor Air) - continued				
Building 1556	11/30/2004	SJS21-MW11S	SJS21-MW11S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/4/2005	SJS21-MW11S	SJS21-MW11S-05D	VOCs
	11/4/2005	SJS21-MW11S	SJS21-MW11S-05D-P	VOCs
	11/9/2005	SJS21-MW12S	SJS21-MW12S-05D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/9/2005	SJS21-MW13S	SJS21-MW13S-05D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/9/2005	SJS21-MW13S	SJS21-MW13S-05D-P	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	10/30/2006	SJS21-MW14S	SJS21-MW14S-06D	VOCs
	10/30/2006	SJS21-MW15S	SJS21-MW15S-06D	VOCs
	10/30/2006	SJS21-MW15S	SJS21-MW15S-06D-P	VOCs
	2/26/2007	SJS21-MW17S	SJS21-MW17S-07A	VOCs
	11/03/05	SJS21-TW101	SJS21-TW101-05D	VOCs
	10/31/05	SJS21-TW102	SJS21-TW102-05D	VOCs
	10/31/05	SJS21-TW102	SJS21-TW102-05D-P	VOCs
	11/01/05	SJS21-TW103	SJS21-TW103-05D	VOCs
	10/31/05	SJS21-TW104	SJS21-TW104-05D	VOCs
	11/02/05	SJS21-TW106	SJS21-TW106-05D	VOCs
	10/31/05	SJS21-TW107	SJS21-TW107-05D	VOCs
	11/02/05	SJS21-TW108	SJS21-TW108-05D	VOCs
	11/01/05	SJS21-TW109	SJS21-TW109-05D	VOCs
	11/02/05	SJS21-TW110	SJS21-TW110-05D	VOCs
	11/02/05	SJS21-TW110	SJS21-TW110-05D-P	VOCs
	11/01/05	SJS21-TW111	SJS21-TW111-05D	VOCs
	02/20/07	SJS21-TW205	SJS21-TW205-07A	VOCs
	02/20/07	SJS21-TW206	SJS21-TW206-07A	VOCs
	02/22/07	SJS21-TW209	SJS21-TW209-07A	VOCs
	02/22/07	SJS21-TW216	SJS21-TW216-07A	VOCs
	10/26/06	SJS21-GW102	SJS21-GW102-13-06D	VOCs
Not associated with any building, used for screening (along with building specific wells identified above)	8/21/2003	SJS21-MW06S	SJS21-MW06S-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	11/30/2004	SJS21-MW06S	SJS21-MW06S-04D	VOCs
	11/30/2004	SJS21-MW07S	SJS21-MW07S-04D	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	3/28/2005	SJS21-MW07S	SJS21-MW07S-05A	VOCs, total Metals, dissolved Metals, Cyanide
	11/4/2005	SJS21-MW06S	SJS21-MW06S-05D	VOCs
	11/7/2005	SJS21-MW07S	SJS21-MW07S-05D	VOCs
	11/01/05	SJS21-TW119	SJS21-TW119-05D	VOCs
	10/31/05	SJS21-TW123	SJS21-TW123-05D	VOCs
	11/07/05	SJS21-TW125	SJS21-TW125-05D	VOCs
	11/07/05	SJS21-TW126	SJS21-TW126-05D	VOCs
	10/25/06	SJS21-TW201	SJS21-TW201-06D	VOCs
	10/25/06	SJS21-TW201	SJS21-TW201P-06D	VOCs
	10/25/06	SJS21-TW202	SJS21-TW202-06D	VOCs
	10/26/06	SJS21-TW203	SJS21-TW203-06D	VOCs
	10/26/06	SJS21-TW204	SJS21-TW204-06D	VOCs
	02/21/07	SJS21-TW208	SJS21-TW208-07A	VOCs
	02/20/07	SJS21-TW210	SJS21-TW210-07A	VOCs
	02/21/07	SJS21-TW211	SJS21-TW211-07A	VOCs
	02/23/07	SJS21-TW217	SJS21-TW217-07A	VOCs
Deep Groundwater				
	8/20/2003	SJS21-MW01D	SJS21-MW01D-03C	VOCs, SVOCs, Pest/PCBs, total Metals, dissolved Metals, Cyanide, Explosives
	12/1/2004	SJS21-MW01D	SJS21-MW01D-04D	total Metals, dissolved Metals, Cyanide
	11/7/2005	SJS21-MW01D	SJS21-MW01D-05D	total Arsenic, dissolved Arsenic
	11/7/2005	SJS21-MW01D	SJS21-MW01D-05D-P	total Arsenic, dissolved Arsenic

Notes:
VOCs - Volatile organic constituents
SVOCs - Semi-volatile organic constituents
Pest/PCBs - Pesticides/Polychlorinated biphenyls
[1] Depth-specific samples
[*] Only total metals evaluated in HHRA

Table 7-2

Summary of Chemicals of Potential Concern for the Baseline Risk Assessment

Site 21 Remedial Investigation Report

St. Juliens Creek Annex

Chesapeake, Virginia

Groundwater	
Deep Groundwater - Tap Water	***Shallow Groundwater - Indoor Air (Industrial)***
Chloroform	**Building 13**
1,3-Dinitrobenzene	cis-1,2-Dichloroethylene
Arsenic	Dichlorodifluoromethane (Freon 12)
Chromium	Trichloroethene
Vanadium	Vinyl Chloride
Deep Groundwater - Shower	**Building 46**
Chloroform	Bromoform
	cis-1,2-Dichloroethylene
Shallow Groundwater - Tap Water and Excavation	Dichlorodifluoromethane (Freon 12)
1,2-Dichloroethane	Trichloroethene
Benzene	
Chloroform	**Building 47**
Tetrachloroethene	Benzene
Trichloroethene	Bromoform
Vinyl chloride	cis-1,2-Dichloroethylene
cis-1,2-Dichloroethene	Dichlorodifluoromethane (Freon 12)
trans-1,2-Dichloroethene	Cumene
bis(2-Ethylhexyl)phthalate	Trichloroethene
Heptachlor epoxide	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
RDX	Vinyl Chloride
Arsenic	
Iron	**Building 54**
Molybdenum	cis-1,2-Dichloroethylene
	Trichloroethene
Shallow Groundwater - Shower and Excavation Air	Vinyl Chloride
1,2-Dichloroethane	
Benzene	**Building 63**
Chloroform	Benzene
Tetrachloroethene	cis-1,2-Dichloroethylene
Trichloroethene	Trichloroethene
Vinyl chloride	Vinyl Chloride
cis-1,2-Dichloroethene	
trans-1,2-Dichloroethene	**Building 90**
	cis-1,2-Dichloroethylene
Shallow Groundwater - Indoor Air (Residential)	Dichlorodifluoromethane (Freon 12)
Benzene	Trichloroethene
Bromoform	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
cis-1,2-Dichloroethylene	Vinyl Chloride
Dichlorodifluoromethane (Freon 12)	
Cumene	**Building 1556**
Trichloroethylene	Benzene
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	Bromoform
Vinyl Chloride	cis-1,2-Dichloroethylene
	Dichlorodifluoromethane (Freon 12)
	Cumene
	Trichloroethene
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
	Vinyl Chloride

Table 7-3
Potentially Complete Human Health Exposure Pathways Conceptual Site Model
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Land Use	Media	Potentially Exposed Populations	Exposure Route (Human Health)	Pathway Selected for Evaluation	Rationale
Current/Future					
Industrial	Shallow Groundwater	Industrial Worker	Inhalation	Yes	Workers may be exposed to vapors that have migrated from shallow groundwater through building foundation into the workplace indoor air.
Future					
Residential	Deep Groundwater	Residents - Adults and Children	Ingestion and dermal contact	Yes	Local municipality currently has some uses for groundwater from deep aquifer. Deep groundwater beneath site could be used as a future potable water supply.
	Deep Groundwater	Residents - Adults	Inhalation	Yes	Local municipality currently has some uses for groundwater from deep aquifer. Deep groundwater beneath site could be used as a future potable water supply. Children assumed to bathe and not shower, therefore inhalation exposure not as great for a child as that for adult.
	Shallow Groundwater	Residents - Adults and Children	Ingestion and dermal contact	Yes	Although unlikely, shallow groundwater may be used as a future potable water supply.
	Shallow Groundwater	Residents - Adults	Inhalation	Yes	Although unlikely, shallow groundwater may be used as a future potable water supply. Children assumed to bathe and not shower, therefore inhalation exposure not as great for a child as that for adult.
	Shallow Groundwater	Residents - Adults and Children	Inhalation	Yes	Future residents may be exposed to vapors that migrate from shallow groundwater through foundation of future residences into indoor air.
Residential or Industrial	Groundwater	Construction Worker	Dermal contact and inhalation	Yes	Workers may have exposed skin surfaces come into contact with groundwater and may inhale volatiles from shallow groundwater during excavation activities.

Table 7-4
Summary of RME Cancer Risks and Hazard Indices
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1
Current/Future	Vapors from	Ingestion	NA				NA	
Industrial Worker Adult	Shallow Groundwater	Dermal Contact	NA				NA	
	Building 13	Inhalation	2.4E-05		Trichloroethene		5.7E-02	
		Total	2.4E-05		Trichloroethene		5.7E-02	
Current/Future	Vapors from	Ingestion	NA				NA	
Industrial Worker Adult	Shallow Groundwater	Dermal Contact	NA				NA	
	Building 46	Inhalation	6.1E-08				2.9E-03	
		Total	6.1E-08				2.9E-03	
Current/Future	Vapors from	Ingestion	NA				NA	
Industrial Worker Adult	Shallow Groundwater	Dermal Contact	NA				NA	
	Building 47	Inhalation	4.7E-05		Vinyl Chloride	Trichloroethene	3.8E-01	
		Total	4.7E-05		Vinyl Chloride	Trichloroethene	3.8E-01	
Current/Future	Vapors from	Ingestion	NA				NA	
Industrial Worker Adult	Shallow Groundwater	Dermal Contact	NA				NA	
	Building 54	Inhalation	3.0E-04	Trichloroethene			7.1E-01	
		Total	3.0E-04				7.1E-01	
Current/Future	Vapors from	Ingestion	NA				NA	
Industrial Worker Adult	Shallow Groundwater	Dermal Contact	NA				NA	
	Building 63	Inhalation	4.2E-07				1.5E-03	
		Total	4.2E-07				1.5E-03	
Current/Future	Vapors from	Ingestion	NA				NA	
Industrial Worker Adult	Shallow Groundwater	Dermal Contact	NA				NA	
	Building 90	Inhalation	2.1E-06			Vinyl chloride	1.5E-02	
		Total	2.1E-06			Vinyl chloride	1.5E-02	
Current/Future	Vapors from	Ingestion	NA				NA	
Industrial Worker Adult	Shallow Groundwater	Dermal Contact	NA				NA	
	Building 1556	Inhalation	1.1E-04		Trichloroethene	Benzene, Vinyl chloride	2.8E-01	
		Total	1.1E-04		Trichloroethene	Benzene, Vinyl chloride	2.8E-01	
Future	Deep	Ingestion	NA				8.4E+00	Arsenic
Resident Adult	Groundwater	Dermal Contact	NA				3.3E-01	
		Inhalation	NA				4.5E-03	
		Total	NA				8.7E+00	Arsenic, Vanadium
Future	Deep	Ingestion	NA				2.0E+01	Arsenic, Vanadium
Resident Child	Groundwater	Dermal Contact	NA				9.7E-01	
		Inhalation	NA				NA	
		Total	NA				2.1E+01	Arsenic, Chromium, Vanadium
Future	Deep	Ingestion	1.6E-03	Arsenic			NA	
Resident Adult/Child	Groundwater	Dermal Contact	9.3E-06			Arsenic	NA	
		Inhalation[1]	1.8E-06			Chloroform	NA	
		Total	1.6E-03	Arsenic		Chloroform	NA	

Table 7-4
Summary of RME Cancer Risks and Hazard Indices
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1
Future Construction Worker Adult	Shallow Groundwater	Ingestion	NA				NA	
		Dermal Contact	1.5E-06				5.9E-01	
		Inhalation	1.9E-07				1.4E-02	
		Total	1.6E-06				6.1E-01	
Future Resident Adult	Shallow Groundwater	Ingestion	NA				2.5E+01	Trichloroethene, Vinyl chloride, cis-1,2-dichlorothene, Arsenic
		Dermal Contact	NA				3.1E+00	Trichloroethene
		Inhalation/Shower	NA				8.6E-01	
		Inhalation/Indoor Air	NA				2.2E+01	Vinyl chloride, Trichloroethene, Dichlorodifluoromethane (Freon 12)
		Total	NA				5.1E+01	Trichloroethene, Vinyl chloride, cis-1,2-dichlorothene, Dichlorodifluoromethane (Freon 12), Arsenic
Future Resident Child	Shallow Groundwater	Ingestion	NA				5.8E+01	Benzene, Trichloroethene, Vinyl chloride, cis-1,2-dichlorothene, Arsenic
		Dermal Contact	NA				7.0E+00	Trichloroethene
		Inhalation/Shower	NA				NA	
		Inhalation/Indoor Air	NA				6.2E+01	Benzene,Vinyl chloride, Trichloroethene, Dichlorodifluoromethane (Freon 12)
		Total	NA				1.3E+02	Benzene, Trichloroethene, Vinyl chloride, cis-1,2-dichlorothene, Dichlorodifluoromethane (Freon 12), Arsenic
Future Resident Adult/Child	Shallow Groundwater	Ingestion	5.2E-03	Trichloroethene, Vinyl chloride, Arsenic	Benzene	Tetrachloroethene, bis(2-Ethylhexyl)phthalate, Heptachlor epoxide, RDX	NA	
		Dermal Contact	2.3E-04		Benzene, Trichloroethene, Vinyl chloride	Tetrachloroethene, bis(2-Ethylhexyl)phthalate, Heptachlor epoxide, Arsenic	NA	
		Inhalation[1]/Shower	2.3E-04	Trichloroethene	Benzene, Vinyl chloride	Chloroform	NA	
		Inhalation/Indoor Air	1.2E-02	Benzene, Trichloroethene, Vinyl chloride				
		Total	1.8E-02	Benzene, Trichloroethene, Vinyl chloride, Arsenic	Tetrachloroethene, bis(2-Ethylhexyl)phthalate	Chloroform, Heptachlor epoxide, RDX	NA	

NA - Not applicable, pathway incomplete.
[1]Inhalation calculated for adult only.

Table 7-5
Summary of CTE Cancer Risks and Hazard Indices
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1
Current/Future Industrial Worker Adult	Vapors from Shallow Groundwater Building 13	Ingestion	NA				NA	
		Dermal Contact	NA				NA	
		Inhalation	2.7E-06			Trichloroethene	1.8E-02	
		Total	2.7E-06			Trichloroethene	1.8E-02	
Current/Future Industrial Worker Adult	Vapors from Shallow Groundwater Building 46	Ingestion	NA				NA	
		Dermal Contact	NA				NA	
		Inhalation	6.8E-09				9.0E-04	
		Total	6.8E-09				9.0E-04	
Current/Future Industrial Worker Adult	Vapors from Shallow Groundwater Building 47	Ingestion	NA				NA	
		Dermal Contact	NA				NA	
		Inhalation	9.2E-06			Vinyl Chloride	7.4E-02	
		Total	9.2E-06			Vinyl Chloride	7.4E-02	
Current/Future Industrial Worker Adult	Vapors from Shallow Groundwater Building 54	Ingestion	NA				NA	
		Dermal Contact	NA				NA	
		Inhalation	5.9E-05		Trichloroethene		3.9E-01	
		Total	5.9E-05		Trichloroethene		3.9E-01	
Current/Future Industrial Worker Adult	Vapors from Shallow Groundwater Building 63	Ingestion	NA				NA	
		Dermal Contact	NA				NA	
		Inhalation	4.7E-08				4.7E-04	
		Total	4.7E-08				4.7E-04	
Current/Future Industrial Worker Adult	Vapors from Shallow Groundwater Building 90	Ingestion	NA				NA	
		Dermal Contact	NA				NA	
		Inhalation	2.4E-07				4.8E-03	
		Total	2.4E-07				4.8E-03	
Current/Future Industrial Worker Adult	Vapors from Shallow Groundwater Building 1556	Ingestion	NA				NA	
		Dermal Contact	NA				NA	
		Inhalation	2.1E-05		Trichloroethene		1.5E-01	
		Total	2.1E-05		Trichloroethene		1.5E-01	
Future Resident Adult	Deep Groundwater	Ingestion	NA				2.4E+00	Arsenic
		Dermal Contact	NA				7.6E-02	
		Inhalation	NA				4.5E-03	
		Total	NA				2.5E+00	Arsenic
Future Resident Child	Deep Groundwater	Ingestion	NA				8.0E+00	Arsenic, Vanadium
		Dermal Contact	NA				1.7E-01	
		Inhalation	NA				NA	
		Total	NA				8.2E+00	Arsenic, Vanadium
Future Resident Adult/Child	Deep Groundwater	Ingestion	3.1E-04	Arsenic			NA	
		Dermal Contact	7.8E-07				NA	
		Inhalation[1]	6.6E-07				NA	
		Total	3.1E-04	Arsenic			NA	
Future Construction Worker Adult	Shallow Groundwater	Ingestion	NA				NA	
		Dermal Contact	2.2E-07				1.0E-01	
		Inhalation	1.6E-08				1.3E-03	
		Total	2.3E-07				1.0E-01	

Table 7-5
Summary of CTE Cancer Risks and Hazard Indices
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1
Future Resident Adult	Shallow Groundwater	Ingestion	NA				7.8E+00	Trichloroethene
		Dermal Contact	NA				1.1E+00	
		Inhalation/Shower	NA				8.6E-01	
		Inhatlation/Indoor Air					8.3E+00	Trichloroethene, Vinyl chloride
		Total	NA				1.8E+01	Trichloroethene, Vinyl chloride
Future Resident Child	Shallow Groundwater	Ingestion	NA				2.6E+01	Trichloroethene, Vinyl chloride, cis 1,2-dichlorothene, Arsenic
		Dermal Contact	NA				2.2E+00	Trichloroethene
		Inhalation/Indoor air	NA				6.2E+01	Benzene,Trichloroethene,Vinyl chloride, Dichlorodifluoromethane (Freon 12)
		Total	NA				9.0E+01	Trichloroethene, Vinyl chloride, cis 1,2-dichlorothene, Dichlorodifluoromethane (Freon 12), Benzene, Arsenic
Future Resident Adult/Child	Shallow Groundwater	Ingestion	1.1E-03	Trichloroethene, Vinyl chloride	Benzene, Arsenic	Tetrachloroethene, Heptachlor epoxide, RDX	NA	
		Dermal Contact	4.3E-05		Trichloroethene, Vinyl chloride	Benzene, Tetrachloroethene	NA	
		Inhalation[1]/Shower	2.3E-04	Trichloroethene	Benzene, Vinyl chloride	Chloroform	NA	
		Inhalation/Indoor Air	7.8E-06			Trichloroethene, Vinyl chloride		
		Total	1.4E-03	Trichloroethene, Vinyl chloride	Benzene, Arsenic	Tetrachloroethene, Chloroform, Heptachlor epoxide, RDX, bis(2-Ethylhexyl)phthalate	NA	

NA - Not applicable, pathway incomplete.
[1]Inhalation calculated for adult only.

Table 7-6
Effect of Use of Draft 2001 TCE Toxicity Values on Human Health Risk Assessment Results
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Receptor	Media	Pre-2001		Draft-2001	
		Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Current/Future Industrial Worker	Groundwater - Indoor Air - Building 13	2.4E-05	5.7E-02	1.4E-03	9.6E-01
	TOTAL	2.4E-05	5.7E-02	1.4E-03	9.6E-01
Current/Future Industrial Worker	Groundwater - Indoor Air - Building 46	6.1E-08	2.9E-03	3.5E-06	5.2E-03
	TOTAL	6.1E-08	2.9E-03	3.5E-06	5.2E-03
Current/Future Industrial Worker	Groundwater - Indoor Air - Building 47	4.7E-05	3.8E-01	2.2E-04	5.0E-01
	TOTAL	4.7E-05	3.8E-01	2.2E-04	5.0E-01
Current/Future Industrial Worker	Groundwater - Indoor Air - Building 54	3.0E-04	7.1E-01	1.7E-02	1.2E+01
	TOTAL	3.0E-04	7.1E-01	1.7E-02	1.2E+01
Current/Future Industrial Worker	Groundwater - Indoor Air - Building 63	4.2E-07	1.5E-03	1.6E-05	1.2E-02
	TOTAL	4.2E-07	1.5E-03	1.6E-05	1.2E-02
Current/Future Industrial Worker	Groundwater - Indoor Air - Building 90	2.1E-06	1.5E-02	1.8E-05	2.6E-02
	TOTAL	2.1E-06	1.5E-02	1.8E-05	2.6E-02
Current/Future Industrial Worker	Groundwater - Indoor Air - Building 1556	1.1E-04	2.8E-01	5.8E-03	4.1E+00
	TOTAL	1.1E-04	2.8E-01	5.8E-03	4.1E+00
Future Construction Worker	Groundwater	1.6E-06	6.1E-01	2.6E-05	1.0E+01
	TOTAL	1.6E-06	6.1E-01	2.6E-05	1.0E+01
Future Resident - Adult (Shallow Groundwater)	Groundwater	NA	2.9E+01	NA	3.5E+02
	Groundwater - Indoor Air	NA	2.2E+01	NA	2.3E+02
	TOTAL	NA	5.1E+01	NA	5.8E+02
Future Resident - Child (Shallow Groundwater)	Groundwater	NA	6.5E+01	NA	7.9E+02
	Groundwater - Indoor Air	NA	6.2E+01	NA	6.5E+02
	TOTAL	NA	1.3E+02	NA	1.4E+03
Future Resident - Child/Adult (Shallow Groundwater)	Groundwater	5.6E-03	NA	9.0E-03	NA
	Groundwater - Indoor Air	1.2E-02	NA	5.2E-01	NA
	TOTAL	1.8E-02	NA	5.3E-01	NA

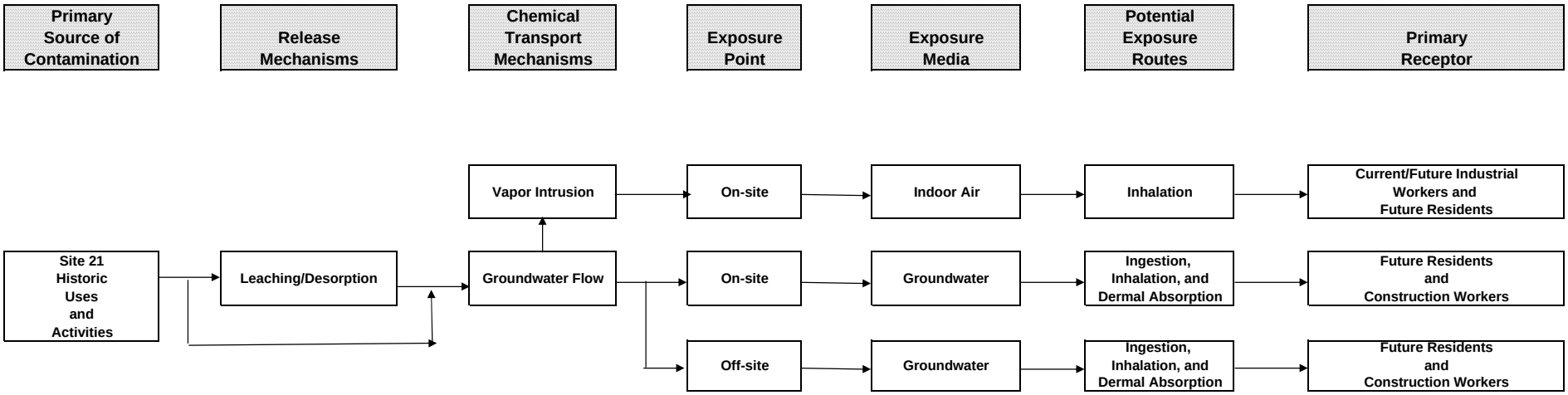

Figure 7-1
Conceptual Exposure Model, Potential Human Exposures at Site 21
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

WDC012820001.XLS

SECTION 8

Ecological Risk Assessment

Based on the recommendations of ERSs conducted during the SSA (CH2M HILL, 2003a) and SI (CH2M HILL, 2004a), an ecological risk assessment is not required for Site 21. As indicated in Section 2, an ERS was conducted during the SSA for Site 21, as well as each of the former sites and AOCs currently included within the expanded Site 21 boundary. To evaluate additional data collected during SI activities, a follow-up ERS was conducted during the SI for Site 21. The ERSs were conducted to determine if there is the potential for adverse effects to potential ecological receptors. As part of this screen, each area was evaluated to determine if it could provide habitat for terrestrial or aquatic life. Potential chemical transport pathways were also reviewed to determine if chemicals could be transported to viable habitats at offsite locations.

The SSA ERS concluded that Site 21 (including the former sites and AOCs currently included within the site boundary) provides little terrestrial habitat (e.g., paved industrial area). In addition, the SSA ERS concluded that there are no viable aquatic habitats (e.g., surface water features) for potential ecological receptors. Therefore, further evaluation was not recommended for Site 21 or any of the former sites or AOCs now included within the Site 21 boundary.

During the SI ERS, groundwater discharge to the Site 2 inlet and adjacent St. Juliens Creek were identified as additional transport pathways to offsite. As an additional screening measure, chemical concentrations in groundwater were screened to determine if they are present at concentrations that could represent a potential risk to aquatic life. Only TCE was detected at concentrations exceeding its ecological screening value, indicating a potential risk. However, based on the transport distance before discharging to surface water, and the potential for mixing and dilution; there is minimal potential for adverse effects to aquatic life from the presence of TCE in groundwater. SVOCs and inorganic chemicals were identified as unlikely to be present in groundwater at concentrations that represent site-related risks to ecological receptors and did not warrant detailed evaluation. Additionally, CVOCs detected in storm water and the surface water at the outfall of the storm sewer system (Site 2 inlet) were screened against the Biological Technical Assistance Group (BTAG) surface water screening criteria. No exceedances were identified; therefore, no additional evaluation of ecological risk was recommended.

SECTION 9

Conclusions and Recommendations

The following conclusions regarding the site background, nature and extent of contamination, fate and transport, and risk to human and ecological receptors have been derived from the data collected during the SI and RI at Site 21, as summarized below. Risk management considerations and recommendations for next steps are also discussed.

9.1 Site Background

The current site boundary and status of Site 21 is the result of numerous activities and investigations. Site 21 began as Building 187 and was located in the vicinity of several other IR Sites (**Figure 2-3**). As investigations of these sites progressed and sites were closed out as a result, the boundary of Site 21 changed. Groundwater was determined to be the only media of concern, and the Site 21 boundary was expanded to encompass the plume, including areas previously identified as separate sites. These investigations and decisions are summarized below.

A preliminary review of all available documents and a visual site inspection (VSI) to identify sites for further action was conducted in 1989 as part of a RFA. Fifteen SWMUs (seven now encompassed by Site 21) and eight AOCs (one now within Site 21) were identified for further action. Based on the RFA, 21 sites were investigated in 1996 during the RRR to identify and prioritize sites requiring further investigation. The RRR included soil and/or groundwater sampling at Sites 9, 10, 11, 18, and 21. The sample locations were focused in areas of potential historical releases/potential risk, representing worst-case scenarios. The data was provided to the Navy for planning purposes, and was later evaluated in the SSA.

Construction of the SIMA Building (Building 1556) began in 1992. Several IR sites (Sites 9, 12, 13, and 14) were included within the footprint of the building. Soil removals were conducted at those sites prior to construction of the SIMA building. Soil samples were collected to characterize the soil at SWMUs 13, 16, and 20 for disposal and to confirm the extent of removal at SWMUs 16 and 20 was sufficient (Baker, 1993). The results of the samples collected to confirm that the extent of removal was sufficient were below regulatory limits and met Virginia requirements for cleanup of petroleum contaminated soil. Although there is limited soil confirmation data, no petroleum-related constituents were detected in shallow groundwater, suggesting that petroleum contaminated soil is not present in the vicinity of Site 9. Additionally, a HHRS was conducted on the remaining soil to confirm no risks to construction workers. The sites were closed as NFA in the FFA (DoD, 2004).

During the SSA, the data from the RRR were evaluated and human health and ecological risk screenings were conducted to evaluate whether sites required additional investigation, removal action, or no further action. Although the number of samples included in the risk screenings appears low in relation to the current site size, the site boundary has grown to encompass the groundwater plume as investigations at the site have progressed. The RRR

recommended NFA for Sites 10, 11, and 18. Soil at Site 21 was recommended for NFA, although groundwater was recommended for further investigation and included incorporation of groundwater at Site 11.

Following the SSA, a SI was conducted to further characterize contamination in groundwater, the remaining media of concern. A HHRS identified VOCs and RDX as COPCs in shallow groundwater; and arsenic, chloroform, and vanadium as COPCs in deep groundwater. An ERS concluded that little ecological habitat exists for potential ecological receptors. The SI recommended further delineation of VOCs in shallow groundwater and sampling of existing wells to confirm or deny the elevated concentrations of arsenic, chloroform, vanadium, and RDX.

A Supplemental SI was conducted to address the SI data gaps, including further characterization of shallow and deep groundwater and evaluation of storm water transport of contaminants to Site 2. The SI was conducted in several phases, which were jointly scoped. In May 2007, the team agreed to expand the Supplemental SI into a RI due to the extensive nature of data collection and because the nature and extent of contamination had been fully delineated.

This RI was conducted to address the remaining data gaps identified. The objectives were to define the shallow groundwater CVOC plume boundary and physical and geochemical characteristics of shallow groundwater; evaluate contaminant fate and transport to develop a CSM; and determine if the site poses unacceptable human health and ecological risks. Because NFA was determined for soil prior to SI, no further investigation of soil was conducted in the RI.

9.2 Nature and Extent of Contamination

A level of uncertainty is associated with the results of the samples where the reporting limits are elevated above the respective MCLs. For this project, the reporting limits were dictated by the CLP analytical method. Due to elevated contaminant concentration for some analytes, the lab was not able to analyze the samples using a low concentration method without risking instrumentation damage. Therefore, the extent of the contaminants may be greater than indicated.

9.2.1 Shallow Groundwater

Of the 31 VOCs detected in the shallow groundwater, six of them—benzene; 1,2-dibromo-3-chloropropane; 1,1-DCE; cis-1,2-DCE; TCE; and VC—were detected at concentrations above their respective MCLs (**Table 5-4** and **Figure 5-2**). TCE and its degradation products were the most frequently detected contaminants. Based on the analytical results, the TCE plume is approximately 8 acres (**Figure 5-3**). The location and extent of the cis-1,2-DCE and VC plumes, covering approximately 8.1 and 3.2 acres, respectively, are aligned with the TCE plume (**Figure 5-4** and **Figure 5-5**).

The maximum concentrations of TCE detected in shallow groundwater at Site 21 are 16,000 µg/L at SJS21-MW15S and 13,000 µg/L at SJS21-MW16S, indicating the likely presence of DNAPL. Depth-specific groundwater samples collected at the bottom of the Columbia aquifer at select monitoring wells (SJS21-MW07S, -MW12S, and -MW13S) resulted in CVOC

concentrations 2 to 7 times higher, indicating that CVOC concentrations at the base of the aquifer at MW15S and MW16S may also be higher and further support the conclusion that DNAPL is likely present.

1,2- dibromo-3-chloropropane and benzene were only detected above the MCL at one well. 1,2-dibromo-3-chloropropane is not considered to be site related because of the isolated detection. Detections of benzene in groundwater are most likely associated with the former UST site upgradient of this well.

The SVOC bis(2-ethylhexyl)phthalate was only detected above its corresponding MCL at one well (**Figure 5-6**). Additionally, one explosive, RDX, was detected at an estimated concentration. There is no MCL established for this constituent. Because these constituents were isolated detections they are not likely related to a site release.

Two pesticides, beta-BHC, and heptachlor epoxide, were detected in shallow groundwater (**Table 5-5**). Beta-BHC does not have a MCL for comparison, and heptachlor epoxide was below its MCL. These low detections were likely associated with routine application during landscaping operations. No PCBs were detected in shallow groundwater.

Several metals were detected, although only arsenic was detected above the corresponding MCL at SJS21-MW09S (**Figure 5-6**). The arsenic is most likely associated with the former UST site upgradient of this well.

9.2.2 Deep Groundwater

One explosive, 1,3-dinitrobenzene, was detected at an estimated concentration (1.1 J µg/L) in deep groundwater. There is no MCL established for this constituent. Several metals were detected, although only arsenic was detected at a concentration exceeding the corresponding MCL. Arsenic exceeded the MCL (10 µg/L) in the initial sample following well installation, detected at concentrations of 72.8 µg/L total and 72 µg/L dissolved. During two subsequent sampling events, arsenic was either not detected or detected below the MCL (**Table 5-6** and **Figure 5-7**).

9.2.3 Storm Water and Surface Water

Several CVOCs, including TCE, cis-1,2-DCE, and VC, were detected in the storm water and surface water (**Table 5-2**). The highest CVOC concentrations (150 µg/L TCE, 32 µg/L, cis-1,2-DCE, 1.5 µg/L VC) were detected in the storm sewer system east and south of Building 1556 and in the surface water at the outlet of the drainage culvert in the Site 2 inlet. Detections of CVOCs in the storm sewers indicate transport and possible release of CVOCs to the Site 2 inlet. The storm sewer system video inspection concluded that the storm sewer system is providing a potential transport mechanism for CVOCs in shallow groundwater to the Site 2 inlet.

9.2.4 Soil

Because the nature and extent of contamination in soil was defined and evaluated during previous investigations in the Site 21 vicinity, and no human health or ecological risks were identified, no further investigation or action for soil was necessary (Sections 2.3 and 2.4). Subsequent to the no further action decision for soil, subsurface soil data were collected from the shallow aquifer during the RI to assist in evaluation of remedial alternatives for

groundwater and determine the presence/absence of DNAPL and are incorporated into the fate and transport discussion (Section 6 and Section 9.3).

9.3 Fate and Transport of Contamination

As depicted in the CSM (**Figure 6-1**), the current primary migration pathways of CVOCs at Site 21 are comprised of:

- Dissolved plume migration downgradient with groundwater flow (advection)
- Groundwater discharge to the leaking storm sewer system and to the south toward St. Juliens Creek
- DNAPL desorbing from the top of the Yorktown confining unit into shallow groundwater

The potential migration pathway of vapor intrusion into indoor air (volatilization) is currently being evaluated.

As discussed in Section 6.1, the mechanisms responsible for the fate of contaminants include:

- Sorption of contaminants to soil surfaces, which affects advection rates and the extent of lateral spreading
- Natural degradation through different pathways (predominantly breakdown by biological processes), which play a significant role in the length of time the contaminants will exist in the subsurface
- Volatilization of contaminants from groundwater into the gas phase, which results in a decrease of contaminant mass from the saturated zone; however, the net effect of volatilization on overall contaminant mass removal from the saturated zone will likely be fairly insignificant.

9.4 Human Health Risk Assessment

The HHRA was conducted to evaluate the potential human health risks associated with current and hypothetical future receptors and exposure scenarios if no remedial action is implemented for shallow and deep aquifer groundwater. A summary of the RME and CTE risks are provided in **Tables 7-4** and **7-5**, respectively.

9.4.1 Shallow Groundwater

There are no non-carcinogenic hazards or carcinogenic risks that exceed USEPA target levels for a construction worker exposed to shallow groundwater during excavation activities. Future potable use of shallow aquifer groundwater may pose non-carcinogenic hazards and carcinogenic risks above USEPA target levels for future hypothetical residents. The non-carcinogenic hazard to the adult resident based on RME is associated with ingestion of TCE, VC, cis-1,2-DCE, and arsenic and inhalation (indoor air) of VC or dichlorodifluoromethane. Based on CTE, the non-carcinogenic hazard to the adult resident is associated with ingestion of TCE and inhalation (indoor air) of VC. The non-carcinogenic hazards to the child resident

based on both RME and CTE are associated with ingestion of benzene, TCE, VC, cis-1,2-DCE, and arsenic and inhalation (indoor air) of TCE. The carcinogenic risk to the hypothetical future lifetime resident based on RME is associated with ingestion of TCE, VC, and arsenic; inhalation (shower) of TCE; and inhalation (indoor air) of TCE and VC. Based on CTE, the carcinogenic risk to the hypothetical future lifetime resident is associated with ingestion and inhalation (shower) of TCE and ingestion of VC.

For current/future land use, there are no non-carcinogenic hazards that exceed the USEPA target for an industrial worker exposed to vapors that may migrate from shallow groundwater to indoor air in current on-site buildings. Carcinogenic risks slightly exceed USEPA target risk range for an industrial worker exposed to vapors, primarily from TCE, that may migrate from shallow groundwater to indoor air into Buildings 54 and 1556 based on RME; however there are no risks based on CTE. The potential risk is less than the ATSDR acute Minimal Risk Level; which indicates there is no acute or short-term risk to building occupants from potential vapor intrusion pathways. Risks associated with indoor air for all other buildings fall below the USEPA target risk range. For hypothetical future residents, both RME and CTE risks and hazards associated with vapors that may migrate from shallow groundwater to indoor air in a future onsite residence, exceed USEPA target levels. These risks and hazards are associated with TCE, VC, benzene, and dichlorodifluoromethane (Freon 12).

Benzene was only detected above the respective MCL at one well, SJS21-MW09S, which is located downgradient of a closed former UST site. Degradation of petroleum compounds from the former leaking UST has resulted in reducing conditions at this location, as indicated by the low DO, negative ORP, and elevated ferrous iron concentrations measured. These reducing conditions have increased the mobility of naturally occurring arsenic, resulting in arsenic concentrations above the MCL at SJS21-MW09S. Although potential risks were identified from exposure to benzene and arsenic at SJS21-MW09S by hypothetical future residents, these compounds are fuel-related and are not treated under CERCLA based on the petroleum exclusion.

9.4.2 Deep Groundwater

For future land use, potable use of deep aquifer groundwater may pose non-carcinogenic hazards and carcinogenic risks above USEPA target levels. The non-carcinogenic hazard to the adult resident is associated with ingestion of arsenic and to the child resident is associated with ingestion of arsenic and vanadium. The carcinogenic risk to the hypothetical future lifetime resident is associated with ingestion of arsenic. Both RME and CTE non-carcinogenic hazards and carcinogenic risks exceed USEPA target levels.

Although the HHRA identified potential human health risks from exposure to arsenic and vanadium in deep groundwater, the deep groundwater does not appear to have been impacted by Site 21 activities. Arsenic and vanadium were detected only sporadically and were not identified in the Columbia aquifer within the same area of the site. Additionally, a laterally extensive hydraulic aquitard (Yorktown confining unit) is present in which there is very low vertical permeability in clay, preventing downward migration of COPCs.

9.4.3 Storm Water and Surface Water

Because no there are no surface water bodies within Site 21, human health risk was not evaluated in this media. Surface water at the outfall of the storm sewer system is within the boundary of IR Site 2, at which a higher concentration CVOC shallow groundwater plume has been identified and is discharging to the same surface water body. Therefore, potential human health risk associated with surface water will be evaluated in the Site 2 RI, and any risks identified will be addressed during the Site 2 Remedial Action.

9.5 Ecological Risk Assessment

Based on the recommendations of ERSs conducted during the SSA (CH2M HILL, 2003a) and SI (CH2M HILL, 2004a), an ecological risk assessment was not conducted for Site 21. The results of the ERS conducted during the SSA concluded that Site 21 provides little terrestrial habitat and no aquatic habitat for potential ecological receptors. Therefore, further evaluation was not recommended for Site 21 or any of the former sites or AOCs now included within the Site 21 boundary.

The additional screening for groundwater discharge conducted during the SI indicated a potential risk based on TCE exceedances of its ecological screening value. However, based on the transport distance before discharging to surface water, and the potential for mixing and dilution; there is minimal potential for adverse effects to aquatic life from the presence of TCE in groundwater. SVOCs and inorganic chemicals were identified as unlikely to be present in groundwater at concentrations that represent site-related risks to ecological receptors and did not warrant detailed evaluation. Additionally, no CVOC exceedances were detected in storm water and the surface water at the outfall of the storm sewer system (Site 2 inlet); therefore, no additional evaluation of ecological risk was recommended.

9.6 Recommendations

Based on the results of the field investigations, the following recommendations have been identified for each media.

9.6.1 Shallow Groundwater

Based on the potential risk identified from inhalation of indoor air in Buildings 54 and 1556, dichlorofluoromethane, TCE, and VC were retained as COPCs. However, because the potential risk was based on indoor air concentrations developed using the Johnson and Ettinger model and uncertainties are associated with its use, further evaluation of the potential vapor intrusion pathway is necessary. Collection of site-specific data is ongoing. A building survey has been performed at the site. In addition, a work plan is being prepared to further evaluate the vapor intrusion pathway at Site 21 buildings. The results of this evaluation will be used to refine the HHRA.

Based on evaluation of the data, TCE, cis-1,2-DCE, VC, and 1,1-DCE were retained as the constituents of concern (COCs) for potable use of the shallow groundwater. **Figure 9-1** shows the location of the COCs. A FS is recommended to evaluate potential remedial alternatives to mitigate unacceptable human health risks from the COCs in shallow

groundwater at Site 21. **Figure 9-1** shows the location of the site-related COCs requiring further action. If appropriate, the FS may include the further evaluation of the potential vapor intrusion pathway as described above.

Because arsenic and benzene are not site-related as discussed in Section 9.3.1, the remedial alternatives do not need to address these constituents; however, the evaluation of remedies should take into consideration the potential for mobilizing naturally occurring arsenic.

9.6.2 Deep Groundwater

Although the HHRA identified potential human health risks from exposure to arsenic and vanadium in deep groundwater (Yorktown aquifer), the risk assessment was performed using the results of all rounds of data collected from the deep aquifer, and the rounds were not consistent. The arsenic and vanadium concentrations in groundwater collected in the first round of sampling indicated potential risk; however, arsenic and vanadium were either not detected or detected below their MCLs in the two subsequent rounds of sampling. Therefore, it is likely that the arsenic and vanadium concentrations detected in the first round of sampling are indicative of natural conditions and not a site release. Arsenic and vanadium were not detected in the shallow aquifer (Columbia aquifer) in the same area of the site, and a laterally extensive hydraulic aquitard (Yorktown confining unit) is present preventing downward migration of contaminants, supporting the fact that deep groundwater does not appear to have been impacted by Site 21 activities. Therefore, the team agrees to risk manage deep groundwater at Site 21 with no further action.

9.6.3 Storm Water and Surface Water

Although the storm sewer system may provide a potential transport mechanism for CVOCs in shallow groundwater to the Site 2 inlet, the damage identified in the sections of the storm sewer system passing through the area of groundwater contamination is classified as light to moderate and it is not expected to negatively impact groundwater remediation. Additionally, shallow groundwater flow is generally towards the storm sewer system and repair of the system may alter the shallow groundwater flow direction, causing contaminant migration further west, under Building 1556. Therefore, it is recommended that no repairs be made to the storm sewer system at Site 21. As indicated in Section 9.3.3, CVOCs in surface water within the Site 2 inlet will be evaluated and addressed as part of Site 2. Because water in the storm sewer system within Site 21 is primarily groundwater, except during precipitation events, it will be addressed during any future groundwater remedial action.

9.6.4 Soil

Based on a review of historical activities and previous investigations at Site 21, and because no human health or ecological risks were identified in soil, the team agrees that no further action is required for Site 21 soil.

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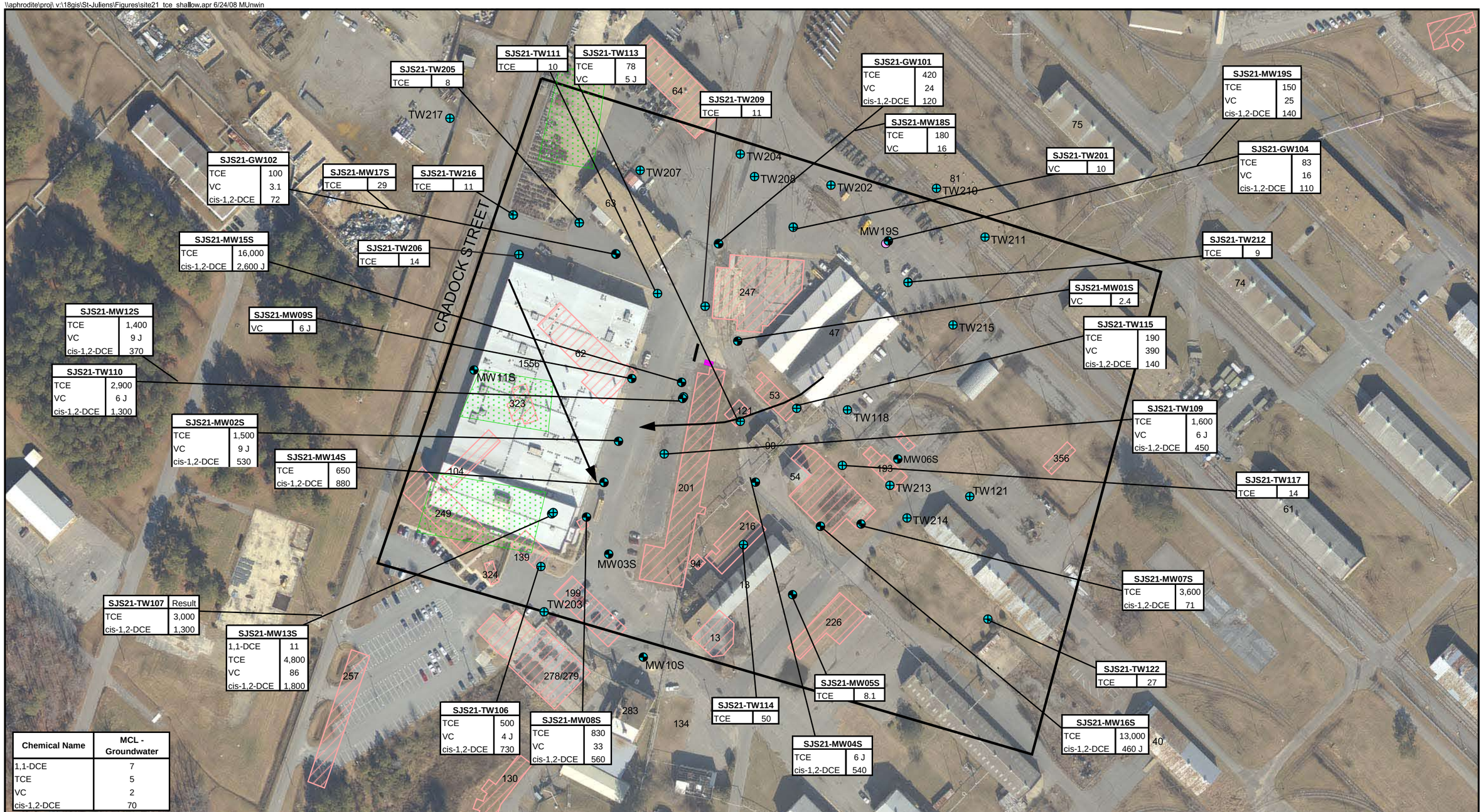

Chemical Name	MCL - Groundwater
1,1-DCE	7
TCE	5
VC	2
cis-1,2-DCE	70

LEGEND

- Site 21 Boundary
- Shallow Monitoring Well Location
- Temporary Monitoring Well Location
- Grab Groundwater Sample Location
- Demolished Buildings
- Estimated Groundwater Flow Direction
- Approx. Areas of TPH Contaminated Soil Removal (1993)
- Approx. Locations of Former USTs
- Former Service Station

DCE - dichloroethene
TCE - trichloroethene
VC - vinyl chloride
J - Reported value is estimated
All results are reported in µg/L.
Results shown are MCL exceedances of site related COCs.
The results shown are the most recent unless the detection limit was elevated, in which case a previous result is shown.

N

0 150 300 Feet

Figure 9-1
Location of Shallow Groundwater COCs
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

SECTION 10

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Appendix A
MIP Data and Report

COLUMBIA TECHNOLOGIES

SmartData Solutions™

Subsurface Characterization Using Membrane Interface Probe (MIP) and Soil Conductivity (SC) Technologies St. Juliens Creek Annex Virginia Beach, Virginia

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APPENDIXES

Appendix A: Trapping Area Count Results

Appendix B: MIP Logs (Best Fit Scale)

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Introduction

CH2MHill (CH2) contracted **COLUMBIA Technologies, LLC (COLUMBIA)** to conduct an investigation of subsurface contamination at the St. Juliens Creek Annex, located Virginia Beach, Virginia. This investigation involved delineating the depth and horizontal extent of contamination using Membrane Interface Probe (MIP) and Soil Conductivity (SC) technologies. The purpose of this investigation was to characterize subsurface soils in the vadose and saturated zones, and delineate the nature and extent of soil contamination.

The investigation was conducted from August 4th, 2003 through August 6th, 2003. COLUMBIA personnel on-site during the investigation included Eric Magdar, Mid-Atlantic Regional Director.

Objectives

The objectives of the MIP/SC investigation were to:

1. Characterize subsurface soils in the vadose and saturated zones.
2. Delineate the lateral boundaries of the contaminant.
3. Delineate the vertical extent of contamination.

Equipment Description

The MIP/SC probe is approximately 12-inches (30 cm) in length and 1.5-inches (3.8 cm) in diameter. The probe is driven into the ground at the nominal rate of one foot per minute using a Geoprobe® or similar direct push rig.

Soil conductivity, the inverse of soil resistivity, is measured using a dipole arrangement. In this process, an alternating electrical current is transmitted through the soil from the center, isolated pin of the probe. This current is then passed back to the probe body. The voltage response of the imposed current to the soil is measured across these same two points. Conductivity is measured in Siemens/meter, and due to the low conductivity of earth materials, the SC probe uses milliSiemens/meter (mS/m). The probe is reasonably accurate in the range of 5

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to 400 mS/m. In general, at a given location, lower conductivity values indicate larger particles such as sands, while higher conductivities are representative of finer sized particles such as silts and clays.

The MIP portion of the probe was developed and patented by Geoprobe Systems, Inc. The operating principle is based on heating the soil and/or water around a semi-permeable polymer membrane to 121°C, which allows volatile organic compounds (VOCs) to partition across this membrane. The MIP can be used in saturated or unsaturated soils, as water does not pass through the membrane. Using nitrogen as a carrier gas, which sweeps across the back of the membrane, the VOCs are carried to the installed detectors. It takes approximately 37 seconds for the nitrogen gas stream to travel through 100 feet of inert tubing and reach the detectors.

COLUMBIA utilizes three detectors: a Photo Ionization Detector (PID), a Flame Ionization Detector (FID) and an Electron Capture Detector (ECD), mounted on a laboratory grade Shimadzu Model 14A gas chromatograph. The output signal from the detectors is captured by a MIP data logging system installed on a MIP Field Computer or laptop computer. Conductivity, speed, detector data and temperature are displayed continuously in real time during each push of the probe. In addition, the data logs can be printed for display and analysis following the data logging run or exported to common spreadsheet software for further analysis using COLUMBIA's ***SmartData Solutions***™ technology.

The PID detector consists of a special UV lamp mounted on a thermostat controlled, low volume, flow-through cell. The temperature is adjustable from ambient temperature to 250°C. The 10.2 electron volt (eV) UV lamp emits energy at a wavelength of 120 nanometers, which is sufficient to ionize most aromatics (benzene, toluene, xylene, etc.) and many other molecules (H_2S, hexane, ethanol) whose ionization potential is below 10.2 eV. The PID also emits a lower response for chlorinated compounds such as TCE and PCE. Methanol and water, which have ionization potentials greater than 10.2 eV, do not respond on the PID. Detection limits for aromatics are in the low picogram range. Since the PID is non-

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destructive, it is often run first in series with other detectors for multiple analyses from a single injection. Use of the PID is mandated in several EPA methods (8021, TO-14 etc.) because of its sensitivity and selectivity.

The most commonly used GC detector is the FID, which responds linearly from its minimum detectable quantity of about 100 picograms. The FID response is very stable from day to day, and is not susceptible to contamination from dirty samples or column bleed. This detector responds to any molecule with a carbon-hydrogen bond, but poorly to compounds such as H_2S, CCl_4, or NH_3. The carrier gas effluent from the GC column is mixed with hydrogen and burned. Hydrogen supports a flame and ionizes the analyte molecules. A collector electrode attracts the negative ions to the electrometer amplifier, producing an analog signal, which is directed to the data system input.

The ECD detector consists of a sealed stainless steel cylinder containing radioactive Nickel-63. The Nickel-63 emits beta particles (electrons), which collide with the carrier gas molecules, ionizing them in the process. This forms a stable cloud of free electrons in the ECD cell. When electro-negative compounds (especially chlorinated, fluorinated or brominated molecules) such as carbon tetrachloride or TCE enter the cell, they immediately combine with the free electrons, temporarily reducing the number remaining in the electron cloud. The detector electronics, which maintain a constant current of about 1 nanoampere through the electron cloud, are forced to pulse at a faster rate to compensate for the decreased number of free electrons. The pulse rate is converted to an analog output, which is transmitted to the data system.

Trapping and Desorbing of MIP Gas Stream

In addition to the continuous profiling of the basic MIP system, further compound speciation was done by trapping the gas stream onto a sorbent. Volatile organic compounds were introduced into the trapping system from the MIP unit equipped with non-destructive detectors (PID and DELCD). When purging was complete, the sorbent tube was heated and back flushed to desorb trapped sample

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components. The analytes were desorbed directly to the analytical column of a laboratory grade SRI 8610C Environmental gas chromatograph for analysis. The column was temperature programmed to separate the analytes, which were then detected using PID, FID and DELCD detectors. Compound identifications are based on peaks placement within established retention time windows. Secondary identification of some compounds can be made from the second detector, if the compound responds on both detectors.

Performance Test

Prior to daily MIP logging, response tests with specific compounds are conducted to evaluate the sensitivity of the particular probe and detector suite to be used. For this site, a mixture of TCE and PCE was used. A standard stock solution of 50mg/mL was created with methanol based on the specific density of each compound. Aliquots of these solutions were added to 500 mL of DI water to create a concentration of one ppm. The heated probe was inserted into this test solution and the PID and ECD detector responses on the MIP were recorded. The test solution is also trapped and desorbed.

Investigation Methods

MIP/SC profiling was conducted at 16 locations on the property of the St. Juliens Creek Annex. All borings, except locations MIP_02 and MIP_04 included trapping and desorbing. Results of the trapping and desorbing efforts are in Appendix A. Drilling was completed using a Conetec designed DPT truck mounted rig, and termination of MIP logging was determined by CH2's representative onsite. The results from each location are shown in Appendix B. Maps and 3D graphics of the site have been prepared for easier visualization of the subsurface.

MIP Log Interpretation

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The MIP logs include six graphs. The first graph is conductivity and is measured in mS/M. In general, lower conductivities are indicative of coarser grained particles, such as sands, and higher conductivities indicate finer grained particles, such as silts and clays. The second graph is the rate of penetration (speed of the probe) and is measured in feet/min. This information can be used to determine how hard the subsurface is. The next three graphs are chemical data: PID, FID, and ECD, measured in microvolts (uV). These graphs are a linear scale, and give relative concentrations of contamination. The last graph displays the temperature of the probe as it is advanced in the subsurface. This graph can be useful to determine where the groundwater table is located.

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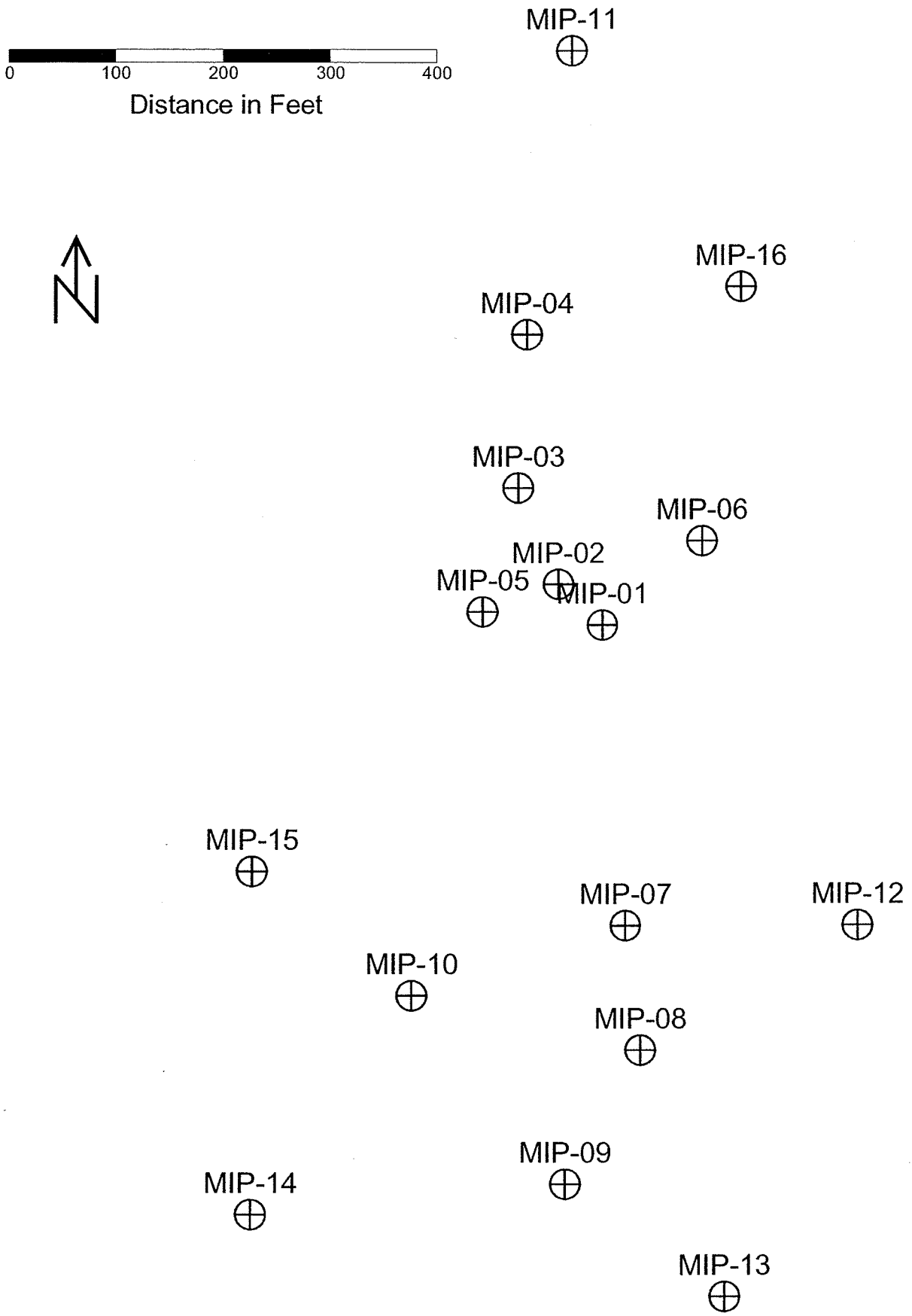

Figure 1
Basemap and MIP Locations
St. Juliens Creek Annex
CH2MHill
August 4th, 2003 – August 6th, 2003

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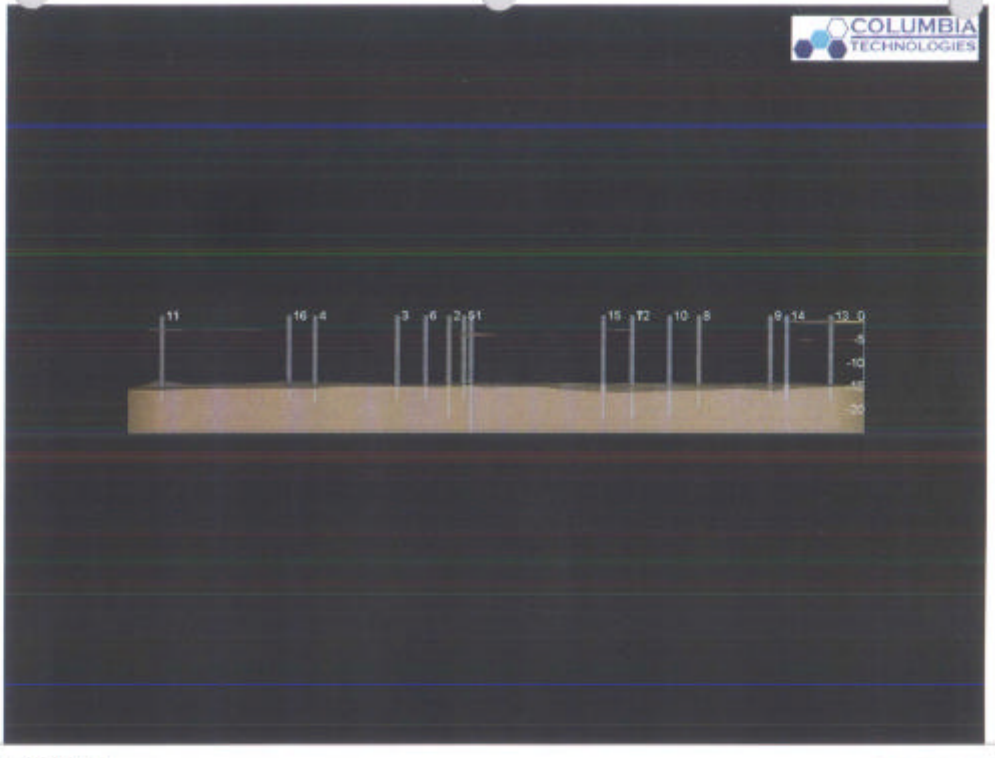

Figure 2
Transect View, Looking West
Soil Conductivity 30mS and Above
St. Juliens Creek Annex
CH2MHill
August 4th, 2003 – August 6th, 2003

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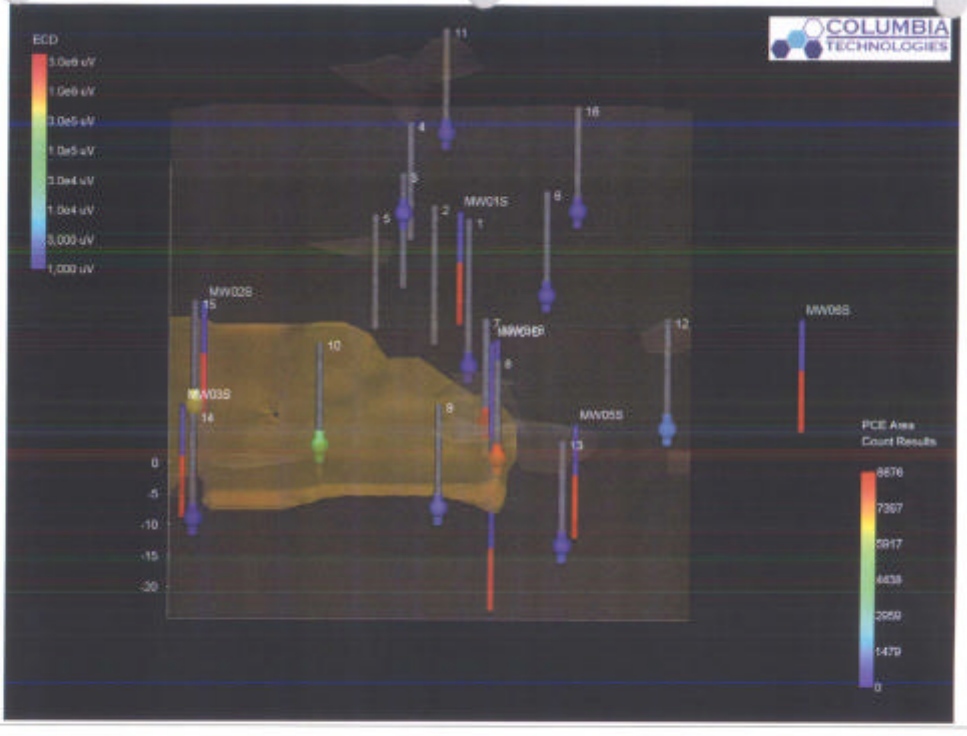

Figure 8
Oblique View, Looking North
ECD Response 8.0E+05uV and Above, With Soil Conductivity 30mS and Above, and PCE Area Counts
St. Juliens Creek Annex
CH2MHill
August 4th, 2003 – August 6th, 2003

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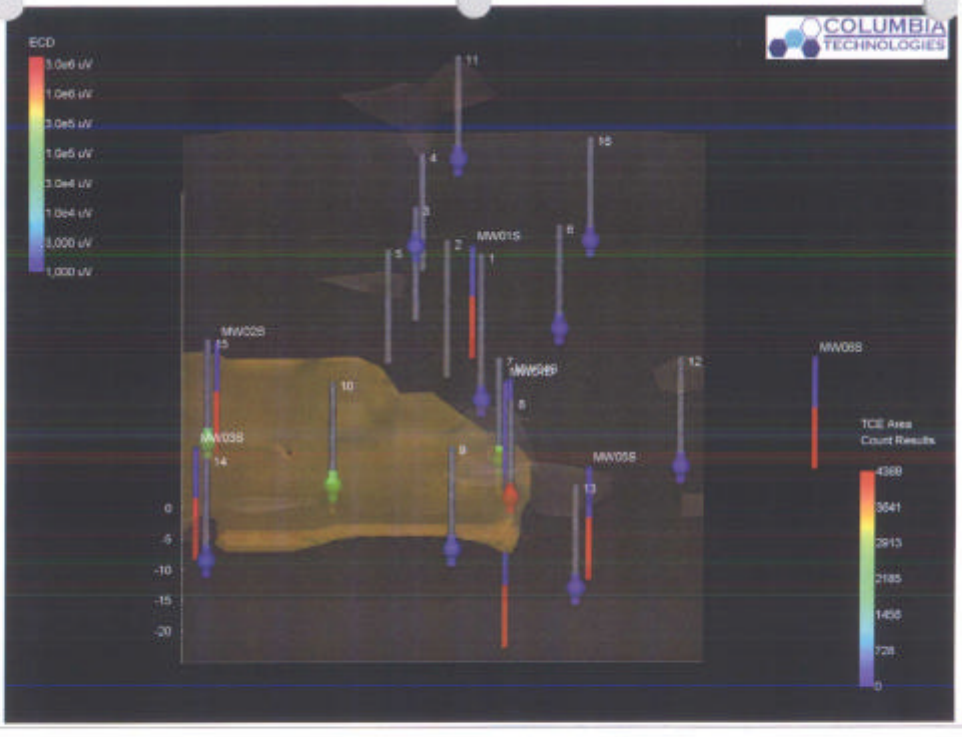

Figure 7
Oblique View, Looking North
ECD Response 8.0E+05uV and Above, With Soil Conductivity 30mS and Above, and TCE Area Counts
St. Juliens Creek Annex
CH2MHill
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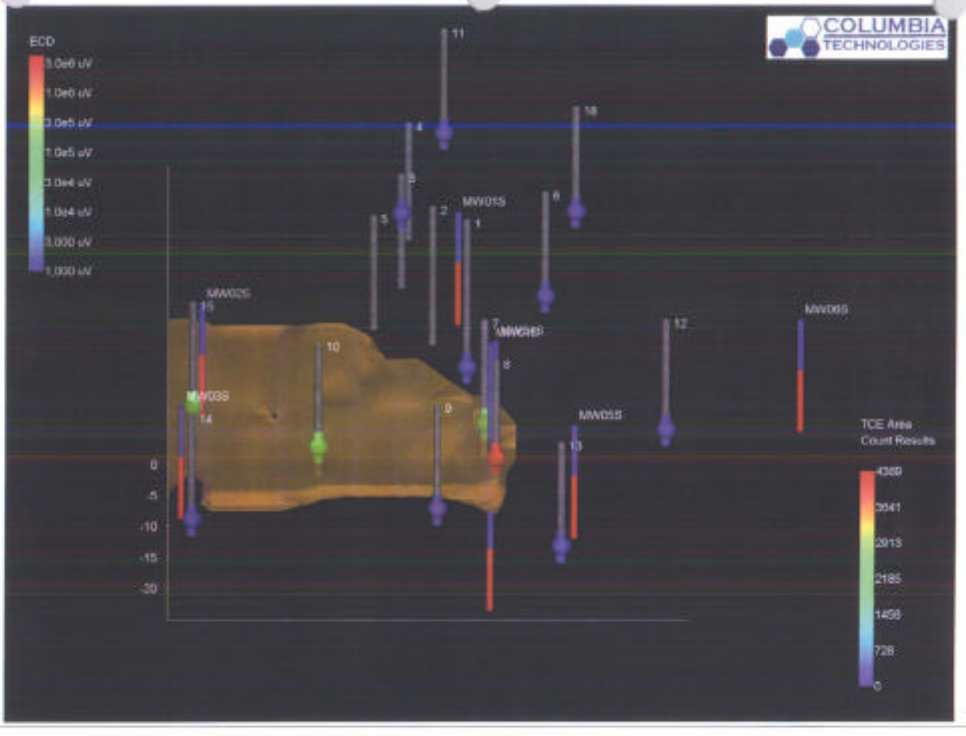

Figure 6
Oblique View, Looking North
ECD Response 8.0E+05uV and Above, With TCE Area Counts
St. Juliens Creek Annex
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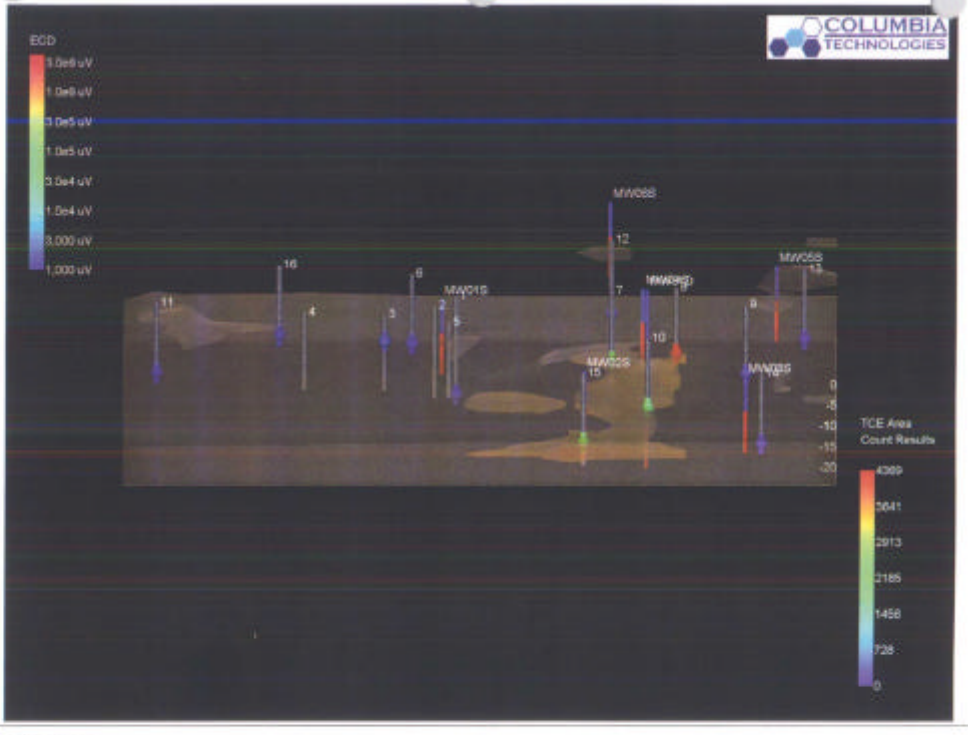

Figure 5
Oblique View, Looking West
ECD Response 1.1E+06uV and Above, With Soil Conductivity 30mS and Above, and TCE Area Counts
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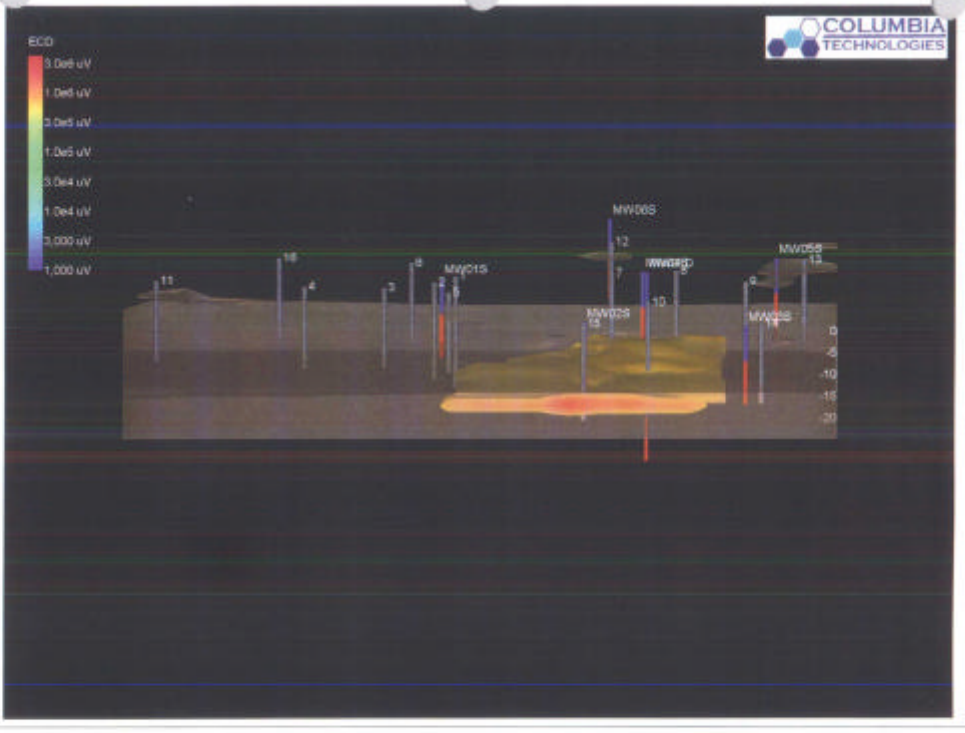

Figure 4
Oblique View, Looking West
ECD Response 8.0E+05uV and Above, With Soil Conductivity 30mS and Above
St. Juliens Creek Annex
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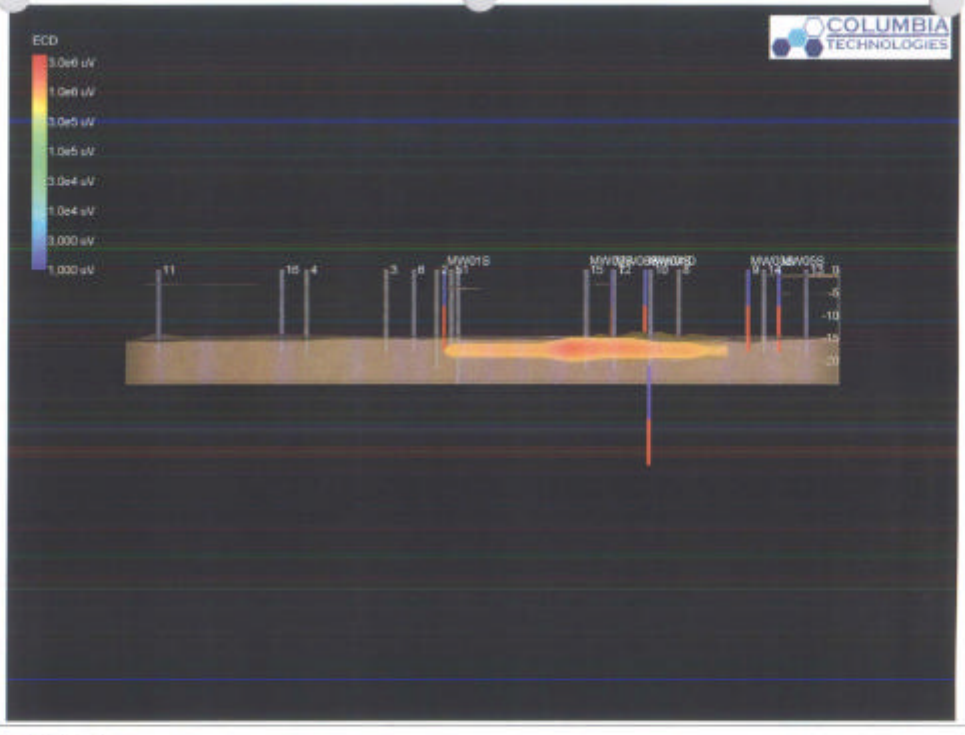

Figure 3
Transect View, Looking West
ECD Response, 8.0E+05uV and Above, With Soil Conductivity, 30 mS and Above
St. Juliens Creek Annex
CH2MHill
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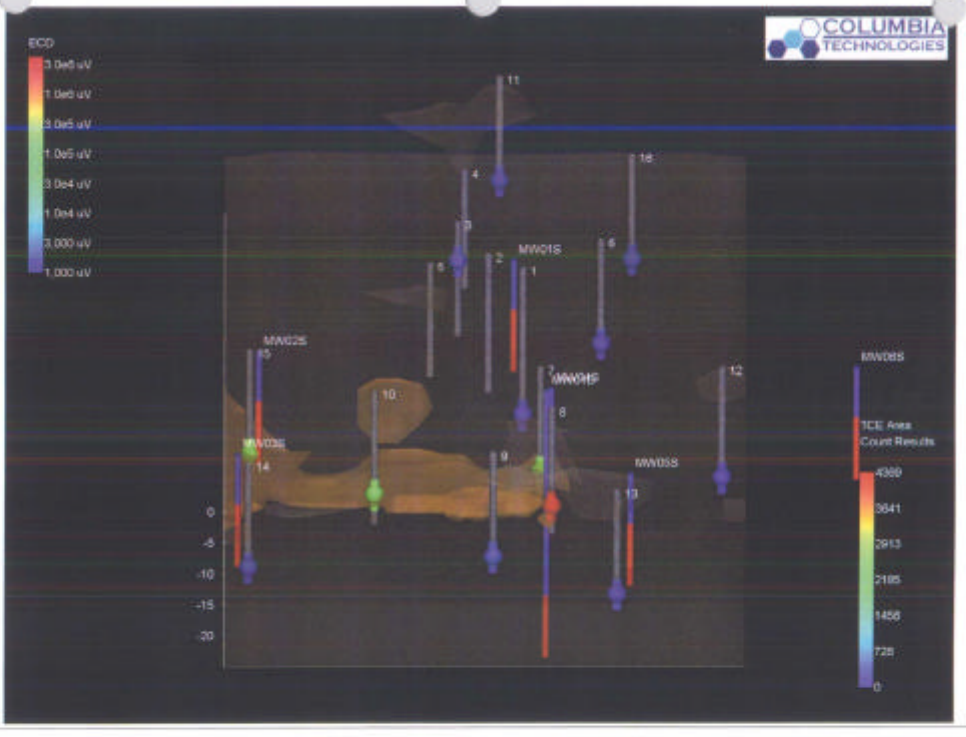

Figure 9
Oblique View, Looking North
ECD Response 1.1E+06uV and Above, With Soil Conductivity 30mS and Above, and TCE Area Counts
St. Juliens Creek Annex
CH2MHill
August 4th, 2003 – August 6th, 2003

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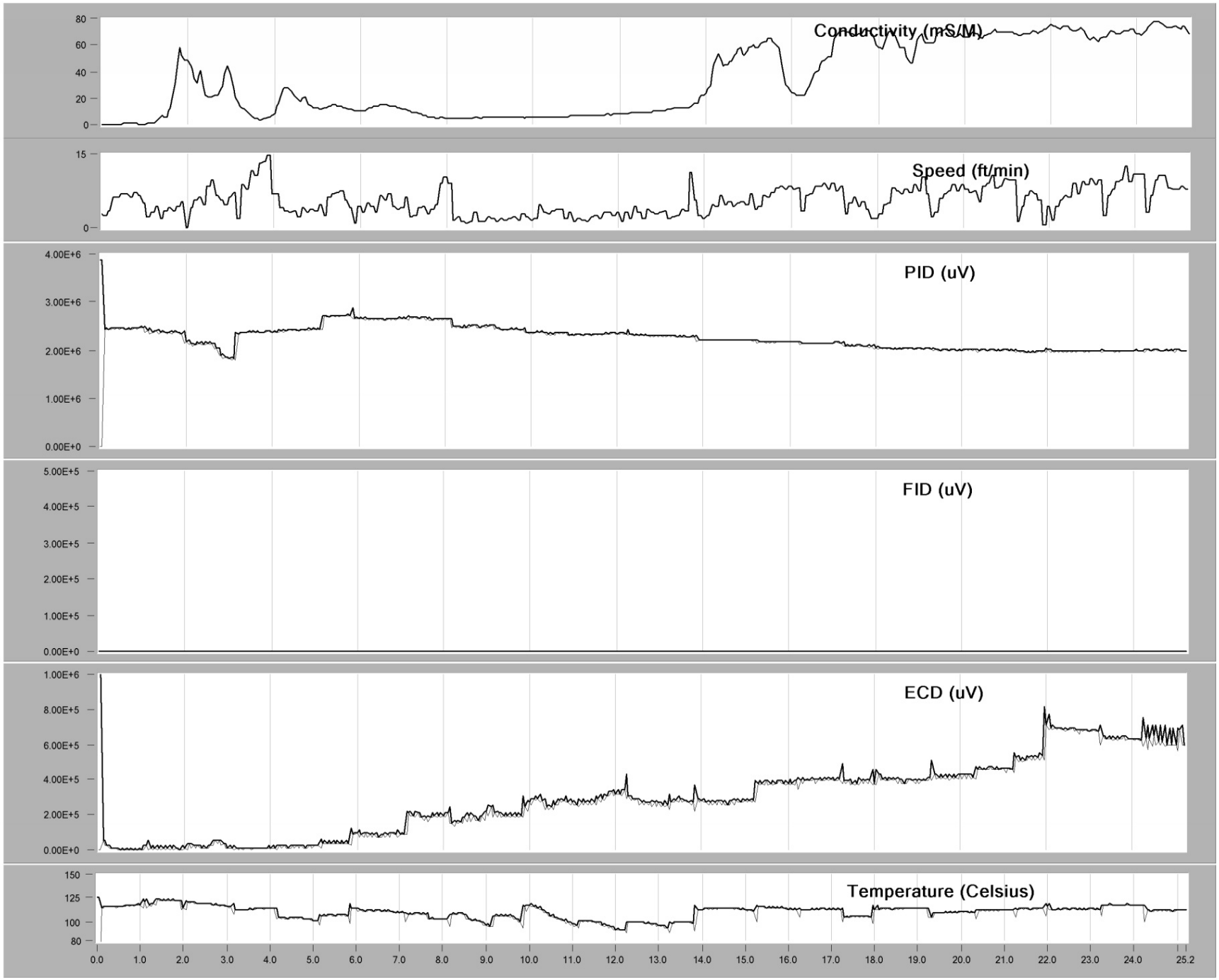
MIP01



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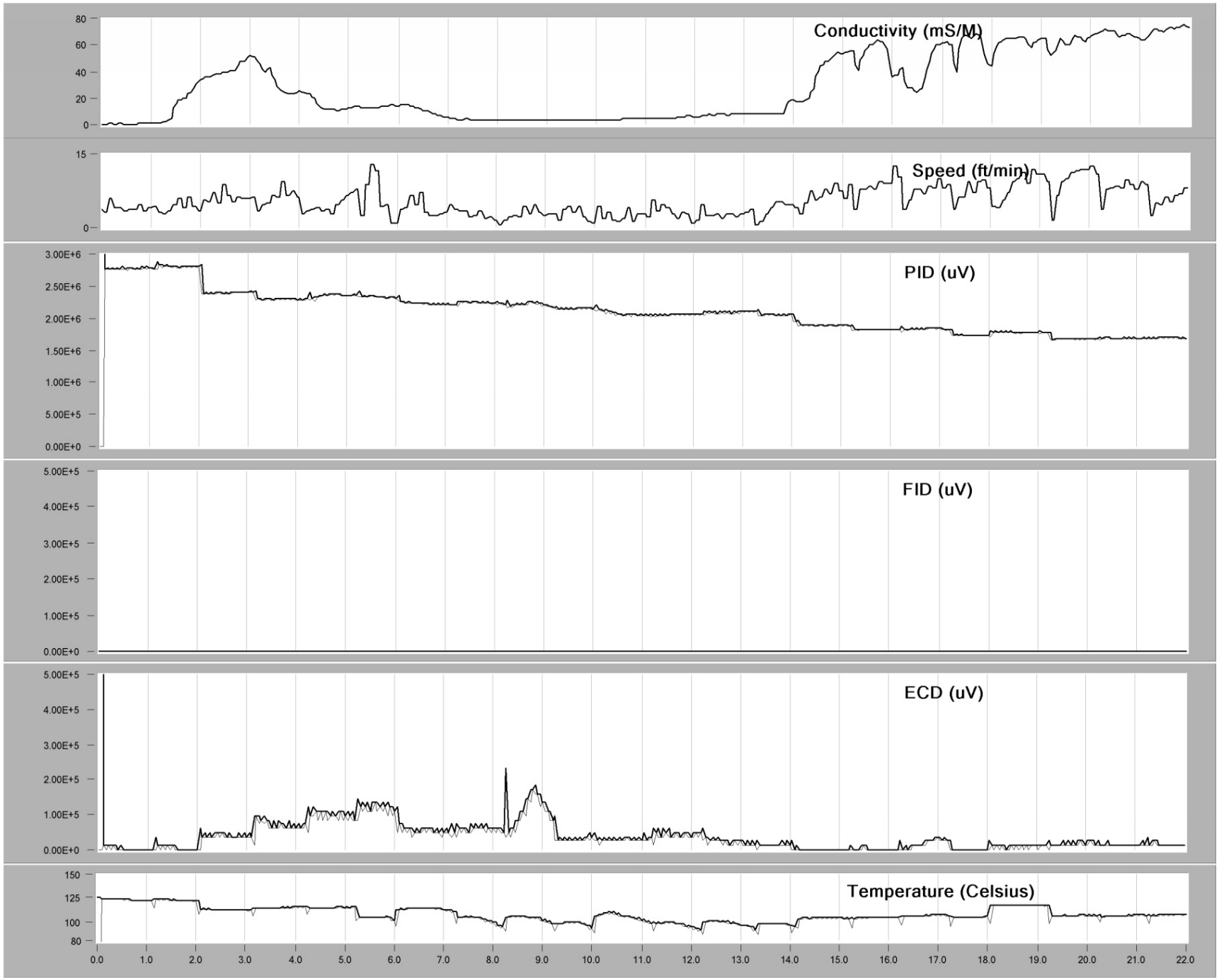
MIP02



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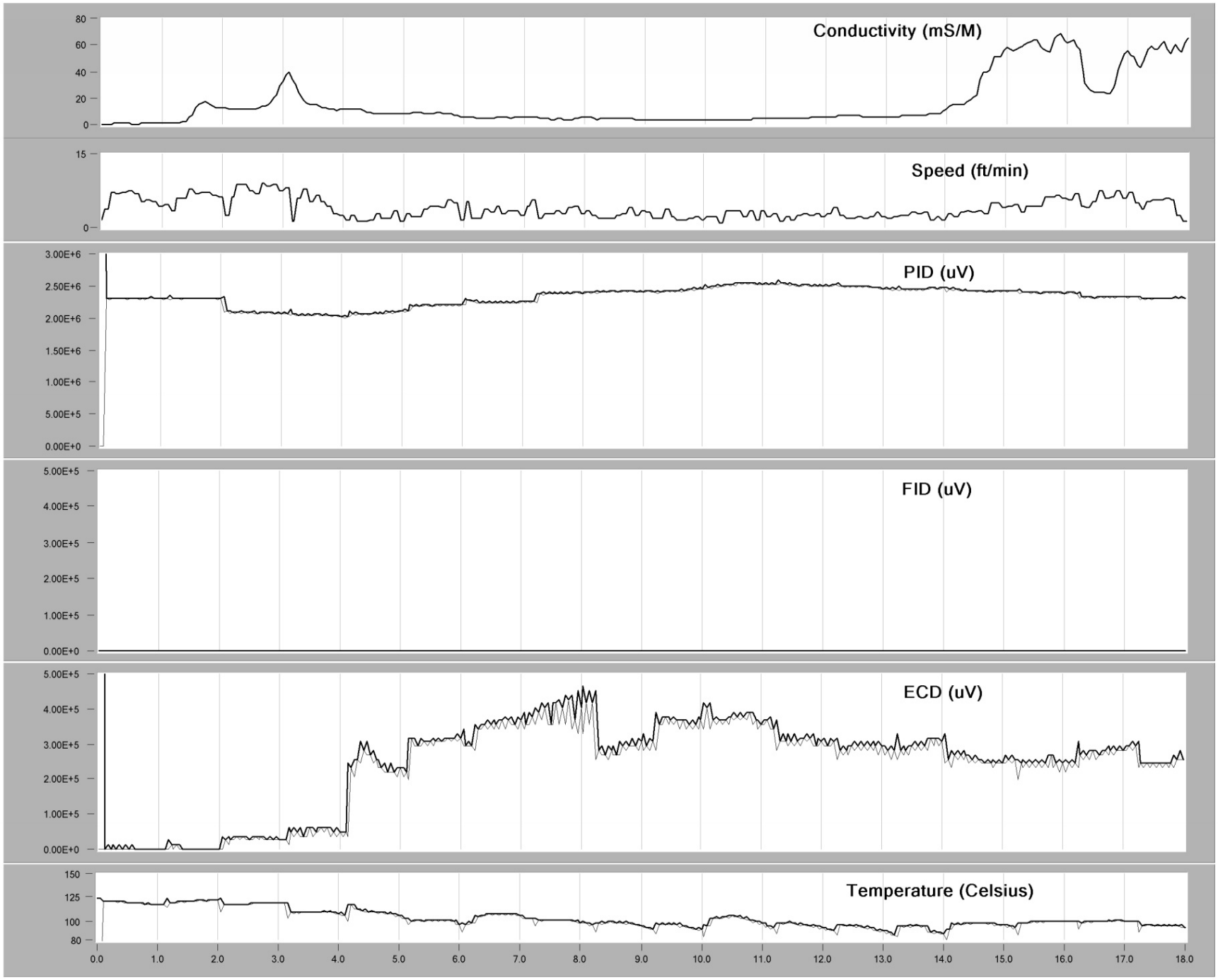

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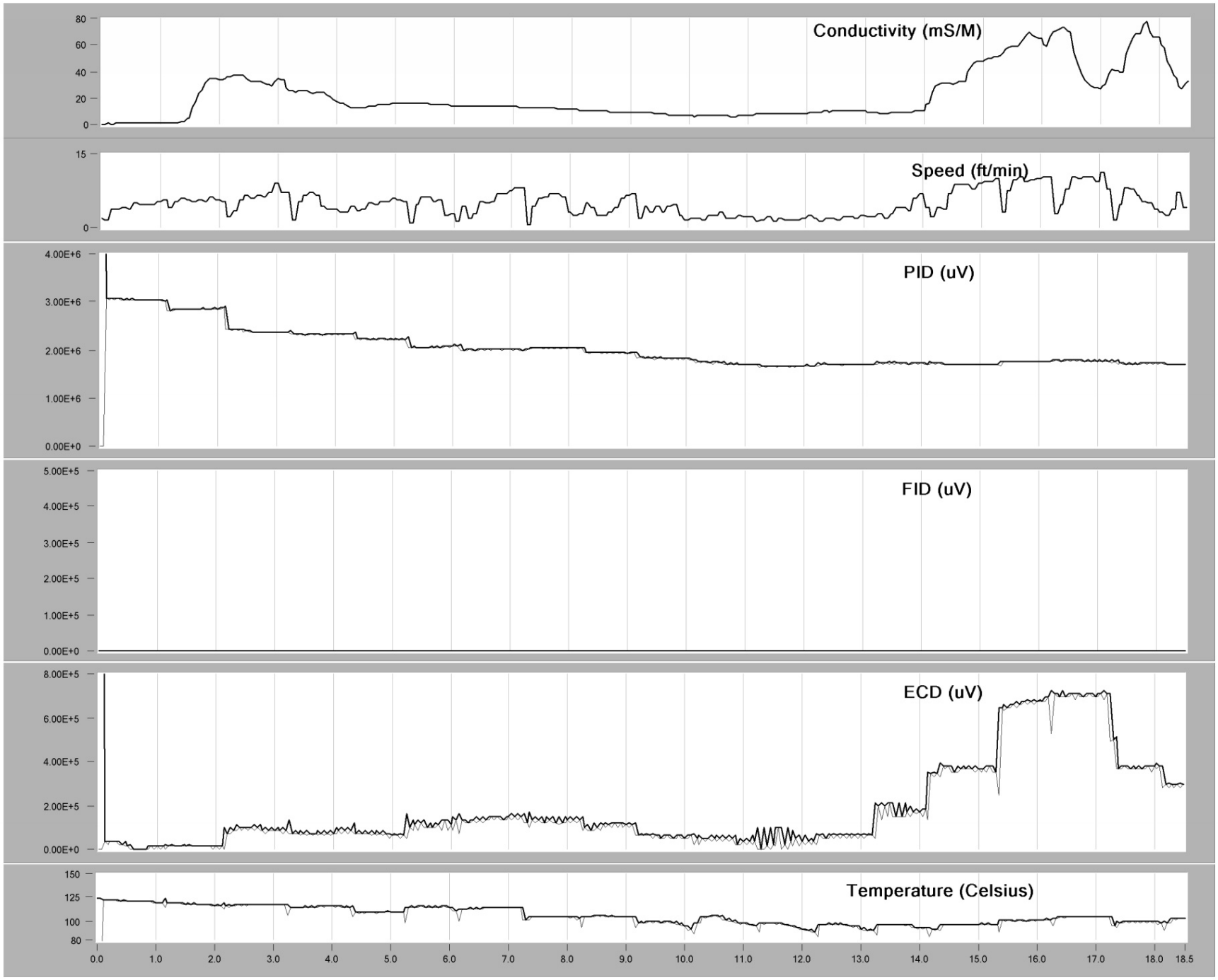

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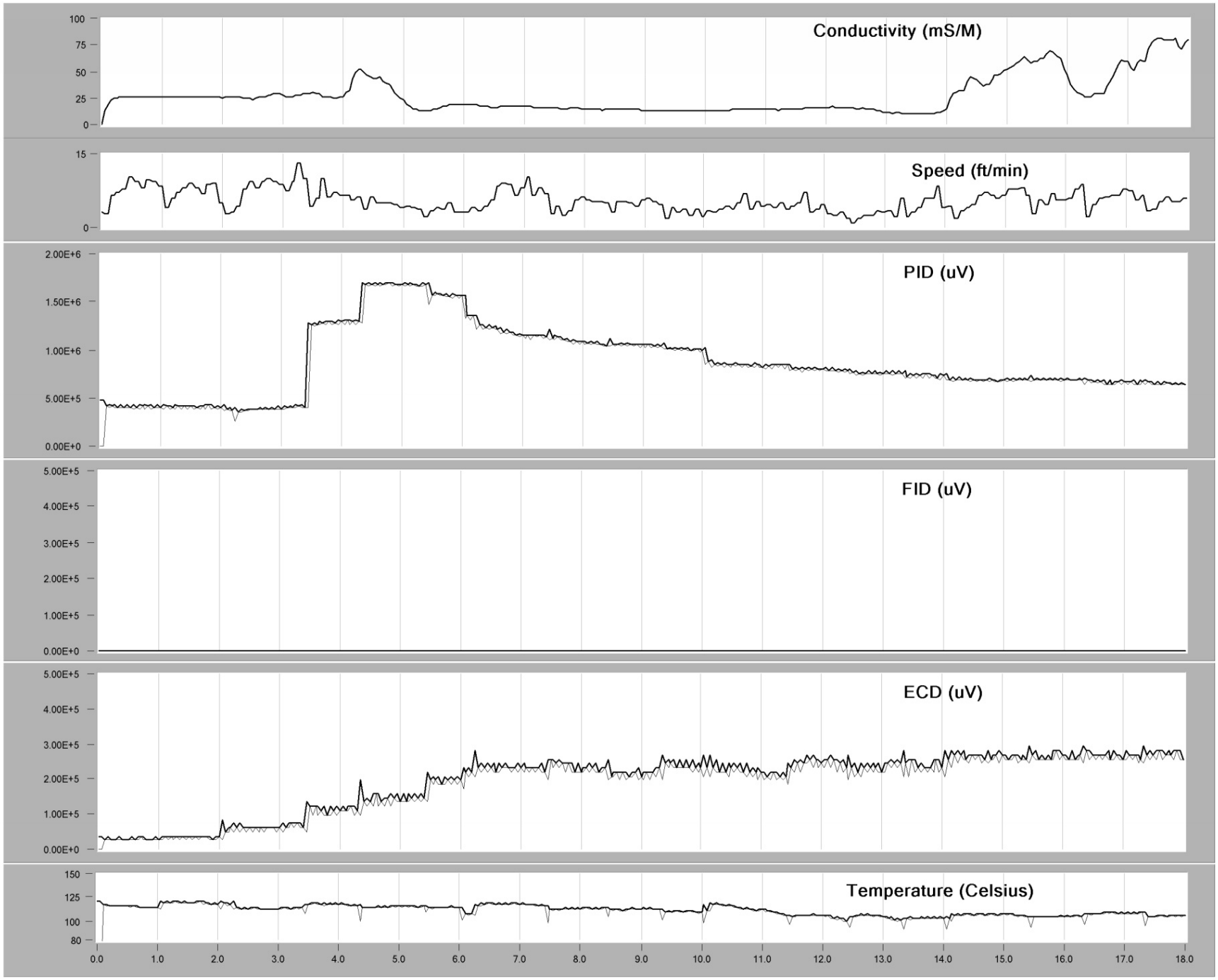

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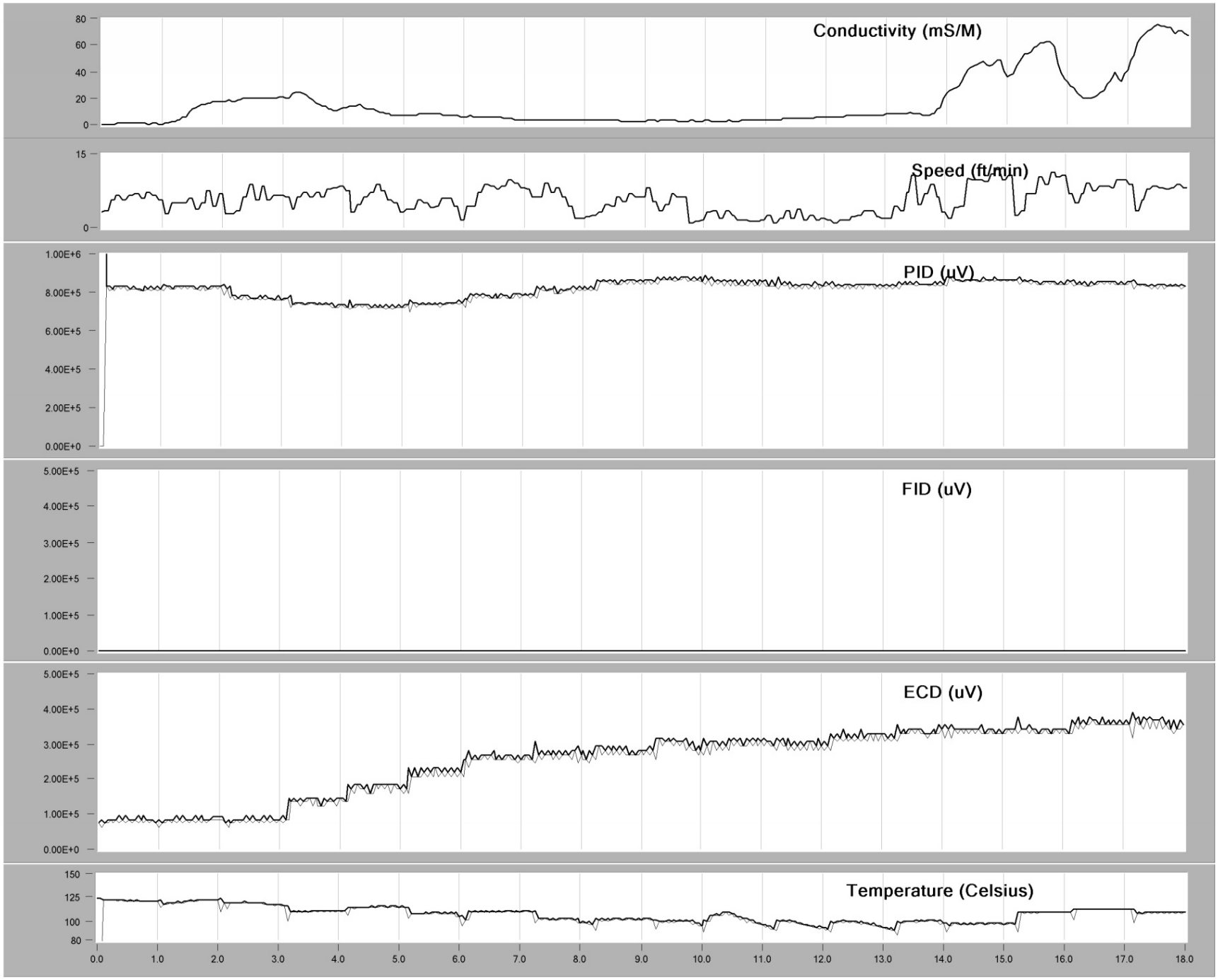

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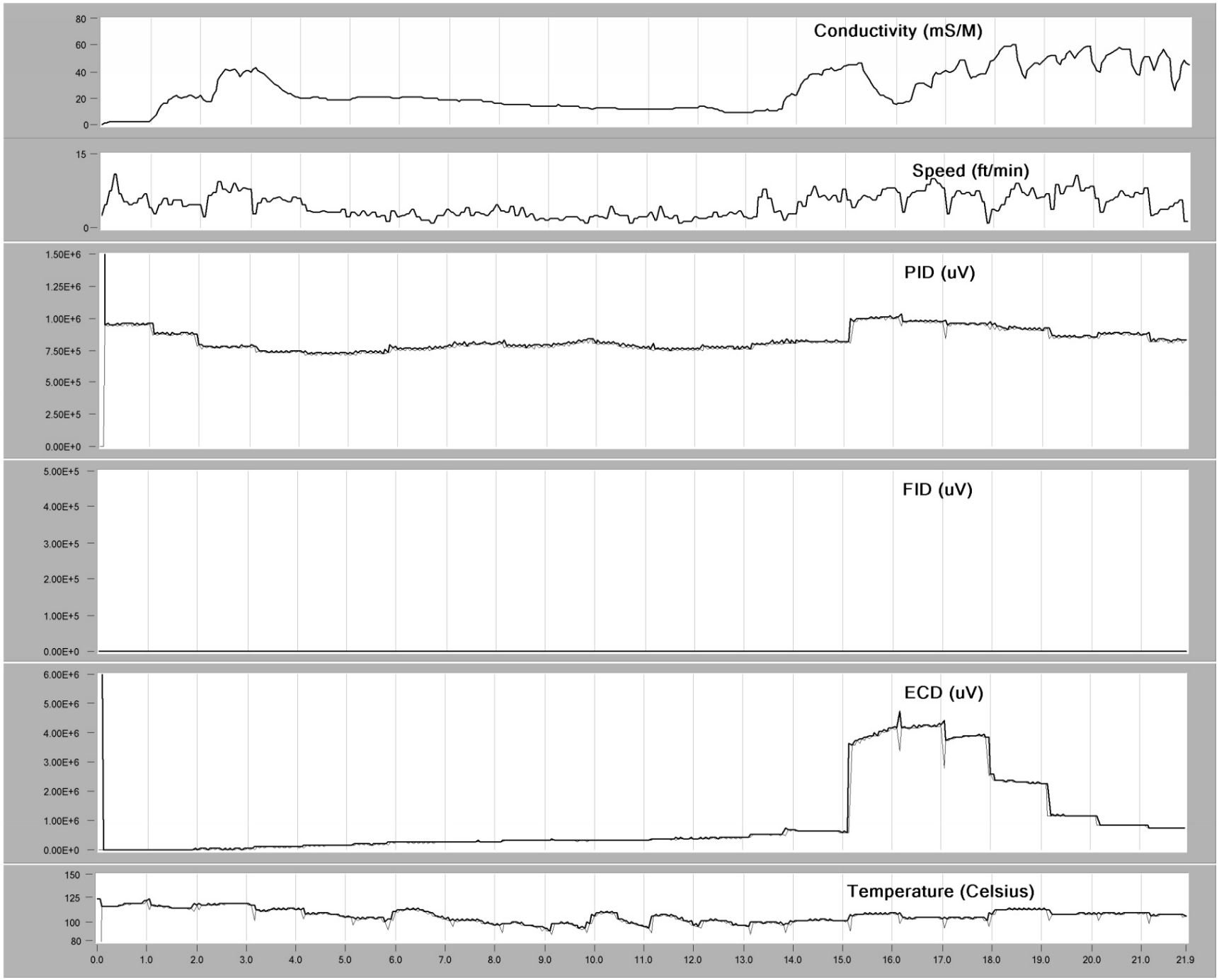

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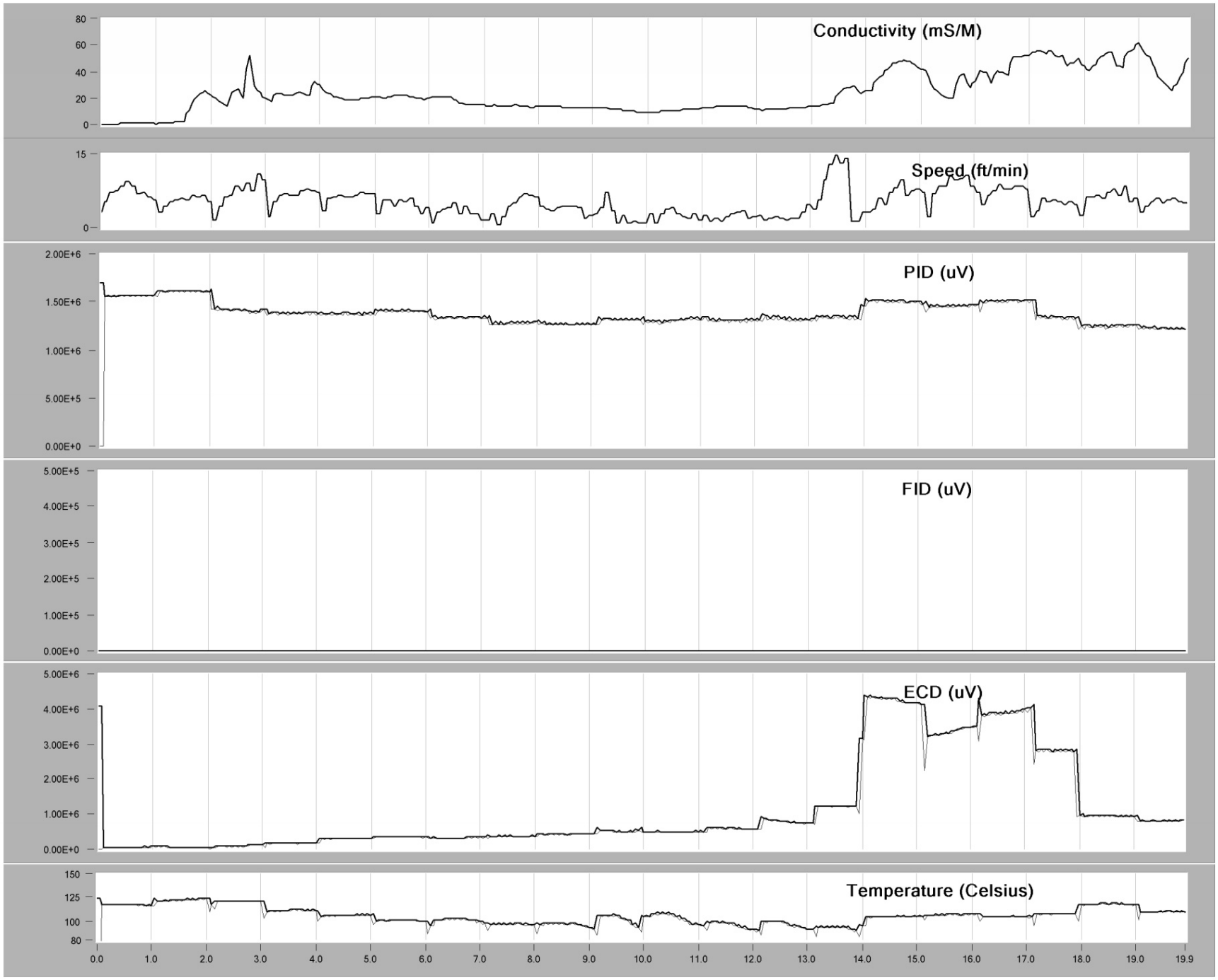

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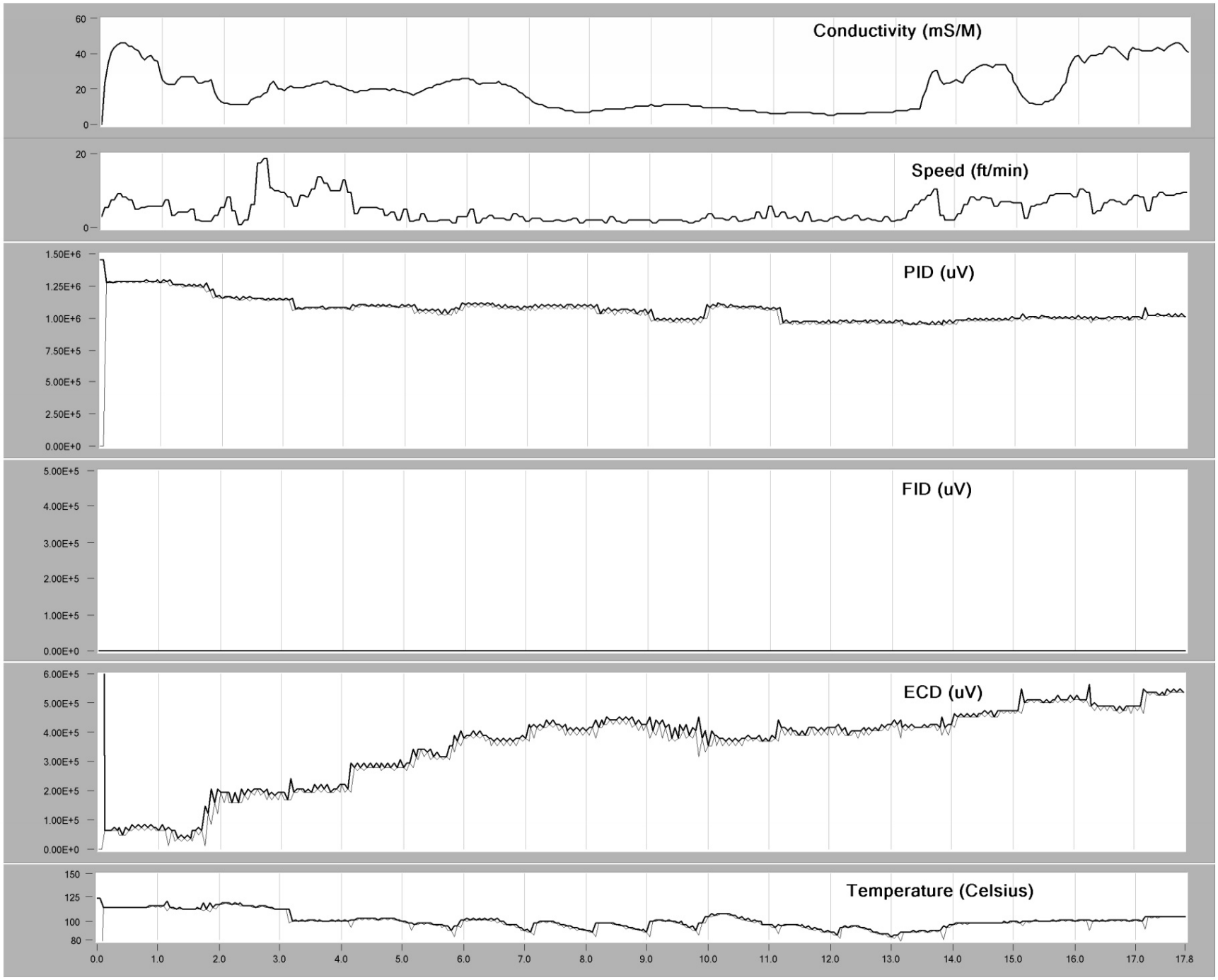

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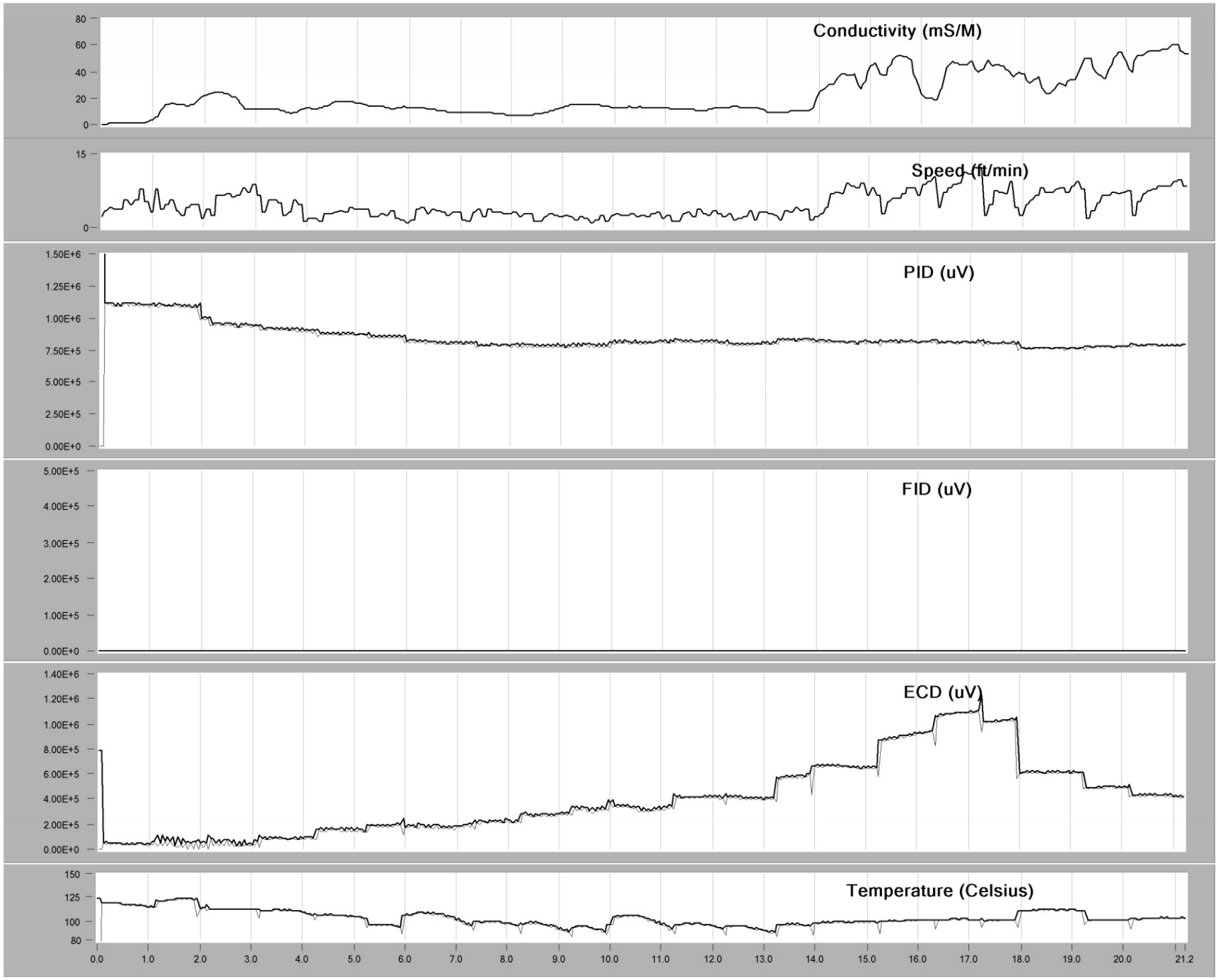

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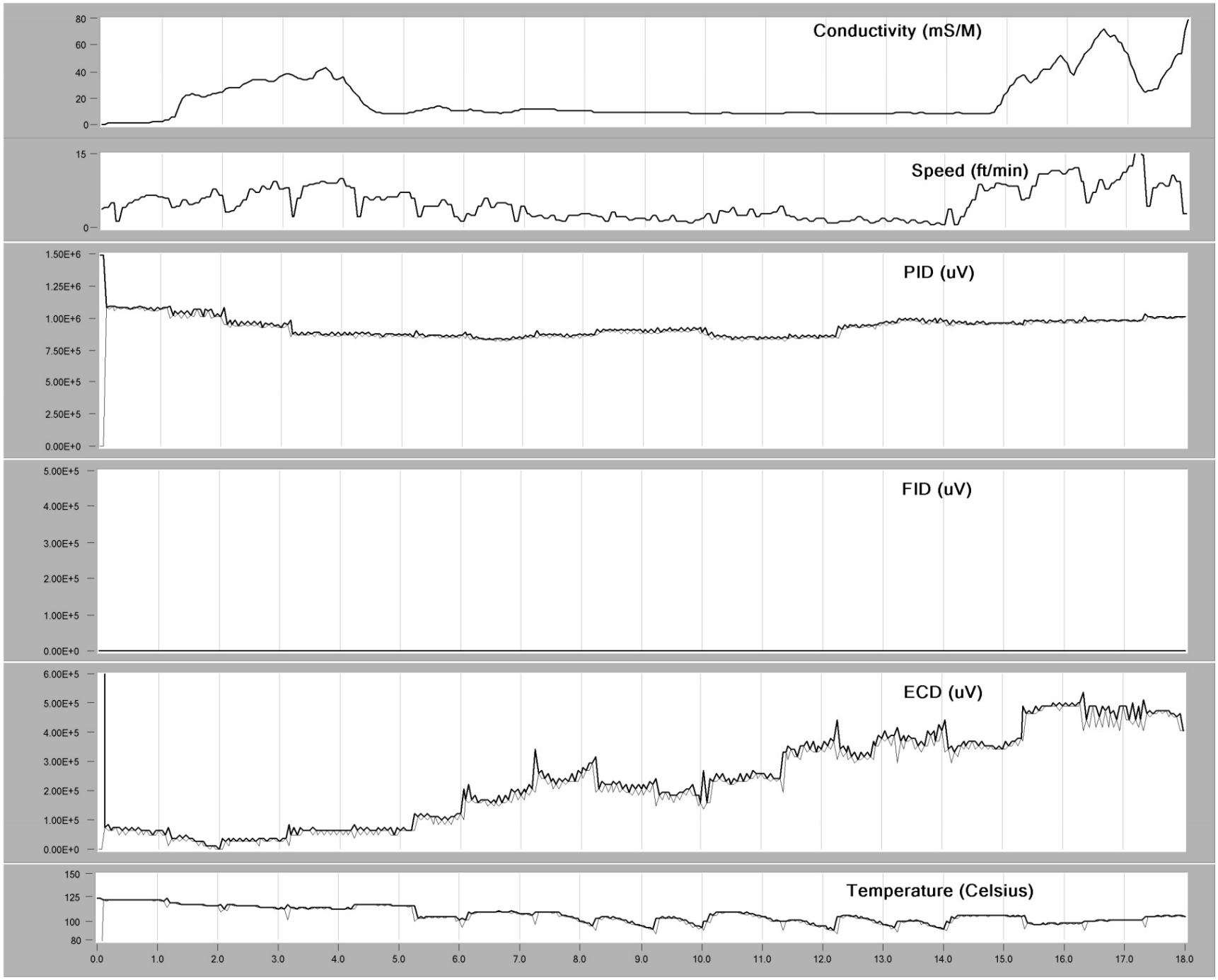

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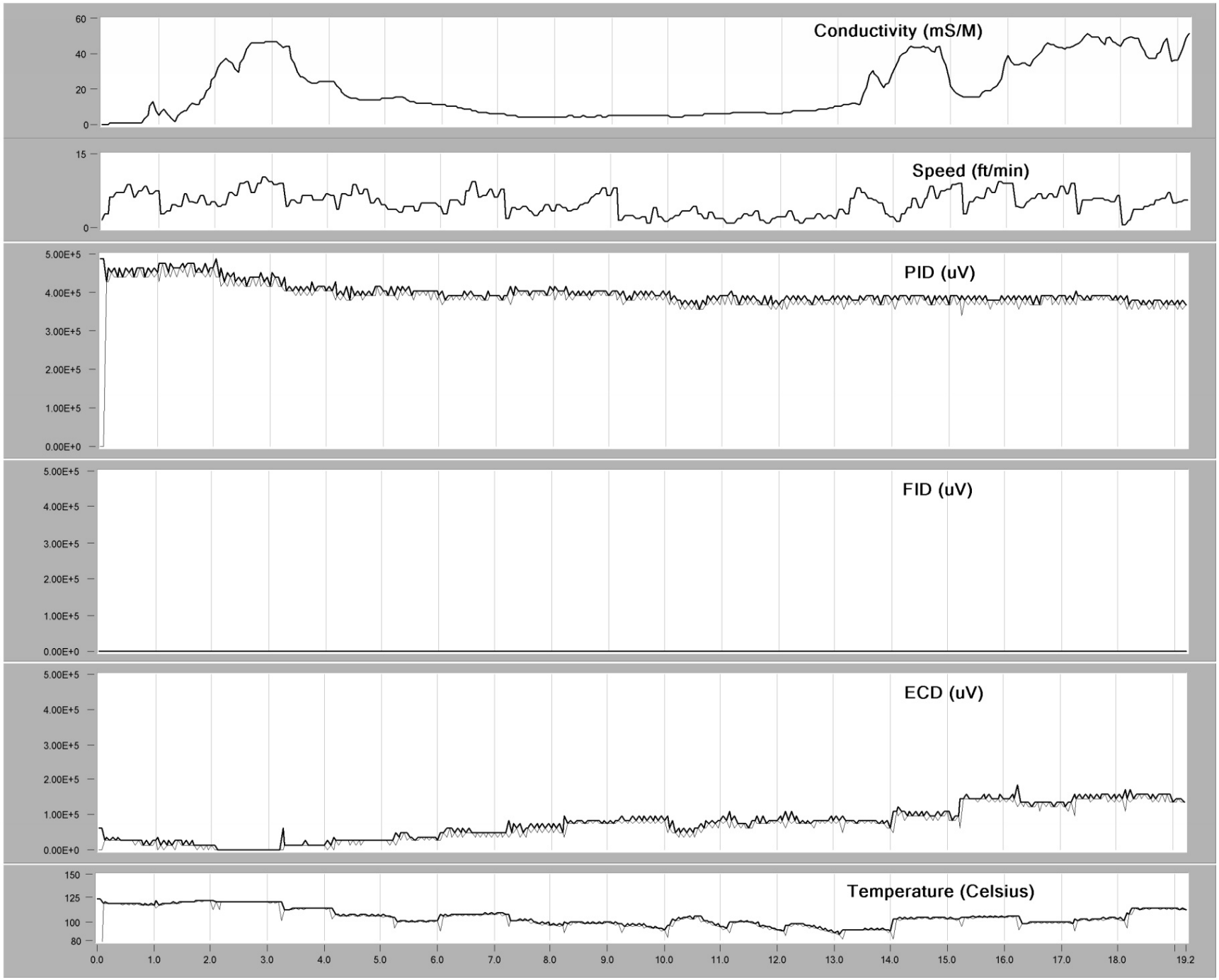

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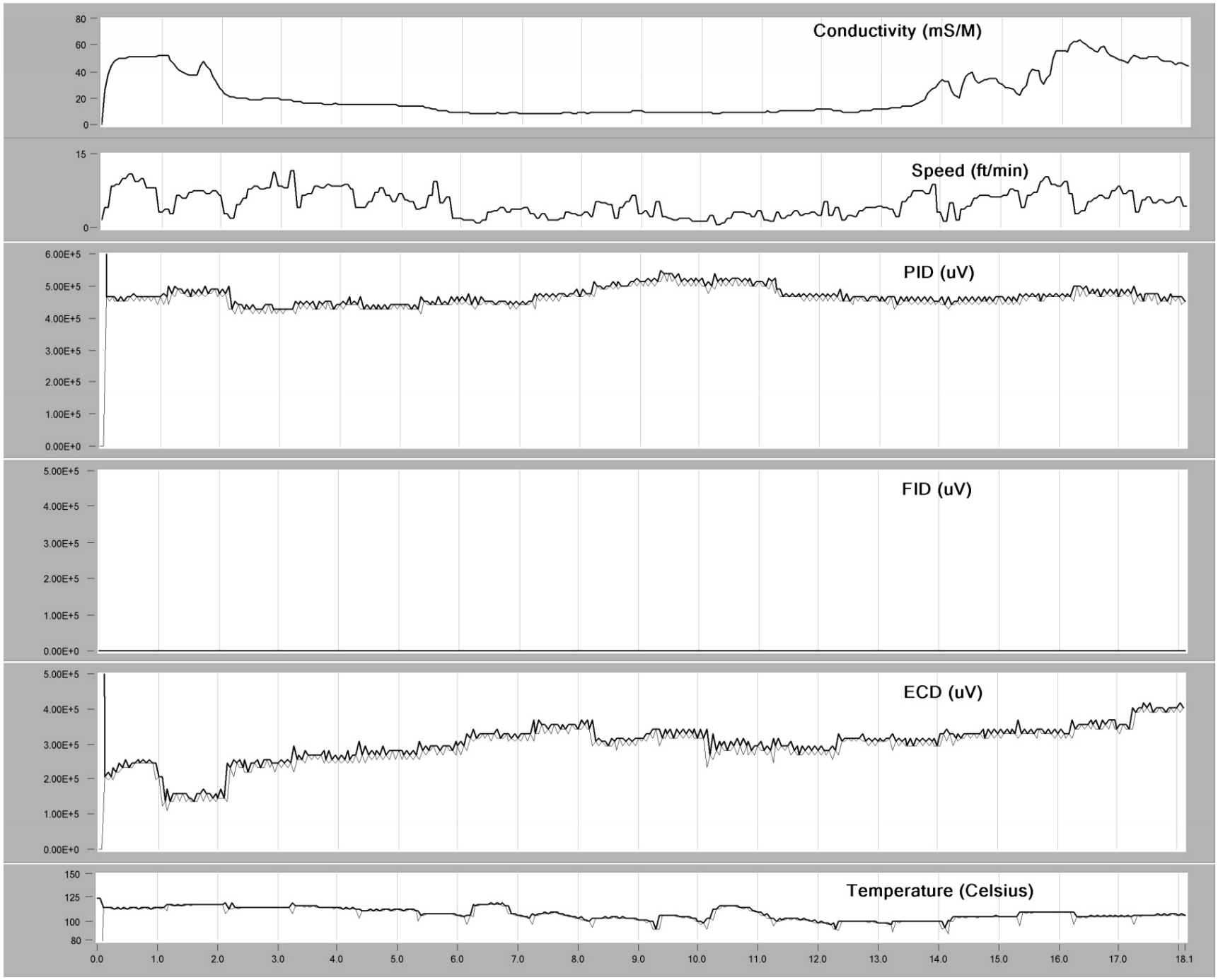

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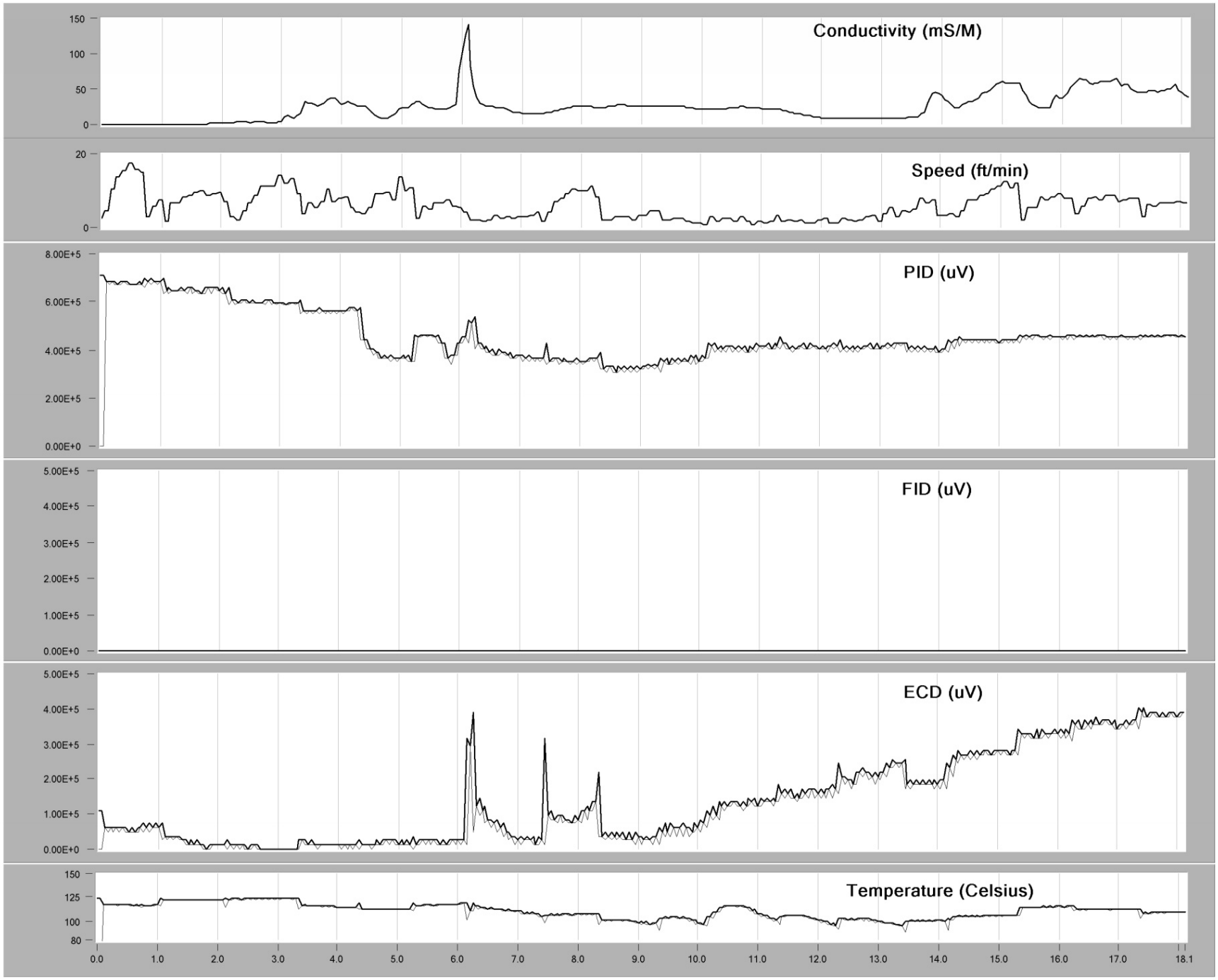

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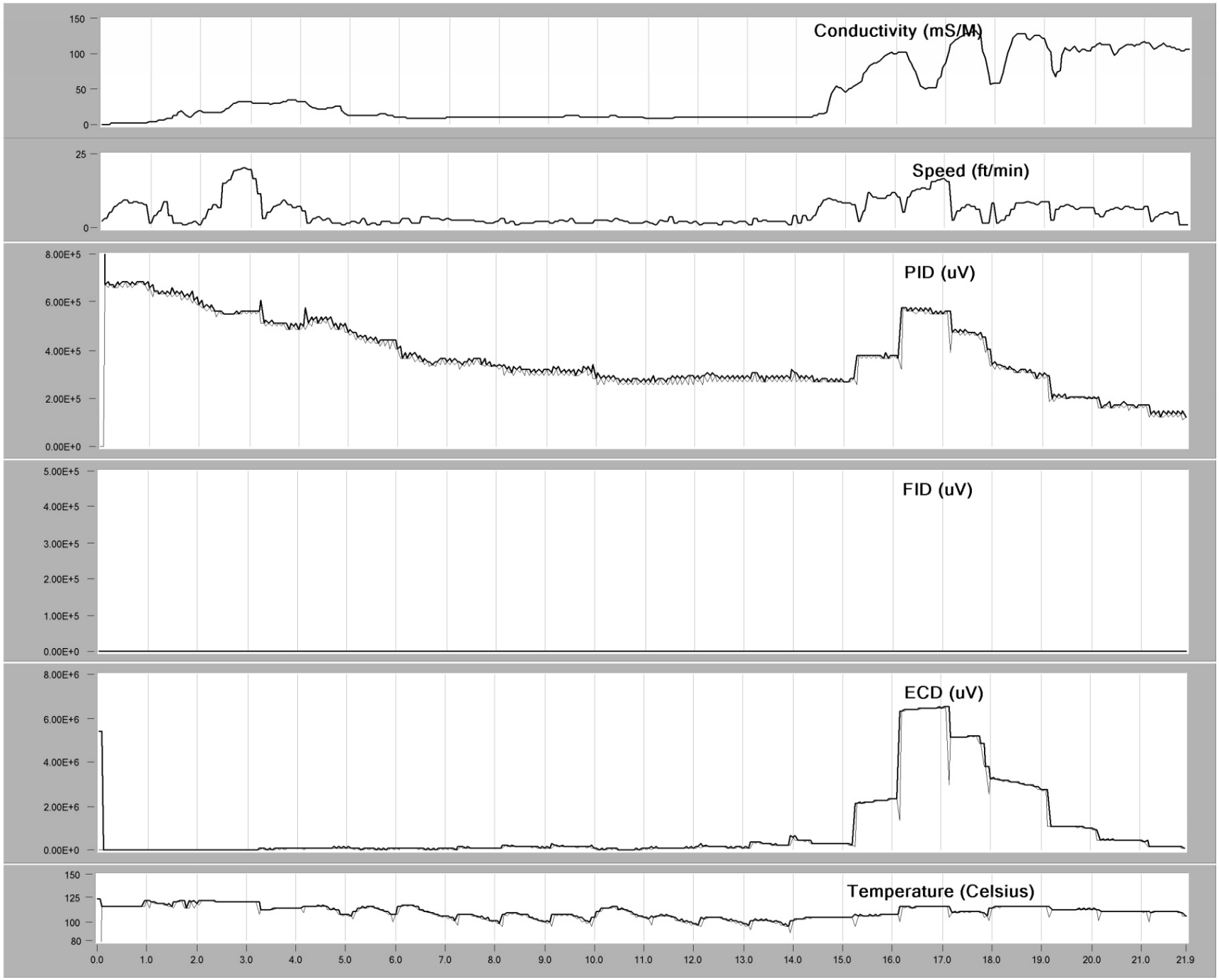

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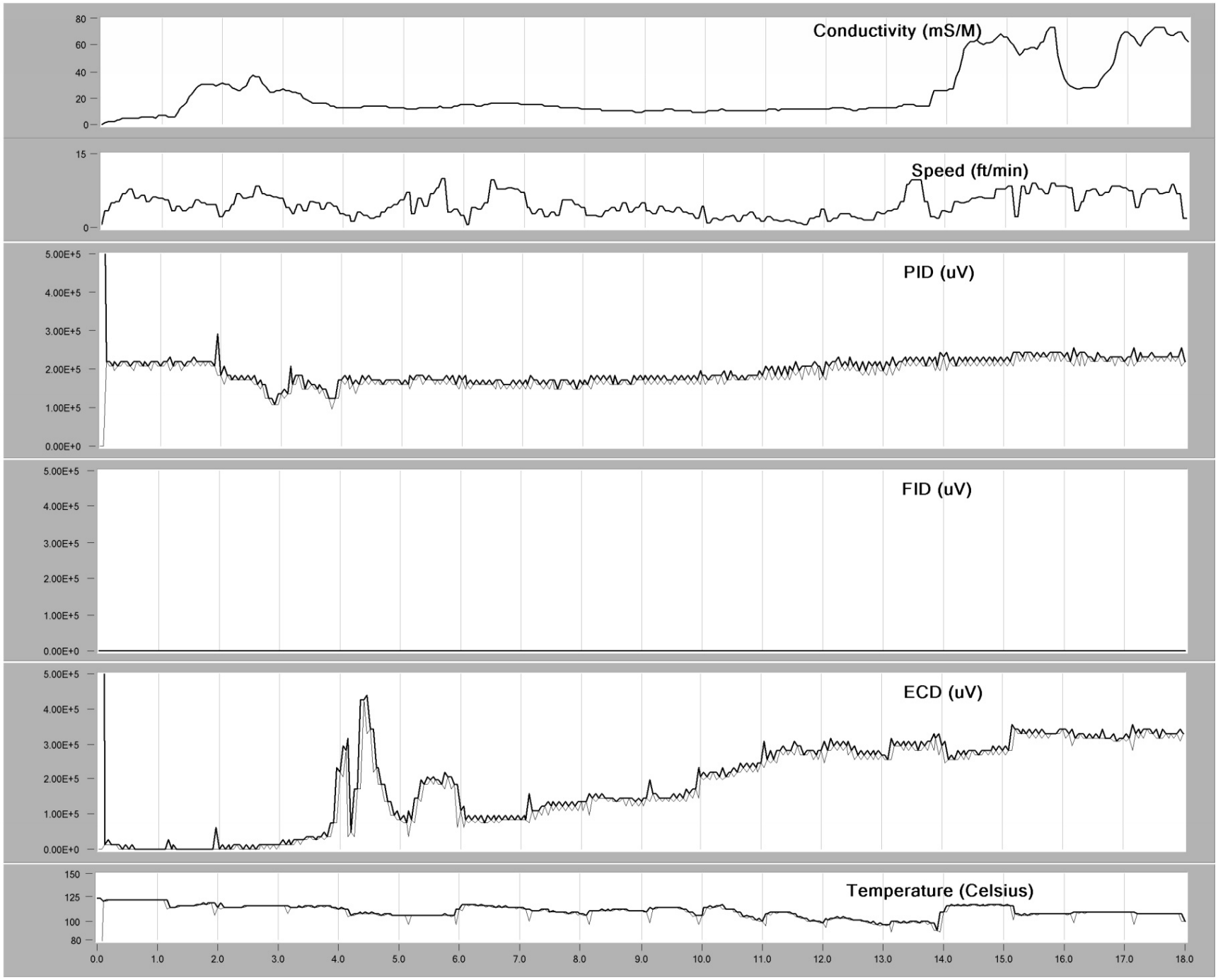

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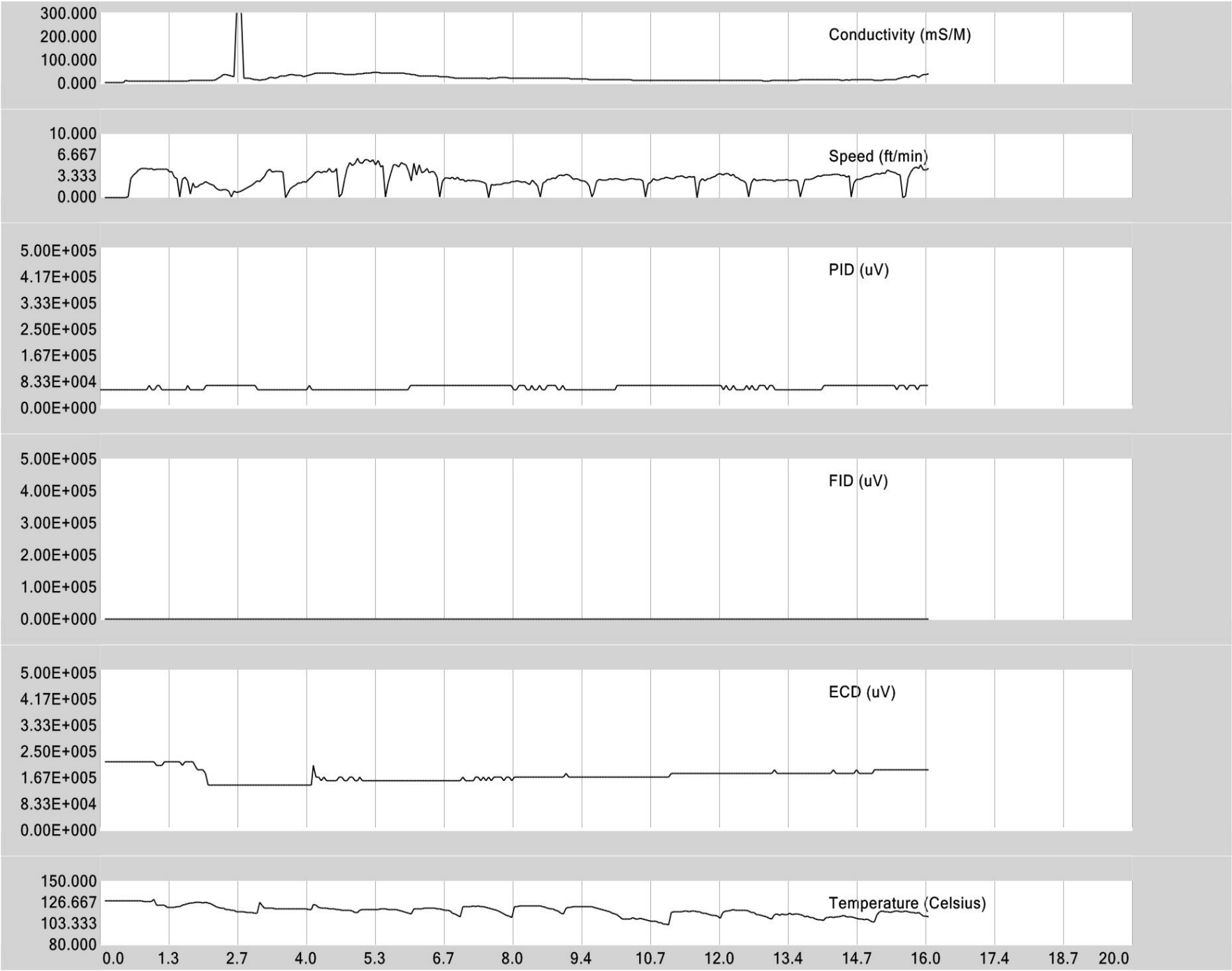

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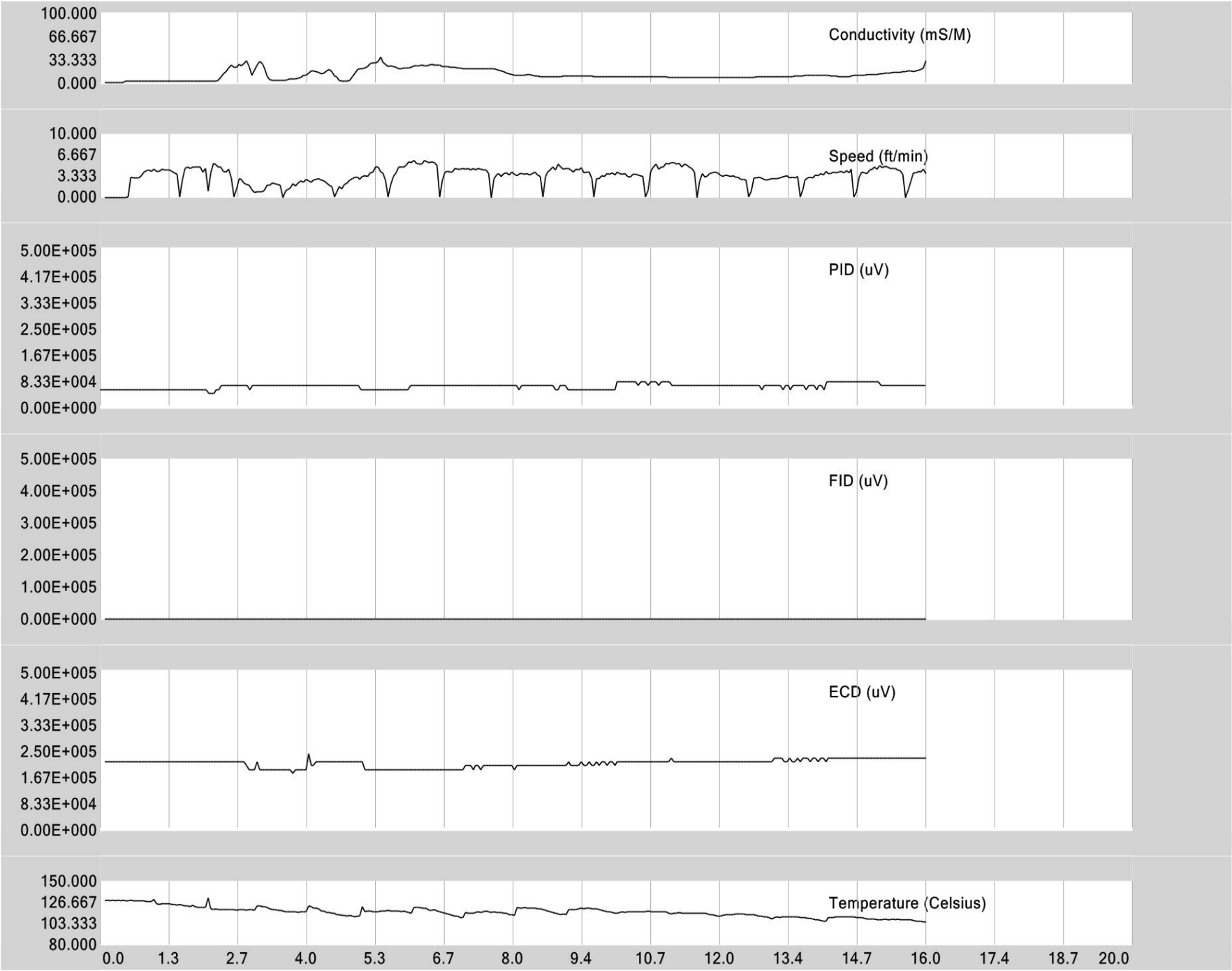

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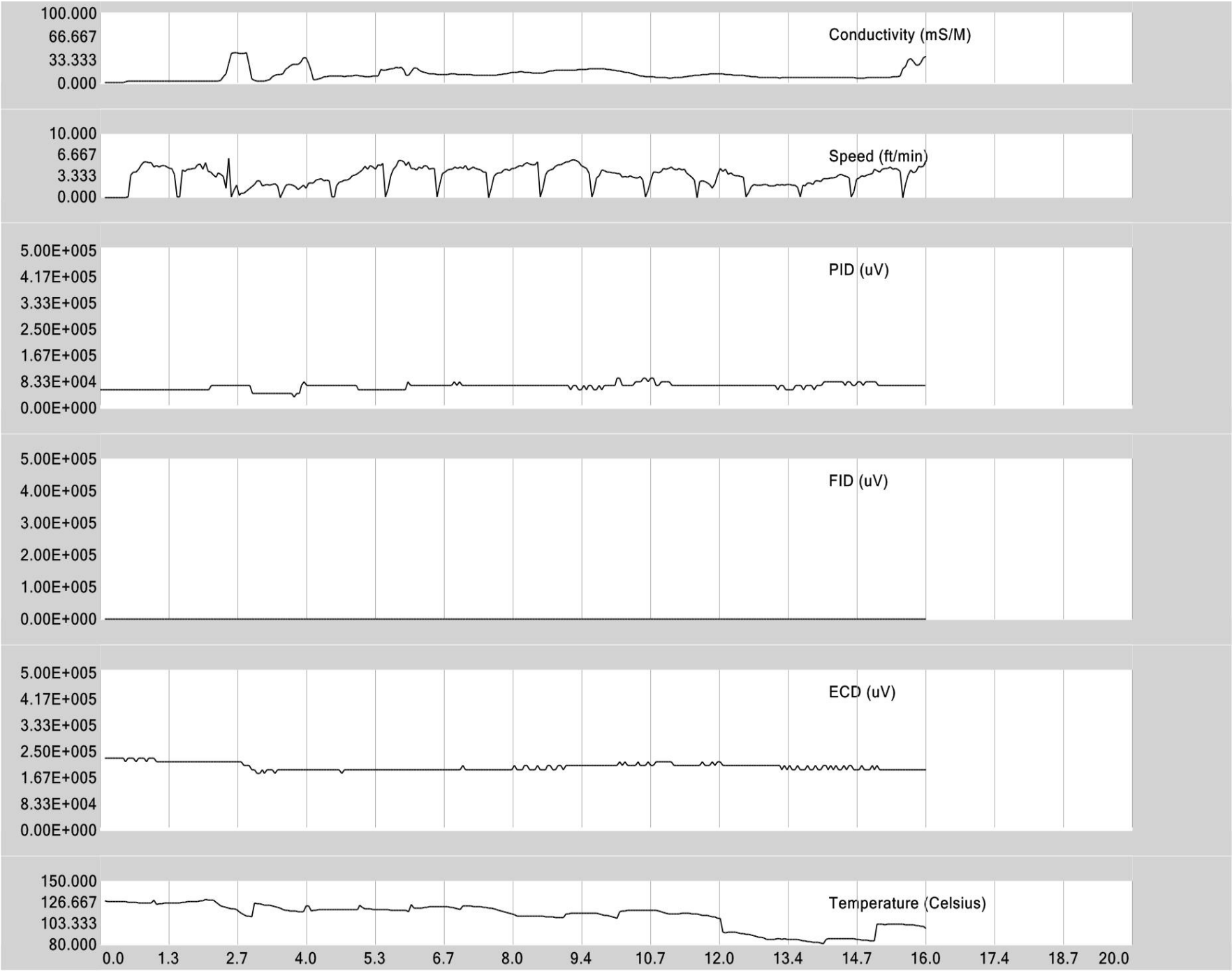

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COLUMBIA TECHNOLOGIES

Appendix B
MEC Summary Reports

November 22, 2004

CH2MHILL
Attn: Mr. William Friedmann
5700 Thurston Ave, Suite 120
Virginia Beach, Virginia 23455

RE: After Action Report (AAR), for Ordnance and Explosives (OE) Avoidance Services at St. Juliens Creek Annex (SJCA), Sites 2, 19 and 21, Chesapeake, Virginia

Dear Mr. Friedmann,

USA Environmental, Inc. (USA) completed the Ordnance and Explosives (OE) Avoidance/Construction Support Services at St. Juliens Creek Annex (SJCA), Sites 2, 19 and 21, Chesapeake, Virginia. All operations were completed safely, on time, and within budgeted funding. No OE/UXO was encountered during operations.

USA began mobilization of two UXO qualified personnel to SJCA on site on 8 November 2004. Both USA UXO personnel working at this site completed Naval Explosive Ordnance Disposal (USNAVSCLEOD) training which details procedures for evaluation and disposal of OE. The USA employees at this job site had completed a training program, prior to beginning work on site, which complies with OSHA Regulations 29 CFR 1910.120e(9). All USA employees who work on hazardous sites receive training, which includes an equivalent of 40 hours of training off-site and actual field experience under the direct supervision of a trained, experienced Supervisor. Management and Supervisors receive an additional 8 hours training on program supervision. Each employee receives 8 hours of OSHA refresher training annually.

On 8 November 2004, USA's UXO Technician III, Mr. Nelson Figeac, coordinated with the CH2MHill on-site Field Team Leader/Site Safety Coordinator (FTL/SSC), assessed the site, assembled, and tested the equipment. USA personnel arrived at the NNSY pass office at 0730 received the installation briefing and security passes. The entire USA/CH2MHILL team received a safety briefing from Mr. Figeac to include an initial OE safety briefing for all team members. Daily, prior to the day's operations (see Attachment 1), Mr. Figeac provided a tailgate safety briefing to re-emphasize UXO precautions and other site-specific safety issues. The following describe the activities performed during the performance of this effort:

Sites 2, 19 and 21 -Groundwater Monitoring Wells and DPT Soil Sampling:

OE Avoidance operations for drilling monitoring wells and DPT soil sampling began on 8 November 2004 and completed on 18 November 2004. Prior to drilling or sampling crews going on site, the OE team conducted a reconnaissance of the approach route to work sites. The reconnaissance included locating a clear path for the crews, vehicles and equipment. The approach paths, at a minimum, were twice the width of the widest vehicle. The boundaries of the approach path were clearly marked to prevent personnel from straying into un-cleared areas. Personnel were instructed to remain within the marked boundary limits. Magnetometers were used to search for near surface anomalies within the approach path.

Prior to drilling equipment being moved to the proposed well location, the OE team located a subsurface anomaly free site. During drilling the OE Team checked the bore every 2-feet with a downhole magnetometer to depth. The following Table-1 depicts the daily OE avoidance operations performed by the OE Team.

Table-1: Daily OE Avoidance Operations

Date	Description	Quantity	Site Area
8-Nov-04	16' to 18' DPT Soil Sampling	3	2
8-Nov-04	16' to 18' DPT Soil Sampling	3	21
9-Nov-04	16' to 18' DPT Soil Sampling	5	2
10-Nov-04	16' to 18' DPT Soil Sampling	6	2
10-Nov-04	Monitoring Well	1	2
11-Nov-04	16' to 18' DPT Soil Sampling	5	2
11-Nov-04	Monitoring Well	3	21
12-Nov-04	16' to 18' DPT Soil Sampling	7	21
12-Nov-04	65' Deep Monitoring Well - Begin	-	21
15-Nov-04	65' Deep Monitoring Well - Continue	-	21
16-Nov-04	65' Deep Monitoring Well - Complete	1	21
16-Nov-04	16' Deep Monitoring Well	1	21
17-Nov-04	Monitoring Well	3	2
18-Nov-04	Monitoring Well	1	2

No OE or OE-related material was encountered during operations at SJCA. USA completed all operations in accordance with the approved Work Plan, the Site Safety and Health Plan and contract requirements. All site operations were completed safely and efficiently and in accordance with the Technical Scope of Work. USA demobilized the OE Team and equipment on 18 November 2004.

Sincerely;

Manok Synakorn
Project Manager

Encl: Attachment 1: Daily Site Summaries and Daily Safety Briefings

CC: Ms. Jamie Butler

ATTACHMENT 1

Daily Operations Summary

And

Safety/Meeting/Training Records

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 09 / 04 TIME: 0730 (AM) PM

LOCATION/SITE: ST. Juliens Creek Annex, Va

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
✓	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	[illegible]	USAE
Robert Stewart	[illegible]	Columbia Tech
Morgan Aycock	[illegible]	Columbia Tech
Phil Balvocius	[illegible]	USAE
Katie Zurich	Katie Z	CH2M Hill
Rebekah Ives	Rebekah Ives	CH2M HILL
WILLIAM J. FRIEDMANN JR.	William J Friedmann Jr	CH2M HILL

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 10 / 04 TIME: 7:30 AM PM

LOCATION/SITE: ST. Juliens Creek annex, VA

1. Reason for Meeting/Training: (Check all that apply)

✓	Daily Safety Meeting/Training
✓	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	[signature]	USAE
Phil Balvocius	[signature]	USAE
Robert Stewart	[signature]	Columbia Tech
Rebekah Ives	[signature]	CH2M HILL
[illegible]	[illegible]	CH2M HILL
Morgan Aycock	[illegible]	Columbia Tech
WILLIAM J. FRIEDMANN JR.	William J. Friedmann Jr.	CH2M HILL
KIM HENDERSON	[signature]	CH2M HILL

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 11 / 04 TIME: 0700 (AM) PM

LOCATION/SITE: ST. Juliens Creek

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
N. Figueroa	[illegible]	USA
Phil Balvocchi	[illegible]	USA
J. Butler	[illegible]	CH2M HILL
A. Chapel	[illegible]	P. Wolff
R. Stewart	[illegible]	Columbia Tech
Scott Graham	[illegible]	P. Wolff Inc.
Kourtney S. Reynolds	[illegible]	Columbia Tech
Rebekah Ives	[illegible]	CH2M HILL
Morgan Aycock	[illegible]	Columbia Tech

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 12 / 04 TIME: 0700 AM PM

LOCATION/SITE: ST. Juliens Creek Annex Chesapeake, VA

1. Reason for Meeting/Training: (Check all that apply)

✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
N. Figueroa	[illegible]	USAE
P. Balvocky	[illegible]	USAE
W. Butler	[illegible]	CH2M Hill
R. Ives	[illegible]	CH2M HILL
Robert Stewart	[illegible]	Columbia Tech
Morgan Aycock	[illegible]	Columbia Tech
Arnold Chase	[illegible]	P.W. IWG
Scott Graham	[illegible]	PV.I.
Katie Zynich	[illegible]	CH2M Hill
William T. Friedmann Jr.	[illegible]	CH2M HILL

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)			
	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 15 / 04 TIME: 0900 AM PM

LOCATION/SITE: St. Juliens Creek annex Ches., Va

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
N. Figenc	[illegible]	USAE
P. Balvocias	[illegible]	USAE
R. Ives	Rebekah Ives	CH2M HILL
J. Butler	[illegible]	CH2M Hill
[illegible]	[illegible]	Parsatt ADEP
A. Chapel	[illegible]	" "
Scott Graham	[illegible]	IWI
William J. Friedmann Jr.	William J Friedmann Jr.	CH2M HILL

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 16 / 04 TIME: 0700 (AM) PM

LOCATION/SITE: St. Juliens Creek Annex Ches. VA.

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	[illegible]	USAE
Paul Balsocci	[illegible]	USAE
Steve R Smith	[illegible]	Parsons Wolff
Rebekah Ives	[illegible]	CH2M HILL
Jamie Butler	[illegible]	CH2M Hill
Arnold Chavez	[illegible]	P.W.
Scott Graham	[illegible]	P.W.

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 17 / 04 TIME: 0700 AM PM

LOCATION/SITE: St. Juliens Creek Annex Ches. Va

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	Nelson Figueroa	USAE
Phil Balvocius	Phil Balvocius	USAE
Rebekah Ives	Rebekah Ives	CH2M HILL
S. Butler	[illegible]	CH2M HILL
A. Chase	[illegible]	P.W.
Steve R Smith	[illegible]	R-W
Scott Graham	[illegible]	R-W
Cecilia White	Cecilia White	CH2M HILL

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 18 / 04 TIME: 0700 AM PM

LOCATION/SITE: _____

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
N. Figueroa	[illegible]	USAE
P. BALVOCIUS	[illegible]	USAE
Steve R. SMITH	Steve R. Smith	PARSAH WOLFD
SCOTT Graham	[illegible]	P WJ
ARNOLD CHAPEL	[illegible]	P.V&E
Cecilia White	[illegible]	CH2M HILL
Rebekah Ives	Rebekah Ives	CH2M HILL

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer

Date: ____/____/____

DAILY OPERATIONS SUMMARY

DATE: 11 / 8 / 04 PAGE ___ OF ___ PAGES

SITE / LOCATION: ST. Julien Creek Annex Ches. VA

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical DOWN hole	6	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: NONE

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

clearing AREA for 6 Direct Push Technology soil sampling, 3 will be done in AREA 21 AND 3 will be in AREA 2.

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	10			
UXO Tech. II	2018-316	10			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. PAGE ___ of ___ PAGES

b. Daily Equipment:

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)		10			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK-26		10			

5. Operational Remarks:

USED MK-26 To clear clean areas/down hole at 3 different locations at site 21 and 3 different locations at site 2. Depth of sampling was 16'–18' depths.

6. Signature / Date:

SUXO / Project Manager

Date: 11/8/04

DAILY OPERATIONS SUMMARY

DATE: 11/9/04 PAGE ___ OF ___ PAGES

SITE / LOCATION: ST. Juliens Creek Annex Ches VA.

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical Down hole	5	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: NONE

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

set up for 5 sampling areas at site 2 using The (DPT) Direct Push Technology.

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	7			
UXO Tech. II	2018-316	9.5			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. PAGE ___ of ___ PAGES

b. **Daily Equipment:**

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)					
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK-26		9.5			

5. **Operational Remarks:**

DID 2 DPT sampling holes down to 16'-18' depth. Geophisical personel decon their equipment. Nelson had a medical appointment at lunch time. OK w/CH2m HILL did it during decon time. Returned and completed 3 more DPT samples at site 2.

6. **Signature / Date:**

Nelson Figueroa
SUXO / Project Manager

Date: 11 / 9 / 04

DAILY OPERATIONS SUMMARY

DATE: 11/10/04 PAGE ___ OF ___ PAGES

SITE / LOCATION: St. Juliens Creek Annex Ches. Va

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical Down hole	1 m.w. 6 DPT samples	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: None

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:
Monitor wells Drillers would be on site along with DPT sampling Team. Clear areas + check Down holes.

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	10			
UXO Tech. II	2018-316	11			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. PAGE ___ of ___ PAGES

b. Daily Equipment:

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)		10			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK-26		10			

5. Operational Remarks:

Phil was in early (1hr) To [redacted] LET - help Geoprobe Team set up Their Track machine close To The Edge OF The woods. completed [redacted] monitoring wells w/ Drillers and 6 DPT samples.

6. Signature / Date:

SUXO / Project Manager

Date: 11/10/09

DAILY OPERATIONS SUMMARY

DATE: 11/11/04 PAGE ___ OF ___ PAGES

SITE / LOCATION: ST. Juliens Creek Ches. Va

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical Down hole	3 mw 5 DPT samples	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: NONE

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:
set up for Drilling Monitoring Wells + DPT samples.

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	10			
UXO Tech. II	2018-316	10			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. PAGE ___ of ___ PAGES

b. Daily Equipment:

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)	2018-316	10			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK 26	2018-316	10			

5. Operational Remarks:
completed 3 monitoring wells w/drillers to a depth of 16'-18' and 5 DPT samples at site 2. The M.W. are in site 21.

6. Signature / Date:

SUXO / Project Manager

Date: 11/11/04

DAILY OPERATIONS SUMMARY

DATE: 11 / 12 / 04 PAGE ___ OF ___ PAGES

SITE / LOCATION: ST. Julien Creek Annex Ches. Va.

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical Down hole	7 DPT samples	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: none

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:
set up Equipment for M.W. Drilling + DPT samples.

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	7			
UXO Tech. II	2018-316	7			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. PAGE ___ of ___ PAGES

b. **Daily Equipment:**

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)	2018-316	7			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK-26	2018-316	7			

5. **Operational Remarks:**

The DPT sample Team Finished all sampling AT 2Pm AND DRILLERS WORKED ON The 65' Deep monitoring well Till 1Pm before ReTurning back To North Carolina. Completed 7 DPT samples.

6. **Signature / Date:**

[signature]
SUXO / Project Manager

Date: 11/12/04

DAILY OPERATIONS SUMMARY

DATE: 11 / 15 / 04 PAGE ___ OF ___ PAGES

SITE / LOCATION: St. Juliens Creek Annex Ches. Va.

1. WORK SUMMARY

a. Work Accomplished:	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical Down hole	0	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: None

c. Inspection Results:	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

Continue To Drill Down To 65' Deep on The Deep monitoring well.

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	9			
UXO Tech. II	2018-316	9			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. PAGE ___ of ___ PAGES

b. **Daily Equipment:**

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)	2018-316	9			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK-26	2018-316	9			

5. **Operational Remarks:**

Still working on 65' deep monitoring well. Probably will not finish till Tuesday 1PM. Started work at 0900 due to well drillers drove back from North Carolina this morning.

6. **Signature / Date:**

Nelson Figueroa
SUXO / Project Manager

Date: 11/15/04

DAILY OPERATIONS SUMMARY

DATE: 11/16/04 PAGE ___ OF ___ PAGES

SITE / LOCATION: St. Juliens Creek Annex Ches VA

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical Down hole	2 mw	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: none

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:
Complete 65' Deep Monitoring Well a Try To do one more at site 21.

4. **Utilization**

a. **Daily Man-hours:**

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	10			
UXO Tech. II	2018-316	10			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. **PAGE ___ of ___ PAGES**

b. **Daily Equipment:**

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)	2018-316	10			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK-26	2018-316	10			

5. **Operational Remarks:**
Completed 65' monitoring well at site 2 and one 16' monitoring well at site 21.

6. **Signature / Date:**

Nelson Engine
SUXO / Project Manager

Date: 11/16/04

DAILY OPERATIONS SUMMARY

DATE: 11/17/04 PAGE ___ OF ___ PAGES

SITE / LOCATION: ST. Juliens Creek Annex Ches. Va.

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical Down hole	3 mw	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: MK 26 was starting to have an intermitten problem at the connector on the control unit. Was able to make it work & still use it.

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:
Try to complete 4 monitoring wells at site 2.

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	11			
UXO Tech. II	2018-316	11			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. PAGE ___ of ___ PAGES

b. Daily Equipment:

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)	2018-316	11			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK-26	2018-316	11			

5. Operational Remarks:

was only able To complete 3 monitoring Wells + start The Last one. Will Return Tomorrow + Finish it in The morning.

6. Signature / Date:

Nelson Tejada
SUXO / Project Manager

Date: 11 / 17 / 04

DAILY OPERATIONS SUMMARY

DATE: 11 / 14 / 04 PAGE ___ OF ___ PAGES

SITE / LOCATION: ST. Juliens Creek Annex Ches. Va.

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical Down hole	1 mw	
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: NONE

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

Finish Last well AT site 2.

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III	2018-316	3			
UXO Tech. II	2018-316	3			
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. PAGE ___ of ___ PAGES

b. **Daily Equipment:**

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)	2018-316	3			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					
MK-26	2018-316	3			

5. **Operational Remarks:**

Completed last monitoring well at site 2. CH2MHill thanked us for job well done. Phil will return home. I will package equipment for shipment back to USAE & De mob 11/18/04.

6. **Signature / Date:**

Nelson Figueroa
SUXO / Project Manager

Date: 11/18/04

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 08 / 04 TIME: 0700 (AM) PM

LOCATION/SITE: St. Juliens Creek Annex, VA

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
✓	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figenc	Nelson Figenc	USAE
Rebekah IVES	Rebekah Ives	CH2M HILL
Katie Lynch	Katie L	CH2M Hill
Phil Bavocius	Phil Bavocius	USAE
Robert Stewart	Robert Stewart	Columbia Tech
Morgan Aycock	Morgan Aycock	Columbia Tech
Sonnie Butler	Sonnie Butler	CH2M Hill

After Action Report
MEC Avoidance for
Additional Investigation for Site 21
St Julian's Creek Annex
Chesapeake, VA
CTO-057

Prepared for CH2M Hill

Under the Navy CLEAN III

Prime Contract N62470-02-D-3052

CTO-057

Prepared by:

USA Environmental, Inc

Tampa, FL

01 December 2005

USA Environmental, Inc.

CH2MHILL
Attn: Cecilia White
5700 Cleveland St Ste. 101
Virginia Beach, VA 23462

Subject: After Action Report, MEC Avoidance for Additional Investigation for Site 21

Dear Ms. White,

USA Environmental, Inc. (USA) has completed providing MEC Avoidance Services at St Julian's Creek Annex (SJCA) in Chesapeake, VA.

Mobilization/Demobilization Schedule:

The USA Team, consisting of UXO qualified personnel (one UXO Technician III and one UXO Technician I mobilized to SJCA on October 30, 2005. MEC avoidance commenced on October 31, 2005 through November 7, 2005. No MEC Avoidance was required during the period of November 4-7, 2005.

All USA Environmental personnel and equipment were demobilized from the project site on November 8, 2005.

Operations:

Equipment checks were completed and safety briefing performed prior to the start of daily field activities. MEC avoidance support was provided for installation of 26 temporary monitoring wells and 2 permanent monitoring well installations.

Throughout the MEC avoidance support provided, no Munitions and Explosives of Concern (MEC), Military Debris (MD), Unexploded Ordnance (UXO), Discarded Military Munitions (DMM), or Material Presenting a Potential Explosive Hazard (MPPEH) was observed or discovered.

On November 7, 2005 UXO Avoidance support was concluded. The USA Team completed all operations in accordance with the Statement of Work (SOW) and with agreement from the on-site CH2MHILL Site Manager.

All daily activities are documented in the Daily Operations Summaries and Tailgate Safety Briefing Sheets are provided as enclosures 1 and 2 to this letter.

USA Environmental, Inc. safely, efficiently, and successfully completed all contract requirements without incident and looks forward to future opportunities with CH2MHILL.

Sincerely,

Richard Hanoski
Program Manager
USA Environmental, Inc.

Enclosures:

Enclosure 1: Site Daily Operations Summaries
Enclosure 2: Tailgate Safety Briefings

Enclosure 1
Site Daily Operations Summaries

DAILY OPERATIONS SUMMARY

DATE: 10 / 31 / 05 PAGE 1 OF 5 PAGES

SITE / LOCATION: SJCA

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical		
(5) Intrusive wells (20')	6	17
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: none

c. Inspection Results: N/A

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

going to set 23 monitoring wells at 80' deep 5 of them will be inside a building + we will start them at 1600 when Navy personell go home. will be working till 10pm.

3. UXO SUMMARY n/a

a. UXO Located:

Type:	Quantity:	Live/Prac.:	Remarks:

b. Demolition Supplies Expended: N/A

Type:	Quantity:	Remarks:

c. Scrap Generation / Deposition: N/A

Type:	Quantity:	Weight:	Remarks:

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #	M/H Today:	M/H 0% :	M/H 4%	M/H 8%
Site Manager					
SUXOS					
UXO Technician III		12			
UXO Technician II		~~12~~			
UXO Technician I		12			
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

b. **Daily Equipment:**

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
SchonsTedT		12			

5. **Operational Remarks:**

USED SchonsTedT To check AREAS For well Drilling. Worked inside A NAVY supply Building completing 3 of The 5 wells To be set INSIDE. Completed 3 OUTSIDE wells, Finished well Drilling AT 12AM. will START work To morrow AT 10 AM

6. **Signature / Date:**

SUXOS

Date: 10 / 31 / 05

DAILY OPERATIONS SUMMARY

DATE: 11 / 1 / 05 PAGE 1 OF 5 PAGES

SITE / LOCATION: SJCA

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical		
(5) Intrusive (well drilling 20' deep)	10	7
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: None

c. Inspection Results: N/A

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

Will be setting wells outside Till 4 or 5 PM Then move into inside of Navy Building ~~[illegible]~~ To finish Last 2 well inside.

3. UXO SUMMARY

a. UXO Located: N/A

Type:	Quantity:	Live/Prac.:	Remarks:

b. Demolition Supplies Expended: N/A

Type:	Quantity:	Remarks:

c. Scrap Generation / Deposition: N/A

Type:	Quantity:	Weight:	Remarks:

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #	M/H Today:	M/H 0% :	M/H 4%	M/H 8%
Site Manager					
SUXOS					
UXO Technician III		13			
UXO Technician II					
UXO Technician I		13			
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

b. **Daily Equipment:**

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt		13			

5. **Operational Remarks:**

Completed 10 more Temp. wells To 30'. Have 7 more To complete. Took longer Than we Thought INSIDE Navy Building Due To Drill being Dull for cutting 1' Deep foundation made of cement.

6. **Signature / Date:**

SUXOS

Date: 11 / 1 / 05

DAILY OPERATIONS SUMMARY

DATE: 1 / 2 / 05 PAGE 1 OF 5 PAGES

SITE / LOCATION: SJCA

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical		
(5) Intrusive wells installed	6	
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies: N/A

c. Inspection Results: N/A

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

Try to complete rest of temp wells, will be installing 3 permanent wells in various locations on monday morning. Have to wait on temp well results prior to getting location for the 3 permanent well locations.

3. UXO SUMMARY

a. UXO Located: N/A

Type:	Quantity:	Live/Prac.:	Remarks:

b. Demolition Supplies Expended: n/a

Type:	Quantity:	Remarks:

c. Scrap Generation / Deposition: n/a

Type:	Quantity:	Weight:	Remarks:

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #	M/H Today:	M/H 0% :	M/H 4%	M/H 8%
Site Manager					
SUXOS					
UXO Technician III		10			
UXO Technician II					
UXO Technician I		10			
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

b. Daily Equipment:

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
schonstadt		10			

5. Operational Remarks:

6. Signature / Date:

SUXOS

Date: 11 / 02 / 05

DAILY OPERATIONS SUMMARY

DATE: 11 / 3 / 05 PAGE 1 OF 5 PAGES

SITE / LOCATION: SJCA

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical		
(5) Intrusive well installed	3	
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies:

c. Inspection Results: N/A

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

installing 3 Temp. wells

3. UXO SUMMARY

a. UXO Located: n/a

Type:	Quantity:	Live/Prac.:	Remarks:

b. Demolition Supplies Expended: n/a

Type:	Quantity:	Remarks:

c. Scrap Generation / Deposition: n/a

Type:	Quantity:	Weight:	Remarks:

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #	M/H Today:	M/H 0% :	M/H 4%	M/H 8%
Site Manager					
SUXOS					
UXO Technician III		5			
UXO Technician II					
UXO Technician I		5			
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

b. Daily Equipment:

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schoenstedt		5			

5. Operational Remarks:

2nd Temp well ~~at~~ 5' below run into an old building foundation + needed To move Location.

6. Signature / Date:

Nelson Figueroa
SUXOS

Date: 11 / 3 / 05

DAILY OPERATIONS SUMMARY

DATE: 11/17/05 PAGE 1 OF 5 PAGES

SITE / LOCATION: SJCA

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical		
(5) Intrusive wells installed	4	0
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies:

c. Inspection Results: N/A

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

installing 3 Temporary wells + 1 Permanent wells. One will be inside The Navy Building.

3. UXO SUMMARY

a. UXO Located: N/A

Type:	Quantity:	Live/Prac.:	Remarks:

b. Demolition Supplies Expended: N/A

Type:	Quantity:	Remarks:

c. Scrap Generation / Deposition: N/A

Type:	Quantity:	Weight:	Remarks:

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #	M/H Today:	M/H 0% :	M/H 4%	M/H 8%
Site Manager					
SUXOS					
UXO Technician III		12			
UXO Technician II					
UXO Technician I		12			
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

b. **Daily Equipment:**

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
schonstedt		12			

5. **Operational Remarks:**

INSTALLED 2 TEMP. WELL OUTSIDE + ONE PERMANENT WELL. WHEN NAVY BUILDING WAS CLOSED AT 1600 WE WENT INSIDE TO DRILL A 10" DIA PLUG OUT OF 14" THICK FOUNDATION AND INSTALLED A PERMANENT WELL. FINISHED AROUND 2300. CECILIA FROM CHAM HILL WAS SATISFIED WITH JOB + SAID WE WERE COMPLETED WITH UXO SUPPORT.

6. **Signature / Date:**

SUXOS

Date: 11 / 7 / 05

Enclosure 2
Tailgate Safety Briefings

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 10/13/05 **TIME:** 12:00 **AM** **PM**

LOCATION/SITE: SJCA

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
✓	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	Nelson Figueroa	USAE
Rebekah Ives	Rebekah Ives	CH2M HILL
Mark Ost	Mark Ost	CH2M HILL
Nathan Sweatline	[illegible]	Parsons Water
Andrew Lutzenkirk	Andrew Lutzenkirk	USAE
GARY ELLINGSWORTH II	[illegible]	Parsons Water
Cecilia White	[illegible]	CH2M HILL

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)			
✓	Site Safety Personnel	✓	Decontamination Procedures
✓	Site/Work Area Description	✓	Emergency Response Plan
✓	Site Characterization		Hazard Communition
	Biological Hazard(s)	✓	On-Site Emergency
	Chemical Hazard(s)	✓	On-Site Injuries/Illnesses
✓	Physical Hazard(s)		Evacuation Procedures
	Heat Stress	✓	Rally Point(s)
✓	Cold Stress		Emergency Communication
	Site Control	✓	Directions to Medical Facility
✓	Work and Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring Program
✓	Air monitoring		Specific Task Training
✓	Safe Work Practices		Confined Spaces
✓	Engineering Controls and Equipment	✓	Heavy Equipment Drill Rig
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

Site Safety Officer

Date: 10/31/05

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 1 / 05 **TIME:** 10 (AM) PM

LOCATION/SITE: STCA

1. Reason for Meeting/Training: (Check all that apply)

✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	Nelson Figueroa	USAE
Andrew L. Fizak	Andrew L. Fizak	USAE
Rebekah Ives	Rebekah Ives	CH2M HILL
Mark Ost	[illegible]	CH2M Hill
Cecilia White	Cecilia White	CH2M HILL
Nathan Sonnenberg	[illegible]	Parratt-Wolff
Gary Ellingsworth II	Gary Ellingsworth II	Parratt-Wolff inc

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)			
	Site Safety Personnel		Decontamination Procedures
✓	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)	✓	On-Site Emergency
	Chemical Hazard(s)	✓	On-Site Injuries/Illnesses
✓	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
✓	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment	✓	Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

Site Safety Officer

Date: 2 / 1 / 05

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 2 / 05 **TIME:** 0900 AM PM

LOCATION/SITE: SJCA

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	[illegible]	USAE
Rebekah Ives	Rebekah Ives	CH2M HILL
Gary Ellingworth	[illegible]	Pinnacle Office
Nate Sweetive	[illegible]	" " "
Andrew Litzgard	Andrew Litzgard	USAE

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)			
✓	Site Safety Personnel		Decontamination Procedures
✓	Site/Work Area Description		Emergency Response Plan
✓	Site Characterization		Hazard Communition
	Biological Hazard(s)	✓	On-Site Emergency
	Chemical Hazard(s)	✓	On-Site Injuries/Illnesses
✓	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment	✓	Heavy Equipment Back hoe
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

Site Safety Officer

Date: 11 / 2 / 05

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 3 / 05 **TIME:** 0800 AM PM

LOCATION/SITE: SJCA

1. Reason for Meeting/Training: (Check all that apply)	
✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	[illegible]	USAE
GARY ELLINGWORTH II	[illegible]	Parratt Wolff inc.
Rebekah Ives	[illegible]	CH2M HILL
Nathan Sweeting	[illegible]	Parratt Wolff
Andrew Litvyak	[illegible]	USAE

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)			
	Site Safety Personnel		Decontamination Procedures
✓	Site/Work Area Description	✓	Emergency Response Plan
	Site Characterization		Hazard Communition
	Biological Hazard(s)	✓	On-Site Emergency
	Chemical Hazard(s)	✓	On-Site Injuries/Illnesses
✓	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
✓	Work and Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring Program
	Air monitoring	✓	Specific Task Training
✓	Safe Work Practices		Confined Spaces
✓	Engineering Controls and Equipment	✓	Heavy Equipment
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

Site Safety Officer

Date: 11 / 13 / 05

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: 11 / 17 / 05 **TIME:** 0700 AM PM

LOCATION/SITE: SJCA

1. Reason for Meeting/Training: (Check all that apply)

✓	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:

Name	Signature	Company
Nelson Figueroa	[signature]	USAE
GARY ELLINGWORTH II	[signature]	Parratt Wolff inc
Jason P. Love	[signature]	Parratt wolff inc
Cecilia White	[signature]	CH2M HILL
Andrew Litvjak	[signature]	USAE

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)			
✓	Site Safety Personnel		Decontamination Procedures
✓	Site/Work Area Description		Emergency Response Plan
✓	Site Characterization		Hazard Communition
	Biological Hazard(s)	✓	On-Site Emergency
	Chemical Hazard(s)	✓	On-Site Injuries/Illnesses
✓	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control	✓	Directions to Medical Facility
✓	Work and Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
✓	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment	✓	Heavy Equipment Drill Rig
	Spill Containment Procedures		Other: (Specify)

4. Remarks:

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

Nelson Figueroa

Site Safety Officer

Date: 11 / 2 / 05

Appendix C
Analytical Results

Table C-1
QC Analytical Results
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Sample ID	SJS21-TB082003	SJS21-FB082003	SJS21-EB113004	SJS21-FB120104	SJS21-FB032805	SJS21-TB103105	SJS21-FB103105	SJS21-TB110205	SJS21-EB110205	SJS21-TB110305	SJS21-TB110405	SJS21-TB110705	SJS21-TB110805	SJS21-TB110905	SJS21-EB110905	SJS21-FB110905	SJS21-TB102406	SJS21-EB102406-B	SJS21-EB102406-S
Sample Date	08/20/03	08/20/03	11/30/04	12/01/04	03/28/05	10/31/05	10/31/05	11/02/05	11/02/05	11/03/05	11/04/05	11/07/05	11/08/05	11/09/05	11/09/05	11/09/05	10/24/06	10/24/06	10/24/06
Chemical Name																			
Volatile Organic Compounds (UG/L)																			
1,1,1-Trichloroethane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,1-Dichloroethene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,4-Trichlorobenzene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,2-Dibromo-3-chloropropane	10 UJ	10 UJ	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,2-Dibromoethane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,2-Dichloroethane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,2-Dichloropropane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
2-Butanone	10 UJ	10 UJ	NA	5 R	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U	10 U	10 U	10 U
2-Hexanone	10 UJ	10 UJ	NA	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U	10 U	10 U	10 U
4-Methyl-2-pentanone	10 UJ	10 UJ	NA	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U	10 U	10 U	10 U
Acetone	10 UJ	34 J	NA	5 R	10 U	4.6 J	2.5 J	7.9	5 U	5.8	12	4.8 J	10 U	5 U	5 U	3.3 J	4 J	4 J	6 J
Benzene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Bromochloromethane	NA	NA	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	NA	NA
Bromodichloromethane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Bromoform	10 U	10 U	NA	0.5 U	10 U	0.2 J	0.17 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.22 J	10 U	10 U	10 U
Bromomethane	10 UJ	10 UJ	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Carbon disulfide	10 UJ	10 UJ	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Carbon tetrachloride	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Chloroethane	10 UJ	10 UJ	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Chloroform	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Chloromethane	10 UJ	10 UJ	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Cyclohexane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Dibromochloromethane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Dichlorodifluoromethane (Freon-12)	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Ethylbenzene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Isopropylbenzene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Methyl acetate	10 U	10 U	NA	0.5 R	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Methylcyclohexane	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Methylene chloride	2 J	3 J	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.18 J	0.5 U	0.12 J	0.17 J	10 U	0.18 J	0.13 J	0.12 J	1 J	1 J	10 U
Styrene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Tetrachloroethene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Toluene	1 J	1 J	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Trichloroethene	10 U	10 U	NA	0.5 U	9 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Trichlorofluoromethane(Freon-11)	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Vinyl chloride	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Xylene, total	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
cis-1,3-Dichloropropene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
trans-1,2-Dichloroethene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	10 U	10 U	NA	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U
Semi-volatile Organic Compounds (UG/L)																			
1,1-Biphenyl	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	NA	10 UJ	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2,4,5-Trichlorophenol	NA	25 U	NA	28 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26 U	26 U	NA	NA	NA
2,4,6-Trichlorophenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2,4-Dichlorophenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2,4-Dimethylphenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2,4-Dinitrophenol	NA	25 U	NA	28 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26 U	26 U	NA	NA	NA
2,4-Dinitrotoluene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2,6-Dinitrotoluene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2-Chloronaphthalene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2-Chlorophenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2-Methylnaphthalene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2-Methylphenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
2-Nitroaniline	NA	25 UJ	NA	28 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26 U	26 U	NA	NA	NA
2-Nitrophenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
3,3'-Dichlorobenzidine	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
3-Nitroaniline	NA	25 U	NA	28 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26 U	26 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	25 U	NA	28 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26 U	26 U	NA	NA	NA
4-Bromophenyl-phenylether	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
4-Chloro-3-methylphenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
4-Chloroaniline	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
4-Chlorophenyl-phenylether	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA

Sample ID	SJS21-TB082003	SJS21-FB082003	SJS21-EB113004	SJS21-FB120104	SJS21-FB032805	SJS21-TB103105	SJS21-FB103105	SJS21-TB110205	SJS21-EB110205	SJS21-TB110305	SJS21-TB110405	SJS21-TB110705	SJS21-TB110805	SJS21-TB110905	SJS21-EB110905	SJS21-FB110905	SJS21-TB102406	SJS21-EB102406-B	SJS21-EB102406-S
Sample Date	08/20/03	08/20/03	11/30/04	12/01/04	03/28/05	10/31/05	10/31/05	11/02/05	11/02/05	11/03/05	11/04/05	11/07/05	11/08/05	11/09/05	11/09/05	11/09/05	10/24/06	10/24/06	10/24/06
4-Methylphenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
4-Nitroaniline	NA	25 UJ	NA	28 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26 U	26 U	NA	NA	NA
4-Nitrophenol	NA	25 U	NA	28 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26 U	26 U	NA	NA	NA
Acenaphthene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Acenaphthylene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Acetophenone	NA	0.3 J	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Anthracene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Atrazine	NA	10 U	NA	11 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Benzaldehyde	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Benzo(a)anthracene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Benzo(a)pyrene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Benzo(b)fluoranthene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Benzo(g,h,i)perylene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Benzo(k)fluoranthene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Butylbenzylphthalate	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Caprolactam	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Carbazole	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Chrysene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Di-n-butylphthalate	NA	10 U	NA	1.4 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Di-n-octylphthalate	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Dibenz(a,h)anthracene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Dibenzofuran	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Diethylphthalate	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Dimethyl phthalate	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Fluoranthene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Fluorene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Hexachlorobenzene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Hexachlorobutadiene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Hexachlorocyclopentadiene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Hexachloroethane	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Isophorone	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Naphthalene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Nitrobenzene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Pentachlorophenol	NA	25 U	NA	28 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26 U	26 U	NA	NA	NA
Phenanthrene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Phenol	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Pyrene	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
bis(2-Chloroethoxy)methane	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
bis(2-Chloroethyl)ether	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	10 U	NA	4.1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
n-Nitroso-di-n-propylamine	NA	10 UJ	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
n-Nitrosodiphenylamine	NA	10 U	NA	11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (UG/L)																			
4,4'-DDD	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
4,4'-DDE	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
4,4'-DDT	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
Aldrin	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
Aroclor-1016	NA	1 U	NA	1.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 U	1 U	NA	NA	NA
Aroclor-1221	NA	2 U	NA	2.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1 U	2 U	NA	NA	NA
Aroclor-1232	NA	1 U	NA	1.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 U	1 U	NA	NA	NA
Aroclor-1242	NA	1 U	NA	1.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 U	1 U	NA	NA	NA
Aroclor-1248	NA	1 U	NA	1.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 U	1 U	NA	NA	NA
Aroclor-1254	NA	1 U	NA	1.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 U	1 U	NA	NA	NA
Aroclor-1260	NA	1 U	NA	1.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1 U	1 U	NA	NA	NA
Dieldrin	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
Endosulfan I	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
Endosulfan II	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
Endosulfan sulfate	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
Endrin	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
Endrin aldehyde	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
Endrin ketone	NA	0.1 U	NA	0.11 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	NA	NA
Heptachlor	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
Heptachlor epoxide	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
Methoxychlor	NA	0.5 U	NA	0.53 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.53 U	0.5 U	NA	NA	NA
Toxaphene	NA	5 U	NA	5.3 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3 U	5 U	NA	NA	NA
alpha-BHC	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
alpha-Chlordane	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
beta-BHC	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
delta-BHC	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
gamma-BHC (Lindane)	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
gamma-Chlordane	NA	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.053 U	0.05 U	NA	NA	NA
Explosives (UG/L)																			
1,3,5-Trinitrobenzene	NA	5.4 U	NA	0.26 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 U	2.5 U	NA	NA	NA

Table C-1
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Sample ID	SJS21-TB082003	SJS21-FB082003	SJS21-EB113004	SJS21-FB120104	SJS21-FB032805	SJS21-TB103105	SJS21-FB103105	SJS21-TB110205	SJS21-EB110205	SJS21-TB110305	SJS21-TB110405	SJS21-TB110705	SJS21-TB110805	SJS21-TB110905	SJS21-EB110905	SJS21-FB110905	SJS21-TB102406	SJS21-EB102406-B	SJS21-EB102406-S
Sample Date	08/20/03	08/20/03	11/30/04	12/01/04	03/28/05	10/31/05	10/31/05	11/02/05	11/02/05	11/03/05	11/04/05	11/07/05	11/08/05	11/09/05	11/09/05	11/09/05	10/24/06	10/24/06	10/24/06
1,3-Dinitrobenzene	NA	5.4 U	NA	0.26 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 U	2.5 U	NA	NA	NA
2,4,6-Trinitrotoluene	NA	5.4 U	NA	0.26 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 U	2.5 U	NA	NA	NA
2,4-Dinitrotoluene	NA	5.4 U	NA	0.26 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
2,6-Dinitrotoluene	NA	7.2 U	NA	0.26 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
2-Amino-4,6-dinitrotoluene	NA	7.2 U	NA	0.26 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
2-Nitrotoluene	NA	5.4 U	NA	0.52 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
3-Nitrotoluene	NA	5.4 U	NA	0.52 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
4-Amino-2,6-dinitrotoluene	NA	7.2 U	NA	0.26 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
4-Nitrotoluene	NA	5.4 U	NA	0.52 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
HMX	NA	7.2 U	NA	0.52 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 U	2.5 U	NA	NA	NA
Nitrobenzene	NA	5.4 U	NA	0.26 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 U	2.5 U	NA	NA	NA
RDX	NA	5.4 U	NA	0.52 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5 U	2.5 U	NA	NA	NA
Tetryl	NA	7.2 U	NA	0.52 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
Total Metals (UG/L)																			
Aluminum	NA	26.7 U	31.5 J	17.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200 U	200 U	NA	NA	NA
Antimony	NA	2.8 U	6.4 U	6.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	60 U	60 U	NA	NA	NA
Arsenic	NA	2.2 U	5.3 U	5.3 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Barium	NA	4.2 J	0.2 U	0.44 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200 U	200 U	NA	NA	NA
Beryllium	NA	0.1 U	0.4 U	0.4 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
Boron	NA	NA	2.7 U	2.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	0.5 U	0.3 U	0.3 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
Calcium	NA	160 U	21.8 U	130 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,000 U	5,000 U	NA	NA	NA
Chromium	NA	1.1 U	1.5 U	1.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Cobalt	NA	0.7 U	1.5 U	1.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50 U	50 U	NA	NA	NA
Copper	NA	3 U	1.1 U	2.7 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25 U	25 U	NA	NA	NA
Cyanide	NA	0.4 U	NA	5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Iron	NA	23.4 U	15.7 U	17.5 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100 U	100 U	NA	NA	NA
Lead	NA	1.8 U	1.6 U	1.6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Magnesium	NA	64.8 U	15.3 U	17.9 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,000 U	5,000 U	NA	NA	NA
Manganese	NA	0.4 U	0.4 J	0.3 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15 U	15 U	NA	NA	NA
Mercury	NA	0.1 U	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.2 U	NA	NA	NA
Molybdenum	NA	NA	1.6 U	1.6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	1.1 U	1.1 U	1.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.97 J	40 U	NA	NA	NA
Potassium	NA	236 J	31.8 U	31.8 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,000 U	5,000 U	NA	NA	NA
Selenium	NA	3.2 U	3.9 U	3.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	35 U	35 U	NA	NA	NA
Silver	NA	1.3 U	1.2 U	1.2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Sodium	NA	338 U	474 U	474 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,000 U	5,000 U	NA	NA	NA
Thallium	NA	3.4 U	6.5 U	6.8 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25 U	25 U	NA	NA	NA
Vanadium	NA	0.71 J	1.7 U	1.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50 U	50 U	NA	NA	NA
Zinc	NA	10.2 U	1.1 J	3.8 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	60 U	60 U	NA	NA	NA
Dissolved Metals (UG/L)																			
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200 U	200 U	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	60 U	60 U	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200 U	200 U	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,000 U	5,000 U	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 J	10 U	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50 U	50 U	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25 U	25 U	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	100 U	100 U	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,000 U	5,000 U	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15 U	15 U	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.2 U	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	40 U	40 U	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,000 U	5,000 U	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	35 U	35 U	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,000 U	5,000 U	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25 U	25 U	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50 U	50 U	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	60 U	60 U	NA	NA	NA
Wet Chemistry (MG/L)																			
Alkalinity	NA	NA	NA	1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	NA	NA	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	NA	NA	NA	1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	NA	NA	NA	1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
J- Analyte detected, reported value is estimated
NA - Not analyzed
U- Not detected

Table C-1
QC Analytical Results
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Sample ID	SJS21-TB102506	SJS21-EB102506-A	SJS21-FB102506-O	SJS21-TB102606	SJS21-FB102606-I	SJS21-EB102606-T	SJS21-TB102706	SJS21-EB102706-S	SJS21-TB103006	SJS21-FB103006-O	SJS21-EB103006-T	SJS21-TB112006	SJS21-FB112006-I	SJS21-EB112006-P	SJS21-TB022607	SJS21-EB022607	SJS21-FB022607
Sample Date	10/25/06	10/25/06	10/25/06	10/26/06	10/26/06	10/26/06	10/27/06	10/27/06	10/30/06	10/30/06	10/30/06	11/20/06	11/20/06	11/20/06	02/26/07	02/26/07	02/26/07
Chemical Name																	
Volatile Organic Compounds (UG/L)																	
1,1,1-Trichloroethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	5 U	5 U	5 U
1,1-Dichloroethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	5 U	5 U	5 U
1,2,3-Trichlorobenzene	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dibromo-3-chloropropane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	1 U	1 U	1 U
1,2-Dibromoethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	1 U	1 U	1 U
1,2-Dichlorobenzene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	5 U	5 U	5 U
1,2-Dichloropropane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	5 U	5 U	5 U
1,3-Dichlorobenzene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Butanone	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	5 U	10 U	5 U	5 UJ	10 U	5 UJ	5 UJ	5 UJ	5 U	5 U	5 UJ	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone	5 U	10 U	5 U	5 UJ	10 U	5 UJ	5 UJ	5 UJ	5 U	5 U	5 UJ	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	4.3 J	10 U	6.9	11	10 U	5.9	8.1	8.5	3.4 J	5.9	6	10 U	10 U	10 U	10 U	10 U	10 U
Benzene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	5 U	5 U	5 U
Bromochloromethane	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
Bromodichloromethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon disulfide	0.5 U	10 U	0.5 U	0.5 U	10 U	0.19 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	5 U	5 U	5 U
Chlorobenzene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroform	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	0.11 J	10 U	0.5 U	0.12 J	10 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.12 J	10 U	10 U	10 U	10 U	10 U	10 U
Dibromochloromethane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Dichlorodifluoromethane (Freon-12)	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Isopropylbenzene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl acetate	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene chloride	0.5 U	10 U	0.1 J	0.5 U	1 J	0.2 J	0.2 J	0.26 J	0.18 J	0.13 J	0.14 J	2 J	3 J	3 J	5 U	1.2 J	5 U
Styrene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	5 U	5 U	5 U
Toluene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 J	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	0.5 U	10 U	0.5 U	0.5 U	2 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	5 U	5 U	5 U
Trichlorofluoromethane(Freon-11)	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl chloride	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	1 U	1 U	1 U
Xylene, total	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,3-Dichloropropene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,2-Dichloroethene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Semi-volatile Organic Compounds (UG/L)																	
1,1-Biphenyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Sample ID	SJS21-TB102506	SJS21-EB102506-A	SJS21-FB102506-O	SJS21-TB102606	SJS21-FB102606-I	SJS21-EB102606-T	SJS21-TB102706	SJS21-EB102706-S	SJS21-TB103006	SJS21-FB103006-O	SJS21-EB103006-T	SJS21-TB112006	SJS21-FB112006-I	SJS21-EB112006-P	SJS21-TB022607	SJS21-EB022607	SJS21-FB022607
Sample Date	10/25/06	10/25/06	10/25/06	10/26/06	10/26/06	10/26/06	10/27/06	10/27/06	10/30/06	10/30/06	10/30/06	11/20/06	11/20/06	11/20/06	02/26/07	02/26/07	02/26/07
4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetophenone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Atrazine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzaldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Caprolactam	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbazole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isophorone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitroso-di-n-propylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (UG/L)																	
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1016	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1221	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin aldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin ketone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-Chlordane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
beta-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
delta-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Explosives (UG/L)																	
1,3,5-Trinitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Sample ID	SJS21-TB102506	SJS21-EB102506-A	SJS21-FB102506-O	SJS21-TB102606	SJS21-FB102606-I	SJS21-EB102606-T	SJS21-TB102706	SJS21-EB102706-S	SJS21-TB103006	SJS21-FB103006-O	SJS21-EB103006-T	SJS21-TB112006	SJS21-FB112006-I	SJS21-EB112006-P	SJS21-TB022607	SJS21-EB022607	SJS21-FB022607
Sample Date	10/25/06	10/25/06	10/25/06	10/26/06	10/26/06	10/26/06	10/27/06	10/27/06	10/30/06	10/30/06	10/30/06	11/20/06	11/20/06	11/20/06	02/26/07	02/26/07	02/26/07
1,3-Dinitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Amino-4,6-dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Amino-2,6-dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HMX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetryl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (UG/L)																	
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Boron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)																	
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry (MG/L)																	
Alkalinity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
J- Analyte detected, reported value is estimated
NA - Not analyzed
U- Not detected

Table C-2
Storm Water and Surface Water Analytical Data
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS02-ST01		SJS02-ST02	SJS02-ST03	SJS02-ST04	SJS02-ST05	SJS02-ST06	SJS02-ST07	SJS02-SW10
Sample ID	SJS02-ST01-03D-P*	SJS02-ST01-03D	SJS02-ST02-03D	SJS02-ST03-03D	SJS02-ST04-03D	SJS02-ST05-03D	SJS02-ST06-03D	SJS02-ST07-03D	SJS02-SW10-03D
Sample Date	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03	12/09/03
Chemical Name									
Volatile Organic Compounds (UG/L)									
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.1	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	4.5 B
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	4	4.4	0.5 U	4.1	5.2	0.5 U	0.75	8.7	4.2
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	12	13	0.5 U	12	15	0.34 J	3.4	28	12
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cumene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.57	0.6	0.5 U	0.6	0.7	0.5 U	0.5 U	1.2	0.5 U
Dichlorodifluoromethane (Freon-12)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl acetate	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene chloride	0.56 B	0.31 B	0.37 B	0.37 B	0.46 B	0.71 B	0.36 B	0.5 U	0.5 U
Styrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	150	140	0.5 U	140	84	1.3	1.3	0.5 U	140
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	1.4	1.5	0.5 U	1.4	0.47 J	0.5 U	0.5 U	0.5 U	1.4
Xylene, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	32	32	0.5 U	32	20	0.74 L	0.5 U	0.5 U	31
cis-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	0.5 UL	0.5 U	0.5 U	0.5 U	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U
trans-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
U- Not detected

Table C-3
Shallow Groundwater Analytical Results
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW01S			SJS21-MW02S				SJS21-MW03S			SJS21-MW04S			SJS21-MW05S		
Sample ID	SJS21-MW01S-03C	SJS21-MW01S-04D	SJS21-MW01S-05D	SJS21-MW02S-03C	SJS21-MW02S-04D	SJS21-MW02S-04D-P*	SJS21-MW02S-05D	SJS21-MW03S-03C	SJS21-MW03S-04D	SJS21-MW03S-05D	SJS21-MW04S-03C	SJS21-MW04S-04D	SJS21-MW04S-05D	SJS21-MW05S-03C	SJS21-MW05S-04D	SJS21-MW05S-05D
Sample Date	08/21/03	11/30/04	11/07/05	08/21/03	12/01/04	12/01/04	11/04/05	08/21/03	12/01/04	11/03/05	08/20/03	12/01/04	11/09/05	08/20/03	11/30/04	11/07/05
Chemical Name																
Volatile Organic Compounds (UG/L)																
1,1,1-Trichloroethane	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,1,2,2-Tetrachloroethane	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	10 U	0.5 UJ	0.5 U	10 U	0.5 J	0.45 J	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,1,2-Trichloroethane	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,1-Dichloroethane	10 U	0.39 J	0.45 J	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,1-Dichloroethene	10 U	0.5 UJ	0.5 U	8 J	4.9	5	5 J	10 U	0.5 U	0.5 U	10 U	1.5	50 U	10 U	0.5 UL	0.5 U
1,2,3-Trichlorobenzene	NA	NA	0.5 U	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
1,2,4-Trichlorobenzene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,2-Dibromo-3-chloropropane	10 UJ	0.5 UJ	0.5 U	10 UJ	0.5 U	0.5 U	10 U	10 UJ	0.5 U	0.5 U	10 UJ	0.5 U	50 U	10 UJ	0.5 UL	0.5 U
1,2-Dibromoethane	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,2-Dichlorobenzene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,2-Dichloroethane	10 U	0.5 UJ	0.41 J	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,2-Dichloropropane	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,3-Dichlorobenzene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
1,4-Dichlorobenzene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
2-Butanone	10 UJ	5 R	5 U	10 UJ	500 R	500 R	10 U	10 UJ	5 R	5 U	10 UJ	130 R	50 U	10 UJ	5 R	5 U
2-Hexanone	10 UJ	5 UJ	5 U	10 UJ	5 U	5 U	10 U	10 UJ	5 U	5 U	10 UJ	5 U	50 U	10 UJ	5 UL	5 U
4-Methyl-2-pentanone	10 UJ	5 UJ	5 U	10 UJ	5 U	5 U	10 U	10 UJ	5 U	5 U	10 UJ	5 U	50 U	10 UJ	5 UL	5 U
Acetone	10 UJ	5 R	5 U	10 UJ	500 R	500 R	10 U	10 UJ	5 R	20	10 UJ	4 J	50 U	10 UJ	5 R	5 U
Benzene	10 U	0.5 UJ	0.28 J	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.1 J	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Bromochloromethane	NA	NA	0.5 U	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Bromodichloromethane	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Bromoform	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Bromomethane	10 UJ	0.5 UJ	0.5 U	10 UJ	0.5 U	0.5 U	10 U	10 UJ	0.5 U	0.5 U	10 UJ	0.5 U	50 U	10 UJ	0.5 UL	0.5 U
Carbon disulfide	10 UJ	0.5 UJ	0.5 U	10 UJ	0.44 J	0.59	10 U	10 UJ	0.5 U	0.5 U	10 UJ	0.5 U	50 U	10 UJ	0.39 J	0.5 U
Carbon tetrachloride	10 U	0.5 UJ	0.16 J	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Chlorobenzene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Chloroethane	10 UJ	0.5 UJ	0.5 U	10 UJ	0.5 U	0.5 U	10 U	10 UJ	0.5 U	0.5 U	10 UJ	0.5 U	50 U	10 UJ	0.5 UL	0.5 U
Chloroform	10 U	0.5 UJ	0.24 J	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Chloromethane	10 UJ	0.5 UJ	0.5 U	10 UJ	0.5 U	0.5 U	10 U	10 UJ	0.5 U	0.5 U	10 UJ	0.5 U	50 U	10 UJ	0.5 UL	0.5 U
Cyclohexane	10 U	0.5 UJ	0.78	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Dibromochloromethane	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Dichlorodifluoromethane (Freon-12)	10 U	0.5 UJ	0.5 UJ	10 U	0.4 J	0.36 J	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 UJ
Ethylbenzene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Isopropylbenzene	2 J	0.61 J	0.21 J	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Methyl acetate	10 U	0.5 R	0.5 U	10 U	50 R	50 R	10 U	10 U	0.5 R	0.5 U	10 U	13 R	50 U	10 U	0.5 R	0.5 UJ
Methyl-tert-butyl ether (MTBE)	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Methylcyclohexane	10 U	3.7 J	2	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Methylene chloride	1 B	0.5 UJ	0.2 B	2 B	0.5 U	0.5 U	10 U	2 B	0.5 U	0.5 U	2 B	0.5 U	50 U	10 U	0.5 UL	0.16 B
Styrene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Tetrachloroethene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Toluene	10 UJ	0.5 UJ	0.5 U	2 B	0.5 U	0.5 U	10 U	1 B	0.5 U	0.5 U	1 B	0.5 U	50 U	10 UJ	0.5 UL	0.5 U
Trichloroethene	2 B	0.81 B	1.3	2,500 J	1,400 J	1,400	1,500	2 B	1.5	2.6	460	120	6 J	10 U	2.6 B	8.1
Trichlorofluoromethane(Freon-11)	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 UJ	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Vinyl chloride	10 U	0.66 J	2.4	12	4.8	5	9 J	10 U	0.5 U	0.5 U	10 U	1.5	50 U	10 U	0.5 UL	0.5 U
Xylene, total	10 U	0.5 UJ	0.1 J	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
cis-1,2-Dichloroethene	10 U	1.6 J	1.4	410 J	530 J	540	530	10 U	1.2	2 J	190	350	540	10 U	0.54 L	0.69
cis-1,3-Dichloropropene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
m- and p-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	10 U	0.5 UJ	0.5 U	9 J	5.9	5.8	9 J	10 U	0.5 U	0.5 UJ	5 J	7.7	6 J	10 U	0.5 UL	0.5 U
trans-1,3-Dichloropropene	10 U	0.5 UJ	0.5 U	10 U	0.5 U	0.5 U	10 U	10 U	0.5 U	0.5 U	10 U	0.5 U	50 U	10 U	0.5 UL	0.5 U
Wet Chemistry (MG/L)																
Alkalinity	NA	10	NA	NA	49 B	51 B	NA	NA	120 B	NA	NA	25 B	NA	NA	52	NA
Carbon	NA	1.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1	NA
Ferrous iron	NA	2.8	6.7 L	NA	NA	NA	3.86 L	NA	NA	1.99 L	NA	NA	7.35 L	NA	5.9	1.26 L
Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	NA	0.05 U	NA	NA	0.05 U	0.05 U	NA	NA	0.05 U	NA	NA	0.05 U	NA	NA	0.05 U	NA
Sulfate	NA	110	NA	NA	65	34	NA	NA	1.1	NA	NA	90	NA	NA	20	NA
Total organic carbon (TOC)	NA	NA	NA	NA	3.2	2.9	NA	NA	1 U	NA	NA	2.9	NA	NA	NA	NA

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
L - Reported value is biased low
NA - Not analyzed
R - Unreliable result
U- Not detected

Table C-3
Shallow Groundwater Analytical Results
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW06S			SJS21-MW07S				SJS21-MW08S		SJS21-MW09S			SJS21-MW10S		SJS21-MW11S		
Sample ID	SJS21-MW06S-03C	SJS21-MW06S-04D	SJS21-MW06S-05D	SJS21-MW07S-04D	SJS21-MW07S-05A	SJS21-MW07S-05D	SJS21-DW101-13-06D	SJS21-MW08S-04D	SJS21-MW08S-05D	SJS21-MW09S-04D	SJS21-MW09S-04D-P*	SJS21-MW09S-05D	SJS21-MW10S-04D	SJS21-MW10S-05D	SJS21-MW11S-04D	SJS21-MW11S-05D	SJS21-MW11S-05D-P*
Sample Date	08/21/03	11/30/04	11/04/05	11/30/04	03/28/05	11/07/05	10/24/06	12/01/04	11/04/05	12/01/04	12/01/04	11/04/05	11/30/04	11/03/05	11/30/04	11/04/05	11/04/05
Chemical Name																	
Volatile Organic Compounds (UG/L)																	
1,1,1-Trichloroethane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.27 L	0.5 U	0.5 U
1,1,2-Trichloroethane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,1-Dichloroethane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.47 J	0.46 J	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,1-Dichloroethene	10 U	0.5 U	0.5 U	2,500 UJ	1 J	500 U	8 J	5.6	4 J	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,2,3-Trichlorobenzene	NA	NA	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	0.5 U	0.5 U
1,2,4-Trichlorobenzene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	10 UJ	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,2-Dibromoethane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,2-Dichlorobenzene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,2-Dichloroethane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,2-Dichloropropane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,3-Dichlorobenzene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
1,4-Dichlorobenzene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
2-Butanone	10 UJ	5 R	5 U	25,000 R	10 U	500 U	10 U	500 R	10 U	50 R	50 R	10 U	5 R	5 U	5 R	5 U	5 U
2-Hexanone	10 UJ	5 U	5 U	25,000 UJ	10 U	500 U	10 U	5 U	10 U	5 U	5 U	10 U	5 UL	5 U	5 UL	5 U	5 U
4-Methyl-2-pentanone	10 UJ	5 U	5 U	25,000 UJ	10 U	500 U	10 U	5 U	10 U	5 U	5 U	10 U	5 UL	5 U	5 UL	5 U	5 U
Acetone	10 UJ	5 R	5 U	25,000 R	10 U	500 U	5 B	500 R	10 U	50 R	50 R	10 U	5 R	5 U	5 R	2.5 B	3.7 B
Benzene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	89 J	75	5 J	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Bromochloromethane	NA	NA	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	0.5 U	0.5 U
Bromodichloromethane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Bromoform	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Bromomethane	10 UJ	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Carbon disulfide	10 UJ	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.44 J	10 U	0.5 UL	0.5 U	0.5 L	0.5 U	0.5 U
Carbon tetrachloride	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Chlorobenzene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Chloroethane	10 UJ	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Chloroform	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	2.1 L	0.5 U	0.5 U
Chloromethane	10 UJ	0.54 J	0.5 U	2,400 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.77 L	0.5 U	0.5 U
Cyclohexane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	7.6	8.1	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Dibromochloromethane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Dichlorodifluoromethane (Freon-12)	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.11 J	0.54 L	0.5 U	0.5 UJ
Ethylbenzene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Isopropylbenzene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	1.5	1.7	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Methyl acetate	10 U	0.5 R	0.5 U	2,500 R	10 U	500 U	10 U	50 R	10 U	5 R	5 R	10 U	0.5 R	0.5 U	19 J	0.5 U	0.5 U
Methyl-tert-butyl ether (MTBE)	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	1 J	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Methylcyclohexane	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	1.2	1.4	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Methylene chloride	2 B	0.5 U	0.5 U	2,500 UJ	10 U	500 U	3 B	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	1.8 J	0.14 B	0.5 U
Styrene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Tetrachloroethene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	1 J	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Toluene	1 B	0.5 U	0.5 U	2,500 UJ	10 UJ	500 U	0.9 B	0.5 U	10 U	1.1	1.2	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Trichloroethene	10 U	0.8 B	0.5 U	7,100 B	1,800	3,600	8,200	1,000 J	830	0.34 J	0.38 J	10 U	0.39 B	0.39 J	0.4 B	0.5 U	0.5 U
Trichlorofluoromethane(Freon-11)	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 UJ	0.5 UL	0.5 U	0.5 U
Vinyl chloride	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	4 J	7.3	33	2.3	2.1	6 J	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Xylene, total	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.54	0.58	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
cis-1,2-Dichloroethene	10 U	0.5 U	0.5 U	2,500 UJ	71	500 U	350 J	710 J	560	8.5	8.1	17	0.5 UL	0.19 J	0.5 UL	0.5 U	0.5 U
cis-1,3-Dichloropropene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
m- and p-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	4 J	5.8	5 J	0.73	0.68	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
trans-1,3-Dichloropropene	10 U	0.5 U	0.5 U	2,500 UJ	10 U	500 U	10 U	0.5 U	10 U	0.5 U	0.5 U	10 U	0.5 UL	0.5 U	0.5 UL	0.5 U	0.5 U
Wet Chemistry (MG/L)																	
Alkalinity	NA	21	NA	20	NA	NA	NA	52 B	NA	120 B	120 B	NA	19	NA	120	NA	NA
Carbon	NA	3	NA	1.9	NA	NA	NA	NA	NA	NA	NA	NA	1.1	NA	7.6	NA	NA
Ferrous iron	NA	3.4	1.45 L	3.6	NA	NA	NA	NA	4.15 L	NA	NA	18.4 L	0.2 U	NA	6	NA	NA
Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	NA	0.05 U	NA	0.05 U	NA	NA	NA	0.05 U	NA	0.05 U	0.05 U	NA	0.05 U	NA	0.05 U	NA	NA
Sulfate	NA	110	NA	37	NA	NA	NA	79	NA	2.7	1.8	NA	71	NA	100	NA	NA
Total organic carbon (TOC)	NA	NA	NA	NA	NA	NA	NA	4.6	NA	11	10	NA	NA	NA	NA	NA	NA

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
L - Reported value is biased low
NA - Not analyzed
R - Unreliable result
U- Not detected

Table C-3
Shallow Groundwater Analytical Results
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW12S		SJS21-MW13S						SJS21-MW14S	SJS21-MW15S		SJS21-MW16S	SJS21-MW17S	SJS21-MW18S		SJS21-MW19S	SJS21-TW101
Sample ID	SJS21-MW12S-05D	SJS21-DW102-14-06D	SJS21-MW13S-05D	SJS21-MW13S-05D-P*	SJS21-DW103-06D	SJS21-DW104-06D	SJS21-DW105-06D	SJS21-DW105P-06D*	SJS21-MW14S-06D	SJS21-MW15S-06D	SJS21-MW15SP-06D*	SJS21-MW16S-06D	SJS21-MW17S-07A	SJS21-MW18S-07A	SJS21-MW18S-07A-P*	SJS21-MW19S-07A	SJS21-TW101-05D
Sample Date	11/09/05	10/24/06	11/09/05	11/09/05	10/26/06	10/27/06	11/20/06	11/20/06	10/30/06	10/30/06	10/30/06	10/30/06	02/26/07	02/26/07	02/26/07	02/26/07	11/03/05
Chemical Name																	
Volatile Organic Compounds (UG/L)																	
1,1,1-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	2.2 J	0.5 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	5 U	5 U	5 U	5 U	0.5 U
1,1-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
1,1-Dichloroethene	2 J	17	10	11	4 J	5 J	1 J	1 J	130 U	2,000 U	1,000 U	670 U	5 U	5 U	5 U	1.6 J	0.5 U
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
1,2-Dibromo-3-chloropropane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	1 U	1 U	1 U	1 U	0.5 U
1,2-Dibromoethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	1 U	1 U	1 U	1 U	0.5 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
1,2-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	5 U	5 U	5 U	5 U	0.5 U
1,2-Dichloropropane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	5 U	5 U	5 U	5 U	0.5 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	5 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	5 U
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	5 U
Acetone	10 U	3 B	10 U	10 U	10 U	10 U	20 B	19 B	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	9.4 B
Benzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	5 U	5 U	5 U	5 U	0.13 J
Bromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Bromoform	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.12 J
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Carbon disulfide	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Carbon tetrachloride	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	5 U	5 U	5 U	5 U	0.5 U
Chlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Chloroform	10 U	10 U	10 U	10 U	10 U	10 U	0.8 B	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Cyclohexane	10 U	10 U	10 U	10 U	10 U	10 U	1 J	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Dibromochloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Dichlorodifluoromethane (Freon-12)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 UJ
Ethylbenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Isopropylbenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Methyl acetate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Methyl-tert-butyl ether (MTBE)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Methylcyclohexane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Methylene chloride	10 U	3 B	10 U	10 U	1 B	10 U	4 B	10 U	130 U	2,000 U	1,000 U	670 U	5 U	5 U	5 U	5 U	0.5 U
Styrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Tetrachloroethene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	5 U	5 U	5 U	5 U	0.5 U
Toluene	10 U	10 U	0.9 J	1 J	1 B	10 U	1 B	0.9 B	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.18 J
Trichloroethene	1,400	9,600	4,800	4,800	1,300	1,800	200	200	650	14,000	16,000	13,000	29	170	180	150	0.5 U
Trichlorofluoromethane(Freon-11)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Vinyl chloride	9 J	13	80	86	110	170	130	130	130 U	2,000 U	1,000 U	670 U	1 U	14	16	25	0.5 U
Xylene, total	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
cis-1,2-Dichloroethene	370	3,500	1,800	1,800	600	950	360	400	880	1,100 J	2,600 J	460 J	22	44	49	140	0.26 J
cis-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
m- and p-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	2 J	15	7 J	8 J	3 J	4 J	1 J	2 J	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
trans-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130 U	2,000 U	1,000 U	670 U	10 U	10 U	10 U	10 U	0.5 U
Wet Chemistry (MG/L)																	
Alkalinity	52.9	NA	58.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ferrous iron	2.8 L	NA	1.26 L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate	0.05 U	NA	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	55.5	NA	51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	4.68 J	NA	4.65 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
L - Reported value is biased low
NA - Not analyzed
R - Unreliable result
U- Not detected

Table C-3
Shallow Groundwater Analytical Results
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-TW102		SJS21-TW103	SJS21-TW104	SJS21-TW106	SJS21-TW107	SJS21-TW108	SJS21-TW109	SJS21-TW110		SJS21-TW111	SJS21-TW112	SJS21-TW113	SJS21-TW114	SJS21-TW115	SJS21-TW116	SJS21-TW117	SJS21-TW118
Sample ID	SJS21-TW102-05D	SJS21-TW102-05D-P*	SJS21-TW103-05D	SJS21-TW104-05D	SJS21-TW106-05D	SJS21-TW107-05D	SJS21-TW108-05D	SJS21-TW109-05D	SJS21-TW110-05D	SJS21-TW110-05D-P*	SJS21-TW111-05D	SJS21-TW112-05D	SJS21-TW113-05D	SJS21-TW114-05D	SJS21-TW115-05D	SJS21-TW116-05D	SJS21-TW117-05D	SJS21-TW118-05D
Sample Date	10/31/05	10/31/05	11/01/05	10/31/05	11/02/05	10/31/05	11/02/05	11/01/05	11/02/05	11/02/05	11/01/05	11/02/05	11/02/05	11/01/05	11/01/05	11/02/05	11/03/05	11/01/05
Chemical Name																		
Volatile Organic Compounds (UG/L)																		
1,1,1-Trichloroethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	15	10 U	10 U	4.6
1,1,2-Trichloroethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.28 J
1,1-Dichloroethene	0.5 U	0.5 U	10 U	0.5 U	1 J	500 U	10 U	2 J	4 J	3 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,2-Dibromoethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,2-Dichlorobenzene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.27 J
1,2-Dichloropropane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
1,4-Dichlorobenzene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
2-Butanone	5 U	5 U	10 U	5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U
2-Hexanone	5 U	5 U	10 U	5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U
4-Methyl-2-pentanone	5 U	5 U	10 U	5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U
Acetone	2.6 J	5.6	10 U	8.8 B	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	7 B	5 U
Benzene	0.5 U	0.5 U	10 U	0.14 J	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.13 J
Bromochloromethane	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U
Bromodichloromethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Bromoform	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.13 J
Bromomethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Carbon disulfide	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Carbon tetrachloride	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	14	10 U	10 U	10 U	10 U	0.5 U
Chloroethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Chloroform	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Chloromethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Cyclohexane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Dibromochloromethane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Dichlorodifluoromethane (Freon-12)	0.5 U	0.5 U	10 U	0.5 UJ	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	21	10 U	10 U	0.3 J
Ethylbenzene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Isopropylbenzene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Methyl acetate	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	11
Methylcyclohexane	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Methylene chloride	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Styrene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Tetrachloroethene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Toluene	0.11 J	0.11 J	10 U	0.11 J	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Trichloroethene	0.1 J	0.5 U	4 J	0.29 J	500	3,000	1 J	1,600	2,800	2,900	10	1 J	78	50	190	1 J	14	1
Trichlorofluoromethane(Freon-11)	0.5 UJ	0.5 UJ	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Vinyl chloride	0.5 U	0.5 U	10 U	0.5 U	4 J	500 U	10 U	6 J	5 J	6 J	10 U	10 U	5 J	10 U	390	10 U	10 U	0.65
Xylene, total	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
cis-1,2-Dichloroethene	0.5 UJ	0.5 U	9 J	2.3 J	730	1,300	10 U	450	1,200	1,300	18	10 U	28	3 J	140	10 U	2 J	1.1 J
cis-1,3-Dichloropropene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
m- and p-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	0.5 UJ	0.5 U	10 U	0.5 UJ	2 J	500 U	10 U	5 J	3 J	3 J	10 U	10 U	10 U	10 U	2 J	10 U	10 U	0.5 UJ
trans-1,3-Dichloropropene	0.5 U	0.5 U	10 U	0.5 U	10 U	500 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.5 U
Wet Chemistry (MG/L)																		
Alkalinity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ferrous iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
L - Reported value is biased low
NA - Not analyzed
R - Unreliable result
U- Not detected

Table C-3
Shallow Groundwater Analytical Results
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-TW119	SJS21-TW120	SJS21-TW121	SJS21-TW122	SJS21-TW123	SJS21-TW124	SJS21-TW125	SJS21-TW126	SJS21-TW127	SJS21-TW201		SJS21-TW202	SJS21-GW101	SJS21-GW102	SJS21-GW103	SJS21-GW104	SJS21-GW105
Sample ID	SJS21-TW119-05D	SJS21-TW120-05D	SJS21-TW121-05D	SJS21-TW122-05D	SJS21-TW123-05D	SJS21-TW124-05D	SJS21-TW125-05D	SJS21-TW126-05D	SJS21-TW127-05D	SJS21-TW201-06D	SJS21-TW201P-06D*	SJS21-TW202-06D	SJS21-GW101-13-06D	SJS21-GW102-13-06D	SJS21-GW103-13-06D	SJS21-GW104-13-06D	SJS21-GW105-13-06D
Sample Date	11/01/05	11/01/05	10/31/05	10/31/05	10/31/05	11/02/05	11/07/05	11/07/05	11/07/05	10/25/06	10/25/06	10/25/06	10/26/06	10/26/06	10/26/06	10/27/06	10/27/06
Chemical Name																	
Volatile Organic Compounds (UG/L)																	
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	200	190	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	2 J	2 J	0.28 J	2 J	0.5 U	10 U	10 U	10 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	2 J	1 J	10 U	0.8 J	10 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	NA	NA	0.5 U	NA	0.5 U	NA	NA	NA
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,2-Dibromoethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,2-Dichloroethane	0.5 U	0.5 U	4.6	10 U	2.5	0.5 U	0.5 UJ	0.5 UJ	0.21 J	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
2-Butanone	5 U	5 U	5 U	10 U	5 U	5 U	5 UJ	5 UJ	5 UJ	10 U	10 U	5 U	10 U	5 U	10 U	10 U	10 U
2-Hexanone	5 U	5 U	5 U	10 U	5 U	5 U	5 UJ	5 UJ	5 UJ	10 U	10 U	5 UJ	10 U	5 U	10 U	10 U	10 U
4-Methyl-2-pentanone	5 U	5 U	5 U	10 U	5 U	5 U	5 UJ	5 UJ	5 UJ	10 U	10 U	5 UJ	10 U	5 U	10 U	10 U	10 U
Acetone	3.9 J	3.1 B	2.7 J	10 U	2.3 J	6.1 B	2.2 B	5 UJ	2.7 B	10 U	10 U	5.7 B	10 U	7.5 B	10 U	10 U	10 U
Benzene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.33 J	0.16 J	0.5 UJ	10 U	10 U	0.5 U	10 U	0.43 J	10 U	10 U	10 U
Bromochloromethane	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	NA	NA	0.5 U	NA	0.5 U	NA	NA	NA
Bromodichloromethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Bromoform	0.5 U	0.12 J	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Bromomethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Carbon disulfide	0.5 U	0.5 U	0.1 J	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.12 B	10 U	10 U	10 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Chloroethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Chloroform	0.5 U	0.5 U	0.5 U	10 U	0.5 U	1.2	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Chloromethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Cyclohexane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	1.2 J	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.16 B	10 U	10 U	10 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Dichlorodifluoromethane (Freon-12)	0.5 U	0.5 UJ	5	10 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.2 J	0.3 J	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Isopropylbenzene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.47 J	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Methyl acetate	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	1 J	1 J	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Methylcyclohexane	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	2.3 J	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Methylene chloride	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.58 B	0.55 B	0.96 B	10 U	1 B	0.13 B	1 B	0.5 U	10 U	10 U	10 U
Styrene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Tetrachloroethene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	1.3	10 U	10 U	10 U
Toluene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.68 J	11 J	0.96 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Trichloroethene	0.5 U	1.2	0.5 U	27	0.5 U	0.55	0.5 UJ	0.13 J	0.5 UJ	1 B	1 B	0.5 U	420	100	10 B	83	10 U
Trichlorofluoromethane(Freon-11)	0.5 UJ	0.5 U	0.5 UJ	10 U	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Vinyl chloride	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10	10	0.5 U	25	3.1	10 U	16	10 U
Xylene, total	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.63 J	0.69 J	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	0.5 UJ	0.69 J	0.5 UJ	2 J	0.5 UJ	0.73 J	0.5 UJ	0.35 J	0.5 UJ	16	18	0.5 U	120	72	5 J	110	10 U
cis-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
m- and p-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	0.5 UJ	0.5 UJ	0.5 UJ	10 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	2 J	2.4 J	10 U	1 J	10 U
trans-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	10 U	10 U	0.5 U	10 U	0.5 U	10 U	10 U	10 U
Wet Chemistry (MG/L)																	
Alkalinity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ferrous iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
L - Reported value is biased low
NA - Not analyzed
R - Unreliable result
U- Not detected

Table C-3
Shallow Groundwater Analytical Results
VOCs and Geochemical Parameters
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-TW203	SJS21-TW204	SJS21-TW205	SJS21-TW206	SJS21-TW207		SJS21-TW208	SJS21-TW209	SJS21-TW210	SJS21-TW211	SJS21-TW212	SJS21-TW213	SJS21-TW214	SJS21-TW215	SJS21-TW216	SJS21-TW217
Sample ID	SJS21-TW203-06D	SJS21-TW204-06D	SJS21-TW205-07A	SJS21-TW206-07A	SJS21-TW207-07A	SJS21-TW207P-07A*	SJS21-TW208-07A	SJS21-TW209-07A	SJS21-TW210-07A	SJS21-TW211-07A	SJS21-TW212-07A	SJS21-TW213-07A	SJS21-TW214-07A	SJS21-TW215-07A	SJS21-TW216-07A	SJS21-TW217-07A
Sample Date	10/26/06	10/26/06	02/20/07	02/20/07	02/20/07	02/20/07	02/21/07	02/22/07	02/20/07	02/21/07	02/21/07	02/21/07	02/21/07	02/21/07	02/22/07	02/23/07
Chemical Name																
Volatile Organic Compounds (UG/L)																
1,1,1-Trichloroethane	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	1 B	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	0.5 U	0.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	2 J	10 U	3 J	10 U	10 U	10 U	10 U	10 U	1 J
1,1-Dichloroethene	0.5 U	0.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U	5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	2 B	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	1 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dibromoethane	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	1 B	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	0.5 U	0.5 U	5 U	5 U	0.7 J	0.8 J	0.8 B	5 U	0.7 J	0.7 B	0.8 B	5 U	0.7 B	0.7 B	5 U	0.7 J
1,2-Dichloropropane	0.5 U	0.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	0.9 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	0.9 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Butanone	5 U	5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	5 U	5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone	5 U	5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	3.1 B	8.2 B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	0.5 U	0.19 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromochloromethane	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	0.5 U	0.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	0.5 U	0.5 U	0.9 B	10 U	10 U	10 U	10 U	0.9 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.7 B
Chloroethane	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroform	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	0.25 B	0.11 B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dichlorodifluoromethane (Freon-12)	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	0.5 U	0.5 U	0.8 J	15 U	15 U	15 U	15 U	0.9 B	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U
Isopropylbenzene	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl acetate	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-tert-butyl ether (MTBE)	0.5 U	0.32 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	0.5 U	0.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.5 U	0.5 U	1 B	5 U	5 U	5 U	5 U	2 B	5 U	5 U	5 U	5 U	5 U	5 U	0.7 B	5 U
Toluene	0.5 U	0.1 B	6 B	15	7 J	6 J	4 J	0.8 B	1 B	1 J	3 J	1 J	15	1 J	0.8 B	5 J
Trichloroethene	0.17 J	1.5	8	14	5 U	5 U	5 U	11	5 U	5 U	9	5	5 U	5 U	11	5 U
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl chloride	0.19 J	0.5 U	2 U	0.8 J	2 U	2 U	2 U	2 U	2 U	2 U	0.9 J	2 U	2 U	2 U	2 J	2 U
Xylene, total	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	2.2	2.4	5 J	9 J	10 U	10 U	10 U	2 J	10 U	10 U	9 J	10 U	10 U	10 U	12	10 U
cis-1,3-Dichloropropene	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
m- and p-Xylene	NA	NA	1 B	1 B	20 U	20 U	0.8 B	2 B	0.7 B	1 B	20 U	1 B	20 U	1 B	1 B	1 B
o-Xylene	NA	NA	10 U	10 U	10 U	10 U	10 U	0.8 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,2-Dichloroethene	0.5 U	0.34 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	0.5 U	0.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Wet Chemistry (MG/L)																
Alkalinity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ferrous iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
L - Reported value is biased low
NA - Not analyzed
R - Unreliable result
U- Not detected

Table C-4
Shallow Groundwater Analytical Results
SVOCs, Pesticides/PCBs, Explosives, and Metals
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW01S	SJS21-MW02S	SJS21-MW03S	SJS21-MW04S		SJS21-MW05S	SJS21-MW06S	SJS21-MW07S	SJS21-MW08S	SJS21-MW09S		SJS21-MW10S	SJS21-MW11S	SJS21-MW12S	SJS21-MW13S	
Sample ID	SJS21-MW01S-03C	SJS21-MW02S-03C	SJS21-MW03S-03C	SJS21-MW04S-03C	SJS21-MW04S-04D	SJS21-MW05S-03C	SJS21-MW06S-03C	SJS21-MW07S-04D	SJS21-MW08S-04D	SJS21-MW09S-04D	SJS21-MW09S-04D-P*	SJS21-MW10S-04D	SJS21-MW11S-04D	SJS21-MW12S-05D	SJS21-MW13S-05D	SJS21-MW13S-05D-P*
Sample Date	08/21/03	08/21/03	08/21/03	08/20/03	12/01/04	08/20/03	08/21/03	11/30/04	12/01/04	12/01/04	12/01/04	11/30/04	11/30/04	11/09/05	11/09/05	11/09/05
Chemical Name																
Semi-volatile Organic Compounds (UG/L)																
1,1-Biphenyl	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2,2'-Oxybis(1-chloropropane)	10 UJ	10 UJ	10 UJ	10 UJ	NA	10 UJ	11 UJ	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	NA	25 U	26 U	28 U	27 U	29 U	29 U	26 U	26 U	25 U	26 U	25 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U	25 U	NA	25 U	26 U	28 U	27 U	29 U	29 U	26 U	26 U	25 UJ	26 UJ	25 UJ
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2-Methylnaphthalene	0.6 J	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
2-Nitroaniline	25 UJ	25 UJ	25 UJ	25 UJ	NA	25 UJ	26 UJ	28 U	27 U	29 U	29 U	26 U	26 U	25 U	26 U	25 U
2-Nitrophenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U	NA	25 U	26 U	28 U	27 U	29 U	29 U	26 U	26 U	25 U	26 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U	25 U	25 U	NA	25 U	26 U	28 U	27 U	29 U	29 U	26 U	26 U	25 U	26 U	25 U
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
4-Chloroaniline	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
4-Nitroaniline	25 UJ	25 UJ	25 UJ	25 UJ	NA	25 UJ	26 UJ	28 U	27 U	29 U	29 U	26 U	26 U	25 U	26 U	25 U
4-Nitrophenol	25 U	25 UJ	25 U	25 U	NA	25 U	26 U	28 U	27 U	29 U	29 U	26 U	26 U	25 U	26 U	25 U
Acenaphthene	0.9 J	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Acetophenone	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Anthracene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Atrazine	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 R	11 R	12 R	12 R	11 R	11 R	10 U	11 U	10 U
Benzaldehyde	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Benzo(a)pyrene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Butylbenzylphthalate	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Caprolactam	10 U	1 J	10 U	1 J	NA	0.8 J	11 U	11 U	3.7 J	12 U	12 U	11 U	3.6 J	10 U	11 U	10 U
Carbazole	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Chrysene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Di-n-butylphthalate	10 U	10 U	10 U	0.5 J	NA	10 U	0.8 J	3.5 B	1.1 B	1.2 B	1.9 B	2.4 B	3.2 B	10 U	11 U	10 U
Di-n-octylphthalate	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Dibenzofuran	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Dimethyl phthalate	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Fluoranthene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Fluorene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Isophorone	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Pentachlorophenol	25 U	25 UJ	25 U	25 U	NA	25 U	26 U	28 U	27 U	29 U	29 U	26 U	26 U	25 U	26 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
Phenol	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	4.1 J	3.8 J	11 U	11 U	10 U	11 U	10 U
Pyrene	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
bis(2-Chloroethyl)ether	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
bis(2-Ethylhexyl)phthalate	10 U	10 U	0.8 B	10 U	NA	10 U	11 U	1.5 B	3 B	2.6 B	2.3 B	1.7 B	4.6 B	10 U	73	10 U
n-Nitroso-di-n-propylamine	10 UJ	10 UJ	10 UJ	10 UJ	NA	10 UJ	11 UJ	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U
n-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	NA	10 U	11 U	11 U	11 U	12 U	12 U	11 U	11 U	10 U	11 U	10 U

Table C-4
Shallow Groundwater Analytical Results
SVOCs, Pesticides/PCBs, Explosives, and Metals
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW01S	SJS21-MW02S	SJS21-MW03S	SJS21-MW04S		SJS21-MW05S	SJS21-MW06S	SJS21-MW07S	SJS21-MW08S	SJS21-MW09S		SJS21-MW10S	SJS21-MW11S	SJS21-MW12S	SJS21-MW13S	
Sample ID	SJS21-MW01S-03C	SJS21-MW02S-03C	SJS21-MW03S-03C	SJS21-MW04S-03C	SJS21-MW04S-04D	SJS21-MW05S-03C	SJS21-MW06S-03C	SJS21-MW07S-04D	SJS21-MW08S-04D	SJS21-MW09S-04D	SJS21-MW09S-04D-P*	SJS21-MW10S-04D	SJS21-MW11S-04D	SJS21-MW12S-05D	SJS21-MW13S-05D	SJS21-MW13S-05D-P*
Sample Date	08/21/03	08/21/03	08/21/03	08/20/03	12/01/04	08/20/03	08/21/03	11/30/04	12/01/04	12/01/04	12/01/04	11/30/04	11/30/04	11/09/05	11/09/05	11/09/05
Chemical Name																
Pesticide/Polychlorinated Biphenyls (UG/L)																
4,4'-DDD	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 U	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 UJ	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
4,4'-DDT	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 U	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
Aldrin	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U
Aroclor-1016	1 U	1 U	1 U	1 U	NA	1 U	1 U	1.1 U	1.1 UJ	1.2 U	1.1 UJ	1.1 U	1.1 U	1 U	1 U	1 U
Aroclor-1221	2 U	2 U	2 U	2.1 U	NA	2 U	2 U	2.1 U	2.2 UJ	2.4 U	2.2 UJ	2.2 U	2.1 U	2 U	2 U	2 U
Aroclor-1232	1 U	1 U	1 U	1 U	NA	1 U	1 U	1.1 U	1.1 UJ	1.2 U	1.1 UJ	1.1 U	1.1 U	1 U	1 U	1 U
Aroclor-1242	1 U	1 U	1 U	1 U	NA	1 U	1 U	1.1 U	1.1 UJ	1.2 U	1.1 UJ	1.1 U	1.1 U	1 U	1 U	1 U
Aroclor-1248	1 U	1 U	1 U	1 U	NA	1 U	1 U	1.1 U	1.1 UJ	1.2 U	1.1 UJ	1.1 U	1.1 U	1 U	1 U	1 U
Aroclor-1254	1 U	1 U	1 U	1 U	NA	1 U	1 U	1.1 U	1.1 UJ	1.2 U	1.1 UJ	1.1 U	1.1 U	1 U	1 U	1 U
Aroclor-1260	1 U	1 U	1 U	1 U	NA	1 U	1 U	1.1 U	1.1 UJ	1.2 U	1.1 UJ	1.1 U	1.1 U	1 U	1 U	1 U
Dieldrin	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 U	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
Endosulfan I	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U
Endosulfan II	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 U	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
Endosulfan sulfate	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 U	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 U	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
Endrin aldehyde	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 U	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
Endrin ketone	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.11 U	0.11 UJ	0.12 U	0.11 UJ	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U
Heptachlor	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor epoxide	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.059	0.015 J	0.029 J
Methoxychlor	0.5 U	0.5 U	0.5 U	0.51 U	NA	0.5 U	0.5 U	0.53 U	0.54 UJ	0.59 UJ	0.56 UJ	0.56 U	0.53 U	0.5 U	0.5 U	0.5 U
Toxaphene	5 U	5 U	5 U	5.1 U	NA	5 U	5 U	5.3 U	5.4 UJ	5.9 U	5.6 UJ	5.6 U	5.3 U	5 U	5 U	5 U
alpha-BHC	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U
alpha-Chlordane	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U
beta-BHC	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.019 J	0.012 J	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.036 J	0.031 J	0.043 J
delta-BHC	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U
gamma-BHC (Lindane)	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U
gamma-Chlordane	0.05 U	0.05 U	0.05 U	0.051 U	NA	0.05 U	0.05 U	0.05 U	0.05 UJ	0.06 U	0.06 UJ	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U
Explosives (UG/L)																
1,3,5-Trinitrobenzene	5.4 U	3 U	5.4 U	5.4 U	0.26 U	4.8 U	4.2 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	2.5 U	2.5 U	2.5 U
1,3-Dinitrobenzene	5.4 U	3 U	5.4 U	5.4 U	0.26 U	4.8 U	4.2 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	2.5 U	2.5 U	2.5 U
2,4,6-Trinitrotoluene	5.4 U	3 U	5.4 U	5.4 U	0.26 U	4.8 U	4.2 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	2.5 U	2.5 U	2.5 U
2,4-Dinitrotoluene	5.4 U	3 U	5.4 U	5.4 U	0.26 U	4.8 U	4.2 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	5 U	5 U	5 U
2,6-Dinitrotoluene	7.2 U	4 U	7.2 U	7.2 U	0.26 U	6.4 U	5.6 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	5 U	5 U	5 U
2-Amino-4,6-dinitrotoluene	7.2 U	4 U	7.2 U	7.2 U	0.26 U	6.4 U	5.6 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	5 U	5 U	5 U
2-Nitrotoluene	5.4 U	3 U	5.4 U	5.4 U	0.52 U	4.8 U	4.2 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	5 U	5 U	5 U
3-Nitrotoluene	5.4 U	3 U	5.4 U	5.4 U	0.52 U	4.8 U	4.2 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	5 U	5 U	5 U
4-Amino-2,6-dinitrotoluene	7.2 U	4 U	7.2 U	7.2 U	0.26 U	6.4 U	5.6 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	5 U	5 U	5 U
4-Nitrotoluene	5.4 U	3 U	5.4 U	5.4 U	0.52 U	4.8 U	4.2 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	5 U	5 U	5 U
HMX	7.2 U	4 U	7.2 U	7.2 U	0.52 U	6.4 U	5.6 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	2.5 U	2.5 U	2.5 U
Nitrobenzene	5.4 U	3 U	5.4 U	5.4 U	0.26 U	4.8 U	4.2 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	2.5 U	2.5 U	2.5 U
RDX	5.4 U	3 U	5.4 U	5.3 J	0.52 U	4.8 U	4.2 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	2.5 U	2.5 U	2.5 U
Tetryl	7.2 U	4 U	7.2 U	7.2 U	0.52 U	6.4 U	5.6 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	5 U	5 U	5 U
Total Metals (UG/L)																
Aluminum	26.7 U	26.7 U	26.7 U	26.7 U	NA	56.3 B	26.7 U	61.4 B	37.7 B	17.9 U	17.9 U	324	178 J	17.9 B	42.7 B	61.8 B
Antimony	2.8 U	2.8 U	2.8 U	2.8 U	NA	2.8 U	2.8 U	6.4 U	6.4 U	6.4 U	6.4 U	6.4 U	6.4 U	60 U	60 U	60 U
Arsenic	2.2 U	2.2 U	2.2 U	2.2 U	NA	2.2 U	2.2 U	5.3 U	5.3 U	47.3	45	5.3 U	5.3 U	10 U	10 U	10 U
Barium	37.1 J	34.2 J	32.9 J	29.8 J	NA	50 J	34 J	34.5 J	37.5 J	21.2 J	21.5 J	47.3 J	51.1 J	40 J	29.7 J	30.4 J
Beryllium	0.12 B	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	5 U	5 U	5 U
Boron	NA	NA	NA	NA	NA	NA	NA	93.5	83	44.9	45.1	191	252	NA	NA	NA
Cadmium	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.3 U	0.3 U	0.48 B	0.37 B	0.3 U	0.3 U	0.44 B	5 U	5 U
Calcium	25,000	15,400	20,400	12,600	NA	11,900	11,100	7,390	20,100	32,300	33,400	9,770	48,000	29,900	33,400	34,100
Chromium	1.1 U	1.1 U	1.1 U	1.1 U	NA	1.1 U	1.1 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	10 U	0.86 J	10 U
Cobalt	4.5 B	4.2 B	7.1 B	3.5 B	NA	14.6 J	12.1 J	3.8 J	11.2 J	2 J	2 J	19.2 J	35.9 J	4.5 J	6.1 J	5.9 J
Copper	3.3 B	3 U	3 U	3 U	NA	3 U	3 U	1.1 U	1.8 B	1.1 U	1.1 U	1.1 U	1.1 U	25 U	25 U	25 U
Cyanide	0.4 U	0.4 U	0.4 U	0.4 U	NA	0.4 U	0.4 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	10 U
Iron	3,810	2,260	770	7,260	NA	3,370	6,080	4,630	2,310 L	26,100 L	25,100 L	634	6,050	2,980 J	3,680 J	3,680 J
Lead	1.8 U	1.8 U	1.8 U	1.8 U	NA	1.8 U	1.8 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	10 U	10 U	10 U
Magnesium	3,270 J	5,360	11,500	4,950 J	NA	6,630	9,770	5,550	6,490	4,790 J	4,920 J	10,300	12,700	5,650	7,810	7,820
Manganese	285	452	1,510	328	NA	926	479	366	983	404	409	1,160	3,040	311	672	665
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.2 U	0.2 U
Molybdenum	NA	NA	NA	NA	NA	NA	NA	1.8 J	1.6 U	18.9	17.7	1.6 U	1.7 J	NA	NA	NA
Nickel	4.2 B	2.6 B	1.7 B	3.9 B	NA	5.2 B	8.6 B	4.4 J	4 J	1.1 U	1.3 J	4 J	3.2 J	5.8 J	2.6 B	2.7 B
Potassium	2,470 J	3,440 J	3,830 J	1,940 J	NA	2,650 J	2,370 J	1,270 J	2,030 J	1,770 J	1,800 J	2,590 J	4,210 J	2,600 J	2,230 J	2,240 J
Selenium	3.2 U	3.2 U	3.2 U	3.2 U	NA	3.2 U	3.2 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	35 U	35 U	35 U
Silver	1.3 U	1.3 U	1.3 U	1.3 U	NA	1.3 U	1.3 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	10 U	10 U	10 U
Sodium	11,000	49,200	38,800	23,700	NA	35,500	54,800	28,000	56,000	17,100	17,500	30,000	28,100	18,500	63,100	63,000
Thallium	3.4 U	3.4 U	3.4 U	3.4 U	NA	3.4 U	3.4 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	25 U	25 U	25 U
Vanadium	2.7 B	1.2 B	0.65 B	0.6 U	NA	1 B	0.6 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	50 U	0.98 J	0.95 J
Zinc	10.2 U	10.2 U	10.2 U	10.2 U	NA	19.2 J	16.9 J	12 J	10.6 B	3.3 B	3.1 B	12.1 J	26.5	60 U	60 U	60 U

Table C-4
Shallow Groundwater Analytical Results
SVOCs, Pesticides/PCBs, Explosives, and Metals
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW01S	SJS21-MW02S	SJS21-MW03S	SJS21-MW04S		SJS21-MW05S	SJS21-MW06S	SJS21-MW07S	SJS21-MW08S	SJS21-MW09S		SJS21-MW10S	SJS21-MW11S	SJS21-MW12S	SJS21-MW13S	
Sample ID	SJS21-MW01S-03C	SJS21-MW02S-03C	SJS21-MW03S-03C	SJS21-MW04S-03C	SJS21-MW04S-04D	SJS21-MW05S-03C	SJS21-MW06S-03C	SJS21-MW07S-04D	SJS21-MW08S-04D	SJS21-MW09S-04D	SJS21-MW09S-04D-P*	SJS21-MW10S-04D	SJS21-MW11S-04D	SJS21-MW12S-05D	SJS21-MW13S-05D	SJS21-MW13S-05D-P*
Sample Date	08/21/03	08/21/03	08/21/03	08/20/03	12/01/04	08/20/03	08/21/03	11/30/04	12/01/04	12/01/04	12/01/04	11/30/04	11/30/04	11/09/05	11/09/05	11/09/05
Chemical Name																
Dissolved Metals (UG/L)																
Aluminum	28.7 U	28.7 U	28.7 U	28.7 U	NA	28.7 U	28.7 U	17.9 U	17.9 U	17.9 U	17.9 U	35.4 B	22.6 B	17.4 B	18.1 B	20.5 B
Antimony	4 U	5.5 J	4 U	4 U	NA	4 U	4 U	6.4 U	6.4 U	6.4 U	6.4 U	6.4 U	6.4 U	60 U	60 U	60 U
Arsenic	5 J	2.6 U	2.6 U	2.6 U	NA	2.6 U	2.6 U	5.3 U	5.3 U	48.6	45.7	5.3 U	5.3 U	10 U	10 U	10 U
Barium	27 J	43.8 J	29.2 J	26.4 J	NA	47.5 J	32.7 J	34 J	36.5 J	21.4 J	22 J	46.3 J	49 J	36.2 J	34.4 J	34.6 J
Beryllium	0.2 U	0.24 B	0.2 U	0.2 U	NA	0.2 U	0.2 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	5 U	5 U	5 U
Boron	NA	NA	NA	NA	NA	NA	NA	88	82.9	44.4	45.1	190	243	NA	NA	NA
Cadmium	0.4 U	0.4 U	0.4 U	0.4 U	NA	0.4 U	0.4 U	0.3 U	0.3 U	0.3 U	0.39 B	0.3 U	0.3 U	5 U	5 U	5 U
Calcium	24,400	14,400	18,800	11,500	NA	11,300	10,700	7,630	20,300	33,200	31,900	9,980	45,400	26,900	33,500	33,300
Chromium	1 U	1.4 B	1 U	1 U	NA	1 U	1 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	10 U	1.1 B	10 U
Cobalt	2.4 B	8 B	7 B	3.7 B	NA	14 J	12.6 J	4 J	11.3 J	2.1 J	1.8 J	18.3 J	37.6 J	5.2 J	6.1 J	5.9 J
Copper	1.6 U	2.7 B	1.6 U	1.6 U	NA	1.6 U	1.6 B	1.1 U	1.6 B	1.1 U	1.7 B	1.1 U	1.1 U	25 U	25 U	25 U
Iron	3,580	2,110	767	6,790	NA	3,310	5,960	3,920	2,340	25,400 L	24,600 L	287	5,750	3,260	2,460	2,330
Lead	2.1 U	2.1 U	2.1 U	2.1 U	NA	2.1 U	2.1 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	10 U	10 U	10 U
Magnesium	3,310 J	5,380	10,900	4,770 J	NA	6,530	9,730	5,470	6,510	4,920 J	4,690 J	10,100	12,600	5,450	8,070	8,110
Manganese	290	446	1,450	323	NA	905	490	354	971	416	403	1,140	3,050	338	672	671
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.2 U	0.2 U
Molybdenum	NA	NA	NA	NA	NA	NA	NA	1.6 U	1.6 U	17.6	16.4 B	1.6 U	1.6 U	NA	NA	NA
Nickel	4 B	6.6 B	2.7 B	3.9 B	NA	6 B	9.6 B	5 J	4.7 J	1.1 U	1.1 U	4.4 J	3.2 J	6.1 J	3.4 J	2.5 J
Potassium	1,740 J	2,600 J	2,710 J	1,340 J	NA	1,930 J	1,800 J	1,240 J	1,960 J	1,860 J	1,930 J	2,600 J	4,050 J	2,430 J	2,430 J	2,430 J
Selenium	4.3 U	4.3 UJ	4.3 U	4.3 U	NA	4.3 U	4.3 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	35 U	35 U	35 U
Silver	1.5 U	1.5 U	1.5 U	1.5 U	NA	1.5 U	1.5 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	10 U	10 U	10 U
Sodium	12,800	48,000	37,500	24,300	NA	35,700	54,600	27,000	54,700	17,400	18,000	31,300	26,600	17,500	63,800	63,700
Thallium	4.4 U	4.4 U	4.4 U	4.4 U	NA	4.4 U	4.4 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	25 U	25 U	25 U
Vanadium	1.4 U	4.2 B	1.4 U	1.4 U	NA	1.4 U	1.4 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1 J	0.94 J	50 U
Zinc	0.9 U	4.2 J	0.9 U	3.3 J	NA	15.3 J	21.4	9.5 J	12.3 B	4.4 B	3 B	11.2 J	25.9	60 U	60 U	60 U

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
L - Reported value is biased low
NA - Not analyzed
U- Not detected

Table C-5
Deep Groundwater Analytical Results
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW01D			
Sample ID	SJS21-MW01D-03C	SJS21-MW01D-04D	SJS21-MW01D-05D	SJS21-MW01D-05D-P*
Sample Date	08/20/03	12/01/04	11/07/05	11/07/05
Chemical Name				
Volatile Organic Compounds (UG/L)				
1,1,1-Trichloroethane	10 U	NA	NA	NA
1,1,2,2-Tetrachloroethane	10 U	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	10 U	NA	NA	NA
1,1,2-Trichloroethane	10 U	NA	NA	NA
1,1-Dichloroethane	10 U	NA	NA	NA
1,1-Dichloroethene	10 U	NA	NA	NA
1,2,4-Trichlorobenzene	10 U	NA	NA	NA
1,2-Dibromo-3-chloropropane	10 UJ	NA	NA	NA
1,2-Dibromoethane	10 U	NA	NA	NA
1,2-Dichlorobenzene	10 U	NA	NA	NA
1,2-Dichloroethane	10 U	NA	NA	NA
1,2-Dichloropropane	10 U	NA	NA	NA
1,3-Dichlorobenzene	10 U	NA	NA	NA
1,4-Dichlorobenzene	10 U	NA	NA	NA
2-Butanone	10 UJ	NA	NA	NA
2-Hexanone	10 UJ	NA	NA	NA
4-Methyl-2-pentanone	10 UJ	NA	NA	NA
Acetone	11 B	NA	NA	NA
Benzene	10 U	NA	NA	NA
Bromodichloromethane	10 U	NA	NA	NA
Bromoform	10 U	NA	NA	NA
Bromomethane	10 UJ	NA	NA	NA
Carbon disulfide	10 UJ	NA	NA	NA
Carbon tetrachloride	10 U	NA	NA	NA
Chlorobenzene	10 U	NA	NA	NA
Chloroethane	10 UJ	NA	NA	NA
Chloroform	3 J	NA	NA	NA
Chloromethane	10 UJ	NA	NA	NA
Cumene	10 U	NA	NA	NA
Cyclohexane	10 U	NA	NA	NA
Dibromochloromethane	10 U	NA	NA	NA
Dichlorodifluoromethane (Freon-12)	10 U	NA	NA	NA
Ethylbenzene	10 U	NA	NA	NA
Methyl acetate	10 U	NA	NA	NA
Methyl-tert-butyl ether (MTBE)	10 U	NA	NA	NA
Methylcyclohexane	10 U	NA	NA	NA
Methylene chloride	2 B	NA	NA	NA
Styrene	10 U	NA	NA	NA
Tetrachloroethene	10 U	NA	NA	NA
Toluene	1 B	NA	NA	NA
Trichloroethene	10 U	NA	NA	NA
Trichlorofluoromethane(Freon-11)	10 U	NA	NA	NA
Vinyl chloride	10 U	NA	NA	NA
Xylene, total	10 U	NA	NA	NA
cis-1,2-Dichloroethene	10 U	NA	NA	NA
cis-1,3-Dichloropropene	10 U	NA	NA	NA
trans-1,2-Dichloroethene	10 U	NA	NA	NA
trans-1,3-Dichloropropene	10 U	NA	NA	NA
Semi-volatile Organic Compounds (UG/L)				
1,1-Biphenyl	11 U	NA	NA	NA
2,4,5-Trichlorophenol	28 U	NA	NA	NA
2,4,6-Trichlorophenol	11 U	NA	NA	NA
2,4-Dichlorophenol	11 U	NA	NA	NA
2,4-Dimethylphenol	11 U	NA	NA	NA
2,4-Dinitrophenol	28 U	NA	NA	NA
2,4-Dinitrotoluene	11 U	NA	NA	NA
2,6-Dinitrotoluene	11 U	NA	NA	NA
2-Chloronaphthalene	11 U	NA	NA	NA
2-Chlorophenol	11 U	NA	NA	NA
2-Methylnaphthalene	11 U	NA	NA	NA
2-Methylphenol	11 U	NA	NA	NA
2-Nitroaniline	28 UJ	NA	NA	NA
2-Nitrophenol	11 U	NA	NA	NA
3,3'-Dichlorobenzidine	11 U	NA	NA	NA
3-Nitroaniline	28 U	NA	NA	NA

Table C-5
Deep Groundwater Analytical Results
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Chesapeake, Virginia

Station ID	SJS21-MW01D			
Sample ID	SJS21-MW01D-03C	SJS21-MW01D-04D	SJS21-MW01D-05D	SJS21-MW01D-05D-P*
Sample Date	08/20/03	12/01/04	11/07/05	11/07/05
Chemical Name				
4,6-Dinitro-2-methylphenol	28 U	NA	NA	NA
4-Bromophenyl-phenylether	11 U	NA	NA	NA
4-Chloro-3-methylphenol	11 U	NA	NA	NA
4-Chloroaniline	11 U	NA	NA	NA
4-Chlorophenyl-phenylether	11 U	NA	NA	NA
4-Methylphenol	11 U	NA	NA	NA
4-Nitroaniline	28 UJ	NA	NA	NA
4-Nitrophenol	28 U	NA	NA	NA
Acenaphthene	11 U	NA	NA	NA
Acenaphthylene	11 U	NA	NA	NA
Acetophenone	0.3 B	NA	NA	NA
Anthracene	11 U	NA	NA	NA
Atrazine	11 U	NA	NA	NA
Benzaldehyde	11 U	NA	NA	NA
Benzo(a)anthracene	11 U	NA	NA	NA
Benzo(a)pyrene	11 U	NA	NA	NA
Benzo(b)fluoranthene	11 U	NA	NA	NA
Benzo(g,h,i)perylene	11 U	NA	NA	NA
Benzo(k)fluoranthene	11 U	NA	NA	NA
Butylbenzylphthalate	11 U	NA	NA	NA
Caprolactam	11 U	NA	NA	NA
Carbazole	11 U	NA	NA	NA
Chrysene	11 U	NA	NA	NA
Di-n-butylphthalate	0.7 J	NA	NA	NA
Di-n-octylphthalate	11 U	NA	NA	NA
Dibenz(a,h)anthracene	11 U	NA	NA	NA
Dibenzofuran	11 U	NA	NA	NA
Diethylphthalate	11 U	NA	NA	NA
Dimethyl phthalate	11 U	NA	NA	NA
Fluoranthene	11 U	NA	NA	NA
Fluorene	11 U	NA	NA	NA
Hexachlorobenzene	11 U	NA	NA	NA
Hexachlorobutadiene	11 U	NA	NA	NA
Hexachlorocyclopentadiene	11 U	NA	NA	NA
Hexachloroethane	11 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	11 U	NA	NA	NA
Isophorone	11 U	NA	NA	NA
Naphthalene	11 U	NA	NA	NA
Nitrobenzene	11 U	NA	NA	NA
Pentachlorophenol	28 U	NA	NA	NA
Phenanthrene	11 U	NA	NA	NA
Phenol	11 U	NA	NA	NA
Pyrene	11 U	NA	NA	NA
bis(2-Chloro-1-methylethyl) ether	11 UJ	NA	NA	NA
bis(2-Chloroethoxy)methane	11 U	NA	NA	NA
bis(2-Chloroethyl)ether	11 U	NA	NA	NA
bis(2-Ethylhexyl)phthalate	11 U	NA	NA	NA
n-Nitroso-di-n-propylamine	11 UJ	NA	NA	NA
n-Nitrosodiphenylamine	11 U	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (UG/L)				
4,4'-DDD	0.1 U	NA	NA	NA
4,4'-DDE	0.1 U	NA	NA	NA
4,4'-DDT	0.1 U	NA	NA	NA
Aldrin	0.051 U	NA	NA	NA
Aroclor-1016	1 U	NA	NA	NA
Aroclor-1221	2.1 U	NA	NA	NA
Aroclor-1232	1 U	NA	NA	NA
Aroclor-1242	1 U	NA	NA	NA
Aroclor-1248	1 U	NA	NA	NA
Aroclor-1254	1 U	NA	NA	NA
Aroclor-1260	1 U	NA	NA	NA
Dieldrin	0.1 U	NA	NA	NA
Endosulfan I	0.051 U	NA	NA	NA
Endosulfan II	0.1 U	NA	NA	NA
Endosulfan sulfate	0.1 U	NA	NA	NA
Endrin	0.1 U	NA	NA	NA
Endrin aldehyde	0.1 U	NA	NA	NA

Table C-5
Deep Groundwater Analytical Results
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW01D			
Sample ID	SJS21-MW01D-03C	SJS21-MW01D-04D	SJS21-MW01D-05D	SJS21-MW01D-05D-P*
Sample Date	08/20/03	12/01/04	11/07/05	11/07/05
Chemical Name				
Endrin ketone	0.1 U	NA	NA	NA
Heptachlor	0.051 U	NA	NA	NA
Heptachlor epoxide	0.051 U	NA	NA	NA
Methoxychlor	0.51 U	NA	NA	NA
Toxaphene	5.1 U	NA	NA	NA
alpha-BHC	0.051 U	NA	NA	NA
alpha-Chlordane	0.051 U	NA	NA	NA
beta-BHC	0.051 U	NA	NA	NA
delta-BHC	0.051 U	NA	NA	NA
gamma-BHC (Lindane)	0.051 U	NA	NA	NA
gamma-Chlordane	0.051 U	NA	NA	NA
Explosives (UG/L)				
1,3,5-Trinitrobenzene	3.6 U	NA	NA	NA
1,3-Dinitrobenzene	1.1 J	NA	NA	NA
2,4,6-Trinitrotoluene	3.6 U	NA	NA	NA
2,4-Dinitrotoluene	3.6 U	NA	NA	NA
2,6-Dinitrotoluene	4.8 U	NA	NA	NA
2-Amino-4,6-dinitrotoluene	4.8 U	NA	NA	NA
2-Nitrotoluene	3.6 U	NA	NA	NA
3-Nitrotoluene	3.6 U	NA	NA	NA
4-Amino-2,6-dinitrotoluene	4.8 U	NA	NA	NA
4-Nitrotoluene	3.6 U	NA	NA	NA
HMX	4.8 U	NA	NA	NA
Nitrobenzene	3.6 U	NA	NA	NA
RDX	3.6 U	NA	NA	NA
Tetryl	4.8 U	NA	NA	NA
Total Metals (UG/L)				
Aluminum	239 B	64.8 B	NA	NA
Antimony	2.8 U	6.4 U	NA	NA
Arsenic	72.8	5.3 U	3.1	3.1
Barium	18.3 B	14.3 J	NA	NA
Beryllium	0.1 U	0.4 U	NA	NA
Boron	NA	75.5	NA	NA
Cadmium	0.5 U	0.94 B	NA	NA
Calcium	48,600	53,300	NA	NA
Chromium	47.2	1.8 J	NA	NA
Cobalt	0.87 B	1.5 U	NA	NA
Copper	4 B	1.3 B	NA	NA
Cyanide	1.8 J	5 U	NA	NA
Iron	266	124 B	NA	NA
Lead	1.8 U	1.6 U	NA	NA
Magnesium	552 B	1,360 J	NA	NA
Manganese	5.3 B	30.5	NA	NA
Mercury	0.1 U	0.1 U	NA	NA
Molybdenum	NA	6.3 B	NA	NA
Nickel	1.1 U	1.1 U	NA	NA
Potassium	50,800	11,100 J	NA	NA
Selenium	3.8 J	3.9 U	NA	NA
Silver	1.3 U	1.2 U	NA	NA
Sodium	64,300	24,100	NA	NA
Thallium	3.4 U	6.5 U	NA	NA
Vanadium	35.9 J	1.7 U	NA	NA
Zinc	10.2 U	2.2 B	NA	NA

Table C-5
Deep Groundwater Analytical Results
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW01D			
Sample ID	SJS21-MW01D-03C	SJS21-MW01D-04D	SJS21-MW01D-05D	SJS21-MW01D-05D-P*
Sample Date	08/20/03	12/01/04	11/07/05	11/07/05
Chemical Name				
Dissolved Metals (UG/L)				
Aluminum	77.5 B	17.9 U	NA	NA
Antimony	4 U	6.4 U	NA	NA
Arsenic	72	5.3 U	2.9	3.2
Barium	15.3 B	13.4 J	NA	NA
Beryllium	0.2 U	0.4 U	NA	NA
Boron	NA	73.3	NA	NA
Cadmium	0.4 U	0.3 U	NA	NA
Calcium	47,100	52,300	NA	NA
Chromium	48.5	1.5 U	NA	NA
Cobalt	1.1 U	1.5 U	NA	NA
Copper	1.6 U	1.7 B	NA	NA
Iron	39.8 B	50 B	NA	NA
Lead	2.1 U	1.6 U	NA	NA
Magnesium	588 J	1,340 J	NA	NA
Manganese	3.4 B	31.4	NA	NA
Mercury	0.1 U	0.1 U	NA	NA
Molybdenum	NA	7.5 B	NA	NA
Nickel	1.7 B	1.1 U	NA	NA
Potassium	48,600	10,700 J	NA	NA
Selenium	4.3 U	3.9 U	NA	NA
Silver	1.5 U	1.2 U	NA	NA
Sodium	64,000	24,300	NA	NA
Thallium	4.4 U	6.5 U	NA	NA
Vanadium	36.3 J	2.6 J	NA	NA
Zinc	2.8 J	1.9 B	NA	NA

Notes:
* Duplicate sample
B- Possible blank contamination
J- Reported value is estimated
NA - Not analyzed
U- Not detected

Table C-6
Subsurface Soil Analytical Results
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Station ID	SJS21-MW16S		SJS21-SO06			SJS21-SO05		
Sample ID	SJS21-SB09-15-06D	SJS21-SB09P-15-06D*	SJS21-SB06-00-05D	SJS21-SB06-01-05D	SJS21-SB06-02-05D	SJS21-SB05-00-05D	SJS21-SB05-01-05D	SJS21-SB05-02-05D
Sample Date	10/25/06	10/25/06	11/07/05	11/07/05	11/07/05	11/07/05	11/07/05	11/07/05
Chemical Name								
Volatile Organic Compounds (UG/KG)								
1,1,1-Trichloroethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,1,2,2-Tetrachloroethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,1,2-Trichloroethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,1-Dichloroethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,1-Dichloroethene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,2,4-Trichlorobenzene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,2-Dibromo-3-chloropropane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,2-Dibromoethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,2-Dichlorobenzene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,2-Dichloroethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,2-Dichloropropane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,3-Dichlorobenzene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
1,4-Dichlorobenzene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
2-Butanone	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
2-Hexanone	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
4-Methyl-2-pentanone	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Acetone	26 B	31 B	6 J	7 J	68	12	16	41
Benzene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Bromodichloromethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Bromoform	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Bromomethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Carbon disulfide	12 U	11 J	12 U	11 U	5 J	12 U	14	19
Carbon tetrachloride	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Chlorobenzene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Chloroethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Chloroform	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Chloromethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Cyclohexane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Dibromochloromethane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Dichlorodifluoromethane (Freon-12)	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Ethylbenzene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Isopropylbenzene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Methyl acetate	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Methyl-tert-butyl ether (MTBE)	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Methylcyclohexane	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Methylene chloride	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Styrene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Tetrachloroethene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Toluene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Trichloroethene	32,000	16,000	17	4 J	190	12 U	320	45,000
Trichlorofluoromethane(Freon-11)	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Vinyl chloride	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
Xylene, total	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
cis-1,2-Dichloroethene	100	150	5 J	11 U	280	12 U	60	270
cis-1,3-Dichloropropene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
trans-1,2-Dichloroethene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U
trans-1,3-Dichloropropene	12 U	12 U	12 U	11 U	17 U	12 U	13 U	17 U

Notes:
* Duplicate sample
B- Potential blank contamination
J- Reported value is estimated
U- Not detected

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone: (865) 573-8188
Fax: (865) 573-8133
Email: info@microbe.com

Analysis Report

Client: Ryan VanOosten
CH2M HILL
5700 Cleveland Street
Suite 101
Virginia Beach, VA 23462

Phone: (757) 671-8311

Fax: (757) 497-6885

MI Identifier: 002DK **Date Rec:** 11/01/2006 **Report Date:** 11/02/2006

Client Project #: **Client Project Name:** CTD-57

Purchase Order #:

Analysis Requested: CENSUS (final)

Comments:

All samples within this data package were analyzed under U.S. EPA Good Laboratory Practice Standards: Toxic Substances Control Act (40 CFR part 790). All samples were processed according to standard operating procedures. Test results submitted in this data package meet the quality assurance requirements established by Microbial Insights, Inc.

Reported By:

Dora M Ogles

Reviewed By:

Anita Biernacki

NOTICE: This report is intended only for the addressee shown above and may contain confidential or privileged information. If the recipient of this material is not the intended recipient or if you have received this in error, please notify Microbial Insights, Inc. immediately. The data and other information in this report represent only the sample(s) analyzed and are rendered upon condition that it is not to be reproduced without approval from Microbial Insights, Inc. Thank you for your cooperation.

MICROBIAL INSIGHTS, INC.

2340 Stock Creek Blvd. Rockford, TN 37853-3044
Tel: (865) 573-8188; Fax: (865) 573-8133

Q Potential (DNA)

Client: **CH2M HILL**
Project: CTD-57

MI Project Number: **002DK**
Date Received: 11/01/2006

Sample Information

Client Sample ID:		**SJS21-MW12S-06D**	**SJS21-MW13S-06D**	**SJS21-MW02S-06D**
Sample Date:		10/31/2006	10/31/2006	10/31/2006
Units:		cells/mL	cells/mL	cells/mL

Dechlorinating Bacteria

Dehalococcoides spp (1)	DHC	**1.97E+02**	**4.07E+03**	**9.46E+02**

Functional Genes

TCE R-Dase (1)	TCE	<1.25E-01	<5E-01	<6.67E-01
BAV1 VC R-Dase (1)	BVC	**2.22E-01**	**8.79E+02**	**3.73E-01 (J)**
VC R-Dase	VCR	**1.23E+00**	**2.48E+03**	**2.67E+00**

Legend:
NA = Not Analyzed NS = Not Sampled J = Estimated gene copies below PQL but above LQL I = Inhibited
< = Result not detected

Notes:
1 Bio-Dechlor Census technology was developed by Dr. Loeffler and colleagues at Georgia Institute of Technology and was licensed for use through Regenesis.

MICROBIAL INSIGHTS

CTD 057

12574

CompuChem
a division of Liberty Analytical Corp.

CHAIN OF CUSTODY

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Page 1 of 1

Courier: Fed Ex
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information	Project Information
Company Name: CH2M HILL	Project Name: CTD-57
Address: 5700 Cleveland St	Sampling Location: St. Juliens Creek Annex - Site 21
City: VA Beach State: VA Zip: 23462	Turnaround time: Per PO
Project Contact: Ryan Van Oosten	Batch QC or Project Specific? If Specific, which Sample ID?
Phone #: 757-671-8311 x465	Are aqueous samples field filtered for metals? Y or N
Sampler's Name: C. White / A. Jones	Are high concentrations expected? Y or N? If yes, which ID(s)?

Requested Analysis (include method and bottle type): DHC / BAV 1 (Q-Potential)

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles (filters)	HCl	NaOH	HNO3	H2SO4	MeOH	Other	DHC / BAV 1 (Q-Potential)	pH / Sample Info (Lab Use)
002 DK 1	SJS21-MW12S-06D	10/31/06	1223	GW	1							X	
2	SJS21-MW13S-06D	10/31/06	1345	GW	1							X	
3	SJS21-MW02S-06D	10/31/06	1447	GW	2							X	

Sample(s) Received: ~~01.11.06~~ FedEx Time: 1015

COC sent: Y N Bottle ID match: Y N (+ field filters)

Temp.: 15°C All intact? ✓

No. of damaged/missing samples:

Sample Analyses Requested

CUL DNA IAQ PLFA VFA Other:

Set #: 002 DK Signed:

Lab Use Only

Sample Unpacked By:
Sample Order Entry By:
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Sample Custody

Relinquished by:	Date/Time: 10/31/06 1600	Received by:
Relinquished by:	Date/Time:	Received by:
Subcontact? Y or N If yes, where?		Custody Seal(s) intact? Y

°C

Samples stored 60 days after date report mailed at no extra charge.

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone: (865) 573-8188
Fax: (865) 573-8133
Email: info@microbe.com

Analysis Report

Client: Ryan VanOosten
CH2M HILL
5700 Cleveland Street
Suite 101
Virginia Beach, VA 23462

Phone: (757) 671-8311

Fax: (757) 497-6885

MI Identifier: 065DJ **Date Rec:** 10/28/2006 **Report Date:** 11/02/2006

Client Project #: 314808.SA.SM **Client Project Name:** St. Julien's Creek Annex Site 21

Purchase Order #:

Analysis Requested: CENSUS (final)

Comments:

All samples within this data package were analyzed under U.S. EPA Good Laboratory Practice Standards: Toxic Substances Control Act (40 CFR part 790). All samples were processed according to standard operating procedures. Test results submitted in this data package meet the quality assurance requirements established by Microbial Insights, Inc.

Reported By:

Dora M Ogles

Reviewed By:

Anita Biernacki

NOTICE: This report is intended only for the addressee shown above and may contain confidential or privileged information. If the recipient of this material is not the intended recipient or if you have received this in error, please notify Microbial Insights, Inc. immediately. The data and other information in this report represent only the sample(s) analyzed and are rendered upon condition that it is not to be reproduced without approval from Microbial Insights, Inc. Thank you for your cooperation.

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2340 Stock Creek Blvd. Rockford, TN 37853-3044
Tel: (865) 573-8188; Fax: (865) 573-8133

Q Potential (DNA)

Client: **CH2M HILL**
Project: St. Julien's Creek Annex Site 21

MI Project Number: **065DJ**
Date Received: 10/28/2006

Sample Information

Client Sample ID:	**SJS21-MW07S-06D**
Sample Date:	10/27/2006
Units:	cells/mL

Dechlorinating Bacteria

Dehalococcoides spp (1)	DHC	**1.3E+03**

Functional Genes

TCE R-Dase (1)	TCE	<2E-01
BAV1 VC R-Dase (1)	BVC	<2E-01
VC R-Dase	VCR	<2E-01

Legend:
NA = Not Analyzed NS = Not Sampled J = Estimated gene copies below PQL but above LQL I = Inhibited
< = Result not detected

Notes:
1 Bio-Dechlor Census technology was developed by Dr. Loeffler and colleagues at Georgia Institute of Technology and was licensed for use through Regenesis.

REPORT TO:

Reports will be provided to the contact(s) listed below. Parties other than the contact(s) listed below will require prior approval.

Name: Ryan VanOosten
Company: CH2M HILL
Address: 5700 Cleveland St. Ste 101
Virginia Beach, Virginia 23462
email: Ryan.Vanoosten@ch2m.com
Phone: (757) 671-8311 x 465
Fax: (757) 497-6885

Project Manager: Janna Staszak
Project Name: St. Julien's Creek Annex Site 21
Project No.: 314808.SA.SM

INVOICE TO:

For Invoices **paid by a third party** it is imperative that contact information & corresponding reference No. be provided.

Name:
Company:
Address:
email:
Phone: ( )
Fax: ( )

Purchase Order No.
Subcontract No.

microbialinsights

2340 Stock Creek Blvd.
Rockford, TN 37853-3044
phone (865) 573-8188
fax: (865) 573-8133
email: info@microbe.com
www.microbe.com

Please Check One:

☐ More samples to follow
☐ No Additional Samples

Saturday Delivery

Please see sampling protocol for instructions

Report Type: ☒ Standard (default) ☐ Comprehensive (15% surcharge) ☐ Historical (30% surcharge)

Please contact us prior to submitting samples regarding questions about the analyses you are requesting at (865) 573-8188 (8:00 am to 4:00 pm M-F). After these hours please call (865) 300-8053.

Sample Information | **Q-Targets:** Prior to selecting targets mark either Q-Potential for DNA or Q-Expression for RNA

MI ID (Laboratory Use Only)	Sample Name	Date Sampled	Time Sampled	Matrix	PLFA	VFA	M/E/E	DGGE+3ID	DGGE+5ID	Q-Potential (DNA)	Q-Expression (RNA)*	qDHC (Dehalococcoides)	qTCE R-Dase	qBAV1 VC R-Dase	qDHB (Dehalobacter)	qDSM (Desulfuromonas)	qDSB (Desulfitobacterium)	qEBAC (Total)	qDSR (SRBs only)	qSRB/IRB	qMGN (methanogens)	qMOB (methanotrophs)	qDNF (Denitrifying)	qADB (ammonia oxidizing)	qPM1 (MTBE aerobic)	qTOD (Intial PAHs aerobic)	qCAT (Intermediate PAHs aerobic)	qBSS (Toluen/Xylene Anaerobic)	qNAH (Napthalene aerobic)	add. qPCR:	add. qPCR:	add. qPCR:	Other:	Other:	Other:
65DJ1	SJS21-MW01S-06D	10/27	1351	GW						X		X																							
65DJ2	SJS21-MW12S-06D	10/27	1525	GW						X		X																							

Relinquished by: [signature] Date: 10/27/06 Received by: [signature] Date

In order for analysis to be completed correctly, it is vital that chain of custody is filled out correctly & that all relative information is provided. Failure to provide sufficient and/or correct information regarding reporting, invoicing & analyses requested information may result in delays for which MI will not be liable. * additional cost and sample preservation are associated with RNA samples.

CH2M HILL
Applied Sciences Group
2300 NW Walnut Blvd
Corvallis, OR
97330-3538
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

CH2MHILL
Applied Sciences Group

December 1, 2004

St. Juliens Creek Annex

157593.FI.FI

RE: Laboratory Report for St. Juliens Creek Annex
Applied Sciences Group Reference No. D4468

Adrienne Jones/VBO:

On November 10, 2004, CH2M HILL Applied Sciences Group received nine samples with a request for analysis of selected parameters. All analyses were performed by CH2M HILL unless otherwise indicated below.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative. This data package meets standards requested by client and is not intended or implied to meet any other standard.

CH2M HILL Applied Sciences Group appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Mark Bos at (541) 758-0235, extension 3135.

Sincerely,

Mark Bos
Analytical Manager

Enclosures

cc: Gary Hickman/CVO

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Sciences Group Reference No. D4468

Sample ID	Client Sample ID	Date Collected	Time Collected
D446801	SJS21-SB02A-05-04D	11/10/2004	12:00
D446802	SJS21-SB02A-10-04D	11/10/2004	12:10
D446803	SJS21-SB02A-14-04D	11/10/2004	12:20
D446804	SJS21-SB02B-06-04D	11/10/2004	14:00
D446805	SJS21-SB02B-10-04D	11/10/2004	14:10
D446806	SJS21-SB02B-12-04D	11/10/2004	14:15
D446807	SJS21-SB04-05-04D	11/10/2004	15:00
D446808	SJS21-SB04-09-04D	11/10/2004	15:10
D446809	SJS21-SB04-12-04D	11/10/2004	15:20

CASE NARRATIVE
SPECIAL ANALYTICS

Lab Reference No.: D4468

Client/Project: St. Juliens Creek Annex

I. Holding Time:
All acceptance criteria were met.

II. Digestion Exceptions:
None

III. Analysis:

A. Calibration:
All acceptance criteria were met.

B. Matrix Spike Sample(s):
All acceptance criteria were met.

C. Duplicate Sample(s):
All acceptance criteria were met.

D. Lab Control Sample(s):
All acceptance criteria were met.

E. Other:
None

III. Documentation Exceptions:
None.

IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: _____

Reviewed by: Kathy McKeiCo

CH2M Hill Applied Sciences Laboratory

Client Information

Project Name: St. Juliens Creek Annex/Site 21
Project Manager: Adrienne Jones/VBO
Sampled By: Jamie Butler/VBO
Sampling Date: 11/10/2004
Sampling Time: See Cross-reference
Type: Grab
Matrix: Soil
Basis: As Received

Lab Information

Lab Batch ID: D4468

Analysis Method: SIREM MOD-48
Units: g/kg
Date Received: 11/10/2004
Report Revision No.: 0
Reported By: MCB
Reviewed By: KM

Client ID	Lab ID	Oxidant Demand Sample Result	Qualifier	Date Analyzed
SJS21-SB02A-05-04D	D446801	2.5		11/18/04
SJS21-SB02A-10-04D	D446802	2.0		11/18/04
SJS21-SB02A-14-04D	D446803	2.5		11/18/04
SJS21-SB02B-06-04D	D446804	2.0		11/18/04
SJS21-SB02B-10-04D	D446805	2.0		11/18/04
SJS21-SB02B-12-04D	D446806	3.0		11/18/04
SJS21-SB04-05-04D	D446807	2.0		11/18/04
SJS21-SB04-09-04D	D446808	2.0		11/18/04
SJS21-SB04-12-04D	D446809	2.5		11/18/04

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
Tel 541.752.4271 Fax 541.752.0276

D44608

~~GPL LABORATORIES, LLLP~~

7210A Corporate Court
Frederick, MD 21703
(301) 694-5310
Fax (301) 620-0731

Contract #/Billing Reference: 157593.FI.FI

1 of 1 Pgs.

Project: Stical
Client: UBO
Send Results To: A. Jones
Address: Copy: Gary Hickman
Phone: ~~H~~ UBO ext 412

Sample ID#	Date Sampled	Time Sampled	Sample Matrix	Sampler's Initials	MOD 48	CLIENT COMMENTS
55521-SB02A-05-040	11/10/04	1200	Soil	JCB	X	-1
55521-SB02A-10-040		1210			X	-2
55521-SB02A-14-040		1220			X	-3
55521-SB02B-06-040		1400			X	-4
55521-SB02B-10-040		1410			X	-5
55521-SB02B-12-040		1415			X	-6
55521-SB04-05-040		1500			X	-7
55521-SB04-09-040		1510			X	-8
55521-SB04-12-040		1520			X	-9

Turnaround Time
# of Containers
Container Type
Preservative Used
Type of Analysis
Lab Cooler No.

Relinquished By:	Date/Time	Received By:	Relinquished By:	Received for Laboratory By:	Date/Time
[illegible]	11/10/04 1900	Wayne Kaumann	11/11/04 1:50		
Relinquished By:	Date/Time	Received By:	Date/Time	Shipper:	Airbill No.:
			11/10/04		
Relinquished By:	Date/Time	Received By:	Lab Comments:		Temp:

G.P. W.O. _____

CH2MHILL
Analytical Services

Sample Receipt Record

Batch Number: 04468 Date received: 11/10/04

Client/Project Site 21

VERIFICATION OF SAMPLE CONDITIONS (verify all items) * HD = Client Hand delivered Samples

Observation	YES	NO
Radiological Screening for AFCEE		✓
Were custody seals intact and on the outside of the cooler?	✓	
If yes, Where? Front____ Rear____ Lt Side____ Rt Side____		
Type of packing material: Ice Blue Ice Bubble wrap	✓	
Was the Chain of Custody inside the cooler?	✓	
Was the Chain of Custody properly filled out?	✓	
Were the sample containers in good condition?	✓	
Containers supplied by ASL?	✓	
Was there ice in the cooler? Enter temp. 4 C	✓	
All VOCs free of air bubbles ? NA		

If the answer to any of the questions above is NO, a Sample Receipt Exceptions Report Must be written.

VERIFICATION OF SAMPLE PRESERVATION (verify all preserved samples except HAAs, HANs and CH)

Sample No	Nutrients pH <2	Metals pH <2	Volatiles pH <2	Cyanides pH >12	TOC pH <2	TOX pH <2	Other (specify)	N/A (soils/unpres)
1								NA for All
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								

LOGIN AND pH VERIFICATIONS PERFORMED BY

Dayna Kaufmann 11/15/04 3:30

Date/Time Date/Time

Appendix D
Field Logs

Location SSA Date 12/9/03

Project / Client Sites 2 and 5 GII

0730 On Site St. Julians Creek Annex for Groundwater Well installation and well construction.

0735 Conduct Health and Safety Brief on well operations and hazards.

0740 Field Crew: D. Blitzer and J. Culbertson. Weather: Sunny Lowes Subcontractors - Parratt Wolf: Driller USA Environmental: UXO.

0745 D. Blitzer Calibrate PID

0750 Begin installation of SJS02-MW08S
Depth of Screen 5-15' bgs.
2' Silica Pack above Screen
2' Bentonite Seal
1' Cement grout.

0900 Complete MW08S MOB to next location
Clearing brush for drill rig access

1010 Begin installing SJS02-MW07S
Spooning to send to estimate ABM to set outer casing.

1050 Push to 6' bgs with 2' split spoons.
Decision to set temp casing at 6' bgs.
Drillers go out PVC. UXO marks Boring locations

Location SSA Date 12/9/03

Project / Client Sites 2 and 5 GII

Boring SJS02-MW08S

1st Split Spoon

0-0.4' Top Soil, organic, 5yr 3/2, Silty Clay, slightly moist, medium, ML

0.4-1.0' 5yr 3/2, Organic Matter, Sandy Clay, SC, stiff, moist, friable
Fill material from 0.4-0.6'
1.0-2.0' - Same as above, more silts presently SC, stiff.
PID = 0.0 PPM

2nd Split Spoon 1' recovery

4-4.2' - 0L, Clay with silt, 5yr 3/2, slightly moist, soft;

4.2-5.1' - 10yr 4/2, medium granular sand, Saturated at 4.2', SW.
PID = 0.0 ppm

3rd Split Spoon 9-11'

9-9.3' - Silty Clay, medium, 5yr 3/2, very moist, CL;

Location SJCA Date 12/9/03

Project / Client Sites 2 al 5 ERI

9.3-11' - 10yr 6/6, Silty Sand, Saturated, medium Density, SM

4th Split Spoon

14-14.5' - Sand Same as above

14.5-15.1' - Silty Clay 5y 5/2, medium, v.g. moist, CL SC

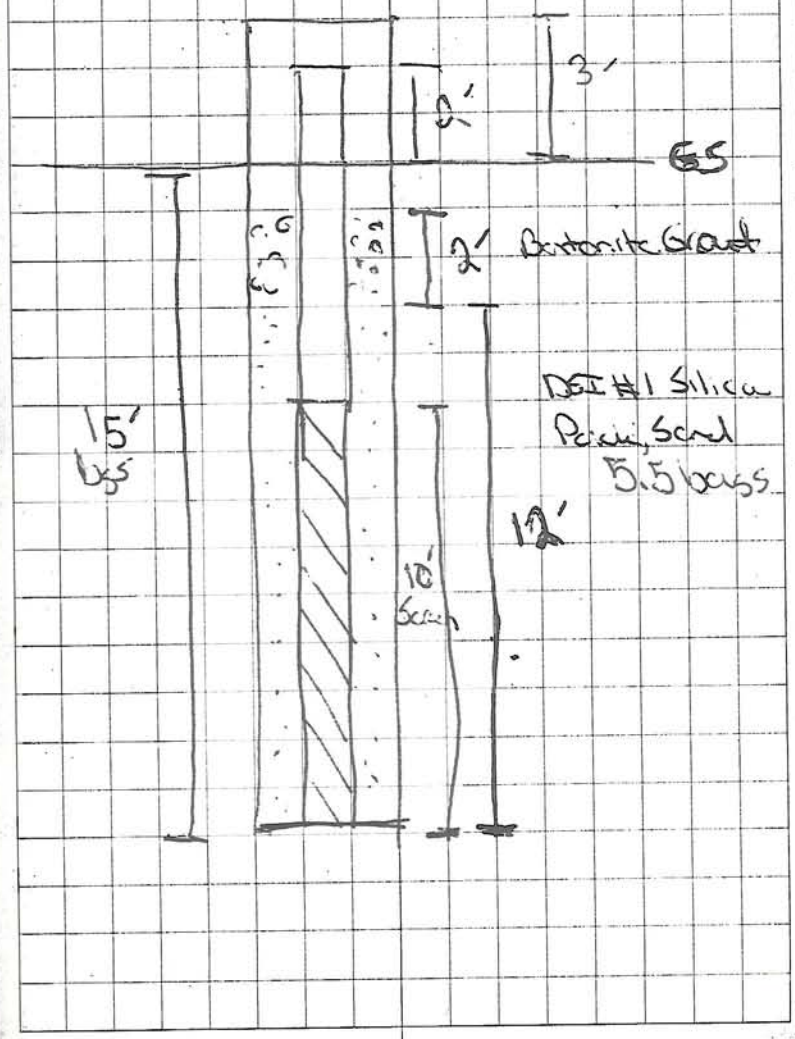
15.1-15.5' - Silty Sand, course grain, 5y 5/2, SM.

15.5-16' - 5y 5/2, Silty Clay, High Plasticity, v.g. moist, CH. YCM

Location SJCA Date 12/9/03

Project / Client Sites 2 al 5 ERI

Well Construction
SJSO2-MW085



Location SSCA Date 12/9/03

Project / Client Sites 2 and 5 ERI

Bore log SSS02-MW07S

1st Split Spoon

0-0.1' Top Soil organic matter silty, clay, 5yr 3/2,

0.1-0.5' - ABM, Black, medium grained

0.5-1.1' - mixture of gravel, abm, fill material, silty sand, 5yr 3/2; GC/SW. Slights moist at medium density, quartz gravel, angular.

2nd Split Spoon 5 inches Recov.,

2'-2.5' - fill material, abm pieces with some grit gravel Backfill.

No recovery beyond. will push another two feet to determine whether we are out of the blast grit cover.

3rd Split Spoon 24' recovery

4-5.2' - Sandy Clay, Trace ABM, 5yr 3/2, saturated at 5.2, root layer at 5.0'; SC; Trace gravels

5.2-6.0' - medium sand, coarsen downward, 10yr 6/2; wet, medium density; SW

PID = 1.0 at hole; 0.0 ppm at Breathing Zone.

Location SSCA Date 12/9/03

Project / Client Sites 2 and 5 ERI

4th Split Spoon 9-11' bgs

24" recovery

9-11' 10yr 6/2, medium sand, saturated, dense, poorly sorted; SW, more gray green at 11' bgs

5th Split spoon 14-16' bgs

14-14.5' - 10yr 6/2, medium sand with fines, poorly sorted; SW.

14.5-15.1' 10yr 6/2, CL, Gray, clay, ~~soft~~

15.1-15.4' - 10yr 6/2, Sand lense coarse grained with oxidation

15.4-16' - Silty Clay, 10yr 6/2, Gray, Very stiff fat clay, CH.

Location 55A Date 12/9/03

Project / Client Sites 2 and 5 ERI

1100 Calibrate Horiba U-22
pH = 3.99 cond = 4.61 Turb = 0
DO = 12.83 Sal = 0.2 ORP = 278

1135 Encountered Difficulty with temp
Casing Drillers Pound 1 bag of #1 Silica
pack down at ground hole.

1250 Begin Surface water Sampling

1255 Collect 55502-SW11-030
for TCL LC VOCs.
pH = 5.75 cond = 3.82 turb = 13
Sal = 0.2 DO = 11.59 ORP = 227
Temp = 8.9.

1310 Collect 55502-SW10-030
for TCL LC VOCs.
pH = 6.34 cond = 0.44 Turb = 11
DO = 9.03 Temp = 13.8 Sal = 0
ORP = 161

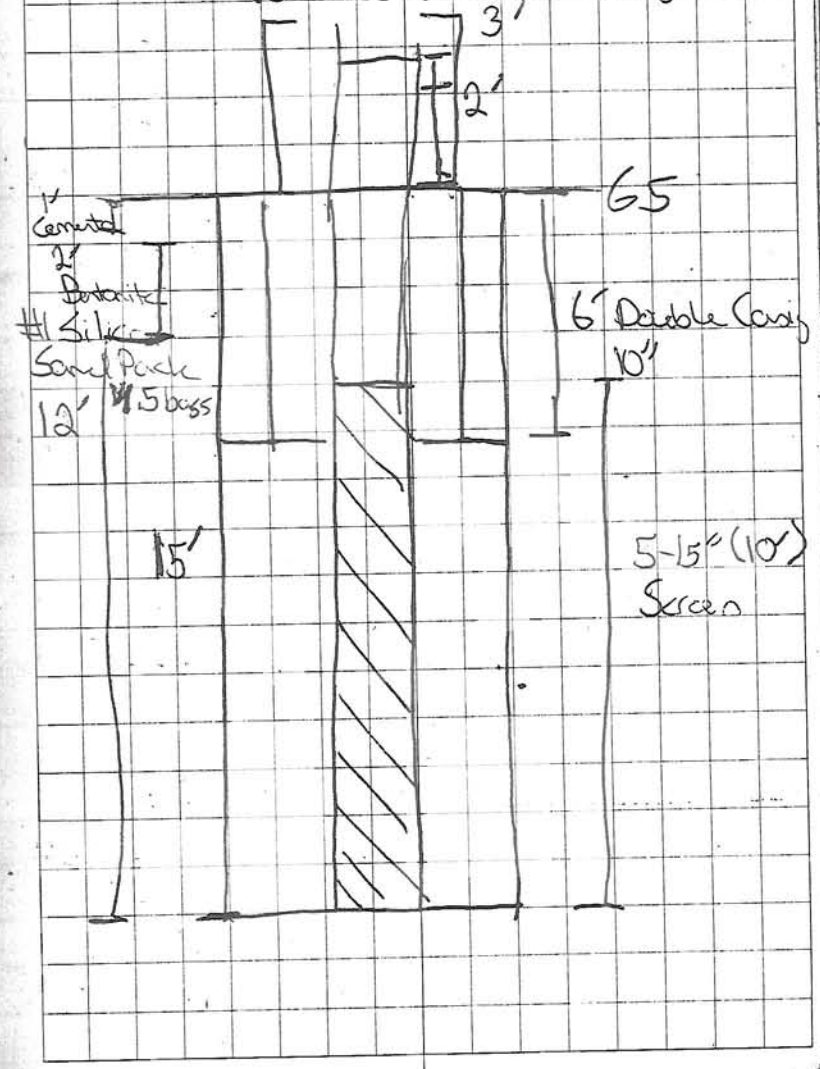
1330 Break for lunch

1430 Collect 55502-ST01-030 for
TCL LC VOCs. Depth to water = 3.55 ft
Total Depth of manhole = 5.06 ft
pH = 6.47 cond = 0.47 Turb = 12
DO = 9.34 Sal = 0 ORP = 142
Temp = 15.3 Also Collect Dup
55502-ST01-030-P at this Location

Location 55A Date 12/9/03

Project / Client Sites 2 and 5 ERI

55502-MW07S
Well Construction Diagram



Location SSCA Date 12/9/03

Project / Client Sites 2 and 5 ERI

1445 Check on Drillers who have begun purging/Developing SS02-MW06S.
Development Reading
pH = 6.44 Cond = 0.314
Turb = 62.1 DO = 11.33 Temp = 16.2
Sal = 0 ORP = 176

1512 Collect SS02-ST02-030 for TCL LC VOCs.

pH	cond	turb	DO	temp	sal	orp
6.24	0.71	25	5.44	15.2	0	127

DTW 5.54'
7.24'

1530 Collect SS02-ST03-030 for TCL LC VOCs.

pH	Cond	Turb	DO	Sal	Temp	Orp
6.93	0.33	0	11.9	0	15.0	76

Depth to Water = 5.35 Depth of Water = 4"
~~Depth of manhole 5.5~~

1540 Collect SS02-ST04-030 for TCL LC VOCs.

pH	Cond	Turb	DO	Temp	Sal	Orp
6.81	0.33	0	12.77	14.8	0	169

Depth of Water: 4" Deep

Location SSCA Date 12/9/03

Project / Client Sites 2 and 5 ERI

Depth To Water: 5.20'

1550 WO expressed concern with SS44. Decision to keep them onsite for Dioxin samples 1/2 day Weekend.

1610 Collect development parameters for SS02-MW09S
~~Cond SC pH = 0.439~~ pH = 6.51 Cond = 0.439
Turb = 107.0 DO = 11.85 Temp = 16.4
Sal = 0 Orp = -55.

1630 Collect SS02-ST05-030 for TCL LC VOCs.

pH	Cond	Turb	DO	Temp
6.33	0.30	52	13.1	13.3

Sal	ORP
0	33

DTW = 4.95'
Depth of Water = 2"

1640 Collect SS02-ST06-030 for TCL LC VOCs. DTW = 1.02'
Depth of Water = 2.85'

pH	Cond	Turb	DO	Temp	Sal	Orp
6.69	0.21	19	9.94	12.5	0	9

Location SJCA Date 12/9/03

Project / Client Sites 2 and 5 ERI

1650 Collect [SS02-STO2-030] for TCL LCVOCs.

pH	Cond	Turb	DO	Temp	Sal	orp
6.90	0.37	0.7	14.2	11.2	0	314

Depth to water = 1.01'

Depth of water = 1.70'

1705 Check with Perrett Wolf. They will finish construction of MW09S and return on Friday. CH2M Hill offsite to pack and ship samples.

12/9/03

Location SJCA Date 12/10/03

Project / Client Sites 2 and 5 ERI

0730 Offsite: St Juliens creek annex to continue Sites 2 and 5 ERI field effort.

0740 Conduct H&S meeting with Perrett Wolf Family LXO. LXO Conducts H&S meeting with CH2M Hill.

Weather: Sunny; rain this afternoon.

Field Crew: D. Blitzer and J. Culbreth

Objective: Conduct Soil Sampling at Site 5 and complete MW installation.

0800 Calibrate Horiba U-22

pH	Cond	DO	Turb	Sal
3.97	4.57	11.9	0	0.2

Orp
305

0805 Water Quality for SS02-MW09S

pH	Cond	Turb	DO	Temp
5.84	1.68	104.0	8.03	16.5

Sal	Orp
0.1	114

0810 Complete meeting at LXO and CH2M Hill mob to site 5 to begin Soil Sampling.

Location St. J.'s Blows Creek Date 10/26/04

Project / Client Phase II BERA

1120 Mobilize under bridge to remove stakes + collect cores.

1130 - Collect sediment core @ ~~204~~. 203 (3rd least of)

1140 - Collect sediment core @ 208. ~~(centrmost further~~ Easternmost location.

1150 - Collect sediment core @ (2nd least of Easternmost location)

1300 - Depart site + return to office.

Location St Js' Date 11/8/04

Project / Client Site 2, 19, + 21 MIP

0705 - Depart office to pick up rental vehicle.

0730 - Load "fleet vehicle" + depart office

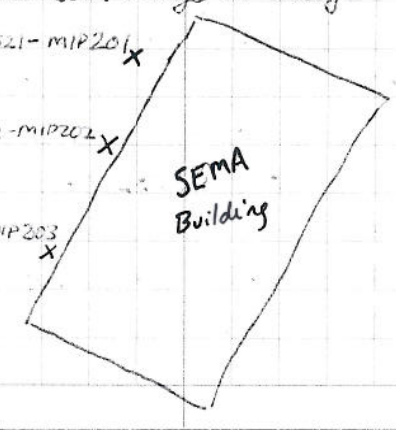
0800 - Arrive @ pass office + meet Columbia Technologies

0845 - On site + meet USA Environmental (UXO).

F Crew - R. Ives, K. Zurich, J Butler.

Subcontractors - UXO (USA Environmental) Phil Balvocius + Nelson Figueac; Columbia Technologies (MIP) - ~~Malcolm~~ Morgan Aycock + Robert Stewart. Weather - Windy, cold, T = 60°F, sunny. Today's obj. - UXO avoidance + MIP locations for well placement. H+S tailgate given by J. Butler + USA Env.

0900 - Set up near SEMA building to begin MIP + "clear" area. Met w/ ~~to~~ Susan Hayes (in lieu of John Weely) of Navy.



Location St. J.'s Date 11/8/04

Project / Client Site 2, 19, 21 MIP

0935 - Begin drilling for MIP investigation @ SJS21 - MIP201 + clear for UXO.

1006 - Begin MIP investigation @ SJS21-MIP201. Punched to 16 feet bgs; estimated depth of confining unit. At ~4 ft. bgs one small peak, probable noise - no hit.

1040 - Withdraw from hole + patch.

1052 - Move to new MIP location + practice UXO avoidance + begin drilling for MIP investigation @ SJS21-MIP202; original location too noisy. Off set ~5 ft. East, closer to building. Second Location is good. Will proceed with MIP.

1115 - Punched to 16 feet bgs; estimated depth of confining unit ~ 16.09 ft bgs. No peaks @ this location. Withdraw from hole. Patch hole w/ Bentonite chips + pavement.

1145 - Move to new MIP location + practice UXO avoidance + begin drilling for MIP investigation @ SJS21-MIP203. Too much "noise" in initial hole Move location East ~ 2 feet, towards building. Second location is good. Will proceed with MIP.

Location St. J.'s Date 11/8/04

Project / Client Site 2, 19, 21 MIP

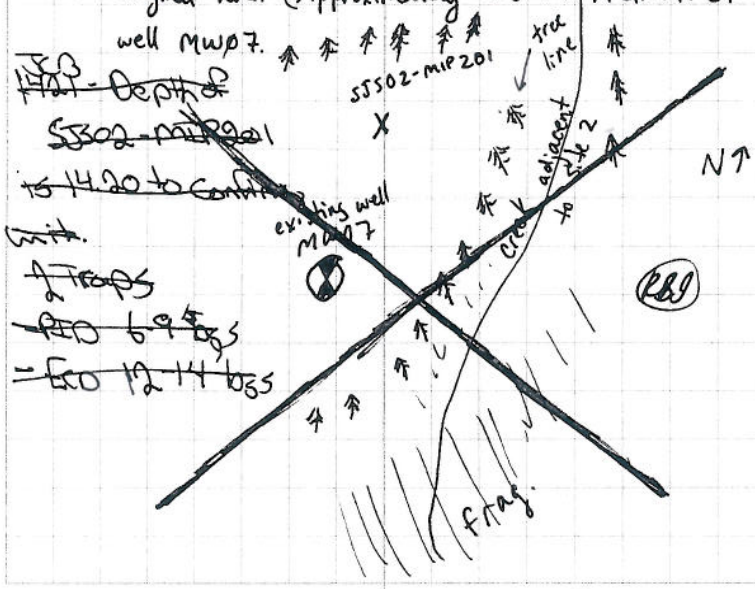
1215 - Pushed to 16 feet; approximate location of confining unit @ 16 feet. No peaks.

1223 - Withdraw from hole + patch. Mobilize to Site 2.

1230 - USA clears locations for MIP investigation.

1330 - Calibrate PID. ~~Begin drilling at~~ (RBJ) Calibrated to ambient air 0.0. Calibrated to Isobutylene 100.9

1332 - Begin drilling at SJS02 - MIP201. PID reads 0.0 in breathing zone. Too "noisy" relocate to new location ~ 1½ ft. west of original hole. (Approximately 25 ft. NORTH of well MWP7.



Location St. J.'s Date 11/16/04

Project / Client Site 2 + 21

0750 Steve / Parratt-Wolff is developing MW085 at Site 21. Will Radio in as it comes up for water quality readings.

0800 - Calibrate Horiba U-22
pH = 3.98, Cond. = 4.55, Turb. = 0.0,
DO = 11.94, T = 10.2°C, SAL = 0.2, ORP = 321

0825 - Calibrate minirae
Zero to fresh air at
103 0 = Isobutylene

0852 - Check water quality @ MW09 @ Site 21. Slight petroleum odor.
pH = 6.40, Cond. = 0.350, Turb = 87.4,
DO = 9.36, T = 21.7°C, sal = 0.0, ORP = 47
Total volume = 40 gallon. Completed development.

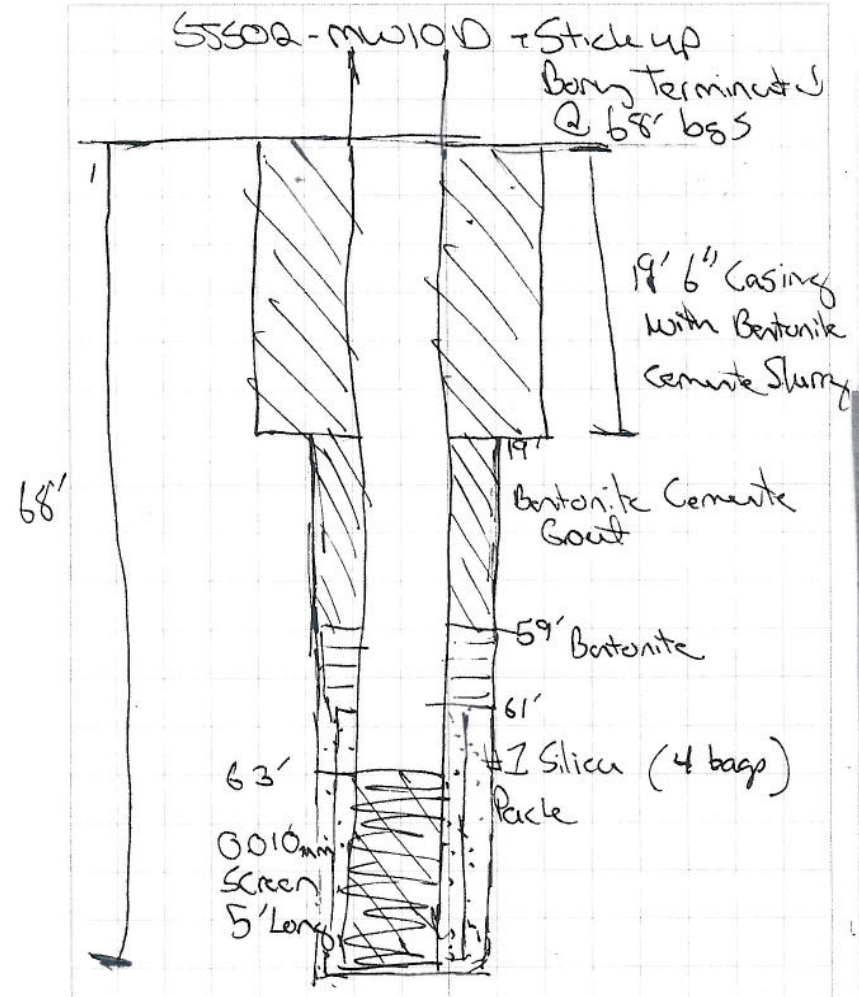
0910 Begin developing SS521-MW085

1000 - Check H_2O quality @ MW085 @ Site 21.
pH = 6.22, cond. = 0.470, Turb. = 385,
DO = 8.99, T = 22.3°C, sal. = 0.0, ORP = 65
~~Total~~ Est. volume = 30 gallons. Will continue to develop.

1020 - Check H_2O quality @ MW085
pH = ~~6.16~~ 6.160, cond. = 0.417, Turb. = 66.8,
DO = 9.48, T = 23.1°C, sal. = 0.0, ORP = 87

Location St. Juliens Creek Date 11-16-04

Project / Client Site 2



Location St. Juliens Date 11/16/04

Project / Client Site 21 + Site 2

1035 - Check H_2O quality @ MW08S
pH = 6.09, cond. = 0.396, Turb. = 20.7,
DO = 9.58, Temp. = 23.7°C, sal. = 0.0, ORP = 104
Total volume = 45 gallons
1037 - Development complete.
1040 - Mobilize to SJS21-MW10S + begin well development.
1115 - Collect H_2O for H_2O quality @ SJS21-MW10S.
pH = 6.31, cond. = 0.308, Turb. = 27.3, DO = 10.11
T° = 22.6°C, sal. = 0.0, ORP = 111
Total purge volume = 55 gallons. Well development complete. Strong odor, possible petroleum + TCE.
~~1144 Drillers Decon~~
1150 Break for lunch
1245 - Return from lunch.
1250 - Drillers stage drums + decon. equipment.
1430 - Mobilize to Site 21 to begin well on west side of old SEMA building; SJS21-MW11S.
1445 - UXO cleared to 2 ft. bgs
1453 - UXO cleared at 4 ft. bgs
1506 - Collect split spoon from 5'-7' bgs. 2 feet of recovery. All fill from parking lot.

Location St. Juliens Date 11-16-04

Project / Client Site 21

1515 - Collect split spoon from 7'-9' bgs. 2 foot recovery.
7'-7'3": fill material
7'3"-7'6": sandy clay, SC, loose, (2.5Y 4/1), dark gray, low-moderate plasticity
7'6"-8'2": clayey silty sand, SM, loose, v. low plasticity, more sand than last 3". olive brown (2.5Y 4/3)
8'2"-8'10": fine silty sand w/ some clay, SM loose - moderate, ~~v. low plasticity~~ (P2) (5Y 6/2), light olive gray
8'10"-9': fine silty sand w/ some clay, SM ~~loose~~ (P2) - moderate, ~~v. low plasticity~~ (P3), light olive brown (2.5Y 5/6)
1535 - Collect split spoon 10'-12' bgs. 2 foot recovery.
12'-12'2": silty sand, SM, saturated, olive gray (5Y 4/2); some clay, moist
12'2"-12'10": same as above except no clay, 5Y 6/3 pale olive
12'10"-13': SAA, olive yellow, 2.5Y 6/8
13'-13'4": SAA, brownish yellow, 10YR 6/8
13'4"-13'8": SAA, yellowish brown, 10YR 5/8
13'8"-14': SAA, strong brown, 7.5YR 5/8

Location St. Juliens Date 11-16-04

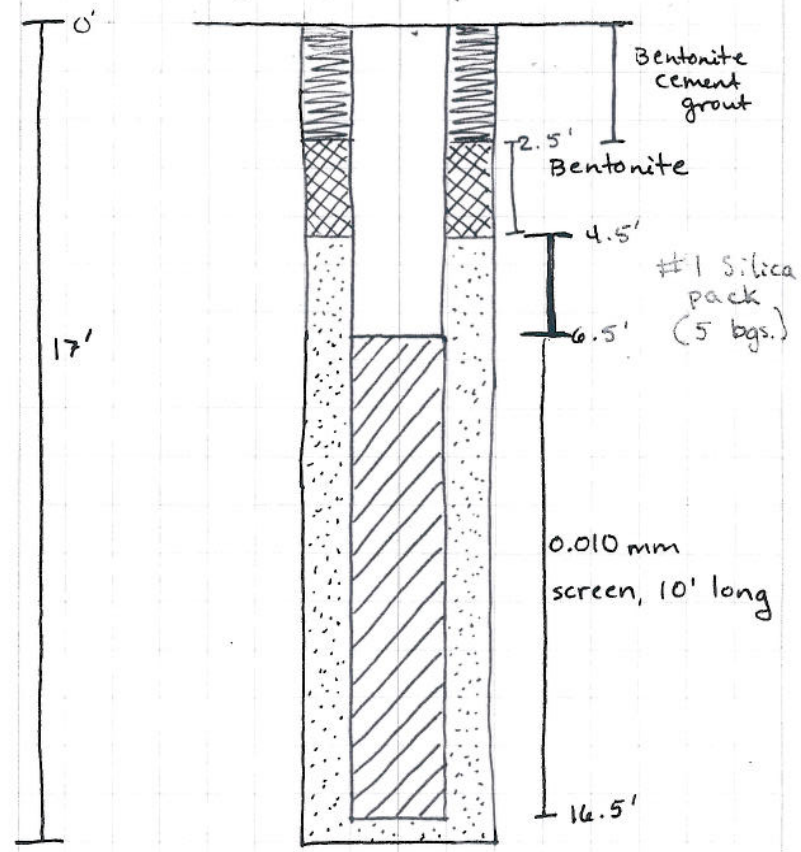
Project / Client Site 21

1547: Collect split spoon 12-14' bgs.
2 feet recovery.
12'-12'2": silty sand w/ some clay, ~~SM~~ (RI) SC
moist, olive, (5Y 5/3)
12'2"-14': silty sand, SM, stiff color
changes @
12.2'-12.10': olive yellow, 2.5Y 6/6
12.10'-13.2': olive yellow, 2.5Y 6/8
13.2'-13.10': yellow, 2.5Y 7/8
13.10-14': yellowish brown, 10YR 5/8
1600: Collect split from 15'-17' bgs.
2 feet recovery
15'-15'5": silty sand, SM, loose-moderate,
moist, pale olive (5Y 6/3)
15'5"-16'2": coarse sand, SW, loose,
moist, olive yellow, (2.5Y 6/8)
16'2"-16'10": coarse sand, SW, loose,
saturated, olive, 5Y 4/1
16'10"-17': fat clay, CH, very soft,
dark greenish gray, (Gley 1 4/10Y)
high plasticity
1410: Begin to set well w/ screen at
6'-16'6" bgs. SJS21-MW11S.

Location St. Juliens Date 11-16-04

Project / Client Site 21

not a sample SJS21-MW11S - Flush Mount
Boring terminated @ 17' bgs.



Location St. Juliens Date 11-16-04

Project / Client Site 21

1710 - UXO offsite. Drillers decon. equipment

1728 - Off-site. Will begin work at 0700 a.m. tomorrow. Note: Reference Book #2 for additional field notes.

Rebekah Ives

Location St. Juliens Date 11-16-04

Project / Client Site 2

0700 - Arrive on site. Weather: Sunny, cool a.m. temps., daily high T = 60°F.; Field Crew - R. Ives + J. Butler; UXO subcontractors - USA Env.: N. Figeauc, P. Balvacious; Drillers: Parratt Wolff - S. Stewart, A. Chapel, S. Smith. Today's obj. - Install MW @ Site ~~21~~ 2 + develop + pad wells @ site 2 + 21.

0715 - J. Butler conducts H + S tailgate.

0725 - Calibrate Minirae to ambient air (0.0) + Isobutylene (99.8)

0730 - Set up @ MW10S to install shallow well w/ screen from 6'-16' bgs. Set pad for MW10D. USA clears next area.

0745 - UXO gives clearance down to 2 ft. bgs

0800 - MiniRae reads 0.0 ppm in breathing zone + 10.5 directly over hole.

0805 - ~~PID~~ Minirae reads 1.2 ppm @ 10' from hole in breathing zone.

0815 - ~~PID~~ minirae jumping btwn ~7 + 11 ppm in breathing zone. ~~PID odor~~ TCE odor at times.

0830 - Minirae jumping. Highest hit ~67 ppm. Nothing over 25 ppm sustained for 1 minute. Strong TCE odor. Average ~9 ppm.

Location St. Juliens Date 11/23/04

Project / Client Site 2 + 21 Slug Tests

0920 - Arrive on site. Today's weather - cool, rainy, overcast, T = 63°F. F. Crew - R. Ives + B. Francisco. Today's obj. - perform slug tests at Site 2 + 21.

0930 - R. Ives gives H+S tailgate.

0935 - Set up @ SJS02-MW05S. Cannot access due to improper key.

0945 - Set up @ SJS02-MW09S. Total depth per Kim is 10' deep. Decon. slug.

1000 - Calibrate MiniRae to fresh air (0.0) + isobutylene (104 ppm).

1005 - Perform slug test @ SJS02-MW09S.
Initial DTW - 4.15' btc, MiniRae = 0.0 ppm
DTW below ground surface ~1.15', approx. 8.5' of H_2O in well. Place transducer @ ~8' bgs
~~Also DTW after slug inserted~~ RI

1048 - Falling head slug test started. (MW09S)

1052 - DTW = 4.11 ft btc @ end of falling head test

1052 - Stop ~~active~~ falling, RR head test.

1100 - Begin rising head slug test MW09SR.
Initial DTW before test = 4.15' btc

1104 - Stop rising head test.
Final DTW after test = 4.20' btc

Location St. Juliens Date 11/23/04

Project / Client Site 2 + 21 Slug Tests

1105 - Clean up @ SJS02-MW09S.

1115 - Mobilize to + set up @ SJS~~02~~ 21 RI-MW06S.

1118 - Initial DTW = 2.08' btc. (flush)
Total depth of well = 18' bgs.

1125 - Probe placement (transducer) @ 10 ft btc.

1146 - Initial DTW = ~~2.08~~ RAI 2.08'

1148 - Begin falling head test ~~SJS~~ MW06SF.
Note = slug did not go all the way into well smoothly. RI ~~Will perform a rising head test~~. Probe shifted. Will redo test.

1156 - Initial DTW = 2.12' btc.

1157 - Begin Falling head test MW06SF2.

1201 - Stop Falling head test
Final DTW after test = 2.0' btc.

1206 - Begin Rising head slug test MW06SR.
Initial DTW = 2.05' btc.

1210 - Stop Rising head test.
Final DTW = 2.15' btc.

1212 - Clean up @ ~~SJS0~~ SJS21-MW06S.

1300 - Set up @ SJS21-MW11S. MiniRae = 0.0 ppm
DTW = 5.76' btc (flushmount)
Total depth of well = 16.5' bgs. Needs lock.

Location St. Juliens Date 11/23/04

Project / Client Site 2+21 slug test

1305 - Place transducer @ 13' btc.
Initial DTW = 5.76' btc
1321 - Begin falling head test 21MW11SF.
1325 - Stop falling head test 21MW11SF.
Final DTW = 5.42' btc.
~~1326 Clean~~ RI
1330 - Begin Rising head test 21MW11SR.
Initial DTW = 5.61' btc.
1335 - Stop rising head test 21MW11SR.
Final DTW = 5.96' btc.
1338 - Clean up @ SJS21-MW11S.
1355 - Depart site + return to office due to improper computer connector. Will try to get another laptop. Download info.
1505 - Onsite @ St. Juliens.
1515 - Mobilize to + set up @ SJS21-MW01S.
Total depth of well is 18' bgs. Needs lock.
DTW = 3.61, MiniRae = 0.0 ppm
1532 - Place transducer @ 11' btc. Will place slug @ ~6' btc. Will not do falling head, due to no laptop
1537 - Begin rising head slug test. 21MW01SR.
Initial DTW = 3.64' btc.
1540 - Stop rising head test 21MW01SR.
Final DTW = 3.78' btc.

Location St. Juliens Date 11/23/04

Project / Client Site 2 + 21 Slug Test

1542 - Clean up @ SJS21-MW01S.
1551 - Set up @ SJS21-MW10S.
Total well depth = 14' bgs.
DTW = 4.08' ~~bgs.~~ btc.
1557 - Place ~~slug~~ RI transducer @ 11' btc.
1600 - Place slug @ 9' btc.
1606 - Initial DTW = 4.02' btc
1608 - Begin rising head test 21MW10SR.
1611 - Stop rising head test 21MW10SR.
Final DTW = 4.11' btc.
1615 - Clean up @ SJS21-MW10S.
1620 - Mobilize to Site 2. SJS02-MW~~05S~~ 01D.
Mini Rae = 0.0 ppm
Well depth = 78' ~~btc~~ RBD bgs.
DTW = 5.52' btc
1630 - Place transducer @ 13'~~11'~~ ~~bgs.~~ RBD btc.
1635 - Place slug @ ~8.0' btc. (~6 ft bgs)
1648 - Initial DTW = 5.52' btc.
1650 - Begin Rising head test 02MW~~05SR~~.01DR.
1652 - Stop Rising head test 2MW~~05SR~~.01DR.
- Final DTW = 5.48' btc
1655 - Clean up @ SJS02-MW10D. Will not sample MW10S due to wasp nest in well casing. Will leave open overnight + test tomorrow

Location St. Juliens Date 11/23/04

Project / Client Site 2 + 21 Slug Test

1720 - Mobilize to + set up @ SJS02-MW10S

1722 - PID reads ~1462 ppm. Will air out + start w/ SJS02-MW10D. Abandon area + move to new location.

1740 - Set up @ SJS21 ~~MW04D~~ - MW01D.

Total well depth = 43' bgs

- Calibrate MiniRae due to high hit that "overwhelmed it."

Malfunction { Freshair = 0.0 ppm. Isobutylene = No gas! } Error. will fix tonight.

DTW = 4.95' btc (flush mount)

1753 - Place transducer @ 16' btc.

1756 - Place slug @ 8' btc.

1802 - Initial DTW = 4.87' btc

~~- Begin rising head test 21MW01SR~~

1810 - Note probe failure. Tried to repair. Unable to. Will try repair in office.

1830 - Depart site.

Location St. Juliens Date 11/24/04

Project / Client Site 2 + 21 Slug tests

0940 - Arrive on site. Today's weather - overcast, drizzly, cool, breezy. F. Crew - R. Ives, B. Francisco. Today's obj. - complete slug tests at Site 2 + Site 21. Note: Tested transducer @ office + MiniRae. Appear to be functioning fine. H+S - wasps + slips/trips + TCE contam.

0945 - At SJS02-MW01S cannot test due to wasps. Tried to kill... will return later.

0958 - Mobilize to + set up @ SJS02-MW05S.

1000 - Calibrate MiniRae to Freshair (0.0) + Isobutylene (109 ppm)

1006 - At SJS02-MW05S. MiniRae = 0.0 ppm

DTW = 5.87' btc

Total Depth = 13' bgs

1007 - Place transducer @ 11' bgs

1010 - Place top of slug @ 5' bgs.

1011 - Initial depth to H_2O = 5.75' btc.

1013 - Begin Rising head test 02MW05SR.

~~1018~~ 1019 - Stop Rising head test 02MW05SR.

~~1018~~ 1015 - Final depth to H_2O = 5.84' btc.

1020 - Clean up @ SJS02-MW05S.

Location St. Juliens Date 11/24/04

Project / Client Site 2 + 21 Slug Test

1027 - Mobilize to SJS02-MW05D.
Total well depth = 51' bgs.

1029 - MiniRae reads = 0.0 ppm
~~Initial well depth~~ DTW = 6.15' btc.

1033 - Place transducer @ 15' bgs.

1038 - Place slug @ 7' bgs.

1039 - Initial depth to H_2O = 6.15' btc.

1039 - Begin Rising Head test 02MW05DR.

1042 - Stop test 02MW05DR.

1043 - Final DTW = 6.17' btc.

1045 - Clean up @ ~~0~~ SJS02-MW05D.

1053 - Mobilize to SJS02-MW01S. Kill remaining wasps. Recalibrate MiniRae (acting funny)
Total well depth = 15' bgs.

~~13~~ 1106 - MiniRae = 0.0 ppm
DTW = 5.82' btc.

1113 ~~1313~~ - Place transducer @ ~~12'~~ 11' bgs.

1115 - Place slug @ 6' bgs.

1121 - Initial Depth to H_2O = 5.45' btc.

1122 - Begin Rising head test 02MW01SR.

1123 - Stop Rising head test 02MW01SR. due to ~~Final DTW~~ slug getting caught up in transducer cord. Test a failure. Will wait for well to recover.

Location St. Juliens Date 11/24/04

Project / Client Site 2 + 21 Slug Tests

1129 - Begin Rising Head test 02MW01SR2.
Initial DTW = 5.69' btc.

1137 - Stop Rising Head test 02MW01SR2.
Final DTW = 6.02' btc.

1138 - Clean up @ SJS02-MW01S.

1146 - Mobilize to SJS02-MW10S + 10D + open wells to "air out."

1230 - Set up @ SJS02-MW10D. MiniRae malfunctioning again. Recalibrate to fresh air + Isobutylene (109 ppm) At MW10D breathing zone = 0.0 ppm + @ MW10S. In well SJS02-MW10S MiniRae reads 15 ppm. At SJS02-MW07S b.z. = 0.0 ppm.

1246 At SJS02-MW10D. Note - test 02015R2 stopped
Total well depth = 6.8' bgs.
DTW = 6.88' btc.

1248 - Place probe @ 15' bgs.

1250 - Place slug @ 7' bgs.

1257 - Initial ~~well depth~~ DTW = 6.81' btc

1258 - Begin Rising Head test 02MW10DR.

1259 - Stop test due to ~~slug~~ probe getting caught up w/ slug. Will wait for well to stabilize again + redo test.

Location St. Juliens Date 11/24/~~05~~04 (RI)

Project / Client Site 2 + 21 Slug Tests

1307 - Begin Rising Head test 02MW10DR2.
1307 - Initial DTW = 6.72' btc.
1312 - Stop Rising head test 02MW10DR2.
1312 - Final DTW = 7.00' btc
1314 - Clean up @ SJS02MW10D.
1316 - Set up @ SJS02 - MW10S.
Total well Depth = 16.5' bgs.
DTW = 7.67' btc
MiniRae = 0.0 ppm in breathing zone
1323 - Place transducer @ 11' bgs.
1325 - Place slug @ 6' bgs.
1330 - Initial DTW = 7.54' btc
1331 - Begin Rising head test 02MW10SR.
1339 Stop Rising head test 02MW10SR.
Final DTW = 7.68' btc
1340 - Clean up @ SJS02-MW10S.
1350 - Mobilize to SJS02-MW07S in woods.
1352 - Set up @ SJS02 - MW07S.
DTW = 5.58' btc
well depth = 15' bgs.
MiniRae = 0.0 ppm in b.z., ~60 in well
1353 - Place probe @ 11' bgs.
1357 Place slug @ 4' bgs.

Location St. Juliens Date 11/24/04

Project / Client Site 2 + 21 Slug Test

1404 - Initial DTW = 5.41' btc
1406 - Begin Rising Head test 02MW07SR.
1418 - Stop Rising Head test 02MW07SR.
1418 - Final DTW = 5.62' btc.
1420 - Clean up @ SJS02 - MW07S.
1425 - Mobilize to SJS21 - MW01D.
~~- Place transducer @~~ (RI)
1428 - well Depth = 43' bgs
1429 - DTW = 4.96' btc (flush mount)
MiniRae = 0.0 ppm in b.z. + well.
1430 - Place probe @ 15' btc.
1434 - Place slug @ 7' btc
1440 - Initial DTW = 4.92' btc.
1442 - Begin Rising Head test 21MW01DR.
1447 - Stop Rising Head test 21MW01DR.
1447 - Final DTW = 5.00' btc
1448 - Clean up SJS21-MW01D.
1451 - Set up @ SJS21-MW04S.
Well Depth = 18' bgs.
1453 - DTW = 2.37' btc (flush)
MiniRae = 0.0 ppm in bz. + well.
1455 - Place transducer @ 11' btc.
1457 - Place slug @ 4' btc.
Lock missing.

Location St. Juliens Date 11/24/04

Project / Client Site 2 + 21 Slug Test

1501 - Initial DTW = 2.32' btc.
1502 - Begin Rising Head test 21MW04SR.
1510 - Final DTW = 2.42' btc.
1510 - Stop Rising Head test 21MW04SR.
1511 - Clean up @ SJS 21-MW04S
1517 - Mobilize to staging area to place Decon H_2O in drums.
1530 - Depart Site.

Nikhil Jain

Location St. Juliens Date 1/7/05

Project / Client Sites 2 & 21 Well Survey (new wells)

0800 K. Zunich arrive at NNSY pass office to meet PHR&A & obtain passes
0900 arrive onsite w/ PHR&A staff Chris Curran
Derrick Ott
0905 H&S TCE exposure

print name	Sign name	Company
Katie Zunich	Katie Z	CH2MHill
Chris Curran	Christopher Curran	PHR&A
Derek Ott	Derek Ott	PHR+A

- advised to pop well tops prior to working around
- 0935 K. Zunich off site

Katie Z

Location St. J.'s Date 11/9/04

Project / Client Site 19

1423 - Collect surface soil sample SJS19-SS15-00-04D for TCL PAHs. MS/MSD collected here.

1428 - Collect surface soil sample SJS 19-SS16-00-04D for TCL PAHs.

1440 - Depart site + return to Site 2.

Fieldwork over

Location St Stephens Creek Date 11-10-04

Project / Client Site 21

1100 Parrot half Attached and Scott on Site to sample NOD and install K. Henderson and B. Friedman Onsite Logistics and morning Start up are in the Site 2 Field Book.
H&S Brief

1130 Setup on SSS21-SB02 to collect NOD Samples.
0-4' - Fill concrete Asphalt, - 0 PID
4-8' - Gray.
4-5' - Sample Clay with Some Silt
5-8' Sandy Silt; Gray
8-12 - 4' recovery
8-10' - Gray Silty Sand, wet
10-12 - Oxidation in organic clay, silty sand with silt.

1200 Collect SSS21-SB02A-05-04D for NOD.

1210 Collect SSS21-SB02A-10-04D for NOD
12-16' - 4' Recovery
12-14 - Oxidation like 10-12' core
14-16' - Coarse Sand Gray

Location St. Julians Creek Date 1-10-04

Project / Client

1220 Collect [55521-SB02A-14-040] from 14-16' for NOD

1230 Drillers meet the Dancy for supplies. Kim and Bill offsite to get lunch for crew.

1259 Setup on 55521-SB02B

1315 Break for lunch

1345 Begin Drilling
0-4' - Backfill, asphalt, Rubble
2-4 - Tight Clay, Stiff
4-8 - 4' Recovery
4-4.5' - fill
4.5-6' - Gray Sand with some Silt. moist
6-8' - Sandy Silt saturated orange at 6' going to gray at 7'-8'.

1400 Collect [55521-SB02B-06-040] for NOD 6-8'
8-12 - 4' Recovery
8-10 - Gray Silty Sand, saturated
10-12 - Silt with Some Sand, orange in color, saturated

1410 Collect [55521-SB02B-10-040] for NOD 10-12'

Location St. Julians Creek Date 1-10-04

Project / Client

12-16 - 4' Recovery
12-14 - Coarse Sand, Gray
14'-16' - Fat Clay, Gray

1415 Collect [55521-SB02B-12-040] for NOD 12-14'

1438 Mobilized Set up at 55521-SB04 to Collect NOD Samples
0-2' - fill material
0-6' - Asphalt
6-2' - fine Sand with Asphalt in it
2-4' - 1' Recovery
2-3' - Saturated orange Sand

~~1430~~

1500 Collect [5521-SB04-05-040] from 5-7' for NOD
4-8 - 3f recovery
5-7 - Gray fine Sand
7-8 - Coarse Sand, Gray

1510 Collect [55521-SB04-09-040] for NOD 9-11'
8-9 - Gray Sand
9-11 - fine orange Silty Sand
11-12 - Coarse Gray Sand

Location St. Juliens Creek Date 11-10-04

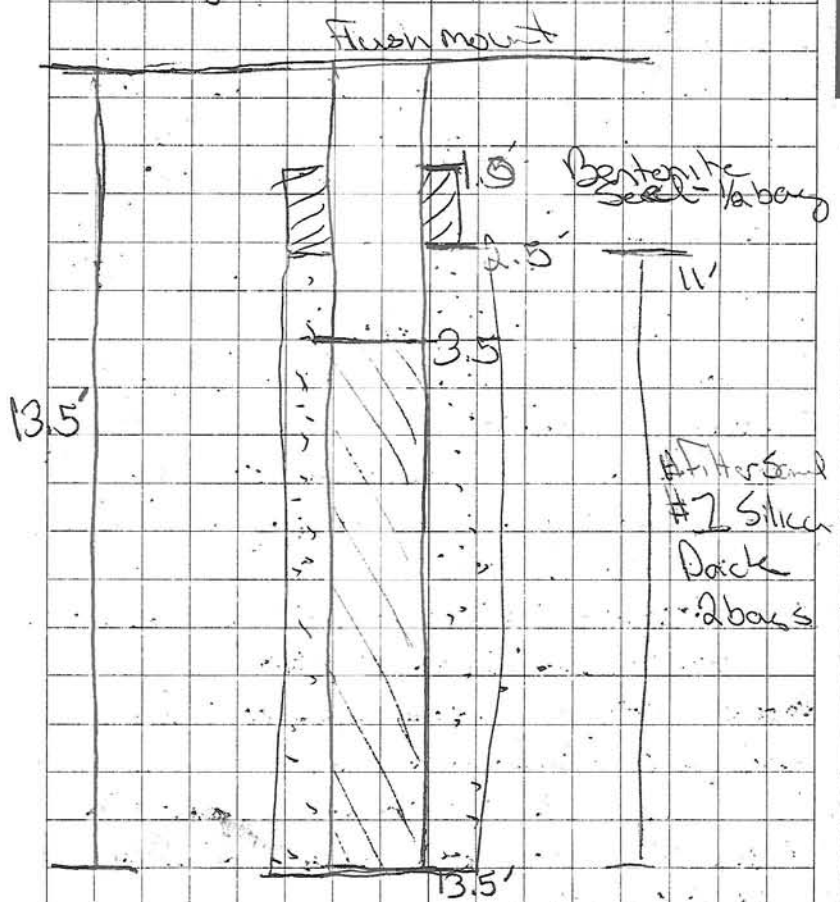
Project / Client

1500 Collected [SSS21-SB04-12-04D]
for NOD 12-14' BGS
12-16' - 4' Recovery
12-14 - Coarse Sand/Gray Saturated
14-16 - YCU; Fat Clay
1530 moved to Setup on SSS21-MW07S
to begin drilling
1600 hit clear hole. Begin split spoon
at 5' bgs.
5-7' bgs - 1' recovery
Silty Sand, wet at 5' BGS
fine grained; Saturated; loose; SM;
5-5.5' - organics
6-7' - 5y 5/3; SM; Loose, Silty Sand
10'-12' - 2' Recovery
10-11.5' - Iron color Sand; fine grained
Saturated; loose; SM; 2.5y 5/6.
11.5-12' - Gray; medium Sand; Saturated
2.5y 4/4.
12-14' 2' recovery
12-13.5 - Same as above
13.5 - Yorktown Confining Unit; fat clay
Soft; CH; Gray 2.5y 5/1
Well Set from 0-13.5'; 10' well Screen
13.5-3.5' bgs

Location St. Juliens Creek Date 11-10-04

Project / Client Site 21

SSS21-MW07S Well Construction Diagram



1730 Drillers off site
1800 Return to office to pack coolers.

Location St. Juliens Creek Date 11-11-04

Project / Client Site 21

0700 On Site St. Juliens Creek annex to install monitoring wells at Site 21. Sign driller logs
Field Crew: J. Butler, R. Ives and K. Tippin from CH2M Hill.
Parratt Wolf Subcontractor:
A. Perlmer; S. Graham.
UXO - Phil and Nelson will clear for well installation
Weather: Sunny high near 60°F
J. Butler held kick off meeting for team. Columbia Tech is onsite mapping at Site 2. R. Ives is keeping field book for MIP activities.
0715 Kick off tailgating meeting complete. Employees sign off on HAS.
Parratt Wolf is drilling borers for well installation today.
0815 Setup on the South eastern side of the SIMA Building to begin installation of SS21-MW08S.
UXO will drill check down to the water table. UXO cleared to 4' and will proceed to complete well drilling.

Location St. Juliens Creek Annex Date 11-11-04

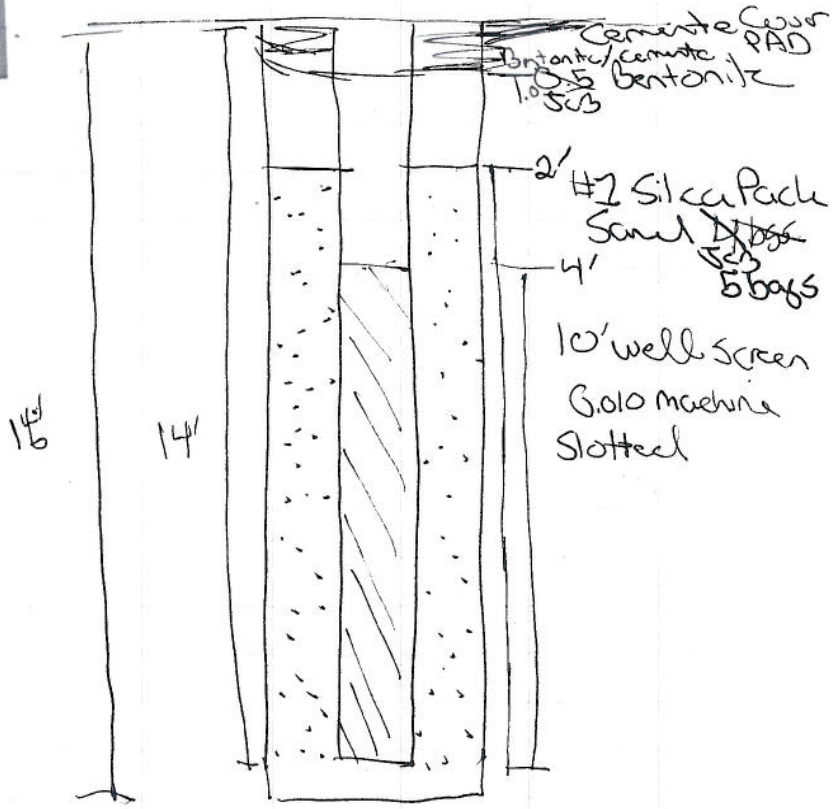
Project / Client Site 21

0830 Drillers will provide cores from 5-7'; 10-12' and then proceed to temp confining unit.
Log for MW08S
5-7' 2'-Recovery
5-6 - Clay; Stiff, 5Y, 3/3, CL
6-8' - fine silty sand, loose; wet at 6.5'; 2.5Y 5/3.
10-12' - saturated loose fine sand w/ some silt SM 10YR 4/6
14-16' - 2' recovery
14-14.5 - same as above
14.5-15 - gray medium sand loose SM w/ little clay 2.5Y 3/1
15-15.5 - silty clay medium 2.5Y 2.5/1 CL
15.5-16 - Yorktown confining unit fat clay 2.5Y, 2.5/1 CH
settling well 4-14'

Location St. Juliers Creek Date 11-11-04

Project / Client Site 21

SS521-MW085
Well Construction



~~SS~~ 1030 Pack completed and Cap Set
at MW085

Location St. Juliers Creek Date 11-11-04

Project / Client Site 21

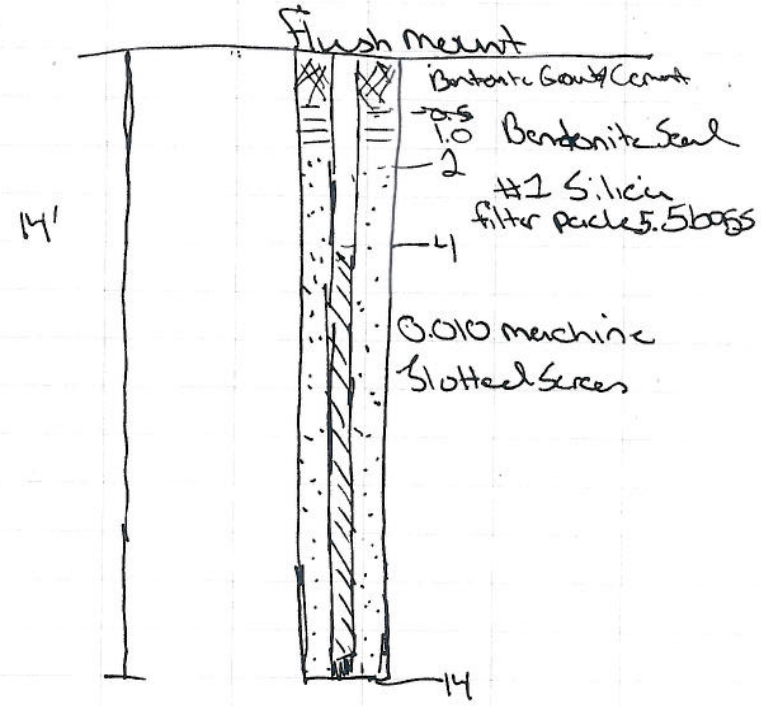
1100 Setup on MW095 to begin well installation.
1125 drilled two ft hit an unknown object (no damage) UXO check, clear, moved to new location, approx. 20 ft north for new hole
1130 start drilling MW095
1145 Breakthrough Clear for UXO
1245 5-7' 2' recovery
5-6' - fill packed silt; 10yr 4/3; SC moderate
6-7' - Water table at 6' bgs; SM; saturated; loose 2.5y 5/3.
10-12' - 2' Recovery
10-11' - Gray Silty Sand; saturated; SM; loose 5y 6/1.
11-12' - 5y 5/3; Brown tan silty Sand; SM; loose; saturated; Slight odor
14-16' - 2' Recovery
14-14.5 - fine Sand; SM; Gray 5y 4/2; Loose;
14.5-16 - Clay; 5y 2.5/1; soft-very soft; becoming moderate at 15.5'; CH
Set well from 4-14' bgs

Location St. Juliens Creek Date 11-11-04

Project / Client Site 21

SS21 - MW09S

Well construction Diagram



Boring terminated @ 16' bgs - Split Spoon

~~0830~~

1430 - Drillers Decon and will begin next well

Location St. Juliens Creek Date 11-11-04

Project / Client Site 21

0330 Setup on SS21-MW10S

Begin Drilling.

4' UXO Clearance

5-7' - 1.5' Recovery

Water table at ~~5.5 bgs~~ 6' bgs

5.5-6 - Silty Sand with some clay 10yr 4/3, soft, SC

6-7' - Fine Sand, SM, 10yr 6/1 Slight petroleum odor

10-12' - Fine Silty Sand 2' recovery Clay lense from 10-10.5' 10yr 4/3, SC

10.5-12' - 10yr 6/5, Silty Sand, SM, wet, saturated, loose.

14-16' - 2' Recovery

14-14.5 - Same as above

14.5-16 - Clay, high Plasticity, CH 10yr 4/1. Slightly Silty Clay at 15' bgs.

1611 Set well from 4-14' bgs.

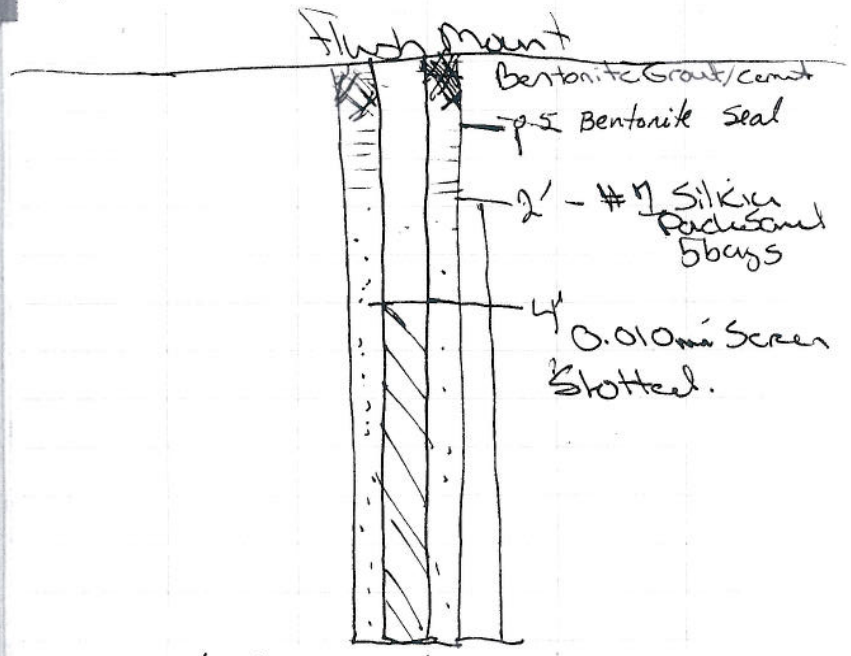
K. Tipper Escorted Columbia to Site 19 to setup for the evening. Will collect DRT GW Sample 1st thing in the morning.

Location St. Juliens Creek Date 11-11-04

Project / Client Site 21

SS21-MW10S

Well Construction Diagram



1625 - Columbia off-site.
1640 - K Zunich offsite
1750 - Drillers offsite.
730 - Off-site.

Rebecca Iver

Location St. J.'s Date 11/12/04

Project / Client Site 19

0700 - Arrive on-site. Today's weather - mild, showers, T = 63°F. F. Crew - R. Ives, J. Butler, K. Zunich. UXO - N. Fijeuk, P. Balvocious, Parratt Wolff - S. ~~Stewart~~ Graham A. Chapel. Columbia - M. Aycock, R. Stewart. Today's obj. - Collect GW + soil sample @ Site 19. ~~Fill~~ GPS locations + finish trash delineation at Site 2. Reference Book #2

0710 - H+S tailgate given by J. Butler.

0720 - K. Zunich calibrates PID.

0734 - K. Zunich calibrates Horiba U-22 pH = 3.95, cond. - 4.53, Turb = 0.0, DO = 9.90, T° = 16.2°C, Sal = 0.2, ORP = 297

0735 - Set up @ groundwater sample location SJS19-GW01.

0745 - Begin drilling; UXO clearance given

0750 - Collect equipment blanks & Field ~~trip~~ blank

0800 - Set up pump to pull H_2O. Screen set @ 10-14' bgs.

0810 - Having some problems w/ pump.

0815 - Pump working; begin purging.

Location St. Juliens Creek Annex Date 11/30/04

Project / Client Site 21

0855 – ARRIVE ON SITE. WEATHER – SUNNY, COOL AM TEMPS, DAILY HIGH T = 55°
FIELD CREW – K. HENDERSON & R. IVES
OBJECTIVE – GROUNDWATER SAMPLING AT SITE 21, H&S TAILGATE CONDUCTED

0900 – CALIBRATE HORIBA
PH – 3.94 TURB – 0 NTU
COND – 4.58 ms/cm DO – 12.54 mg/L
TEMP – 9.3°C SAL – 0.2%
TDS – 2.9 g/L ORP – 352 mV

0905 – CALIBRATE MINIRAE 2000 TO AMBIENT AIR = 0.0 ppm AND ISOBUTYLENE = 102 ppm

0905 – SET UP AT SJS21-MW06S
DTW = 1.48' PID = 0

0910 – BEGIN PURGING

0950 – COLLECT SAMPLE SJS21-MW06S-04D
FOR VOCs, TOC, Sulfate, Nitrate, Ferrous Iron, Alkalinity

1015 – SET UP AT SJS21-MW07S
DTW = 2.19' PID = 0 BREATHING ZONE
5 ABOVE WELL

Location St. Juliens Creek Annex Date 11/30/04

Project / Client Site 21

SJS21-MW06S

TIME	PH	COND	TURB	DO	TEMP	SAL	ORP	DTW	FLOW (ml/min)	TDS
0915	4.06	0.001	233	9.83	15.6	0	322	2.10	400	0
0920	4.24	0	217	8.81	18.9	0	315	1.99	400	0
0925	4.36	0	207	8.64	20.0	0	310	1.91	250	0
0930	4.39	0	204	8.62	20.3	0	310	1.91	250	0
0935	4.42	0	201	8.63	20.7	0	309	1.90	250	0
0940	4.43	0	201	8.60	20.9	0	309	1.80	200	0
0945	4.44	0	201	8.65	21.0	0	309	1.81	200	0

TOTAL VOLUME PURGED = 3.75 GALLONS

Location St. Juliens Creek Annex Date 11/30/04

Project / Client Site 21

1027 PID BREATHING ZONE = 0
ABOVE WELL CASING = 3.3

1100 COLLECT SAMPLE SJS21-MW07S-04D FOR VOCs, SVOCs, Pest/PCBs, Total Metals/Cyanide, Dissolved Metals, Explosives, TOC, Nitrate, Sulfate, Ferrous Iron, & Alkalinity - Triple Volume for MS/MSD

1236 - Depart MW07S. + put purge H_2O into drum.

1245 - DEPART SJCA FOR LUNCH + SUPPLIES.

1330 - Return to Site 21 Set up @ SJS21-MW10S. DTW = 3.87
PID = 0

1405 - COLLECT SJS21-MW10S-04D FOR VOCs, SVOCs, PEST/PCBs, EXPLOSIVES, TOC, NITRATE, SULFATE, FERROUS IRON, ALKALINITY, TOTAL & DISSOLVED METALS, CYANIDE NOTE: HORIBA MAY BE MISREADING TURBIDITY - CONSISTENTLY READING ABOVE 200 AND WATER LOOKS CLEAR

Location St. Juliens Creek Annex Site 21 Date 11/30/04

Project / Client

SJS21 - MW07S

TIME	pH	COND	TURB	DO	TEMP	SAL	TDS	DTW SAL	ORP	DTW FLOW
1020	4.39	0	214	9.24	20.1	0	0	2.54	312	325
1025	4.42	0	211	9.30	20.5	0	0	2.54	311	325
1030	4.45	0	210	9.38	20.7	0	0	2.58	309	325
1035	4.50	0	130	9.51	20.9	0	0	2.54	308	325
1040	4.53	0	214	9.57	21.2	0	0	2.55	309	250
1045	4.55	0	220	9.72	21.4	0	0	2.56	305	250
1050	4.56	0	231	9.75	21.4	0	0	2.54	304	250

TOTAL VOLUME PURGED = 4.75 GALLONS

Location St. Juliens Creek Annex Date 11/30/04

Project / Client Site 21

SJS21-MW10S

TIME	PH	COND	TURB	DO	TEMP	SAL	TDS	ORP	DTW	FLOW
1335	4.09	0	252	9.12	19.4	0	0	286	3.87	250
1340	4.15	0	262	8.67	20.8	0	0	294	3.84	250
1345	4.18	0	244	8.61	21.4	0	0	294	3.84	250
1350	4.21	0	227	8.48	22.2	0	0	293	3.84	250
1355	4.23	0	224	8.42	22.5	0	0	292	3.84	250
1400	4.23	0	221	8.50	22.5	0	0	291		

TOTAL VOLUME PURGED = 2.5 GALLONS

SJS21-MW05S

1500	5.17	0.401	29	0.64	22.9	0	0.26	171	2.51	500
1505	5.25	0.388	53	0.50	22.7	0	0.25	167	2.36	325
1510	5.25	0.390	15.4	0.47	22.6	0	0.25	164	2.29	300
1515	5.25	0.381	0.0	0.45	22.6	0	0.25	163	2.30	300
1520	5.26	0.374	0.0	0.40	22.6	0	0.24	162	2.29	300

Total Volume Purged = 2.5 Gallons

Location St. Juliens Creek Annex Date 11/30/04

Project / Client SITE 21

1445 SET UP AT SJS21-MW05S-04D
PID=0 DTW=1.91 HORIBA
CLEANED WORKING

1524 - COLLECT SAMPLE SJS21-MW05S-04D
FOR VOCS, TOC, Sulfate, Nitrate, Ferrous Iron, Alkalinity.

1535 Depart SJS21-MW05S + put purge H_2O into drums @ Staging Area @ Site 2.

1535 COLLECT EQUIPMENT BLANK SJS21-EB113004 FOR DISSOLVED METALS

1550 SET UP AT SJS21-MW11S - NO LOCK
PID=0 DTW=5.62

1630 COLLECT SAMPLE SJS21-MW11S-04D
FOR VOCS, SVOCS, Pest/PCBs, Explosives, T-tri & Dissolved Metals, Cyanide, Nitrate, Sulfate, Ferrous Iron, & Alkalinity

1705 SET UP AT SJS21-MW01S
DTW = 3.16 PID = 0

1740 COLLECT SAMPLE SJS21-MW01S-04D
FOR VOCS, TOC, SULFATE, NITRATE, FERROUS IRON, ALKALINITY

Location St. Juliens Creek Annex Date 11/30/04
Project / Client Site 21

SJS21-MW11S

TIME	PH	COND	TURB	DO	TEMP	SAL	TDS	ORP	DTW	FLOW
1600	6.38	0.529	93.1	0.73	21.4	0	0.34	3	6.56	400
1605	6.40	0.521	42.3	0.43	21.6	0	0.33	-9	6.54	250
1610	6.35	0.506	24.7	0.37	21.4	0	0.32	-7	6.55	250
1615	6.31	0.494	16.1	0.37	21.6	0	0.32	1	6.54	250
1620	6.27	0.487	13.8	0.35	21.6	0	0.32	1	6.51	250
1625	6.24	0.471	0	0.32	21.5	0	0.31	1	6.39	250

TOTAL VOL. PURGED = 3 GALLONS

SJS21-MW01S

1715	5.82	0.153	55.5	1.14	22	0	0.10	4	3.71	400
1720	6.12	0.154	0	0.41	22	0	0.10	-28	3.59	400
1725	6.09	0.152	0	0.41	21.9	0	0.10	-33	3.55	275
1730	6.03	0.150	0	0.34	22	0	0.10	-36	3.54	275
1735	6.00	0.150	0	0.33	22	0	0.10	-38	3.55	275

TOTAL VOL PURGED = 2.5 GALLONS

Location St. Juliens Creek Annex Date 11/30/04
Project / Client Site 21

1800 Disposal of purge water and left SJCA to FedEx

Released

Location St. Juliens Creek Annex Date 12/01/04

Project / Client Site 21

0745 ARRIVE ON SITE. WEATHER: OVERCAST WINDY, & WARM, DAILY HIGH T = 60°
FIELD CREW: RIES & K HENDERSON
OBJECTIVE: GROUNDWATER SAMPLING AT SITES 21 & 2

0750 CALIBRATE MINIRAE 2000 TO AMBIENT AIR = 0.0 PPM & ISO BUTYLENE = 105PPM

0755 SET UP AT SJS21-MW09S
DTW = 5.57 PID = 0
CALIBRATE HORIBA
PH = 3.97 TURB = 0.5
COND = 4.5 DO = 10.78
TEMP = 14.1 SAL = 0.2
TDS = 2.9 ORP = 299

0830 COLLECT SAMPLES SJS21-MW09S-04D AND SJS21-MW09S-04D-P FOR VOCs, SVOCs, Pest/PCBs, Explosives, TOC, Nitrate, Sulfate, Ferrous Iron, & Alkalinity, Total & Dissolved Metals & Cyanide

0850 SLIGHT PETROLEUM/TCE ODOR. PID=0 SLIGHT SHEEN IN PURGE WATER. GREEN ALGAE-LIKE PARTICLES.

Location St. Juliens Creek Annex Date 12/01/04

Project / Client Site 21

SJS21-MW09S

TIME	PH	COND	TURB	DO	TEMP	SAL	TDS	ORP	DTW	FLOW
0805	6.35	0.339	219	6.63	21.8	0	0.22	-93	6.11	500
0810	6.47	0.331	144	0.42	21.9	0	0.22	-100	5.99	275
0815	6.45	0.331	74.7	0.41	22	0	0.21	-101	5.98	275
0820	6.45	0.334	38.3	0.45	21.9	0	0.22	-105	5.96	275
0825	6.44	0.333	26.7	0.51	22.0	0	0.21	-105	5.98	275

TOTAL VOL. PURGED = 3 GAL.

SJS21-MW02S

1000	5.83	0.297	259	1.88	22.8	0	0.19	95	5.31	400
1005	5.80	0.294	147	0.00	23	0	0.19	85	5.09	150
1010	5.74	0.303	96.7	0.52	23	0	0.20	78	5.08	150
1015	5.77	0.300	49.8	0.44	23	0	0.20	79	5.08	150
1020	5.75	0.300	76	0.43	23	0	0.20	76	5.08	150

TOTAL VOL PURGED = 3 GAL

Location St. Juliens Creek Annex Date 12/01/02

Project / Client Site 21

0950 Set up at SJS21-MW02S
PID = 0 DTW = 4.83 CAP 8
LOCK DOES NOT FIT

1030 COLLECT SAMPLE [SJS21-MW02S-04D]
FOR VOCS, TOC, Nitrate, Sulfate,
Ferrous Iron, & Alkalinity

1035 COLLECT SAMPLE [SJS21-MW02S-04D-P]
FOR SAME PARAMETERS AS DUPLICATE

1050 SETUP AT SJS21-MW08S
DTW = 6.21 PID = 0 IN BREATHING
ZONE 1 ABOVE NEW CASING.
RAINING

1135 COLLECT SAMPLE [SJS21-MW08S-04D]
FOR VOCs, SVOCs, Pest/PCBs,
Explosives, TOC, Total & Dissolved
Metals, Cyanide, Alkalinity,
Ferrous Iron, Nitrate, & Sulfate

1215 DISOPOSED OF PURGE WATER &
LEFT SJCA FOR LUNCH + supplies.

1300 ARRIVE AT SJCA SETUP AT
SJS21-MW01D
PID = 0 DTW = 5.02

1345 COLLECT SAMPLE [SJS21-MW01D-04D]
FOR TOTAL & DISSOLVED METALS
AND CYANIDE

Location St Juliens Creek Annex Date 12/01/04

Project / Client Site 21

SJS21-MW08S

TIME	PH	COND	TURB	DO	TEMP	SAL	TDS	ORP	DTW	FLOW
1100	5.82	0.424	54.3	0.84	22.5	0	0.28	87	6.70	300
1105	5.83	0.431	21.3	0.58	22.7	0	0.28	83	6.41	300
1110	5.81	0.430	17.4	0.52	22.7	0	0.28	84	6.51	300
1115	5.80	0.428	15.1	0.40	22.7	0	0.28	83	6.56	300
1120	5.80	0.430	16.3	0.50	22.7	0	0.28	82	6.58	300
1125	5.79	0.432	17.1	0.47	22.7	0	0.28	81	6.59	300
1130	5.79	0.431	5.2	0.42	22.8	0	0.28	83	6.62	300

TOTAL VOL PURGED = 3 GAL

SJS21-MW01D

1315	8.79	0.363	47.5	0.57	20.4	0	0.23	-153	5.44	375
1320	8.77	0.367	36.7	0.42	20.7	0	0.24	-177	5.35	300
1330	8.74	0.367	30.0	0.41	20.7	0	0.24	-185	5.39	300
1335	8.73	0.368	38.9	0.37	20.5	0	0.24	-196	5.37	300
1340	8.70	0.364	37.7	0.24	20.4	0	0.24	-204	5.28	300

TOTAL VOL. PURGED = 2.5 GAL

Location St. Juliens Creek Annex Date 12/01/04

Project / Client Sites 21 + 2

1400 - Set up @ SJS 21-MW04S.
DTW = 2.09 PID = 0

1430 - COLLECT [SJS21-MW04S-04D] FOR VOCs, TOC, Ferrous Iron, Alkalinity, Sulfate, Nitrate, & Explosives

1445 - Clean up @ SJS21-MW04S.

1505 - Set up @ SJS21-MW03S.
DTW = 5.40' btc
Minirae = 0.0 ppm

1535 - COLLECT [SJS21-FB120104] FOR VOCs, SVOCs, Pest/PCBs, Explosives, Total Metals, Cyanide, TOC, Sulfate, Nitrate, Alkalinity, Ferrous Iron

1550 - COLLECT [SJS21-MW03S-04D] FOR VOCs, TOC, SULFATE, NITRATE, ALKALINITY, FERROUS IRON

1608 - DISPOSED OF SITE 21 PURGEWATER

1625 - SET UP AT SJS02-MW01D
PID = 0 DTW = 5.80

1730 - COLLECT [SJS02-MW01D-04D] FOR VOCs, TOC, SULFATE, NITRATE, ALKALINITY, & FERROUS IRON

1800 ~~DISPOSE~~ PACKED COOLERS, DISPOSED OF PURGEWATER & LEFT SJCA TO FEDEX

Location St. Juliens Creek Annex Date 12/01/04

Project / Client Site 21

SJS21-MW04S

TIME	PH	COND	TURB	DO	TEMP	SAL	TDS	ORP	DTW	FLOW
~~1405~~ 1405	5.79	0.278	170.0	0.68	21.9	0	0.18	79	2.63	400
1410	5.53	0.277	89.8	0.37	21.7	0	0.18	75	2.56	300
1415	5.54	0.280	70.0	0.33	21.6	0	0.18	62	2.56	300
1420	5.63	0.283	70.4	0.34	21.6	0	0.18	52	2.56	300
1425	5.69	0.284	39.8	0.32	21.6	0	0.18	46	2.57	300
1430	5.72	0.286	33.2	0.45	21.4	0	0.19	43	2.52	300

TOTAL VOL. PURGED = 2.75 GAL

SJS21-MW03S

1520	6.35	0.364	19.2	0.78	22.4	0	0.24	7	6.16	375
1525	6.32	0.361	3.5	0.33	22.5	0	0.24	3	6.10	300
1530	6.30	0.362	6.4	0.30	22.5	0	0.23	1	6.09	300
1535	6.38	0.359	0.9	0.29	22.5	0	0.23	0	6.04	300
1540	6.39	0.360	1.2	0.24	22.5	0	0.23	0	5.99	300
1545	6.40	0.359	1.2	0.28	22.4	0	0.23	1	6.00	300

TOTAL VOL PURGED = 4.5 GAL

Location ST. JULIENS CREEK ANNEX Date 22-FEB 05

Project / Client SITE 4

1135 DECON EQUIPMENT

1145 COLLECT SJSØ4-SDØ4-Ø1Ø2-05A

1150 DECON EQUIPMENT

1200 COLLECT SJCA-TCLP-03, SJCA-TPH/DRO-03, SJCA-EOX-03, SJCA-VOC-03, SJCA-RIC-03

1215 COLLECT SJSØ4-SDØ5-Ø1Ø2-05A

1230 - Return to vehicle + clean up. Mob to drums to dispose of decon. H_2O.

1255 - Depart site.

1400 Packed coolers, included trip blank

Jeremy J. Conner

Location St. Juliens Creek Annex Date 3/28/05

Project / Client Site 2 + 21 GW Sampling

9:00 Arrive at Base Pass Office and attain base pass for A. Jones.

9:10 Arrive at St. Juliens. Proceed to Site 4/3 to obtain empty drums for purge water. Don from Agvig assisting with drum transport to staging area.

Weather: Rainy, mid 60's, thunderstorms scattered & very windy

Field Crew: A. Jones & R. Ives

9:30 Dropped of drum at staging area.

9:37 - Due to lightening calibrating instruments + waiting for storm to pass. Today's obj. = collect gw samples @ 4 wells + take water levels

0940 - Calibrate MiniRae. Due to lack of gas connector... unable to calibrate. MiniRae reads 0.0 ppm in ambient air + reads ~50 ppm w/ sharpie top.

0950 - Check Dräger pump for leaks. No leaks.

0952 - Calibrate Horiba U-22.

PH = 3.96 SC = 4.49 Turb = Ø DO = 9.2

Temp = 19.48 Sal = Ø.23 ORP = 344

10:00 - R. Ives conducts H&S briefing

10:10 - Arrive at SJS21-MWØ7S to take water level

Location St. Juliens Creek Annex Date 3-28-05

Project / Client Site 2 & 21 GW sampling

10:27 Water level = 1.56' BTC. Note - unable to get ~~lock~~ cap off SJS21-MW07S. Had to remove 6" PVC connection & replace. Needs new cap. Mini rae not functioning properly, possibly due to high humidity.

10:33 Water level at SJS02-MW02D = 4.02' BTC. mini rae reads 6 initially but climbing, malfunctioning. Note: Replaced lock

11:08 Attempted to take water level at SJS02-MW01D but unable to get cap off. Proceeding to MW10D and will try SJS02-MW01D again later. Water level at SJS02-MW10D = 6.62' BTC

11:18 Set up at SJS02-MW07S
Water level = 1.36' BTC

11:29 Begin purging well

11:56 Collect field blank SJS21-FB032805 for VOCs

12:00 Collect GW sample SJS21-MW07S-05A for VOCs. Collected ms/msd at this location. Note: Well needs new cap.

12:20 Set up at SJS02-MW02D
DTW = 4.19'

12:25 Begin purging well

1300 Collect GW sample SJS02-MW02D-05A for VOCs

Location St. Juliens Creek Annex

Project / Client

SJS21-MW07S

Time	pH	cond.	Turb.	DO	Temp.	SAL	TDS	ORP	DTW	Flow
1130	5.46	0.161	70.7	0.0	13.5	0.01	0.10	200	1.83	400
1135	5.68	0.152	54.0	0.0	13.6	0.01	0.10	127	1.78	375
1140	5.73	0.157	32.2	0.0	13.8	0.01	0.10	98	1.78	375
1145	5.75	0.162	31.0	0.0	13.8	0.01	0.11	92	1.75	375
1150	5.75	0.170	31.2	0.0	13.8	0.01	0.11	87	1.74	375
1155	5.77	0.175	21.9	0.0	13.9	0.01	0.11	81	1.74	375

Total vol = 3 gal.

SJS02-MW02D

Time	pH	Cond.	Turb.	DO	Temp.	Sal.	TDS	ORP	DTW	Flow
1230	6.33	0.467	48.9	0.28	17.22	0.02	0.30	-38	4.29	400
1235	6.99	0.465	149.0	0.0	17.37	0.02	0.30	-85	4.3	400
1240	7.19	0.463	170.0	0.0	17.41	0.02	0.30	-97	4.32	400
1245	7.27	0.461	104.9	0.0	17.37	0.02	0.30	-102	4.3	400
1250	7.31	0.460	33.5	0.0	17.39	0.02	0.30	-106	4.32	400
1255	7.34	0.457	24.6	0.0	17.4	0.02	0.30	-108	4.32	400

Total vol = 3 gal

Location St. Juliens Creek Annex Date 3/28/05

Project / Client Site 2 & 21 GW Sampling

1305 Collect Duplicate GW sample [SJS02-MW02D-05A-P] for VOCs

1310 Went back to SJS21-MW01D and was able to get cap off well.

1315 Left St. Js for lunch

1355 Set up at SJS02-MW01D
DTW = 5.17' BTC

1400 Begin purging SJS02-MW01D
Try mini rae again, still not functioning properly.

1440 - Collect gw sample [SJS02-MW01D-05A] for VOCs.

1445 - Set up at SJS02-MW10D
DTW = 6.55' BTC

1450 - Begin purging SJS02-MW10D
note - bail at 1500

1540 - Collect gw sample [SJS02-MW10D-05A2] for VOCs

1545 - Collect Equipment Blank [SJS02-EB032805] for VOCs

1555 - Mob to drums & dispose of purge water

1600 - Leave Site to ship cooler.

Location St. Juliens Creek Annex Date 3/28/05

Project / Client Site 2 & 21 GW Sampling

SJS02-MW01D

Gal purged = 2.5

Time	pH	Cond.	Turb	DO	Temp	Sal	TDS	ORP	DTW	Flow
1405	7.5	0.284	10.7	7.4	16.40	0.01	0.18	127	5.22	375
1410	7.41	0.285	9.5	3.44	16.70	0.01	0.19	113	5.21	375
1415	7.6	0.296	11.3	2.02	16.73	0.01	0.20	-51	5.22	375
1420	7.87	0.306	37.1	Ø	16.80	0.01	0.24	-102	5.22	375
1425	7.93	0.370	69.1	0.0	16.80	0.02	0.24	-116	5.22	375
1430	7.95	0.375	103	0.0	16.7	0.02	0.24	-124	5.22	375
1434	7.96	0.374	113	0.0	16.6	0.02	0.24	-126	5.23	375

SJS02-MW10D

Gal purged =

Time	pH	Cond.	Turb.	DO	Temp	Sal	TDS	ORP	DTW	Flow
1450	7.64	0.400	1.0	0.0	17.30	0.02	0.26	-183	7.18 ~~6.78~~	400
1455	7.64	0.359	3.9	0.0	17.19	0.02	0.24	-214	7.19	375
1500	7.05	0.401	19.4	0.0	17.08	0.02	0.26	-243	7.19	375
1505	7.87	0.387	25.6	0.0	17.04	0.02	0.25	-250	7.19	375
1510	8.05	0.387	31.9	0.0	17.05	0.02	0.25	-251	7.19	375
1515	8.13	0.387	20.9	0.0	17.24	0.02	0.25	-250	7.19	375

continued on p. 104

Location SJCA Date 11/4/05

Project / Client Basewide well repair and abandonment

SJS21-MW11S, SJS21-MW03S, SJS21-MW08S, SJS21-MW02S, SJS21-MW09S, and SJS21-MW01S.

1330 lay top soil, seed, and hay at site & abandoned wells, asphalt patch SJS08-MW01S.

1430 P. Wolff conducts housekeeping at staging area.

1500 P. Wolff offsite

1515 CH2M Hill offsite

Location SJCA Date 11/7/05

Project / Client Site 21 Temporary and Permanent Well Installation

1145 P. Wolff and USA Environmental onsite

Field Activities: Install 3 temporary wells and two permanent wells

Field Crew: C. White > CH2M Hill
M. Ost
G. Ellingworth > P. Wolff
J. Love
N. Figeac > USA Env.
A. Litviak

Weather: sunny, high 70°F

1200 Conduct H&S briefing

1210 Calibrate multiRae

Fresh Air: VOC 0.0
LEL 0
OXY 20.9

Isobutylene: VOC: 99.9 ppm

Methane: LEL: 50

1217 Begin drilling TW127

1223 VOC: 0.0
LEL: 0
OXY: 20.2

1242 TW127 installed to 20' bgs, screened to 5' bgs

(CW)

Location SJCH Date 11/7/05

Project / Client Site 21 Temporary and Permanent well installation

1302 Begin drilling TW125
1305 VOC: 0.0
LEL: 0
OXY: 20.2
} downhole 2' bgs
1317 VOC: 0.0
LEL: 27
OXY: 16.7
} downhole 10.0' bgs
1327 TW125 installed to 20.0' bgs, Screeded to 5' bgs
1347 Begin drilling TW126
1352 VOC: 0.0
LEL: 19
OXY: 19.1
} downhole 2' bgs
1408 VOC: 0.0
LEL: 86
OXY: 19.1
} downhole 12' bgs
1415 TW126 installed to 20.0' bgs, Screened to 5' bgs.
1440 P. Wolff decon and prepare to install permanent well, retrieve water for well installation
1520 Begin DPT soil sampling at SJS21-SB05

Location SJCH Date 11/7/05

Project / Client Site 21 Temporary and Permanent well installation

0-4' Multi Lae downhole
VOC: 3.4 LEL: 4 OXY: 19.2
BZ VOC 0.0 LEL 0 OXY 20.9
3.0' recovery
0.0-0.3' asphalt
0.3-1.0 no recovery
1.0-1.5' gravel (fill), GP, dry, very dense.
1.5-1.8 medium SAND, trace clay (SC), trace shell fragments, dry, med. dense. 2.5Y 4/1 dark gray
1.8-2.2 SILT, trace fine sand (ML), dry, very dense 2.5Y 2.5/1 black
2.2-~~4.0~~ 3.8' layer SILT (SC), moist, med. dense, 2.5Y 4/1 dark gray.
3.8-4.0 silty fine SAND (SM), moist, med. dense, 2.5Y 5/1 gray
4-8' ~~4.0'~~ recovery. 3.2'
4.8-5.0' Same as above
5.0-5.2' Clean fine SAND (SP), saturated, med. dense, 2.5Y/7/2.

Location SJCA Date 11/7/05

Project / Client Site 21 Temporary and Permanent well installation

light gray.

5.0-8.0' silty fine sand (SM), saturated, med. dense, 2.5Y 6/2 light brownish gray, trace mottling

1545 collect soil sample. SJS21-SB05-00-05D
1 X TCL VOC from 5-7' bgs

8.0-12.0' no recovery, move over and try to retrieve sample.

1615 begin coring at SJS21-SB06

1623 retrieve 8-12' core from SJS21-SB05 downhole

VOC: 0.0 LEL: 0 OXY 20.5
BZ: VOC 0.0 LEL 0 OXY 20.9

4.2' recovery.

8.8-12.0' same as above,

12-14 recovery 3.5' 12.5 14.5'

color change at 10.0' 10YR 6/6

~~12.0-16.0'~~ silty fine SAND (SM), trace med. sand, saturated, dense, 2.5Y 4/1 dark gray.

14.5'-16' clay, (CH), saturated, dense, GLEY 1 4/5G, dark greenish gray.

1645 collect sample ID SJS21-SB05-01-05D
1 X VOC from 12.5-14.5' bgs

(cw)

Location SJCA Date 11/7/05

Project / Client Site 21 Temporary and Permanent well Installation

1650 collect sample ID SJS21-SB05-02-05D
1 X VOC from 14.5'-16' bgs.

1655 Begin augering SJS21-MW125, will set well at 15' bgs, screen to 5' bgs.

1710 augering complete, begin installing well.

1810 well installation complete, will form concrete pad tomorrow

1830 abandon temporary wells, TW125 and TW126.

1850 steam clean augers and DPT equipment.

1950 Coring complete, will remove concrete from hole.

2010 Begin DPT soil sampling at SJS21-SB06

0.0-4.0 8" recovery. due to subbase gravel below floor

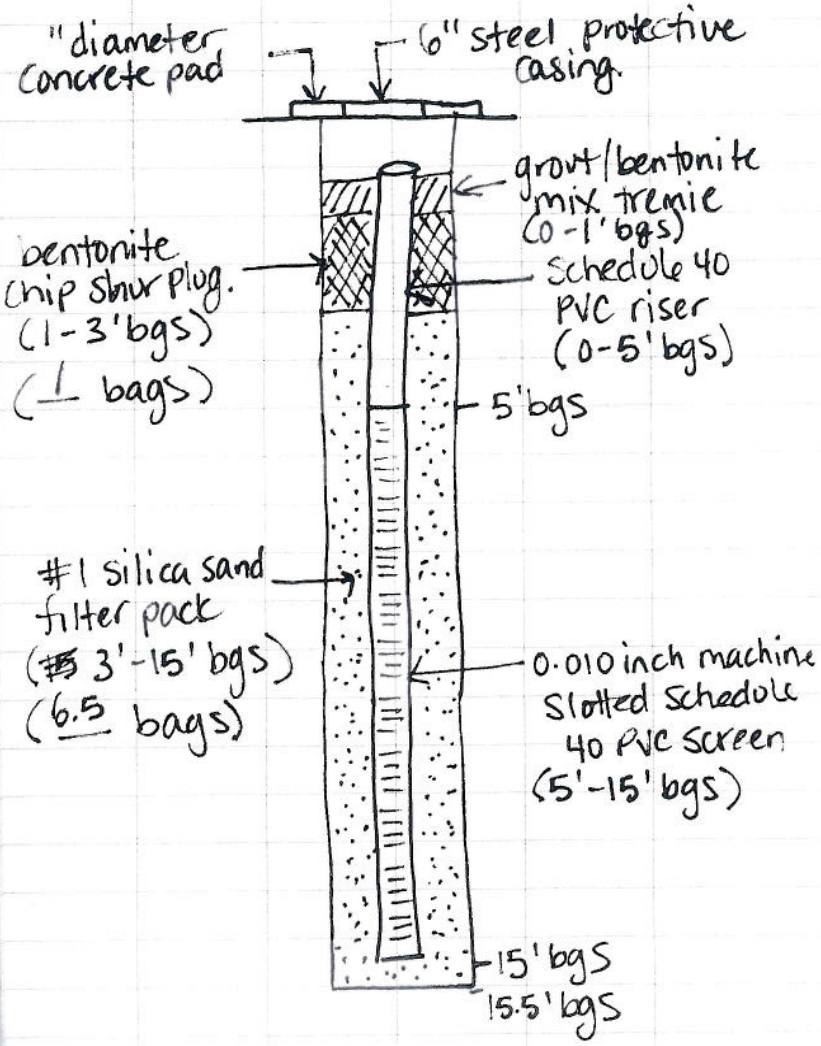
3.2-4.0' med SAND, some fine sand and gravel (SW), dry, med dense, 2.5Y 3/2 very dark grayish brown.

(cw)

Location SJCA Date 11/7/05

Project / Client Site 21 Temporary and Permanent Well Installation

SJS21-MW12S



Location SJCA Date 11/7/05

Project / Client Site 21 Temporary and Permanent Well Installation

4.0-8.0' downhole BZ VOC 0.0 LEL 0 OXY 20.2
VOC 0.0 LEL 0 OXY 20.1
2.5' recovery.
5.5-7.0' silty fine SAND (SM), trace clay, moist, med. dense, 2.5Y 5/3 light olive brown
7.0-8.0 clean med SAND, some fine SAND (SP), med. dense, 2.5Y 7/2 light gray
8.0-12.0 down hole
VOC 0.0 LEL 0 OXY 19.3
BZ VOC 0.0 LEL 0 OXY 20.9
3.5' recovery.
8.5-12.0' med to fine SAND, trace silt (SM), moist to 10' saturated from 10-12' 2.5Y 6/4, light yellowish brown
- color change at 11.0' 10YR 5/6 yellowish brown
2035 collect sample ID SJS21-SB06-00-05D
1x TCL VOC from 9-11' bgs.
12-16' downhole
VOC 0.0 LEL 0 OXY 20.6

Location SJCA Date 11/7/05

Project / Client Site 21 Temporary and Permanent Well Installation

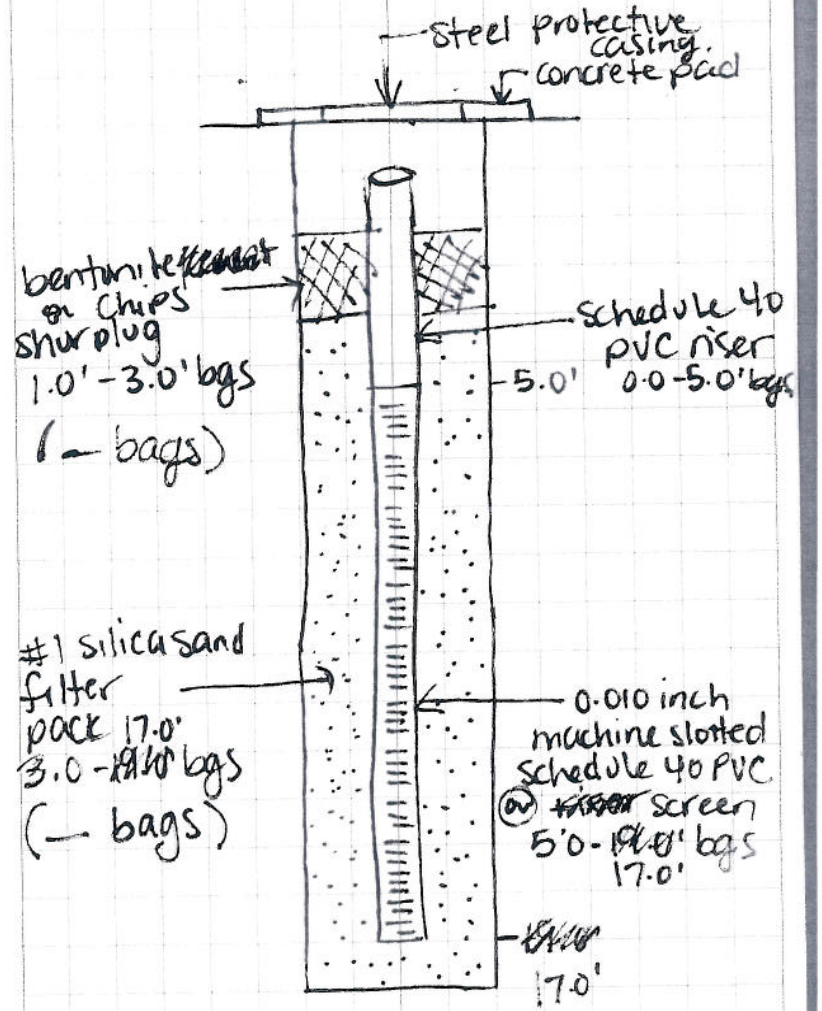
BZ VOC 0.0 LEL 0.0 OXY 20.9
3.0' recovery
13.0' - 14.5' same as above
14.5-15' fine SAND (SM) Some Silt, Saturated, very dense. 5Y 5/1 gray
15'-16' med SAND, Some fine sand and silt (SW), Saturated, very dense 5Y 5/1, gray.
16-20' 4' recovery.
16-18.5' CLAY, med. dense, moist, GLEY 1 4/5G, dark greenish gray.
18.5-19.5 med. SAND, trace fine sand + silt, moist med dense 5Y 5/1, gray
19.5-19.7 peat layer
19.7-20.0 CLAY, very dense, moist GLEY 1 4/5G, dark greenish gray.
2055 Begin augering for SJS21-MW13S.
2057 collect sample ID SJS21-S006.01-0501 1x TCL VOC from 14-16' bgs

CW

Location SJCA Date 11/7/05

Project / Client Site 21 Temporary and Permanent Well Installation

SJS21-MW13S



Location SJCA Date 11/7/05

Project / Client Site 21 Temporary and Permanent Well Installation

2102 Collect sample ID SJS21-SB06-02-050 1 x TCL VOC from 16-18' bags.

2240 well installation complete, perform general housekeeping

2330 off base

Leave blank

Location SJCA Date 11/8/05

Project / Client Site 21 Well Installation and Basewide Repair

0720 On Site

Field Activities: complete well repair, develop wells at Site 21

Field Crew: C. White
G. Ellingworth > P. Wolff
J. Love

Weather: sunny, high 65°

0730 P. Wolff decoring augers and DPT equipment.

0815 Decon complete, depart base to return coring equipment and repair well at Little Creek.

0930 will not repair at Little Creek back on base at SJCH

0936 SJS02-MW02S, fix flip top.

0945 SJS02-MW13S, remove rust from swivel top.

0947 SJS02-MW12S, replace O-rings

1002 SJS04-MW03D, replace hinge

1015 SJSBK-MW06S, cleared, replaced O-rings, cut PVC

(CW)

Location SJCA Date 11/8/05

Project / Client Site 21 Permanent Well Installation and Basewide Repair

1030 SJSBK-MW01S + SJSBK-MW01D, remove wood base.

1033 SJSB-MW07S already clear

1035 SJS05-MW05S, straighten bollard, remove wood base.

1115 Arrive at Site 21 to replace o-rings in wells SJS21-MW01D, SJS21-MW04S, SJS21-MW06S, SJS21, MW07S, SJS21-MW10S and SJS21-MW05S, cut PVC at MW05S and MW07S

1143 SJSBK-MW03S and SJSBK-MW03D remove wood base.

1150 SJSBK-MW08S and SJSBK-MW08D remove wood base

1200 off base to retrieve supplies

1300 on base

1320 finish replacing hinge at SJS04-MW03D

1335 SJS05-MW04S and SJS05-MW04D, cleared.

1345 SJS05-MW03S, cleared, hinge replaced.

1408 set up to develop SJS21-MW12S

1412 Begin purging (CW)

Location SJCA Date 11/8/05

Project / Client Site 21 Permanent Well Installation and Basewide Repair

Time	pH	COND	TURB	DO	TEMP	SAL	ORP
~~1412~~ 1420	7.12	0.215	999.0	6.31	23.70	.01	84
1430	6.24	0.175	999.0	4.46	22.68	.01	90
1440	6.06	0.167	573.0	3.78	22.26	.01	95
1450	6.01	0.162	927.0	4.04	21.75	.01	89
1455	6.04	0.166	793.0	3.24	22.48	.01	81
1500	6.09	0.159	487.0	3.82	21.78	.01	84
1505	6.04	0.159	853.0	4.40	21.51	.01	91
1510	6.04	0.157	444.0	4.35	21.52	.01	91
1515	6.02	0.157	278.0	3.16	21.66	.01	85
1520	6.07	0.157	315.0	4.03	21.72	.01	80

1522 development complete. approximately 95 gallons purged.

1607 set up to develop SJS21-MW13S

1610 Begin purging

Time	pH	COND	TURB	DO	TEMP	SAL	ORP
1615	6.24	0.441	673.0	4.86	23.16	.02	57
1620	6.34	0.441	848.0	4.26	23.21	.02	37
1625	6.35	0.451	214.0	3.78	23.11	.02	38
1630	6.36	0.451	323.0	3.94	23.12	.02	37
1635	6.37	0.438	655.0	4.63	23.20	.02	40
1640	6.32	0.446	479.0	3.89	23.22	.02	40
1645	6.40	0.451	283.0	3.77	23.05	.02	33

(CW)

Location SJCA Date 11/8/05

Project / Client SITE 21 Permanent Well Installation and Basewide Repair

Time	pH	COND	TURB	DO	TEMP	SAL	ORP
1650	6.40	0.439	123.0	3.34	23.14	0.02	30
1655	6.41	0.450	82.4	3.74	23.02	.02	28
1700	6.40	0.438	410.0	4.39	23.13	.02	34
1705	6.44	0.437	109.0	4.23	23.20	.02	25
1710	6.44	0.446	48.0	4.22	23.13	.02	22

1715 development complete
approximately 90 gallons purged.
1720 concrete holes left from SJS21-TW105 filled.
1730 stage drums,
2 soil
7 aqueous
1740 offbase

Location SJCA Date 12/01/05

Project / Client Site 21 Temporary + Monitoring Well Survey; Basewide Repair Survey

0800 - Arrive @ pass office to obtain passes + meet surveyors.
0830 - Arrive on-site.
F. Crew - R. Ives + C. White
Surveyors - George
Kyle of MSA.
Weather - Cold, T= 50°F, partly cloudy, breezy
Objectives - Survey temporary wells @ Site 21 + new MW locations. Also survey new PVC elevations @ SJS21-MW05S, SJS21-MW07S, SJS04-MW03S, SJS04-MW01S SJS05-MW02S,
0835 - R. Ives conducts H+S tailgate.
0840 - Drive around base to show surveyors well locations.
0910 - Go inside old SEMA Building #1556 ~~for~~ to show drillers locations of wells inside Bldg.
0920 - Spray paint + flag well locations. MSA begins setting up.
1036 depart site

Location St. Juliens Creek Annex Date 11/20/06
Project / Client Site 4 Well Redevelopment & Site 21 PDB Sampling

1115 - Arrive at Site 4
Field Crew - A. Jones, D. Livingston } HILL
Weather - Sunny, clear, breezy,
Objective - Redevelop select Site 4 monitoring wells & Collect PDB sample at Site 21.
1123 - Conduct Health & Safety tailgate: COCs, Snakes, slips, trips, & falls. Sign HASP.
1125 - Begin building secondary containment area within Site 4 gated area, on gravel road.
1150 - Set up at SJS21-MW13S to collect PDB sample for VOCs.
1205 - Collect groundwater sample [SJS21-DW105-060] & duplicate gw sample [SJS21-DW105P-060D]
1206 - Collect fieldblank for SJS21-MW13S by pouring DI water into sample bottles inside building [SJS21-FB112006-I] for VOCs.
1215 - Collect equipment blank [SJS21-EB112006-P] for VOCs by pouring DI water over PDB
1220 - Pick up pallet for Site 4 staging area from Site 2 staging area.
1225 - Off site to buy ice & eat lunch.
1315 - Arrive back at Site 4. Set up to develop SJS21-MW01S, using surge & purge method.

— aj —

Location St. Juliens Creek Annex Date 11/20/06
Project / Client Site 4 Well Redevelopment

1330 - Initial DTB = 16.00' btoc
Initial DTW = 2.55' btoc
~~13 - Begin purgin~~ aj 3 well vol = 6.85 Gal.
1332 - Begin surging well with surge block
1335 - Calibrate Horiba U-22 (# 100900) w/ Auto Cal Solution (Lot # 5368, Exp. 8/03/2007)
pH = 3.98
Cond = 4.48 ms/cm
Turb = 0.1 NTU
Temp = 19.50
1345 - Begin purging [SJS21-MW01S]

Time	pH	Cond	Turb	DO	Temp	Sal	ORP	vol
1347	4.78	0.558	57.5	12.12	16.19	0.02	32	—
1357	5.58	0.558	172.0	11.89	16.70	0.02	-31	~12 Gal

*1402 - Well dry, will allow to recharge before purging
1424 - Begin purging again, well recharged to DTW ~8' btc

1426	5.80	0.597	74.0	13.29	15.11	0.02	51	—
1433	5.98	0.637	403	12.15	16.01	0.03	48	~20 Gal

1437 - Well dry, will allow to recharge before purging again

1510	6.12	0.597	494	12.97	15.23	0.02	86	—
1515	6.17	0.666	188	13.12	15.21	0.03	62	27 Gal
1520	6.23	0.666	594	12.21	15.39	0.03	23	

1523 - Well dry

1547	6.38	0.637	302	13.04	15.39	0.03	11	~40 Gal

— aj 11/20/06 —

Location St. Juliens Creek Annex Date 11/20/06
Project / Client Site 4 Well Redevelopment

SJS21-MW01S (cont.)

Time	pH	Cond	Turb	DO	Temp	Sal	ORP	Vol.

1552 - Well dry ~50 Gal purged
1600 - Pump purge water at staging area
1620 - Off site to ship cooler.
* Note: DTB =

Adriana Jones
11/20/06

Location St. Juliens Creek Annex Date 11/20/06
Project / Client Site 4 Well Redevelopment

0858 Arrive at Site 4
Field Crew - A. Jones, D. Livingston > HILL
Weather - overcast, windy, 45°F
Objective - Finish redeveloping select wells at Site 4.

0900 Conduct H&S Briefing: Cold stress, snakes, slips, trips, & falls.

0909 Calibrate Horiba U-22 (# 100900) w/ Auto Cal Solution (Lot # 53168, Exp. 8/3/07)
pH = 3.97
Cond = 4.59 ms/cm
Turb = -0.6 NTU
~~DO~~ Temp = 7.48

0911 Set up at SJS21-MW04S
DTB = 16.1' btc
DTW = 4.92' btc
3 well vol = 5.46 Gal

0915 Begin surging well * Water very clark
0925 Begin purging well SJS21-MW04S

Time	pH	Cond	Turb	DO	Temp	Sal	ORP	Vol.

0935 - Well dry, will allow to recharge, surge, & cont. purging
1010 - Begin purging again, water appears murky

AJ 11/20/06

Appendix E
Storm Sewer System Video Inspection TM

Site 21 – Storm Sewer System Video Inspection, St. Juliens Creek Annex, Chesapeake, Virginia

PREPARED FOR: SJCA Tier 1 Partnering Team

PREPARED BY: CH2M HILL /VBO

DATE: March 21, 2007

Introduction

The purpose of this memorandum is to summarize the results of the video inspection of the storm sewer system conducted at St. Juliens Creek Annex (SJCA) Site 21, and to present recommendations for further action. The inspection was conducted to achieve the following objectives:

- Evaluate the potential for transport and release of chlorinated volatile organic compounds (CVOCs) from shallow groundwater through the adjacent storm sewer system.
- Ensure existing damage to the storm sewer system will not adversely affect groundwater treatment.

Site Description

Site 21 is located in an industrial area in the central portion of SJCA. The area consists mostly of asphalt roadways and parking lots and contains several active buildings, which are used primarily for warehousing and storage operations. Buildings at Site 21 were historically used for machine, vehicle, and locomotive maintenance; electrical shops; and munitions loading. Railroad tracks were present throughout the industrial area and a fuel service station was located in the vicinity. Waste oils and degreasers were reportedly disposed on the ground surface and former railroad tracks and adjacent to building foundations in the industrial area. A CVOC groundwater plume has been identified in the shallow groundwater at the site. In addition, CVOCs have been detected in the storm sewer systems passing through Site 21, indicating that leaks may be present and providing a pathway for groundwater contaminants to enter the storm sewer system. The storm sewer system is located approximately 3.5 to 6 feet (ft) below ground surface (bgs). Shallow groundwater at Site 21 is generally encountered at 2 to 7 ft bgs. The drainage area feeding to the storm sewer system is unknown. It discharges to the tidal wetland at Site 2 and is controlled by the elevation of the surface water at the outlet; sections of the storm sewer system near the outfall often contain standing water.

Figure 1 presents a layout of Site 21 including the storm sewer system and the manhole and drop inlet identification numbers of the portion of the line that was inspected.

Storm Sewer System Video Inspection Activities

Tri-State Utilities conducted the video inspection of the storm sewer system using closed circuit television (CCTV) on the following dates: October 12, 2006, December 19 and 20, 2006, and January 17, 2007. A total of 1,127 ft was surveyed. There was no precipitation on any of the days during which the video inspection was conducted. Low flow was observed within the storm sewer system, likely a sign of upgradient groundwater infiltration. The flow was not sufficient to negatively impact the video inspection and did not need to be blocked.

In order to provide sufficient visibility to perform the inspection, the interior of the pipe was cleaned. With SJCA Facilities Operations approval, Tri-State obtained water from a site fire hydrant to fill a tanker truck. A hose from the truck was then inserted into the storm sewer line to clean the pipe using hydraulic pressure. Accumulated sediment was washed toward the outfall as the video inspection progressed. Sediment was analyzed and characterized as non-hazardous. Potomac Environmental, Inc. removed the built up sediment with a vacuum truck and transported it to an off-site disposal facility. In total, 6,750 gallons of water and sediment were collected and disposed at the Chesapeake Facility of Soilex Corporation.

Following clearing of each section of pipe, the video inspection was performed. A remotely controlled video camera was lowered into the storm sewer system at a manhole/drop inlet. The video technician viewed the video as the camera traversed through the storm sewer system and recorded damage in an observation log (Attachment A). The sections of the storm sewer system inspected are summarized in Table 1.

TABLE 1
Summary of Storm Sewer System Sections Inspected

Start	End	Distance (ft)	Pipe Description
DI-1	DI-2	79.1	24” RCP
DI-2	DI-3	112.1	30” RCP
DI-3	MH-4	191.0	30” RCP
MH-4	DI-5	30.4	30” RCP
DI-5	DI-6	213.8	29”x45” RCP
DI-7	DI-6	62.8	12” RCP
DI-7	DI-8	15.9	12” VCP
DI-6	MH-9	114.2	29”x45” RCP
MH-9	MH-10	76.9	29”x45” RCP
DI-11	MH-10	40.4	24” RCP
MH-10	MH-12	81.7	29’x45” RCP
MH-12	Outfall	108.3	29”x45” RCP

DI: Drop Inlet
MH: Manhole
RCP: Reinforced Concrete Pipe
VCP: Vitrified Clay Pipe

Table 2 presents a summary of damage identified within each section of the storm sewer system. Damage locations are identified by the distance from the start of the section surveyed. Damage severity is ranked on the following scale: light, moderate, average,

heavy, and severe. The level of severity is subjective and is based on the experience of the Tri-State Utilities video technician. Images from each section of the storm sewer system inspection are included as Attachment B. A DVD of the video inspection is available if requested but is not included with this technical memorandum.

TABLE 2
Video Inspection Results Summary

Start	End	Damage Location Distance from Start of Section (ft)	Damage[1] and Severity
DI-1	DI-2	7.0	Multiple 3-ft long (longitudinal) cracks. Light.
		9.3	Infiltration weeper and stain. Light.
		17.2	Infiltration stain. Light.
		25.3	Infiltration stain. Light.
		41.6	Infiltration stain. Light.
		49.7	Broken pipe. 1'x1' and infiltration stain. Light.
		57.9	Infiltration stain. Light.
		66.0	Joint separated. 4" exposed gasket. Light.
DI-2	DI-3	2.0	6"x1' deposits attached to pipe. Moderate.
		7.0	Infiltration stain 1'x1' Light.
		8.8	Longitudinal cracks. 3' Light.
		13.4	Infiltration weeper. Moderate.
		21.1	Longitudinal crack 3' Light.
		21.4	Infiltration weeper. Moderate.
		29.6	Infiltration weeper. Light
		38.1	Infiltration weeper. Light.
		46.4	Infiltration weeper. Light
		70.1	Infiltration runner. Light
		94.3	Multiple Cracks 2'x2' and infiltration weeper. Light
		102.3	Infiltration stain. Light.
DI-3	MH-4	9.0	Circular crack with infiltration. Moderate.
		12.3	Longitudinal crack. Light.
		16.4	Circular Crack with light infiltration. Light.
		72.9	Circular crack. Light.
		97.1	Broken pipe at joint. Light.
		137.3	Circular crack. Light.
		177.6	Infiltration weeper. Light.
		183.2	Longitudinal cracks. Light.
MH-4	DI-5	8.9	Circular crack. Light
		9.1	Infiltration weeper. Light.
DI-5	DI-6	12.7	Deposits attached 6"x2'. Moderate.
		28.7	Infiltration weeper. Light.
		133.2	Signs of infiltration. Moderate.
		141.7	Signs of infiltration. Light.
		150.0	Signs of infiltration. Light.
		165.8	Signs of infiltration. Light.
		173.5	Deposits attached 1'x1'. Light.
		173.7	Signs of infiltration. Light.
DI-7	DI-6	33.2	Joint offset 1". Moderate.

TABLE 2
Video Inspection Results Summary

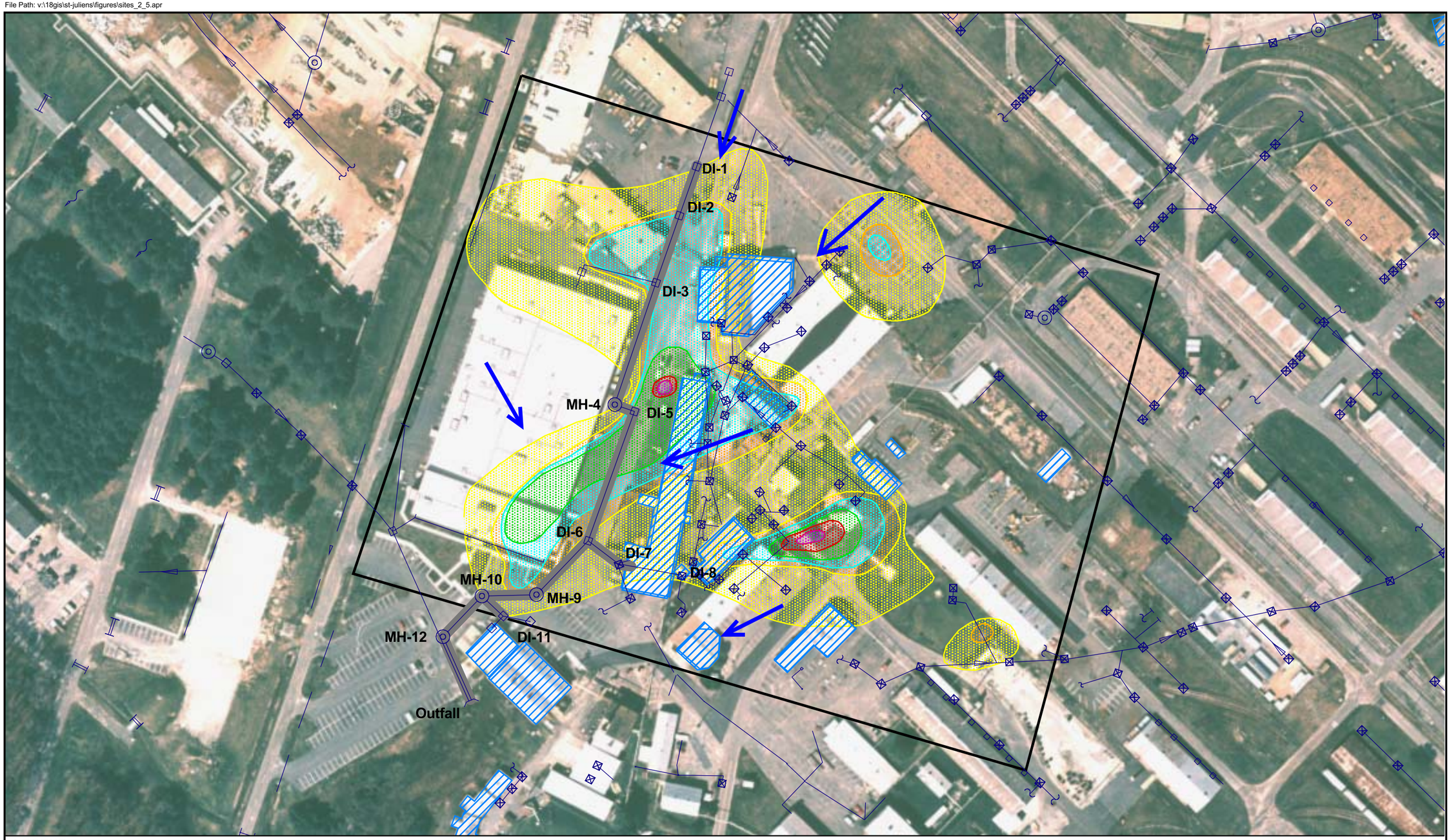
Start	End	Damage Location Distance from Start of Section (ft)	Damage[1] and Severity
DI-7	DI-8	3.0 11.7 15.6 15.9	Fractures 12”. Moderate. Fractures 7”. Moderate. Decrease in pipe size. Moderate. Inspection abandoned; pipe collapsed.
DI-6	MH-9	32.7 40.8	Signs of infiltration. Light. Signs of infiltration. Light.
MH-9	MH-10	33.3 48.8 56.5	Signs of infiltration. Light. Exposed gasket 6”. Light. Slight joint offset. Light.
D-11	MH-10	Not applicable	No damage to section.
MH-10	MH-12	61.7 70.2	Infiltration weeper. Infiltration runner.
MH-12	Outfall	16.2 24.2 102.8	Infiltration runner. Infiltration runner. Roots in Joint. 3’x3’.

DI: Drop Inlet
MH: Manhole
[1] Damage Nomenclature:
Weeper: fluid infiltration with no significant flow or dripping
Runner: solid stream of fluid flow
Deposits: chemical or mineral deposits on pipe wall (not sampled)
Infiltration stain: discoloration of the pipe surface by infiltrating fluids; no flow at time of observation

Conclusion and Recommendation

The video inspection indicates that the storm sewer system is in fair condition with light to moderate signs of infiltration at the cracks and joints. Therefore, the storm sewer system is providing a potential transport mechanism for CVOCs in shallow groundwater to the Site 2 inlet to St. Juliens Creek. However, because the damage identified in the sections of the storm sewer system passing through the area of groundwater contamination is classified as light to moderate it is not expected to negatively impact groundwater remediation. Additionally, shallow groundwater flow is generally towards the storm sewer system (Figure 1) and repair of the system may alter the shallow groundwater flow direction, causing contaminant migration further west, under Building 1556. Therefore, it is recommended that no repairs be made to the storm sewer system at Site 21.

File Path: v:\18gis\st-juliens\figures\sites_2_5.apr



LEGEND

- Stormwater System
- Site 21 Boundary
- Demolished Buildings
- Video Survey Location
- Manhole (MH)
- Drop Inlet (DI)
- Estimated Groundwater Flow Direction
- TCE Concentration 1 - 25
- TCE Concentration 1000 - 4999
- TCE Concentration 26 - 49
- TCE Concentration 50 - 999
- TCE Concentration 5000 - 9999
- TCE Concentration >= 10,000

N

0 150 300 Feet

Figure 1
Video Inspection Location
Site 21 Storm Sewer System
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Attachment A

POSM
PIPELINE OBSERVATION SYSTEM MANAGEMENT

Session Name	Date	Location	Manhole Numbers	Size
- 20799/ ST. JULIENS CREEK ANNEX	12/20/2006 3:41:14 PM	ST. JULIENS CREEK, CHESAPEAKE	DI 11 To MH 10	52.0 MB
- 20799/ ST. JULIENS CREEK ANNEX	12/20/2006 11:19:02 AM	ST. JULIENS CREEK, CHESAPEAKE	MH 9 To MH 10	168 MB
- 20799/ ST. JULIENS CREEK ANNEX	12/20/2006 9:22:21 AM	ST. JULIENS CREEK, CHESAPEAKE	DI 6 To MH 9	228 MB
- 20799/ ST. JULIENS CREEK ANNEX	12/20/2006 8:54:44 AM	ST. JULIENS CREEK, CHESAPEAKE	DI 7 To DI 6	54.5 MB
- 20799/ ST. JULIENS CREEK ANNEX	12/20/2006 8:44:58 AM	ST. JULIENS CREEK, CHESAPEAKE	DI 7 To DI 8	51.0 MB
- 20799/ ST. JULIENS CREEK ANNEX	12/19/2006 11:18:39 AM	ST. JULIENS CREEK, CHESAPEAKE	DI 5 To DI 6	408 MB
- 20799/ ST. JULIENS CREEK ANNEX	12/19/2006 9:57:17 AM	ST. JULIENS CREEK, CHESAPEAKE	MH 4 To DI 5	65.3 MB
- 20799/ ST. JULIENS CREEK ANNEX	12/19/2006 8:36:06 AM	ST. JULIENS CREEK, CHESAPEAKE	DI 3 To MH 4	173 MB
- 20799/ ST. JULIENS CREEK ANNEX	10/12/2006 10:26:05 AM	ST. JULIENS CREEK, CHESAPEAKE	DI 2 To DI 3	164 MB
- 20799/ ST. JULIENS CREEK ANNEX	10/12/2006 9:49:32 AM	ST. JULIENS CREEK, CHESAPEAKE	DI 1 To DI 2	121 MB
20799/ ST. JULIENS CREEK ANNEX	01/17/2007 13:08	PORTSMOUTH, VIRGINIA	MH 12 To OUTFALL	132 MB
20799/ ST. JULIENS CREEK ANNEX	01/17/2007 10:36	PORTSMOUTH, VIRGINIA	MH 10 To MH 12	143 MB

Summary Reports
All Sessions

You may need to download Divx to view Video clips
http://www.divx.com

20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

10/12/2006 9:49:32 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE ,
VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	1
		Pipe Name	24 INCH RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	79.1
Comments	PRE TV. T.L.L. 80'		

Pipe Information	
Pipe Name	24 INCH RCP
Type Of Pipe	RCP
Size Of Pipe	24 INCH

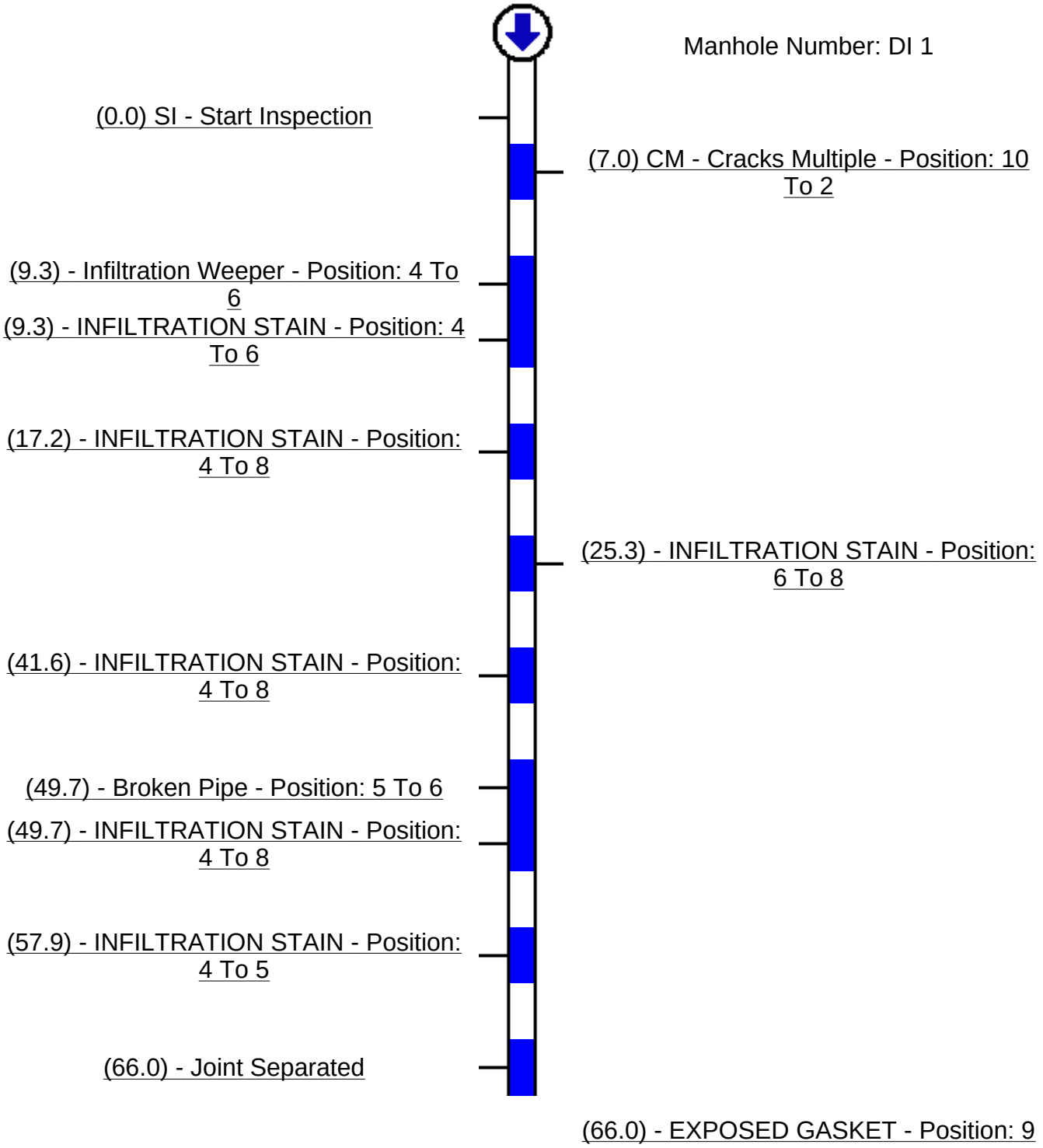
Manhole Information			
Start Manhole Number	DI 1	**End Manhole Number**	DI 2
SMH Depth	5.0	**EMH Depth**	5.2
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	PLUGGED	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 10/12/2006 9:49:32 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 79.1
Run Number: 1

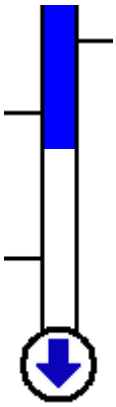
Start Manhole Number: DI 1
End Manhole Number: DI 2
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe



To 3

(66.0) - INFILTRATION STAIN - Position: 3 To 9



(79.1) EI - End Inspection

Total Distance: 79.1

Manhole Number: DI 2

20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

10/12/2006 10:26:05 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE ,
VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	2
		Pipe Name	30 INCH RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	112.1
Comments	PRE TV. T.L.L. 114'		

Pipe Information	
Pipe Name	30 INCH RCP
Type Of Pipe	RCP
Size Of Pipe	30 INCH

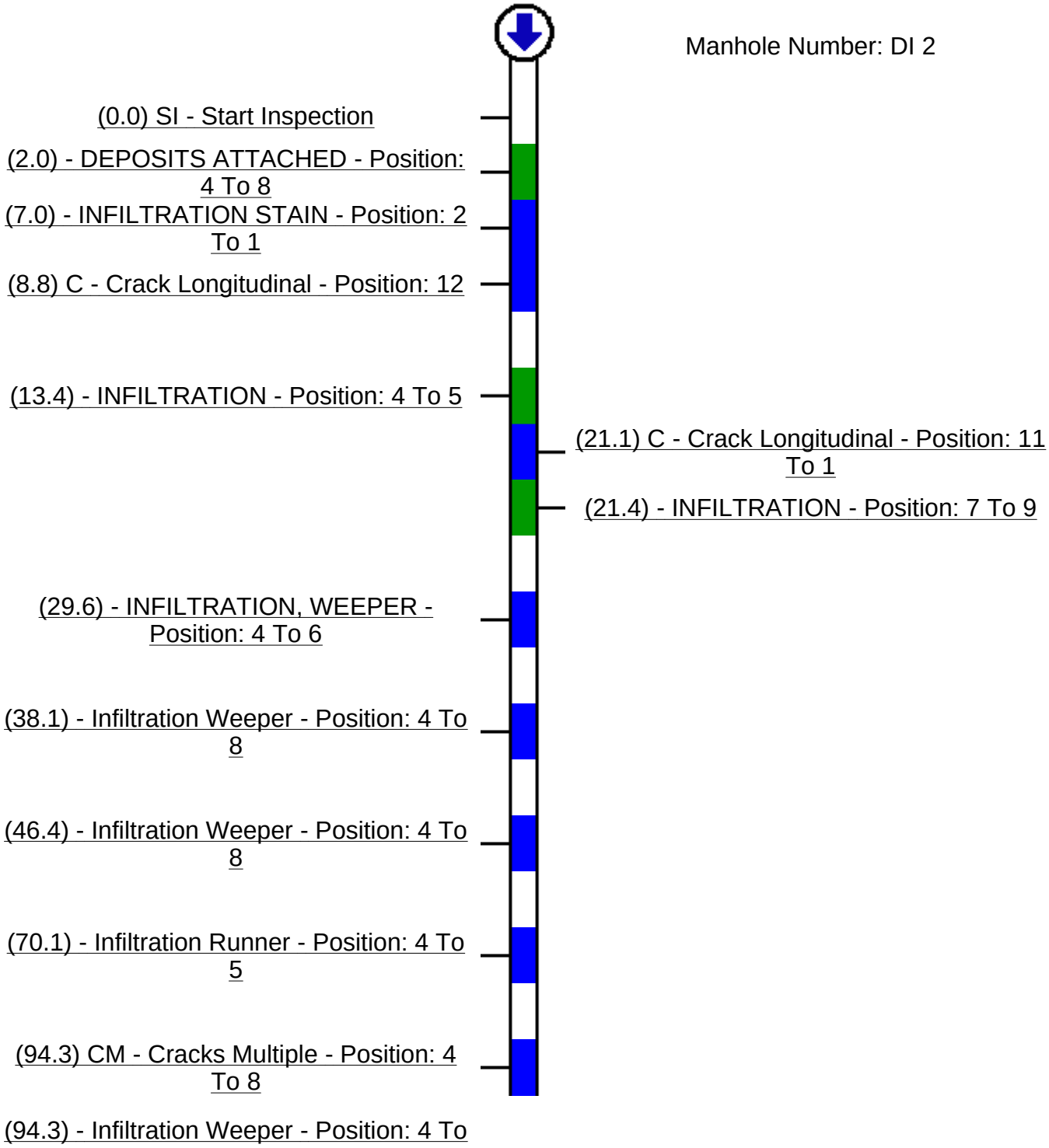
Manhole Information			
Start Manhole Number	DI 2	**End Manhole Number**	DI 3
SMH Depth	5.2	**EMH Depth**	5.1
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	PLUGGED	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 10/12/2006 10:26:05 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 112.1
Run Number: 2

Start Manhole Number: DI 2
End Manhole Number: DI 3
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe

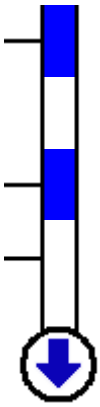


8

(102.3) - INFILTRATION STAIN - Position: 4 To 8

(112.1) EI - End Inspection

Total Distance: 112.1



Manhole Number: DI 3

20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

12/19/2006 8:36:06 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE , VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	3
		Pipe Name	30 INCH RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	191
Comments	PRE TV.		

Pipe Information	
Pipe Name	30 INCH RCP
Type Of Pipe	RCP
Size Of Pipe	30 INCH

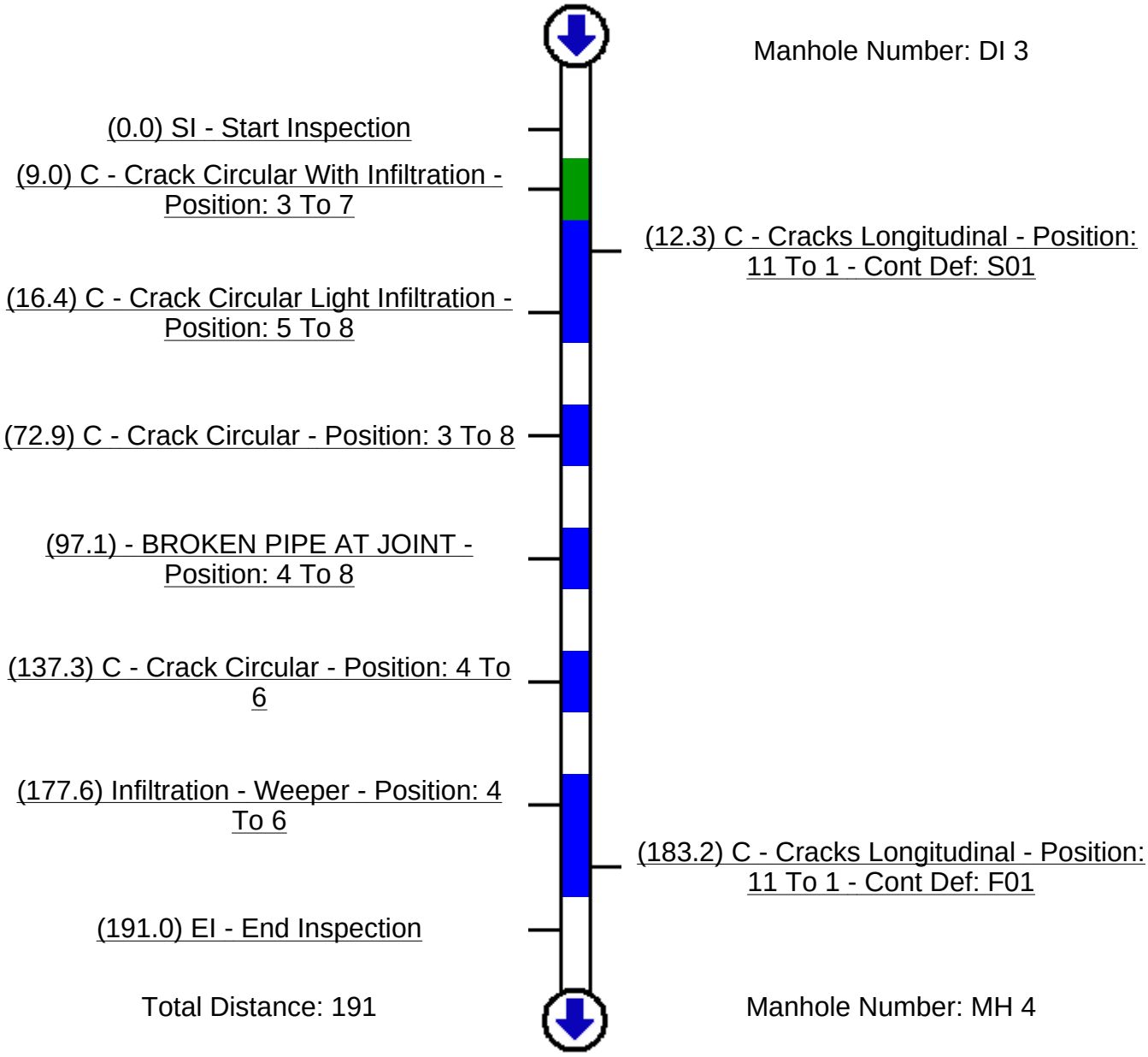
Manhole Information			
Start Manhole Number	DI 3	**End Manhole Number**	MH 4
SMH Depth	5.1	**EMH Depth**	7.2
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	LESS 1/4 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/19/2006 8:36:06 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 191
Run Number: 3

Start Manhole Number: DI 3
End Manhole Number: MH 4
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

12/19/2006 9:57:17 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE , VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	4
		Pipe Name	30 INCH RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	30.4
Comments	PRE TV.		

Pipe Information	
Pipe Name	30 INCH RCP
Type Of Pipe	RCP
Size Of Pipe	30 INCH

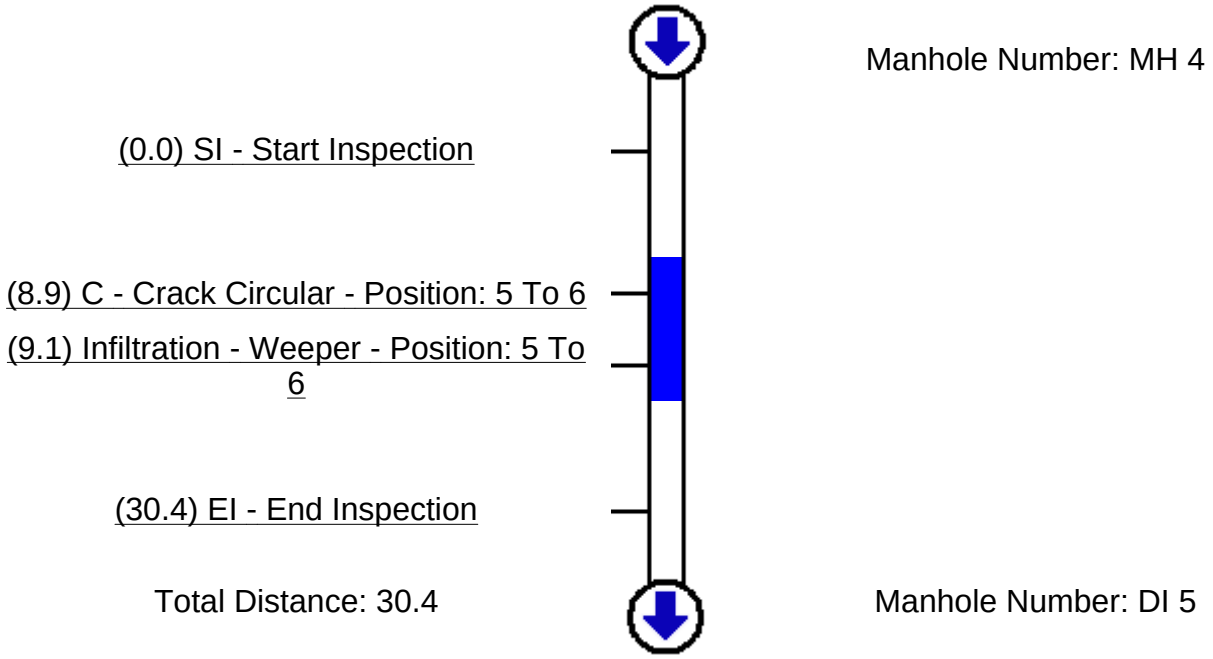
Manhole Information			
Start Manhole Number	MH 4	**End Manhole Number**	DI 5
SMH Depth	7.2	**EMH Depth**	5.5
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	1/4 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/19/2006 9:57:17 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 30.4
Run Number: 4

Start Manhole Number: MH 4
End Manhole Number: DI 5
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

12/19/2006 11:18:39 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE ,
VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	5
		Pipe Name	29"X 45" RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	213.8
Comments	PRE TV. HEAVY CLEAN.		

Pipe Information	
Pipe Name	29"X 45" RCP
Type Of Pipe	RCP
Size Of Pipe	29"X 45" OVAL

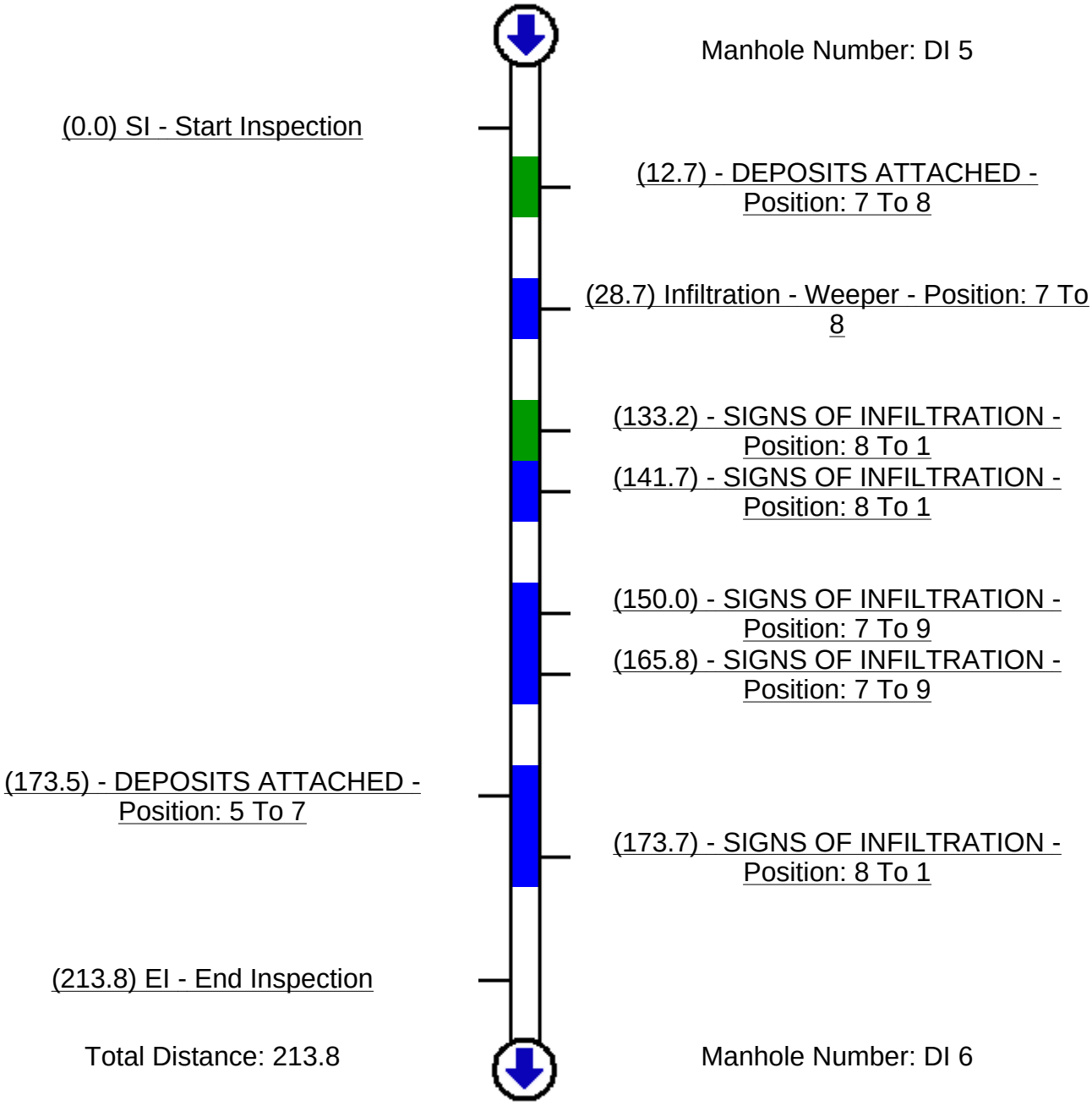
Manhole Information			
Start Manhole Number	DI 5	**End Manhole Number**	DI 6
SMH Depth	5.5	**EMH Depth**	6.0
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	1/4 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/19/2006 11:18:39 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 213.8
Run Number: 5

Start Manhole Number: DI 5
End Manhole Number: DI 6
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

12/20/2006 8:54:44 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE , VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	7
		Pipe Name	12 INCH RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	62.8
Comments	PRE TV.		

Pipe Information	
Pipe Name	12 INCH RCP
Type Of Pipe	RCP
Size Of Pipe	12 INCH

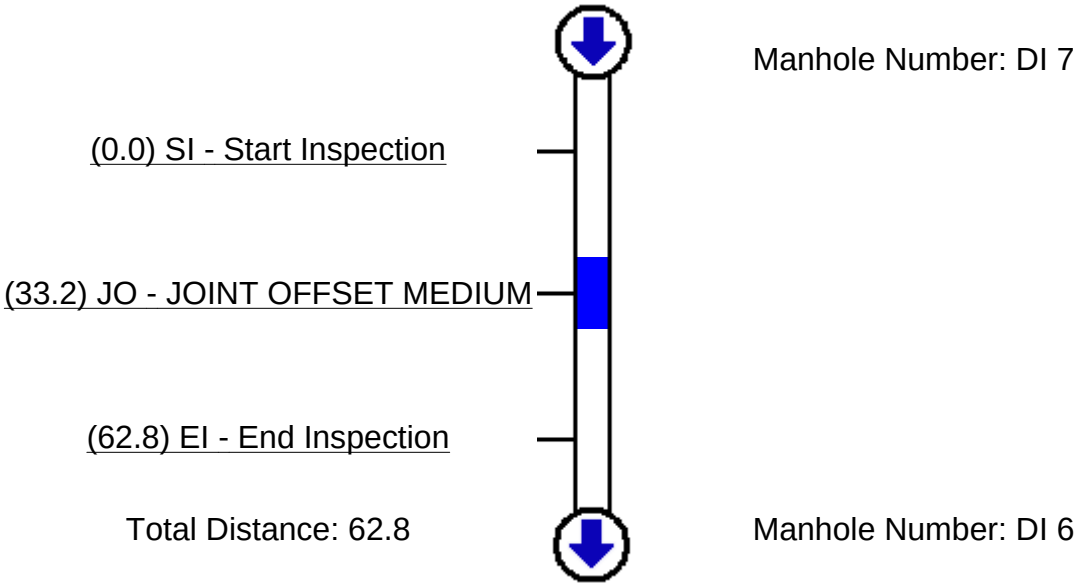
Manhole Information			
Start Manhole Number	DI 7	**End Manhole Number**	DI 6
SMH Depth	6.6	**EMH Depth**	6.0
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	1/4 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 8:54:44 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 62.8
Run Number: 7

Start Manhole Number: DI 7
End Manhole Number: DI 6
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

12/20/2006 8:44:58 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE ,
VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	6
		Pipe Name	12 INCH VCP
VCR Tape Number	1	**Flow Direction**	AGAINST
Truck Number	34	**Distance Traveled**	15.9
Comments	PRE TV. REVERSE INSPECTION. PIPE CALLAPSED AT ABOUT 43' FROM DI 7.		

Pipe Information	
Pipe Name	12 INCH VCP
Type Of Pipe	VCP
Size Of Pipe	12 INCH

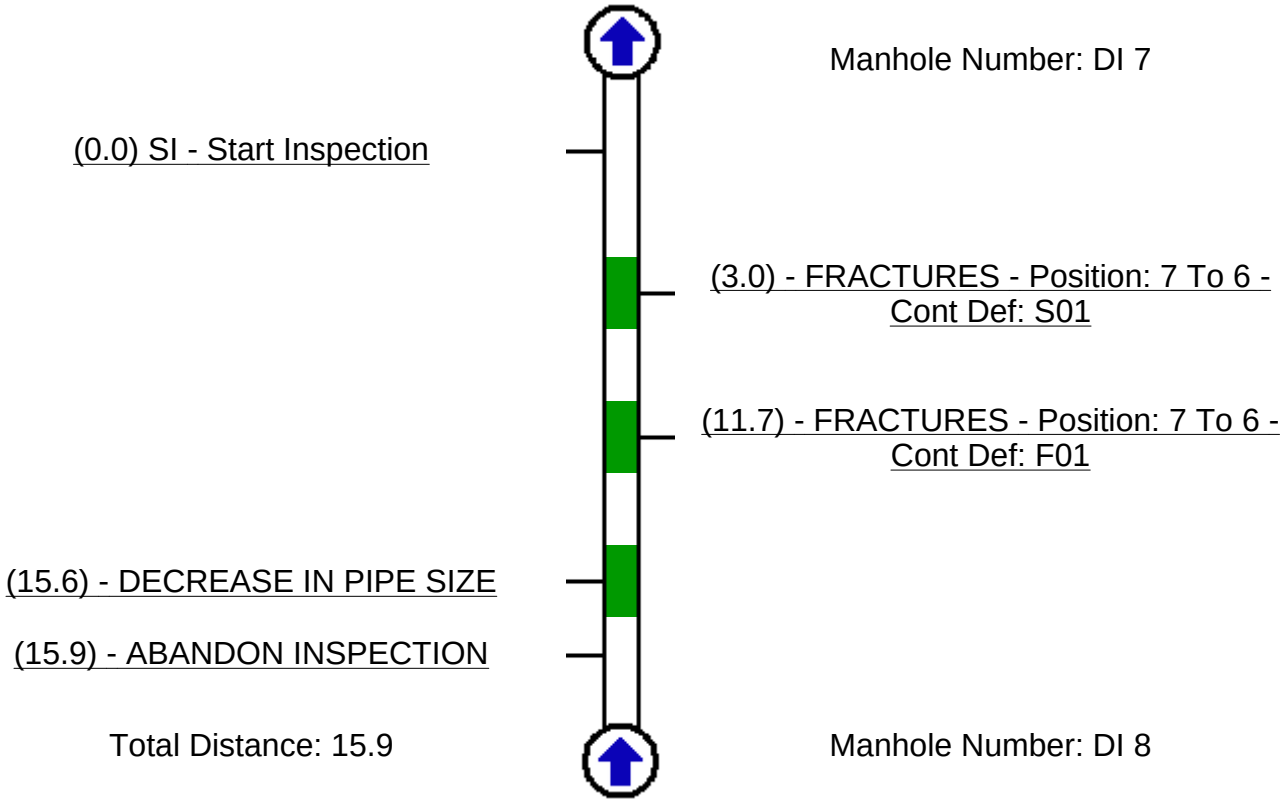
Manhole Information			
Start Manhole Number	DI 7	**End Manhole Number**	DI 8
SMH Depth	6.6	**EMH Depth**	5.0
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	1/4 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 8:44:58 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 15.9
Run Number: 6

Start Manhole Number: DI 7
End Manhole Number: DI 8
Flow Direction: AGAINST
Type Of Pipe: VCP

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

12/20/2006 9:22:21 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE , VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	8
		Pipe Name	29"X 45" RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	114.2
Comments	PRE TV. HEAVY CLEAN.		

Pipe Information	
Pipe Name	29"X 45" RCP
Type Of Pipe	RCP
Size Of Pipe	29"X 45" OVAL

Manhole Information			
Start Manhole Number	DI 6	**End Manhole Number**	MH 9
SMH Depth	6.0	**EMH Depth**	
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	1/4 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

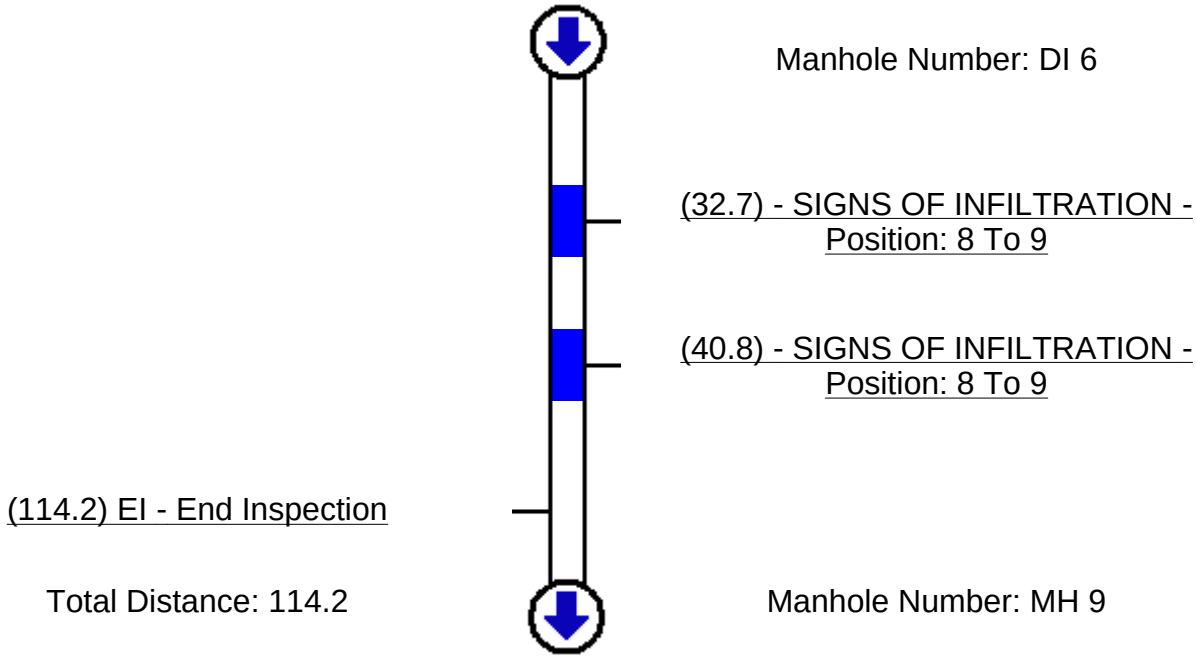
Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 9:22:21 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 114.2
Run Number: 8

Start Manhole Number: DI 6

End Manhole Number: MH 9
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

12/20/2006 11:19:02 AM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE , VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	9
		Pipe Name	29"X 45" RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	76.9
Comments	PRE TV. HEAVY CLEAN.		

Pipe Information	
Pipe Name	29"X 45" RCP
Type Of Pipe	RCP
Size Of Pipe	29"X 45" OVAL

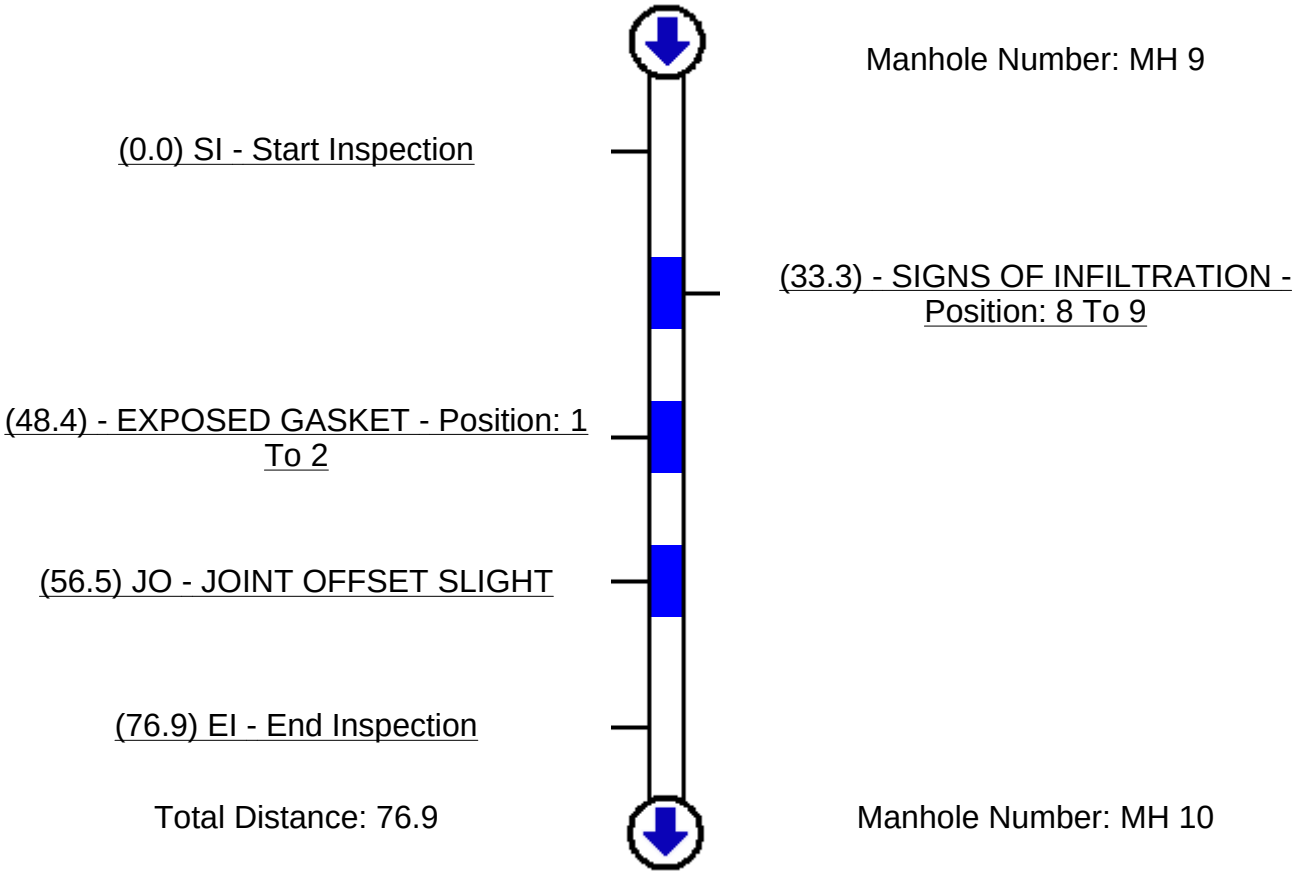
Manhole Information			
Start Manhole Number	MH 9	**End Manhole Number**	MH 10
SMH Depth	6.5	**EMH Depth**	6.2
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	1/4 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 11:19:02 AM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 76.9
Run Number: 9

Start Manhole Number: MH 9
End Manhole Number: MH 10
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

TRISTATE UTILITIES

12/20/2006 3:41:14 PM

Contact
TRISTATE UTILITIES
757-366-9505

Address
2111 SMITH AVENUE
CHESAPEAKE , VIRGINIA
23320

Operator
ROBERT SMITH

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	ST. JULIENS CREEK, CHESAPEAKE	**Run Number**	10
		Pipe Name	24 INCH RCP
VCR Tape Number	1	**Flow Direction**	WITH
Truck Number	34	**Distance Traveled**	40.4
Comments	PRE TV. HEAVY CLEAN.		

Pipe Information	
Pipe Name	24 INCH RCP
Type Of Pipe	RCP
Size Of Pipe	24 INCH

Manhole Information			
Start Manhole Number	DI 11	**End Manhole Number**	MH 10
SMH Depth		**EMH Depth**	6.2
SMH Location	BY BUILDING 1556	**EMH Location**	BY BUILDING 1556
Amount of Flow:	1/4 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

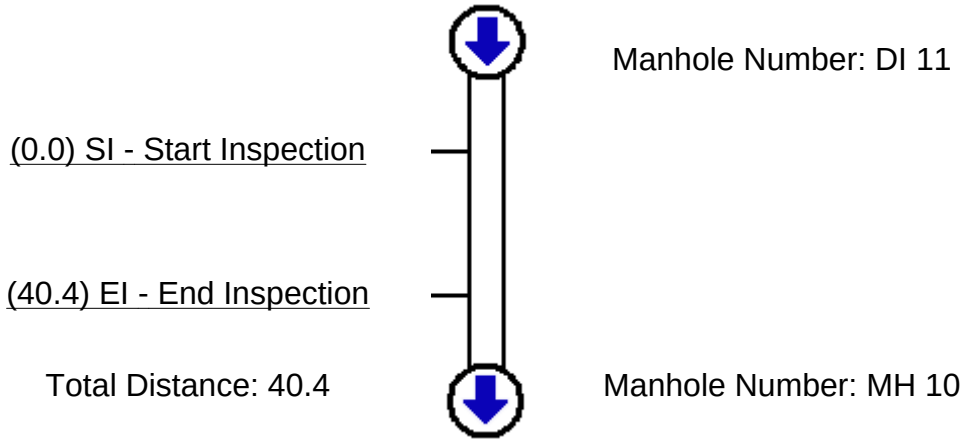
Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 3:41:14 PM
Location: ST. JULIENS CREEK, CHESAPEAKE
Total Distance: 40.4
Run Number: 10

Start Manhole Number: DI 11

End Manhole Number: MH 10
Flow Direction: WITH
Type Of Pipe: RCP

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

Tri State Utilities

01/17/2007 10:36

Contact
Tri State Utilities
757-366-9505

Address
2111 Smith Avenue
Chesapeake , VA
23320

Operator
Robert

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	PORTSMOUTH, VIRGINIA	**Run Number**	11
		Pipe Name	
VCR Tape Number	1	**Flow Direction**	Downstream
Truck Number	34	**Distance Traveled**	81.7
Comments			

Pipe Information	
Pipe Name	
Type Of Pipe	Concrete Segments (unbolted)
Size Of Pipe	29"x 45"

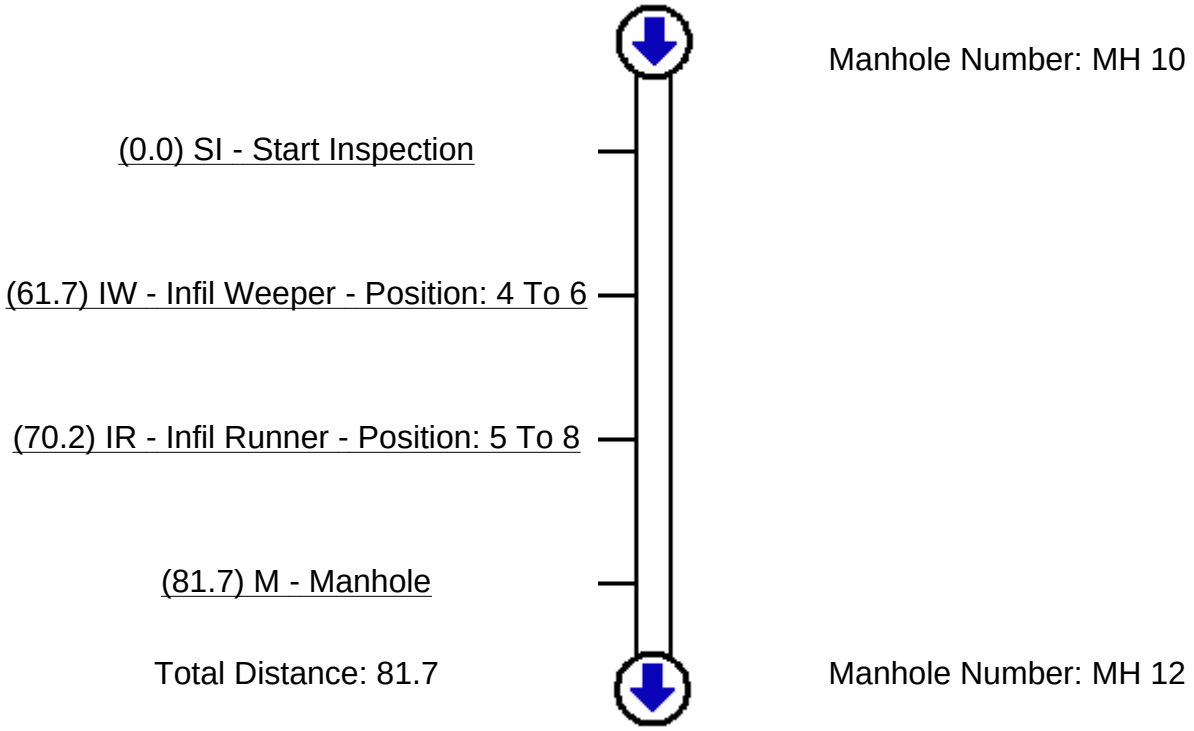
Manhole Information			
Start Manhole Number	MH 10	**End Manhole Number**	MH 12
SMH Depth	6.2	**EMH Depth**	5.5
SMH Location	BY BLDG. 1556	**EMH Location**	BY BLDG. 1556
Amount of Flow:	1 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 1/17/2007 10:36:00 AM
Location: PORTSMOUTH, VIRGINIA
Total Distance: 81.7
Run Number: 11

Start Manhole Number: MH 10
End Manhole Number: MH 12
Flow Direction: Downstream
Type Of Pipe: Concrete Segments (unbolted)

Severity
Light
Moderate
Average
Heavy
Severe



20799/ ST. JULIENS CREEK ANNEX

Tri State Utilities

01/17/2007 13:08

Contact
Tri State Utilities
757-366-9505

Address
2111 Smith Avenue
Chesapeake , VA
23320

Operator
Robert

Session Information			
Project Name	20799/ ST. JULIENS CREEK ANNEX		
Location	PORTSMOUTH, VIRGINIA	**Run Number**	12
		Pipe Name	
VCR Tape Number	1	**Flow Direction**	Downstream
Truck Number	34	**Distance Traveled**	108.3
Comments			

Pipe Information	
Pipe Name	
Type Of Pipe	Concrete Segments (unbolted)
Size Of Pipe	29"x45"

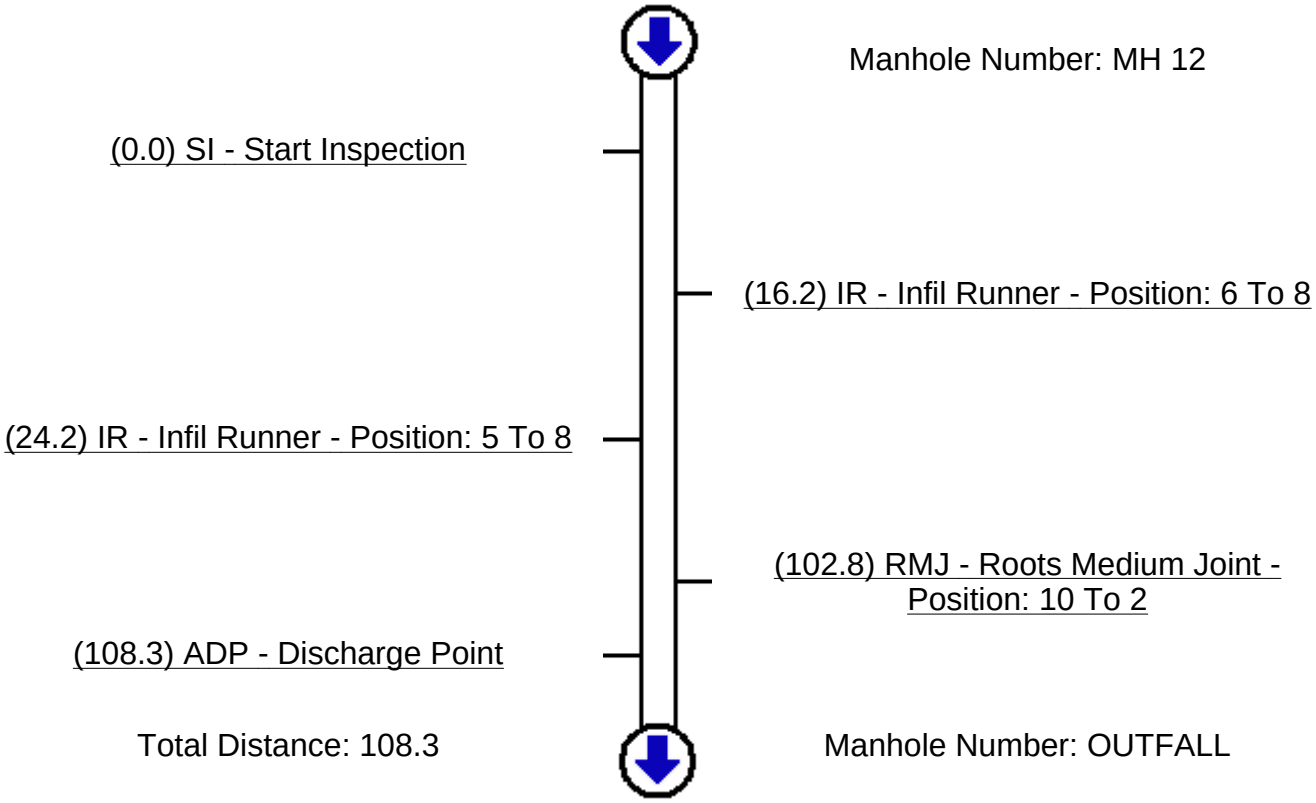
Manhole Information			
Start Manhole Number	MH 12	**End Manhole Number**	OUTFALL
SMH Depth	5.5	**EMH Depth**	0
SMH Location	BY BLDG. 1556	**EMH Location**	BY BLDG. 1556
Amount of Flow:	1 INCH	**Signs Of Surcharge:**	No
Manhole Condition	DRY		

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 1/17/2007 1:08:00 PM
Location: PORTSMOUTH, VIRGINIA
Total Distance: 108.3
Run Number: 12

Start Manhole Number: MH 12
End Manhole Number: OUTFALL
Flow Direction: Downstream
Type Of Pipe: Concrete Segments (unbolted)

Severity
Light
Moderate
Average
Heavy
Severe



Attachment B

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 10/12/2006 9:49:32 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

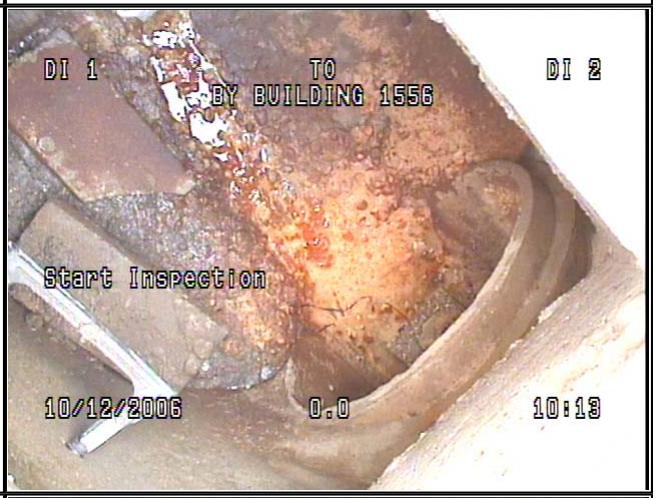
Start Manhole Number: DI 1

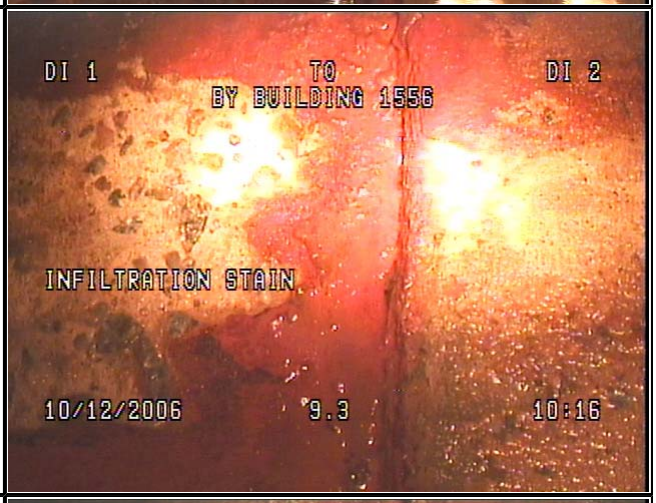
Total Distance: 79.1

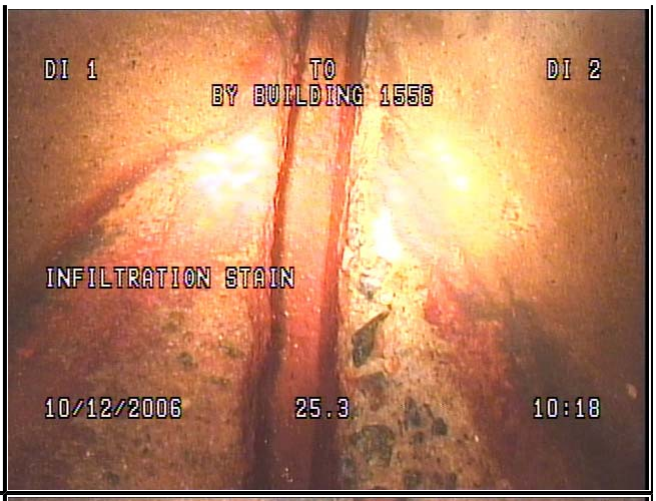
End Manhole Number: DI 2

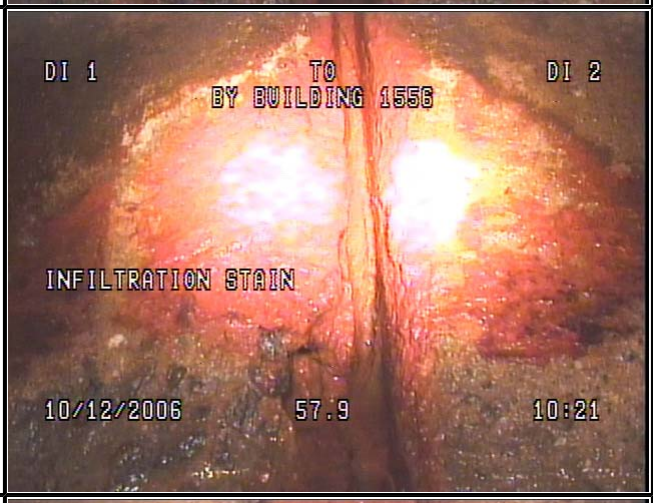
Run Number: 1

Flow Direction: WITH

Footage	Fault Observation	Time	Picture
0.0	**Start Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**01:00** **00:01:22**	
7.0	**Cracks Multiple** **Position: 10 To 2** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0**	**02:14** **00:02:38**	

9.3	**Infiltration Weeper Position: 4 To 6 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**02:51 00:03:14**	
9.3	**INFILTRATION STAIN Position: 4 To 6 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**03:18 00:03:42**	
17.2	**INFILTRATION STAIN Position: 4 To 8 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**04:16 00:04:39**	

25.3	**INFILTRATION STAIN** **Position: 6 To 8** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**05:12** **00:05:36**	
41.6	**INFILTRATION STAIN** **Position: 4 To 8** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**06:59** **00:07:22**	
49.7	**Broken Pipe** **Position: 5 To 6** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**08:00** **00:08:23**	

49.7	**INFILTRATION STAIN** **Position: 4 To 8** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**08:20** **00:08:43**	
57.9	**INFILTRATION STAIN** **Position: 4 To 5** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**08:52** **00:09:16**	
66.0	**Joint Separated** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**09:40** **00:10:02**	

66.0	**EXPOSED GASKET** **Position: 9 To 3** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**09:57** **00:10:20**	
66.0	**INFILTRATION STAIN** **Position: 3 To 9** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**10:15** **00:10:39**	
79.1	**End Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**11:35** **00:11:57**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 10/12/2006 10:26:05 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

Start Manhole Number: DI 2

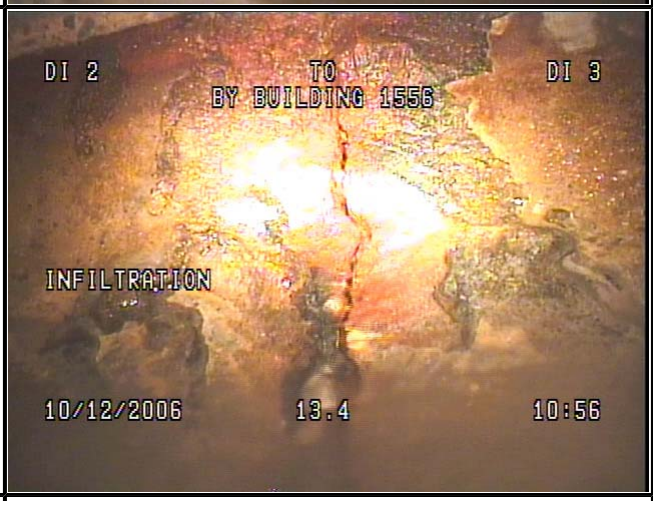
Total Distance: 112.1

End Manhole Number: DI 3

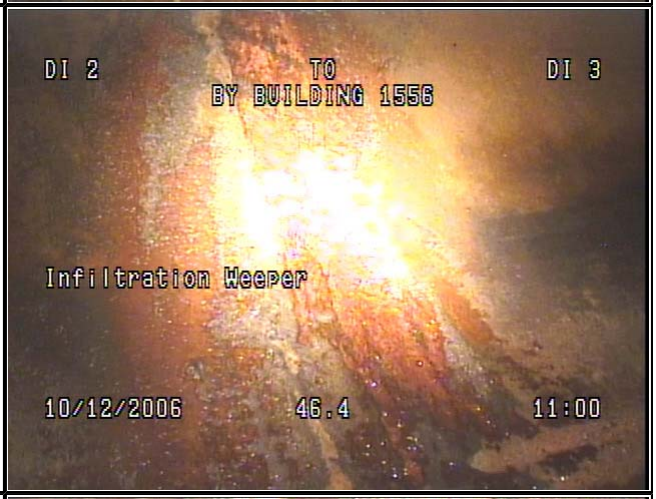
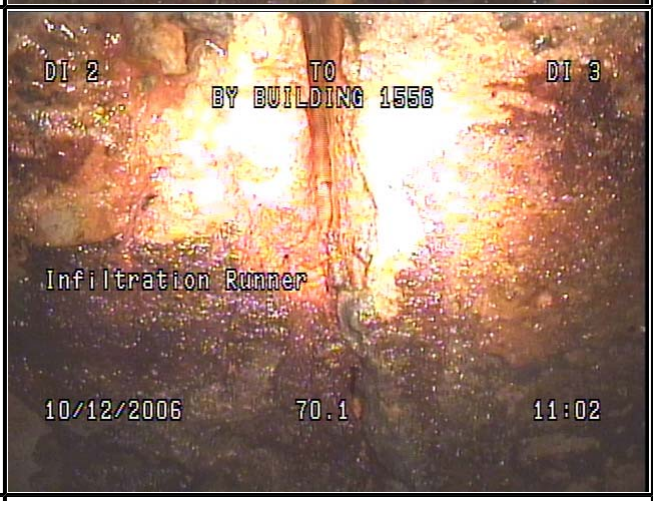
Run Number: 2

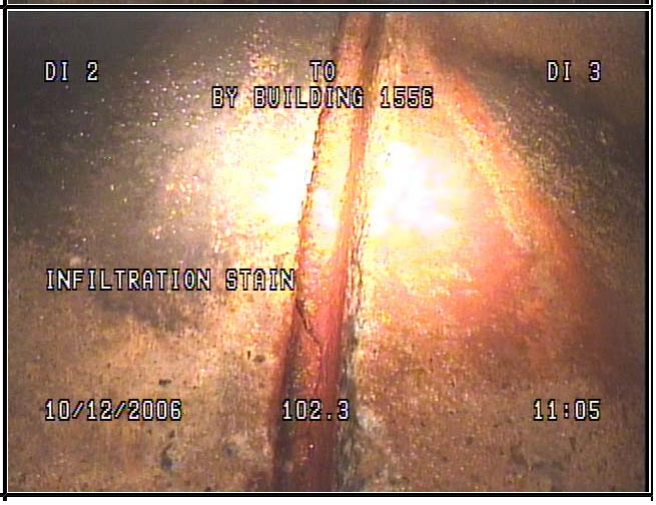
Flow Direction: WITH

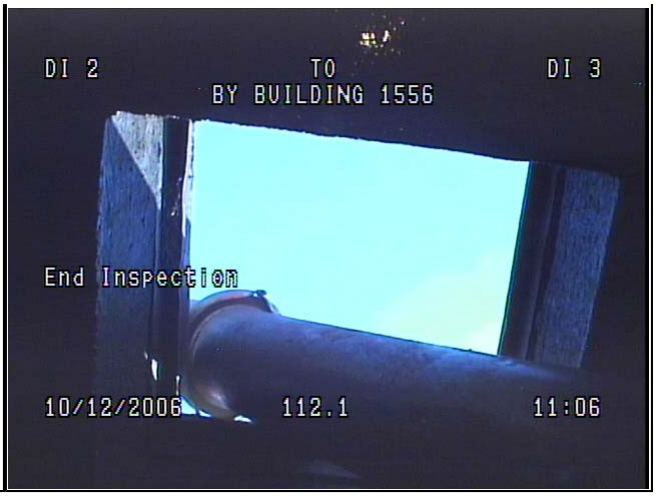
Footage	Fault Observation	Time	Picture
0.0	**Start Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**01:01** **00:13:24**	
2.0	**DEPOSITS ATTACHED** **Position: 4 To 8** **Severity: Moderate** **Value 2nd Dimension: 0** **Value Percent: 0**	**01:34** **00:13:58**	

7.0	**INFILTRATION STAIN** **Position: 2 To 1** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**02:41** **00:15:05**	
8.8	**Crack Longitudinal** **Position: 12** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0**	**03:23** **00:15:47**	
13.4	**INFILTRATION** **Position: 4 To 5** **Severity: Moderate** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**05:06** **00:17:30**	

21.1	**Crack Longitudinal Position: 11 To 1 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**06:00 00:18:25**	
21.4	**INFILTRATION Position: 7 To 9 Severity: Moderate Value 2nd Dimension: 0 Value Percent: 0 Joint**	**06:27 00:18:52**	
29.6	**INFILTRATION, WEEPER Position: 4 To 6 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**07:27 00:19:52**	

38.1	**Infiltration Weeper Position: 4 To 8 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**08:11 00:20:36**	
46.4	**Infiltration Weeper Position: 4 To 8 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**08:55 00:21:19**	
70.1	**Infiltration Runner Position: 4 To 5 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**10:53 00:23:17**	

94.3	**Cracks Multiple** **Position: 4 To 8** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**13:34** **00:25:58**	
94.3	**Infiltration Weeper** **Position: 4 To 8** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**13:55** **00:26:19**	
102.3	**INFILTRATION STAIN** **Position: 4 To 8** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**14:43** **00:27:07**	

112.1	**End Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**15:39** **00:28:02**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/19/2006 8:36:06 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

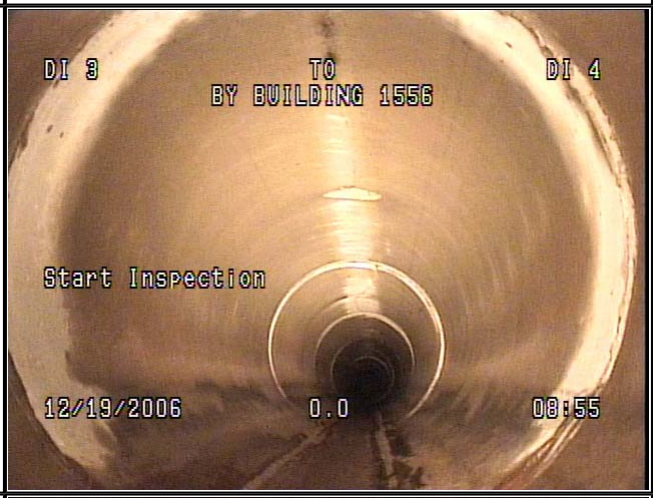
Start Manhole Number: DI 3

Total Distance: 191

End Manhole Number: MH 4

Run Number: 3

Flow Direction: WITH

Footage	Fault Observation	Time	Picture
0.0	Start Inspection Severity: None Value 2nd Dimension: 0 Value Percent: 0	01:05 00:29:49	
9.0	Crack Circular With Infiltration Position: 3 To 7 Severity: Moderate Value 2nd Dimension: 0 Value Percent: 0 Joint	01:56 00:30:43	

12.3	**Cracks Longitudinal Position: 11 To 1 Severity: Light Cont. Def.: S01 Value 2nd Dimension: 0 Value Percent: 0**	**02:38 00:31:26**	
16.4	**Crack Circular Light Infiltration Position: 5 To 8 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**03:43 00:32:31**	
72.9	**Crack Circular Position: 3 To 8 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**07:07 00:35:54**	

97.1	**BROKEN PIPE AT JOINT Position: 4 To 8 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**08:42 00:37:29**	
137.3	**Crack Circular Position: 4 To 6 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**11:38 00:40:25**	
177.6	**Weeper Position: 4 To 6 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**14:33 00:43:19**	

183.2	**Cracks Longitudinal** **Position: 11 To 1** **Severity: Light** **Cont. Def.: F01** **Value 2nd Dimension: 0** **Value Percent: 0**	**17:01** **00:45:40**	
191.0	**End Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**16:35** **00:45:11**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/19/2006 9:57:17 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

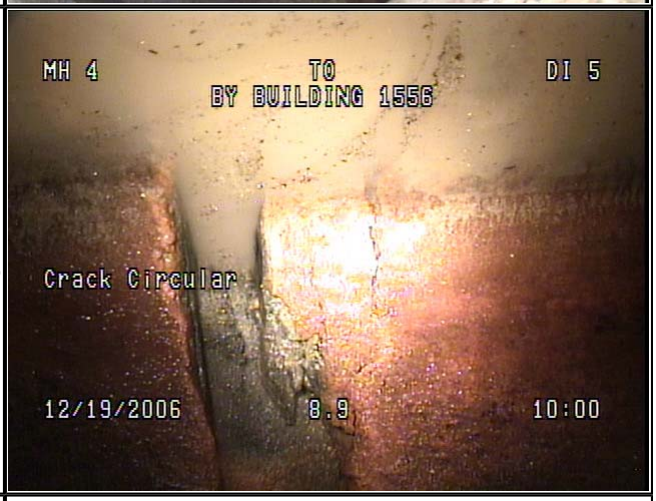
Start Manhole Number: MH 4

Total Distance: 30.4

End Manhole Number: DI 5

Run Number: 4

Flow Direction: WITH

Footage	Fault Observation	Time	Picture
0.0	Start Inspection Severity: None Value 2nd Dimension: 0 Value Percent: 0	01:04 00:47:11	
8.9	Crack Circular Position: 5 To 6 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint	02:46 00:48:55	

9.1	**Weeper** **Position: 5 To 6** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**03:05** **00:49:13**	
30.4	**End Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**06:15** **00:52:12**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/19/2006 11:18:39 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

Start Manhole Number: DI 5

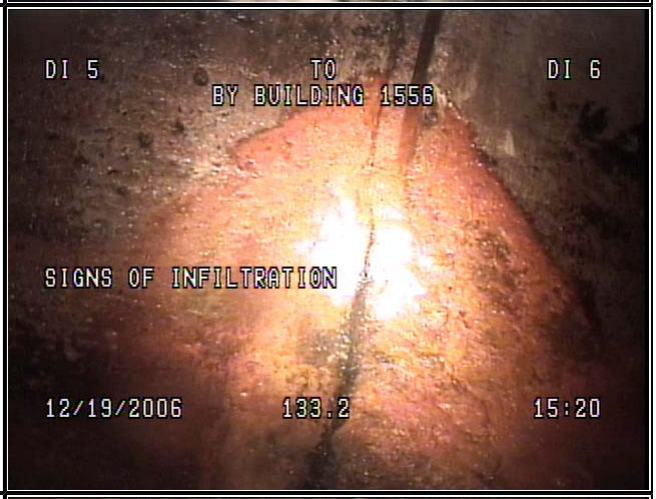
Total Distance: 213.8

End Manhole Number: DI 6

Run Number: 5

Flow Direction: WITH

Footage	Fault Observation	Time	Picture
0.0	**Start Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**01:02** **00:53:41**	
12.7	**DEPOSITS ATTACHED** **Position: 7 To 8** **Severity: Moderate** **Value 2nd Dimension: 0** **Value Percent: 0**	**03:31** **00:56:04**	

28.7	**Weeper Position: 7 To 8 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**06:04 00:58:28**	
133.2	**SIGNS OF INFILTRATION Position: 8 To 1 Severity: Moderate Value 2nd Dimension: 0 Value Percent: 0 Joint**	**21:29 01:13:19**	
141.7	**SIGNS OF INFILTRATION Position: 8 To 1 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**22:05 01:13:56**	

150.0	**SIGNS OF INFILTRATION Position: 7 To 9 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**23:15 01:14:56**	
165.8	**SIGNS OF INFILTRATION Position: 7 To 9 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**26:29 01:18:11**	
173.5	**DEPOSITS ATTACHED Position: 5 To 7 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**27:21 01:19:03**	

173.7	**SIGNS OF INFILTRATION Position: 8 To 1 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint**	**27:49 01:19:31**	
213.8	**End Inspection Severity: None Value 2nd Dimension: 0 Value Percent: 0**	**40:39 01:32:09**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 8:54:44 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

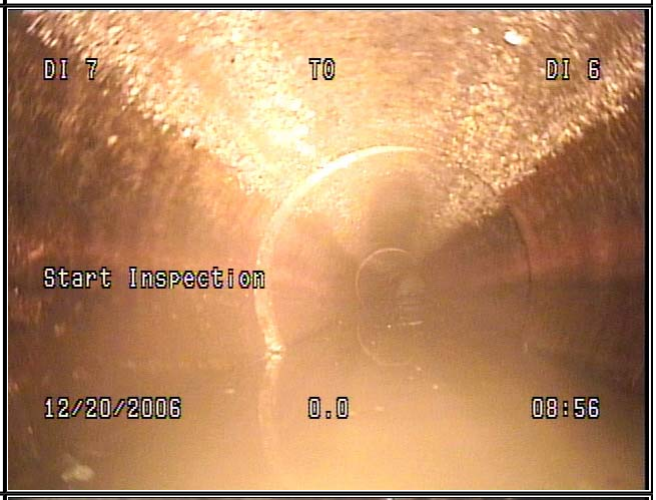
Start Manhole Number: DI 7

Total Distance: 62.8

End Manhole Number: DI 6

Run Number: 7

Flow Direction: WITH

Footage	Fault Observation	Time	Picture
0.0	Start Inspection Severity: None Value 2nd Dimension: 0 Value Percent: 0	01:04 01:39:19	
33.2	JOINT OFFSET MEDIUM Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint	02:43 01:41:00	

62.8	**End Inspection Severity: None Value 2nd Dimension: 0 Value Percent: 0**	**05:03 01:43:18**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 8:44:58 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

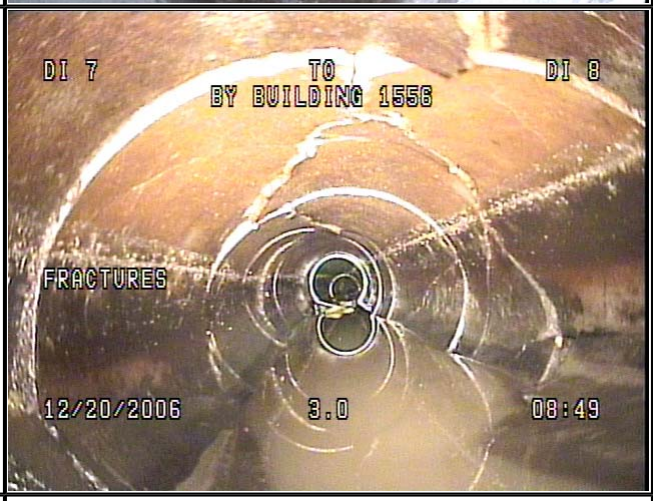
Start Manhole Number: DI 7

Total Distance: 15.9

End Manhole Number: DI 8

Run Number: 6

Flow Direction: AGAINST

Footage	Fault Observation	Time	Picture
0.0	**Start Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**01:00** **01:33:58**	
3.0	**FRACTURES** **Position: 7 To 6** **Severity: Moderate** **Cont. Def.: S01** **Value 2nd Dimension: 0** **Value Percent: 0**	**02:03** **01:35:03**	

11.7	**FRACTURES** **Position: 7 To 6** **Severity: Moderate** **Cont. Def.: F01** **Value 2nd Dimension: 0** **Value Percent: 0**	**02:41** **01:35:42**	
15.6	**DECREASE IN PIPE SIZE** **Severity: Moderate** **Value 1st Dimension: 8** **Value 2nd Dimension: 0** **Value Percent: 0**	**03:14** **01:36:13**	
15.9	**ABANDON INSPECTION** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**04:36** **01:37:34**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 9:22:21 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

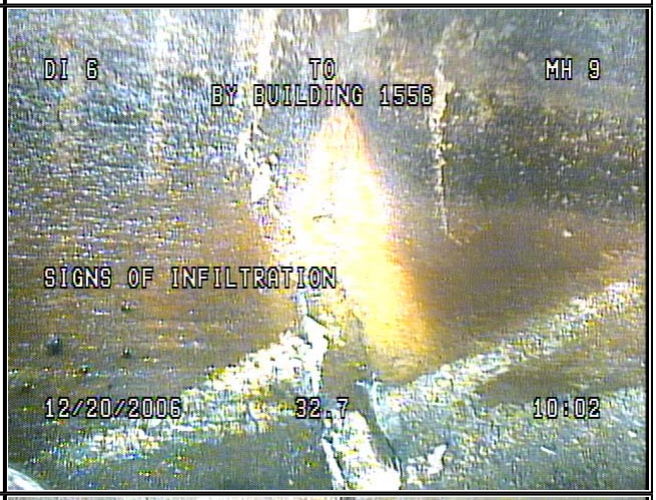
Start Manhole Number: DI 6

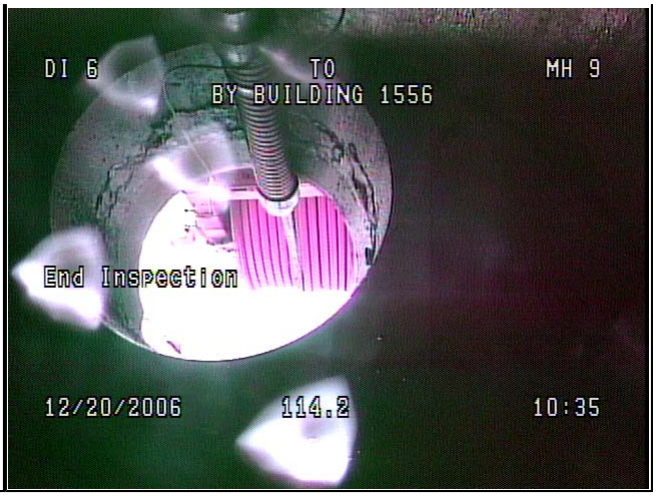
Total Distance: 114.2

End Manhole Number: MH 9

Run Number: 8

Flow Direction: WITH

Footage	Fault Observation	Time	Picture
32.7	**SIGNS OF INFILTRATION** **Position: 8 To 9** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**08:03** **01:52:03**	
40.8	**SIGNS OF INFILTRATION** **Position: 8 To 9** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**09:21** **01:53:21**	

114.2	**End Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**22:27** **02:06:10**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 11:19:02 AM

Location: ST. JULIENS CREEK, CHESAPEAKE

Start Manhole Number: MH 9

Total Distance: 76.9

End Manhole Number: MH 10

Run Number: 9

Flow Direction: WITH

Footage	Fault Observation	Time	Picture
0.0	Start Inspection Severity: None Value 2nd Dimension: 0 Value Percent: 0	01:06 02:07:56	
33.3	SIGNS OF INFILTRATION Position: 8 To 9 Severity: Light Value 2nd Dimension: 0 Value Percent: 0 Joint	04:59 02:11:51	

48.4	**EXPOSED GASKET** **Position: 1 To 2** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**06:00** **02:12:51**	
56.5	**JOINT OFFSET SLIGHT** **Severity: Light** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint**	**07:05** **02:13:47**	
76.9	**End Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**16:12** **02:22:52**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 12/20/2006 3:41:14 PM

Location: ST. JULIENS CREEK, CHESAPEAKE

Start Manhole Number: DI 11

Total Distance: 40.4

End Manhole Number: MH 10

Run Number: 10

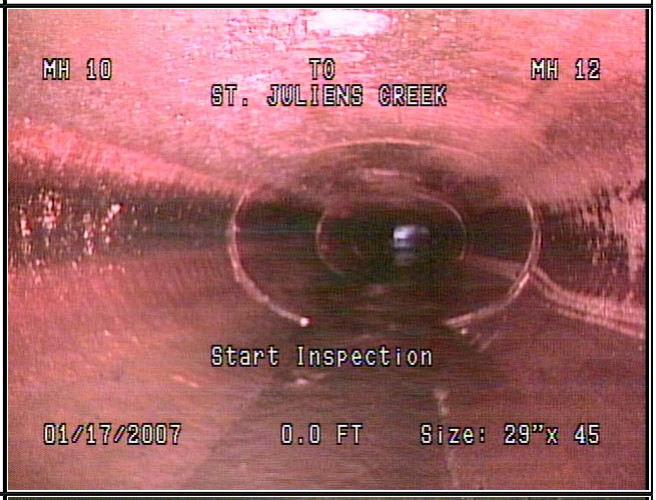
Flow Direction: WITH

Footage	Fault Observation	Time	Picture
0.0	**Start Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**01:01** **02:24:41**	
40.4	**End Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**04:37** **02:28:18**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 1/17/2007 10:36:00 AM

Location: PORTSMOUTH, VIRGINIA
Start Manhole Number: MH 10
Total Distance: 81.7
End Manhole Number: MH 12
Run Number: 11
Flow Direction: Downstream

Footage	Fault Observation	Time	Picture
0.0	Start Inspection Severity: None Value 2nd Dimension: 0 Value Percent: 0	01:36 02:28:17	
61.7	Infil Weeper Position: 4 To 6 Severity: None Value 2nd Dimension: 0 Value Percent: 0 Joint Maint Weight: 2	08:48 02:35:23	

70.2	**Infil Runner** **Position: 5 To 8** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint** **Maint Weight: 4**	**09:45** **02:36:18**	
81.7	**Manhole** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**14:00** **02:40:17**	

Session Name: 20799/ ST. JULIENS CREEK ANNEX

Date: 1/17/2007 1:08:00 PM

Location: PORTSMOUTH, VIRGINIA
Total Distance: 108.3
Run Number: 12

Start Manhole Number: MH 12
End Manhole Number: OUTFALL
Flow Direction: Downstream

Footage	Fault Observation	Time	Picture
0.0	**Start Inspection** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**02:34** **02:43:07**	
16.2	**Infil Runner** **Position: 6 To 8** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint** **Maint Weight: 4**	**03:52** **02:44:27**	

24.2	**Infil Runner** **Position: 5 To 8** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0** **Joint** **Maint Weight: 4**	**05:05** **02:45:32**	
102.8	**Roots Medium Joint** **Position: 10 To 2** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 25** **Joint** **Maint Weight: 3**	**12:11** **02:52:45**	
108.3	**Discharge Point** **Severity: None** **Value 2nd Dimension: 0** **Value Percent: 0**	**12:51** **02:53:23**	

Appendix F
Soil Boring Logs and MW Construction Diagrams

PROJECT NUMBER	BORING NUMBER	
180296.FI.FS	SJS21-MW01S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8.9' DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 4' bgs during drilling START : 7 Aug 2003 09:00 END : 10:15 LOGGER : Erica Mathews

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	no sample collected		no blow counts recorded 4' macrosampler used	0-2": asphalt	0 ppm
5	4-8'	48"			4-6': fine SAND; greenish gray (6/10Y); saturated; medium dense; sheen and odor between 5 and 5.5' bgs 6-8': fine SAND; light olive brown (2.5Y5/6); wet; medium dense	0 ppm in breathing zone 8.0 ppm in sample
	8-12'	48"			8-10': fine SAND; light brownish gray (2.5Y6/2); saturated; slight odor 10-12': same as above; olive yellow (2.5Y6/8)	0 ppm
10						
	12-16'	48"			12-15': fine SAND with some silt and clay; dark greenish gray (4/10GY); saturated; medium dense 15-16': silty CLAY; dark greenish gray (4/10GY); wet; stiff; Yorktown Confining Unit	0 ppm
15						
	16-20'	48"			16-18': same as above 18-20': CLAY; very dark gray (3/10Y); wet; stiff	0 ppm
20						
					End of boring 20' bgs	
25						

PROJECT NUMBER	BORING NUMBER	
180296.FI.FS	SJS21-MW01D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 7.7' DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 8.25" ID hollow stem auger to 22' bgs. 6" mud rotary to 43' bgs.

WATER LEVELS : 3' bgs during drilling START : 11 Aug 2003 15:00 END : 13 Aug 11:00 LOGGER : Laura Cook

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	no sample collected		no blow counts recorded 4' macrosampler used	0-1" asphalt 1"-4': fine to coarse silty SAND (SM); yellowish brown (10YR5/6); moist to wet; very loose	0 ppm 0-4' dug with fence post digger for UXO avoidance
	4-8'	48"			4-7': same as above; saturated 7-8': fine to medium silty SAND (SM); light olive gray (5Y6/2); saturated; loose	0 ppm
	8-12'	44"			8-12': same as above; olive yellow (5Y6/6) and brownish yellow (10YR6/8); saturated	0 ppm
10						
	12-16'	12"			12-16': fine to coarse silty SAND (SM); bluish gray (10B5/1); saturated; very loose	0 ppm
	16-20'	48"			16-20': CLAY trace silt (CL); greenish gray (10GY5/1); medium stiff; plastic; Yorktown Confining Unit	0 ppm
20					No samples collected between 20 and 28 feet Split spoon sampler used after 28' bgs	
	28-30'	24"		2-1-2-1	28-30': sandy CLAY (CL) with some silty sand lenses; dark greenish gray (5G4/1); wet; soft; numerous shell fragments	0 ppm
30						
	33-35'	22"		3-19-17-20	33-35': silty SAND (SM); dark greenish gray (5G4/1); saturated; loose	0 ppm
	38-40'	24"		13-28-40-23	38-40': medium to coarse SAND (SW); dark greenish gray (5GY4/1); saturated; medium dense; quartzose; 40-41.5': same as above	
40	40-42'	24"		18-16-22-28		
	42-44'	24"		8-36-32-33	41.5-41.75': sandy CLAY (CL); medium stiff; moist 41.75-42': silty SAND (SM); dark greenish gray (5GY4/1); dense; saturated 42-44': medium to coarse SAND (SW); dark greenish gray (5GY4/1); some gravel and pebbles; subangular to subround; mostly quartz; saturated; loose to med dense	
50					End of boring 44' bgs	

PROJECT NUMBER	BORING NUMBER	
180296.FI.FS	SJS21-MW02S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8.5' DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 8' bgs during drilling START : 7 Aug 2003 END : 7 Aug 2003 LOGGER : Erica Mathews

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	auger cuttings only		no blow counts recorded 4' macrosampler used	0-4': asphalt, fill and a second layer of asphalt	0 ppm
5	4-8'	48"			4-6': fine to medium SAND; greenish gray (5/5GY); moist; medium dense 6-8': fine to medium SAND; light yellowish brown (2.5Y6/4); moist; medium dense	0 ppm
10	8-12'	48"			8-12': same as above; olive yellow (2.5Y6/8)	0 ppm
15	12-16'	48"			12-14': same as above; saturated; loose 14-15': fine to coarse SAND; dark greenish gray (4/10GY); saturated; loose 15-16': silty CLAY; dark greenish gray (4/10GY); moist; stiff	0 ppm
					End of boring 16' bgs	
20						
25						

PROJECT NUMBER	BORING NUMBER	
180296.FI.FS	SJS21-MW03S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8' DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 8' bgs during drilling START : 8 Aug 2003 07:20 END : 08:30 LOGGER : Erica Mathews

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	no sample collected		no blow counts recorded 4' macrosampler used	0-2" asphalt	0 ppm
5	4-8'	48"			4-5.5': fine SAND with some silt and clay; dark grayish brown (10YR4/2); moist; medium dense 5.5-7.5': same as above; light brownish gray (2.5Y6/2) 7.5-8': fine SAND with little fines; light olive brown (2.5Y5/6); moist	0 ppm
	8-12'	48"			8-12': fine SAND with little fines; olive yellow (2.5Y6/6); wet; medium dense	0 ppm
10						
	12-16'	48"			12-14': fine to coarse SAND; wet; medium dense 14-14.5': fine to coarse SAND; dark greenish gray (3/15G) 14.5-16': silty CLAY (CL); dark greenish gray (3/10GY); wet; dense	0 ppm
15						
					End of boring 16' bgs	
20						
25						

PROJECT NUMBER	BORING NUMBER	
180296.FI.FS	SJS21-MW04S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 7.7' DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 3.3' bgs during drilling START : 11 Aug 2003 12:00 END : 14:50 LOGGER : Laura Cook

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	auger cuttings only		no blow counts recorded 4' macrosampler used	0-6": asphalt 6"-2': silty CLAY with some sand and gravel (CL); dark greenish gray (10Y3/1); moist; very soft; 2'-4': silty CLAY (CL); dark greenish gray (10GY4/1); moist; very soft	0 ppm
5	4-8'	42"			4-8': 4'-4'6": same as above 4'6"-8': fine silty SAND (SM); grades from gray (6/N) to pale olive (5Y6/4); very moist to wet; loose;	0 ppm
	8-12'	44"			8-12': same as above; olive yellow (5Y6/6); saturated	0 ppm
10						
	12-16'	44"			12-14': fine to coarse silty SAND (SM); greenish gray (10GY5/1); saturated; loose 14-16': CLAY (CL); greenish gray (10GY5/1); wet; very soft; slight sheen	0 ppm small amount of sand in tip of sleeve; will collect another sample to be sure this is Yorktown
15						
	16-20'	44"			16-17': fine to coarse silty SAND (SM); greenish gray (10GY5/1); saturated; loose; quartzose 17-20': CLAY (CL); greenish gray (10GY5/1); moist; medium stiff; plastic; Yorktown Confining Unit	0 ppm
20					End of boring 20' bgs	
25						

PROJECT NUMBER	BORING NUMBER	
180296.FI.FS	SJS21-MW05S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 7.7' DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 22" bgs during drilling START : 12 Aug 2003 07:30 END : 12:00 LOGGER : Laura Cook

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	auger cuttings only		no blow counts recorded 4' macrosampler used	0-2": asphalt 2"-4': SILT some clay (ML); dark greenish gray (10Y4/1); moist; medium dense; cohesive	0 ppm
5	4-8'	43"			4-5': same as above 5-8': fine to medium silty SAND (SM); yellow (2.5Y7/6); moist to wet; loose	0 ppm
	8-12'	44"			8-12': same as above; saturated	0 ppm
10						
	12-16'	48"			12-13.5': same as above 13.5-15.5': medium to coarse SAND, some silt (SM); greenish gray (5G5/1); saturated; loose 15.5-16': sandy CLAY (CL); greenish gray (5G5/1); wet; soft	0 ppm
15						
	16-20'	48"			16-20': CLAY (CL) trace silt and sand; greenish gray (10GY5/1); moist; soft; plastic; some degraded organic material	0 ppm
20					End of boring 20' bgs	
25						

PROJECT NUMBER	BORING NUMBER	
180296.FI.FS	SJS21-MW06S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8' DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 3.5' bgs during drilling START : 12 Aug 2003 13:30 END : 15:30 LOGGER : Laura Cook

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	auger cuttings only		no blow counts recorded 4' macrosampler used	0-2": asphalt 2"-4': silty CLAY some fine sand (CL); dark greenish gray (5GY3/1); moist; soft; cohesive	0 ppm
5	4-8'	44"			4-4.5': same as above 4.5-8': silty fine to medium SAND (SM); greenish gray (5GY6/1) and pale olive (5Y6/4); moist to wet; medium dense	0 ppm
10	8-12'	46"			same as above; olive yellow (5Y6/8)	0 ppm
15	12-16'	46"			12-15.5': medium to coarse sand some silt (SM); greenish gray (5G5/1); saturated; loose 15.5-16': clay (CL); greenish gray (10GY5/1); moist; soft; plastic; Yorktown Confining Unit	0 ppm
					End of boring 16' bgs	
20						
25						

PROJECT NUMBER	BORING NUMBER	
180296.SI.DR	SJS21-MW07S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8.08 ft amsl DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" hollow stem auger

WATER LEVELS : 5' bgs during drilling START : 10 NOV 2004 1530 END : 1730 LOGGER : Jamie Butler

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-5'	no sample collected		no blow counts recorded		0 ppm
5	5-7'	12"			5-5.5': organics, saturated at 5' 6-7': fine silty sand (SM); (5Y5/3): saturated; loose	0 ppm
10	10-12'	24"			10-11.5': fine sand (SM); orange-red (2.5Y5/6); saturated; loose 11.5-12': medium sand (SM); gray (2.5Y4/4); saturated	0 ppm
	12-14'	24"			12-13.5': same as above 13.5-14': clay (CH); (GLEY 1 4/5GY); soft; Yorktown Confining Unit	
15					End of boring 14' bgs	
20						
25						

PROJECT NUMBER	BORING NUMBER	
180296.SI.DR	SJS21-MW08S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8.45 amsl DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" hollow stem auger

WATER LEVELS : 6.5' bgs during drilling START : 11 NOV 2004 0830 END : 1030 LOGGER : Jamie Butler

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-5'	no sample collected		no blow counts recorded		0 ppm
5	5-7'	24"			5-6': clay (CL); (5Y3/3); stiff 6-7': fine silty sand (SM); (2.5Y5/3); wet at 6.5' loose	0 ppm
10	10-12'	24"			10-12': fine sand with some silt (SM); (10YR4/6); saturated; loose	0 ppm
15	14-16'	24"			14-14.5': same as above 14.5-15': medium sand with little clay (SM); gray (2.5Y3/1); loose 15-15.5': silty clay (CL); (2.5Y2.5/1); medium 15.5-16': clay (CH); (2.5Y2.5/1); Yorktown Confining Unit End of boring 16' bgs	0 ppm
20						
25						

PROJECT NUMBER	BORING NUMBER	
180296.SI.DR	SJS21-MW09S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8.69 ft amsl DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" hollow stem auger

WATER LEVELS : 6' bgs during drilling START : 11 NOV 2004 1130 END : 1430 LOGGER : Jamie Butler

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-5'	no sample collected		no blow counts recorded		0 ppm
5	5-7'	24"			5-6': fill packed silt (SC); (10YR4/3); moderate 6-7': silty sand (SM); gray (2.5Y5/3); saturated; loose	0 ppm
10	10-12'	24"			10-11': silty sand (SM); gray (5Y6/1); saturated; loose 11-12': silty sand (SM); brown/tan (5Y5/3); saturated; loose; slight odor	0 ppm
15	14-16'	24"			14-14.5': fine sand (SM); gray (5Y4/2); loose 14.5-16': clay (CH); (5Y2.5/1); soft-very soft, becoming moderate at 15.5'	0 ppm
20					End of boring 16' bgs	
25						

PROJECT NUMBER	BORING NUMBER	
180296.SI.DR	SJS21-MW10S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8.03 ft amsl DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" hollow stem auger

WATER LEVELS : 6' bgs during drilling START : 11 NOV 2004 1530 END : 1630 LOGGER : Jamie Butler

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-5'	no sample collected		no blow counts recorded		0 ppm
5	5-7'	18"			5.5-6': silty sand with some clay (SC); (10YR4/3); saturated at 6'; soft 6-7':fine sand (SM); (10YR6/1); slight petroleum odor	0 ppm
10	10-12'	24"			10-12': fine silty sand (SC-SM); (10YR6/5); saturated; loose; clay (SC) lens at 10-10.5' (10YR4/3)	0 ppm
15	14-16'	24"			14-14.5': same as above 14.5-16': clay (CH); (10YR4/1); Yorktown Confining Unit; slightly silty clay at 15'	
					End of boring 16' bgs	
20						
25						

PROJECT NUMBER	BORING NUMBER	
180296.SI.DR	SJS21-MW11S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

ELEVATION : 8.91 ft amsl DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : 4.25" hollow stem auger

WATER LEVELS : 5.69 btc START : 16 NOV 2004 1430 END : 1630 LOGGER : Rebekah Ives

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-5'	no sample collected		no blow counts recorded		0 ppm
5	5-7'	24"			5-7': fill	0 ppm
	7-9':	24"			7-7.25': fill material 7.25-7.5': sandy clay (SC); dark gray (2.5Y4/1); loose 7.5-8.2': silty clayey sand (SM); olive brown (2.5Y4/3); loose	
10	10-12'	24"			8.2-8.8': fine silty sand with some clay (SM); light olive gray (5Y6/2); loose 8.8-9': fine silty sand with some clay (SM); light olive brown (2.5Y5/6); medium	0 ppm
	12-14'	24"			10-10.2': silty sand some clay(SM); olive gray (5Y4/2): saturated 10.2-10.8': silty sand (SM); pale olive (5Y6/3) 10.8-11': same as above; olive yellow (2.5Y6/8) 11-11.3': same as above; brownish yellow (10YR6/8) 11.3-11.7': same as above; yellowish brown (10YR5/8)	
15	15-17'	24"			11.7-12': same as above; brown (7.5YR5/8) 12-12.2': silty sand with some clay (SC); olive (5Y5/3); moist 12.2-12.8': silty sand (SM); olive yellow (2.5Y6/6); stiff 12.8-13.2': same as above; olive yellow (2.5Y6/8) 13.2-13.8': same as above; yellow (2.5Y7/8) 13.8-14': same as above; yellowish brown (10YR5/8)	
20					15-15.5': silty sand (SM); pale olive (5Y6/3); moist; loose 15.5'-16.2': coarse sand (SW); olive yellow (2.5Y6/8); moist; loose 16.2-16.8': coarse sand (SW); olive (5Y4/1); saturated; loose 16.8-17': clay (CH); greenish gray (Gley 1 4/10Y); very soft	
					End of boring 17' bgs	
25						

PROJECT NUMBER		BORING NUMBER	
314808.FI.FS		SJS21-SB05 (MW12S)	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO-014 | DRILLING CONTRACTOR :Parrat Wolff | LOCATION : St. Juliens Creek Annex 21

ELEVATION : | NORTHING: 3453423.4690 | EASTING: 12123056.1666

DRILLING METHOD AND EQUIPMENT USED : DPT/Acetate Sleeve

WATER LEVELS : | START: 11/07/05 1520 | END: 11/07/05 1645 | LOGGER : C. White

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	36"	1	N/A	0.0-0.3' Asphalt 0.3-1.0' No Recovery 1.0-1.5' Gravel FILL, GP, dry, v. dense 1.5-1.8' Med. SAND (SC), trace clay, trace shell fragments, dry, med. dense, 2.5Y 4/1, dark grey 1.8-2.2' SILT, trace fine sand, (SM), dry, v. dense, 2.5Y 2.5/1, black 2.2-3.8' Clayey SILT, (SC), moist, med. dense, 2.5Y 4/1, dark grey 3.8-4.0' Silty fine SAND, (SC), moist, med. dense, 2.5Y 5/1, grey	PID Reading = 3.4
5	4-8'	38.4"	2		4.0-4.8' No Recovery 4.8-5.0' SAA 5.0-5.2' Clean fine SAND, (SP), saturated, med. dense, 2.5Y 7/2, light grey 5.2-8.0' Silty fine SAND, (SM), saturated, med. dense, 2.5Y 6/2, light brownish grey, trace mottling	sample SJS21-SB05-00-05D collected from 5.0-7.0'
	8-12'	38.4"	3		8.0-10.0' SAA	PID Reading + 0.0
10					10.0-12.0' Silty fine SAND, (SM), saturated, med. dense, 10YR 6/6, trace mottling	
	12-16'	42"	4		12.0-12.5' No Recovery 12.5-14.5' Silty fine SAND, (SM), trace med. sand, saturated, dense, 2.5Y 4/1, dark grey	sample SJS21-SB05-01-05D collected from 12.5-14.5'
15					14.5-16.0' CLAY, (CH), saturated, dense, GLEY 1 4/5G, dark greenish grey	sample SJS21-SB05-02-05D collected from 14.5-16.0'
					End of Boring @ 16.0'	SJS21-MW12S installed
20						
25						

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
314808.FI.FS	SJS21-SB06 (MW13S)	

SOIL BORING LOG

PROJECT : CTO-014 | DRILLING CONTRACTOR :Parrat Wolff | LOCATION : St. Juliens Creek Annex 21

ELEVATION : | NORTHING: 3453241.3220 | EASTING: 12122849.8662

DRILLING METHOD AND EQUIPMENT USED : DPT/Acetate Sleeve

WATER LEVELS : | START: 11/07/05 2010 | END: 11/07/05 2055 | LOGGER : C. White

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	8"	1	N/A	0.0-3.2' No Recovery, sub-base gravel in sleeve	
					3.2-4.0" Medium SAND, some fine sand and gravel, (SW), dry, med. dense, 2.5Y3/2 very dark greyish brown	
	4-8'	30"	2		4.0-5.5' No Recovery	PID Reading = 0.0
5						
					5.5-7.0' Silty fine SAND, (SM), trace clay, moist, med. dense, 2.5Y 5/3, light olive brown	
					7.0-8.0' Clean medium SAND, (SP), some fine sand, saturated, med. dense, 2.5Y 7/2, light grey	
	8-12'	42"	3		8.0-8.5' No Recovery	PID Reading = 0.0
					8.5-10.0' Medium to fine SAND, (SM), trace silt, moist, 2.5Y 6/4, light yellow brown	sample SJS21-SB06-00-05D collected from 9.0-11.0'
10					10.0-12.0' Medium to fine SAND, (SM), trace silt, saturated, 2.5Y 6/4, light yellowish brown	
	12-16'	36"	4		12.0-13.0' No Recovery	PID Reading = 0.0
					13.0-14.5' SAA	sample SJS21-SB06-01-05D collected from 14.0-16.0'
					14.5-15.0' Fine SAND, (SM), some silt, saturated, v. dense, 5Y 5/1, grey	
15					15.0-16.0' Medium SAND, (SW) some fine sand and silt, saturated, v. dense, 5Y 5/1, grey	
	16-20'	48"	5		16.0-18.5' CLAY, (CH), moist, med. dense, G	
					18.5-19.5' Medium SAND, (SW) trace fine sand and silt, moist, med. dense, 5Y 5/1, grey, peat last 2"	
20					19.7-20.0' CLAY, (CH), moist, v. dense, Gley 1 4/5G, dark greenish grey	
					End of Boring @ 20.0'	SJS21-MW13S installed
25						

PROJECT NUMBER	BORING NUMBER	
314808.FI.FS	SJS21-MW14S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO-057 | DRILLING CONTRACTOR : Parratt Wolff | LOCATION : St Juliens Creek Annex Site 21

ELEVATION : 8.49' amsl | NORTHING: 3453291.4572 | EASTING: 12122932.2777

DRILLING METHOD AND EQUIPMENT USED : Direct Push Technology / 4' Acetate sleeves

WATER LEVELS : | START: 10/23/2006 1545 | END: 10/23/2006 1700 | LOGGER : A. Jones/C. White

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	42"	1	NA	0.0-0.6' No recovery 0.6-2.0' Fill, strong petroleum odor	PID Reading = 0.0 ppm
					2.0-2.9' Fine SAND, some clay, (SC), 10YR 4/3 (brown), moist, very dense, med. plasticity 2.9-4.0' Fine SAND, some silt and clay, (ML), 2.5Y 5/6 (light olive brown), moist, dense, slight plasticity	
5	4-8'	37"	2		4.0-4.9' No recovery 4.9-5.3' Fine SAND, some silt and clay, (ML), 2.5Y 5/6 (light olive brown), moist, dense, slight plasticity 5.3-5.5' SAA, some coarse sand 5.5-6.8' Medium fine SAND, some silt, (SM), 2.5Y 7/2 (light gray), saturated at 5.8', dense 6.8-8.0' SAA, 2.5Y 6/6 (olive yellow), medium dense	
	8-12'	36"	3		8.0-11.0' SAA, 7.5YR 5/8 (strong brown), heavy iron staining	
10					11.0-12.0' No recovery	
	12-16'	48"	4		12.0-13.5' Fine SAND, some clay, trace med. sand, (ML), GLEY1 4/10GY (dark greenish gray), saturated, loose 13.5-14.5' CLAY with fine to medium sand and organics (OL), GLEY1 2.5/10Y (greenish black), saturated, med. dense, med. plasticity	
15					14.5-16.0' Fine SAND, some clay, trace med. sand, (ML), GLEY1 4/10GY (dark greenish gray), saturated, med. dense	15.0-15.5' - No color noted in Indigo Blue test kits for DNAPL
	16-18.7'	31"	5		16.0-18.7' CLAY, trace fine sand, (CH), GLEY1 2.5/10Y (greenish black), saturated, med. dense, high plasticity, Yorktown Confining Unit	16.0-16.5' - No color noted in Indigo Blue test kits for DNAPL
20					End of boring 18.7' bgs	Monitoring Well MW14S installed to 16' bgs (see well diagram for details)
25						

PROJECT NUMBER	BORING NUMBER	
314808.FI.FS	SJS21-MW15S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO-057 | DRILLING CONTRACTOR : Parratt Wolff | LOCATION : St Juliens Creek Annex Site 21

ELEVATION : 8.27' amsl | NORTHING: 3453448.9935 | EASTING: 12123054.8979

DRILLING METHOD AND EQUIPMENT USED : Direct Push Technology / 4' Acetate sleeves

WATER LEVELS : | START: 10/23/2006 1330 | END: 10/23/2006 1415 | LOGGER : A. Jones/C. White

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
				NA	0.0-0.5' Asphalt 0.5-1.0' Fill 1.0-1.3' Fill	PID Reading = 0.0 ppm
	1-5'	48"	1		1.3-2.0' Clayey SILT (CL), 2.5YR 4/2 (darkish gray brown), moist, very dense, med. plasticity 2.0-4.0' Clayey fine SAND (CL), 2.5Y 4/3 (olive brown), moist, stiff, med. plasticity 4.0-4.5' Fine to med. SAND, some clay, (SC), 2.5 Y 4/3 (olive brown), iron staining, moist, med. stiff, med. plasticity	
5	5-9'	26"	2		4.5-5.0' Medium SAND, some fine sand and silt, (SM), 5Y 6/2 (light olive gray), moist, med. dense 5.0-6.8' No recoverey 6.8-7.9' Downhole material, some large gravel 7.9-9.0' Medium SAND, some fine sand and silt, (SM), 5Y 6/2 (light olive gray), saturated, med. dense	
10	9-13'	34"	3		9.0-12.0' Fine SAND, some medium sand, (SP), color SAA, changes at 9.7' to 10YR 6/8 (brownish yellow), saturated, medium dense 12.0-13.0' No Recovery	
15	13-17'	48"	4		13.0-14.9' Fine SAND, some silt, (SM), 2.5Y 4/1 (dark gray), saturated, dense 14.9-16.5' Fine SAND, some clay, (SC), 2.5Y 4/1 (dark gray), saturated, soft 16.5-17.0' CLAY (CH), GLEY1 3/5GY (dark greenish gray), saturated, very soft, Yorktown Confining Unit	15.5-16' - No color noted in Indigo Blue test kits for DNAPL 16-17' - No color noted in Indigo Blue test kits for DNAPL
20					End of boring 17' bgs	Monitoring Well MW15S installed to 17.0' bgs (see well installation log for details)
25						

PROJECT NUMBER	BORING NUMBER	
314808.FI.FS	SJS21-MW16S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO-057 | DRILLING CONTRACTOR : Parratt Wolff | LOCATION : St Juliens Creek Annex Site 21

ELEVATION : 7.69' amsl | NORTHING: 3453221.999 | EASTING: 12123274.0247

DRILLING METHOD AND EQUIPMENT USED : Direct Push Technology / 4' Acetate sleeves

WATER LEVELS : | START: 10/25/2006 1600 | END: 10/25/2006 1645 | LOGGER : A. Jones/C. White

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-4'	48"	1	NA	0.0-0.2' Topsoil 0.2-1.3' Fill 1.3-2.5' Silty fine SAND (SM), 2.5Y 6/3 (light yellowish brown), moist, very dense 2.5-4.0' Fine to medium SAND, some clay, (SC), 2.5Y 6/1 (gray), some iron staining, moist, med. dense, med. plasticity	PID Reading = 0.0 ppm
5	4-8'	46"	2		4.0-5.8' Fine SAND, some silt, (SM), 5Y 6/3 (pale olive), iron staining, saturated at 6.5', dense, organic odor 5.8-7.3' Fine to medium clean SAND, (SP), 5Y 6/2 (light olive gray), saturated, med. dense 7.3-7.8' Clayey SILT, some fine sand, (ML), 5Y 3/1 (very dark gray), saturated, dense, med. plasticity	
	8-12'	38"	3		8.0-8.6' No recovery 8.6-12.0' Fine SAND, some silt, (SM), 5Y 6/3 (pale olive) changing to 2.5Y 7/6 (yellow), saturated, dense	
10						
	12-16'	47"	4		12.0-12.1' No recovery 12.1-14.5' Fine to med. SAND, some silt, (SM), 5Y 4/1 (dark gray), saturated, med. dense	
15					14.5-18.0' CLAY (CH), GLEY1 4/5GY (dark greenish gray), saturated, med. soft, Yorktown Confining Unit	14.5-15.0' - No color noted in Indigo Blue test kits for DNAPL 15.0-15.5' - No color noted in Indigo Blue test kits for DNAPL
					End of boring 18' bgs	Monitoring Well MW16S installed to 15' bgs (see well diagram for details)
20						
25						

PROJECT NUMBER	BORING NUMBER	
314808.FI.SI	SJS21-MW17S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO- 057 | DRILLING CONTRACTOR : Parratt Wolff | LOCATION : St. Juliens Creek Annex, Site

ELEVATION : 8.49' amsl | NORTHING: 3453651.4356 | EASTING: 12122951.4162

DRILLING METHOD AND EQUIPMENT USED :4 1/4" Hollow Stem Auger

WATER LEVELS : | START: 02/23/2007 1315 | END: 02/23/2007 1400 | LOGGER : Shaun Whitmore

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone / Above Hole
	0-1'				Asphalt	0
	1-5'	48			1-3': Fine sandy silt (SM), grayish brown (2.5Y 5/2), medium dense, dry to slightly moist	
					3-5': Silty fine to medium sand (SM), gray (5Y 5/1), medium dense, slightly moist	
5	5-9'	48			5-6': Same as above	
					6-9': Silty fine to medium sand (SM), pale olive (5Y 6/3), moist to wet, medium dense	
	9-13'	36				
10					10-12': Silty sand with fines (SM), brownish yellow (10YR 6/8), loose to medium dense, saturated	
					12-13': Fine sand with silt (SM), gray (2.5Y 5/1), medium dense, wet	
	13-17'	48			13-14': Same as above, some clay at 14'	
					14-17': Clay with fine sand (CL), dark gray (5Y 4/1), soft to medium soft, moist	
15						
					End of boring 17' bgs	
20						
25						

PROJECT NUMBER	BORING NUMBER	
314808.FI.SI	SJS21-MW18S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO- 057 | DRILLING CONTRACTOR : Parratt Wolff | LOCATION : St. Juliens Creek Annex, Site

ELEVATION : 8.40' amsl | NORTHING: 3453667.5883 | EASTING: 12123113.3936

DRILLING METHOD AND EQUIPMENT USED :4 1/4" Hollow Stem Auger

WATER LEVELS : | START: 02/22/2007 1310 | END: 02/22/2007 1410 | LOGGER : Shaun Whitmore

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
	0-1'				Asphalt	
	1-5'	48			1-1.5': Fill 1.5-4.5': Silty clay (CL), gray (2.5Y 5/1), medium soft, medium plasticity, moist	
5	5-9'	48			4.5-5': Medium fine sand with silt (SM), gray (2.5Y 5/1), medium soft, moist 5-9': Medium to fine Sandy clay (SC), grayish brown (2.5Y 5/2), wet becoming saturated, medium dense	
	9-13'	48			9-10.5': Clayey fine sand (SC), olive yellow (2.5Y 6/6), saturated, medium dense	
10					10.5-13': Fine silty sand (SM), gray (5Y 5/1), saturated, dense	
	13-17'	24				
15					15-15.25': Same as above 15.25-17': Sandy clay (SC), dark gray (gley N/4), moist, soft	
	17-21'	48			17-20': Silty clay (CL), very dark gray (5Y 3/1), moist, soft	
20					20-21': Clayey fine sand (SC), dark gray (2.5Y 4/1), moist, medium dense	
	21-23'	24			21-23': Silty clay (CL), very dark gray (5Y 3/1), moist, medium soft, 2.5" organic layer at 22.5'	
					End of boring 23' bgs	
25						

PROJECT NUMBER	BORING NUMBER	
314808.FI.SI	SJS21-MW19S	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : CTO- 057 | DRILLING CONTRACTOR : Parratt Wolff | LOCATION : St. Juliens Creek Annex, Site

ELEVATION : 7.85' amsl | NORTHING: 3453672.2487 | EASTING: 12123380.6932

DRILLING METHOD AND EQUIPMENT USED :4 1/4" Hollow Stem Auger

WATER LEVELS : | START: 02/23/2007 1010 | END: 02/23/2007 1105 | LOGGER : Shaun Whitmore

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone / Above Hole
	0-1'				Asphalt	0
	1-5'	48			1-3.5': Silty clay with fine sand (CL), olive gray (5Y 4/2), medium soft, dry to slightly moist	
					3.5-5': Clayey fine to medium sand (SC), gray (2.5Y 6/1), moist to saturated at 4.5', medium dense	
5	5-9'	48			5-6': Silty sand (SM), dark gray (2.5Y 4/1), saturated, loose 6-9': Silty sand (SM), grayish brown (2.5Y 5/2), saturated, loose to medium dense	
	9-13'	36				
10					10-11': Silty sand (SM), light olive brown (2.5Y 5/6), saturated, loose 11-13': Silty sand (SM), dark gray (2.5Y 4/1), wet, loose to medium dense	
	13-17'	48			13-17': Sandy clay with silt (SM/SC), dark gray (2.5Y 4/1), moist, soft to medium soft	
15						
	17-21'	48			17-18': Silty sand (SM), very dark gray (5Y 3/1), moist, medium dense 18-21': Silty clay (CL), very dark gray (5Y 3/1), moist, medium dense	
20						
					End of boring 21' bgs	
25						

PROJECT NUMBER	WELL NUMBER	
180296.FI.FS	SJS21-MW01S	SHEET 1 OF 1

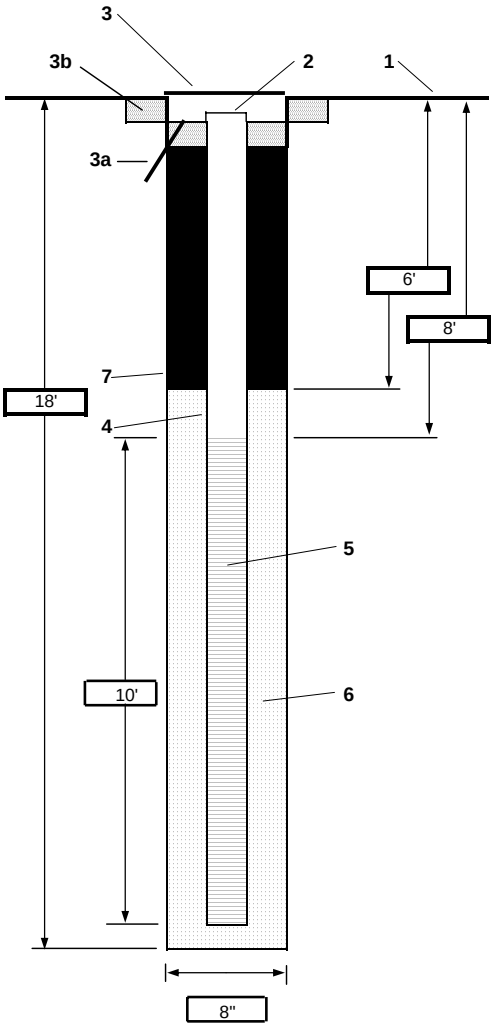
WELL COMPLETION DIAGRAM

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 8' bgs during installation START : 7 Aug 2003 END : 7 Aug 2003 LOGGER : Erica Mathews



1-	Ground elevation at well	8.9'
2-	Top of casing elevation	8.53'
3-	Wellhead protection cover type	8" steel flushmount cover
	a) drain tube?	no, sand filter installed
	b) concrete pad dimensions	24" round
4-	Dia./type of well casing	2" Schedule 40 PVC
5-	Type/slot size of screen	0.010 Slot Schedule 40 PVC
6-	Type screen filter	DSI #1 Silica Sand
	a) Quantity used	300 lbs
7-	Type of seal	3/8" hydrated bentonite chips
	a) Quantity used	75 lbs
	Grout	none
	a) Grout mix used	
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	pump and surge
	Development time	28 minutes
	Estimated purge volume	40 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
180296.FI.FS	SJS21-MW01D	SHEET 1 OF 1

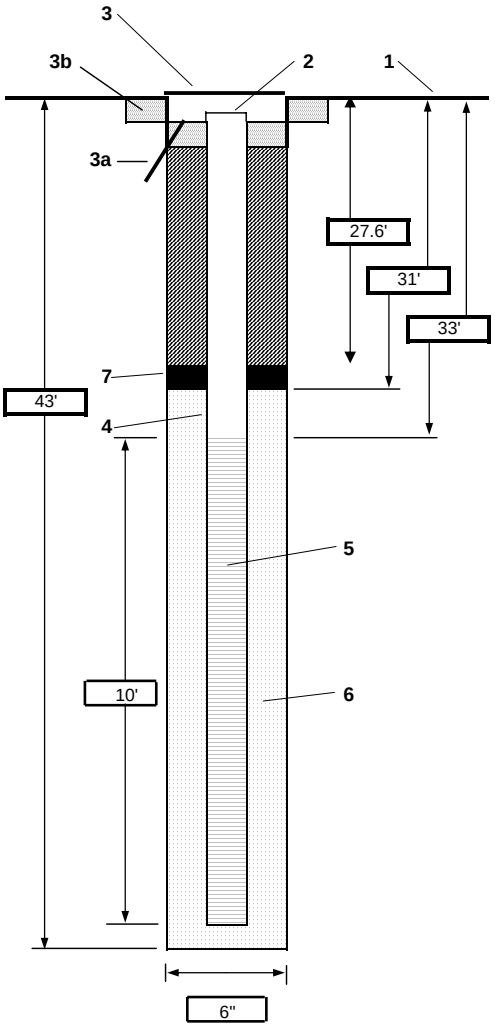
WELL COMPLETION DIAGRAM

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 8.25" ID hollow stem auger to 22'. 6" Mud rotary to 43'

WATER LEVELS : 3' bgs during installation START :11 Aug 2003 15:00 END : 13 Aug 11:00 LOGGER : Laura Cook



1-	Ground elevation at well	7.7'
2-	Top of casing elevation	7.37'
3-	Wellhead protection cover type	8" steel flushmount cover
	a) drain tube?	no, sand filter installed
	b) concrete pad dimensions	24" round
4-	Dia./type of well casing	2" Schedule 40 PVC inner casing
		6" Schedule 40 PVC outer casing
5-	Type/slot size of screen	2" diam. 0.010 Slot Schedule 40 PVC
6-	Type screen filter	DSI #1 Silica Sand
	a) Quantity used	225 lbs
7-	Type of seal	3/8" hydrated bentonite chips
	a) Quantity used	50 lbs
	Grout	none
	a) Grout mix used	10% bentonite 90% portland cement
		7 gallons of water to 100 lbs grout mix
	b) Method of placement	tremie pipe
	c) Vol. of well casing grout	45 gallons
	Development method	pump and surge
	Development time	52 minutes
	Estimated purge volume	45 gallons

Comments Outer casing set at 22' bgs

PROJECT NUMBER	WELL NUMBER	
180296.FI.FS	SJS21-MW02S	SHEET 1 OF 1

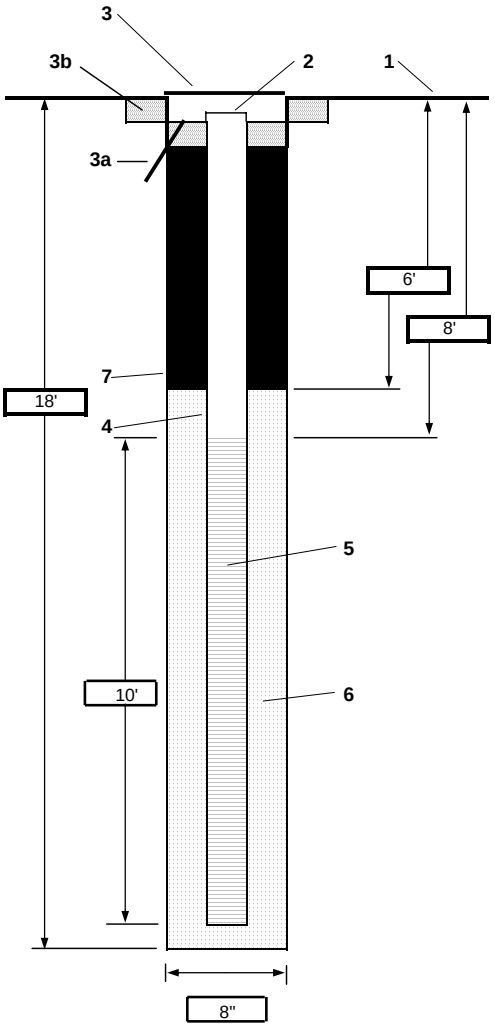
WELL COMPLETION DIAGRAM

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 8' bgs during installation START : 7 Aug 2003 END : 7 Aug 2003 LOGGER : Erica Mathews



1-	Ground elevation at well	8.5'
2-	Top of casing elevation	8.03'
3-	Wellhead protection cover type	8" steel flushmount cover
	a) drain tube?	no, sand filter installed
	b) concrete pad dimensions	24" round
4-	Dia./type of well casing	2" Schedule 40 PVC
5-	Type/slot size of screen	0.010 Slot Schedule 40 PVC
6-	Type screen filter	DSI #1 Silica Sand
	a) Quantity used	300 lbs
7-	Type of seal	3/8" hydrated bentonite chips
	a) Quantity used	75 lbs
	Grout	none
	a) Grout mix used	
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	pump and surge
	Development time	25 minutes
	Estimated purge volume	35 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
180296.FI.FS	SJS21-MW03S	SHEET 1 OF 1

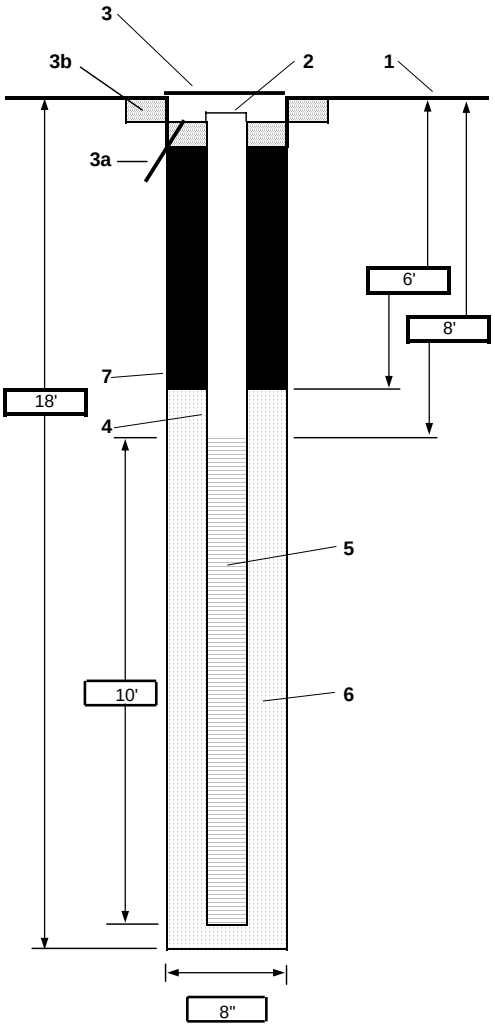
WELL COMPLETION DIAGRAM

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 8' bgs during installation START : 8 Aug 2003 07:20 END : 08:30 LOGGER : Erica Mathews



1-	Ground elevation at well	8'
2-	Top of casing elevation	7.64'
3-	Wellhead protection cover type	8" steel flushmount cover
	a) drain tube?	no, sand filter installed
	b) concrete pad dimensions	24" round
4-	Dia./type of well casing	2" Schedule 40 PVC
5-	Type/slot size of screen	0.010 Slot Schedule 40 PVC
6-	Type screen filter	DSI #1 Silica Sand
	a) Quantity used	300 lbs
7-	Type of seal	3/8" hydrated bentonite chips
	a) Quantity used	75 lbs
	Grout	none
	a) Grout mix used	
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	pump and surge
	Development time	63 minutes
	Estimated purge volume	25 gallons

Comments Well pumped dry once during development

PROJECT NUMBER	WELL NUMBER	
180296.FI.FS	SJS21-MW04S	SHEET 1 OF 1

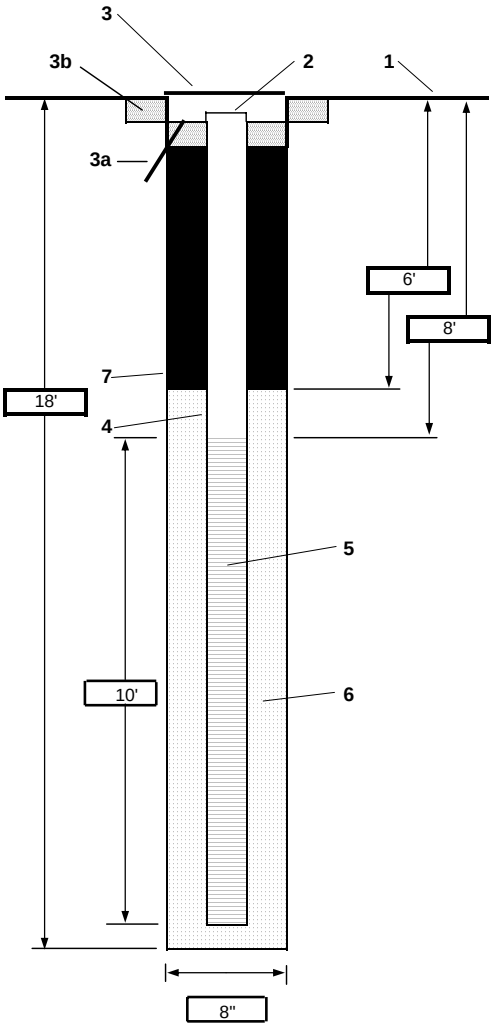
WELL COMPLETION DIAGRAM

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 3.3' bgs during installation START : 11 Aug 2003 12:00 END : 14:50 LOGGER : Laura Cook



1-	Ground elevation at well	7.7'
2-	Top of casing elevation	7.34'
3-	Wellhead protection cover type	8" steel flushmount cover
	a) drain tube?	no, sand filter installed
	b) concrete pad dimensions	24" round
4-	Dia./type of well casing	2" Schedule 40 PVC
5-	Type/slot size of screen	0.010 Slot Schedule 40 PVC
6-	Type screen filter	DSI #1 Silica Sand
	a) Quantity used	325 lbs
7-	Type of seal	3/8" hydrated bentonite chips
	a) Quantity used	75 lbs
	Grout	none
	a) Grout mix used	
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	pump and surge
	Development time	100 minutes
	Estimated purge volume	110 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
180296.FI.FS	SJS21-MW05S	SHEET 1 OF 1

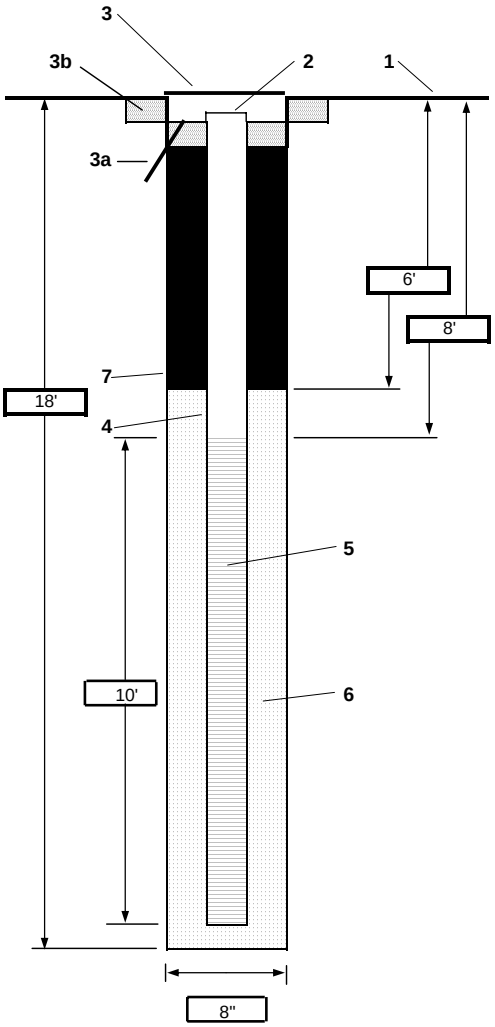
WELL COMPLETION DIAGRAM

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 22" bgs during installation START : 12 Aug 2003 07:30 END : 12:00 LOGGER : Laura Cook



1-	Ground elevation at well	7.7'
2-	Top of casing elevation	7.53'
3-	Wellhead protection cover type	8" steel flushmount cover
	a) drain tube?	no, sand filter installed
	b) concrete pad dimensions	24" round
4-	Dia./type of well casing	2" Schedule 40 PVC
5-	Type/slot size of screen	0.010 Slot Schedule 40 PVC
6-	Type screen filter	DSI #1 Silica Sand
	a) Quantity used	325 lbs
7-	Type of seal	3/8" hydrated bentonite chips
	a) Quantity used	75 lbs
	Grout	none
	a) Grout mix used	
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	pump and surge
	Development time	27 minutes
	Estimated purge volume	45 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
180296.FI.FS	SJS21-MW06S	SHEET 1 OF 1

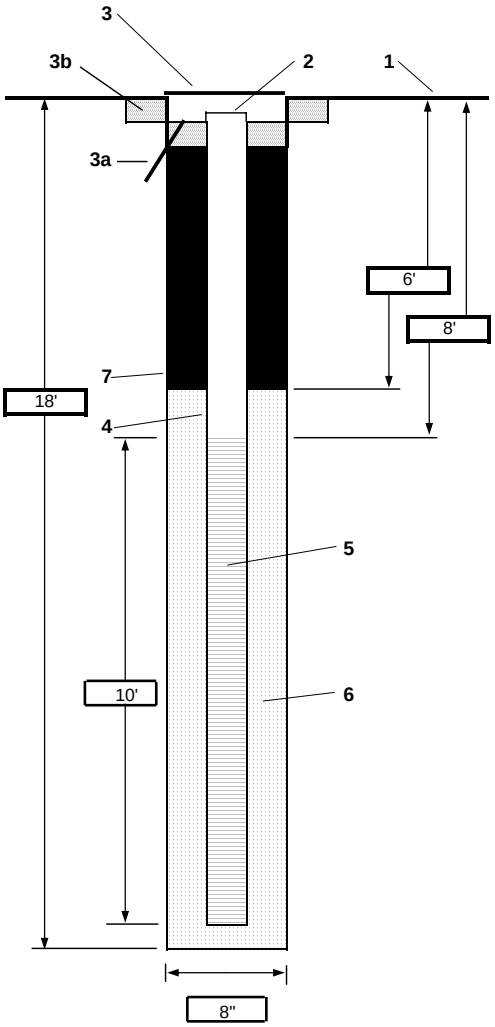
WELL COMPLETION DIAGRAM

PROJECT : SJCA Site 21 Investigation LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : CME 75 and 4.25" ID hollow stem auger

WATER LEVELS : 3.5' bgs during installation START : 12 Aug 2003 13:30 END : 15:30 LOGGER : Laura Cook



1-	Ground elevation at well	8'
2-	Top of casing elevation	7.63'
3-	Wellhead protection cover type	8" steel flushmount cover
	a) drain tube?	no, sand filter installed
	b) concrete pad dimensions	24" round
4-	Dia./type of well casing	2" Schedule 40 PVC
5-	Type/slot size of screen	0.010 Slot Schedule 40 PVC
6-	Type screen filter	DSI #1 Silica Sand
	a) Quantity used	325 lbs
7-	Type of seal	3/8" hydrated bentonite chips
	a) Quantity used	75 lbs
	Grout	none
	a) Grout mix used	
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	pump and surge
	Development time	35 minutes
	Estimated purge volume	45 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
180296.SI.DR	SJS21-MW07S	SHEET 1	OF 1

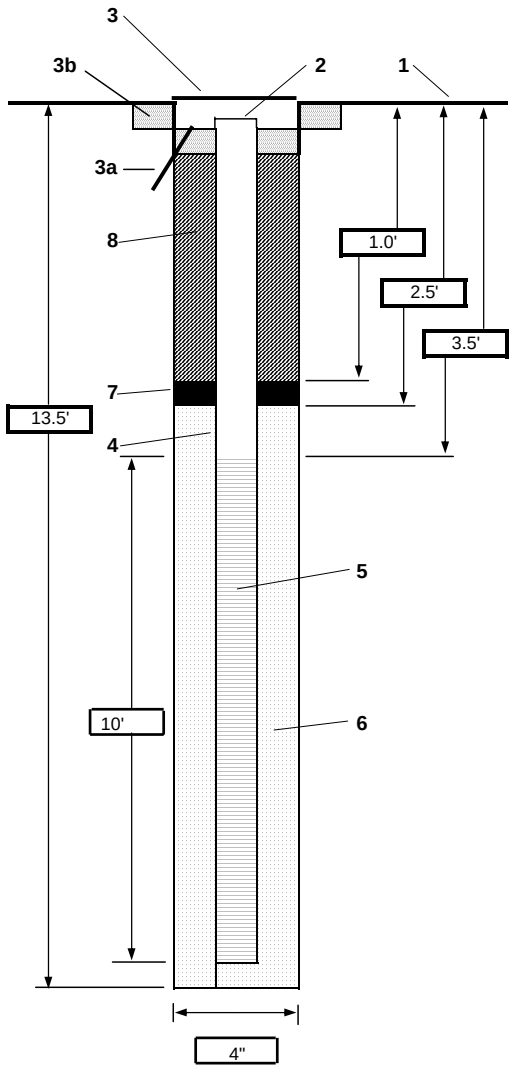
WELL COMPLETION DIAGRAM

PROJECT : St. Juliens Creek Annex — LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff — NORTHING: 3453226.15 — EASTING: 12123338.68

DRILLING METHOD AND EQUIPMENT USED : 4.25" Hollow Stem Auger

WATER LEVELS : 2.54' — START : 10 NOV 2004 1530 — END : 1730 — LOGGER : R. Ives and J. Butler



1-	Ground elevation at well	8.2 ft amsl
2-	Top of casing elevation	8.08 ft amsl
3-	Wellhead protection cover type	flush mount
	a) drain tube?	no
	b) concrete pad dimensions	~2 ft. by 2 ft. square, elevation=8.26 ft amsl
4-	Dia./type of well casing	2 " PVC Sch. 40
5-	Type/slot size of screen	2" PVC Sch. 40 10 slot
6-	Type screen filter	#1 silica pack
	a) Quantity used	2 bags
7-	Type of seal	bentonite, 3/8" chips
	a) Quantity used	1/2 bag
8-	Grout	
	a) Grout mix used	bentonite cement grout
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	whale pump
	Development time	approximately 60 minutes
	Estimated purge volume	55 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
180296.SI.DR	SJS21-MW08S	SHEET 1	OF 1

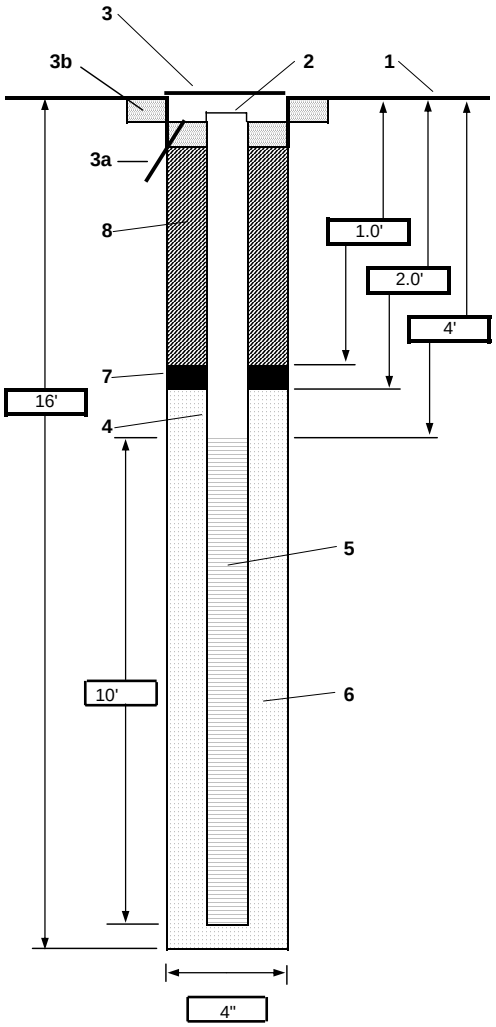
WELL COMPLETION DIAGRAM

PROJECT : St. Juliens Creek Annex LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff NORTHING: 3453236.50 EASTING: 12122904.69

DRILLING METHOD AND EQUIPMENT USED : 4.25" Hollow Stem Auger

WATER LEVELS :6.08' START : 11 NOV 2004 0830 END : 1030 LOGGER : R. Ives and J. Butler



1-	Ground elevation at well	8.70 ft amsl
2-	Top of casing elevation	8.45 ft amsl
3-	Wellhead protection cover type	flush mount
	a) drain tube?	no
	b) concrete pad dimensions	~ 2 ft. by 2 ft. square, elevation=8.73 ft amsl
4-	Dia./type of well casing	2 " PVC Sch. 40
5-	Type/slot size of screen	2" PVC Sch. 40 10 slot
6-	Type screen filter	#1 silica pack
	a) Quantity used	5 bags
7-	Type of seal	bentonite, 3/8" chips
	a) Quantity used	1/2 bag
8-	Grout	
	a) Grout mix used	bentonite cement grout
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	whale pump
	Development time	approximately 40 minutes
	Estimated purge volume	45 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
180296.SI.DR	SJS21-MW09S	SHEET 1	OF 1

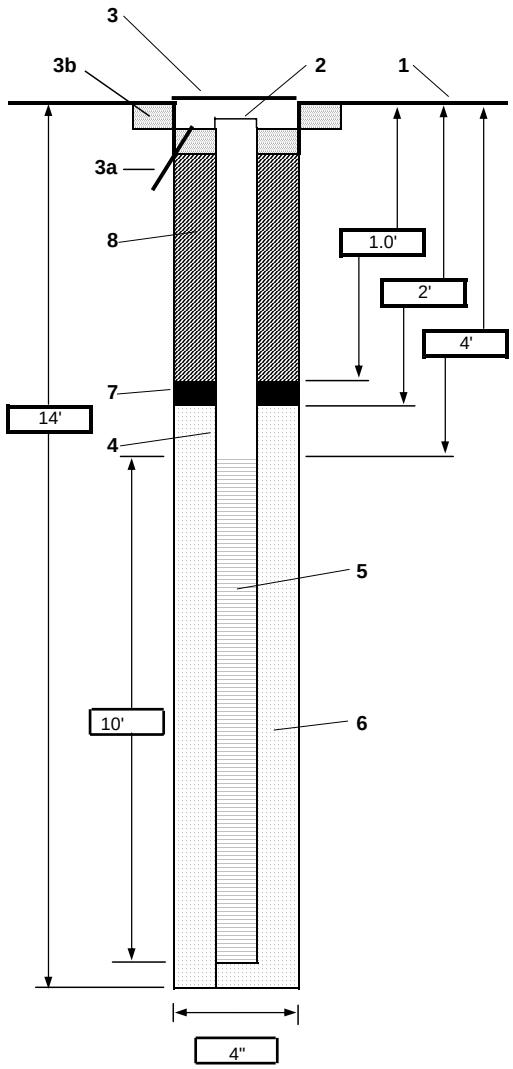
WELL COMPLETION DIAGRAM

PROJECT : St. Juliens Creek Annex — LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff — NORTHING: 3453454.90 — EASTING: 12122976.44

DRILLING METHOD AND EQUIPMENT USED : 4.25" Hollow Stem Auger

WATER LEVELS : 5.74' btc — START : 11 NOV 2004 1130 — END : 1430 — LOGGER : R. Ives and J. Butler



1- Ground elevation at well	9.05 ft amsl
2- Top of casing elevation	8.69 ft amsl
3- Wellhead protection cover type	flush mount
a) drain tube?	no
b) concrete pad dimensions	~2 ft. by 2 ft. square, elevation=9.05
4- Dia./type of well casing	2 " PVC Sch. 40
5- Type/slot size of screen	2" PVC Sch. 40 10 slot
6- Type screen filter	#1 silica pack
a) Quantity used	5.5 bags
7- Type of seal	bentonite, 3/8" chips
a) Quantity used	
8- Grout	
a) Grout mix used	bentonite cement grout
b) Method of placement	
c) Vol. of well casing grout	
Development method	whale pump
Development time	approximately 60 minutes
Estimated purge volume	40 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
180296.SI.DR	SJS21-MW10S	SHEET 1	OF 1

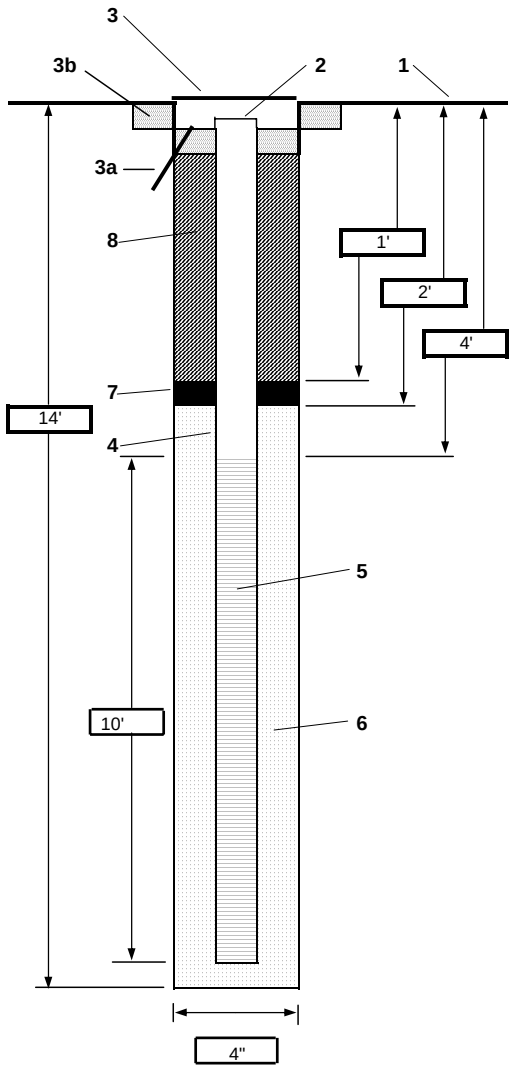
WELL COMPLETION DIAGRAM

PROJECT : St. Juliens Creek Annex — LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff — NORTHING: 3453015.58 — EASTING: 12122994.30

DRILLING METHOD AND EQUIPMENT USED : 4.25" Hollow Stem Auger

WATER LEVELS : 3.87' btc — START : 11 NOV 2004 1530 — END : 1630 — LOGGER : R. Ives and J. Butler



1-	Ground elevation at well	8.32 ft amsl
2-	Top of casing elevation	8.03 ft amsl
3-	Wellhead protection cover type	flush mount
	a) drain tube?	no
	b) concrete pad dimensions	~2 ft. by 2 ft. square, 8.35 ft amsl
4-	Dia./type of well casing	2 " PVC Sch. 40
5-	Type/slot size of screen	2" PVC Sch. 40 10 slot
6-	Type screen filter	#1 silica pack
	a) Quantity used	5 bags
7-	Type of seal	bentonite, 3/8" chips
	a) Quantity used	
8-	Grout	
	a) Grout mix used	bentonite cement grout
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	whale pump
	Development time	approximately 30 minutes
	Estimated purge volume	55 gallons

Comments

PROJECT NUMBER	WELL NUMBER		
180296.SI.DR	SJS21-MW11S	SHEET 1	OF 1

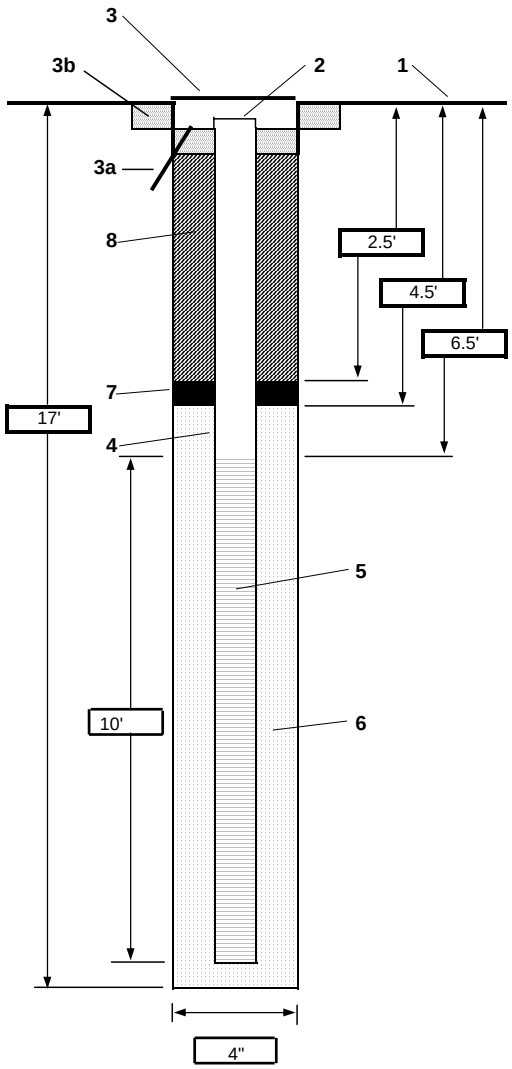
WELL COMPLETION DIAGRAM

PROJECT : St. Juliens Creek Annex — LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff — NORTHING: 3453468.56 — EASTING: 12122727.19

DRILLING METHOD AND EQUIPMENT USED : 4.25" Hollow Stem Auger

WATER LEVELS : 5.69' btc — START : 16 NOV 2004 1430 — END : 1630 — LOGGER : R. Ives and J. Butler



1-	Ground elevation at well	9.16 ft amsl
2-	Top of casing elevation	8.91 ft amsl
3-	Wellhead protection cover type	flush mount
	a) drain tube?	no
	b) concrete pad dimensions	~2 ft. by 2 ft. square, elevation=9.21 ft amsl
4-	Dia./type of well casing	2 " PVC Sch. 40
5-	Type/slot size of screen	2" PVC Sch. 40 10 slot
6-	Type screen filter	#1 silica pack
	a) Quantity used	5 bags
7-	Type of seal	bentonite, 3/8" chips
	a) Quantity used	
8-	Grout	
	a) Grout mix used	bentonite cement grout
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	whale pump
	Development time	approximately 90 minutes
	Estimated purge volume	8 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
314808.FI.FS	SJS21-MW12S	SHEET 1 OF 1

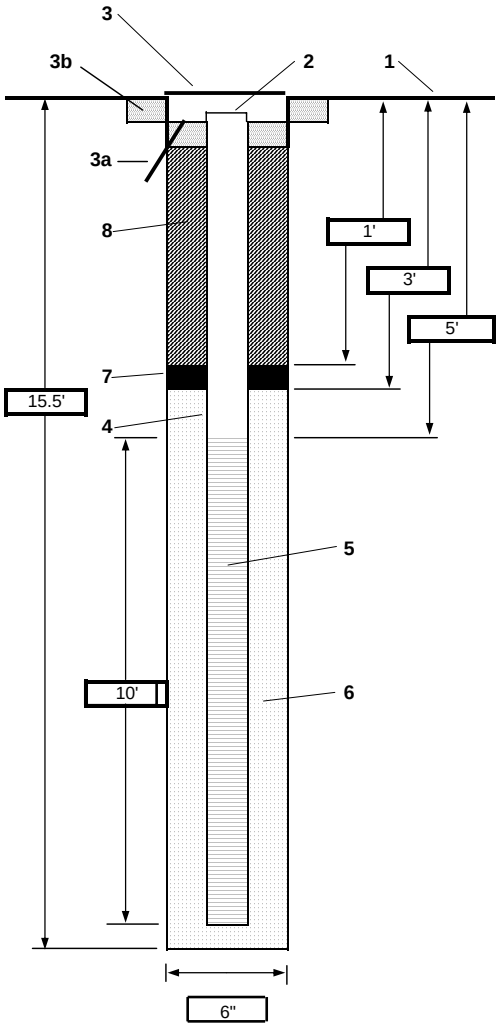
WELL COMPLETION DIAGRAM

PROJECT : CTO-014 LOCATION : St. Juliens Creek Annex Site 21

DRILLING CONTRACTOR : Parrat-Wolff NORTHING: 3453423.4690 EASTING: 12123056.1666

DRILLING METHOD AND EQUIPMENT USED : 41/4" Hollow Stem Auger

WATER LEVELS : START : 11/07/05 1655 END : 11/07/05 1810 LOGGER : C. White



1- Ground elevation at well	8.39'
2- Top of casing elevation	8.13'
3- Wellhead protection cover type:	6.0" Flushmount
a) drain tube?	No
b) concrete pad dimensions	2 ft. Diameter Round
4- Dia./type of well casing	2" PVC Sch 40
5- Type/slot size of screen	2" Sch 40 PVC .010 machine slotted
6- Type screen filter	#1 Filter Sand
a) Quantity used	6.5 Bags
7- Type of Seal	Shur Plug 3/8" chips
a) Quantity used	1 Bag
8- Grout	
a) Grout mix used	Grout Bentonite Mix
b) Method of placement	Tremie
c) Vol. of well casing grout	
Development method	Whale Pump
Development time	60 minutes
Estimated purge volume	95 gallons

Comments

PROJECT NUMBER	WELL NUMBER	
314808.FI.FS	SJS21-MW13S	SHEET 1 OF 1

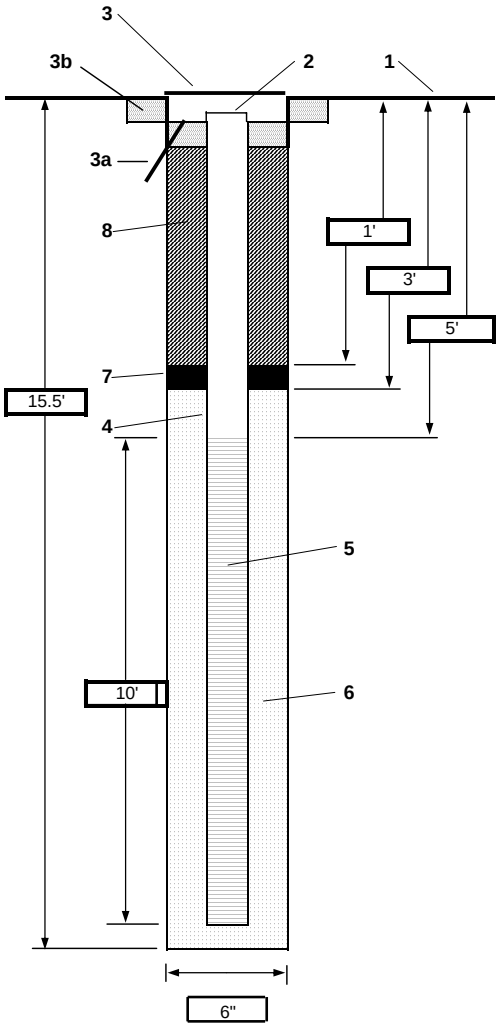
WELL COMPLETION DIAGRAM

PROJECT : CTO-014 LOCATION : St. Juliens Creek Annex Site 21

DRILLING CONTRACTOR : Parrat-Wolff NORTHING: 3453241.3220 EASTING: 12122849.8662

DRILLING METHOD AND EQUIPMENT USED : 41/4" Hollow Stem Auger

WATER LEVELS : START : 11/07/05 2055 END : 11/07/05 2240 LOGGER : C. White



1- Ground elevation at well	9.82'
2- Top of casing elevation	9.31'
3- Wellhead protection cover type:	6.0" Flushmount
a) drain tube?	No
b) concrete pad dimensions	2 ft. Diameter Round
4- Dia./type of well casing	2" PVC Sch 40
5- Type/slot size of screen	2" Sch 40 PVC .010" machine slotted
6- Type screen filter	#1 Filter Sand
a) Quantity used	6 Bags
7- Type of Seal	Shur Plug 3/8" chips
a) Quantity used	1 Bag
8- Grout	
a) Grout mix used	Bentonite/Grout mix
b) Method of placement	
c) Vol. of well casing grout	
Development method	Whale Pump
Development time	55 minutes
Estimated purge volume	90 gallons

Comments No grout used

PROJECT NUMBER	WELL NUMBER	
314808.FI.FS	SJS21-MW14S	SHEET 1 OF 1

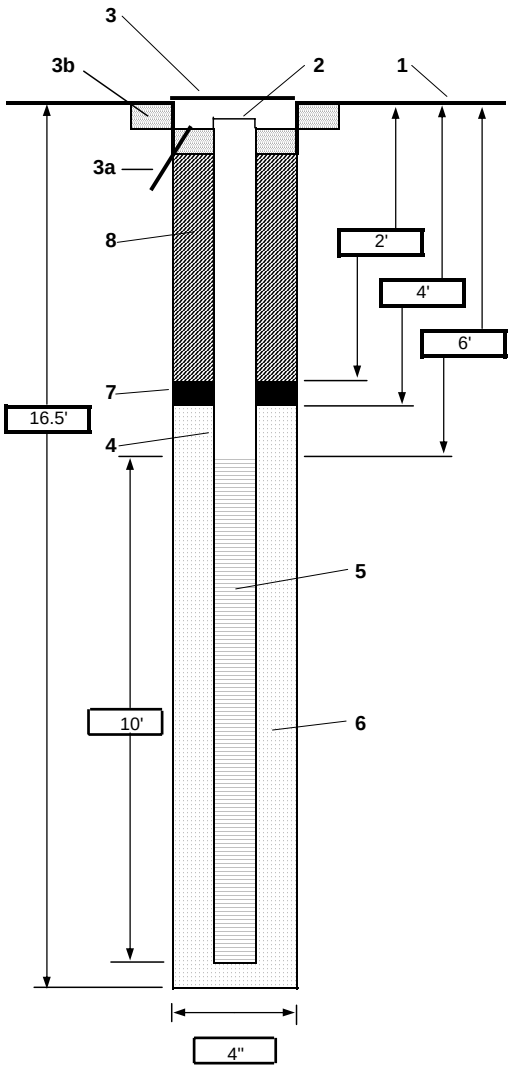
WELL COMPLETION DIAGRAM - FLUSH MOUNT

PROJECT : CTO 057 LOCATION : St. Juliens Creek Annex Site 21

DRILLING CONTRACTOR : Parratt Wolff NORTHING: 3453291.4572 EASTING: 12122932.2777

DRILLING METHOD AND EQUIPMENT USED : 4 1/4" Hollow Stem Auger

WATER LEVELS DURING DEVELOPMENT: START : 10/24/2006 0755 END : 10/24/2006 08 LOGGER : A. Jones/C. White



1- Ground elevation at well: 8.49' amsl

2- Top of casing elevation: 8.20' amsl

3- Wellhead protection cover type: 6.0" Flushmount
- a) drain tube?: No
- b) concrete pad dimensions: 2 ft. Diameter Round

4- Dia./type of well casing: 2" PVC Sch 40

5- Type/slot size of screen: 2" Sch 40 PVC .010 machine slotted

6- Type screen filter: #1 Filter Sand
- a) Quantity used:

7- Type of seal: bentonite, 3/8" chips
- a) Quantity used:

8- Grout
- a) Grout mix used: bentonite cement grout
- b) Method of placement:
- c) Vol. of well casing grout:

Development method: whale pump

Development time: approximately 2 hours

Estimated purge volume: 45 Gal

Comments:

PROJECT NUMBER	WELL NUMBER	
314808.FI.FS	SJS21-MW15S	SHEET 1 OF 1

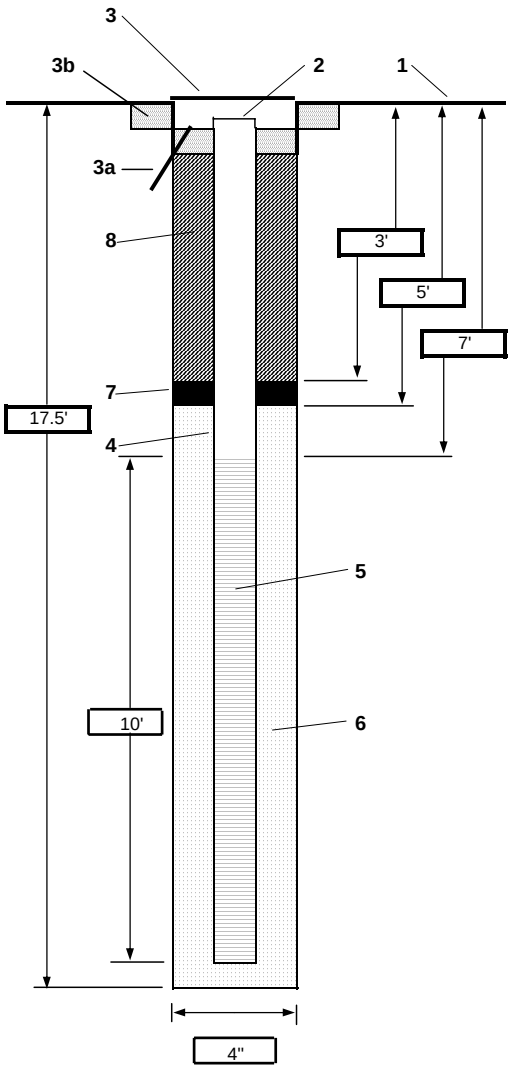
WELL COMPLETION DIAGRAM - FLUSH MOUNT

PROJECT : CTO 057 LOCATION : St. Juliens Creek Annex Site 21

DRILLING CONTRACTOR : Parratt Wolff NORTHING: 3453448.9935 EASTING: 12123054.8979

DRILLING METHOD AND EQUIPMENT USED : 41/4" Hollow Stem Auger

WATER LEVELS DURING DEVELOPMENT: START : 10/23/2006 1415 END : 10/23/2006 1510 LOGGER : A. Jones/C. White



1- Ground elevation at well: 8.27' amsl

2- Top of casing elevation: 8.02' amsl

3- Wellhead protection cover type: 6.0" Flushmount
- a) drain tube?: No
- b) concrete pad dimensions: 2 ft. Diameter Round

4- Dia./type of well casing: 2" PVC Sch 40

5- Type/slot size of screen: 2" Sch 40 PVC .010 machine slotted

6- Type screen filter: #1 Filter Sand
- a) Quantity used:

7- Type of seal: bentonite, 3/8" chips
- a) Quantity used:

8- Grout
- a) Grout mix used: bentonite cement grout
- b) Method of placement:
- c) Vol. of well casing grout:

Development method: whale pump

Development time: approximately 2 hours

Estimated purge volume: 50 Gal

Comments: Well ran dry during development

PROJECT NUMBER	WELL NUMBER	
314808.FI.FS	SJS21-MW16S	SHEET 1 OF 1

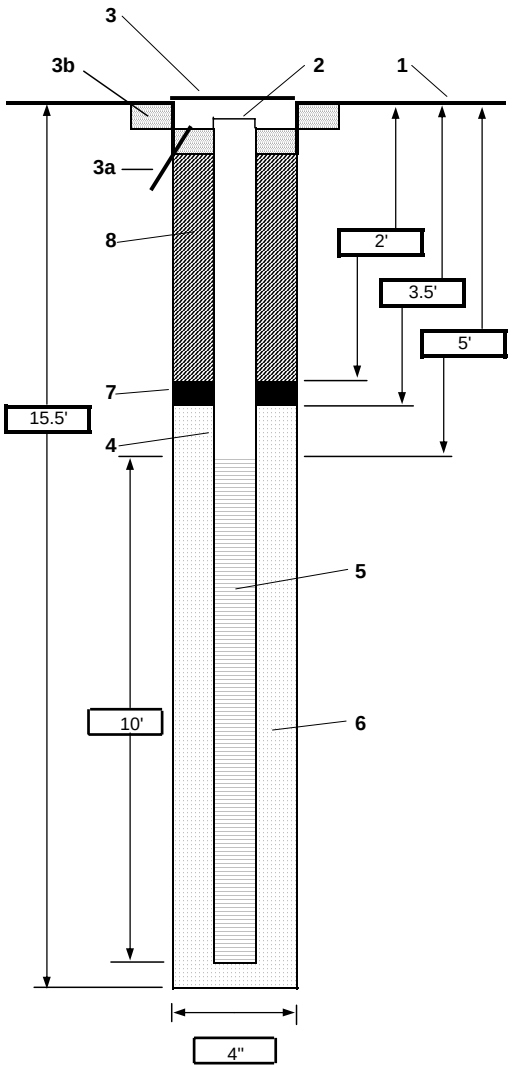
WELL COMPLETION DIAGRAM - FLUSH MOUNT

PROJECT : CTO 057 LOCATION : St. Juliens Creek Annex Site 21

DRILLING CONTRACTOR : Parratt Wolff NORTHING: 3453221.999 EASTING: 12123274.0247

DRILLING METHOD AND EQUIPMENT USED : 41/4" Hollow Stem Auger

WATER LEVELS DURING DEVELOPMENT: START : 10/25/2006 1645 END : 10/25/2006 1800 LOGGER : A. Jones/C. White



1- Ground elevation at well	7.69' amsl
2- Top of casing elevation	7.39' amsl
3- Wellhead protection cover type	6.0" Flushmount
a) drain tube?	No
b) concrete pad dimensions	2 ft. Diameter Round
4- Dia./type of well casing	2" PVC Sch 40
5- Type/slot size of screen	2" Sch 40 PVC .010 machine slotted
6- Type screen filter	#1 Filter Sand
a) Quantity used	
7- Type of seal	bentonite, 3/8" chips
a) Quantity used	
8- Grout	
a) Grout mix used	bentonite cement grout
b) Method of placement	
c) Vol. of well casing grout	
Development method	whale pump
Development time	approximately 1 hour
Estimated purge volume	70 Gal

Comments

PROJECT NUMBER	WELL NUMBER	
314808.FI.SI	SJS21-MW17S	SHEET 1 OF 1

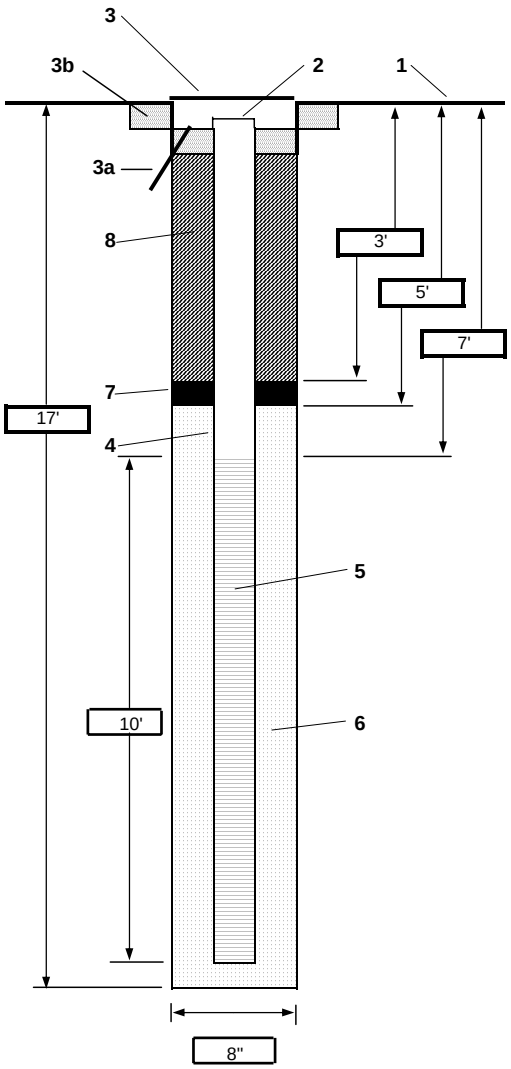
WELL COMPLETION DIAGRAM - FLUSH MOUNT

PROJECT : St. Juliens Creek Annex, CTO 057 LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff NORTHING: 3453651.4356 EASTING: 12122951.4162

DRILLING METHOD AND EQUIPMENT USED : 4 1/4" Hollow Stem Auger

WATER LEVELS DURING DEVELOPMENT: START : 02/23/2007 1403 END : 02/23/2007 1500 LOGGER : Shaun Whitmore



1- Ground elevation at well: 8.49' amsl

2- Top of casing elevation: 8.17' amsl

3- Wellhead protection cover typ: 6" steel flushmount cover
- a) drain tube?: no, sand filter installed
- b) concrete pad dimensions: 24" round

4- Dia./type of well casing: 2" Schedule 40 PVC

5- Type/slot size of screen: 0.010 Slot Schedule 40 PVC

6- Type screen filter: DSI #1 Silica Sand
- a) Quantity used:

7- Type of seal: 3/8" bentonite chips
- a) Quantity used:

8- Grout
- a) Grout mix used: Bentonite cement mix
- b) Method of placement:
- c) Vol. of well casing grout:

Development method: pump and surge

Development time: 40 minutes

Estimated purge volume: 45 Gallons

Comments:

PROJECT NUMBER	WELL NUMBER	
314808.FI.SI	SJS21-MW18S	SHEET 1 OF 1

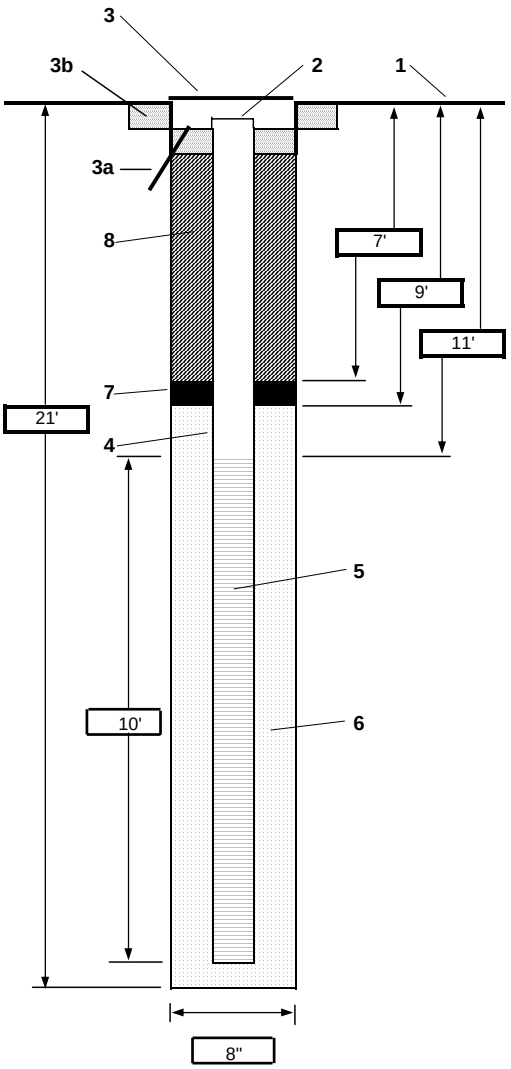
WELL COMPLETION DIAGRAM - FLUSH MOUNT

PROJECT : St. Juliens Creek Annex, CTO 057 LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff NORTHING: 3453667.5883 EASTING: 12123113.3936

DRILLING METHOD AND EQUIPMENT USED : 4 1/4" Hollow Stem Auger

WATER LEVELS DURING DEVELOPMENT: START : 02/22/2007 1410 END : 02/22/2007 1630 LOGGER : Shaun Whitmore



1- Ground elevation at well: 8.40' amsl

2- Top of casing elevation: 8.17' amsl

3- Wellhead protection cover typ: 6" steel flushmount cover
- a) drain tube?: no, sand filter installed
- b) concrete pad dimensions: 24" round

4- Dia./type of well casing: 2" Schedule 40 PVC

5- Type/slot size of screen: 0.010 Slot Schedule 40 PVC

6- Type screen filter: DSI #1 Silica Sand
- a) Quantity used:

7- Type of seal: 3/8" bentonite chips
- a) Quantity used:

8- Grout
- a) Grout mix used: Bentonite cement grout mix
- b) Method of placement:
- c) Vol. of well casing grout:

Development method: pump and surge

Development time: 30 minutes

Estimated purge volume: 45 Gallons

Comments:

PROJECT NUMBER	WELL NUMBER	
314808.FI.SI	SJS21-MW19S	SHEET 1 OF 1

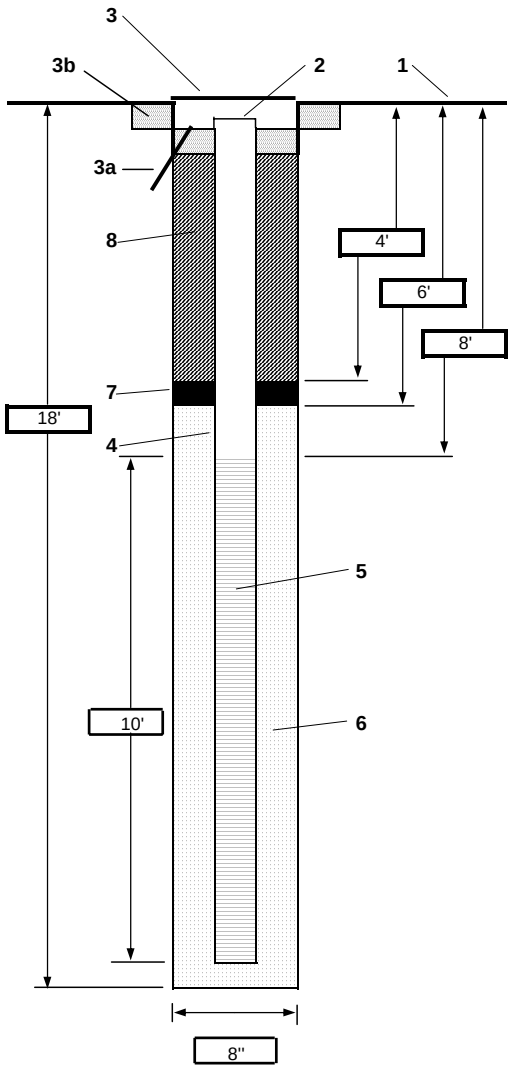
WELL COMPLETION DIAGRAM - FLUSH MOUNT

PROJECT : St. Juliens Creek Annex, CTO 057 LOCATION : Site 21

DRILLING CONTRACTOR : Parratt Wolff NORTHING: 3453672.2487 EASTING: 12123380.6932

DRILLING METHOD AND EQUIPMENT USED : 4 1/4" Hollow Stem Auger

WATER LEVELS DURING DEVELOPMENT: START : 02/23/2007 1110 END : 02/23/2007 1200 LOGGER : Shaun Whitmore



1-	Ground elevation at well	7.85' amsl
2-	Top of casing elevation	7.52' amsl
3-	Wellhead protection cover type	6" steel flushmount cover
	a) drain tube?	no, sand filter installed
	b) concrete pad dimensions	24" round
4-	Dia./type of well casing	2" Schedule 40 PVC
5-	Type/slot size of screen	0.010 Slot Schedule 40 PVC
6-	Type screen filter	DSI #1 Silica Sand
	a) Quantity used	
7-	Type of seal	3/8" bentonite chips
	a) Quantity used	
8-	Grout	
	a) Grout mix used	Bentonite cement mix
	b) Method of placement	
	c) Vol. of well casing grout	
	Development method	pump and surge
	Development time	35 minutes
	Estimated purge volume	45 Gallons

Comments

Appendix G
Data Validation Summaries

DATA VALIDATION SUMMARY
REPORT

COMPANY:	CH2M HILL
SITE NAME:	CTO-150, St. Juliens Creek Annex, Site 21 GW
CONTRACTED LAB:	GPL Laboratories, Inc.
PROJECT NUMBER:	157593.SA.SM
QA/QC LEVEL:	EPA Level IV
EPA SOW/METHOD:	EPA 1990 SOW
VALIDATION GUIDELINES:	*USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, 1994, Region III Modifications*
SAMPLE MATRIX:	Water
TYPES OF ANALYSES:	Volatile Organics, Semivolatile Organics (SVOA), Pesticides / Polychlorinated Biphenyls (PCBs), Explosives, Total Metals, Filtered Metals, Total Cyanide, Total Alkalinity, Ferrous Iron, Nitrate/Nitrite, Sulfate, Total Organic Carbon
SDG NUMBER:	412011

OVERVIEW

SAMPLES:

Client Lab Sample #	Volatile Sample #	Matrix	Organics	Pest/ SVOA	PCB
SJS21-MW06S-04D	412011-001	Water	X		
SJS21-MW07S-04DDL	412011-002	Water	X	X	X
SJS21-MW10S-04D	412011-004	Water	X	X	X
SJS21-MW05S-04D	412011-006	Water	X		
SJS21-MW11S-04D	412011-008	Water	X	X	X
SJS21-MW01S-04D	412011-010	Water	X		
SJS21-MW07S-04DMS	412011-002MS	Water	X	X	X
SJS21-MW07S-04DMSD	412011-002MSD	Water	X	X	X

Client Lab Sample #	Sample #	Matrix	Total Explosives	Filtered Metals	Metals
SJS21-MW07S-04D	412011-002	Water	X	X	
SJS21-MW07S-04D	412011-003	Water			X
SJS21-MW10S-04D	412011-004	Water	X	X	
SJS21-MW10S-04D	412011-005	Water			X
SJS21-EB113004	412011-007	Water		X	
SJS21-MW11S-04D	412011-008	Water	X	X	
SJS21-MW11S-04D	412011-009	Water			X

Client Sample #	Lab Sample #	Matrix	Total Explosives	Filtered Metals	Metals
SJS21-MW07S-04DMD	412011-002MD	Water		X	
SJS21-MW07S-04DMS	412011-002MS	Water	X	X	
SJS21-MW07S-04DMSD	412011-002MSD	Water	X		
SJS21-MW07S-04DMD	412011-003MD	Water			X
SJS21-MW07S-04DMS	412011-003MS	Water			X

Client Sample #	Lab Sample #	Total Matrix	Total Cyanide	Ferrous Alkalinity	Iron
SJS21-MW06S-04D	412011-001	Water		X	X
SJS21-MW07S-04D	412011-002	Water	X	X	X
SJS21-MW10S-04D	412011-004	Water	X	X	X
SJS21-MW05S-04D	412011-006	Water		X	X
SJS21-MW11S-04D	412011-008	Water	X	X	X
SJS21-MW01S-04D	412011-010	Water		X	X
SJS21-MW07S-04DMD	412011-002MD	Water	X	X	X
SJS21-MW07S-04DMS	412011-002MS	Water	X	X	X

Client Sample #	Lab Sample #	Nitrate/ Matrix	Nitrite	Sulfate	TOC
SJS21-MW06S-04D	412011-001	Water	X	X	X
SJS21-MW07S-04D	412011-002	Water	X	X	X
SJS21-MW10S-04D	412011-004	Water	X	X	X
SJS21-MW05S-04D	412011-006	Water	X	X	X
SJS21-MW11S-04D	412011-008	Water	X	X	X
SJS21-MW01S-04D	412011-010	Water	X	X	X
SJS21-MW07S-04DMD	412011-002MD	Water	X	X	
SJS21-MW07S-04DMS	412011-002MS	Water	X	X	X

Suffix Codes: DL = DILUTION, EB = EQUIPMENT BLANK, MD = MATRIX DUPLICATE, MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE

DATA REVIEWERS: Amy L. Hogan, Kevin C. Harmon, Monalisa B. Beasley

RELEASE SIGNATURE:

DATA QUALIFICATION SUMMARY

GPL Laboratories, Inc. - 412011- Organics and Inorganics

SAMPLES: SJS21-MW06S-04D, SJS21-MW07S-04D, SJS21-MW10S-04D, SJS21-MW05S-04D, SJS21-MW11S-04D, SJS21-MW01S-04D, SJS21-EB113004

VOLATILE ORGANICS

SUMMARY

I.) General:

The analyses for volatile organics were performed by gas chromatography / mass spectroscopy (GC / MS) using USEPA Method OLC03.2.

II.) Overall Assessment of Data:

All non-detect results for acetone, methyl acetate and 2-butanone in the SDG samples were rejected (R) based on extremely low Relative Response Factors in the Initial and Continuing Calibrations.

The Chain of Custodies for this SDG list trip blank SJS21-TB113004. No data for this sample was found in any of the nine data packages received for this project.

All other laboratory data were acceptable with qualification.

MAJOR ISSUES

Initial Calibration:

The Average Relative Response Factors (RRFs) for the standards analyzed on 10/31/04 on instrument E were below the 0.050 QC limit for the following compounds:

acetone	0.019
methyl acetate	0.045
2-butanone	0.025

The positive result for methyl acetate in SDG sample SJS21-MW11S-04D was flagged as

estimated (J). while all other results for these compounds in the SDG samples, which consisted entirely of non-detects, were rejected (R).

Continuing Calibrations:

The Relative Response Factors (RRFs) for the standards run on 12/08/04 at 14:36 on instrument E were below the 0.050 QC limit for the following compounds:

acetone	0.022
2-butanone	0.030

All results for these compounds in the associated samples were previously flagged based on the Initial Calibration, so no further action was required.

The Relative Response Factors (RRFs) for the standards run on 12/09/04 at 11:28 on instrument E were below the 0.050 QC limit for the following compounds:

acetone	0.018
methyl acetate	0.041
2-butanone	0.023

All results for these compounds in the associated samples were previously flagged based on the Initial Calibration, so no further action was required.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC / MS Tuning:

All GC / MS Tuning criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviation (%RSD) was 40.3% for methlyene chloride for the standards analyzed on 10/31/04 on instrument E, which exceeded the 30% QC limit. The positive result for methylene chloride in associated sample SJS21-MW11S-04D was flagged as estimated (J).

Continuing Calibration:

The Percent Differences (%D's) for the standards run on 12/08/04 at 14:36 on instrument E exceeded the 25% QC limit for the following compounds:

bromomethane	38.6%
carbon disulfide	25.2%
methyl acetate	182%

The results for methyl acetate in the associated SDG samples were previously flagged based on the Initial Calibratio. The positive results for carbon disulfide in associated sample SJS21-MW05S-04D and SJS21-MW11S-04D were flagged as estimated (J). There were no positive results for bromomethane in the associated samples, so no further action was required.

The Percent Difference (%D) of 27.4% for methylene chloride for the standards run on 12/09/04 at

11:28 on instrument E exceeded the 25% QC limit. Since the result for methlyene chloride in the associated sample was a non-detect, no action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this SDG. No action was required.

Holding Blank:

Trichloroethene was detected at 2.5 ug/L in the Holding Blank for this SDG. All positive results for trichloroethene in the SDG samples less than 5X the blank amount were flagged as suspected blank contamination (B).

Tentatively Identified Compounds (TIC):

There were no TIC detections in the blanks associated with this SDG. No action was required.

V.) Surrogate Recoveries:

The Percent Recoveries (%R's) of bromoform-d5, trans-1,3-dichlorobenzene-d4 and 1,1-dichloroethene-d2 were outside their 76-135%, 80-128% and 65-130% QC limits, respectively, for the following samples:

Sample Identification	bromoform-d5 %R	trans-1,3-dichlorobenzene-d5 %R	1,1-dichloroethene-d2 %R
BLK70879	54%		
SJS21-MW01S-04D			61%
SJS21-MW05S-04D	75%		64%
SJS21-MW10S-04D	64%	79%	63%
SJS21-MW11S-04D	74%	79%	64%
BLK70908	64%		
Holding Blank			44%
SJS21-MW07S-04DDL	70%		

All positive and non-detect results for samples SJS21-MW05S-04D, SJS21-MW10S-04D and SJS21-MW11S-04D were flagged as potentially biased low (L) and (UL). All positive and non-detect results for samples SJS21-MW01S-04D and SJS21-MW07S-04DDL were flagged as estimated (J) and (UJ). Since the other samples were QC samples, no further action was required.

VI.) Laboratory Control Samples (LCS):

Two LCSs were analyzed by the laboratory. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample SJS21-MW07S-04D. Two Relative Percent Differences (RPDs) and one Percent Recovery (%R) exceeded the QC limits. Data qualification based on MS / MSD criteria was not required. No action was taken.

VIII.) Field Duplicates:

There were no field duplicate samples identified for this fraction of the SDG. No action was required.

IX.) Internal Standards Performance (ISTD):

All ISTD criteria were met. No action was required.

X.) TCL Compound Identification:

The Retention Time Difference (delta RRT) exceeded the 0.06 minute QC limit for the following compounds:

Sample	Compound	Delta RRT
SJS21-MW06S-04D	chloromethane	0.11
SJS21-MW07S-04DDL	chloromethane	0.09
SJS21-MW11S-04D	dichlorodifluoromethane	0.17
	chloromethane	0.09

Based on professional judgment, the results for these compounds in the listed SDG samples were flagged as estimated (J).

XI.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):

All CRQL criteria were met. No action was required.

XII.) Tentatively Identified Compounds (TIC):

All TIC criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was required.

SEMIVOLATILE ORGANICS

SUMMARY

I.) General:

The analyses for semivolatile organics were performed by gas chromatography / mass spectroscopy (GC / MS) using USEPA Method OLM04.3.

II.) Overall Assessment of Data:

All non-detect results for atrazine for the SDG samples were rejected (R) based on an extremely low Relative Response Factor in the Continuing Calibrations.

All other laboratory data were acceptable with qualification.

MAJOR ISSUES

Continuing:

The Relative Response Factor (RRF) was 0.045 for atrazine for the standards run on 12/08/04 at

13:37 on instrument H, which was below the 0.050 QC limit. All results for atrazine in the SDG samples, which consisted entirely of non-detects, were rejected (R).

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC / MS Tuning:

All GC / MS Tuning criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviation (%RSD) for the standards analyzed on 11/05/04 on instrument H exceeded the 30% QC limit for atrazine at 37.0%. All results for atrazine in the SDG samples were previously rejected, so no further action was required.

Continuing Calibration:

The Percent Differences (%D's) for the standards run on 12/08/04 at 13:37 on instrument H exceeded the 25% QC limit for the following compounds:

atrazine	64.3%
benzaldehyde	28.6%
hexachlorobutadiene	26.1%
2-nitroaniline	26.4%

The results for atrazine in the SDG samples were previously rejected. There were no positive results for the other compounds in the SDG samples, so no further action was required.

IV.) Blanks:

Bis(2-ethylhexyl)phthalate and di-n-butylphthalate were detected at 5.2 ug/L and 3.1 ug/L, respectively, in method blank BLK70703. All positive results for these two compounds in the SDG samples less than 10X the blank amount were flagged as suspected blank contamination (B).

Tentatively Identified Compounds (TIC):

Hexadecanoic acid was detected at 15 ug/L in method blank BLK70703. All postive results for hexadecanoic acid in the SDG samples less than 10X the blank amount were flagged as suspected blank contamination (B).

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

One LCS was analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample SJS21-MW07S-04D. A total of five Percent Recoveries (%Rs) exceeded the QC limits. Data qualification based on MS/MSD criteria was not required. No action was taken.

VIII.) Field Duplicates:

There were no field duplicate samples identified for this SDG. No action was required.

IX.) Internal Standards Performance (ISTD):

All ISTD criteria were met. No action was required.

X.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

XI.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):

All CRQL criteria were met. No action was required.

XII.) Tentatively Identified Compounds (TIC):

All TIC criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was required.

PESTICIDES / PCBS

SUMMARY

I.) General:

The analyses for Pesticides / PCBs were performed by gas chromatography (GC) using USEPA Method OLM04.3.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

There were no major problems for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

One LCS was analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample SJS21-MW07S-04D. All MS/MSD criteria were met. No action was required.

VIII.) Field Duplicates:

There were no field duplicate samples identified for this SDG. No action was required.

IX.) Florisil Cleanup:

All Florisil Cleanup criteria were met. No action was required.

X.) GPC Cleanup:

GPC Cleanup was not required for this SDG. No action was taken.

XI.) Pesticide / PCB Identification Summary (PIS):

All PIS criteria were met. No action was required.

XII.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):

All CRQL criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was required.

EXPLOSIVES

SUMMARY

I.) General:

The analyses for Explosives were performed by gas chromatography (GC) using SW846 Method 8330.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

There were no major problems for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

One LCS was analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample SJS21-MW07S-04D. Two Percent Recoveries (%R's) exceeded the QC limits. Data qualification based on MS/MSD criteria was not required. No action was taken.

VIII.) Field Duplicates:

There were no field duplicate samples identified for this SDG. No action was required.

IX.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):

All CRQL criteria were met. No action was required.

X.) System Performance:

All System Performance criteria were met. No action was required.

TOTAL AND FILTERED METALS

SUMMARY

I.) General:

The analyses for Total and Filtered Metals were performed using USEPA Method ILM04.1.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualification.

MAJOR ISSUES

There were no major problems associated with this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

III.) CRDL Standards for ICP:

All CRDL criteria were met. No action was required.

IV.) Blanks:

The following blank results represent the highest detections associated with the samples and were used for data qualification:

Blank Type / ID#	Analyte	Max. Conc.	Action Level
CCB3	aluminum	31.6 ug/L	160 ug/L
CCB2	barium	0.3 ug/L	1.5 ug/L
CCB3	calcium	77.5 ug/L	390 ug/L
CCB3	iron	20.2 ug/L	100 ug/L
CCB3	magnesium	82.7 ug/L	410 ug/L
SJS21-EB113004	manganese	0.40 ug/L	2.0 ug/L
SJS21-EB113004	zinc	1.1 ug/L	5.5 ug/L

CCB = Continuing Calibration Blank, EB = Equipment Blank

All associated sample results, which were less than 5X the blank amount, were flagged as suspected blank contamination (B).

IV.) ICP Interference Check Sample Results:

All Interference Percent Recovery criteria were met. No action was required.

The following analytes were detected in the ICS Solution A with results greater than the IDL:

antimony	1 ug/L
barium	3 ug/L

beryllium	1 ug/L
boron	3 ug/L
cadmium	3 ug/L
cobalt	3 ug/L
lead	2 ug/L
manganese	13 ug/L
nickel	2 ug/L
selenium	3 ug/L
sodium	203 ug/L
thallium	10 ug/L
vanadium	1 ug/L
zinc	22 ug/L

These analytes should not be present. Since neither aluminum, calcium, iron nor magnesium was detected in any sample at a concentration comparable to or greater than the respective concentration in ICS Solution A, data qualification was not required.
The following analytes had negative results in the ICS Solution A with the absolute value greater than the IDL:

arsenic	-1 ug/L
copper	-1 ug/L
molybdenum	-1 ug/L
potassium	-9 ug/L

These analytes should not be present. Since neither aluminum, calcium, iron nor magnesium was detected in any sample at a concentration comparable to or greater than the respective concentration in ICS Solution A, data qualification was not required.

V.) ICP Serial Dilution Analysis:

All Serial Dilution Analysis criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

VII.) Duplicate Sample Analysis:

MD analyses were performed on total and filtered SDG samples SJS21-MW07S-04D. All MD criteria were met. No action was required.

VIII.) Matrix Spike (MS):

MS analyses were performed on total and filtered SDG samples SJS21-MW07S-04D. All MS criteria were met. No action was required.

IX.) Field Duplicates:

There were no field duplicate samples identified for this SDG. No action was required.

X.) Total / Filtered:

The filtered metals results for calcium, cobalt and nickel were greater than the total metals results in sample SJS21-MW07S-04D. All calculated Percent Differences (%Ds) were within the 15% QC limit, so no action was required.

The filtered metals results for calcium, nickel, potassium and sodium were greater than the total metals results in sample SJS21-MW10S-04D. All calculated Percent Differences (%Ds) were within the 15% QC limit, so no action was required.

The filtered metals results for cobalt and manganese were greater than the total metals results in sample SJS21-MW11S-04D. All calculated Percent Differences (%Ds) were within the 15% QC limit, so no action was required.

XI.) Sample Result, Calculation/Transcription Verification:

All criteria were met. No action was taken.

XII.) Quarterly Verification of Instrumental Parameters:

All criteria were met. No action was taken.

TOTAL CYANIDE

SUMMARY

I.) General:

The analyses for total cyanide were made using EPA Method ILM04.1.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections in the method blanks associated with this fraction of the SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

MD analysis was performed on SDG sample SJS21-MW07S-04D. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):

MS analysis was performed on SDG sample SJS21-MW07S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

There were no field duplicate samples identified for this fraction of the SDG. No action was required.

TOTAL ALKALINITY

SUMMARY

I.) General:

The analyses for Total Alkalinity were made using USEPA Method 310.1.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

Blank criteria were not required for this fraction of the SDG. No action was taken.

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

MD analysis was performed on SDG sample SJS21-MW07S-04D. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):
MS analysis was performed on SDG sample SJS21-MW07S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

There were no field duplicate samples identified for this SDG. No action was required.

FERROUS IRON

SUMMARY

I.) General:

The analyses for Ferrous Iron were made using Standards Method 3500-Fe.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

MD analysis was performed on SDG sample SJS21-MW07S-04D. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):

MS analysis was performed on SDG sample SJS21-MW07S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

There were no Field duplicate samples identified for this SDG. No action was required.

NITRATE/NITRITE

SUMMARY

I.) General:

The analyses for Nitrate/Nitrite were made using USEPA Method 353.2.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

MD analysis was performed on SDG sample SJS21-MW07S-04D. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):

MS analysis was performed on SDG sample SJS21-MW07S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

There were no field duplicate samples identified for this SDG. No action was required.

SULFATE

SUMMARY

I.) General:

The analyses for Sulfate were made using USEPA method 375.4.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

MD analysis was performed on SDG sample SJS21-MW07S-04D. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):

MS analysis was performed on SDG sample SJS21-MW07S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

There were no field duplicate samples identified for this SDG. No action was required.

TOC

SUMMARY

I.) General:

The analyses for TOC were made using SW-846 Method 9060.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

LCS criteria was not required. No action was taken.

V.) Matrix Duplicate (MD):

MD criteria was not required. No action was taken.

VI.) Matrix Spike (MS):

MS analyses were performed on SDG sample SJS21-MW07S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

There were no field duplicate samples identified for this SDG. No action was required.

DATA VALIDATION SUMMARY
REPORT

COMPANY:	CH2M HILL
SITE NAME:	CTO-150, St. Juliens Creek Annex, Site 21 GW
CONTRACTED LAB:	GPL Laboratories, Inc.
PROJECT NUMBER:	157593.SA.SM
QA/QC LEVEL:	EPA Level IV
EPA SOW/METHOD:	EPA 1990 SOW
VALIDATION GUIDELINES:	*USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, 1994, Region III Modifications*
SAMPLE MATRIX:	Water
TYPES OF ANALYSES:	Volatile Organics, Semivolatile Organics (SVOA), Pesticides / Polychlorinated Biphenyls (PCBs), Explosives, Total Metals, Filtered Metals, Total Cyanide, Total Alkalinity, Nitrate/Nitrite, Sulfate, Total Organic Carbon (TOC)
SDG NUMBER:	412022

OVERVIEW

SAMPLES:

Client Sample #	Lab Sample #	Matrix	Volatile Organics	Pest/ SVOA	PCB
SJS21-MW09S-04D	412022-001	Water	X	X	X
SJS21-MW09S-04DDL	412022-001DL	Water	X		
SJS21-MW09S-04DP	412022-003	Water	X	X	X
SJS21-MW09S-04DPDL	412022-003DL	Water	X		
SJS21-MW02S-04D	412022-005	Water	X		
SJS21-MW02S-04DDL	412022-005DL	Water	X		
SJS21-MW08S-04D	412022-006	Water	X	X	X

Client Sample #	Lab Sample #	Matrix	Volatile Pest/ Organics	SVOA	PCB
SJS21-MW08S-04DDL	412022-006DL	Water	X		
SJS21-MW02S-04DP	412022-007	Water	X		
SJS21-MW02S-04DPDL	412022-007DL	Water	X		
SJS21-MW04S-04D	412022-010	Water	X		
SJS21-MW04S-04DDL	412022-010DL	Water	X		
SJS21-FB120104	412022-011	Water	X	X	X
SJS21-MW01D-04D	412022-012	Water	X		

Client Sample #	Lab Sample #	Matrix	Volatile Organics	Pest/ SVOA	PCB
SJS21-MW03S-04D	412022-013	Water	X		
SJS21-MW09S-04DMS	412022-001MS	Water	X		
SJS21-MW09S-04DMSD	412022-001MSD	Water	X		

Client Sample #	Lab Sample #	Matrix	Total Explosives	Filtered Metals	Metals
SJS21-MW09S-04D	412022-001	Water	X	X	
SJS21-MW09S-04D	412022-002	Water			X
SJS21-MW09S-04DP	412022-003	Water	X	X	
SJS21-MW09S-04DP	412022-004	Water			X
SJS21-MW08S-04D	412022-006	Water	X	X	
SJS21-MW02S-04DP	412022-007	Water			
SJS21-MW01D-04D	412022-009	Water			X
SJS21-FB120104	412022-011	Water	X	X	
SJS21-MW01D-04D	412022-012	Water		X	
SJS21-MW03S-04D	412022-013	Water	X		
SJS21-MW08S-04D	412022-016	Water			X
SJS21-MW09S-04DPMD	412022-003MD	Water		X	
SJS21-MW09S-04DPMS	412022-003MS	Water		X	

Client Sample #	Lab Sample #	Matrix	Total Cyanide	Total Alkalinity	Nitrate/ Nitrite
SJS21-MW09S-04D	412022-001	Water	X	X	X
SJS21-MW09S-04DP	412022-003	Water	X	X	X
SJS21-MW02S-04D	412022-005	Water		X	X
SJS21-MW08S-04D	412022-006	Water	X	X	X
SJS21-MW02S-04DP	412022-007	Water		X	X
SJS21-MW04S-04D	412022-010	Water		X	X
SJS21-FB120104	412022-011	Water	X	X	X
SJS21-MW01D-04D	412022-012	Water	X	X	X
SJS21-MW03S-04D	412022-013	Water		X	X
SJS21-MW09S-04DMD	412022-001MD	Water	X		X
SJS21-MW09S-04DMS	412022-001MS	Water	X		X

Client Sample #	Lab Sample #	Matrix	Sulfate	TOC
SJS21-MW09S-04D	412022-001	Water	X	X
SJS21-MW09S-04DP	412022-003	Water	X	X
SJS21-MW02S-04D	412022-005	Water	X	X
SJS21-MW08S-04D	412022-006	Water	X	X
SJS21-MW02S-04DP	412022-007	Water	X	X
SJS21-MW04S-04D	412022-010	Water	X	X
SJS21-FB120104	412022-011	Water	X	X
SJS21-MW01D-04D	412022-012	Water	X	X
SJS21-MW03S-04D	412022-013	Water		X

Client Sample #	Lab Sample #	Matrix	Sulfate	TOC
SJS21-MW02S-04DMS	412022-005MS	Water		X
SJS21-MW03S-04DMS	412022-013MS	Water		X

Suffix Codes: DL = DILUTION, FB = FIELD BLANK, MD = MATRIX DUPLICATE, MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE, P = FIELD DUPLICATE

DATA REVIEWERS: Amy L. Hogan, Kevin C. Harmon, Monalisa B. Beasley

RELEASE SIGNATURE:

DATA QUALIFICATION SUMMARY

GPL Laboratories, Inc. - 412022- Organics and Inorganics

SAMPLES: SJS21-MW09S-04D, SJS21-MW09S-04DP, SJS21-MW02S-04D, SJS21-MW08S-04D , SJS21-MW02S-04DP, SJS21-MW04S-04D, SJS21-FB120104, SJS21-MW01D-04D, SJS21-MW03S-04D

VOLATILE ORGANICS

SUMMARY

I.) General:

The analyses for volatile organics were performed by gas chromatography / mass spectroscopy (GC / MS) using USEPA Method OLC03.2.

II.) Overall Assessment of Data:

All non-detect results for acetone, methyl acetate and 2-butanone in the SDG samples were rejected (R) based on extremely low Relative Response Factors in the Initial and Continuing Calibrations.

The laboratory Case Narrative stated that the trip blank associated with this SDG was lost during analysis. It appears that the trip blank was not listed on the associated Chain-of-Custodies for this SDG, so a client ID sample is not available. No action was taken since identification and sample references could not be established.

All other laboratory data were acceptable with qualification.

MAJOR ISSUES

Initial Calibration:

The Average Relative Response Factors (RRFs) for the standards analyzed on 10/31/04 on instrument E were below the 0.050 QC limit for the following compounds:

acetone	0.019
methyle acetate	0.045
2-butanone	0.025

The positive result for acetone in SDG sample SJS21-MW04S-04D was flagged as estimated (J), while all other results for these compounds in the SDG samples, which consisted entirely of non-detects, were rejected (R).

Continuing Calibrations:

The Relative Response Factors (RRFs) for the standards run on 12/03/04 at 14:49 on instrument E were below the 0.050 QC limit for the following compounds:

acetone	0.019
methyl acetate	0.044
2-butanone	0.024

All results for these compounds in the associated samples were previously flagged based on the Initial Calibration, so no further action was required.

The Relative Response Factors (RRFs) for the standards run on 12/05/04 at 08:25 on instrument E were below the 0.050 QC limit for the following compounds:

acetone	0.025
2-butanone	0.025

All results for these compounds in the associated samples were previously flagged based on the Initial Calibration, so no further action was required.

The Relative Response Factors (RRFs) for the standards run on 12/06/04 at 10:33 on instrument E were below the 0.050 QC limit for the following compounds:

acetone	0.022
methyl acetate	0.048
2-butanone	0.025

All results for these compounds in the associated samples were previously flagged based on the Initial Calibration, so no further action was required.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC / MS Tuning:

All GC / MS Tuning criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviation (%RSD) was 40.3% for methlyene chloride for the standards analyzed on 10/31/04 on instrument E, which exceeded the 30% QC limit. Since there were no positive results for methylene chloride in the SDG samples, no action was required.

Continuing Calibration:

The Percent Differences (%D's) for the standards run on 12/03/04 at 14:49 on instrument E exceeded the 25% QC limit for the following compounds:

chloromethane	34.7%
bromomethane	38.0%
methylene chloride	25.6%

There were no positive results for these compounds in the associated SDG samples, so no action was required.

The Percent Differences (%D) for the standards run on 12/05/04 at 08:25 on instrument E exceeded the 25% QC limit for the following compounds:

acetone	36.0%
chloromethane	45.3%
methyl acetate	33.7%
bromoform	27.3%

There were no positive results for these compounds in the associated SDG samples, so no action was required.

The Percent Difference (%D) for the standards run on 12/06/04 at 10:33 on instrument E was 26.0% for methylene chloride, which exceeded the 25% QC limit. Since the associated sample was a QC sample, no action was required.

IV.) Blanks:

Method Blanks:

Chloromethane was detected at 0.42 ug/L in method blank BLK71090. Since the associated sample

was a QC sample, no action was required.

Holding Blank:

Chloromethane was detected at 0.42 ug/L in the Holding Blank for this SDG. There were no positive results for chloromethane in the SDG samples, so no action was required.

Field Blanks:

There were no detections in the field blanks associated with this SDG. No action was required.

Tentatively Identified Compounds (TIC):

1-tridecene was detected at 1 ug/L in method blank BLK71080. Since there were no detections of 1-tridecene in the associated SDG samples, no action was required.

V.) Surrogate Recoveries:

The Percent Recoveries (%R's) of bromoform-d5, trans-1,3-dichlorobenzene-d4 and 1,1-dichloroethene-d2 were outside their 76-135%, 80-128% and 65-130% QC limits, respectively, for the following samples:

Sample Identification	bromoform-d5 %R	trans-1,3-dichlorobenzene-d5 %R	1,1-dichloroethene-d2 %R
BLK71080	73%		
SJS21-FB120104	69%		
BLK71088	75%		
SJS21-MW01D-04D	53%	70%	59%
SJS21-MW02S-04DDL	74%		
SJS21-MW08S-04DDL	72%		
SJS21-MW09S-04DDL	70%		
Holding Blank			58%

All positive and non-detect results for sample SJS21-MW01D-04D were flagged as potentially biased low (L) and (UL). All positive and non-detect results for samples SJS21-MW02S-04DDL, SJS21-MW08S-04DDL and SJS21-MW09S-04DDL flagged as estimated (J) and (UJ), unless rejected based on other criteria. Since the other samples were QC samples, no further action was required.

The Percent Recovery (%R) of 1,2-dichloropropane-d4 was 182% for sample SJS21-MW08S-04D, which exceeded the 84-123% QC limits. All positive and non-detect results for this compound were flagged as estimated (J) and (UJ).

VI.) Laboratory Control Samples (LCS):

Three LCSs were analyzed by the laboratory. All LCS criteria were met.
No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were performed on SDG sample SJS21-MW09S-04D. One Relative Percent Difference (RPD) and three Percent Recoveries (%Rs) were outside the QC limits. Data qualification based on MS / MSD criteria was not required. No action was taken.

VIII.) Field Duplicates:

Two sets of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP and SJS21-MW02S-04D / SJS21-MW02S-04DP) were identified for this fraction of the SDG. The calculable Relative Percent Differences (RPDs) were:

Compound	SJS02-MW09S-04D	SJS02-MW09S-04DP	RPD
1,1-dichloroethene	0.47 ug/L	0.46 ug/L	2.2%
benzene	89 ug/L	75 ug/L	17%
cyclohexane	7.6 ug/L	8.1 ug/L	6.4%
isopropylbenzene	1.5 ug/L	1.7 ug/L	12%
methylcyclohexane	1.2 ug/L	1.4 ug/L	15%
toluene	1.1 ug/L	1.2 ug/L	8.7%
total xylenes	0.54 ug/L	0.58 ug/L	7.1%
trichloroethene	0.34 ug/L	0.38 ug/L	11%
vinyl chloride	2.3 ug/L	2.1 ug/L	9.1%
cis-1,2-dichloroethene	8.5 ug/L	8.1 ug/L	4.8%
trans-1,2-dichloroethene	0.73 ug/L	0.68 ug/L	7.1%

Compound	SJS02-MW02S-04D	SJS21-MW02S-04DP	RPD
1,1-dichloroethene	4.9 ug/L	5.0 ug/L	2.0%
carbon disulfide	0.44 ug/L	0.59 ug/L	29%
dichlorodifluoromethane	0.40 ug/L	0.36 ug/L	11%
freon 113	0.50 ug/L	0.45 ug/L	11%
tichloroethene	1400 ug/L	1400 ug/L	0%
vinyl chloride	4.8 ug/L	5.0 ug/L	4.1%
cis-1,2-dichloroethene	530 ug/L	540 ug/L	1.9%
trans-1,2-dichloroethene	5.9 ug/L	5.8 ug/L	1.7%

All RPDs were within the 30% QC limit for water samples. No action was required.

IX.) Internal Standards Performance (ISTD):

All ISTD criteria were met. No action was required.

X.) TCL Compound Identification:

The Retention Time Difference (delta RRT) exceeded the 0.06 minute QC limit for the following compounds:

Sample	Compound	Delta RRT
SJS21-MW02S-04D	trichloroethene	0.09
SJS02-MW02S-04DDL	chloromethane	0.09

The results for these compounds in the listed samples were rejected based on dilution criteria, so no further action was required.

XI.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):

The result for benzene in the initial analysis of sample SJS21-MW09S-04D exceeded the linear calibration range. A dilution analysis was performed with all calibration criteria met. The result for benzene in the initial analysis and the results for all compounds except benzene in the dilution analysis were rejected (R) based on data redundancy.

The result for benzene in the initial analysis of sample SJS21-MW09S-04DP exceeded the linear calibration range. A dilution analysis was performed with all calibration criteria met. The result for benzene in the initial analysis and the results for all compounds except benzene in the dilution analysis were rejected (R) based on data redundancy.

The results for trichloroethene and cis-1,2-dichloroethene in the initial analysis of sample SJS21-MW02S-04D exceeded the linear calibration range. A dilution analysis was performed with all calibration criteria met. The results for trichloroethene and cis-1,2-dichloroethene in the initial analysis and the results for all compounds except trichloroethene and cis-1,2-dichloroethene in the dilution analysis were rejected (R) based on data redundancy.

The results for trichloroethene and cis-1,2-dichloroethene in the initial analysis of sample SJS21-MW08S-04D exceeded the linear calibration range. A dilution analysis was performed with all calibration criteria met. The results for trichloroethene and cis-1,2-dichloroethene in the initial analysis and the results for all compounds except trichloroethene and cis-1,2-dichloroethene in the dilution analysis were rejected (R) based on data redundancy.

The results for trichloroethene and cis-1,2-dichloroethene in the initial analysis of sample SJS21-MW02S-04DP exceeded the linear calibration range. A dilution analysis was performed with all calibration criteria met. The results for trichloroethene and cis-1,2-dichloroethene in the initial analysis and the results for all compounds except trichloroethene and cis-1,2-dichloroethene in the dilution analysis were rejected (R) based on data redundancy.

The results for trichloroethene and cis-1,2-dichloroethene in the initial analysis of sample SJS21-MW04S-04D exceeded the linear calibration range. A dilution analysis was performed with all calibration criteria met. The results for trichloroethene and cis-1,2-dichloroethene in the initial analysis and the results for all compounds except trichloroethene and cis-1,2-dichloroethene in the dilution analysis were rejected (R) based on data redundancy.

XII.) Tentatively Identified Compounds (TIC):

All TIC criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was required.

SEMIVOLATILE ORGANICS

SUMMARY

I.) General:

The analyses for semivolatile organics were performed by gas chromatography / mass spectroscopy (GC / MS) using USEPA Method OLM04.3.

II.) Overall Assessment of Data:

All non-detect results for atrazine in the SDG samples were rejected (R) based on an extremely low Relative Response Factor in the Continuing Calibrations.

All other laboratory data were acceptable with qualification.

MAJOR ISSUES

Continuing Calibration:

The Relative Response Factor (RRF) was 0.042 for atrazine for the standards run on 12/10/04 at 19:51 on instrument H, which was below the 0.050 QC limit. The non-detect results for atrazine in the SDG samples were rejected (R).

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC / MS Tuning:

All GC / MS Tuning criteria were met. No action was required.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviation (%RSD) for the standards analyzed on 11/05/04 on instrument H exceeded the 30% QC limit for atrazine at 37.0%. There were no positive results for atrazine in the SDG samples, so no action was required.

Continuing Calibration:

The Percent Differences (%D's) for the standards run on 12/10/04 at 19:51 on instrument H exceeded the 25% QC limit for the following compounds:

atrazine	66.7%
hexachlorobutadiene	39.8%
hexachlorocyclopentadiene	28.8%

2,4-dinitrophenol	44.1%
4,6-dinitro-2-methylphenol	31.3%
hexachlorobenzene	36.6%
3,3'-dichlorobenzidine	28.7%

The results for atrazine in the SDG samples were previously rejected. There were no positive results for the other compounds in the SDG samples, so no further action was required.

IV.) Blanks:

Method Blanks:

There were no detections in the method blanks associated with this SDG. No action was required.

Field Blanks:

Bis(2-ethylhexyl)phthalate and di-n-butylphthalate were detected at 4.1 ug/L and 1.4 ug/L, respectively, in field blank SJS21-FB120104. All positive results for bis(2-ethylhexyl)phthalate and di-n-butyl-phthalate in the SDG samples less than 10X the blank amount were flagged as suspected blank contamination (B).

Tentatively Identified Compounds (TIC):

Hexadecanoic acid was detected at 16 ug/L in field blank SJS21-FB120104. All positive results for hexadecanoic acid in the SDG samples less than 10X the blank amount were flagged as suspected blank contamination (B).

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

One LCS was analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

Batch MS / MSD analyses were submitted for this fraction of the SDG. Five Percent Recoveries (%R's) exceeded their QC limits. Data qualification based on MS/MSD criteria was not required. No action was taken.

VIII.) Field Duplicates:

One set of field duplicate samples (SJS21-MW09-04D / SJS21-MW09S-04DP) was identified for this SDG. The calculable Relative Percent Difference (RPD) for phenol was 7.6%, which was within the 30% QC limit for water samples. No action was required.

IX.) Internal Standards Performance (ISTD):

All ISTD criteria were met. No action was required.

X.) TCL Compound Identification:

All TCL Compound Identification criteria were met. No action was required.

XI.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):

All CRQL criteria were met. No action was required.

XII.) Tentatively Identified Compounds (TIC):

All TIC criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was required.

PESTICIDES / PCBS

SUMMARY

I.) General:

The analyses for Pesticides / PCBs were performed by gas chromatography (GC) using USEPA Method OLM04.3.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualification.

MAJOR ISSUES

There were no major problems for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

The Percent Differences (%D's) were 27.0% for 4,4'-DDT and 27.2% for methoxychlor for the PEM analyzed on 12/10/04 at 14:10, which exceeded the 25% QC limit. All results for 4,4'-DDT and methoxychlor in the SDG samples, which consisted entirely of non-detects, were flagged as estimated (UJ).

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was required.

Continuing Calibration:

The Percent Differences (%D) of 26.5% for methoxychlor for the standards run on 12/10/04 at 05:24 exceeded the 25% QC limit. All results for methoxychlor in the SDG samples were previously flagged, so no further action was required.

IV.) Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

V.) Surrogate Recoveries:

The Percent Recoveries (%R's) for decachlorobiphenyl were below the 60-150% QC limits for the following samples:

Sample	DCB, Col. 1	DCB, Col. 2
SJS21-MW08S-04D	55%	45%
SJS21-MW09SD-04D		56%
SJS21-MW09S-04DP	55%	46%

All positive and non-detect results for samples SJS21-MW08S-04D and SJS21-MW09S-04DP were flagged as estimated (J) and (UJ). Since only one %R was below the QC limits for sample SJS21-MW09S-04D, no action was required.

VI.) Laboratory Control Samples (LCS):

One LCS was analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

Batch MS / MSD analyses were submitted for this fraction of the SDG. All MS/MSD criteria were met. No action was required.

VIII.) Field Duplicates:

One set of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP) was identified for this SDG. There were no calculable Relative Percent Differences (RPDs). No action was required.

IX.) Florisil Cleanup:

All Florisil Cleanup criteria were met. No action was required.

X.) GPC Cleanup:

GPC Cleanup was not required for this SDG. No action was taken.

XI.) Pesticide / PCB Identification Summary (PIS):

All PIS criteria were met. No action was required.

XII.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):

All CRQL criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was required.

EXPLOSIVES

SUMMARY

I.) General:

The analyses for Explosives were performed by gas chromatography (GC) using SW-846 Method 8330.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

There were no major problems for this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Laboratory Control Samples (LCS):

One LCS was analyzed by the laboratory for this SDG. All LCS criteria were met. No action was required.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

Batch MS / MSD analyses were submitted for this fraction of the SDG. Two Percent Recoveries (%R's) exceeded the QC limits. Data qualification based on MS/MSD criteria was not required. No action was taken.

VIII.) Field Duplicates:

One set of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP) was identified for this SDG. There were no calculable Relative Percent Differences (RPDs). No action was required.

IX.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):

All CRQL criteria were met. No action was required.

X.) System Performance:

All System Performance criteria were met. No action was required.

TOTAL AND FILTERED METALS

SUMMARY

I.) General:

The analyses for Total and Filtered Metals were performed using USEPA Method ILM04.1.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualification.

MAJOR ISSUES

There were no major problems associated with this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

III.) CRDL Standards for ICP:

All CRDL criteria were met. No action was required.

IV.) Blanks:

The following blank results represent the highest detections associated with the samples and were used for data qualification:

Blank Type / ID#	Analyte	Max. Conc.	Action Level
CCB2	aluminum	37.5 ug/L	190 ug/L
CCB2	barium	0.6 ug/L	3.0 ug/L
CCB2	cadmium	0.4 ug/L	2.0 ug/L
SJS21-FB120104	calcium	130 ug/L	650 ug/L
SJS21-FB120104	copper	2.7 ug/L	14 ug/L
CCB2	iron	43.1 ug/L	220 ug/L
CCB4	magnesium	82.7 ug/L	410 ug/L
CCB2	manganese	0.7 ug/L	3.5 ug/L
CCB2	molybdenum	3.3 ug/L	17 ug/L
SJS21-FB120104	thallium	6.8 ug/L	34 ug/L
SJS21-FB120104	zinc	3.8 ug/L	19 ug/L

CCB = Continuing Calibration Blank, FB = Field Blank

All associated sample results, which were less than 5X the blank amount, were flagged as suspected blank contamination (B).

IV.) ICP Interference Check Sample Results:

All Interference Percent Recovery criteria were met. No action was required.

The following analytes were detected in the ICS Solution A with results greater than the IDL:

antimony	1 ug/L
barium	3 ug/L
beryllium	1 ug/L
boron	3 ug/L
cadmium	5 ug/L
chromium	1 ug/L

cobalt	4 ug/L
copper	2 ug/L
lead	2 ug/L
manganese	13 ug/L
nickel	2 ug/L
sodium	238 ug/L
vanadium	1 ug/L
zinc	22 ug/L

These analytes should not be present. Since neither aluminum, calcium, iron nor magnesium was detected in any sample at a concentration comparable to or greater than the respective concentration in ICS Solution A, data qualification was not required.

The following analytes had negative results in the ICS Solution A with the absolute value greater than the IDL:

arsenic	-1 ug/L
molybdenum	-1 ug/L
potassium	-9 ug/L
selenium	-2 ug/L
thallium	-10 ug/L

These analytes should not be present. Since neither aluminum, calcium, iron nor magnesium was detected in any sample at a concentration comparable to or greater than the respective concentration in ICS Solution A, data qualification was not required.

V.) ICP Serial Dilution Analysis:

The Percent Difference (%D) for potassium was 13.3%, which exceeded the 10% QC limit. All positive results for potassium in the SDG samples were flagged as estimated (J).

VI.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

VII.) Duplicate Sample Analysis:

MD analysis was performed on total SDG sample SJS21-MW09S-04DP. All MD criteria were met. No action was required.

VIII.) Matrix Spike (MS):

MS analysis was performed on total SDG samples SJS21-MW09-04DP. The Percent Recovery (%R) of iron was 30.5%, which was below the 75-125% QC limits. All positive and non-detect results for iron in the SDG total metals samples were flagged as potentially biased low (L) and (UL).

IX.) Field Duplicates:

One set of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP) was identified

for this SDG. The calculable Relative Percent Differences (RPDs) were:

Analyte	SJS21-MW09S-04D	SJS21-MW09S-04DP	RPD
total arsenic	47.3 ug/L	45.0 ug/L	5.0%
total barium	21.2 ug/L	21.5 ug/L	1.4%
total boron	44.9 ug/L	45.1 ug/L	0.4%
total calcium	32300 ug/L	33400 ug/L	3.3%
total cobalt	2.0 ug/L	2.0 ug/L	0%
total iron	26100 ug/L	25100 ug/L	3.9%
total magnesium	4790 ug/L	4920 ug/L	2.7%
total manganese	404 ug/L	409 ug/L	1.2%
total molybdenum	18.9 ug/L	17.7 ug/L	6.5%
total potassium	1770 ug/L	1800 ug/L	1.7%
total sodium	17100 ug/L	17500 ug/L	2.3%
filtered arsenic	48.6 ug/L	45.7 ug/L	6.2%
filtered barium	21.4 ug/L	22.0 ug/L	2.8%
filtered boron	44.4 ug/L	45.1 ug/L	1.6%
filtered calcium	33200 ug/L	31900 ug/L	0.4%
filtered cobalt	2.1 ug/L	1.8 ug/L	15%
filtered iron	25400 ug/L	24600 ug/L	3.2%
filtered magnesium	4920 ug/L	4690 ug/L	4.8%
filtered manganese	416 ug/L	403 ug/L	3.2%
filtered molybdenum	17.6 ug/L	16.4 ug/L	7.1%
filtered potassium	1860 ug/L	1930 ug/L	3.7%
filtered sodium	17400 ug/L	18000 ug/L	3.4%

All RPDs were within the 30% QC limit for water samples. No action was required.

X.) Total / Filtered:

The filtered metals results for arsenic, barium, calcium, cobalt, magnesium, manganese, potassium and sodium were greater than the total metals results in sample SJS21-MW09-04D. The calculated Percent Differences (%Ds) were within the 15% QC limit, so no action was required.

The filtered metals results for arsenic, barium, cadmium, potassium and sodium were greater than the total metals results in sample SJS21-MW09S-04DP. The calculated Percent Differences (%Ds) were within the 15% QC limit, so no action was required.

The filtered metals results for calcium, cobalt, iron, magnesium and nickel were greater than the total metals results in sample SJS21-MW08S-04D. The calculated Percent Difference (%D) for nickel was 17%, which exceeded the 15% QC limit. The positive results for nickel in the total and filtered nickel for this sample were flagged as estimated (J). All other %D's were within the 15% QC limit. No further action was required.

The filtered metals results for manganese, molybdenum and sodium were greater than the total metals results in sample SJS21-MW01D-04D. The calculated Percent Differences (%D's) were within the 15% QC limit, so no action was required.

XI.) Sample Result, Calculation/Transcription Verification:

All criteria were met. No action was taken.

XII.) Quarterly Verification of Instrumental Parameters:

All criteria were met. No action was taken.

TOTAL CYANIDE

SUMMARY

I.) General:

The analyses for total cyanide were performed using EPA Method ILM04.1.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections in the blanks associated with this fraction of the SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

MD analysis was performed on SDG sample SJS21-MW09S-04D. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):

MS analysis was performed on SDG sample SJS21-MW09S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

One set of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP) was identified for this fraction of the SDG. There was no calculable Relative Percent Difference (RPD). No action was required.

TOTAL ALKALINITY

SUMMARY

I.) General:

The analyses for Total Alkalinity were performed using USEPA Method 310.1.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

Alkalinity was detected at 36 mg/L in method blank BLK73238. All positive results for alkalinity in the SDG samples less than 5X the blank amount were flagged as suspected blank contamination (B).

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

Batch MD analysis was submitted for this fraction of the SDG. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):

MS analysis was not submitted for this fraction of the SDG. All positive and non-detect results for total alkalinity in the SDG samples were flagged as estimated (J) and (UJ).

VII.) Field Duplicates:

One set of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP) was identified for this SDG. There was no calculable Relative Percent Difference (RPD), so no action was required.

NITRATE/NITRITE

SUMMARY

I.) General:

The analyses for Nitrate/Nitrite were performed using USEPA Method 353.2.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

MD analysis was performed on SDG sample SJS21-MW09S-04D. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):

MS analysis was performed on SDG sample SJS21-MW09S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

Two sets of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP and SJS21-MW02S-04D / SJS21-MW02S-04DP) were identified for this SDG. There were no calculable Relative Percent Differences (RPDs), so no action was required.

SULFATE

SUMMARY

I.) General:

The analyses for Sulfate were performed using USEPA Method 375.4.

II.) Overall Assessment of Data:

All laboratory data were acceptable with qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections for sulfate in the blanks associated with this SGD. No action was required.

IV.) Laboratory Control Samples (LCS):

All LCS criteria were met. No action was required.

V.) Matrix Duplicate (MD):

Batch MD analysis was submitted for this fraction of the SDG. All MD criteria were met. No action was required.

VI.) Matrix Spike (MS):

Batch MS analysis was submitted for this fraction of the SDG. All MS criteria were met. No action was required.

VII.) Field Duplicates:

Two sets of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP and SJS21-MW02S-04D / SJS21-MW02S-04DP) were identified for this SDG. The calculable Relative Percent Differences (RPD) were 40% for SJS21-MW09S-04D / SJS21-MW09S-04DP and 63% for SJS21-MW02S-04D / SJS21-MW02S-04DP, which exceeded the 30% QC limit for water samples. Data qualification based on field duplicate criteria was not required. No action was taken.

TOC

SUMMARY

I.) General:

The analyses for TOC were made using SW-846 Method 9060.

II.) Overall Assessment of Data:

All laboratory data were acceptable without qualification.

MAJOR ISSUES

No major problems were observed in this fraction of the SDG.

MINOR ISSUES

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

There were no detections in the blanks associated with this SDG. No action was required.

IV.) Laboratory Control Samples (LCS):

LCS criteria was not required. No action was taken.

V.) Matrix Duplicate (MD):

MD criteria was not required. No action was taken.

VI.) Matrix Spike (MS):

MS analyses were performed on SDG samples SJS21-MW02S-04D and SJS21-MW03S-04D. All MS criteria were met. No action was required.

VII.) Field Duplicates:

Two sets of field duplicate samples (SJS21-MW09S-04D / SJS21-MW09S-04DP and SJS21-MW02S-04D / SJS21-MW02S-04DP) were identified for this SDG. The calculable Relative Percent Differences (RPD) were 9.5% for SJS21-MW09S-04D / SJS21-MW09S-04DP and 9.8% for SJS21-MW02S-04D / SJS21-MW02S-04DP, which were within the 30% QC limit for water samples. No action was required.

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8382
Fraction: Organic
Matrix: Aqueous
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The samples were analyzed for volatile organic compounds, semivolatile organic compounds, pesticide/PCBs, and explosive compounds. The sample analyses were performed in accordance with the procedures outlined in the OLM04 USEPA Contract Laboratory Program (CLP) Statements of Work for Organic Analysis, and "Test Methods for Evaluating Solid Wastes", SW-846, third edition, Promulgated Updates II, IIA, and III, June 1997.

For the volatile and semivolatile fractions determined by Gas Chromatography/Mass Spectrometry, library searches were performed to "tentatively identify" chromatographic peaks whose characteristics did not match those of targeted compounds. Library searches were performed for up to thirty volatile and thirty semivolatile extraneous peaks.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Organic Analyses", USEPA 9/94. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The parameters presented on the following page were evaluated.

X	•	Data Completeness
X	•	Chain of Custody Documentation
X	•	Holding Times
X	•	Instrument Performance
X	•	Initial and Continuing Calibrations
X	•	Laboratory and Field Blank Analysis Results
X	•	Surrogate Compound Recoveries
	•	Matrix Spike/Matrix Spike Duplicate Recoveries and Reproducibility
X	•	Field Duplicate Analysis Results
X	•	Laboratory Control Sample Results
X	•	Internal Standard Performance
X	•	Qualitative Identification
X	•	Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2006

Date

1.0 *DATA COMPLETENESS*

The data deliverables were complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

The chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INSTRUMENT PERFORMANCE*

All criteria were met. No qualifiers were applied.

5.0 *INITIAL AND CONTINUING CALIBRATIONS*

The positive results and quantitation limits for the 2,4-dinitrophenol for the following samples should be considered quantitative estimates. The continuing calibration precision criterion (the percent difference between initial and continuing calibration RRFs $\leq$ 25 percent) was exceeded for these compounds. This indicates a lack of instrument stability for these compounds. The positive results for these compounds in the samples have been marked with "J" qualifiers to indicate that they are quantitative estimates. EDQ uses a professional judgment criterion of 60 percent for the qualification of nondetected compounds. Nondetected results have been marked "UJ".

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

All criteria were met. No qualifiers were applied.

7.0 *SURROGATE COMPOUNDS*

All criteria were met. No qualifiers were applied.

8.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

All criteria were met. No qualifiers were applied.

9.0 *FIELD DUPLICATE RESULTS*

Duplicate samples SJS21-MW13S-05Dand SJS21-MW13S-05D-P were submitted to the laboratory to evaluate sampling and analytical precision for those organic compounds determined to be present. Results for these duplicate samples are presented in Table 2. Precision is evaluated by calculating the relative percent difference (%RPD) between duplicate pair results. There are no USEPA-established acceptance criteria for field duplicate samples. EDQ uses internal acceptance criteria of twenty percent for volatile detected compounds (and 25 percent for extractable compounds) to evaluate field duplicate samples.

10.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

11.0 *INTERNAL STANDARD PERFORMANCE*

All criteria were met. No qualifiers were applied.

12.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

13.0 *QUANTITATION/REPORTING LIMITS*

Sample SJS21-MW07S-05D was analyzed at a 50-fold dilution for volatile organic compounds. The dilution analysis was performed because of the suspected presence of high levels of target compounds and/or interferences. Quantitation limits are elevated by the dilution factor for these samples for target compounds that were not detected. The elevated quantitation limits should be noted when assessing the data for this sample.

The samples presented below were re-analyzed at dilutions for volatile organic compounds. The reanalyses were performed because the responses for volatile compounds exceeded the linear range of the GC/MS instrument for the initial analyses. The affected results were reported from the dilution analyses. All other results have been reported from the initial analyses.

Sample	Dilution Factor	Results Exceeding the Linear Range
SJS21-MW02S-05D	20.0	cis-1,2-Dichloroethene, Trichloroethene
SJS21-MW08S-05D	5.6	cis-1,2-Dichloroethene, Trichloroethene
SJS21-MW12S-05D	12.5	cis-1,2-Dichloroethene, Trichloroethene
SJS21-MW13S-05D	33.3	cis-1,2-Dichloroethene, Trichloroethene
SJS21-MW13S-05D-P	33.3	cis-1,2-Dichloroethene, Trichloroethene

As required by USEPA protocol, all compounds, which were qualitatively identified at concentrations below their respective Quantitation Limits (QLs), have been marked with "J" qualifiers to indicate that they are quantitative estimates.

As required by USEPA protocol, all volatile and semivolatile tentatively identified compounds (TICs) have been reported with "J" qualifiers to indicate that they are quantitative estimates. EDQ has reported only those TIC results that have not been determined to be laboratory or field artifacts, and where possible has grouped TIC of similar classification.

METHODOLOGY REFERENCES

Analysis	Reference
Volatile Organic Compounds	OLM04.3 USEPA Contract Laboratory Program (CLP) Statement of Work for Organic Analyses
Semivolatile Organic Compounds	OLM04.3 USEPA Contract Laboratory Program (CLP) Statement of Work for Organic Analyses
Explosive Compounds	Method 8330, "Test Methods for Evaluating Solid Wastes", SW-846, third edition, Promulgated Updates II, IIA, and III, June 1997

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8382

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed					
				VOA	PEST/PCB	SVOA	EXPLO	METAL	WCHEM
SJS21-EB110905	838210	11/9/2005	Equipment Blank		30	73	15	24	
SJS21-FB110905	838209	11/9/2005	Field Blank		30	73	15	24	
SJS21-MW02S-05D	838203	11/4/2005	Groundwater	102					1
SJS21-MW04S-05D	838211	11/9/2005	Groundwater	51					1
SJS21-MW07S-05D	838205	11/7/2005	Groundwater	51					
SJS21-MW08S-05D	838201	11/4/2005	Groundwater	102					1
SJS21-MW09S-05D	838202	11/4/2005	Groundwater	51					1
SJS21-MW12S-05D	838206	11/9/2005	Groundwater	102	30	73	15	46	5
SJS21-MW13S-05D	838207	11/9/2005	Groundwater	102	30	73	15	24	5
SJS21-MW13S-05D-P	838208	11/9/2005	Groundwater	102	30	73	15	24	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8381
Fraction: Organic
Matrix: Aqueous
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The samples were analyzed for volatile organic compounds. The sample analyses were performed in accordance with the procedures outlined in the OLC03 USEPA Contract Laboratory Program (CLP) Statements of Work for Organic Analysis.

For the volatile fraction determined by Gas Chromatography/Mass Spectrometry, library searches were performed to "tentatively identify" chromatographic peaks whose characteristics did not match those of targeted compounds. Library searches were performed for up to thirty volatile extraneous peaks.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Organic Analyses", USEPA 9/94. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The parameters presented on the following page were evaluated.

1.0 *DATA COMPLETENESS*

The data deliverables were complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

The chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INSTRUMENT PERFORMANCE*

All criteria were met. No qualifiers were applied.

5.0 *INITIAL AND CONTINUING CALIBRATIONS*

The positive results and quantitation limits for the compounds in the following samples should be considered quantitative estimates. The continuing calibration precision criterion (the percent difference between initial and continuing calibration RRFs $\leq$ 25 percent) was exceeded for these compounds. This indicates a lack of instrument stability for these compounds. The positive results for these compounds in the samples have been marked with "J" qualifiers to indicate that they are quantitative estimates. EDQ uses a professional judgment criterion of 60 percent for the qualification of nondetected compounds. Nondetected results have been marked "UJ".

Compound	Qualified Results
Methyl Acetate	SJS21-MW05S-05D
Dichlorodifluoromethane	SJS21-MW11S-05D-P, SJS21-MW01S-05D, SJS21-MW05S-05D, SJS21-TW127-05D, SJS21-TW125-05D, SJS21-TW126-05D

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

The following positive results for acetone and methylene chloride for the samples are qualitatively invalid due to the presence of these compounds in associated laboratory method and/or field blanks. USEPA Region III protocol requires positive results for common contaminants, such as acetone, that are less than or equal to ten times the associated blank contamination level, to be considered qualitatively invalid. Placing "B" qualifiers next to these quantitative results for these samples has indicated this.

7.0 *SURROGATE COMPOUNDS*

The positive results and/or quantitation limits for samples SJS21-TW125-05D, SJS21-TW126-05D, and SJS21-TW127-05D should be considered quantitative estimates. Low recoveries were obtained for the associated surrogate compounds for the volatile analyses of these samples. The laboratory did not reanalyze the samples to confirm the unacceptable recoveries. Positive results are marked with "J" qualifiers to indicate that they are estimates. Quantitation limits are marked "UJ".

8.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

The laboratory did not select a site sample to perform matrix spike/ matrix spike duplicate analyses. Therefore, the associated sample data could not be evaluated based on these parameters. This should be noted when assessing the sample data.

9.0 *FIELD DUPLICATE RESULTS*

Duplicate sample SJS21-MW11S-05D and SJS21-MW11S-05D-P were submitted to the laboratory to evaluate sampling and analytical precision for those organic compounds determined to be present. Results for these duplicate samples are presented in Table 2. Precision is evaluated by calculating the relative percent difference (%RPD) between duplicate pair results. There are no USEPA-established acceptance criteria for field duplicate samples. EDQ uses internal acceptance criteria of twenty percent for volatile detected compounds (and 25 percent for extractable compounds) to evaluate field duplicate samples.

10.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

11.0 *INTERNAL STANDARD PERFORMANCE*

All criteria were met. No qualifiers were applied.

12.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

13.0 *QUANTITATION/REPORTING LIMITS*

As required by USEPA protocol, all compounds, which were qualitatively identified at concentrations below their respective Quantitation Limits (QLs), have been marked with "J" qualifiers to indicate that they are quantitative estimates.

As required by USEPA protocol, all volatile tentatively identified compounds (TICs) have been reported with "J" qualifiers to indicate that they are quantitative estimates. EDQ has reported only those TIC results that have not been determined to be laboratory or field artifacts, and where possible has grouped TIC of similar classification.

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8381

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed	
				VOA	FE3+
SJS21-EB110905	838110	11/9/2005	Equipment Blank	X	
SJS21-FB110905	838109	11/9/2005	Field Blank	X	
SJS21-MW01S-05D	838106	11/7/2005	Groundwater	X	X
SJS21-MW05S-05D	838107	11/7/2005	Groundwater	X	X
SJS21-MW06S-05D	838101	11/4/2005	Groundwater	X	X
SJS21-MW11S-05D	838102	11/4/2005	Groundwater	X	
SJS21-MW11S-05D-P	838103	11/4/2005	Groundwater	X	
SJS21-TB0110405	838104	11/4/2005	Trip Blank	X	
SJS21-TB110705	838108	11/7/2005	Trip Blank	X	
SJS21-TB110905	838111	11/9/2005	Trip Blank	X	
SJS21-TW125-05D	838113	11/7/2005	Groundwater	X	
SJS21-TW126-05D	838114	11/7/2005	Groundwater	X	
SJS21-TW127-05D	838112	11/7/2005	Groundwater	X	

Table 2 Field Duplicate Sample Results for Organic Analyses
Duplicate Samples SJS21-MW11S-05D and SJS21-MW11S-05D-P

	SJS21-MW11S-05D (µg/L)		SJS21-MW11S-05D-P (µg/L)	RPD	Comments
Acetone	2.5	B	3.7	NC	
Methylene Chloride	0.14	B	ND	NC	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8338
Fraction: Organic
Matrix: Aqueous
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The samples were analyzed for volatile organic compounds. The sample analyses were performed in accordance with the procedures outlined in the OLM04 USEPA Contract Laboratory Program (CLP) Statements of Work for Organic Analysis.

For the volatile fraction determined by Gas Chromatography/Mass Spectrometry, library searches were performed to "tentatively identify" chromatographic peaks whose characteristics did not match those of targeted compounds. Library searches were performed for up to thirty volatile extraneous peaks.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Organic Analyses", USEPA 9/94. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The parameters presented on the following page were evaluated.

X	•	Data Completeness
X	•	Chain of Custody Documentation
X	•	Holding Times
X	•	Instrument Performance
X	•	Initial and Continuing Calibrations
X	•	Laboratory and Field Blank Analysis Results
X	•	Surrogate Compound Recoveries
	•	Matrix Spike/Matrix Spike Duplicate Recoveries and Reproducibility
X	•	Field Duplicate Analysis Results
X	•	Laboratory Control Sample Results
X	•	Internal Standard Performance
X	•	Qualitative Identification
X	•	Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2001

Date

1.0 *DATA COMPLETENESS*

The data deliverables were complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

The chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INSTRUMENT PERFORMANCE*

All criteria were met. No qualifiers were applied.

5.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

The following positive results for acetone for samples SJS21-TW117-05D and SJS21-TW101-05D are qualitatively invalid due to the presence of this compound in associated laboratory method and/or field blanks. USEPA Region III protocol requires positive results for common contaminants, such as acetone, that are less than or equal to ten times the associated blank contamination level, to be considered qualitatively invalid. Placing "B" qualifiers next to these quantitative results for these samples has indicated this.

7.0 *SURROGATE COMPOUNDS*

All criteria were met. No qualifiers were applied.

8.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

The laboratory did not select a site sample to perform matrix spike/ matrix spike duplicate analyses. Therefore, the associated sample data could not be evaluated based on these parameters. This should be noted when assessing the sample data.

9.0 *FIELD DUPLICATE RESULTS*

Duplicate sample SJS21-TW110-05D and SJS21-TW110-05D-P were submitted to the laboratory to evaluate sampling and analytical precision for those organic compounds determined to be present. Results for these duplicate samples are presented in Table 2. Precision is evaluated by calculating the relative percent difference (%RPD) between duplicate pair results. There are no USEPA-established acceptance criteria for field duplicate samples. EDQ uses internal acceptance criteria of twenty percent for volatile detected compounds (and 25 percent for extractable compounds) to evaluate field duplicate samples.

10.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

11.0 *INTERNAL STANDARD PERFORMANCE*

All criteria were met. No qualifiers were applied.

12.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

13.0 *QUANTITATION/REPORTING LIMITS*

The samples presented in the table below were re-analyzed at dilutions for volatile organic compounds. The re-analyses were performed because the responses for volatile compounds exceeded the linear range of the GC/MS instrument for the initial analysis. The affected results were reported from the dilution analyses. All other results have been reported from the initial analyses.

Sample	Dilution Factor	Results Exceeding the Linear Range
SJS21-TW109-05D	20.0	cis-1,2-Dichloroethene, Trichloroethene
SJS21-TW110-05D	50.0	cis-1,2-Dichloroethene, Trichloroethene
SJS21-TW110-05D-P	50.0	cis-1,2-Dichloroethene, Trichloroethene
SJS21-TW106-05D	10.0	cis-1,2-Dichloroethene, Trichloroethene

As required by USEPA protocol, all compounds, which were qualitatively identified at concentrations below their respective Quantitation Limits (QLs), have been marked with "J" qualifiers to indicate that they are quantitative estimates.

As required by USEPA protocol, all volatile tentatively identified compounds (TICs) have been reported with "J" qualifiers to indicate that they are quantitative estimates. EDQ has reported only those TIC results that have not been determined to be laboratory or field artifacts, and where possible has grouped TIC of similar classification.

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8338

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed
				VOA
SJS21-TW103-05D	833803	11/1/2005	Groundwater	X
SJS21-TW106-05D	833811	11/2/2005	Groundwater	X
SJS21-TW108-05D	833810	11/2/2005	Groundwater	X
SJS21-TW109-05D	833802	11/1/2005	Groundwater	X
SJS21-TW110-05D	833804	11/2/2005	Groundwater	X
SJS21-TW110-05D-P	833805	11/2/2005	Groundwater	X
SJS21-TW112-05D	833807	11/2/2005	Groundwater	X
SJS21-TW113-05D	833806	11/2/2005	Groundwater	X
SJS21-TW114-05D	833801	11/1/2005	Groundwater	X
SJS21-TW116-05D	833808	11/2/2005	Groundwater	X
SJS21-TW117-05D	833813	11/3/2005	Groundwater	X

Table 2 Field Duplicate Sample Results for Organic Analyses
Duplicate Samples SJS21-TW110-05D and SJS21-TW110-05D-P

	SJS21-TW110-05D (µg/L)		SJS21-TW110-05D-P (µg/L)		RPD	Comments
Vinyl Chloride	5	J	6	J	18.2	
1,1-Dichloroethene	4	J	3	J	28.6	
trans-1,2-Dichloroethene	3	J	3	J	0.0	
cis-1,2-Dichloroethene	1200		1300		8.0	
Trichloroethene	2800		2900		3.5	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8330
Fraction: Organic
Matrix: Aqueous
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The samples were analyzed for volatile organic compounds. The sample analyses were performed in accordance with the procedures outlined in the OLC03 USEPA Contract Laboratory Program (CLP) Statements of Work for Organic Analysis.

For the volatile fraction determined by Gas Chromatography/Mass Spectrometry, library searches were performed to "tentatively identify" chromatographic peaks whose characteristics did not match those of targeted compounds. Library searches were performed for up to thirty volatile extraneous peaks.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Organic Analyses", USEPA 9/94. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The parameters presented on the following page were evaluated.

X	•	Data Completeness
X	•	Chain of Custody Documentation
X	•	Holding Times
X	•	Instrument Performance
X	•	Initial and Continuing Calibrations
X	•	Laboratory and Field Blank Analysis Results
X	•	Surrogate Compound Recoveries
X	•	Matrix Spike/Matrix Spike Duplicate Recoveries and Reproducibility
X	•	Field Duplicate Analysis Results
X	•	Laboratory Control Sample Results
X	•	Internal Standard Performance
X	•	Qualitative Identification
X	•	Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2005
Date

1.0 *DATA COMPLETENESS*

The data deliverables were complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

The chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INSTRUMENT PERFORMANCE*

All criteria were met. No qualifiers were applied.

5.0 *INITIAL AND CONTINUING CALIBRATIONS*

The positive results and quantitation limits for the compounds in the samples presented below should be considered quantitative estimates. The continuing calibration precision criterion (the percent difference between initial and continuing calibration RRFs $\leq$ 25 percent) was exceeded for these compounds. This indicates a lack of instrument stability for these compounds. The positive results for these compounds in the samples have been marked with "J" qualifiers to indicate that they are quantitative estimates. EDQ uses a professional judgment criterion of 60 percent for the qualification of nondetected compounds. Nondetected results have been marked "UJ".

Compound	Qualified Results
Trichlorofluoromethane	SJS21-MW10S-05D, SJS21-MW03S-05D, SJS21-TW119-05D, SJS21-TW121-05D, SJS21-TW123-05D, SJS21-TW102-05D, SJS21-TW102-05D-P

Dichlorodifluoromethane	SJS21-TW104-05D, SJS21-TW120-05D, SJS21-TW124-05D, SJS21-TW101-05D

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

The following positive results for acetone for samples SJS21-TW104-05D, SJS21-TW120-05D, SJS21-TW124-05D, and SJS21-TW101-05D are qualitatively invalid due to the presence of this compound in associated laboratory method and/or field blanks. USEPA Region III protocol requires positive results for common contaminants, such as acetone, that are less than or equal to ten times the associated blank contamination level, to be considered qualitatively invalid. Placing "B" qualifiers next to these quantitative results for these samples has indicated this.

7.0 *SURROGATE COMPOUNDS*

The positive results and/or quantitation limits for cis-1,2-dichloroethene and trans-1,2-dichloroethene for samples SJS21-MW03S-05D, SJS21-TW119-05D, SJS21-TW121-05D, SJS21-TW123-05D, SJS21-TW102-05D, SJS21-TW104-05D, SJS21-TW120-05D, SJS21-TW118-05D, and SJS21-TW124-05D should be considered quantitative estimates. Low recoveries were obtained for the associated surrogate compound, 1,1-dichloroethene-d_2 for the volatile analyses of these samples. The laboratory did not reanalyze the samples to confirm the unacceptable recoveries. Compound results for associated volatile compounds should be considered quantitative estimates. Positive results are marked with "J" qualifiers to indicate that they are estimates. Quantitation limits are marked "UJ".

8.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

All criteria were met. No qualifiers were applied.

9.0 *FIELD DUPLICATE RESULTS*

Duplicate sample SJS21-TW102-05D and SJS21-TW102-05D-P were submitted to the laboratory to evaluate sampling and analytical precision for those organic compounds determined to be present. Results for these duplicate samples are presented in Table 2. Precision is evaluated by calculating the relative percent difference (%RPD) between duplicate pair results. There are no USEPA-established acceptance criteria for field duplicate samples. EDQ uses internal acceptance criteria of twenty percent for volatile detected compounds (and 25 percent for extractable compounds) to evaluate field duplicate samples.

10.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

11.0 *INTERNAL STANDARD PERFORMANCE*

All criteria were met. No qualifiers were applied.

12.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

13.0 *QUANTITATION/REPORTING LIMITS*

As required by USEPA protocol, all compounds, which were qualitatively identified at concentrations below their respective Quantitation Limits (QLs), have been marked with "J" qualifiers to indicate that they are quantitative estimates.

As required by USEPA protocol, all volatile tentatively identified compounds (TICs) have been reported with "J" qualifiers to indicate that they are quantitative estimates. EDQ has reported only those TIC results that have not been determined to be laboratory or field artifacts, and where possible has grouped TIC of similar classification.

1LCA
LOW CONCENTRATION WATER VOLATILE ORGANICS ANALYSIS
DATA SHEET

EPA SAMPLE NO.

SJS21-MW03S-05D

Lab Name: COMPUCHEM Contract: OLC03-REVS

Lab Code: LIBRTY Case No.: Client No.: SDG No.: 8330

Lab Sample ID: 833007 Date Received: 11/04/2005

Lab File ID: 833007A73 Date Analyzed: 11/07/2005

Purge Volume: 25.0(ML) Dilution Factor: 1.0

GC Column: RTX-624 ID: 0.32(MM) Length: 60.0(M)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (UG/L)	Q
75-71-8	Dichlorodifluoromethane	0.50	U
74-87-3	Chloromethane	0.50	U
75-01-4	Vinyl Chloride	0.50	U
74-83-9	Bromomethane	0.50	U
75-00-3	Chloroethane	0.50	U
75-69-4	Trichlorofluoromethane	0.50	UJ cd
75-35-4	1,1-Dichloroethene	0.50	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	0.50	U
67-64-1	Acetone	20	
75-15-0	Carbon Disulfide	0.50	U
79-20-9	Methyl Acetate	0.50	U
75-09-2	Methylene Chloride	0.50	U
156-60-5	trans-1,2-Dichloroethene	0.50	UJ SSI
1634-04-4	Methyl tert-Butyl Ether	0.50	U
75-34-3	1,1-Dichloroethane	0.50	U
156-59-2	cis-1,2-Dichloroethene	2.0	J SSI
78-93-3	2-Butanone	5.0	U
74-97-5	Bromochloromethane	0.50	U
67-66-3	Chloroform	0.50	U
71-55-6	1,1,1-Trichloroethane	0.50	U
110-82-7	Cyclohexane	0.50	U
56-23-5	Carbon Tetrachloride	0.50	U
71-43-2	Benzene	0.10	J
107-06-2	1,2-Dichloroethane	0.50	U

SMM 11/9/2005

Table 2 Field Duplicate Sample Results for Organic Analyses
Duplicate Samples SJS21-TW102-05D and SJS21-TW102-05D-P

	SJS21-TW102-05D (µg/L)		SJS21-TW102-05D-P (µg/L)		RPD	Comments
Acetone	2.6	J	5.6		73.2	
Trichloroethene	0.10	J	ND		NC	
Toluene	0.11	J	0.11	J	0.0	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8324
Fraction: Organic
Matrix: Aqueous
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The samples were analyzed for volatile organic compounds. The sample analyses were performed in accordance with the procedures outlined in the OLM04 USEPA Contract Laboratory Program (CLP) Statements of Work for Organic Analysis.

For the volatile fraction determined by Gas Chromatography/Mass Spectrometry, library searches were performed to "tentatively identify" chromatographic peaks whose characteristics did not match those of targeted compounds. Library searches were performed for up to thirty volatile extraneous peaks.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Organic Analyses", USEPA 9/94. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The parameters presented on the following page were evaluated.

X	•	Data Completeness
X	•	Chain of Custody Documentation
X	•	Holding Times
X	•	Instrument Performance
X	•	Initial and Continuing Calibrations
X	•	Laboratory and Field Blank Analysis Results
X	•	Surrogate Compound Recoveries
	•	Matrix Spike/Matrix Spike Duplicate Recoveries and Reproducibility
X	•	Field Duplicate Analysis Results
X	•	Laboratory Control Sample Results
X	•	Internal Standard Performance
X	•	Qualitative Identification
X	•	Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2006

Date

1.0 *DATA COMPLETENESS*

The data deliverables were complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

The chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INSTRUMENT PERFORMANCE*

All criteria were met. No qualifiers were applied.

5.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

All criteria were met. No qualifiers were applied.

7.0 *SURROGATE COMPOUNDS*

All criteria were met. No qualifiers were applied.

8.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

The laboratory did not select a site sample to perform matrix spike/ matrix spike duplicate analyses. Therefore, the associated sample data could not be evaluated based on these parameters. This should be noted when assessing the sample data.

9.0 *FIELD DUPLICATE RESULTS*

Duplicate sample 'SJS21-TW102-05D and 'SJS21-TW102-05D-P were submitted to the laboratory to evaluate sampling and analytical precision for those organic compounds determined to be present. There were no positive results for the duplicate samples.

10.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

11.0 *INTERNAL STANDARD PERFORMANCE*

All criteria were met. No qualifiers were applied.

12.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

13.0 *QUANTITATION/REPORTING LIMITS*

Sample SJS21-TW115-05D was re-analyzed at a 2.5-fold dilution for volatile organic compounds. The re-analysis was performed because the response for vinyl chloride exceeded the linear range of the GC/MS instrument for the initial analysis. The affected result was reported from

the dilution analysis. All other results have been reported from the initial analyses.

As required by USEPA protocol, all compounds, which were qualitatively identified at concentrations below their respective Quantitation Limits (QLs), have been marked with "J" qualifiers to indicate that they are quantitative estimates.

As required by USEPA protocol, all volatile tentatively identified compounds (TICs) have been reported with "J" qualifiers to indicate that they are quantitative estimates. EDQ has reported only those TIC results that have not been determined to be laboratory or field artifacts, and where possible has grouped TIC of similar classification.

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8324

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed
				VOA
SJS21-TW102-05D	832405	10/31/2005	Groundwater	X
SJS21-TW102-05D-P	832406	10/31/2005	Groundwater	X
SJS21-TW104-05D	832407	10/31/2005	Groundwater	X
SJS21-TW107-05D	832404	10/31/2005	Groundwater	X
SJS21-TW111-05D	832412	11/1/2005	Groundwater	X
SJS21-TW115-05D	832411	11/1/2005	Groundwater	X
SJS21-TW118-05D	832410	11/1/2005	Groundwater	X
SJS21-TW119-05D	832409	11/1/2005	Groundwater	X
SJS21-TW120-05D	832408	11/1/2005	Groundwater	X
SJS21-TW121-05D	832401	10/31/2005	Groundwater	X
SJS21-TW122-05D	832403	10/31/2005	Groundwater	X
SJS21-TW123-05D	832402	10/31/2005	Groundwater	X

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8439
Fraction: Inorganic
Matrix: Groundwater
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The sample analyses were performed in accordance with the procedures outlined in the USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-media, Multi-concentration, ILM05.3.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Inorganic Analyses", USEPA 4/93. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The following parameters were evaluated:

- X • Data Completeness
- X • Chain of Custody Documentation
- X • Holding Times
- X • Initial and Continuing Calibrations
- X • ICP Interference Check Sample Results
- X • Laboratory and Field Blank Analysis Results
- X • Matrix Spike Recoveries and Reproducibility
- X • Laboratory Duplicate Analysis Results
- X • ICP Serial Dilution Results
- • Field Duplicate Analysis Results
- X • Laboratory Control Sample Results
- • GFAA Post-Digestion Spike Recovery/Duplicate Burn Precision
- X • Qualitative Identification

X • Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2002

Date

1.0 *DATA COMPLETENESS*

The data package was complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

All chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

5.0 *ICP INTERFERENCE CHECK SAMPLE RESULTS*

This parameter is not applicable to the analyses performed.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

Positive results reported for inorganic analytes for the following samples are qualitatively invalid due to their presence in the associated laboratory method blanks. USEPA Region III protocol requires positive results for inorganic contaminants, that are less than or equal to five times the blank contamination level, to be considered qualitatively invalid. Placing "B" qualifiers next to the quantitative results for these metals in the samples has indicated this.

Analyte	Affected Samples
Aluminum	SJS21-MW12S-05D, SJS21-MW13S-05D, SJS21-MW13S-05D-P
Chromium	SJS21-MW13S-05D

7.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

All criteria were met. No qualifiers were applied.

8.0 *LABORATORY DUPLICATE RESULTS*

All criteria were met. No qualifiers were applied.

9.0 *ICP SERIAL DILUTION RESULTS*

All criteria were met. No qualifiers were applied.

10.0 *FIELD DUPLICATE RESULTS*

Duplicate samples SJS21-MW13S-05D and SJS21-MW13S-05D-P were submitted to the laboratory evaluate sampling and analytical precision for those analytes determined to be present. Results for these duplicate samples are presented in Table 2. There are no USEPA-established acceptance criteria for field duplicate samples. EDQ uses internal an acceptance criterion of 25 percent for values greater than five times the CRDL (or $\pm$ the CRDL for results less than five times the CRDL.

11.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

12.0 *GFAA POST-DIGESTION SPIKE/DUPLICATE BURN*

This parameter is not applicable to the analyses performed.

13.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

14.0 *QUANTITATION/REPORTING LIMITS*

The laboratory reported results for metals detected in samples at concentrations greater than the instrument detection limit, but less than the QL with "B" flags. EDQ has flagged results for metals below the QL with "J" qualifiers to indicate that they are quantitative estimates.

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8439

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed
				FMETAL
SJS21-EB110905	843905	11/9/2005	Equipment Blank	X
SJS21-FB110905	843902	11/9/2005	Field Blank	X
SJS21-MW12S-05D	843901	11/9/2005	Groundwater	X
SJS21-MW13S-05D	843903	11/9/2005	Groundwater	X
SJS21-MW13S-05D-P	843904	11/9/2005	Groundwater	X

Table 2 Field Duplicate Sample Results for Inorganic Analyses
Samples SJS21-MW13S-05D and SJS21-MW13S-05D-P

Analyte	Sample		Field Duplicate		RPD	ACTION
	SJS21-MW13S-05D		SJS21-MW13S-05D-P			
Aluminum	18.1	J	20.5	J	12.4	
Barium	34.4	J	34.6	J	0.6	*
Calcium	33500		33300		0.6	
Chromium	1.1	B	ND		NC	
Cobalt	6.1	J	5.9	J	3.3	
Iron	2460		2330		5.4	
Magnesium	8070		8110		0.5	
Manganese	672		671		0.1	
Nickel	3.4	J	2.5	J	30.5	
Potassium	2430	J	2430	J	0.0	
Sodium	63800		63700		0.2	
Vanadium	0.94	J			200.0	
Zinc						

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8405
Fraction: Inorganic
Matrix: Groundwater
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The sample analyses were performed in accordance with the procedures outlined in the USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-media, Multi-concentration, ILM05.3.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Inorganic Analyses", USEPA 4/93. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The following parameters were evaluated:

- X • Data Completeness
- X • Chain of Custody Documentation
- X • Holding Times
- X • Initial and Continuing Calibrations
- X • ICP Interference Check Sample Results
- X • Laboratory and Field Blank Analysis Results
- X • Matrix Spike Recoveries and Reproducibility
- X • Laboratory Duplicate Analysis Results
- X • ICP Serial Dilution Results
- • Field Duplicate Analysis Results
- X • Laboratory Control Sample Results
- • GFAA Post-Digestion Spike Recovery/Duplicate Burn Precision
- X • Qualitative Identification

X • Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2006
Date

1.0 *DATA COMPLETENESS*

The data package was complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

All chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

5.0 *ICP INTERFERENCE CHECK SAMPLE RESULTS*

This parameter is not applicable to the analyses performed.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

All criteria were met. No qualifiers were applied.

7.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

All criteria were met. No qualifiers were applied.

8.0 *LABORATORY DUPLICATE RESULTS*

All criteria were met. No qualifiers were applied.

9.0 *ICP SERIAL DILUTION RESULTS*

All criteria were met. No qualifiers were applied.

10.0 *FIELD DUPLICATE RESULTS*

Duplicate samples SJS21-MW01D-05D and SJS21-MW01D-05D-P were submitted to the laboratory evaluate sampling and analytical precision for those analytes determined to be present. Results for these duplicate samples are presented in Table 2. There are no USEPA-established acceptance criteria for field duplicate samples. EDQ uses internal an acceptance criterion of 25 percent for values greater than five times the CRDL (or ± the CRDL for results less than five times the CRDL.

11.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

12.0 *GFAA POST-DIGESTION SPIKE/DUPLICATE BURN*

This parameter is not applicable to the analyses performed.

13.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

14.0 *QUANTITATION/REPORTING LIMITS*

The laboratory reported results for metals detected in samples at concentrations greater than the instrument detection limit, but less than the QL with "B" flags. EDQ has flagged results for metals below the QL with "J" qualifiers to indicate that they are quantitative estimates.

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8405

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed
				FAs
SJS21-MW01D-05D	840501	11/7/2005	Groundwater	X
SJS21-MW01D-05D-P	840502	11/7/2005	Groundwater	X

Table 2 Field Duplicate Sample Results for Inorganic Analyses
Samples SJS21-MW01D-05D and SJS21-MW01D-05D-P

Analyte	Sample	Field Duplicate	RPD	ACTION
	SJS21-MW01D-05D	SJS21-MW01D-05D-P		
Arsenic	2.9	3.2	9.8	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8404
Fraction: Inorganic
Matrix: Groundwater
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The sample analyses were performed in accordance with the procedures outlined in the USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-media, Multi-concentration, ILM05.3.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Inorganic Analyses", USEPA 4/93. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The following parameters were evaluated:

X • Data Completeness

X • Chain of Custody Documentation

X • Holding Times

X • Initial and Continuing Calibrations

X • ICP Interference Check Sample Results

X • Laboratory and Field Blank Analysis Results

X • Matrix Spike Recoveries and Reproducibility

X • Laboratory Duplicate Analysis Results

X • ICP Serial Dilution Results

• Field Duplicate Analysis Results

X • Laboratory Control Sample Results

• GFAA Post-Digestion Spike Recovery/Duplicate Burn Precision

X • Qualitative Identification

X • Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2006

Date

1.0 *DATA COMPLETENESS*

The data package was complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

All chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

5.0 *ICP INTERFERENCE CHECK SAMPLE RESULTS*

This parameter is not applicable to the analyses performed.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

All criteria were met. No qualifiers were applied.

7.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

All criteria were met. No qualifiers were applied.

8.0 *LABORATORY DUPLICATE RESULTS*

All criteria were met. No qualifiers were applied.

9.0 *ICP SERIAL DILUTION RESULTS*

All criteria were met. No qualifiers were applied.

10.0 *FIELD DUPLICATE RESULTS*

Duplicate samples SJS21-MW01D-05D and SJS21-MW01D-05D-P were submitted to the laboratory evaluate sampling and analytical precision for those analytes determined to be present. Results for these duplicate samples are presented in Table 2. There are no USEPA-established acceptance criteria for field duplicate samples. EDQ uses internal an acceptance criterion of 25 percent for values greater than five times the CRDL (or $\pm$ the CRDL for results less than five times the CRDL.

11.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

12.0 *GFAA POST-DIGESTION SPIKE/DUPLICATE BURN*

This parameter is not applicable to the analyses performed.

13.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

14.0 *QUANTITATION/REPORTING LIMITS*

The laboratory reported results for metals detected in samples at concentrations greater than the instrument detection limit, but less than the QL with "B" flags. EDQ has flagged results for metals below the QL with "J" qualifiers to indicate that they are quantitative estimates.

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8404

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed
				As
SJS21-MW01D-05D	840401	11/7/2005	Groundwater	X
SJS21-MW01D-05D-P	840402	11/7/2005	Groundwater	X

Table 2 Field Duplicate Sample Results for Inorganic Analyses
Samples SJS21-MW01D-05D and SJS21-MW01D-05D-P

Analyte	Sample	Field Duplicate	RPD	ACTION
	SJS21-MW01D-05D	SJS21-MW01D-05D-P		
Arsenic	3.1	3.1	0.0	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8382
Fraction: Inorganic
Matrix: Groundwater
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The sample analyses were performed in accordance with the procedures outlined in the USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-media, Multi-concentration, ILM05.3.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Inorganic Analyses", USEPA 4/93. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The following parameters were evaluated:

- X • Data Completeness
- X • Chain of Custody Documentation
- X • Holding Times
- X • Initial and Continuing Calibrations
- X • ICP Interference Check Sample Results
- X • Laboratory and Field Blank Analysis Results
- X • Matrix Spike Recoveries and Reproducibility
- X • Laboratory Duplicate Analysis Results
- X • ICP Serial Dilution Results
- X • Field Duplicate Analysis Results
- X • Laboratory Control Sample Results
- • GFAA Post-Digestion Spike Recovery/Duplicate Burn Precision
- X • Qualitative Identification

X • Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2006
Date

1.0 *DATA COMPLETENESS*

The data package was complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

All chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All ferrous iron results should be considered biased low quantitative estimates, and may be higher than reported. The laboratory analyzed these samples outside of the 48-hour holding time specified by 40 CFR. Because the samples were analyzed outside of the holding time biological or chemical degradation may have occurred. Positive results have been marked with "L" qualifiers to indicate that they are estimates.

4.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

5.0 *ICP INTERFERENCE CHECK SAMPLE RESULTS*

This parameter is not applicable to the analyses performed.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

Positive results reported for inorganic analytes for the following samples are qualitatively invalid due to their presence in the associated laboratory method blanks. USEPA Region III protocol requires positive results for inorganic contaminants, that are less than or equal to five times the blank contamination level, to be considered qualitatively invalid. Placing "B" qualifiers next to the quantitative results for these metals in the samples has indicated this.

Analyte	Affected Samples
Aluminum	SJS21-MW12S-05D, SJS21-MW13S-05D, SJS21-MW13S-05D-P
Cadmium	SJS21-MW12S-05D
Nickel	SJS21-MW13S-05D, SJS21-MW13S-05D-P

7.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

All criteria were met. No qualifiers were applied.

8.0 *LABORATORY DUPLICATE RESULTS*

All criteria were met. No qualifiers were applied.

9.0 *ICP SERIAL DILUTION RESULTS*

The positive results for iron should be considered quantitative estimates. The ICP serial dilution criterion was exceeded for these elements. The lack of precision may be due to interferences in samples of similar matrix. The positive results for this metal have been marked with "J" qualifiers to indicate that they are quantitative estimates.

10.0 *FIELD DUPLICATE RESULTS*

Duplicate samples SJS21-MW13S-05D and SJS21-MW13S-05D-P were submitted to the laboratory evaluate sampling and analytical precision for those analytes determined to be present. Results for these duplicate samples are presented in Table 2. There are no USEPA-established acceptance criteria for field duplicate samples. EDQ uses internal an acceptance criterion of 25 percent for values greater than five times the CRDL (or $\pm$ the CRDL for results less than five times the CRDL.

11.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

12.0 *GFAA POST-DIGESTION SPIKE/DUPLICATE BURN*

This parameter is not applicable to the analyses performed.

13.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

14.0 *QUANTITATION/REPORTING LIMITS*

The laboratory reported results for metals detected in samples at concentrations greater than the instrument detection limit, but less than the QL with "B" flags. EDQ has flagged results for metals below the QL with "J" qualifiers to indicate that they are quantitative estimates.

METHODOLOGY REFERENCES

Analysis	Reference
TAL Metals and Cyanide	USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multi-media, Multi-concentration, ILM05.3
Alkalinity	Method 310.1, "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983, and revisions, Method 314.0
Nitrate and Sulfate	Method 300.0, "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983, and revisions
Total Organic Carbon	Method 9060, "Test Methods for Evaluating Solid Wastes", SW-846, third edition, Promulgated Updates II, IIA, and III, June 1997
Ferrous Iron	Method 3500, "Standard Methods for the Examination of Water and Wastewater", 18th edition. 1992

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8382

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed					
				VOA	PEST/PCB	SVOA	EXPLO	METAL	WCHEM
SJS21-EB110905	838210	11/9/2005	Equipment Blank		30	73	15	24	
SJS21-FB110905	838209	11/9/2005	Field Blank		30	73	15	24	
SJS21-MW02S-05D	838203	11/4/2005	Groundwater	102					1
SJS21-MW04S-05D	838211	11/9/2005	Groundwater	51					1
SJS21-MW07S-05D	838205	11/7/2005	Groundwater	51					
SJS21-MW08S-05D	838201	11/4/2005	Groundwater	102					1
SJS21-MW09S-05D	838202	11/4/2005	Groundwater	51					1
SJS21-MW12S-05D	838206	11/9/2005	Groundwater	102	30	73	15	46	5
SJS21-MW13S-05D	838207	11/9/2005	Groundwater	102	30	73	15	24	5
SJS21-MW13S-05D-P	838208	11/9/2005	Groundwater	102	30	73	15	24	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8381
Fraction: Inorganic
Matrix: Aqueous
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The sample analyses were performed in accordance with the procedures outlined in "Standard Methods for the Examination of Water and Wastewater", 18th edition.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Inorganic Analyses", USEPA 4/93. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The following parameters were evaluated:

X • Data Completeness

X • Chain of Custody Documentation

X • Holding Times

X • Initial and Continuing Calibrations

X • ICP Interference Check Sample Results

X • Laboratory and Field Blank Analysis Results

• Matrix Spike Recoveries and Reproducibility

• Laboratory Duplicate Analysis Results

• ICP Serial Dilution Results

• Field Duplicate Analysis Results

X • Laboratory Control Sample Results

X • Qualitative Identification

X • Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

_____

Shawne M. Rodgers
President

_____

Date

1.0 *DATA COMPLETENESS*

The data package was complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

All chain of custody documentation was complete.

3.0 *HOLDING TIMES*

The ferrous iron result should be considered a biased low quantitative estimate, and may be higher than reported. The laboratory analyzed the sample outside of the holding times specified by 40 CFR. Because the samples were analyzed outside of the holding time biological or chemical degradation may have occurred. Positive results have been marked with an "L" qualifier to indicate that it is a biased low quantitative estimate.

4.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

5.0 *ICP INTERFERENCE CHECK SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

All criteria were met. No qualifiers were applied.

7.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

The laboratory did not select a site sample to perform matrix spike analyses. Therefore, the associated sample data could not be evaluated based on this parameter. This should be noted when assessing the sample data.

8.0 *LABORATORY DUPLICATE RESULTS*

The laboratory did not select a site sample to perform laboratory duplicate analyses. Therefore, the associated sample data could not be evaluated based on this parameter. This should be noted when assessing the sample data.

9.0 *ICP SERIAL DILUTION RESULTS*

This parameter is not applicable to the analyses performed.

10.0 *FIELD DUPLICATE RESULTS*

There was no field duplicate sample submitted with this SDG.

11.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

12.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

13.0 *QUANTITATION/REPORTING LIMITS*

All criteria were met. No qualifiers were applied.

METHODOLOGY REFERENCES

Analysis	Reference
Ferrous Iron	Method 3500, ""Standard Methods for the Examination of Water and Wastewater", 18th edition

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8381

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed	
				VOA	FE3+
SJS21-EB110905	838110	11/9/2005	Equipment Blank	X	
SJS21-FB110905	838109	11/9/2005	Field Blank	X	
SJS21-MW01S-05D	838106	11/7/2005	Groundwater	X	X
SJS21-MW05S-05D	838107	11/7/2005	Groundwater	X	X
SJS21-MW06S-05D	838101	11/4/2005	Groundwater	X	X
SJS21-MW11S-05D	838102	11/4/2005	Groundwater	X	
SJS21-MW11S-05D-P	838103	11/4/2005	Groundwater	X	
SJS21-TB0110405	838104	11/4/2005	Trip Blank	X	
SJS21-TB110705	838108	11/7/2005	Trip Blank	X	
SJS21-TB110905	838111	11/9/2005	Trip Blank	X	
SJS21-TW125-05D	838113	11/7/2005	Groundwater	X	
SJS21-TW126-05D	838114	11/7/2005	Groundwater	X	
SJS21-TW127-05D	838112	11/7/2005	Groundwater	X	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8330
Fraction: Inorganic
Matrix: Aqueous
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for groundwater samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The sample analyses were performed in accordance with the procedures outlined in "Standard Methods for the Examination of Water and Wastewater", 18th edition.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Inorganic Analyses", USEPA 4/93. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The following parameters were evaluated:

- X • Data Completeness
- X • Chain of Custody Documentation
- X • Holding Times
- X • Initial and Continuing Calibrations
- X • ICP Interference Check Sample Results
- X • Laboratory and Field Blank Analysis Results
- • Matrix Spike Recoveries and Reproducibility
- • Laboratory Duplicate Analysis Results
- • ICP Serial Dilution Results
- • Field Duplicate Analysis Results
- X • Laboratory Control Sample Results
- X • Qualitative Identification
- X • Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2006

Date

1.0 *DATA COMPLETENESS*

The data package was complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

All chain of custody documentation was complete.

3.0 *HOLDING TIMES*

The ferrous iron result should be considered a biased low quantitative estimate, and may be higher than reported. The laboratory analyzed the sample outside of the holding times specified by 40 CFR. Because the samples were analyzed outside of the holding time biological or chemical degradation may have occurred. Positive results have been marked with an "L" qualifier to indicate that it is a biased low quantitative estimate.

4.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

5.0 *ICP INTERFERENCE CHECK SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

All criteria were met. No qualifiers were applied.

7.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

The laboratory did not select a site sample to perform matrix spike analyses. Therefore, the associated sample data could not be evaluated based on this parameter. This should be noted when assessing the sample data.

8.0 *LABORATORY DUPLICATE RESULTS*

The laboratory did not select a site sample to perform laboratory duplicate analyses. Therefore, the associated sample data could not be evaluated based on this parameter. This should be noted when assessing the sample data.

9.0 *ICP SERIAL DILUTION RESULTS*

This parameter is not applicable to the analyses performed.

10.0 *FIELD DUPLICATE RESULTS*

There was no field duplicate sample submitted with this SDG.

11.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

12.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

13.0 *QUANTITATION/REPORTING LIMITS*

All criteria were met. No qualifiers were applied.

METHODOLOGY REFERENCES

Analysis	Reference
Ferrous Iron	Method 3500, ""Standard Methods for the Examination of Water and Wastewater", 18th edition

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8330

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed	
				VOA	FE3+
SJS21-EB110205	833005	11/2/2005	Equipment Blank	X	
SJS21-FB103105	833001	10/31/2005	Field Blank	X	
SJS21-MW03S-05D	833007	11/3/2005	Groundwater	X	X
SJS21-MW10S-05D	833006	11/3/2005	Groundwater	X	
SJS21-TB103105	833002	10/31/2005	Groundwater	X	
SJS21-TB110205	833004	11/2/2005	Groundwater	X	
SJS21-TB110305	833008	11/3/2005	Groundwater	X	
SJS21-TW101-05D	833018	11/3/2005	Groundwater	X	
SJS21-TW102-05D	833012	10/31/2005	Groundwater	X	
SJS21-TW102-05D-P	833013	10/31/2005	Groundwater	X	
SJS21-TW104-05D	833014	10/31/2005	Groundwater	X	
SJS21-TW118-05D	833016	11/1/2005	Groundwater	X	
SJS21-TW119-05D	833009	11/1/2005	Groundwater	X	
SJS21-TW120-05D	833015	11/1/2005	Groundwater	X	
SJS21-TW121-05D	833010	10/31/2005	Groundwater	X	
SJS21-TW123-05D	833011	10/31/2005	Groundwater	X	
SJS21-TW124-05D	833017	11/2/2005	Groundwater	X	

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8330

Sample I.D	Laboratory I.D	Date Collected	Matrix	Analyses Performed	
				VOA	FE3+
SJS21-EB110205	833005	11/2/2005	Equipment Blank	X	
SJS21-FB103105	833001	10/31/2005	Field Blank	X	
SJS21-MW03S-05D	833007	11/3/2005	Groundwater	X	X
SJS21-MW10S-05D	833006	11/3/2005	Groundwater	X	
SJS21-TB103105	833002	10/31/2005	Groundwater	X	
SJS21-TB110205	833004	11/2/2005	Groundwater	X	
SJS21-TB110305	833008	11/3/2005	Groundwater	X	
SJS21-TW101-05D	833018	11/3/2005	Groundwater	X	
SJS21-TW102-05D	833012	10/31/2005	Groundwater	X	
SJS21-TW102-05D-P	833013	10/31/2005	Groundwater	X	
SJS21-TW104-05D	833014	10/31/2005	Groundwater	X	
SJS21-TW118-05D	833016	11/1/2005	Groundwater	X	
SJS21-TW119-05D	833009	11/1/2005	Groundwater	X	
SJS21-TW120-05D	833015	11/1/2005	Groundwater	X	
SJS21-TW121-05D	833010	10/31/2005	Groundwater	X	
SJS21-TW123-05D	833011	10/31/2005	Groundwater	X	
SJS21-TW124-05D	833017	11/2/2005	Groundwater	X	

Project: St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21 (CTO-21)
Laboratory: Compuchem
Sample Delivery Group: 8406
Fraction: Organic
Matrix: Solid
Report Date: 1/11/2006

This analytical quality assurance report is based upon a review of analytical data generated for soil samples. The sample locations, laboratory identification numbers, sample collection dates, sample matrix, and analyses performed are presented in Table 1.

The samples were analyzed for volatile organic compounds. The sample analyses were performed in accordance with the procedures outlined in the OLM04 USEPA Contract Laboratory Program (CLP) Statements of Work for Organic Analysis.

For the volatile fraction determined by Gas Chromatography/Mass Spectrometry, library searches were performed to "tentatively identify" chromatographic peaks whose characteristics did not match those of targeted compounds. Library searches were performed for up to thirty volatile extraneous peaks.

All sample analyses have undergone an analytical quality assurance review to ensure adherence to the required protocols. Results have been validated or qualified according to general guidance provided in the Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Organic Analyses", USEPA 9/94. This document specifies procedures for validating data generated for CLP analyses. Therefore, the quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate the non-CLP data. The parameters presented on the following page were evaluated.

X	•	Data Completeness
X	•	Chain of Custody Documentation
X	•	Holding Times
X	•	Instrument Performance
X	•	Initial and Continuing Calibrations
X	•	Laboratory and Field Blank Analysis Results
X	•	Surrogate Compound Recoveries
	•	Matrix Spike/Matrix Spike Duplicate Recoveries and Reproducibility
	•	Field Duplicate Analysis Results
X	•	Laboratory Control Sample Results
X	•	Internal Standard Performance
X	•	Qualitative Identification
X	•	Quantitation/Reporting Limits

X - Denotes parameter evaluated.

It is recommended that the data only be used according to the qualifiers presented, and discussed in this report. All other data should be considered qualitatively and quantitatively valid as reported by the laboratory, based on the items evaluated.

Report Approved By:

Shawne M. Rodgers
President

1/11/2006

Date

1.0 *DATA COMPLETENESS*

The data deliverables were complete.

2.0 *CHAIN OF CUSTODY DOCUMENTATION*

The chain of custody documentation was complete.

3.0 *HOLDING TIMES*

All criteria were met. No qualifiers were applied.

4.0 *INSTRUMENT PERFORMANCE*

All criteria were met. No qualifiers were applied.

5.0 *INITIAL AND CONTINUING CALIBRATIONS*

All criteria were met. No qualifiers were applied.

6.0 *LABORATORY AND FIELD BLANK ANALYSIS RESULTS*

All criteria were met. No qualifiers were applied.

7.0 *SURROGATE COMPOUNDS*

All criteria were met. No qualifiers were applied.

8.0 *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES AND REPRODUCIBILITY*

The laboratory did not select a site sample to perform matrix spike/ matrix spike duplicate analyses. Therefore, the associated sample data could not be evaluated based on these parameters. This should be noted when assessing the sample data.

9.0 *FIELD DUPLICATE RESULTS*

There were no field duplicate samples submitted with this SDG.

10.0 *LABORATORY CONTROL SAMPLE RESULTS*

All criteria were met. No qualifiers were applied.

11.0 *INTERNAL STANDARD PERFORMANCE*

All criteria were met. No qualifiers were applied.

12.0 *QUALITATIVE IDENTIFICATION*

All criteria were met. No qualifiers were applied.

13.0 *QUANTITATION/REPORTING LIMITS*

The following samples were re-analyzed at dilutions for volatile organic compounds. The re-analyses were performed because the responses for volatile compounds exceeded the linear range of the GC/MS instrument for the initial analysis. The affected results were reported from the dilution analyses. All other results have been reported from the initial analyses.

Sample	Dilution Factor	Results Exceeding the Linear Range
SJS21-SB05-01-05D	10.0	Trichloroethene
SJS21-SB05-02-05D	4.0 (Medium Level)	Trichloroethene
SJS21-SB06-02-05D	2.5	Trichloroethene

As required by USEPA protocol, all compounds, which were qualitatively identified at concentrations below their respective Quantitation Limits (QLs), have been marked with "J" qualifiers to indicate that they are quantitative estimates.

As required by USEPA protocol, all volatile tentatively identified compounds (TICs) have been reported with "J" qualifiers to indicate that they are quantitative estimates. EDQ has reported only those TIC results that have not been determined to be laboratory or field artifacts, and where possible has grouped TIC of similar classification.

Table 1 Samples For Data Validation Review
St. Juliens Creek Annex: Additional Groundwater Delineation at Site 21
CTO-57
Compuchem Sample Delivery Group 8406

Sample I.D	aboratory I.	Date Collected	Matrix	Analyses Performed
				VOA
SJS21-SB05-00-05D	840601	11/7/2005	Soil	X
SJS21-SB05-01-05D	840602	11/7/2005	Soil	X
SJS21-SB05-02-05D	840603	11/7/2005	Soil	X
SJS21-SB06-00-05D	840604	11/7/2005	Soil	X
SJS21-SB06-01-05D	840605	11/7/2005	Soil	X
SJS21-SB06-02-05D	840606	11/7/2005	Soil	X
SJS21-TB110805	840607	11/8/2005	Trip Blank	X

e*data, inc.
Environmental Data Management
& Chemistry Consulting Services

December 13, 2006

Ryan VanOosten
CH2M HILL, Inc.
5700 Cleveland Ave, Suite 101
Virginia Beach, VA 23462

Subject: Data Validation Report for St. Juliens Creek Annes – Site 21 Samples.
Contract No. N26470-02-D-3052, CTO#0057

Dear Mr. VanOosten,

Enclosed is the data validation package of CTO #0057, St. Juliens Creek Annex, Site 21 samples. A copy of the validated database file in MS-Excel file format has been e-mailed to your attention. The data fields, [DV_Qual] and {DV_Qual_Code] have been updated with the validation qualifiers. This report addresses 4 data packages and EDDs, which included work group ID No. 11307, 11325, 11326, and 11601.

Please call me at (919) 829-3571 if you have any questions or need additional information.

Sincerely,

Christopher M. Ohland

Christopher Ohland
Senior Environmental Chemist

Enclosures
CMO/kk

edata:20061213LTR.doc

1 Bay Aire Road, STE 1A
Marmora, NJ 08223

Tel: (856) 466-1504
Fax: (603) 947-6251
chris.ohland@edatainc.biz

Data Validation Report

Site 21
St. Juliens Creek Annex, NNSY
Chesapeake, Virginia

December 13, 2006
Revision 0

Prepared For CH2MHILL
Navy CLEAN III Prime Contract No.
N26470-02-D-3052, CTO#0057

Prepared by E-Data, Inc.
213 Oberlin Road,
Carriage House
Raleigh, North Carolina 27605

Acronyms and Abbreviations

AA Atomic Absorption

AOB Analytical Operations Branch

APO Administrative Project Officer

BFB Bromofluorobenzene

BNA Base-neutral/acid

CCB Continuing Calibration Blank

CCV Continuing Calibration Verification

CF Calibration Factor

CLP Contract Laboratory Program

COC Chain-of-Custody

CRDL Contract Required Detection Limit

CRQL Contract Required Quantitation Limit

CV Coefficient of Variation

%D Percent Difference

DFTPP Decafluorotriphenylphosphine

DQO Data Quality Objective

DV Data Validation

DUP Duplicate

ECD Electron Capture Detector

EICP Extracted Ion Current Profile

EPA Environmental Protection Agency

GC Gas Chromatography

GS/MS Gas Chromatography/Mass Spectroscopy

GPC Gel Permeation Chromatography

ICB Initial Calibration Blank

ICP Inductively Coupled Plasma

ICS Inter-element Check Sample

ICV Initial Calibration Verification

IDL Instrument Detection Limit

IS Internal Standard

LCS Laboratory Control Sample

MDL Method Detection Limit

mL Milliliter

MS Matrix Spike

MSD Matrix Spike Duplicate

MSA Method of Standard Addition

m/z the ration of mass (m) to charge (z) of ions measured by GC/MS

NFG Nation Functional Guidelines

PB Preparation Blank

PCB Polychlorinated Biphenyl

PEST Pesticides

QA Quality Assurance

QAPP Quality Assurance Program Project (or Project) Plan

QC Quality Control

%R Percent Recovery of Spiked Amounts of Analytes

RIC Reconstructed Ion Chromatogram

RL Reporting Limits

RPD Relative Percent Difference

RRF Relative Response Factor

RSD Relative Standard Deviation

RT Retention Time

SDG Sample Delivery Group

SMC System Monitoring Compound

SOW Scope of Work

SVOC Semi Volatile Organic Compound

TAL Target Analyte List

TCL Target Compound List

TIC Tentatively Identified Compound

VOC Volatile Organic Compound

Overview

The U.S Department of the Navy issued a task order to conduct sampling and analysis activities at St. Juliens Creek Annex under the Navy Clean III Prime Contract No. N26470-02-D-3052, CTO#0057. This report describes the validation of analytical data generated under this scope of work. E-Data Inc., located in Raleigh, NC provided the data validation services.

Field teams collected aqueous and solid environmental samples and associated field quality control samples between the dates of October 24, 2006 and October 30, 2006 and again on November 20, 2006. Environmental samples were taken at 19 unique field locations. A summary of the samples collected is shown in Table 1. Field quality control samples including 4 field duplicate samples, 7 equipment rinse blank, 4 field blank, and 6 trip blank sample were also submitted to the laboratory. The laboratory prepared project-specific samples for matrix spike/matrix spike duplicate (MS/MSD) analyses.

TABLE 1
Sample Cross-Reference Summary
(St. Juliens Creek Annex)

Lab ID No.	Field Sample ID No.	Type of Sample	Sampled
1130701	SJS21-TB102406	Trip Blank	10/24/2006
1130702	SJS21-EB102406-B	Equipment Blank	10/24/2006 9:30:00 AM
1130703	SJS21-DW101-13-06D	Normal	10/24/2006 12:50:00 PM
1130704	SJS21-EB102406-S	Equipment Blank	10/24/2006 1:15:00 PM
1130705	SJS21-DW102-14-06D	Normal	10/24/2006 1:40:00 PM
1130707	SJS21-TW201-06D	Normal	10/25/2006 12:25:00 PM
1130708	SJS21-TW201P-06D	Field Duplicate	10/25/2006 12:30:00 PM
1130709	SJS21-EB102506-A	Equipment Blank	10/25/2006 5:05:00 PM
1130710	SJS21-GW101-13-06D	Normal	10/26/2006 11:55:00 AM
1130711	SJS21-DW103-06D	Normal	10/26/2006 1:35:00 PM
1130712	SJS21-FB102606-I	Field Blank	10/26/2006 1:30:00 PM
1130713	SJS21-GW103-13-06D	Normal	10/26/2006 5:25:00 PM
1130714	SJS21-GW104-13-06D	Normal	10/27/2006 8:50:00 AM
1130715	SJS21-GW105-13-06D	Normal	10/27/2006 10:50:00 AM
1130716	SJS21-DW104-06D	Normal	10/27/2006 11:20:00 AM
1130717	SJS21-MW16S-06D	Normal	10/30/2006 11:40:00 AM
1130718	SJS21-MW15-06D	Normal	10/30/2006 3:00:00 PM
1130718	SJS21-MW15S-06D	Normal	10/30/2006 3:00:00 PM
1130719	SJS21-MW15SP-06D	Field Duplicate	10/30/2006 3:05:00 PM
1130720	SJS21-MW14S-06D	Normal	10/30/2006 4:40:00 PM
1132501	SJS21-TB102506	Trip Blank	10/25/2006
1132502	SJS21-TW202-06D	Normal	10/25/2006 3:20:00 PM
1132503	SJS21-FB102506-O	Field Blank	10/25/2006 5:20:00 PM
1132505	SJS21-TB102606	Trip Blank	10/26/2006
1132506	SJS21-TW203-06D	Normal	10/26/2006 9:10:00 AM
1132507	SJS21-TW204-06D	Normal	10/26/2006 10:45:00 AM
1132508	SJS21-GW102-13-06D	Normal	10/26/2006 4:00:00 PM
1132509	SJS21-EB102606-T	Equipment Blank	10/26/2006 4:45:00 PM
1132511	SJS21-EB102706-S	Equipment Blank	10/27/2006 9:15:00 AM
1132512	SJS21-TB102706	Trip Blank	10/27/2006
1132513	SJS21-TB103006	Trip Blank	10/30/2006

TABLE 1
Sample Cross-Reference Summary
(St. Juliens Creek Annex)

Lab ID No.	Field Sample ID No.	Type of Sample	Sampled
1132514	SJS21-FB103006-O	Field Blank	10/30/2006 3:45:00 PM
1132515	SJS21-EB103006-T	Equipment Blank	10/30/2006 4:45:00 PM
1132601	SJS21-SB09-15-06D	Normal	10/25/2006 4:30:00 PM
1132602	SJS21-SB09P-15-06D	Field Duplicate	10/25/2006 4:40:00 PM
1160101	SJS21-DW105-06D	Normal	11/20/2006 12:05:00 PM
1160102	SJS21-DW105P-06D	Field Duplicate	11/20/2006 12:05:00 PM
1160103	SJS21-FB112006-I	Field Blank	11/20/2006 12:06:00 PM
1160104	SJS21-EB112006-P	Equipment Blank	11/20/2006 12:15:00 PM
1160105	SJS21-TB112006	Trip Blank	11/20/2006

Samples were delivered to Compuchem Laboratory located in Cary, North Carolina for analytical testing. Compuchem performed analytical tests for this scope of work including trace level volatile organic analyses using EPA SOW OLC03 and OLM04. All analyses were conducted at the Cary facility.

After laboratory analyses were completed and reviewed, Compuchem assembled hardcopy data packages and electronic data deliverables (EDD), which was delivered to CH2MHILL Inc., office located in Virginia Beach, VA office and forwarded to E-Data. Compuchem provided four data packages and EDDs, which included work group ID Nos. 11307, 11325, 11326, and 11601.

Data validation was conducted as described in the USEPA National Laboratory Functional Guidelines for Organic Data Review and USEPA Region 3 Modifications to the Functional Guidelines. A copy of the project chain-of-custody forms and laboratory reports with data qualifiers applied as a result of data validation are provided in Appendix A. Appendix B contains results of all tentatively identified compounds. Appendix C contains copies of the completed checklists used to document the data validation effort.

Summary of Sample Analyses

Hardcopy Data Packages

Project completeness is calculated at 100 percent (1898 valid results of 1898 total results) of the laboratory data undergoing data validation. No major issues were identified as a result of data validation. Minor issues are described below. Project data qualifiers are added to the laboratory reports. A list of project data qualifiers is shown in Table 2.

TABLE 2
List of Project Qualifiers
(St. Juliens Creek Annex)

Qualifier	Description
[*none*]	The analyte was positively identified.
B	The analyte was also detected in the associated QC blank samples. The measured concentration is likely an artifact of procedural contamination as indicated by the QC blank samples.
J	The analyte was positively identified; however, the concentration value is an estimate. Also used if a result was measured at a concentration below the Contract Required Quantification Limit (CRQL) or Contract Required Detection Limit (CRDL).
UJ	The analyte was analyzed for, but not detected; however, the concentration value is an estimate.
U	The analyte was analyzed for, but not detected.

Field samples are qualified for the introduction of contaminants resulting from laboratory and field activities as measured in the laboratory method blank, equipment rinse blank, field blank, and trip blank audit samples. Equipment rinse blank, field blank, and trip blank audit samples are not qualified.

A summary of all qualified results is shown on Table D-1 (Appendix D).

Electronic Data Deliverable

The sample results were verified by comparing the results to the validated laboratory Form 1's. Table E-1 (Appendix E) summarizes the 2524 sample results that were verified.

Major Technical Issues

No major technical issues were identified.

Minor Technical Issues

Volatile Organic Analyses (SDG 11307)

Chain of Custody, Sample Login, Preservation, and Holding Times
Samples were received at 1.6 – 5.2°C and analyzed from 0 to 7 days after sample collection. There were no deficiencies noted during the review.

Surrogate Recoveries
Surrogate recoveries were within acceptable QC limits.

Matrix Spike and Matrix Spike Duplicate
Matrix spike and matrix spike duplicate analyses were performed on sample 1130717 (water) at the dilution level of 1:67 and 1132601 (solid). Acceptable accuracy and precision objectives were not met for three of the five compounds in the water matrix and one of five compounds in a solid matrix. The trichloroethene result for both matrices is inconclusive because the amount fortified in the sample is much less than the amount measured in the native sample. The result for benzene and toluene in the water matrix indicates a high bias; however these compounds are not detected in the field samples at concentrations greater than the report limit. No action is taken to qualify the sample results based on the matrix spike data.

Laboratory Control Samples
A LCS pair was performed with SDG 11601 because MS/D analyses were not requested. Acceptable performance was demonstrated..

Method and Field Blanks
Trace levels of volatile organics were detected in one or more field, trip, equipment, or laboratory method blank analysis. Action levels were calculated using the 5X and 10X Rule. Sample results less than the calculated action level are qualified as non-detected and flagged "B." The following action levels were applied: 1,2,4-trichlorobenzene (10), 2-butanone (20), acetone (80), chloroform (5), methylene chloride (30), toluene (5), and trichloroethene (15).

Field Duplicate
Field duplicate samples were collected and analyses were performed using field sample pairs 1130707/1130708, 1130718/1130719, and 1160101/1160102. Acceptable field duplicate precision objectives were obtained except the 1,2-dichloroethene results for sample pair 1130718/1130719. These results were reported near the report limits and were within 2X the report limit; however because high concentrations are being reported the results have been qualified as estimates and flagged "J."

Calibrations
Initial and continuing calibrations were within acceptable control limits, except for

compounds that were not detected at concentrations greater than the report limit. No action was taken to qualify the sample results for calibration deficiencies.

Internal Standard Recovery
Internal standard spike recoveries were acceptable.

Reporting Limits
Nominal reporting limits were achieved except for the following samples that were diluted, per the case narrative, based on screening data. 1130717 (1:66.7), 1130718 (1:200), 1130719 (1:100), and 1130720 (1:12.5).

Volatile Organic Analyses (SDG 11325)

Chain of Custody, Sample Login, Preservation, and Holding Times
Samples were received at 2.2 to 5.2°C and sample aliquots and dilutions were analyzed within 5 days of sample collection. The sample SJS21-TB102706 was recorded as SJS21-FB102706 on the COC documents. The sample was logged in as SJS21-TB102706.

Surrogate Recovery
Recoveries were outside the established quality control limits for four of the fourteen surrogates. Five samples reported chloroethane-d5 above the control limits; however no action was taken to qualify the non-detected results. Sample 1132508 reports 1,1-dichloroethene-d2 above the control limits. The associated detected results have been qualified as estimates and flagged "J." The 1,2-dichloropropane surrogate is below the control limit for samples 1132509 and 1132508DL. No data is reported from 1132508DL; however the associated non-detected results for sample 1132509 have been qualified as estimates and flagged "UJ." The 2-hexanone-d5 surrogate is below the control limit for samples 1132502, 1132505, 1132509, 1132511, 1132512, and 1132515. The associated non-detected results for these samples have been qualified as estimates and flagged "UJ."

Matrix Spike and Matrix Spike Duplicate
Matrix spike and matrix spike duplicate analyses were performed not requested for project-specific field samples. An assessment of this QC type could not be completed.

Laboratory Control Sample
Laboratory control sample analyses were performed by the laboratory. All accuracy and precision objectives were met.

Blank Contaminants
Trace levels of VOCs were present in at least one or more method blank, field blank, or trip blank analyses. Action levels were determined using the 5/10X Rule. Sample results less than the Action Levels are qualified as non-detected and flagged "B." The following action levels were applied (ug/l): acetone (110), carbon disulfide (0.95), cyclohexane (0.6), methylene chloride (2.6), toluene (0.5), and 1,1,2-trichloro-1,2,2-trifluoroethane (0.65)

Field Duplicate
Field duplicate samples were not collected and analyses with this delivery group. An assessment of this QC type could not be completed.

Calibrations
Minor initial and continuing calibration QC deficiencies were observed for compounds that

were not detected in the associated field samples. No action was taken to qualify the sample results.

Internal Standards
Internal standard recoveries were within acceptable QC limits.

Reporting Limits
Samples were analyzed neat and nominal quantification limits were achieved.

ENVIRONMENTAL
Data Services, Inc.

VOLATILE ORGANIC COMPOUNDS
USEPA Region III - Level IV Review

Site: St. Julien's Creek, CTO-057 SDG #: KB2

Client: CH2M HILL, Inc., Virginia Beach, Virginia Date: March 26, 2007

Laboratory: KB Labs, Inc., Gainesville, FL Reviewer: Nancy Weaver

EDS ID	Client Sample ID	Laboratory File ID	Matrix
1	SJS21-TW205-07A	02200706.D	Water
2	SJS21-TW206-07A	02200707.D	Water
3	SJS21-TW207-07A	02200708.D	Water
4	SJS21-TW207P-07A	02200709.D	Water
4MS	SJS21-TW207P-07AMS	02200712.D MS	Water
4MSD	SJS21-TW207P-07AMSD	02200711.D MSD	Water
5	SJS21-TW210-07A	02200714.D	Water
6	SJS21-TW211-07A	02210706.D	Water
6MS	SJS21-TW211-07AMS	02210707.D MS	Water
6MSD	SJS21-TW211-07AMSD	02210708.D MSD	Water
7	SJS21-TW212-07A	02210710.D	Water
8	SJS21-TW213-07A	02210711.D	Water
9	SJS21-TW214-07A	02210712.D	Water
10	SJS21-TW215-07A	02210713.D	Water
11	SJS21-TW208-07A	02210714.D	Water
12	SJS21-TW209-07A	02220706.D	Water
12MS	SJS21-TW209-07AMS	02220707.D MS	Water
12MSD	SJS21-TW209-07AMSD	02220708.D MSD	Water
13	SJS21-TW216-07A	02220710.D	Water
14	SJS21-TW217-07A	02230706.D	Water
14MS	SJS21-TW217-07AMS	02230707.D MS	Water
14MSD	SJS21-TW217-07AMSD	02230711.D MSD	Water

The USEPA "Region III Modifications to the National Functional Guidelines for Organic Data Review", September 1994, was used in evaluating the data in this summary report.

Holding Times - All samples were analyzed within 14 days for preserved water samples.

GC/MS Tuning - All of the BFB tunes in the initial and continuing calibrations met the percent relative abundance criteria.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and mean RRF values.

Continuing Calibration - The continuing calibrations exhibited acceptable %D and RRF values.

CCAL Date	Compound	%D/RRF	Qualifier	Affected Samples
2/20/07	Chloromethane	30.1	None	Samples ND
	1,2-Dibromo-3-chloropropane	26.5	None	
2/22/07	MTBE	26.8	None	
2/23/07	Chloromethane	26.9	None	

Surrogates - All samples exhibited acceptable surrogate recoveries.

MS/MSD - The MS/MSD samples exhibited acceptable %R and RPD values.

Laboratory Control Sample - The LCS samples exhibited acceptable %R values.

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
VBLK01	Toluene	0.8	4.0	B	1, 5
	Tetrachloroethene	0.9	4.5	B	1
	Chlorobenzene	0.8	4.0	B	
	m,p-Xylene	1	5.0	B	1, 2, 5
	1,1,2,2-Tetrachloroethane	0.9	4.5	B	1
VBLK02	1,2-Dichloroethane	0.7	3.5	B	6, 7, 9-11
	m,p-Xylene	0.7	3.5	B	6, 8, 10, 11
VBLK03	Toluene	1.0	5.0	B	12, 13
	Tetrachloroethene	1.0	5.0	B	12, 13
	Ethylbenzene	0.8	4.0	B	12
	m,p-Xylene	1.0	5.0	B	12, 13
	1,1,2,2-Tetrachloroethane	0.9	4.5	None	None
	1,2-Dichlorobenzene	0.7	3.5	B	12
	1,2,4-Trichlorobenzene	1.0	5.0	B	12
VBLK04	Toluene	0.9	4.5	B	14
	Tetrachloroethene	0.9	4.5	B	14
VBLK04	Chlorobenzene	0.8	4.0	B	14
	m,p-Xylene	0.9	4.5	None	None

Trip, Field, Equipment Blank - Field QC samples are not included in this data package.

Field Duplicates - Field duplicate results are summarized below.

Compound	SJS21-TW207-07A ug/L	SJS21-TW207-07AP ug/L	RPD	Qualifier
1,2-Dichloroethane	0.7	0.8	13%	None
Toluene	7	6	15%	

Tentatively Identified Compounds (TICs) - All "unknown" TICs were qualified as estimated (J), all "known" TICs were qualified (NJ) and all TICs affected by blank contamination were qualified (B).

Compound Quantitation - No discrepancies were identified.

ENVIRONMENTAL
Data Services, Inc.

VOLATILE ORGANIC COMPOUNDS
USEPA Region III - Level IV Review

Site: St. Julien's Creek, CTO-057 SDG #: CH2.V02206

Client: CH2M HILL, Inc., Virginia Beach, Virginia Date: March 26, 2007

Laboratory: Empirical Labs, Nashville, TN Reviewer: Nancy Weaver

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	SJS21-MW19S-07A	0702206-01	Water
2	SJS21-MW17S-07A	0702206-02	Water
3	SJS21-MW18S-07A	0702206-03	Water
4	SJS21-MW18S-07AP	0702206-04	Water
5	SJS21-TB022607	0702206-05	Water
6	SJS21-FB022607	0702206-06	Water
7	SJS21-EB022607	0702206-07	Water

The USEPA "Region III Modifications to the National Functional Guidelines for Organic Data Review", September 1994, was used in evaluating the data in this summary report.

Holding Times - All samples were analyzed within 14 days for preserved water samples.

GC/MS Tuning - All of the BFB tunes in the initial and continuing calibrations met the percent relative abundance criteria.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and mean RRF values.

Continuing Calibration - The continuing calibrations exhibited acceptable %D and RRF values except the following.

CCAL Date	Compound	%D/RRF	Qualifier	Affected Samples
3/2/07	2-Hexanone	25.1	None	Sample ND
	Methylcyclohexane	27.6	None	

Surrogates - All samples exhibited acceptable surrogate recoveries.

MS/MSD - The MS/MSD sample exhibited acceptable %R and RPD values.

Laboratory Control Sample - A LCS sample was not analyzed.

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
V4BLK0302	Methylene chloride	2	20	None	All ND
V4BLK0303	None	ND	-	-	-
Storage Blank	Methylene chloride	1.2	12	None	See MB

Trip, Field, Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
SJS21-TB022607	None	ND	-	-	-
SJS21-FB022607	None	ND	-	-	-
SJS21-EB022607	Methylene chloride	1.2	12	None	See MB

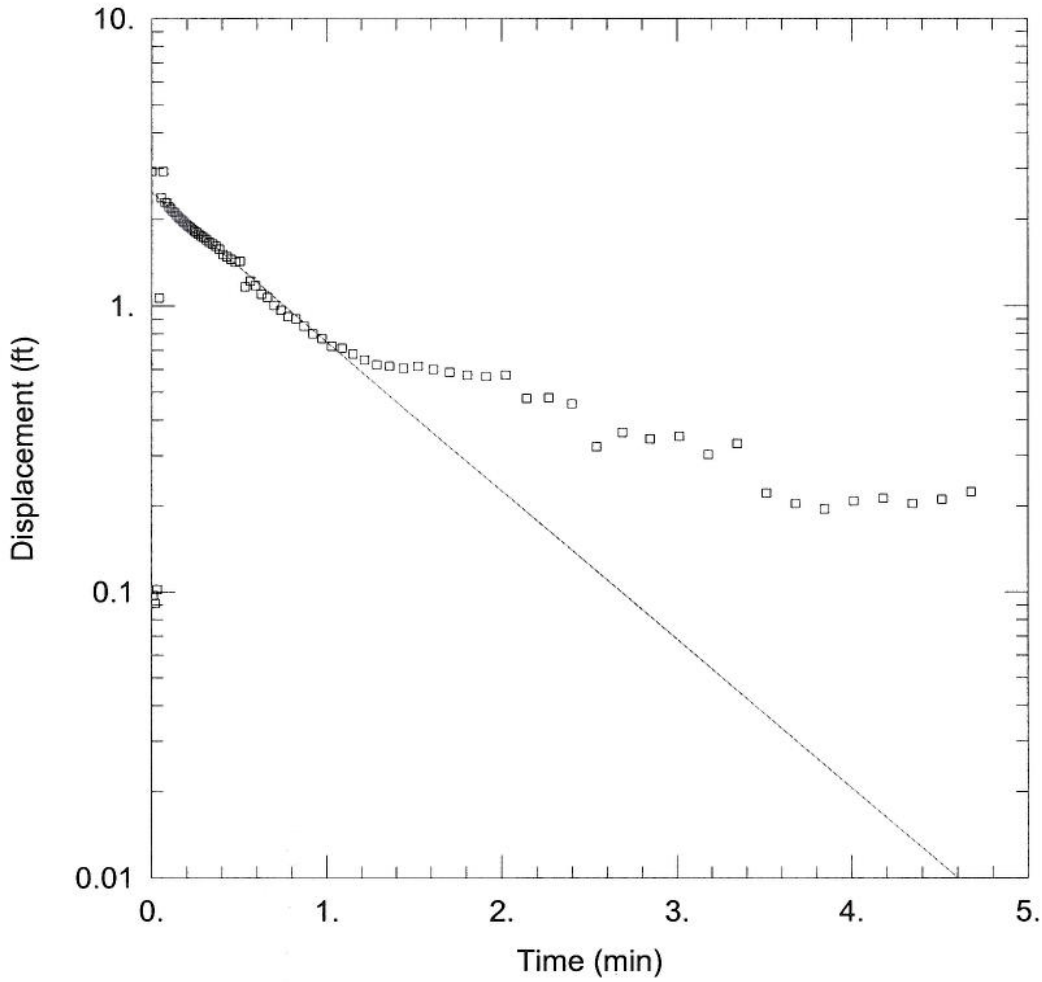
Field Duplicates - Field duplicate results are summarized below.

Compound	SJS21-MW18S-07A ug/L	SJS21-MW18S-07AP ug/L	RPD	Qualifier
cis-1,2-Dichloroethene	44	49	11%	None
Trichloroethene	170	180	6%	
Vinyl chloride	14	16	13%	

Tentatively Identified Compounds (TICs) - All "unknown" TICs were qualified as estimated (J), all "known" TICs were qualified (NJ) and all TICs affected by blank contamination were qualified (B).

Compound Quantitation - No discrepancies were identified.

Appendix H
Slug Test Data



WELL TEST ANALYSIS

Data Set: \\Ariadne\proj\CLEANII\BASES\St. Juliens\Slug Tests\21MW01D.aqt
Date: 02/13/06 Time: 17:19:16

AQUIFER DATA

Saturated Thickness: 145. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (21MW01D)

Initial Displacement: 2.929 ft Casing Radius: 0.167 ft
Wellbore Radius: 0.5 ft Well Skin Radius: 0.5 ft
Screen Length: 10. ft Total Well Penetration Depth: 12. ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.001549 cm/sec y0 = 2.479 ft

In-Situ Inc. Hermit 3000

Report generated: 02/13/06 17:24:38
Report from file: ...\SN45451 2004-11-24 144256 21MW01DR .bin
Win-Situ Version 4.50

Serial number: 00045451
Firmware Version 7.10
Unit name: HERMIT 3000

Test name: 21MW01DR

Test defined on: 11/24/04 14:42:29
Test started on: 11/24/04 14:42:56
Test stopped on: 11/24/04 14:47:45
Test extracted on: 11/24/04 16:09:39

Data gathered using Logarithmic testing
   Maximum time between data points: 10.0 Seconds.
   Number of data samples: 79

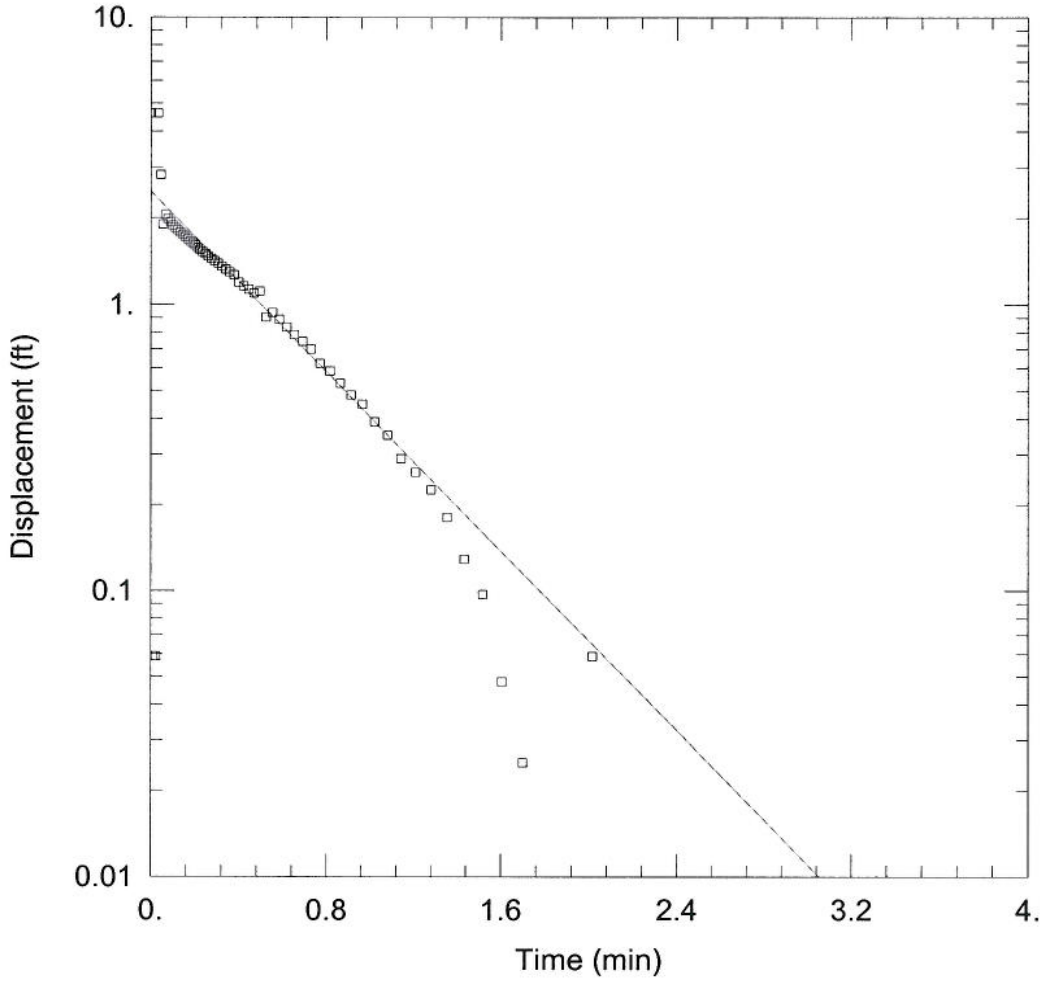
TOTAL DATA SAMPLES 79

Channel number [1]
  Measurement type: Pressure
  Channel name:
  Linearity: 0.0722000
  Scale: 15.6629000
  Offset: -0.1253000
  Warmup: 50
  Specific gravity: 1.000
  Mode: TOC
  User-defined reference: 10.481 Feet H2O
  Referenced on: channel definition.
  Pressure head at reference: 10.486 Feet H2O

Channel number [0]
  Measurement type: Barometric Pressure
  Channel name: Barometric
  Linearity: 0.0000000
  Scale: 0.0000000
  Offset: 0.0000000
  Warmup: 50

Date	Time	ET (sec)	Chan[1] Pressure Feet H2O	Chan[0] Barometric Inches Hg
11/24/04	14:42:56	0.0	10.518	29.732
11/24/04	14:42:56	0.7	10.615	29.732
11/24/04	14:42:57	1.3	10.608	29.732
11/24/04	14:42:57	2.0	10.620	29.732
11/24/04	14:42:58	2.6	11.584	29.732
11/24/04	14:42:59	3.3	12.894	29.732
11/24/04	14:42:59	4.0	13.446	29.732
11/24/04	14:43:00	4.6	12.806	29.732
11/24/04	14:43:01	5.3	12.793	29.732
11/24/04	14:43:01	5.9	12.725	29.732
11/24/04	14:43:02	6.6	12.693	29.730
11/24/04	14:43:03	7.3	12.650	29.732
11/24/04	14:43:03	7.9	12.627	29.730
11/24/04	14:43:04	8.6	12.575	29.730
11/24/04	14:43:05	9.2	12.546	29.730
11/24/04	14:43:05	9.9	12.519	29.732
11/24/04	14:43:06	10.6	12.492	29.730
11/24/04	14:43:07	11.2	12.464	29.730
11/24/04	14:43:07	11.9	12.437	29.732
11/24/04	14:43:08	12.5	12.412	29.732
11/24/04	14:43:09	13.2	12.390	29.732
11/24/04	14:43:09	13.9	12.365	29.730
11/24/04	14:43:10	14.6	12.340	29.732
11/24/04	14:43:11	15.3	12.320	29.732
11/24/04	14:43:12	16.1	12.292	29.732

11/24/04	14:43:12	16.9	12.267	29.732
11/24/04	14:43:13	17.8	12.243	29.732
11/24/04	14:43:14	18.8	12.213	29.732
11/24/04	14:43:15	19.8	12.186	29.732
11/24/04	14:43:16	20.8	12.157	29.732
11/24/04	14:43:17	21.9	12.127	29.732
11/24/04	14:43:19	23.1	12.093	29.734
11/24/04	14:43:20	24.4	12.025	29.732
11/24/04	14:43:21	25.7	11.998	29.732
11/24/04	14:43:23	27.1	11.969	29.732
11/24/04	14:43:24	28.6	11.937	29.734
11/24/04	14:43:26	30.2	11.946	29.732
11/24/04	14:43:27	31.9	11.681	29.734
11/24/04	14:43:29	33.7	11.738	29.734
11/24/04	14:43:31	35.6	11.695	29.734
11/24/04	14:43:33	37.5	11.616	29.734
11/24/04	14:43:35	39.6	11.588	29.734
11/24/04	14:43:37	41.9	11.521	29.734
11/24/04	14:43:40	44.3	11.484	29.736
11/24/04	14:43:42	46.8	11.435	29.732
11/24/04	14:43:45	49.4	11.419	29.734
11/24/04	14:43:48	52.3	11.367	29.732
11/24/04	14:43:51	55.2	11.317	29.734
11/24/04	14:43:54	58.4	11.287	29.734
11/24/04	14:43:57	61.8	11.242	29.734
11/24/04	14:44:01	65.3	11.231	29.734
11/24/04	14:44:05	69.1	11.199	29.734
11/24/04	14:44:09	73.0	11.165	29.732
11/24/04	14:44:13	77.3	11.140	29.734
11/24/04	14:44:17	81.7	11.136	29.732
11/24/04	14:44:22	86.5	11.124	29.734
11/24/04	14:44:27	91.5	11.133	29.732
11/24/04	14:44:32	96.8	11.118	29.732
11/24/04	14:44:38	102.4	11.104	29.734
11/24/04	14:44:44	108.4	11.090	29.734
11/24/04	14:44:50	114.7	11.086	29.732
11/24/04	14:44:57	121.4	11.090	29.732
11/24/04	14:45:04	128.5	10.993	29.734
11/24/04	14:45:12	136.0	10.995	29.730
11/24/04	14:45:19	144.0	10.973	29.732
11/24/04	14:45:28	152.4	10.839	29.734
11/24/04	14:45:37	161.3	10.880	29.734
11/24/04	14:45:46	170.8	10.862	29.732
11/24/04	14:45:56	180.8	10.869	29.732
11/24/04	14:46:06	190.8	10.821	29.734
11/24/04	14:46:16	200.8	10.848	29.734
11/24/04	14:46:26	210.8	10.740	29.732
11/24/04	14:46:36	220.8	10.721	29.732
11/24/04	14:46:46	230.8	10.712	29.734
11/24/04	14:46:56	240.8	10.726	29.730
11/24/04	14:47:06	250.8	10.730	29.734
11/24/04	14:47:16	260.8	10.721	29.732
11/24/04	14:47:26	270.8	10.728	29.734
11/24/04	14:47:36	280.8	10.742	29.732



WELL TEST ANALYSIS

Data Set: \\Ariadne\proj\CLEANII\BASES\St. Juliens\Slug Tests\21MW01S.aqt
Date: 02/13/06 Time: 17:34:53

AQUIFER DATA

Saturated Thickness: 11.36 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (21MW01S)

Initial Displacement: 4.621 ft
Wellbore Radius: 0.5 ft
Screen Length: 10. ft
Casing Radius: 0.167 ft
Well Skin Radius: 0.5 ft
Total Well Penetration Depth: 11.36 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.002938 cm/sec
y0 = 2.47 ft

In-Situ Inc. Hermit 3000

Report generated: 02/13/06 17:41:42
Report from file: ...\SN45451 2004-11-23 153718 21MW01SR .bin
Win-Situ Version 4.50

Serial number: 00045451
Firmware Version 7.10
Unit name: HERMIT 3000

Test name: 21MW01SR

Test defined on: 11/23/04 15:31:51
Test started on: 11/23/04 15:37:18
Test stopped on: 11/23/04 15:41:03
Test extracted on: 11/23/04 18:55:10

Data gathered using Logarithmic testing
   Maximum time between data points: 10.0 Seconds.
   Number of data samples: 72

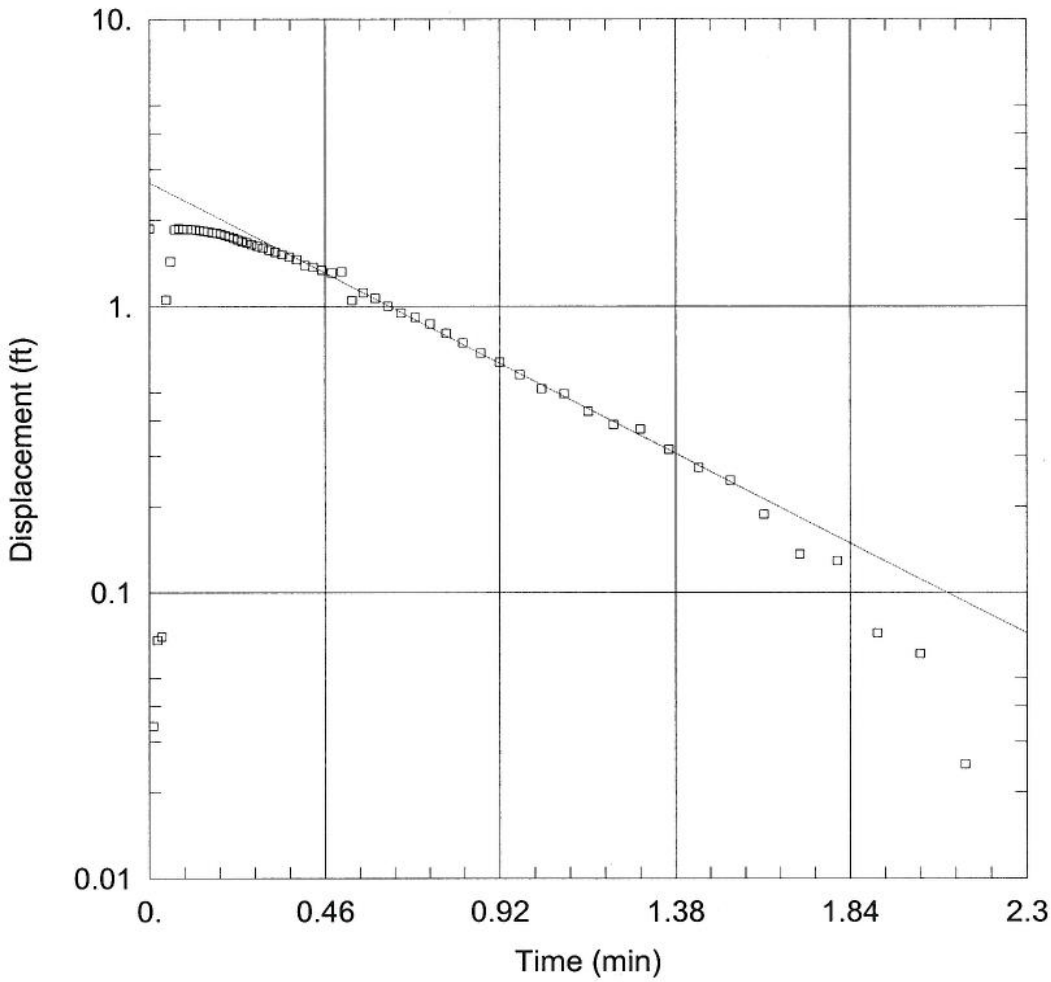
TOTAL DATA SAMPLES 72

Channel number [1]
  Measurement type: Pressure
  Channel name:
  Linearity: 0.0722000
  Scale: 15.6629000
  Offset: -0.1253000
  Warmup: 50
  Specific gravity: 1.000
  Mode: TOC
  User-defined reference: 6.713 Feet H2O
  Referenced on: channel definition.
  Pressure head at reference: 6.713 Feet H2O

Channel number [0]
  Measurement type: Barometric Pressure
  Channel name: Barometric
  Linearity: 0.0000000
  Scale: 0.0000000
  Offset: 0.0000000
  Warmup: 50

Date	Time	ET (sec)	Chan[1] Pressure Feet H2O	Chan[0] Barometric Inches Hg
11/23/04	15:37:18	0.0	6.738	29.948
11/23/04	15:37:18	0.7	6.797	29.950
11/23/04	15:37:19	1.3	6.797	29.948
11/23/04	15:37:20	2.0	11.359	29.948
11/23/04	15:37:20	2.7	9.563	29.945
11/23/04	15:37:21	3.4	8.636	29.948
11/23/04	15:37:22	4.0	8.794	29.948
11/23/04	15:37:22	4.7	8.722	29.945
11/23/04	15:37:23	5.4	8.674	29.950
11/23/04	15:37:24	6.0	8.625	29.948
11/23/04	15:37:24	6.7	8.584	29.948
11/23/04	15:37:25	7.4	8.552	29.945
11/23/04	15:37:26	8.0	8.518	29.948
11/23/04	15:37:26	8.7	8.487	29.948
11/23/04	15:37:27	9.4	8.455	29.950
11/23/04	15:37:28	10.1	8.426	29.948
11/23/04	15:37:28	10.7	8.396	29.945
11/23/04	15:37:29	11.4	8.369	29.948
11/23/04	15:37:30	12.1	8.344	29.945
11/23/04	15:37:30	12.7	8.315	29.945
11/23/04	15:37:31	13.4	8.290	29.948
11/23/04	15:37:32	14.1	8.263	29.945
11/23/04	15:37:32	14.9	8.238	29.945
11/23/04	15:37:33	15.6	8.211	29.945
11/23/04	15:37:34	16.5	8.184	29.945

11/23/04	15:37:35	17.4	8.157	29.948
11/23/04	15:37:36	18.3	8.127	29.945
11/23/04	15:37:37	19.3	8.098	29.948
11/23/04	15:37:38	20.4	8.066	29.948
11/23/04	15:37:39	21.5	8.037	29.945
11/23/04	15:37:40	22.7	8.005	29.948
11/23/04	15:37:41	23.9	7.933	29.945
11/23/04	15:37:43	25.3	7.896	29.945
11/23/04	15:37:44	26.7	7.867	29.945
11/23/04	15:37:46	28.2	7.833	29.945
11/23/04	15:37:47	29.8	7.851	29.945
11/23/04	15:37:49	31.4	7.643	29.943
11/23/04	15:37:51	33.2	7.675	29.945
11/23/04	15:37:53	35.1	7.625	29.945
11/23/04	15:37:55	37.1	7.573	29.945
11/23/04	15:37:57	39.2	7.523	29.945
11/23/04	15:37:59	41.4	7.483	29.945
11/23/04	15:38:01	43.8	7.437	29.945
11/23/04	15:38:04	46.3	7.363	29.945
11/23/04	15:38:06	49.0	7.324	29.945
11/23/04	15:38:09	51.8	7.270	29.943
11/23/04	15:38:12	54.8	7.222	29.945
11/23/04	15:38:15	57.9	7.189	29.945
11/23/04	15:38:19	61.3	7.130	29.945
11/23/04	15:38:22	64.8	7.089	29.945
11/23/04	15:38:26	68.6	7.028	29.941
11/23/04	15:38:30	72.6	6.999	29.945
11/23/04	15:38:34	76.8	6.965	29.943
11/23/04	15:38:39	81.3	6.919	29.945
11/23/04	15:38:44	86.0	6.867	29.941
11/23/04	15:38:49	91.0	6.836	29.945
11/23/04	15:38:54	96.3	6.786	29.945
11/23/04	15:38:59	102.0	6.763	29.945
11/23/04	15:39:05	107.9	6.707	29.945
11/23/04	15:39:12	114.3	6.705	29.945
11/23/04	15:39:18	120.9	6.797	29.943
11/23/04	15:39:26	128.0	6.652	29.945
11/23/04	15:39:33	135.5	6.637	29.948
11/23/04	15:39:41	143.5	6.623	29.948
11/23/04	15:39:49	151.9	6.630	29.950
11/23/04	15:39:58	160.8	6.600	29.948
11/23/04	15:40:08	170.3	6.625	29.950
11/23/04	15:40:18	180.3	6.605	29.948
11/23/04	15:40:28	190.3	6.605	29.950
11/23/04	15:40:38	200.3	6.582	29.950
11/23/04	15:40:48	210.3	6.600	29.950
11/23/04	15:40:58	220.3	6.614	29.952



WELL TEST ANALYSIS

Data Set: \\Ariadne\proj\CLEANII\BASES\St. Juliens\Slug Tests\21MW04S.aqt
Date: 02/13/06 Time: 17:42:36

AQUIFER DATA

Saturated Thickness: 14.63 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (21MW04S)

Initial Displacement: 1.864 ft Casing Radius: 0.167 ft
Wellbore Radius: 0.5 ft Well Skin Radius: 0.5 ft
Screen Length: 10. ft Total Well Penetration Depth: 14.63 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.002728 cm/sec y0 = 2.693 ft

In-Situ Inc. Hermit 3000

Report generated: 02/13/06 17:46:27
Report from file: ...\SN45451 2004-11-24 150249 21MW04SR .bin
Win-Situ Version 4.50

Serial number: 00045451
Firmware Version 7.10
Unit name: HERMIT 3000

Test name: 21MW04SR

Test defined on: 11/24/04 14:58:29
Test started on: 11/24/04 15:02:49
Test stopped on: 11/24/04 15:10:30
Test extracted on: 11/24/04 16:10:09

Data gathered using Logarithmic testing
   Maximum time between data points: 10.0 Seconds.
   Number of data samples: 96

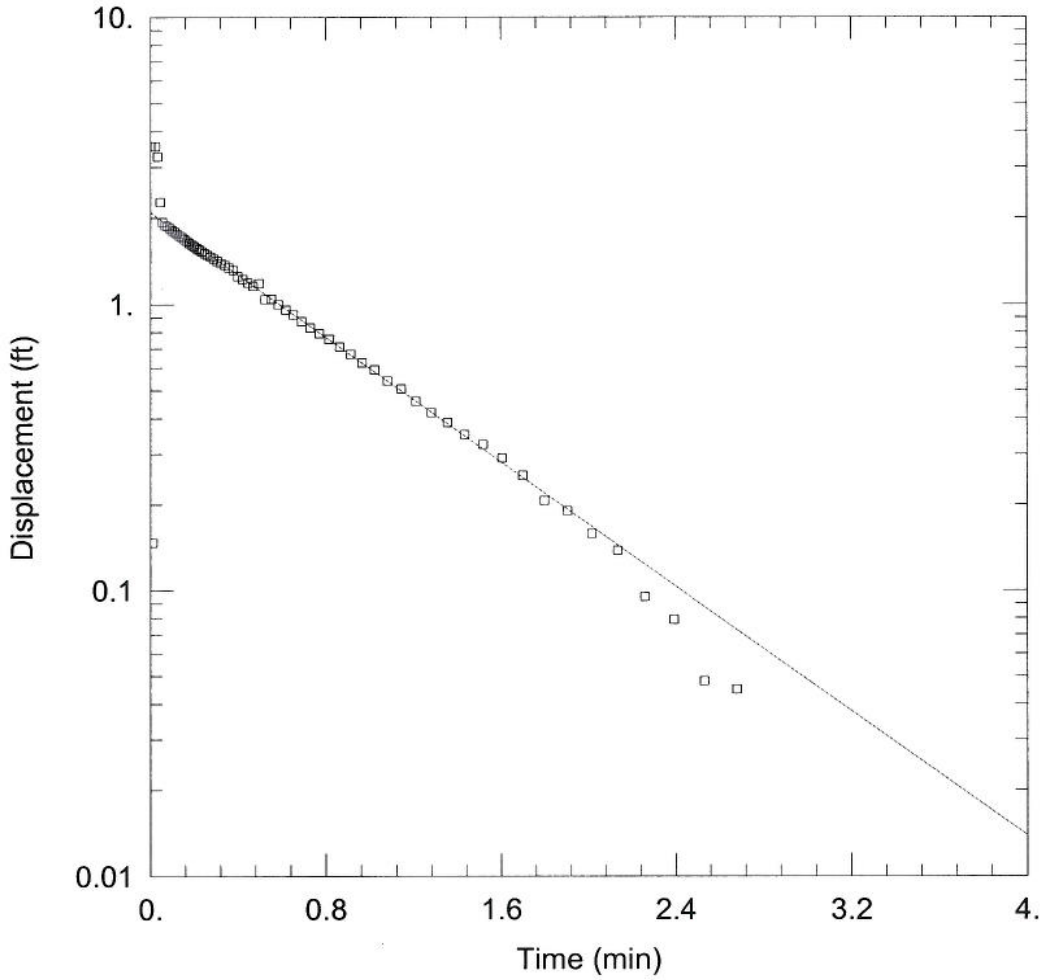
TOTAL DATA SAMPLES 96

Channel number [1]
  Measurement type: Pressure
  Channel name:
  Linearity: 0.0722000
  Scale: 15.6629000
  Offset: -0.1253000
  Warmup: 50
  Specific gravity: 1.000
  Mode: TOC
  User-defined reference: 8.092 Feet H2O
  Referenced on: channel definition.
  Pressure head at reference: 8.090 Feet H2O

Channel number [0]
  Measurement type: Barometric Pressure
  Channel name: Barometric
  Linearity: 0.0000000
  Scale: 0.0000000
  Offset: 0.0000000
  Warmup: 50

Date	Time	ET (sec)	Chan[1] Pressure Feet H2O	Chan[0] Barometric Inches Hg
11/24/04	15:02:49	0.0	8.157	29.736
11/24/04	15:02:49	0.7	8.191	29.732
11/24/04	15:02:50	1.3	8.225	29.734
11/24/04	15:02:50	2.0	8.227	29.734
11/24/04	15:02:51	2.6	9.211	29.736
11/24/04	15:02:52	3.3	9.591	29.734
11/24/04	15:02:52	4.0	10.007	29.736
11/24/04	15:02:53	4.6	10.021	29.736
11/24/04	15:02:54	5.3	10.014	29.736
11/24/04	15:02:54	5.9	10.010	29.736
11/24/04	15:02:55	6.6	10.007	29.734
11/24/04	15:02:56	7.3	10.001	29.736
11/24/04	15:02:56	7.9	9.992	29.736
11/24/04	15:02:57	8.6	9.985	29.736
11/24/04	15:02:58	9.2	9.973	29.734
11/24/04	15:02:58	9.9	9.962	29.736
11/24/04	15:02:59	10.6	9.955	29.736
11/24/04	15:03:00	11.2	9.942	29.736
11/24/04	15:03:00	11.9	9.926	29.736
11/24/04	15:03:01	12.5	9.906	29.736
11/24/04	15:03:02	13.2	9.885	29.734
11/24/04	15:03:02	13.9	9.863	29.736
11/24/04	15:03:03	14.6	9.842	29.736
11/24/04	15:03:04	15.3	9.824	29.734
11/24/04	15:03:05	16.1	9.799	29.734

11/24/04	15:03:05	16.9	9.774	29.734
11/24/04	15:03:06	17.8	9.752	29.734
11/24/04	15:03:07	18.8	9.725	29.734
11/24/04	15:03:08	19.8	9.700	29.734
11/24/04	15:03:09	20.8	9.670	29.734
11/24/04	15:03:10	21.9	9.643	29.736
11/24/04	15:03:12	23.1	9.612	29.738
11/24/04	15:03:13	24.4	9.548	29.736
11/24/04	15:03:14	25.7	9.526	29.738
11/24/04	15:03:16	27.1	9.494	29.738
11/24/04	15:03:17	28.6	9.465	29.738
11/24/04	15:03:19	30.2	9.476	29.736
11/24/04	15:03:20	31.9	9.204	29.738
11/24/04	15:03:22	33.7	9.272	29.738
11/24/04	15:03:24	35.6	9.225	29.738
11/24/04	15:03:26	37.5	9.159	29.738
11/24/04	15:03:28	39.6	9.107	29.738
11/24/04	15:03:30	41.9	9.073	29.738
11/24/04	15:03:33	44.3	9.023	29.738
11/24/04	15:03:35	46.8	8.962	29.738
11/24/04	15:03:38	49.4	8.903	29.740
11/24/04	15:03:41	52.3	8.845	29.738
11/24/04	15:03:44	55.2	8.795	29.738
11/24/04	15:03:47	58.4	8.734	29.738
11/24/04	15:03:50	61.8	8.673	29.738
11/24/04	15:03:54	65.3	8.652	29.738
11/24/04	15:03:58	69.1	8.587	29.740
11/24/04	15:04:02	73.0	8.544	29.740
11/24/04	15:04:06	77.3	8.530	29.740
11/24/04	15:04:10	81.7	8.474	29.740
11/24/04	15:04:15	86.5	8.431	29.740
11/24/04	15:04:20	91.5	8.403	29.740
11/24/04	15:04:25	96.8	8.345	29.740
11/24/04	15:04:31	102.4	8.293	29.740
11/24/04	15:04:37	108.4	8.286	29.742
11/24/04	15:04:43	114.7	8.229	29.740
11/24/04	15:04:50	121.4	8.218	29.740
11/24/04	15:04:57	128.5	8.182	29.740
11/24/04	15:05:05	136.0	8.159	29.740
11/24/04	15:05:12	144.0	8.143	29.742
11/24/04	15:05:21	152.4	8.116	29.742
11/24/04	15:05:30	161.3	8.071	29.744
11/24/04	15:05:39	170.8	8.073	29.744
11/24/04	15:05:49	180.8	8.055	29.742
11/24/04	15:05:59	190.8	8.048	29.744
11/24/04	15:06:09	200.8	8.028	29.744
11/24/04	15:06:19	210.8	8.003	29.742
11/24/04	15:06:29	220.8	8.023	29.744
11/24/04	15:06:39	230.8	7.994	29.744
11/24/04	15:06:49	240.8	7.987	29.746
11/24/04	15:06:59	250.8	7.976	29.744
11/24/04	15:07:09	260.8	7.962	29.744
11/24/04	15:07:19	270.8	7.967	29.744
11/24/04	15:07:29	280.8	7.937	29.746
11/24/04	15:07:39	290.8	7.944	29.744
11/24/04	15:07:49	300.8	7.974	29.746
11/24/04	15:07:59	310.8	7.960	29.746
11/24/04	15:08:09	320.8	7.940	29.744
11/24/04	15:08:19	330.8	7.944	29.744
11/24/04	15:08:29	340.8	7.940	29.746
11/24/04	15:08:39	350.8	7.942	29.744
11/24/04	15:08:49	360.8	7.931	29.744
11/24/04	15:08:59	370.8	7.935	29.746
11/24/04	15:09:09	380.8	7.937	29.744
11/24/04	15:09:19	390.8	7.937	29.744
11/24/04	15:09:29	400.8	7.946	29.744
11/24/04	15:09:39	410.8	7.919	29.744
11/24/04	15:09:49	420.8	7.903	29.744
11/24/04	15:09:59	430.8	7.912	29.744
11/24/04	15:10:09	440.8	7.917	29.742
11/24/04	15:10:19	450.8	7.921	29.742



WELL TEST ANALYSIS

Data Set: \\Ariadne\proj\CLEANII\BASES\St. Juliens\Slug Tests\21MW06S.aqt
Date: 02/13/06 Time: 17:47:29

AQUIFER DATA

Saturated Thickness: 9.89 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (21MW06S)

Initial Displacement: 3.542 ft
Wellbore Radius: 0.5 ft
Screen Length: 10. ft

Casing Radius: 0.167 ft
Well Skin Radius: 0.5 ft
Total Well Penetration Depth: 9.89 ft

SOLUTION

Aquifer Model: Unconfined
K = 0.001967 cm/sec

Solution Method: Bouwer-Rice
y0 = 2.094 ft

In-Situ Inc. Hermit 3000

Report generated: 02/13/06 17:54:41
Report from file: ...\SN45451 2004-11-23 120631 21MW06SR .bin
Win-Situ Version 4.50

Serial number: 00045451
Firmware Version 7.10
Unit name: HERMIT 3000

Test name: MW06SR

Test defined on: 11/23/04 12:05:27
Test started on: 11/23/04 12:06:31
Test stopped on: 11/23/04 12:10:28
Test extracted on: 11/23/04 14:24:28

Data gathered using Logarithmic testing
   Maximum time between data points: 10.0 Seconds.
   Number of data samples: 73

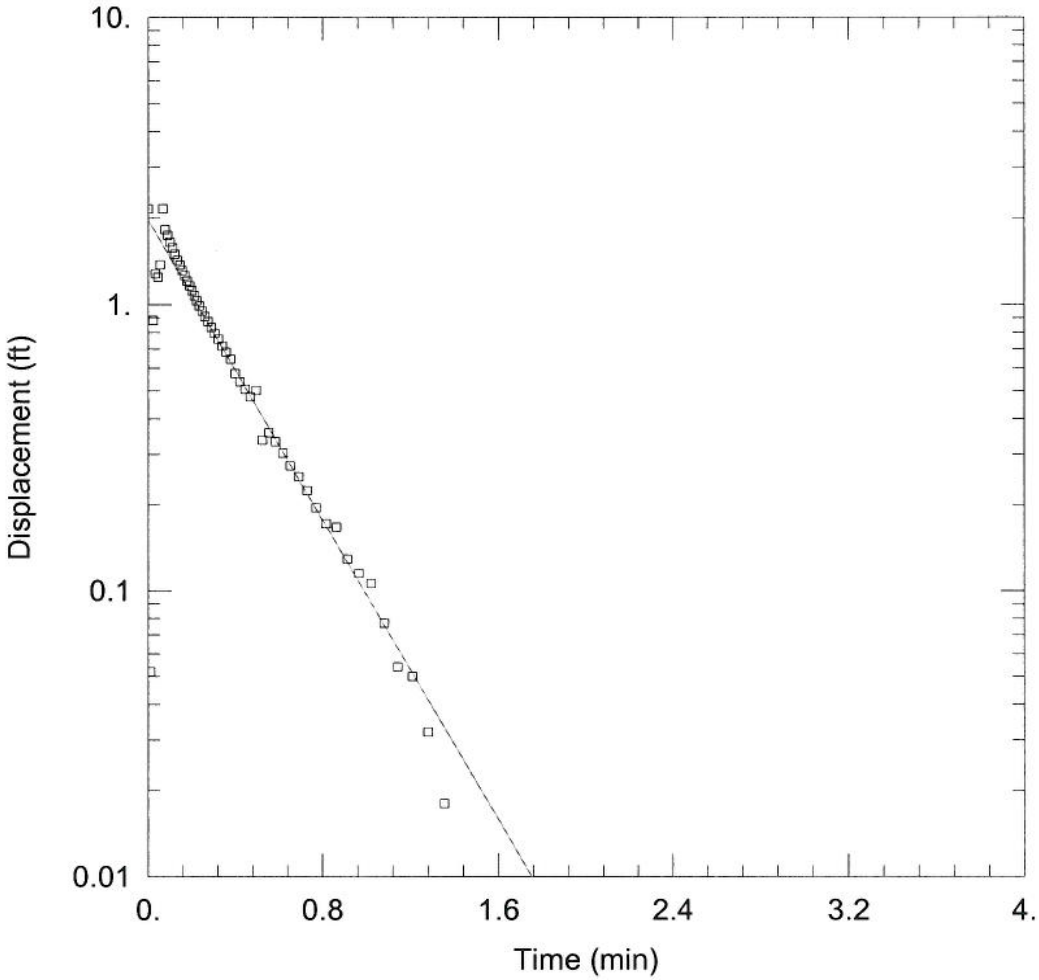
TOTAL DATA SAMPLES 73

Channel number [1]
  Measurement type: Pressure
  Channel name:
  Linearity: 0.0722000
  Scale: 15.6629000
  Offset: -0.1253000
  Warmup: 50
  Specific gravity: 1.000
  Mode: TOC
  User-defined reference: 8.067 Feet H2O
  Referenced on: channel definition.
  Pressure head at reference: 8.063 Feet H2O

Channel number [0]
  Measurement type: Barometric Pressure
  Channel name: Barometric
  Linearity: 0.0000000
  Scale: 0.0000000
  Offset: 0.0000000
  Warmup: 50

Date	Time	ET (sec)	Chan[1] Pressure Feet H2O	Chan[0] Barometric Inches Hg
11/23/04	12:06:31	0.0	8.078	29.996
11/23/04	12:06:31	0.7	8.225	29.998
11/23/04	12:06:32	1.3	11.620	29.996
11/23/04	12:06:33	2.0	11.339	30.000
11/23/04	12:06:33	2.7	10.349	29.998
11/23/04	12:06:34	3.4	10.012	30.000
11/23/04	12:06:35	4.0	9.962	29.998
11/23/04	12:06:35	4.7	9.946	29.998
11/23/04	12:06:36	5.4	9.919	29.998
11/23/04	12:06:37	6.0	9.887	29.998
11/23/04	12:06:37	6.7	9.860	29.998
11/23/04	12:06:38	7.4	9.833	29.998
11/23/04	12:06:39	8.0	9.808	29.998
11/23/04	12:06:39	8.7	9.786	29.998
11/23/04	12:06:40	9.4	9.759	29.998
11/23/04	12:06:41	10.1	9.736	29.998
11/23/04	12:06:41	10.7	9.711	29.998
11/23/04	12:06:42	11.4	9.691	30.000
11/23/04	12:06:43	12.1	9.670	29.998
11/23/04	12:06:43	12.7	9.645	29.998
11/23/04	12:06:44	13.4	9.627	29.998
11/23/04	12:06:45	14.1	9.607	29.998
11/23/04	12:06:45	14.9	9.582	29.998
11/23/04	12:06:46	15.6	9.564	29.998
11/23/04	12:06:47	16.5	9.541	30.000

11/23/04	12:06:48	17.4	9.516	29.998
11/23/04	12:06:49	18.3	9.494	29.998
11/23/04	12:06:50	19.3	9.469	29.998
11/23/04	12:06:51	20.4	9.444	29.998
11/23/04	12:06:52	21.5	9.419	29.998
11/23/04	12:06:53	22.7	9.390	29.998
11/23/04	12:06:54	23.9	9.329	29.996
11/23/04	12:06:56	25.3	9.299	29.998
11/23/04	12:06:57	26.7	9.265	29.996
11/23/04	12:06:59	28.2	9.236	30.000
11/23/04	12:07:00	29.8	9.261	29.998
11/23/04	12:07:02	31.4	9.118	29.998
11/23/04	12:07:04	33.2	9.121	30.000
11/23/04	12:07:06	35.1	9.078	30.000
11/23/04	12:07:08	37.1	9.035	29.998
11/23/04	12:07:10	39.2	8.998	29.998
11/23/04	12:07:12	41.4	8.951	30.000
11/23/04	12:07:14	43.8	8.906	30.000
11/23/04	12:07:17	46.3	8.869	29.998
11/23/04	12:07:19	49.0	8.833	30.000
11/23/04	12:07:22	51.8	8.788	30.000
11/23/04	12:07:25	54.8	8.747	29.998
11/23/04	12:07:28	57.9	8.702	29.998
11/23/04	12:07:32	61.3	8.668	29.998
11/23/04	12:07:35	64.8	8.618	29.998
11/23/04	12:07:39	68.6	8.584	29.998
11/23/04	12:07:43	72.6	8.537	29.998
11/23/04	12:07:47	76.8	8.496	30.000
11/23/04	12:07:52	81.3	8.464	30.000
11/23/04	12:07:57	86.0	8.428	29.998
11/23/04	12:08:02	91.0	8.401	30.000
11/23/04	12:08:07	96.3	8.367	29.998
11/23/04	12:08:12	102.0	8.331	29.998
11/23/04	12:08:18	107.9	8.283	29.998
11/23/04	12:08:25	114.3	8.268	29.998
11/23/04	12:08:31	120.9	8.236	29.996
11/23/04	12:08:39	128.0	8.216	29.998
11/23/04	12:08:46	135.5	8.173	29.996
11/23/04	12:08:54	143.5	8.157	29.996
11/23/04	12:09:02	151.9	8.125	29.998
11/23/04	12:09:11	160.8	8.123	29.998
11/23/04	12:09:21	170.3	8.087	29.996
11/23/04	12:09:31	180.3	8.066	29.998
11/23/04	12:09:41	190.3	8.055	29.998
11/23/04	12:09:51	200.3	8.039	29.998
11/23/04	12:10:01	210.3	8.030	29.998
11/23/04	12:10:11	220.3	8.026	29.996
11/23/04	12:10:21	230.3	8.021	30.000



WELL TEST ANALYSIS

Data Set: \\Ariadne\proj\CLEANII\BASES\St. Juliens\Slug Tests\21MW10S.aqt
Date: 02/13/06 Time: 17:55:27

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (21MW10S)

Initial Displacement: 2.153 ft Casing Radius: 0.167 ft
Wellbore Radius: 0.5 ft Well Skin Radius: 0.5 ft
Screen Length: 10. ft Total Well Penetration Depth: 10. ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.004746 cm/sec y0 = 1.973 ft

In-Situ Inc. Hermit 3000

Report generated: 02/13/06 17:56:09
Report from file: ...\SN45451 2004-11-23 160845 21MW10SR .bin
Win-Situ Version 4.50

Serial number: 00045451
Firmware Version 7.10
Unit name: HERMIT 3000

Test name: 21MW10SR

Test defined on: 11/23/04 16:05:45
Test started on: 11/23/04 16:08:45
Test stopped on: 11/23/04 16:12:05
Test extracted on: 11/23/04 18:57:39

Data gathered using Logarithmic testing
   Maximum time between data points: 10.0 Seconds.
   Number of data samples: 69

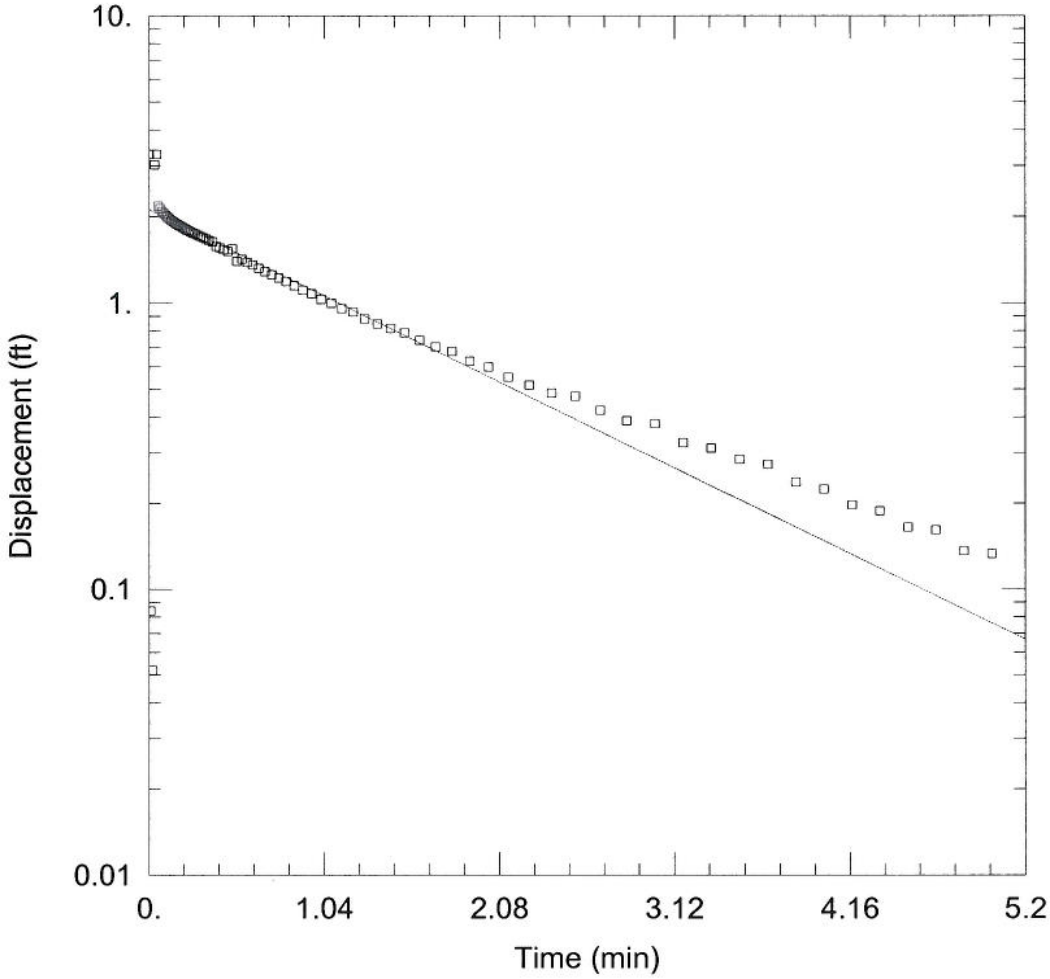
TOTAL DATA SAMPLES 69

Channel number [1]
  Measurement type: Pressure
  Channel name:
  Linearity: 0.0722000
  Scale: 15.6629000
  Offset: -0.1253000
  Warmup: 50
  Specific gravity: 1.000
  Mode: TOC
  User-defined reference: 6.475 Feet H2O
  Referenced on: channel definition.
  Pressure head at reference: 6.473 Feet H2O

Channel number [0]
  Measurement type: Barometric Pressure
  Channel name: Barometric
  Linearity: 0.0000000
  Scale: 0.0000000
  Offset: 0.0000000
  Warmup: 50

Date	Time	ET (sec)	Chan[1] Pressure Feet H2O	Chan[0] Barometric Inches Hg
11/23/04	16:08:45	0.0	6.489	29.954
11/23/04	16:08:45	0.7	6.541	29.954
11/23/04	16:08:46	1.3	7.371	29.952
11/23/04	16:08:47	2.0	7.769	29.954
11/23/04	16:08:47	2.7	7.733	29.954
11/23/04	16:08:48	3.4	7.864	29.954
11/23/04	16:08:49	4.0	8.641	29.954
11/23/04	16:08:49	4.7	8.311	29.954
11/23/04	16:08:50	5.4	8.230	29.952
11/23/04	16:08:51	6.0	8.137	29.954
11/23/04	16:08:51	6.7	8.063	29.952
11/23/04	16:08:52	7.4	7.984	29.954
11/23/04	16:08:53	8.0	7.916	29.954
11/23/04	16:08:53	8.7	7.859	29.954
11/23/04	16:08:54	9.4	7.800	29.954
11/23/04	16:08:55	10.1	7.748	29.954
11/23/04	16:08:55	10.7	7.696	29.952
11/23/04	16:08:56	11.4	7.649	29.954
11/23/04	16:08:57	12.1	7.606	29.956
11/23/04	16:08:57	12.7	7.561	29.954
11/23/04	16:08:58	13.4	7.518	29.954
11/23/04	16:08:59	14.1	7.477	29.954
11/23/04	16:08:59	14.9	7.439	29.954
11/23/04	16:09:00	15.6	7.398	29.954
11/23/04	16:09:01	16.5	7.359	29.954

11/23/04	16:09:02	17.4	7.321	29.954
11/23/04	16:09:03	18.3	7.283	29.954
11/23/04	16:09:04	19.3	7.246	29.954
11/23/04	16:09:05	20.4	7.206	29.954
11/23/04	16:09:06	21.5	7.172	29.952
11/23/04	16:09:07	22.7	7.133	29.956
11/23/04	16:09:08	23.9	7.063	29.952
11/23/04	16:09:10	25.3	7.027	29.954
11/23/04	16:09:11	26.7	6.995	29.954
11/23/04	16:09:13	28.2	6.966	29.954
11/23/04	16:09:14	29.8	6.991	29.954
11/23/04	16:09:16	31.4	6.826	29.954
11/23/04	16:09:18	33.2	6.846	29.956
11/23/04	16:09:20	35.1	6.821	29.952
11/23/04	16:09:22	37.1	6.792	29.954
11/23/04	16:09:24	39.2	6.762	29.954
11/23/04	16:09:26	41.4	6.740	29.954
11/23/04	16:09:28	43.8	6.713	29.954
11/23/04	16:09:31	46.3	6.683	29.954
11/23/04	16:09:33	49.0	6.661	29.954
11/23/04	16:09:36	51.8	6.656	29.956
11/23/04	16:09:39	54.8	6.618	29.956
11/23/04	16:09:42	57.9	6.604	29.954
11/23/04	16:09:46	61.3	6.595	29.954
11/23/04	16:09:49	64.8	6.566	29.954
11/23/04	16:09:53	68.6	6.543	29.954
11/23/04	16:09:57	72.6	6.538	29.954
11/23/04	16:10:01	76.8	6.520	29.954
11/23/04	16:10:06	81.3	6.507	29.952
11/23/04	16:10:11	86.0	6.482	29.952
11/23/04	16:10:16	91.0	6.466	29.954
11/23/04	16:10:21	96.3	6.450	29.952
11/23/04	16:10:26	102.0	6.450	29.954
11/23/04	16:10:32	107.9	6.432	29.952
11/23/04	16:10:39	114.3	6.425	29.954
11/23/04	16:10:45	120.9	6.432	29.954
11/23/04	16:10:53	128.0	6.380	29.954
11/23/04	16:11:00	135.5	6.403	29.954
11/23/04	16:11:08	143.5	6.364	29.954
11/23/04	16:11:16	151.9	6.364	29.954
11/23/04	16:11:25	160.8	6.364	29.956
11/23/04	16:11:35	170.3	6.367	29.954
11/23/04	16:11:45	180.3	6.369	29.954
11/23/04	16:11:55	190.3	6.355	29.954



WELL TEST ANALYSIS

Data Set: \\Ariadne\proj\CLEANII\BASES\St. Juliens\Slug Tests\21MW11S.aqt
Date: 02/13/06 Time: 17:56:23

AQUIFER DATA

Saturated Thickness: 11. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (21MW11S)

Initial Displacement: 3.29 ft
Casing Radius: 0.167 ft
Wellbore Radius: 0.5 ft
Well Skin Radius: 0.5 ft
Screen Length: 10. ft
Total Well Penetration Depth: 11. ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001072 cm/sec
y0 = 2.113 ft

In-Situ Inc. Hermit 3000

Report generated: 02/13/06 17:57:29
Report from file: ...\SN45451 2004-11-23 133114 21MW11SR .bin
Win-Situ Version 4.50

Serial number: 00045451
Firmware Version 7.10
Unit name: HERMIT 3000

Test name: 21MW11SR

Test defined on: 11/23/04 13:27:21
Test started on: 11/23/04 13:31:14
Test stopped on: 11/23/04 13:36:15
Test extracted on: 11/23/04 14:25:15

Data gathered using Logarithmic testing
Maximum time between data points: 10.0 Seconds.
Number of data samples: 80

TOTAL DATA SAMPLES 80

Channel number [1]
Measurement type: Pressure
Channel name:
Linearity: 0.0722000
Scale: 15.6629000
Offset: -0.1253000
Warmup: 50
Specific gravity: 1.000
Mode: TOC
User-defined reference: 6.491 Feet H2O
Referenced on: channel definition.
Pressure head at reference: 6.491 Feet H2O

Channel number [0]
Measurement type: Barometric Pressure
Channel name: Barometric
Linearity: 0.0000000
Scale: 0.0000000
Offset: 0.0000000
Warmup: 50

Date	Time	ET (sec)	Chan[1] Pressure Feet H2O	Chan[0] Barometric Inches Hg
11/23/04	13:31:14	0.0	6.505	29.954
11/23/04	13:31:14	0.7	6.588	29.954
11/23/04	13:31:15	1.3	6.557	29.954
11/23/04	13:31:16	2.0	9.528	29.956
11/23/04	13:31:16	2.7	9.795	29.954
11/23/04	13:31:17	3.4	8.680	29.956
11/23/04	13:31:18	4.0	8.635	29.954
11/23/04	13:31:18	4.7	8.587	29.958
11/23/04	13:31:19	5.4	8.549	29.956
11/23/04	13:31:20	6.0	8.517	29.956
11/23/04	13:31:20	6.7	8.495	29.954
11/23/04	13:31:21	7.4	8.465	29.958
11/23/04	13:31:22	8.0	8.443	29.954
11/23/04	13:31:22	8.7	8.422	29.956
11/23/04	13:31:23	9.4	8.402	29.956
11/23/04	13:31:24	10.1	8.384	29.956
11/23/04	13:31:24	10.7	8.368	29.956
11/23/04	13:31:25	11.4	8.352	29.956
11/23/04	13:31:26	12.1	8.334	29.956
11/23/04	13:31:26	12.7	8.321	29.956
11/23/04	13:31:27	13.4	8.305	29.956
11/23/04	13:31:28	14.1	8.289	29.956
11/23/04	13:31:28	14.9	8.273	29.956
11/23/04	13:31:29	15.6	8.257	29.956
11/23/04	13:31:30	16.5	8.244	29.956

11/23/04	13:31:31	17.4	8.228	29.956
11/23/04	13:31:32	18.3	8.210	29.956
11/23/04	13:31:33	19.3	8.194	29.954
11/23/04	13:31:34	20.4	8.176	29.956
11/23/04	13:31:35	21.5	8.156	29.954
11/23/04	13:31:36	22.7	8.138	29.956
11/23/04	13:31:37	23.9	8.081	29.956
11/23/04	13:31:39	25.3	8.061	29.954
11/23/04	13:31:40	26.7	8.036	29.954
11/23/04	13:31:42	28.2	8.018	29.956
11/23/04	13:31:43	29.8	8.047	29.956
11/23/04	13:31:45	31.4	7.900	29.956
11/23/04	13:31:47	33.2	7.925	29.956
11/23/04	13:31:49	35.1	7.891	29.956
11/23/04	13:31:51	37.1	7.864	29.956
11/23/04	13:31:53	39.2	7.823	29.954
11/23/04	13:31:55	41.4	7.789	29.956
11/23/04	13:31:57	43.8	7.758	29.956
11/23/04	13:32:00	46.3	7.726	29.958
11/23/04	13:32:02	49.0	7.692	29.956
11/23/04	13:32:05	51.8	7.654	29.956
11/23/04	13:32:08	54.8	7.615	29.954
11/23/04	13:32:11	57.9	7.584	29.954
11/23/04	13:32:15	61.3	7.536	29.954
11/23/04	13:32:18	64.8	7.504	29.954
11/23/04	13:32:22	68.6	7.461	29.956
11/23/04	13:32:26	72.6	7.437	29.956
11/23/04	13:32:30	76.8	7.385	29.954
11/23/04	13:32:35	81.3	7.351	29.954
11/23/04	13:32:40	86.0	7.321	29.954
11/23/04	13:32:45	91.0	7.292	29.954
11/23/04	13:32:50	96.3	7.247	29.954
11/23/04	13:32:55	102.0	7.208	29.954
11/23/04	13:33:01	107.9	7.183	29.956
11/23/04	13:33:08	114.3	7.131	29.954
11/23/04	13:33:14	120.9	7.104	29.954
11/23/04	13:33:22	128.0	7.057	29.954
11/23/04	13:33:29	135.5	7.023	29.954
11/23/04	13:33:37	143.5	6.991	29.956
11/23/04	13:33:45	151.9	6.977	29.954
11/23/04	13:33:54	160.8	6.928	29.954
11/23/04	13:34:04	170.3	6.894	29.952
11/23/04	13:34:14	180.3	6.885	29.954
11/23/04	13:34:24	190.3	6.830	29.952
11/23/04	13:34:34	200.3	6.817	29.954
11/23/04	13:34:44	210.3	6.790	29.954
11/23/04	13:34:54	220.3	6.778	29.954
11/23/04	13:35:04	230.3	6.742	29.954
11/23/04	13:35:14	240.3	6.729	29.954
11/23/04	13:35:24	250.3	6.702	29.954
11/23/04	13:35:34	260.3	6.692	29.956
11/23/04	13:35:44	270.3	6.670	29.954
11/23/04	13:35:54	280.3	6.665	29.956
11/23/04	13:36:04	290.3	6.640	29.956
11/23/04	13:36:14	300.3	6.638	29.954

Appendix I
HHRA Tables

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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	Groundwater	Vapors from Shallow Groundwater	Indoor Air	Industrial Worker	Adult	Inhalation	On-Site	Quant	Workers may be exposed to vapors that have migrated from shallow groundwater through building foundation into workspace indoor air
Future	Groundwater	Deep Groundwater	Tap Water	Resident*	Adult	Dermal	On-Site	Quant	Future residents may use deep groundwater as a potable water supply.
						Ingestion	On-Site	Quant	Future residents may use deep groundwater as a potable water supply.
					Child	Dermal	On-Site	Quant	Future residents may use deep groundwater as a potable water supply.
						Ingestion	On-Site	Quant	Future residents may use deep groundwater as a potable water supply.
					Adult/Child	Dermal	On-Site	Quant	Future residents may use deep groundwater as a potable water supply.
						Ingestion	On-Site	Quant	Future residents may use deep groundwater as a potable water supply.
		Air	Shower	Resident*	Adult	Inhalation	On-Site	Quant	Future residents may use deep groundwater as a potable water supply.
					Child	Inhalation	On-Site	None	Children expected to bath and not shower, exposure not as great as that for adult.
		Shallow Groundwater	Construction Excavation	Construction Worker	Adult	Dermal	On-Site	Quant	Workers may have exposed skin surfaces come into contact with groundwater
		Air	Construction Excavation	Construction Worker	Adult	Inhalation	On-Site	Quant	Workers may inhale volatiles from shallow groundwater
		Shallow Groundwater	Tap Water	Resident*	Adult	Dermal	On-Site	Quant	Although unlikely, future residents may use shallow groundwater as a potable water source.
						Ingestion	On-Site	Quant	Although unlikely, future residents may use shallow groundwater as a potable water source.
					Child	Dermal	On-Site	Quant	Although unlikely, future residents may use shallow groundwater as a potable water source.
						Ingestion	On-Site	Quant	Although unlikely, future residents may use shallow groundwater as a potable water source.
					Adult/Child	Dermal	On-Site	Quant	Although unlikely, future residents may use shallow groundwater as a potable water source.
						Ingestion	On-Site	Quant	Although unlikely, future residents may use shallow groundwater as a potable water source.
		Air	Shower	Resident*	Adult	Inhalation	On-Site	Quant	Although unlikely, future residents may use shallow groundwater as a potable water source.
					Child	Inhalation	On-Site	None	Children expected to bath and not shower, exposure not as great as that for adult.
		Vapors from Shallow Groundwater	Indoor Air	Resident*	Adult	Inhalation	On-Site	Quant	Future residents may be exposed to vapors that migrate from shallow groundwater through foundation of future residences into indoor air
					Child	Inhalation	On-Site	Quant	Future residents may be exposed to vapors that migrate from shallow groundwater through foundation of future residences into indoor air
					Adult/Child	Inhalation	On-Site	Quant	Future residents may be exposed to vapors that migrate from shallow groundwater through foundation of future residences into indoor air

*Noncarcinogenic hazards are calculated for adult and child resident, carcinogenic risk calculated for adult/child.

TABLE 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Indoor Air (all data)	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	2.70E-01 L	2.00E+02	UG/L	SJS21-TW201-06D	6/85	0.5 - 2500	2.00E+02	NA	1.5E+02 N	N/A		YES	ASL
	75-34-3	1,1-Dichloroethane	2.80E-01 J	3.00E+00 J	UG/L	SJS21-TW211-07A	10/85	0.5 - 2500	3.00E+00	NA	2.2E+02 N	N/A		NO	BSL
	75-35-4	1,1-Dichloroethene	8.00E-01 J	1.10E+01	UG/L	SJS21-MW13S-05D-P	17/85	0.5 - 2500	1.10E+01	NA	1.9E+01 N	7.0E+00	MCL-1	NO	BSL
	96-12-8	1,2-Dibromo-3-chloropropane	1.00E+00 J	1.00E+00 J	UG/L	SJS21-TW209-07A	1/85	0.5 - 2500	1.00E+00	NA	3.3E+00 N	2.0E+00	MCL-1	NO	BSL
	107-06-2	1,2-Dichloroethane	2.10E-01 J	4.60E+00	UG/L	SJS21-TW121-05D	8/85	0.5 - 2500	4.60E+00	NA	5.00E+00 C	5.00E+00	MCL-1	NO	BSL
	541-73-1	1,3-Dichlorobenzene	9.00E-01 J	9.00E-01 J	UG/L	SJS21-TW209-07A	1/85	0.5 - 2500	9.00E-01	NA	8.30E+01 N	N/A		NO	BSL
	106-46-7	1,4-Dichlorobenzene	9.00E-01 J	9.00E-01 J	UG/L	SJS21-TW209-07A	1/85	0.5 - 2500	9.00E-01	NA	8.20E+02 N	N/A		NO	BSL
	67-64-1	Acetone	2.30E+00 J	2.00E+01	UG/L	SJS21-MW03S-05D	6/62	5 - 2000	2.00E+01	NA	2.2E+04 N	N/A		NO	BSL
	71-43-2	Benzene	1.00E-01 J	8.90E+01 J	UG/L	SJS21-MW09S-04D	11/85	0.5 - 2500	8.90E+01	NA	5.0E+00 C	5.0E+00	MCL-1	YES	ASL
	75-25-2	Bromoform	1.20E-01 J	1.30E-01 J	UG/L	SJS21-TW118-05D	3/72	0.5 - 2500	1.30E-01	NA	8.30E-03 C	NA		YES	ASL
	75-15-0	Carbon disulfide	1.00E-01 J	5.90E-01	UG/L	SJS21-MW02S-04D-P	5/72	0.5 - 2500	5.90E-01	NA	5.60E+01 N	NA		NO	BSL
	56-23-5	Carbon tetrachloride	1.60E-01 J	1.60E-01 J	UG/L	SJS21-MW01S-05D	1/85	0.5 - 2500	1.60E-01	NA	5.00E+00 C	5.0E+00	MCL-1	NO	BSL
	108-90-7	Chlorobenzene	9.00E-01 J	1.40E+01	UG/L	SJS21-TW113-05D	2/85	0.5 - 2500	1.40E+01	NA	3.90E+01 N	1.00E+02	MCL-1	NO	BSL
	67-66-3	Chloroform	2.40E-01 J	2.10E+00 L	UG/L	SJS21-MW11S-04D	3/85	0.5 - 2500	2.10E+00	NA	8.00E+01 N	8.0E+01	MCL-1	NO	BSL
	74-87-3	Chloromethane	5.40E-01 J	7.70E-01 L	UG/L	SJS21-MW11S-04D	2/85	0.5 - 2500	7.70E-01	NA	6.70E+00 C	NA		NO	BSL
	98-82-8	Cumene	2.10E-01 J	2.00E+00 J	UG/L	SJS21-MW01S-03C	5/72	0.5 - 2500	2.00E+00	NA	8.40E-01 N	NA		YES	ASL
	110-82-7	Cyclohexane	7.80E-01	8.10E+00	UG/L	SJS21-MW09S-04D-P	3/72	0.5 - 2500	8.10E+00	NA	NA	NA		NO	NTX
	75-71-8	Dichlorodifluoromethane (Freon-12)	1.10E-01 J	2.10E+01	UG/L	SJS21-TW115-05D	7/85	0.5 - 2500	2.10E+01	NA	1.40E+00 N	NA		YES	ASL
	100-41-4	Ethylbenzene	2.00E-01 J	8.00E-01 J	UG/L	SJS21-TW205-07A	3/85	0.5 - 2500	8.00E-01	NA	7.00E+02 C	7.00E+02	MCL-1	NO	BSL
	79-20-9	Methyl acetate	1.90E+01 J	1.90E+01 J	UG/L	SJS21-MW11S-04D	1/62	0.5 - 2000	1.90E+01	NA	7.20E+04 N	NA		NO	BSL
	1634-04-4	Methyl-tert-butyl ether (MTBE)	3.20E-01 J	1.10E+01	UG/L	SJS21-TW118-05D	4/85	0.5 - 2500	1.10E+01	NA	1.20E+04 N	NA		NO	BSL
	108-87-2	Methylcyclohexane	1.40E+00	3.70E+00 J	UG/L	SJS21-MW01S-04D	4/72	0.5 - 2500	3.70E+00	NA	7.10E+01 N	NA		NO	BSL
	75-09-2	Methylene chloride	1.80E+00 J	1.80E+00 J	UG/L	SJS21-MW11S-04D	1/85	0.5 - 2500	1.80E+00	NA	5.80E+01 C	5.0E+00	MCL-1	NO	BSL
	127-18-4	Tetrachloroethene	1.30E+00	1.30E+00	UG/L	SJS21-GW102-13-06D	1/85	0.5 - 2500	1.30E+00	NA	5.00E+00 C	5.0E+00	MCL-1	NO	BSL
	108-88-3	Toluene	1.10E-01 J	1.50E+01	UG/L	21-TW206-07A SJS21-TW214	16/85	0.5 - 2500	1.50E+01	NA	1.50E+02 N	1.0E+03	MCL-1	NO	BSL
	79-01-6	Trichloroethene	1.00E-01 J	1.60E+04	UG/L	SJS21-MW15SP-06D	55/85	0.5 - 3300	1.60E+04	NA	5.00E+00 C	5.0E+00	MCL-1	YES	ASL
	75-01-4	Vinyl chloride	1.90E-01 J	3.90E+02	UG/L	SJS21-TW115-05D	28/85	0.5 - 2500	3.90E+02	NA	2.00E+00 C	2.0E+00	MCL-1	YES	ASL
	1330-20-7	Xylene, total	1.00E-01 J	6.90E-01 J	UG/L	SJS21-TW126-05D	4/72	0.5 - 2500	6.90E-01	NA	2.20E+03 N	1.0E+04	MCL-1	NO	BSL
	156-59-2	cis-1,2-Dichloroethene	1.90E-01 J	2.60E+03 J	UG/L	SJS21-MW15SP-06D	55/85	0.5 - 2500	2.60E+03	NA	2.10E+01 N	7.0E+01	MCL-1	YES	ASL
	95-47-6	o-Xylene	8.00E-01 J	8.00E-01 J	UG/L	SJS21-TW209-07A	1/13	10 - 10	8.00E-01	NA	3.30E+03 N	NA		NO	BSL
	156-60-5	trans-1,2-Dichloroethene	3.40E-01 J	9.00E+00 J	UG/L	1-MW02S-03C SJS21-MW02S	19/85	0.5 - 2500	9.00E+00	NA	1.80E+01 N	1.0E+02	MCL-1	NO	BSL
	91-57-6	2-Methylnaphthalene	6.00E-01 J	6.00E-01 J	UG/L	SJS21-MW01S-03C	1/13	10 - 12	6.00E-01	NA	3.30E+02 N	NA		NO	BSL
	83-32-9	Acenaphthene	9.00E-01 J	9.00E-01 J	UG/L	SJS21-MW01S-03C	1/13	10 - 12	9.00E-01	NA	NA	NA		NO	BSL

TABLE 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Screening value is target groundwater concentration from Table 2c, Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), November 1, 2002, EPA530-D-02-004.
Screening values based on non-carcinogenic endpoints are divided by 10. Screening values based on cancer are based on target cancer risk of 10^{-6}.
For acenaphthene, the target soil concentration exceeds the maximum possible vapor concentration; therefore, the pathway is incomplete.

[5] Rationale Codes

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

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic
MCL-1 = Primary National Drinking Water Standard (USEPA, 2004)
ug/L = Micrograms per liter.
ND = Not detected
NA = Not applicable or not available

TABLE 2.2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration	Qualifier	Maximum [1] Concentration	Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Tap Water	67-66-3	Chloroform	3.0E+00	J	3.0E+00	J	UG/L	SJS21-MW01D-03C	1/1	10 - 10	3.0E+00	NA	1.5E-01	C	8.0E+01	MCL-1	YES	ASL
	84-74-2	Di-n-butylphthalate	7.0E-01	J	7.0E-01	J	UG/L	SJS21-MW01D-03C	1/1	11 - 11	7.0E-01	NA	3.7E+02	N	NA		NO	BSL
	99-65-0	1,3-Dinitrobenzene	1.1E+00	J	1.1E+00	J	UG/L	SJS21-MW01D-03C	1/1	3.6 - 3.6	1.1E+00	NA	3.7E-01	N	NA		YES	ASL
	7440-38-2	Arsenic	3.1E+00	J	7.3E+01	J	UG/L	SJS21-MW01D-03C	2/3	1 - 10	7.3E+01	NA	4.5E-02	C	1.0E+01	MCL-1	YES	ASL
	7440-39-3	Barium	1.4E+01	J	1.4E+01	J	UG/L	SJS21-MW01D-04D	1/2	200 - 200	1.4E+01	NA	7.3E+02	N	2.0E+03	MCL-1	NO	BSL
	7440-42-8	Boron	7.6E+01	J	7.6E+01	J	UG/L	SJS21-MW01D-04D	1/1	15 - 15	7.6E+01	NA	7.3E+02	N	NA		NO	BSL
	7440-70-2	Calcium	4.9E+04	J	5.3E+04	J	UG/L	SJS21-MW01D-04D	2/2	5000 - 5000	5.3E+04	NA	NA		NA		NO	NUT
	7440-47-3	Chromium	1.8E+00	J	4.7E+01	J	UG/L	SJS21-MW01D-03C	2/2	10 - 10	4.7E+01	NA	1.1E+01	N	1.0E+02	MCL-1	YES	ASL
	57-12-5	Cyanide	1.8E+00	J	1.8E+00	J	UG/L	SJS21-MW01D-03C	1/2	5 - 10	1.8E+00	NA	7.3E+01	N	2.0E+02	MCL-1	NO	BSL
	7439-89-6	Iron	2.7E+02		2.7E+02		UG/L	SJS21-MW01D-03C	1/2	100 - 100	2.7E+02	NA	2.6E+03	N	3.0E+02	MCL-2	NO	BSL
	7439-95-4	Magnesium	1.4E+03		1.4E+03		UG/L	SJS21-MW01D-04D	1/2	5000 - 5000	1.4E+03	NA	NA		NA		NO	NUT
	7439-96-5	Manganese	3.1E+01		3.1E+01		UG/L	SJS21-MW01D-04D	1/2	15 - 15	3.1E+01	NA	7.3E+01	N	5.0E+01	MCL-2	NO	BSL
	7440-09-7	Potassium	1.1E+04		5.1E+04		UG/L	SJS21-MW01D-03C	2/2	5000 - 5000	5.1E+04	NA	NA		NA		NO	NUT
	7782-49-2	Selenium	3.8E+00	J	3.8E+00	J	UG/L	SJS21-MW01D-03C	1/2	5 - 5	3.8E+00	NA	1.8E+01	N	5.0E+01	MCL-1	NO	BSL
	7440-23-5	Sodium	2.4E+04	J	6.4E+04	J	UG/L	SJS21-MW01D-03C	2/2	5000 - 5000	6.4E+04	NA	NA		NA		NO	NUT
	7440-62-2	Vanadium	3.6E+01	J	3.6E+01	J	UG/L	SJS21-MW01D-03C	1/2	50 - 50	3.6E+01	NA	3.7E+00	N	NA		YES	ASL

[1] Minimum/Maximum detected concentrations. Total inorganics results are reported.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, October 11, 2007, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC.
RBCs based on non-carcinogenic endpoints are divided by 10.
RBC value for hexavalent chromium used for total chromium.
RBCs based on non-carcinogenic endpoints are divided by 10.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

C = Carcinogenic

N = Noncarcinogenic

MCL-1 = Primary National Drinking Water Standard (USEPA, 2004)

MCL-2 = National Secondary Drinking Water Standard (USEPA, 2004)

ug/L = Micrograms per liter.

NA = Not applicable or not available

TABLE 2.3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air (Deep Groundwater)

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Shower	67-66-3	Chloroform	3.0E+00 J	3.0E+00 J	UG/L	SJS21-MW01D-03C	1/1	10 - 10	3.0E+00	NA	1.5E-01 C	8.0E+01	MCL-1	YES	ASL

[1] Minimum/Maximum detected concentrations. Total inorganics results are reported.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] Risk-Based Concentration Table, October 11, 2007, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC.
RBCs based on non-carcinogenic endpoints are divided by 10.
[5] Rationale Codes

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

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
MCL-1 = Primary National Drinking Water Standard (USEPA, 2004)
MCL-2 = National Secondary Drinking Water Standard (USEPA, 2004)
ug/L = Micrograms per liter.
NA = Not applicable or not available

TABLE 2.4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Construction Excavation and Tap Water	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	2.7E-01 L	2.2E+00 J	UG/L	SJS21-MW19S-07A	3/42	0.5 - 2500	2.2E+00	NA	5.9E+03 N	NA		NO	BSL
	75-34-3	1,1-Dichloroethane	3.9E-01 J	4.7E-01 J	UG/L	SJS21-MW09S-04D	3/42	0.5 - 2500	4.7E-01	NA	9.0E+01 N	NA		NO	BSL
	75-35-4	1,1-Dichloroethene	1.0E+00 J	1.7E+01	UG/L	SJS21-DW102-14-06D	15/42	0.5 - 2500	1.7E+01	NA	3.5E+01 N	7.0E+00	MCL-1	NO	BSL
	107-06-2	1,2-Dichloroethane	4.1E-01 J	4.1E-01 J	UG/L	SJS21-MW01S-05D	1/42	0.5 - 2500	4.1E-01	NA	1.2E-01 C	5.0E+00	MCL-1	YES	ASL
	67-64-1	Acetone	4.0E+00 J	2.0E+01	UG/L	SJS21-MW03S-05D	2/32	5 - 2000	2.0E+01	NA	5.5E+02 N	NA		NO	BSL
	71-43-2	Benzene	1.0E-01 J	8.9E+01 J	UG/L	SJS21-MW09S-04D	4/42	0.5 - 2500	8.9E+01	NA	3.4E-01 C	5.0E+00	MCL-1	YES	ASL
	75-15-0	Carbon disulfide	3.9E-01 J	5.9E-01	UG/L	SJS21-MW02S-04D-P	4/42	0.5 - 2500	5.9E-01	NA	1.0E+02 N	NA		NO	BSL
	56-23-5	Carbon tetrachloride	1.6E-01 J	1.6E-01 J	UG/L	SJS21-MW01S-05D	1/42	0.5 - 2500	1.6E-01	NA	1.6E-01 C	5.0E+00	MCL-1	NO	BSL
	67-66-3	Chloroform	2.4E-01 J	2.1E+00 L	UG/L	SJS21-MW11S-04D	2/42	0.5 - 2500	2.1E+00	NA	1.5E-01 C	8.0E+01	MCL-1	YES	ASL
	74-87-3	Chloromethane	5.4E-01 J	7.7E-01 L	UG/L	SJS21-MW11S-04D	2/42	0.5 - 2500	7.7E-01	NA	1.9E+01 N	NA		NO	BSL
	98-82-8	Cumene	2.1E-01 J	2.0E+00 J	UG/L	SJS21-MW01S-03C	4/42	0.5 - 2500	2.0E+00	NA	6.6E+01 N	NA		NO	BSL
	110-82-7	Cyclohexane	7.8E-01	8.1E+00	UG/L	SJS21-MW09S-04D-P	3/42	0.5 - 2500	8.1E+00	NA	1.2E+03 N	NA		NO	BSL
	75-71-8	Dichlorodifluoromethane (Freon-12)	1.1E-01 J	5.4E-01 L	UG/L	SJS21-MW11S-04D	3/42	0.5 - 2500	5.4E-01	NA	3.5E+01 N	NA		NO	BSL
	79-20-9	Methyl acetate	1.9E+01 J	1.9E+01 J	UG/L	SJS21-MW11S-04D	1/32	0.5 - 2000	1.9E+01	NA	6.1E+02 N	NA		NO	BSL
	1634-04-4	Methyl-tert-butyl ether (MTBE)	1.0E+00 J	1.0E+00 J	UG/L	SJS21-MW09S-05D	1/42	0.5 - 2500	1.0E+00	NA	2.6E+00 C	NA		NO	BSL
	108-87-2	Methylcyclohexane	1.4E+00	3.7E+00 J	UG/L	SJS21-MW01S-04D	3/42	0.5 - 2500	3.7E+00	NA	6.3E+02 N	NA		NO	BSL
	75-09-2	Methylene chloride	1.8E+00 J	1.8E+00 J	UG/L	SJS21-MW11S-04D	1/42	0.5 - 2500	1.8E+00	NA	4.1E+00 C	5.0E+00	MCL-1	NO	BSL
	127-18-4	Tetrachloroethene	1.0E+00 J	1.0E+00 J	UG/L	SJS21-DW101-13-06D	1/42	0.5 - 2500	1.0E+00	NA	1.0E-01 C	5.0E+00	MCL-1	YES	ASL
	108-88-3	Toluene	1.0E+00 J	1.2E+00	UG/L	SJS21-MW09S-04D-P	2/42	0.5 - 2500	1.2E+00	NA	2.3E+02 N	1.0E+02	MCL-1	NO	BSL
	79-01-6	Trichloroethene	3.8E-01 J	1.6E+04	UG/L	SJS21-MW15SP-06D	29/42	0.5 - 3300	1.6E+04	NA	2.6E-02 C	5.0E+00	MCL-1	YES	ASL
	75-01-4	Vinyl chloride	6.6E-01 J	1.7E+02	UG/L	SJS21-DW104-06D	19/42	0.5 - 2500	1.7E+02	NA	1.5E-02 C	2.0E+00	MCL-1	YES	ASL
	1330-20-7	Xylene, total	1.0E-01 J	5.8E-01	UG/L	SJS21-MW09S-04D-P	2/42	0.5 - 2500	5.8E-01	NA	2.1E+01 N	1.0E+04	MCL-1	NO	BSL
	156-59-2	cis-1,2-Dichloroethene	1.9E-01 J	3.5E+03	UG/L	SJS21-DW102-14-06D	31/42	0.5 - 2500	3.5E+03	NA	6.1E+00 N	7.0E+01	MCL-1	YES	ASL
	156-60-5	trans-1,2-Dichloroethene	7.3E-01	1.5E+01	UG/L	SJS21-DW102-14-06D	16/42	0.5 - 2500	1.5E+01	NA	1.2E+01 N	1.0E+02	MCL-1	YES	ASL
	91-57-6	2-Methylnaphthalene	6.0E-01 J	6.0E-01 J	UG/L	SJS21-MW01S-03C	1/13	10 - 12	6.0E-01	2.5E+00	2.4E+00 N	NA		NO	BSL
	83-32-9	Acenaphthene	9.0E-01 J	9.0E-01 J	UG/L	SJS21-MW01S-03C	1/13	10 - 12	9.0E-01	1.5E+01	3.7E+01 N	NA		NO	BSL
	105-60-2	Caprolactam	8.0E-01 J	3.7E+00 J	UG/L	SJS21-MW08S-04D	5/13	10 - 12	3.7E+00	ND	1.8E+03 N	NA		NO	BSL
	84-74-2	Di-n-butylphthalate	5.0E-01 J	8.0E-01 J	UG/L	SJS21-MW06S-03C	2/13	10 - 12	8.0E-01	ND	3.7E+02 N	NA		NO	BSL
	108-95-2	Phenol	4.1E+00 J	4.1E+00 J	UG/L	SJS21-MW09S-04D	1/13	10 - 12	4.1E+00	ND	1.1E+03 N	NA		NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	7.3E+01	7.3E+01	UG/L	SJS21-MW13S-05D	1/13	10 - 12	7.3E+01	1.0E+00	4.8E+00 C	6.0E+00	MCL-1	YES	ASL
	1024-57-3	Heptachlor epoxide	2.9E-02 J	5.9E-02	UG/L	SJS21-MW12S-05D	2/13	0.05 - 0.06	5.9E-02	ND	7.4E-03 C	2.0E-01	MCL-1	YES	ASL
	319-85-7	beta-BHC	1.2E-02 J	4.3E-02 J	UG/L	SJS21-MW13S-05D-P	4/13	0.05 - 0.06	4.3E-02	5.6E-02	3.7E-02 C	NA		NO	BBL
	121-82-4	RDX	5.3E+00 J	5.3E+00 J	UG/L	SJS21-MW04S-03C	1/14	0.52 - 5.4	5.3E+00	ND	6.1E-01 C	NA		YES	ASL
	7429-90-5	Aluminum	1.8E+02 J	3.2E+02	UG/L	SJS21-MW10S-04D	2/13	200 - 200	3.2E+02	1.7E+03	3.7E+03 N	50 TO 200	MCL-2	NO	BSL

TABLE 2.4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-38-2	Arsenic	4.7E+01	4.7E+01	UG/L	SJS21-MW09S-04D	1/13	10 - 10	4.7E+01	8.0E+00	4.5E-02 C	1.0E+01	MCL-1	YES	ASL
	7440-39-3	Barium	2.2E+01 J	5.1E+01 J	UG/L	SJS21-MW11S-04D	13/13	200 - 200	5.1E+01	7.7E+01	7.3E+02 N	2.0E+03	MCL-1	NO	BSL
	7440-42-8	Boron	4.5E+01	2.5E+02	UG/L	SJS21-MW11S-04D	5/5	15 - 15	2.5E+02	ND	7.3E+02 N	NA		NO	BSL
	7440-70-2	Calcium	7.4E+03	4.8E+04	UG/L	SJS21-MW11S-04D	13/13	5000 - 5000	4.8E+04	5.3E+05	NA	NA		NO	NUT
	7440-47-3	Chromium	8.6E-01 J	8.6E-01 J	UG/L	SJS21-MW13S-05D	1/13	10 - 10	8.6E-01	3.2E+00	1.1E+01 N	1.0E+02	MCL-1	NO	BSL
	7440-48-4	Cobalt	2.0E+00 J	3.6E+01 J	UG/L	SJS21-MW11S-04D	9/13	50 - 50	3.6E+01	1.6E+01	7.3E+01 N	NA		NO	BSL
	7439-89-6	Iron	6.3E+02	2.6E+04 L	UG/L	SJS21-MW09S-04D	13/13	100 - 100	2.6E+04	1.1E+05	2.6E+03 N	3.0E+02	MCL-2	YES	ASL
	7439-95-4	Magnesium	3.3E+03 J	1.3E+04	UG/L	SJS21-MW11S-04D	13/13	5000 - 5000	1.3E+04	3.0E+05	NA	NA		NO	NUT
	7439-96-5	Manganese	2.9E+02	3.0E+03	UG/L	SJS21-MW11S-04D	13/13	15 - 15	3.0E+03	1.4E+04	7.3E+01 N	5.0E+01	MCL-2	NO	BBL
	7439-98-7	Molybdenum	1.7E+00 J	1.9E+01	UG/L	SJS21-MW09S-04D	3/5	5 - 5	1.9E+01	ND	1.8E+01 N	NA		YES	ASL
	7440-02-0	Nickel	1.3E+00 J	5.8E+00 J	UG/L	SJS21-MW12S-05D	6/13	40 - 40	5.8E+00	2.0E+01	7.3E+01 N	NA		NO	BSL
	7440-09-7	Potassium	1.3E+03 J	4.2E+03 J	UG/L	SJS21-MW11S-04D	13/13	5000 - 5000	4.2E+03	8.5E+04	NA	NA		NO	NUT
	7440-23-5	Sodium	1.1E+04	6.3E+04	UG/L	SJS21-MW13S-05D	13/13	5000 - 5000	6.3E+04	8.1E+05	NA	NA		NO	NUT
	7440-62-2	Vanadium	9.8E-01 J	9.8E-01 J	UG/L	SJS21-MW13S-05D	1/13	50 - 50	9.8E-01	1.4E+01	3.7E+00 N	NA		NO	BSL
	7440-66-6	Zinc	1.2E+01 J	2.7E+01	UG/L	SJS21-MW11S-04D	5/13	20 - 60	2.7E+01	2.4E+02	1.1E+03 N	5.0E+03	MCL-2	NO	BSL

[1] Minimum/Maximum detected concentrations. Total inorganics results are reported.

[2] Maximum concentration is used for screening.

[3] Background value is UTL for Columbia aquifer from *Final Background Investigation Report Addendum for Groundwater, St. Juliens Creek Annex, Chesapeake, Virginia* (CH2M HILL, August 2004).

[4] Risk-Based Concentration Table, October 11, 2007, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC.
RBCs based on non-carcinogenic endpoints are divided by 10.
Early-life values used for vinyl chloride to be conservative.
RBC value for hexavalent chromium used for total chromium.
Cobalt was withdrawn from October 2005 RBC Table due to expiration of NCEA provisional toxicity values. Value is from the April 2005 RBC table.
RBC value for manganese-nonfood used as surrogate for manganese.

[5] Rationale Codes

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

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic
MCL-1 = Primary National Drinking Water Standard (USEPA, 2004)
MCL-2 = National Secondary Drinking Water Standard (USEPA, 2004)
ug/L = Micrograms per liter.
ND = Not detected
NA = Not applicable or not available

TABLE 2.5

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air (Shallow Groundwater)

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion
Construction Excavation and Shower	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	2.7E-01 L	2.2E+00 J	UG/L	SJS21-MW19S-07A	3/42	0.5 - 2500	2.2E+00	NA	5.9E+03 N	NA		NO	BSL
	75-34-3	1,1-Dichloroethane	3.9E-01 J	4.7E-01 J	UG/L	SJS21-MW09S-04D	3/42	0.5 - 2500	4.7E-01	NA	9.0E+01 N	NA		NO	BSL
	75-35-4	1,1-Dichloroethene	1.0E+00 J	1.7E+01	UG/L	SJS21-DW102-14-06D	15/42	0.5 - 2500	1.7E+01	NA	3.5E+01 N	7.0E+00	MCL-1	NO	BSL
	107-06-2	1,2-Dichloroethane	4.1E-01 J	4.1E-01 J	UG/L	SJS21-MW01S-05D	1/42	0.5 - 2500	4.1E-01	NA	1.2E-01 C	5.0E+00	MCL-1	YES	ASL
	67-64-1	Acetone	4.0E+00 J	2.0E+01	UG/L	SJS21-MW03S-05D	2/32	5 - 2000	2.0E+01	NA	5.5E+02 N	NA		NO	BSL
	71-43-2	Benzene	1.0E-01 J	8.9E+01 J	UG/L	SJS21-MW09S-04D	4/42	0.5 - 2500	8.9E+01	NA	3.4E-01 C	5.0E+00	MCL-1	YES	ASL
	75-15-0	Carbon disulfide	3.9E-01 J	5.9E-01	UG/L	SJS21-MW02S-04D-P	4/42	0.5 - 2500	5.9E-01	NA	1.0E+02 N	NA		NO	BSL
	56-23-5	Carbon tetrachloride	1.6E-01 J	1.6E-01 J	UG/L	SJS21-MW01S-05D	1/42	0.5 - 2500	1.6E-01	NA	1.6E-01 C	5.0E+00	MCL-1	NO	BSL
	67-66-3	Chloroform	2.4E-01 J	2.1E+00 L	UG/L	SJS21-MW11S-04D	2/42	0.5 - 2500	2.1E+00	NA	1.5E-01 C	8.0E+01	MCL-1	YES	ASL
	74-87-3	Chloromethane	5.4E-01 J	7.7E-01 L	UG/L	SJS21-MW11S-04D	2/42	0.5 - 2500	7.7E-01	NA	1.9E+01 N	NA		NO	BSL
	98-82-8	Cumene	2.1E-01 J	2.0E+00 J	UG/L	SJS21-MW01S-03C	4/42	0.5 - 2500	2.0E+00	NA	6.6E+01 N	NA		NO	BSL
	110-82-7	Cyclohexane	7.8E-01	8.1E+00	UG/L	SJS21-MW09S-04D-P	3/42	0.5 - 2500	8.1E+00	NA	1.2E+03 N	NA		NO	BSL
	75-71-8	Dichlorodifluoromethane (Freon-12)	1.1E-01 J	5.4E-01 L	UG/L	SJS21-MW11S-04D	3/42	0.5 - 2500	5.4E-01	NA	3.5E+01 N	NA		NO	BSL
	79-20-9	Methyl acetate	1.9E+01 J	1.9E+01 J	UG/L	SJS21-MW11S-04D	1/32	0.5 - 2000	1.9E+01	NA	6.1E+02 N	NA		NO	BSL
	1634-04-4	Methyl-tert-butyl ether (MTBE)	1.0E+00 J	1.0E+00 J	UG/L	SJS21-MW09S-05D	1/42	0.5 - 2500	1.0E+00	NA	2.6E+00 C	NA		NO	BSL
	108-87-2	Methylcyclohexane	1.4E+00	3.7E+00 J	UG/L	SJS21-MW01S-04D	3/42	0.5 - 2500	3.7E+00	NA	6.3E+02 N	NA		NO	BSL
	75-09-2	Methylene chloride	1.8E+00 J	1.8E+00 J	UG/L	SJS21-MW11S-04D	1/42	0.5 - 2500	1.8E+00	NA	4.1E+00 C	5.0E+00	MCL-1	NO	BSL
	127-18-4	Tetrachloroethene	1.0E+00 J	1.0E+00 J	UG/L	SJS21-DW101-13-06D	1/42	0.5 - 2500	1.0E+00	NA	1.0E-01 C	5.0E+00	MCL-1	YES	ASL
	108-88-3	Toluene	1.0E+00 J	1.2E+00	UG/L	SJS21-MW09S-04D-P	2/42	0.5 - 2500	1.2E+00	NA	2.3E+02 N	1.0E+02	MCL-1	NO	BSL
	79-01-6	Trichloroethene	3.8E-01 J	1.6E+04	UG/L	SJS21-MW15SP-06D	29/42	0.5 - 3300	1.6E+04	NA	2.6E-02 C	5.0E+00	MCL-1	YES	ASL
	75-01-4	Vinyl chloride	6.6E-01 J	1.7E+02	UG/L	SJS21-DW104-06D	19/42	0.5 - 2500	1.7E+02	NA	1.5E-02 C	2.0E+00	MCL-1	YES	ASL
	1330-20-7	Xylene, total	1.0E-01 J	5.8E-01	UG/L	SJS21-MW09S-04D-P	2/42	0.5 - 2500	5.8E-01	NA	2.1E+01 N	1.0E+04	MCL-1	NO	BSL
	156-59-2	cis-1,2-Dichloroethene	1.9E-01 J	3.5E+03	UG/L	SJS21-DW102-14-06D	31/42	0.5 - 2500	3.5E+03	NA	6.1E+00 N	7.0E+01	MCL-1	YES	ASL
	156-60-5	trans-1,2-Dichloroethene	7.3E-01	1.5E+01	UG/L	SJS21-DW102-14-06D	16/42	0.5 - 2500	1.5E+01	NA	1.2E+01 N	1.0E+02	MCL-1	YES	ASL
	91-57-6	2-Methylnaphthalene	6.0E-01 J	6.0E-01 J	UG/L	SJS21-MW01S-03C	1/13	10 - 12	6.0E-01	NA	2.4E+00 N	NA		NO	BSL
	83-32-9	Acenaphthene	9.0E-01 J	9.0E-01 J	UG/L	SJS21-MW01S-03C	1/13	10 - 12	9.0E-01	NA	3.7E+01 N	NA		NO	BSL

[1] Minimum/Maximum detected concentrations. Total inorganics results are reported.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, October 11, 2007, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC.
RBCs based on non-carcinogenic endpoints are divided by 10.
Early-life values used for vinyl chloride to be conservative.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic
MCL-1 = Primary National Drinking Water Standard (USEPA, 2004)
MCL-2 = National Secondary Drinking Water Standard (USEPA, 2004)
ug/L = Micrograms per liter.
ND = Not detected
NA = Not applicable or not available

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration[a,b] (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Buildling 13	cis-1,2-Dichloroethylene	ug/L	NA	NA	5.4E+02		2.6E+01	µg/m^3	Max	(1)
Indoor Air	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	1.1E-01	J	4.0E-01	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	1.3E+04		1.6E+03	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	1.5E+00		6.0E-01	µg/m^3	Max	(1)
Buildling 46	Bromoform	ug/L	NA	NA	1.2E-01	J	3.8E-04	µg/m^3	Max	(1)
Indoor Air	cis-1,2-Dichloroethylene	ug/L	NA	NA	2.0E+00	J	1.2E-01	µg/m^3	Max	(1)
	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	5.0E+00		2.3E+01	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	2.7E+01		4.0E+00	µg/m^3	Max	(1)
Buildling 47	Benzene	ug/L	NA	NA	2.8E-01	J	8.4E-03	µg/m^3	Max	(1)
Indoor Air	Bromoform	ug/L	NA	NA	1.3E-01	J	1.7E-04	µg/m^3	Max	(1)
	cis-1,2-Dichloroethylene	ug/L	NA	NA	1.4E+02		2.9E+00	µg/m^3	Max	(1)
	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	2.1E+01		3.5E+01	µg/m^3	Max	(1)
	Cumene	ug/L	NA	NA	2.0E+00	J	1.3E-01	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	1.9E+02		1.0E+01	µg/m^3	Max	(1)
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ug/L	NA	NA	1.5E+01		3.8E+01	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	3.9E+02		6.3E+01	µg/m^3	Max	(1)
Buildling 54	cis-1,2-Dichloroethylene	ug/L	NA	NA	5.4E+02		1.5E+01	µg/m^3	Max	(1)
Indoor Air	Trichloroethene	ug/L	NA	NA	1.3E+04		9.6E+02	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	5.0E+00	J	9.6E-01	µg/m^3	Max	(1)

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration[a,b] (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Buildling 63	Benzene	ug/L	NA	NA	4.3E-01	J	1.2E-02	µg/m^3	Max	(1)
Indoor Air	cis-1,2-Dichloroethylene	ug/L	NA	NA	1.2E+02		2.1E+00	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	4.2E+02		1.9E+01	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	2.5E+01		3.9E+00	µg/m^3	Max	(1)
Buildling 90	cis-1,2-Dichloroethylene	ug/L	NA	NA	5.4E+02		8.4E+00	µg/m^3	Max	(1)
Indoor Air	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	2.1E+01		2.3E+01	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	4.6E+02		1.8E+01	µg/m^3	Max	(1)
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ug/L	NA	NA	1.5E+01		2.8E+01	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	3.9E+02		5.6E+01	µg/m^3	Max	(1)
Buildling 1556	Benzene	ug/L	NA	NA	8.9E+01	J	1.0E+00	µg/m^3	Max	(1)
Indoor Air	Bromoform	ug/L	NA	NA	1.2E-01	J	8.6E-05	µg/m^3	Max	(1)
	cis-1,2-Dichloroethylene	ug/L	NA	NA	2.6E+03	J	2.1E+01	µg/m^3	Max	(1)
	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	5.4E-01	L	3.3E-01	µg/m^3	Max	(1)
	Cumene	ug/L	NA	NA	1.7E+00		4.2E-02	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	1.6E+04		3.2E+02	µg/m^3	Max	(1)
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ug/L	NA	NA	5.0E-01	J	4.7E-01	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	8.6E+01		5.5E+00	µg/m^3	Max	(1)

TABLE 3.1.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future

Medium: Groundwater

Exposure Medium: Vapors from Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration[a,b] (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Residential Building Indoor Air	Benzene	ug/L	NA	NA	8.9E+01	J	2.6E+01	µg/m^3	Max	(1)
	Bromoform	ug/L	NA	NA	1.3E-01	J	1.2E-03	µg/m^3	Max	(1)
	cis-1,2-dichloroethylene	ug/L	NA	NA	2.6E+03	J	5.0E+02	µg/m^3	Max	(1)
	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	2.1E+01		3.1E+02	µg/m^3	Max	(1)
	Cumene	ug/L	NA	NA	2.0E+00	J	1.2E+00	µg/m^3	Max	(1)
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ug/L	NA	NA	2.0E+02		4.8E+03	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	1.6E+04		8.1E+03	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	3.9E+02		6.6E+02	µg/m^3	Max	(1)

Rationale:

(1) The maximum detected groundwater concentration (ug/L) was conservatively used to calculate the indoor air concentrations (ug/m ^{3}). The indoor air concentrations were modeled using the Johnson and Ettinger Model (1991).

Notes:

(a) For the industrial scenario, the maximum detected concentration of COPCs for each building was based on analytical results from shallow wells (permanent, temporary, and direct push) with 100 feet of the building.

(b) For the residential scenario, the maximum detected concentration of each COPC was based on analytical results from all shallow wells (permanent, temporary, and direct push) with in the Site.

µg/L = micrograms per liter.

µg/m^3 = micrograms per cubic meter.

COPC = chemical of potential concern

J - Analyte present. Reported value may or may not be accurate or precise.

L - Result biased low.

TABLE 3.2.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Tap Water	Chloroform	ug/L	3.0E+00	NA	3.0E+00 J	3.0E+00	ug/L	Max	(1)
	1,3-Dinitrobenzene	ug/L	1.1E+00	NA	1.1E+00 J	1.1E+00	ug/L	Max	(1)
	Arsenic	ug/L	2.6E+01	NA	7.3E+01 J	7.3E+01	ug/L	Max	(1)
	Chromium	ug/L	2.5E+01	NA	4.7E+01 J	4.7E+01	ug/L	Max	(1)
	Vanadium	ug/L	1.8E+01	NA	3.6E+01 J	3.6E+01	ug/L	Max	(1)

Full statistics for data included in Appendix .
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 3.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T);
Mean of data (Mean-N)

(1) Less than five samples in data set, therefore, maximum detected concentration was used as the EPC.

mg/kg = Milligrams per kilogram.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J - Analyte present. Reported value may or may not be accurate or precise.

TABLE 3.3.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater (deep)
Exposure Medium: Air (concentrations are groundwater)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Shower	Chloroform	ug/L	3.0E+00	NA	3.0E+00 J	3.0E+00	ug/L	Max	(1)

Full statistics for data included in Appendix .
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 3.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T);
Mean of data (Mean-N)

(1) Less than five samples in data set, therefore, maximum detected concentration was used as the EPC.

mg/kg = Milligrams per kilogram.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J - Analyte present. Reported value may or may not be accurate or precise.

TABLE 3.4.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Construction Excavation and Tap Water	1,2-Dichloroethane	ug/L	6.0E+01	3.9E+02 (NP)	4.1E-01	J	4.1E-01	ug/L	Max	(5,6)
	Benzene	ug/L	6.2E+01	3.9E+02 (NP)	8.9E+01	J	8.9E+01	ug/L	Max	(5,6)
	Chloroform	ug/L	6.0E+01	3.9E+02 (NP)	2.1E+00	L	2.1E+00	ug/L	Max	(5,6)
	Tetrachloroethene	ug/L	6.0E+01	3.9E+02 (NP)	1.0E+00	J	1.0E+00	ug/L	Max	(5,6)
	Trichloroethene	ug/L	1.8E+03	3.1E+03 (NP)	1.6E+04		3.1E+03	ug/L	95% Hall	(5)
	Vinyl chloride	ug/L	7.4E+01	4.0E+02 (NP)	1.7E+02		1.7E+02	ug/L	Max	(5,6)
	cis-1,2-Dichloroethene	ug/L	4.2E+02	1.5E+03 (NP)	3.5E+03		1.5E+03	ug/L	99% Cheb-m	(5)
	trans-1,2-Dichloroethe	ug/L	6.0E+01	3.9E+02 (NP)	1.5E+01		1.5E+01	ug/L	Max	(5,6)
	bis(2-Ethylhexyl)phtha	ug/L	8.5E+00	1.7E+01 (T)	7.3E+01		1.7E+01	ug/L	95% Cheb	(1)
	Heptachlor epoxide	ug/L	2.9E-02	3.3E-02 (NP)	5.9E-02		3.3E-02	ug/L	95% Stud-t	(5)
	RDX	ug/L	1.5E+00	5.4E+00 (NP)	5.3E+00	J	5.3E+00	ug/L	Max	(5,6)
	Arsenic	ug/L	5.7E+00	4.0E+01 (NP)	4.7E+01		4.0E+01	ug/L	99% Cheb-m	(5)
	Iron	ug/L	5.4E+03	9.0E+03 (G)	2.6E+04	L	9.0E+03	ug/L	95% App G	(1,3,4)
	Molybdenum	ug/L	4.8E+00	1.3E+01 (T)	1.9E+01		1.3E+01	ug/L	95% Cheb	(1)

Full statistics for data included in Appendix .
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 3.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% Student's-T test (95% Stud-t); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T);
95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m);
99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mea
95% Hall's Bootstrap UCL (95% Hall); 95% Approximate Gamma UCL (95% App G); Mean of data (Mean-N)

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Anderson-Darling Test indicates data are gamma distributed.
(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.
(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(6) The maximum detected concentration was used as the UCL because the value recommended by ProUCL 3.0 was higher than the maximum detected concentrat

mg/kg = Milligrams per kilogram.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J - Analyte present. Reported value may or may not be accurate or precise.
L = Biased Low

TABLE 3.5.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater (shallow)
Exposure Medium: Air (concentrations are groundwater)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Construction Excavation and Shower	1,2-Dichloroethane	ug/L	6.0E+01	3.9E+02 (NP)	4.1E-01	J	4.1E-01	ug/L	Max	(5,6)
	Benzene	ug/L	6.2E+01	3.9E+02 (NP)	8.9E+01	J	8.9E+01	ug/L	Max	(5,6)
	Chloroform	ug/L	6.0E+01	3.9E+02 (NP)	2.1E+00	L	2.1E+00	ug/L	Max	(5,6)
	Tetrachloroethene	ug/L	6.0E+01	3.9E+02 (NP)	1.0E+00	J	1.0E+00	ug/L	Max	(5,6)
	Trichloroethene	ug/L	1.8E+03	3.1E+03 (NP)	1.6E+04		3.1E+03	ug/L	95% Hall	(5)
	Vinyl chloride	ug/L	7.4E+01	4.0E+02 (NP)	1.7E+02		1.7E+02	ug/L	Max	(5,6)
	cis-1,2-Dichloroethene	ug/L	4.2E+02	1.5E+03 (NP)	3.5E+03		1.5E+03	ug/L	99% Cheb-m	(5)
	trans-1,2-Dichloroethe	ug/L	6.0E+01	3.9E+02 (NP)	1.5E+01		1.5E+01	ug/L	Max	(5,6)

Full statistics for data included in Appendix .
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 3.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% Student's-T test (95% Stud-t); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T);
95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m);
99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T
95% Hall's Bootstrap UCL (95% Hall); Mean of data (Mean-N)

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Anderson-Darling Test indicates data are gamma distributed.
(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.
(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(6) The maximum detected concentration was used as the UCL because the value recommended by ProUCL 3.0 was higher than the maximum detected concentration.

mg/kg = Milligrams per kilogram.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J - Analyte present. Reported value may or may not be accurate or precise.
L = Biased Low

TABLE 3.1.CTE
EXPOSURE POINT CONCENTRATION SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration[a,b] (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Buildling 13	cis-1,2-Dichloroethylene	ug/L	NA	NA	5.4E+02		2.6E+01	µg/m^3	Max	(1)
Indoor Air	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	1.1E-01	J	4.0E-01	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	1.3E+04		1.6E+03	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	1.5E+00		6.0E-01	µg/m^3	Max	(1)
Buildling 46	Bromoform	ug/L	NA	NA	1.2E-01	J	3.8E-04	µg/m^3	Max	(1)
Indoor Air	cis-1,2-Dichloroethylene	ug/L	NA	NA	2.0E+00	J	1.2E-01	µg/m^3	Max	(1)
	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	5.0E+00		2.3E+01	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	2.7E+01		4.0E+00	µg/m^3	Max	(1)
Buildling 47	Benzene	ug/L	NA	NA	2.8E-01	J	8.4E-03	µg/m^3	Max	(1)
Indoor Air	Bromoform	ug/L	NA	NA	1.3E-01	J	1.7E-04	µg/m^3	Max	(1)
	cis-1,2-Dichloroethylene	ug/L	NA	NA	1.4E+02		2.9E+00	µg/m^3	Max	(1)
	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	2.1E+01		3.5E+01	µg/m^3	Max	(1)
	Cumene	ug/L	NA	NA	2.0E+00	J	1.3E-01	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	1.9E+02		1.0E+01	µg/m^3	Max	(1)
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ug/L	NA	NA	1.5E+01		3.8E+01	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	3.9E+02		6.3E+01	µg/m^3	Max	(1)
Buildling 54	cis-1,2-Dichloroethylene	ug/L	NA	NA	5.4E+02		1.5E+01	µg/m^3	Max	(1)
Indoor Air	Trichloroethene	ug/L	NA	NA	1.3E+04		9.6E+02	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	5.0E+00	J	9.6E-01	µg/m^3	Max	(1)

TABLE 3.1.CTE
EXPOSURE POINT CONCENTRATION SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration[a,b] (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Buildling 63	Benzene	ug/L	NA	NA	4.3E-01	J	1.2E-02	µg/m^3	Max	(1)
Indoor Air	cis-1,2-Dichloroethylene	ug/L	NA	NA	1.2E+02		2.1E+00	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	4.2E+02		1.9E+01	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	2.5E+01		3.9E+00	µg/m^3	Max	(1)
Buildling 90	cis-1,2-Dichloroethylene	ug/L	NA	NA	5.4E+02		8.4E+00	µg/m^3	Max	(1)
Indoor Air	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	2.1E+01		2.3E+01	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	4.6E+02		1.8E+01	µg/m^3	Max	(1)
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ug/L	NA	NA	1.5E+01		2.8E+01	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	3.9E+02		5.6E+01	µg/m^3	Max	(1)
Buildling 1556	Benzene	ug/L	NA	NA	8.9E+01	J	1.0E+00	µg/m^3	Max	(1)
Indoor Air	Bromoform	ug/L	NA	NA	1.2E-01	J	8.6E-05	µg/m^3	Max	(1)
	cis-1,2-Dichloroethylene	ug/L	NA	NA	2.6E+03	J	2.1E+01	µg/m^3	Max	(1)
	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	5.4E-01	L	3.3E-01	µg/m^3	Max	(1)
	Cumene	ug/L	NA	NA	1.7E+00		4.2E-02	µg/m^3	Max	(1)
	Trichloroethene				1.6E+04		3.2E+02	µg/m^3		
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ug/L	NA	NA	5.0E-01	J	4.7E-01	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	8.6E+01		5.5E+00	µg/m^3	Max	(1)

TABLE 3.1.CTE

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future

Medium: Groundwater

Exposure Medium: Vapors from Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration[a,b] (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Residential Building Indoor Air	Benzene	ug/L	NA	NA	8.9E+01	J	2.6E+01	µg/m^3	Max	(1)
	Bromoform	ug/L	NA	NA	1.3E-01	J	1.2E-03	µg/m^3	Max	(1)
	cis-1,2-dichloroethylene	ug/L	NA	NA	2.6E+03	J	5.0E+02	µg/m^3	Max	(1)
	Dichlorodifluoromethane (Freon 12)	ug/L	NA	NA	2.1E+01		3.1E+02	µg/m^3	Max	(1)
	Cumene	ug/L	NA	NA	2.0E+00	J	1.2E+00	µg/m^3	Max	(1)
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ug/L	NA	NA	2.0E+02		4.8E+03	µg/m^3	Max	(1)
	Trichloroethene	ug/L	NA	NA	1.6E+04		8.1E+03	µg/m^3	Max	(1)
	Vinyl Chloride	ug/L	NA	NA	3.9E+02		6.6E+02	µg/m^3	Max	(1)

Rationale:

(1) Indoor air concentration modeled using the Johnson and Ettinger Model (1991). Maximum detected concentration conservatively used as the EPC.

Notes:

(a) For the industrial scenario, the maximum detected concentration of COPCs for each building was based on analytical results from shallow wells (permanent, temporary, and direct push) with 100 feet of the building.

(b) For the residential scenario, the maximum detected concentration of each COPC was based on analytical results from all shallow wells (permanent, temporary, and direct push) with in the Site.

µg/L = micrograms per liter.

µg/m^3 = micrograms per cubic meter.

COPC = chemical of potential concern

J - Analyte present. Reported value may or may not be accurate or precise.

L - Result biased low.

TABLE 3.2.CTE

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Tap Water	Chloroform	ug/L	3.0E+00	NA	3.0E+00 J	3.0E+00	ug/L	Mean-N	(2)
	1,3-Dinitrobenzene	ug/L	1.1E+00	NA	1.1E+00 J	1.1E+00	ug/L	Mean-N	(2)
	Arsenic	ug/L	2.6E+01	NA	7.3E+01 J	2.6E+01	ug/L	Mean-N	(2)
	Chromium	ug/L	2.5E+01	NA	4.7E+01 J	2.5E+01	ug/L	Mean-N	(2)
	Vanadium	ug/L	1.8E+01	NA	3.6E+01 J	1.8E+01	ug/L	Mean-N	(2)

Full statistics for data included in Appendix .
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 3.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T);
Mean of data (Mean-N)

1) Less than five samples in data set, therefore, maximum detected concentration was used as the EPC.
2) Less than five samples in data set, therefore, distributions not tested, used mean based on normal distribution as central tendency exposure EPC

mg/kg = Milligrams per kilogram.
J - Analyte present. Reported value may or may not be accurate or precise.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

TABLE 3.3.CTE

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater (deep)
Exposure Medium: Air (concentrations are groundwater)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Shower	Chloroform	ug/L	3.0E+00	NA	3.0E+00 J	3.0E+00	ug/L	Mean-N	(2)

Full statistics for data included in Appendix .
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 3.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T);
Mean of data (Mean-N)

1) Less than five samples in data set, therefore, maximum detected concentration was used as the EPC.
2) Less than five samples in data set, therefore, distributions not tested, used mean based on normal distribution as central tendency exposure EPC

mg/kg = Milligrams per kilogram.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J - Analyte present. Reported value may or may not be accurate or precise.

TABLE 3.4.CTE
EXPOSURE POINT CONCENTRATION SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Construction Excavation and Tap Water	1,2-Dichloroethane	ug/L	6.0E+01	3.9E+02	(NP)	4.1E-01	J	4.1E-01	ug/L	Max	(5,6)
	Benzene	ug/L	6.2E+01	3.9E+02	(NP)	8.9E+01	J	6.2E+01	ug/L	Mean-N	(5)
	Chloroform	ug/L	6.0E+01	3.9E+02	(NP)	2.1E+00	L	2.1E+00	ug/L	Max	(5,6)
	Tetrachloroethene	ug/L	6.0E+01	3.9E+02	(NP)	1.0E+00	J	1.0E+00	ug/L	Max	(5,6)
	Trichloroethene	ug/L	1.8E+03	3.1E+03	(NP)	1.6E+04		1.8E+03	ug/L	Mean-N	(5)
	Vinyl chloride	ug/L	7.4E+01	4.0E+02	(NP)	1.7E+02		7.4E+01	ug/L	Mean-N	(5)
	cis-1,2-Dichloroethene	ug/L	4.2E+02	1.5E+03	(NP)	3.5E+03		4.2E+02	ug/L	Mean-N	(5)
	trans-1,2-Dichloroethe	ug/L	6.0E+01	3.9E+02	(NP)	1.5E+01		1.5E+01	ug/L	Max	(5,6)
	bis(2-Ethylhexyl)phtha	ug/L	8.5E+00	1.7E+01	(T)	7.3E+01		6.3E+00	ug/L	Mean-T	(1)
	Heptachlor epoxide	ug/L	2.9E-02	3.3E-02	(NP)	5.9E-02		2.9E-02	ug/L	Mean-N	(5)
	RDX	ug/L	1.5E+00	5.4E+00	(NP)	5.3E+00	J	1.5E+00	ug/L	Mean-N	(5)
	Arsenic	ug/L	5.7E+00	4.0E+01	(NP)	4.7E+01		5.7E+00	ug/L	Mean-N	(5)
	Iron	ug/L	5.4E+03	9.0E+03	(G)	2.6E+04	L	5.4E+03	ug/L	Mean-N	(1,3,4)
	Molybdenum	ug/L	4.8E+00	1.3E+01	(T)	1.9E+01		3.8E+00	ug/L	Mean-T	(1)

Full statistics for data included in Appendix .
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 3.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% Student's-T test (95% Stud-t); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T);
95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m);
99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-
95% Hall's Bootstrap UCL (95% Hall); Mean of data (Mean-N)

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Anderson-Darling Test indicates data are gamma distributed.
(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.
(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(6) The maximum detected concentration was used as the UCL because the mean value was higher than the maximum detected concentration.

mg/kg = Milligrams per kilogram.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J - Analyte present. Reported value may or may not be accurate or precise.
L = Biased Low

TABLE 3.5.CTE
EXPOSURE POINT CONCENTRATION SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater (shallow)
Exposure Medium: Air (concentrations are groundwater)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Construction Excavation and Shower	1,2-Dichloroethane	ug/L	6.0E+01	3.9E+02 (NP)	4.1E-01	J	4.1E-01	ug/L	Max	(5,6)
	Benzene	ug/L	6.2E+01	3.9E+02 (NP)	8.9E+01	J	6.2E+01	ug/L	Mean-N	(5)
	Chloroform	ug/L	6.0E+01	3.9E+02 (NP)	2.1E+00	L	2.1E+00	ug/L	Max	(5,6)
	Tetrachloroethene	ug/L	6.0E+01	3.9E+02 (NP)	1.0E+00	J	1.0E+00	ug/L	Max	(5,6)
	Trichloroethene	ug/L	1.8E+03	3.1E+03 (NP)	1.6E+04		1.8E+03	ug/L	Mean-N	(5)
	Vinyl chloride	ug/L	7.4E+01	4.0E+02 (NP)	1.7E+02		7.4E+01	ug/L	Mean-N	(5)
	cis-1,2-Dichloroethene	ug/L	4.2E+02	1.5E+03 (NP)	3.5E+03		4.2E+02	ug/L	Mean-N	(5)
	trans-1,2-Dichloroethe	ug/L	6.0E+01	3.9E+02 (NP)	1.5E+01		1.5E+01	ug/L	Max	(5,6)

Full statistics for data included in Appendix .
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
ProUCL, Version 3.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% Student's-T test (95% Stud-t); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mea 95% Hall's Bootstrap UCL (95% Hall); Mean of data (Mean-N)

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Anderson-Darling Test indicates data are gamma distributed.
(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.
(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(6) The maximum detected concentration was used as the UCL because the mean value was higher than the maximum detected concentration.

mg/kg = Milligrams per kilogram.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J - Analyte present. Reported value may or may not be accurate or precise.
L = Biased Low

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Industrial Worker	Adult	Indoor Air - Buildings 13, 46, 63, 90	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	1.6	m^3/hour	EPA, 1997 (1)	
				ET	Exposure Time	2	hr/day	(2)	
				EF	Exposure Frequency	48	days/year	(2)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
			Indoor Air - Buildings 47, 54, 1556	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	1.6	m^3/hour	EPA, 1997 (1)	
				ET	Exposure Time	8	hr/day	EPA, 1991	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

Notes:

1. Moderate activity inhalation rate for adult, from page 5-24 of EPA, 1997.
2. Building used for storage, sporadic access.

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 Final. OSWER Directive 9285.6-03.

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

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	See Table 3.1.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	2	liters/day	EPA, 1997	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	1.09	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	24	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	
Dermal	Resident	Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	1.0	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	1.0	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	24	years	EPA, 2004	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

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 Final. OSWER Directive 9285.6-03.

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

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Shower	CW	Chemical Concentration in Water	See Table 3.2.RME	µg/l	See Table 3.2.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x EV xED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	24	years	EPA, 1991	for InhExp
				EV	Event Frequency	1	events/day	EPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

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 Final. OSWER Directive 9285.6-03.
EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Construction Excavation	CW	Chemical Concentration in Water	See Table 3.4.RME		See Table 3.4.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	4.0	hr/event	VADEQ	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	VADEQ	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	125	days/year	VA DEQ	
				ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	See Table 3.1.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	2	liters/day	EPA, 1997	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	1.09	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	24	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	1.0	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
		Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	1.0	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	24	years	EPA, 2004	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child/Adult	Tap Water	ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

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 Final. OSWER Directive 9285.6-03.

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

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

VADEQ : Virginial Department of Environmental Quality Voluntary Remediation Program Risk Assessment Guidance (http://www.deq.virginia.gov/vrprisk/raguide.html)

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	Construction Excavation	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	See Table 3.5.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3		CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	2.5	m^3/hour	EPA, 1997	
				ET	Exposure Time	4	hr/day	VADEQ	CA calculated using two-film model
				EF	Exposure Frequency	125	days/year	VADEQ	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Resident	Adult	Shower	CW	Chemical Concentration in Water	See Table 3.2.RME	µg/l	See Table 3.2.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x EV xED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	24	years	EPA, 1991	for InhExp
				EV	Event Frequency	1	events/day	EPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

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 Final. OSWER Directive 9285.6-03.

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

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

VADEQ : Virginial Department of Environmental Quality Voluntary Remediation Program Risk Assessment Guidance (http://www.deq.virginia.gov/vrprisk/raguide.html)

TABLE 4.6.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Indoor Air	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	0.83	m^3/hour	EPA, 1997	
				ET	Exposure Time	24	hr/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Indoor Air	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	0.5	m^3/hour	EPA, 2007	
				ET	Exposure Time	24	hr/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Indoor Air	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN-Adj x EF x 1/AT
				IN-A	Inhalation Rate - Adult	0.83	m^3/hour	EPA, 1997	
				IN-C	Inhalation Rate - Child	0.5	m^3/hour	EPA, 2007	
				IN-Adj	Ingestion Rate of Water, Age-adjuste	11.63	m3-year/kg-day	calculated	IN-Adj (m3-year/kg-day) =
				ET	Exposure Time	24	hr/day	EPA, 1991	(ED-C x IN-C x ET / BW-C) +
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-A x IN-A x ET/ BW-A)
				ED-A	Exposure Duration - Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration -Child	6	years	EPA, 1991	
				BW-A	Body Weight - Adult	70	kg	EPA, 1991	CW x IR-W-Adj x EF x CF1 x 1/AT
				BW-C	Body Weight - Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

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 Final. OSWER Directive 9285.6-03.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2007: EPA Region III RBC Table.

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Industrial Worker	Adult	Indoor Air - Buildings 13, 46, 63, 90	CW	Chemical Concentration in Water	See Table 3.3.CTE	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	1	m^3/hour	EPA, 1997 (1)	
				ET	Exposure Time	2	hr/day	(2)	
				EF	Exposure Frequency	24	days/year	(2)	
				ED	Exposure Duration	9	years	EPA, 2004	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
			Indoor Air - Buildings 47, 54, 1556	CW	Chemical Concentration in Water	See Table 3.3.CTE	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	1	m^3/hour	EPA, 1997 (1)	
				ET	Exposure Time	8	hr/day	EPA, 1991	
				EF	Exposure Frequency	219	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2004	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Notes:

1. Light activity inhalation rate for adult, from page 5-24 of EPA, 1997.
2. Building used for storage, sporadic access. CTE EF one-half of RME EF.

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 Final. OSWER Directive 9285.6-03.

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

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.2.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	See Table 3.1.CTE	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1.4	liters/day	EPA, 1993	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	9	years	EPA, 2004	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CTE	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CTE	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	1.4	liters/day	EPA, 1993	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.58	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	9	years	EPA, 2004	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	See Table 3.1.CTE	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	
Dermal	Resident	Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CTE	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	0.33	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Deep Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CTE	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.33	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	9	years	EPA, 2004	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

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 Final. OSWER Directive 9285.6-03.

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

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

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.3.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Shower	CW	Chemical Concentration in Water	See Table 3.2.CTE	µg/l	See Table 3.2.CTE	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x EV xED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	9	years	EPA, 2004	for InhExp
				EV	Event Frequency	1	events/day	EPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

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 Final. OSWER Directive 9285.6-03.
EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Construction Excavation	CW	Chemical Concentration in Water	See Table 3.4.CTE		See Table 3.4.CTE	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	2.0	hr/event	proj. jugdement (1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	VADEQ	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	63	days/year	proj. jugdement (1)	
				ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	See Table 3.1.CTE	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1.4	liters/day	EPA, 1993	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	9	years	EPA, 2004	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CTE	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CTE	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	1.4	liters/day	EPA, 1993	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.58	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	9	years	EPA, 2004	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	See Table 3.1.CTE	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	9	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CTE	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	0.33	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
		Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CTE	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.33	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	9	years	EPA, 2004	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child/Adult	Tap Water	ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

Notes:

(1) Professional judgment, assumed 1/2 the RME value.

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 Final. OSWER Directive 9285.6-03.

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

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

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

VADEQ : Virginial Department of Environmental Quality Voluntary Remediation Program Risk Assessment Guidance (http://www.deq.virginia.gov/vrprisk/raguide.html)

TABLE 4.5.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDANCY

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	Construction Excavation	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	See Table 3.5.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3		CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	1.5	m^3/hour	EPA, 1997	
				ET	Exposure Time	2	hr/day	proj. jugdement (1)	CA calculated using two-film model
				EF	Exposure Frequency	63	days/year	proj. jugdement (1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Resident	Adult	Shower	CW	Chemical Concentration in Water	See Table 3.2.CTE	µg/l	See Table 3.2.CTE	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x EV xED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	9	years	EPA, 2004	for InhExp
				EV	Event Frequency	1	events/day	EPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Notes:

(1) Professional judgment, assumed 1/2 the RME value.

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 Final. OSWER Directive 9285.6-03.

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

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

VADEQ : Virginial Department of Environmental Quality Voluntary Remediation Program Risk Assessment Guidance (http://www.deq.virginia.gov/vrprisk/raguide.html)

TABLE 4.6.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDANCY
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Vapors from Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Indoor Air	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	0.83	m^3/hour	EPA, 1997	
				ET	Exposure Time	9	hr/day	EPA, 2004	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Indoor Air	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	0.5	m^3/hour	EPA, 2007	
				ET	Exposure Time	24	hr/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Indoor Air	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				Cair	Indoor Air Concentration	calculated	mg/m^3	J&E Model	CA x IN-Adj x EF x 1/AT
				IN-A	Inhalation Rate - Adult	0.83	m^3/hour	EPA, 1997	
				IN-C	Inhalation Rate - Child	0.5	m^3/hour	EPA, 2007	
				IN-Adj	Ingestion Rate of Water, Age-adjuste	7.36	m3-year/kg-day	calculated	IN-Adj (m3-year/kg-day) =
				ET	Exposure Time	24	hr/day	EPA, 1991	(ED-C x IN-C x ET / BW-C) +
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-A x IN-A x ET/ BW-A)
				ED-A	Exposure Duration - Adult	9	years	EPA, 2004	
				ED-C	Exposure Duration -Child	6	years	EPA, 1991	
				BW-A	Body Weight - Adult	70	kg	EPA, 1991	CW x IR-W-Adj x EF x CF1 x 1/AT
				BW-C	Body Weight - Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

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 Final. OSWER Directive 9285.6-03.
EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
EPA, 2007: EPA Region III RBC Table.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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 (3) (MM/DD/YY)
Benzene	Chronic	4.0E-03	mg/kg-day	NA	4.0E-03	mg/kg-day	Blood, Immune	300/1	IRIS	4/20/2007
	Subchronic	3.0E-03	mg/kg/day	NA	3.0E-03	mg/kg/day	Blood, Immune	3000	NCEA	7/8/1998
Chloroform	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver	1000/1	IRIS	4/20/2007
	Subchronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver	1000	HEAST	7/1/1997
1,2-Dichloroethane	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene	Chronic	1.0E-04	mg/kg-day	NA	1.0E-04	mg/kg-day	Spleen	3000/1	IRIS	4/20/2007
	Subchronic	1.0E-03	mg/kg-day	NA	1.0E-03	mg/kg-day	Spleen	100	HEAST	7/1/1997
Tetrachloroethene	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver, Whole body	1000/1	IRIS	4/20/2007
	Subchronic	1.0E-01	mg/kg-day	NA	1.0E-01	mg/kg-day	Liver, Whole body	100	HEAST	7/1/1997
Trichloroethene (older NCEA value, used in HHRA calculations)	Chronic	6.0E-03	mg/kg-day	NA	6.0E-03	mg/kg-day	Liver	3000	NCEA	3/5/1992
	Subchronic	N/A	mg/kg-day	NA	N/A	mg/kg-day	N/A	N/A	NA	N/A
Trichloroethene (draft 2001 value, used for uncertainty evaluation)	Chronic	3.0E-04	mg/kg-day	NA	3.0E-04	mg/kg-day	Liver, Kidney, Fetus	3000	NCEA	8/1/2001
	Subchronic	N/A	mg/kg-day	NA	N/A	mg/kg-day	N/A	N/A	NA	NA
Vinyl chloride	Chronic	3.0E-03	mg/kg-day	NA	3.0E-03	mg/kg-day	Liver	30/1	IRIS	4/20/2007
	Subchronic	N/A	mg/kg-day	NA	N/A	mg/kg-day	N/A	N/A	NA	NA
cis-1,2-Dichloroethene	Chronic	1.0E-02	mg/kg/day	NA	1.0E-02	mg/kg/day	Blood	3000	PPRTV	3/1/2006
	Subchronic	1.0E-01	mg/kg/day	NA	1.0E-01	mg/kg/day	Blood	300	PPRTV	3/1/2006
trans-1,2-Dichloroethene	Chronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Blood	1000/1	IRIS	4/20/2007
	Subchronic	2.0E-01	mg/kg-day	NA	2.0E-01	mg/kg-day	Blood	100	HEAST	7/1/1997
bis(2-Ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Liver	1000/1	IRIS	4/20/2007
	Subchronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Reproductive	3000	NCEA	3/28/1996
Heptachlor epoxide	Chronic	1.3E-05	mg/kg-day	NA	1.3E-05	mg/kg-day	Liver	1000/1	IRIS	4/20/2007
	Subchronic	1.3E-05	mg/kg-day	NA	1.3E-05	mg/kg-day	Liver	1000	HEAST	7/1/1997
RDX	Chronic	3.0E-03	mg/kg-day	80%	3.0E-03	mg/kg-day	Prostate	100/1	IRIS	4/20/2007
	Subchronic	3.0E-03	mg/kg-day	80%	3.0E-03	mg/kg-day	Prostate	100/1	HEAST	7/1/1997

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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 (3) (MM/DD/YY)
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3/1	IRIS	4/20/2007
	Subchronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3	HEAST	7/1/1997
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	Not identified	300/3	IRIS	4/20/2007
	Subchronic	2.0E-02	mg/kg-day	2.5%	5.0E-04	mg/kg-day	Not identified	100	HEAST	7/1/1997
Iron	Chronic	7.0E-01	mg/kg-day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1.5	PPRTV	7/29/2005
	Subchronic	7.0E-01	mg/kg-day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1.5	PPRTV	7/29/2005
Molybdenum	Chronic	5.0E-03	mg/kg-day	4%	2.0E-04	mg/kg-day	Kidney	30/1	IRIS	4/20/2007
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	Chronic	1.0E-03	mg/kg-day	2.6%	2.6E-05	mg/kg-day	Kidney	300	NCEA	5/1/2000
	Subchronic	7.0E-03	mg/kg-day	2.6%	1.8E-04	mg/kg-day	Lifetime	100	HEAST	7/1/1997

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment (Final).

Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%.

Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

(2) Adjusted Dermal RfD = RfD (oral) x Absorption Efficiency or ABS_{GI}

(3) For IRIS values, the date IRIS was searched.

For NCEA values, the date of the NCEA article.

For HEAST values, the date of HEAST document.

CNS = Central Nervous System

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NA = Not Applicable

NCEA = National Center for Environmental Assessment

PPRTV = Provisional Peer-Reviewed Toxicity Assessment

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (2) (MM/DD/YY)
Benzene	Chronic	3.0E-02	mg/m3	8.6E-03	mg/kg-day	Blood, Immune	300/1	IRIS	4/20/2007
	Subchronic	6.0E-02	mg/m3	1.7E-02	mg/kg-day	Blood	100	NCEA	7/2/1996
Bromoform	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	Chronic	4.9E-02	mg/m3	1.4E-02	mg/kg-day	Liver	NA	NCEA	1/22/2003
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Cumene	Chronic	4.0E-01	mg/m3	1.1E-01	mg/kg-day	kidney	1000/1	IRIS	03/09/2007
	Subchronic	9.0E-02	mg/m3	2.6E-02	mg/kg-day	CNS, respiratory	1000	HEAST	07/31/1997
1,2-Dichloroethane	Chronic	2.5E+00	mg/m3	7.0E-01	mg/kg-day	Blood, Kidney, Liver	NA	ATSDR	9/1/2001
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Dichlordifluoromethane	Chronic	2.0E-01	mg/m3	5.0E-02	mg/kg-day	Liver	10000	HEAST Alternate	07/31/1997
	Subchronic	2.0E+00	mg/m3	5.0E-01	mg/kg-day	Liver	1.0E+03	HEAST Alternate	7/31/1997
1,3-Dinitrobenzene	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	Chronic	2.8E-01	mg/m3	8.0E-02	mg/kg-day	Liver, Kidney	NA	ATSDR	9/1/1997
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene (CalEPA value, used in HHRA calculations)	Chronic	5.95E-01	mg/m3	1.7E-01	mg/kg-day	Nervous System, Eyes	NA	CalEPA	3/4/2008
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene (draft 2001 value, used for uncertainty evaluation)	Chronic	3.50E-02	mg/m3	1.0E-02	mg/kg-day	CNS, Liver, Endocrine system	1000	NCEA	8/1/2001
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	Chronic	3.0E+01	mg/m3	8.6E+00	mg/kg-day	Whole Body	1.0E+02	HEAST	7/31/1997
	Subchronic	3.0E+01	mg/m3	8.6E+00	mg/kg-day	Whole Body	1.0E+02	HEAST	07/31/1997
Vinyl chloride	Chronic	9.8E-02	mg/m3	2.8E-02	mg/kg-day	Liver	30/1	IRIS	4/20/2007
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	Chronic	6.0E-02	mg/m^3	1.70E-02	mg/kg-day	Liver, Lung	3000/1	PPRTV	3/1/2006
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (2) (MM/DD/YY)
RDX	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	Chronic	1.0E-04	mg/m^3	3.0E-05	mg/kg-day	Respiratory System	300/1	IRIS	2/27/2006
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Iron	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA

(1) Adjustment factor applied to Inhalation Reference Concentration (RfC) to calculate Inhalation Reference Dose.

Inhalation Reference Dose (RfD) = RfC x 20m3/day x 1/70kg

(2) For IRIS values, the date IRIS was searched.

For HEAST values, the date of HEAST document.

For NCEA values, the date of the article provided by NCEA.

ATSDR = Agency for Toxic Substances and Disease Registry

CNS - Central Nervous System

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NA = Not Applicable

NCEA = National Center for Environmental Assessment

PPRTV = Provisional Peer-Reviewed Toxicity Assessment

CalEPA = California EPA

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	EPA Carcinogen Group	Source	Date (2) (MM/DD/YY)
Benzene	5.5E-02	NA	5.5E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
Chloroform	NA	NA	NA	NA	B2	IRIS	4/20/2007
1,2-Dichloroethane	9.1E-02	NA	9.1E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	4/20/2007
1,3-Dinitrobenzene	NA	NA	NA	NA	D	IRIS	4/20/2007
Tetrachloroethene	5.4E-01	NA	5.4E-01	$(mg/kg\text{-}day)^{-1}$	B2	CalEPA	4/26/2004
Trichloroethene (Cal-EPA, value, used in HHRA calculations)	1.3E-02	NA	1.3E-02	$(mg/kg\text{-}day)^{-1}$	B2 - C	CalEPA	3/4/2008
Trichloroethene (draft 2001 value, used for uncertainty evaluation)	4.0E-01	NA	4.0E-01	$(mg/kg\text{-}day)^{-1}$	B2 - C	NCEA	8/1/2001
Vinyl Chloride (adult)	7.2E-01	NA	7.2E-01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
Vinyl chloride (includes early life)	1.4E+00	NA	1.4E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
cis-1,2-Dichloroethene	NA	NA	NA	NA	D	IRIS	4/20/2007
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	1.4E-02	NA	1.4E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	4/20/2007
Heptachlor epoxide	9.1E+00	NA	9.1E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	4/20/2007
RDX	1.1E-01	80%	1.1E-01	$(mg/kg\text{-}day)^{-1}$	C	IRIS	4/20/2007
Arsenic	1.5E+00	95%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
Chromium (hexavalent)	NA	NA	NA	NA	D	IRIS	4/20/2007
Iron	NA	NA	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%.

(2) For IRIS values, the date IRIS was searched.
For HEAST values, the date of HEAST document.
For NCEA values, article date provided by NCEA.

CalEPA = California EPA
HEAST= Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not available
NCEA = National Center for Environmental Assessment

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Chemical of Potential Concern	Unit Risk	Units	Adjustment (1)	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guidance Description	Source	Date (2) (MM/DD/YY)
Benzene	7.7E-06	$(ug/m^3)^{-1}$	3500	2.7E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
Bromoform	1.1E-06	$(ug/m^3)^{-1}$	3500	3.9E-03	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	8/2/2007
Chloroform	2.3E-05	$(ug/m^3)^{-1}$	3500	8.1E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	4/20/2007
Cumene	NA	NA	NA	NA	NA	D	IRIS	03/09/2007
1,2-Dichloroethane	2.6E-05	$(ug/m^3)^{-1}$	3500	9.1E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	4/20/2007
Dichlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene	NA	NA	NA	NA	NA	D	IRIS	4/20/2007
Tetrachloroethene	5.7E-06	$(ug/m^3)^{-1}$	3500	2.0E-02	$(mg/kg\text{-}day)^{-1}$	N/A	CalEPA	4/26/2004
Trichloroethene (CalEPA value, used in HHRA calculations)	2.0E-06	$(ug/m3)^{-1}$	3500	7.0E-03	$(mg/kg\text{-}day)^{-1}$	B2 -C	CalEPA	3/4/2008
Trichloroethene (draft 2001 value, used for uncertainty evaluation)	1.1E-04	$(ug/m^3)^{-1}$	3500	4.0E-01	$(mg/kg\text{-}day)^{-1}$	B2-C	NCEA	8/1/2001
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride (adult)	4.4E-06	$(ug/m^3)^{-1}$	3500	1.5E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
Vinyl chloride (includes early life)	8.8E-06	$(ug/m^3)^{-1}$	3500	3.1E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	D	IRIS	4/20/2007
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	B2	IRIS	4/20/2007
Heptachlor epoxide	2.6E-03	$(ug/m^3)^{-1}$	3500	9.1E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	4/20/2007
RDX	NA	NA	NA	NA	NA	C	IRIS	4/20/2007
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	3500	1.5E+01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
Chromium (hexavalent)	1.2E-02	$(ug/m^3)^{-1}$	3500	4.1E+01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/20/2007
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA

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

(2) For IRIS values, the date IRIS was searched.
For HEAST values, the date of HEAST document.
For NCEA values, article date provided by NCEA.

CalEPA = California EPA

HEAST= Health Effects Assessment Summary Tables

IRIS = Integrated Risk Information System

NA = Not available

NCEA = National Center for Environmental Assessment

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Vapors from Shallow Groundwater	Building 13 Indoor Air	Inhalation	cis-1,2-Dichloroethylene	2.6E-02	mg/m3	5.5E-05	mg/kg/day	NA	NA	NA	1.5E-04	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	4.0E-04	mg/m3	8.7E-07	mg/kg/day	NA	NA	NA	2.4E-06	mg/kg/day	5.0E-02	mg/kg/day	4.9E-05
				Trichloroethene	1.6E+00	mg/m3	3.4E-03	mg/kg/day	7.0E-03	1/mg/kg-day	2.4E-05	9.6E-03	mg/kg/day	1.7E-01	mg/kg/day	5.7E-02
				Vinyl Chloride	6.0E-04	mg/m3	1.3E-06	mg/kg/day	1.5E-02	1/mg/kg-day	2.0E-08	3.6E-06	mg/kg/day	2.8E-02	mg/kg/day	1.3E-04
			Exp. Route Total								2.4E-05					5.7E-02
		Exposure Point Total									2.4E-05					5.7E-02
		Building 46 Indoor Air	Inhalation	Bromoform	3.8E-07	mg/m3	8.3E-10	mg/kg/day	3.9E-03	1/mg/kg-day	3.2E-12	2.3E-09	mg/kg/day	NA	NA	NA
				cis-1,2-Dichloroethylene	1.2E-04	mg/m3	2.5E-07	mg/kg/day	NA	NA	NA	6.9E-07	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	2.3E-02	mg/m3	4.9E-05	mg/kg/day	NA	NA	NA	1.4E-04	mg/kg/day	5.0E-02	mg/kg/day	2.7E-03
				Trichloroethene	4.0E-03	mg/m3	8.7E-06	mg/kg/day	7.0E-03	1/mg/kg-day	6.1E-08	2.4E-05	mg/kg/day	1.7E-01	mg/kg/day	1.4E-04
			Exp. Route Total								6.1E-08					2.9E-03
		Exposure Point Total									6.1E-08					2.9E-03
		Building 47 Indoor Air	Inhalation	Benzene	8.4E-06	mg/m3	3.8E-07	mg/kg/day	2.7E-02	1/mg/kg-day	1.0E-08	1.1E-06	mg/kg/day	8.6E-03	mg/kg/day	1.2E-04
				Bromoform	1.7E-07	mg/m3	7.7E-09	mg/kg/day	3.9E-03	1/mg/kg-day	3.0E-11	2.2E-08	mg/kg/day	NA	NA	NA
				cis-1,2-Dichloroethylene	2.9E-03	mg/m3	1.3E-04	mg/kg/day	NA	NA	NA	3.7E-04	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.5E-02	mg/m3	1.5E-03	mg/kg/day	NA	NA	NA	4.3E-03	mg/kg/day	5.0E-02	mg/kg/day	8.6E-02
				Cumene	1.3E-04	mg/m3	5.9E-06	mg/kg/day	NA	NA	NA	1.7E-05	mg/kg/day	1.1E-01	mg/kg/day	1.4E-04
				Trichloroethene	1.0E-02	mg/m3	4.5E-04	mg/kg/day	7.0E-03	1/mg/kg-day	3.2E-06	1.3E-03	mg/kg/day	1.7E-01	mg/kg/day	7.4E-03
				1,1,2-Trichloro-1,2,2-trifluoroethane (Fr	3.8E-02	mg/m3	1.7E-03	mg/kg/day	NA	NA	NA	4.7E-03	mg/kg/day	8.6E+00	mg/kg/day	5.5E-04
				Vinyl Chloride	6.3E-02	mg/m3	2.8E-03	mg/kg/day	1.5E-02	1/mg/kg-day	4.3E-05	7.9E-03	mg/kg/day	2.8E-02	mg/kg/day	2.8E-01
			Exp. Route Total								4.7E-05					3.8E-01
		Exposure Point Total									4.7E-05					3.8E-01
		Building 54 Indoor Air	Inhalation	cis-1,2-Dichloroethylene	1.5E-02	mg/m3	6.8E-04	mg/kg/day	NA	NA	NA	1.9E-03	mg/kg/day	NA	NA	NA
				Trichloroethene	9.6E-01	mg/m3	4.3E-02	mg/kg/day	7.0E-03	1/mg/kg-day	3.0E-04	1.2E-01	mg/kg/day	1.7E-01	mg/kg/day	7.0E-01
				Vinyl Chloride	9.6E-04	mg/m3	4.3E-05	mg/kg/day	1.5E-02	1/mg/kg-day	6.6E-07	1.2E-04	mg/kg/day	2.8E-02	mg/kg/day	4.3E-03
			Exp. Route Total								3.0E-04					7.1E-01
		Exposure Point Total									3.0E-04					7.1E-01

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
		Building 63	Inhalation													
		Indoor Air		Benzene	1.2E-05	mg/m3	2.5E-08	mg/kg/day	2.7E-02	1/mg/kg-day	6.7E-10	7.0E-08	mg/kg/day	8.6E-03	mg/kg/day	8.1E-06
				cis-1,2-Dichloroethylene	2.1E-03	mg/m3	4.6E-06	mg/kg/day	NA	NA	NA	1.3E-05	mg/kg/day	NA	NA	NA
				Trichloroethene	1.9E-02	mg/m3	4.1E-05	mg/kg/day	7.0E-03	1/mg/kg-day	2.9E-07	1.1E-04	mg/kg/day	1.7E-01	mg/kg/day	6.7E-04
				Vinyl Chloride	3.9E-03	mg/m3	8.3E-06	mg/kg/day	1.5E-02	1/mg/kg-day	1.3E-07	2.3E-05	mg/kg/day	2.8E-02	mg/kg/day	8.3E-04
			Exp. Route Total								4.2E-07					1.5E-03
		Exposure Point Total									4.2E-07					1.5E-03
		Building 90	Inhalation													
		Indoor Air		cis-1,2-Dichloroethylene	8.4E-03	mg/m3	1.8E-05	mg/kg/day	NA	NA	NA	5.0E-05	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	2.3E-02	mg/m3	5.0E-05	mg/kg/day	NA	NA	NA	1.4E-04	mg/kg/day	5.0E-02	mg/kg/day	2.8E-03
				Trichloroethene	1.8E-02	mg/m3	4.0E-05	mg/kg/day	7.0E-03	1/mg/kg-day	2.8E-07	1.1E-04	mg/kg/day	1.7E-01	mg/kg/day	6.5E-04
				1,1,2-Trichloro-1,2,2-trifluoroethane (Fr	2.8E-02	mg/m3	6.0E-05	mg/kg/day	NA	NA	NA	1.7E-04	mg/kg/day	8.6E+00	mg/kg/day	1.9E-05
				Vinyl Chloride	5.6E-02	mg/m3	1.2E-04	mg/kg/day	1.5E-02	1/mg/kg-day	1.8E-06	3.4E-04	mg/kg/day	2.8E-02	mg/kg/day	1.2E-02
			Exp. Route Total								2.1E-06					1.5E-02
		Exposure Point Total									2.1E-06					1.5E-02
		Building 1556	Inhalation													
		Indoor Air		Benzene	1.0E-03	mg/m3	4.7E-05	mg/kg/day	2.7E-02	1/mg/kg-day	1.3E-06	1.3E-04	mg/kg/day	8.6E-03	mg/kg/day	1.5E-02
				Bromoform	8.6E-08	mg/m3	3.9E-09	mg/kg/day	3.9E-03	1/mg/kg-day	1.5E-11	1.1E-08	mg/kg/day	NA	NA	NA
				cis-1,2-Dichloroethylene	2.1E-02	mg/m3	9.3E-04	mg/kg/day	NA	NA	NA	2.6E-03	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.3E-04	mg/m3	1.5E-05	mg/kg/day	NA	NA	NA	4.1E-05	mg/kg/day	5.0E-02	mg/kg/day	8.2E-04
				Cumene	4.2E-05	mg/m3	1.9E-06	mg/kg/day	NA	NA	NA	5.2E-06	mg/kg/day	1.1E-01	mg/kg/day	4.6E-05
				Trichloroethene	3.2E-01	mg/m3	1.5E-02	mg/kg/day	7.0E-03	1/mg/kg-day	1.0E-04	4.1E-02	mg/kg/day	1.7E-01	mg/kg/day	2.4E-01
				1,1,2-Trichloro-1,2,2-trifluoroethane (Fr	4.7E-04	mg/m3	2.1E-05	mg/kg/day	NA	NA	NA	5.9E-05	mg/kg/day	8.6E+00	mg/kg/day	6.9E-06
				Vinyl Chloride	5.5E-03	mg/m3	2.5E-04	mg/kg/day	1.5E-02	1/mg/kg-day	3.8E-06	6.9E-04	mg/kg/day	2.8E-02	mg/kg/day	2.5E-02
			Exp. Route Total								1.1E-04					2.8E-01
		Exposure Point Total									1.1E-04					2.8E-01

Notes-
NA = Not applicable.

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Deep Groundwater	Tap Water	Ingestion	Chloroform	3.0E+00	ug/L	NA	NA	NA	NA	NA	8.2E-05	mg/kg/day	1.0E-02	mg/kg/day	8.2E-03
				1,3-Dinitrobenzene	1.1E+00	ug/L	NA	NA	NA	NA	NA	3.0E-05	mg/kg/day	1.0E-04	mg/kg/day	3.0E-01
				Arsenic	7.3E+01	ug/L	NA	NA	NA	NA	NA	2.0E-03	mg/kg/day	3.0E-04	mg/kg/day	6.6E+00
				Chromium	4.7E+01	ug/L	NA	NA	NA	NA	NA	1.3E-03	mg/kg/day	3.0E-03	mg/kg/day	4.3E-01
				Vanadium	3.6E+01	ug/L	NA	NA	NA	NA	NA	9.8E-04	mg/kg/day	1.0E-03	mg/kg/day	9.8E-01
			Exp. Route Total								NA					8.4E+00
			Dermal Absorption	Chloroform	3.0E+00	ug/L	NA	NA	NA	NA	NA	7.5E-06	mg/kg/day	1.0E-02	mg/kg/day	7.5E-04
				1,3-Dinitrobenzene	1.1E+00	ug/L	NA	NA	NA	NA	NA	9.6E-07	mg/kg/day	1.0E-04	mg/kg/day	9.6E-03
				Arsenic	7.3E+01	ug/L	NA	NA	NA	NA	NA	1.0E-05	mg/kg/day	3.0E-04	mg/kg/day	3.5E-02
				Chromium	4.7E+01	ug/L	NA	NA	NA	NA	NA	6.8E-06	mg/kg/day	7.5E-05	mg/kg/day	9.0E-02
				Vanadium	3.6E+01	ug/L	NA	NA	NA	NA	NA	5.1E-06	mg/kg/day	2.6E-05	mg/kg/day	2.0E-01
			Exp. Route Total								NA					3.3E-01
		Exposure Point Total									NA					8.7E+00
	Exposure Medium Total										NA					8.7E+00
	Air	Shower	Inhalation	Chloroform	3.0E+00	ug/L	2.2E-05	mg/kg/day	8.1E-02	1/mg/kg/day	1.8E-06	6.4E-05	mg/kg/day	1.4E-02	mg/kg/day	4.5E-03
			Exp. Route Total								1.8E-06					4.5E-03
		Exposure Point Total									1.8E-06					4.5E-03
	Exposure Medium Total										1.8E-06					4.5E-03
Medium Total											1.8E-06					8.7E+00
Total of Receptor Risks Across All Media											1.8E-06	Total of Receptor Hazards Across All Media				8.7E+00

Notes-
NA = Not applicable.
DAevent for exposure to groundwater while showering is calculated on Table 7.1.RME Supplement A.
Shower exposure calculated on Table 7.1.RME Supplement C.

Table 7.2.RME Supplement A
Calculation of DAevent
Resident Adult Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	3.0E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.58	3.0E-08	2
1,3-Dinitrobenzene	1.1E+00	1.7E-03	8.7E-03	9.2E-01	2.2E+00	1.0E+00	0.58	3.9E-09	2
Arsenic	7.3E+01	1.0E-03	NA	NA	NA	NA	0.58	4.2E-08	1
Chromium	4.7E+01	1.0E-03	NA	NA	NA	NA	0.58	2.7E-08	1
Vanadium	3.6E+01	1.0E-03	NA	NA	NA	NA	0.58	2.1E-08	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If $t_{event} < t^*$ then

$$DA_{event} = 2 \times FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}} \qquad \text{(eq 2)}$$

If $t_{event} > t^*$ then

$$DA_{event} = FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad \text{(eq 3)}$$

Notes:
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
NA - not applicable.

Table 7.2.RME Supplement B
Calculation of DAevent
Resident Adult Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical	MW	log Kow	Kow	log Kp[1]	Kp (cm/hr)	B[1]	log D_{sc}/l_{sc}[1]	D_{sc}/l_{sc}[1]	l_{sc} (cm)	D_{sc} (cm^2/hr)	τ_{event}[1] (hr)	c[1]	b[1]	t*[1] (hr)
1,3-Dinitrobenzene	168.11	1.49	3.09E+01	-2.76E+00	1.75E-03	8.71E-03	-3.74E+00	1.81E-04	1.00E-03	1.81E-07	9.19E-01	3.39E-01	3.09E-01	2.21E+00

1. Equations from Risk Assessment Guidance for Superfund Volume 1; Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment, EPA/540/R/99/005. July 2004.

Table 7.2.RME Supplement C
Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical	Exposure Point Concentration Cwo (μg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (μg/l)	S (μg/m^3 -min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
Chloroform	3.0E+00	1.2E+02	3.67E-03	1.2E+03	1.2E+01	1.1E+01	1.5E+01	3.6E-01	3.0E-01	6.6E-05

Variables*	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	μg/l	Solved by Eq 5
sdt = shower droplet drop time	sec	0.5
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	10
SV = shower room air volume	m^3	12
S = indoor VOC generation rate	μg/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables*	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	30
Dt = total duration in shower room	min	60
R = air exchange rate	min^{-1}	0.0083
Ca = indoor air concentration of VOCs	μg/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	3000 * (18 / HH)$^{0.5}$
Equation 2:	Kl(VOC) =	20 * (44 / HH)$^{0.5}$
Equation 3:	KL =	((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))$^{-1}$
Equation 4:	Kal =	(KL * (((Tl * Us) / (Ts * Ul))$^{-0.5}$))
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))
Equation 6:	S =	(Cwd * FR / SV)
Equation 7:	see time series example on Table I-GW-5	
Equation 8:	Einh =	If t>Ds (((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

* Values for variables are default EPA Region III values that have been provided by EPA on past projects.

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Deep Groundwater	Tap Water	Ingestion	Chloroform	3.0E+00	ug/L	NA	NA	NA	NA	NA	1.9E-04	mg/kg/day	1.0E-02	mg/kg/day	1.9E-02
				1,3-Dinitrobenzene	1.1E+00	ug/L	NA	NA	NA	NA	NA	7.0E-05	mg/kg/day	1.0E-04	mg/kg/day	7.0E-01
				Arsenic	7.3E+01	ug/L	NA	NA	NA	NA	NA	4.7E-03	mg/kg/day	3.0E-04	mg/kg/day	1.6E+01
				Chromium	4.7E+01	ug/L	NA	NA	NA	NA	NA	3.0E-03	mg/kg/day	3.0E-03	mg/kg/day	1.0E+00
				Vanadium	3.6E+01	ug/L	NA	NA	NA	NA	NA	2.3E-03	mg/kg/day	1.0E-03	mg/kg/day	2.3E+00
			Exp. Route Total								NA					2.0E+01
			Dermal Absorption	Chloroform	3.0E+00	ug/L	NA	NA	NA	NA	NA	1.7E-05	mg/kg/day	1.0E-02	mg/kg/day	1.7E-03
				1,3-Dinitrobenzene	1.1E+00	ug/L	NA	NA	NA	NA	NA	2.1E-06	mg/kg/day	1.0E-04	mg/kg/day	2.1E-02
				Arsenic	7.3E+01	ug/L	NA	NA	NA	NA	NA	3.1E-05	mg/kg/day	3.0E-04	mg/kg/day	1.0E-01
				Chromium	4.7E+01	ug/L	NA	NA	NA	NA	NA	2.0E-05	mg/kg/day	7.5E-05	mg/kg/day	2.7E-01
				Vanadium	3.6E+01	ug/L	NA	NA	NA	NA	NA	1.5E-05	mg/kg/day	2.6E-05	mg/kg/day	5.8E-01
			Exp. Route Total								NA					9.7E-01
		Exposure Point Total									NA					2.1E+01
	Exposure Medium Total										NA					2.1E+01
Medium Total											NA					2.1E+01
										Total of Receptor Risks Across All Media	NA				Total of Receptor Hazards Across All Media	2.1E+01

Table 7.3.RME Supplement A
Calculation of DAevent
Resident Adult Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	3.0E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	1	4.0E-08	2
1,3-Dinitrobenzene	1.1E+00	1.7E-03	8.7E-03	9.2E-01	2.2E+00	1.0E+00	1	5.1E-09	2
Arsenic	7.3E+01	1.0E-03	NA	NA	NA	NA	1	7.3E-08	1
Chromium	4.7E+01	1.0E-03	NA	NA	NA	NA	1	4.7E-08	1
Vanadium	3.6E+01	1.0E-03	NA	NA	NA	NA	1	3.6E-08	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If t_{event} < t* then

$$DA_{event} = 2 \times FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}} \qquad \text{(eq 2)}$$

If t_{event} > t* then

$$DA_{event} = FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad \text{(eq 3)}$$

Notes:
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
NA - not applicable.

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Deep Groundwater	Tap Water	Ingestion	Chloroform	3.0E+00	ug/L	4.5E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				1,3-Dinitrobenzene	1.1E+00	ug/L	1.6E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	7.3E+01	ug/L	1.1E-03	mg/kg/day	1.5E+00	1/mg/kg/day	1.6E-03	NA	NA	NA	NA	NA
				Chromium	4.7E+01	ug/L	7.0E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	3.6E+01	ug/L	5.4E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								1.6E-03					0.0E+00
			Dermal Absorption	Chloroform	3.0E+00	ug/L	4.0E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				1,3-Dinitrobenzene	1.1E+00	ug/L	5.1E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	7.3E+01	ug/L	6.2E-06	mg/kg/day	1.5E+00	1/mg/kg/day	9.3E-06	NA	NA	NA	NA	NA
				Chromium	4.7E+01	ug/L	4.0E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	3.6E+01	ug/L	3.1E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								9.3E-06					NA
		Exposure Point Total									1.6E-03					NA
	Exposure Medium Total										1.6E-03					NA
Medium Total											1.6E-03					NA
Total of Receptor Risks Across All Media											1.6E-03	Total of Receptor Hazards Across All Media				NA

Notes-

NA = Not applicable

DAevent for exposure to groundwater while showering and bathing is calculated on Tables 7.2.RME Supplement A and 7.3.RME Supplement B.

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Construction Excavation	Dermal													
				1,2-Dichloroethane	4.10E-01	µg/L	1.9E-09	mg/kg/day	9.1E-02	1/mg/kg-day	1.7E-10	1.3E-07	mg/kg/day	NA	NA	NA
				Benzene	8.90E+01	µg/L	1.3E-06	mg/kg/day	5.5E-02	1/mg/kg-day	7.4E-08	9.4E-05	mg/kg/day	3.0E-03	mg/kg/day	3.1E-02
				Chloroform	2.1E+00	µg/L	1.6E-08	mg/kg/day	NA	NA	NA	1.1E-06	mg/kg/day	1.0E-02	mg/kg/day	1.1E-04
				Tetrachloroethene	1.0E+00	µg/L	4.2E-08	mg/kg/day	5.4E-01	1/mg/kg-day	2.3E-08	3.0E-06	mg/kg/day	1.0E-01	mg/kg/day	3.0E-05
				Trichloroethene	3.1E+03	µg/L	4.3E-05	mg/kg/day	1.3E-02	1/mg/kg-day	5.6E-07	3.0E-03	mg/kg/day	6.0E-03	mg/kg/day	5.0E-01
				Vinyl chloride	1.7E+02	µg/L	9.7E-07	mg/kg/day	7.2E-01	1/mg/kg-day	7.0E-07	6.8E-05	mg/kg/day	3.0E-03	mg/kg/day	2.3E-02
				cis-1,2-Dichloroethene	1.5E+03	µg/L	1.3E-05	mg/kg/day	NA	NA	NA	8.8E-04	mg/kg/day	1.0E-01	mg/kg/day	8.8E-03
				trans-1,2-Dichloroethene	1.5E+01	µg/L	1.2E-07	mg/kg/day	NA	NA	NA	8.7E-06	mg/kg/day	2.0E-01	mg/kg/day	4.3E-05
				bis(2-Ethylhexyl)phthalate	1.7E+01	µg/L	2.3E-06	mg/kg/day	1.4E-02	1/mg/kg-day	3.2E-08	1.6E-04	mg/kg/day	2.0E-02	mg/kg/day	7.9E-03
				Heptachlor epoxide	3.3E-02	µg/L	1.1E-09	mg/kg/day	9.1E+00	1/mg/kg-day	9.7E-09	7.5E-08	mg/kg/day	1.3E-05	mg/kg/day	5.7E-03
				RDX	5.3E+00	µg/L	9.4E-10	mg/kg/day	1.1E-01	1/mg/kg-day	1.0E-10	6.6E-08	mg/kg/day	3.0E-03	mg/kg/day	2.2E-05
				Arsenic	4.0E+01	µg/L	3.7E-08	mg/kg/day	1.5E+00	1/mg/kg-day	5.6E-08	2.6E-06	mg/kg/day	3.0E-04	mg/kg/day	8.7E-03
				Iron	9.0E+03	µg/L	8.3E-06	mg/kg/day	NA	NA	NA	5.8E-04	mg/kg/day	7.0E-01	mg/kg/day	8.3E-04
				Molybdenum	1.3E+01	µg/L	1.2E-08	mg/kg/day	NA	NA	NA	8.2E-07	mg/kg/day	2.0E-04	mg/kg/day	4.1E-03
			Exp. Route Total								1.5E-06					5.9E-01
		Exposure Point Total									1.5E-06					5.9E-01
	Exposure Medium Total										1.5E-06					5.9E-01
Groundwater	Air	Construction Excavation	Inhalation													
				1,2-Dichloroethane	4.1E-01	µg/L	2.7E-09	mg/kg/day	9.1E-02	1/mg/kg-day	2.4E-10	1.9E-07	mg/kg/day	7.0E-01	mg/kg/day	2.7E-07
				Benzene	8.9E+01	µg/L	6.3E-07	mg/kg/day	2.7E-02	1/mg/kg-day	1.7E-08	4.4E-05	mg/kg/day	1.7E-02	mg/kg/day	2.6E-03
				Chloroform	2.1E+00	µg/L	1.3E-08	mg/kg/day	8.1E-02	1/mg/kg-day	1.1E-09	9.4E-07	mg/kg/day	1.4E-02	mg/kg/day	6.7E-05
				Tetrachloroethene	1.0E+00	µg/L	5.9E-09	mg/kg/day	2.0E-02	1/mg/kg-day	1.2E-10	4.2E-07	mg/kg/day	8.0E-02	mg/kg/day	5.2E-06
				Trichloroethene	3.1E+03	µg/L	1.9E-05	mg/kg/day	7.0E-03	1/mg/kg-day	1.4E-07	1.4E-03	mg/kg/day	1.7E-01	mg/kg/day	8.0E-03
				Vinyl chloride	1.7E+02	µg/L	1.3E-06	mg/kg/day	3.1E-02	1/mg/kg-day	4.0E-08	9.0E-05	mg/kg/day	2.8E-02	mg/kg/day	3.2E-03
				cis-1,2-Dichloroethene	1.5E+03	µg/L	1.0E-05	mg/kg/day	NA	NA	NA	7.2E-04	mg/kg/day	NA	NA	NA
				trans-1,2-Dichloroethene	1.5E+01	µg/L	1.0E-07	mg/kg/day	NA	NA	NA	7.1E-06	mg/kg/day	1.7E-02	mg/kg/day	4.2E-04
			Exp. Route Total								1.9E-07					1.4E-02
		Exposure Point Total									1.9E-07					1.4E-02
	Exposure Medium Total										1.9E-07					1.4E-02
Groundwater - Shallow Groundwater in Excavation Total											1.6E-06					6.1E-01
										Total of Receptor Risks Across All Media	1.6E-06				Total of Receptor Hazards Across All Media	6.1E-01

Notes-
NA = Not applicable
Subcronic RfD values used when available

DAevent for exposure to shallow aquifer groundwater during excavation activities calculated on Table 7.5.RME Supplement A.
EPC for inhalation of volatiles from shallow aquifer groundwater from excavation pit calculated on Table 7.5.RME Supplement B.

Table 7.5.RME Supplement A
Calculation of DAevent
Construction Worker
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
1,2-Dichloroethane	4.1E-01	4.2E-03	1.6E-02	3.8E-01	9.2E-01	1.0E+00	4	8.1E-09	3
Benzene	8.9E+01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	4	5.8E-06	3
Chloroform	2.1E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	4	7.0E-08	3
Tetrachloroethene	1.0E+00	3.3E-02	1.7E-01	9.1E-01	2.2E+00	1.0E+00	4	1.8E-07	3
Trichloroethene	3.1E+03	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	4	1.9E-04	3
Vinyl chloride	1.7E+02	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	4	4.2E-06	3
cis-1,2-Dichloroethene	1.5E+03	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	4	5.5E-05	3
trans-1,2-Dichloroethene	1.5E+01	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	4	5.4E-07	3
bis(2-Ethylhexyl)phthalate	1.7E+01	2.5E-02	1.9E-01	1.7E+01	4.0E+01	1.0E+00	4	9.8E-06	2
Heptachlor epoxide	3.3E-02	8.6E-03	6.4E-02	1.3E+01	3.2E+01	8.0E-01	4	4.6E-09	2
RDX	5.3E+00	1.0E-04	5.8E-04	1.9E+00	4.5E+00	1.0E+00	4	4.1E-09	2
Arsenic	4.0E+01	1.0E-03	NA	NA	NA	NA	4	1.6E-07	1
Iron	9.0E+03	1.0E-03	NA	NA	NA	NA	4	3.6E-05	1
Molybdenum	1.3E+01	1.0E-03	NA	NA	NA	NA	4	5.1E-08	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If tevent<t*, then DAevent =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =
FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:
NA - Not applicable
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).
t* - Time to reach steady-state
trans-1,2-Dichloroethene values used as surrogate for cis-1,2-dichloroethene.
Heptachlor values used as surrogate for Heptachlor epoxide.

Table 7.5.RME Supplement B
Inhalation of Volatiles from Groundwater During Construction Excavation
Inhalation Exposure Concentrations Calculated Using a Two-Film Volatilization Model
Future Construction Worker Senario
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical	Cw (μg/L)	MW (mol/gram)	KH (unitless)	kl (cm/hr)	kg (cm/hr)	Kv (cm/hr)	ER (mg/hr)	ERa (g/sec-m2)	Ca (mg/m3)
1,2-Dichloroethane	4.1E-01	9.9E+01	4.8E-02	3.3E+00	2.0E+03	3.2E+00	1.3E+00	1.4E-10	3.8E-06
Benzene	8.9E+01	7.8E+01	2.3E-01	3.5E+00	2.1E+03	3.5E+00	3.1E+02	3.2E-08	9.1E-04
Chloroform	2.1E+00	1.2E+02	1.5E-01	3.2E+00	1.9E+03	3.1E+00	6.6E+00	6.8E-10	1.9E-05
Tetrachloroethene	1.0E+00	1.7E+02	7.2E-01	2.9E+00	1.8E+03	2.9E+00	2.9E+00	3.0E-10	8.5E-06
Trichloroethene	3.1E+03	1.3E+02	4.0E-01	3.1E+00	1.9E+03	3.1E+00	9.5E+03	9.8E-07	2.8E-02
Vinyl chloride	1.7E+02	6.3E+01	1.1E+00	3.7E+00	2.3E+03	3.7E+00	6.3E+02	6.5E-08	1.8E-03
cis-1,2-Dichloroethene	1.5E+03	9.7E+01	1.7E-01	3.3E+00	2.0E+03	3.3E+00	5.0E+03	5.2E-07	1.5E-02
trans-1,2-Dichloroethene	1.5E+01	9.7E+01	3.9E-01	3.3E+00	2.0E+03	3.3E+00	5.0E+01	5.1E-09	1.5E-04

Equations

Equation 1	$Kv = 1/(1/k_l + 1/K_H * K_g)$
Equation 2	$k_g = 700(18/MW)^{1/4}V$
Equation 3	$k_l = (32/MW)^{1/4}Ka'$
Equation 4	$ER = Kv * Cw * L/1000\ cm^3 * mg/1000\ \mu g$
Equation 5	$ERa = ER * g/1000\ mg * hr/60\ min * min/60\ sec * 1/A$

Variables	Units	Exposure Assumptions
Cw = groundwater concentration	(μg/L)	chem-specific
MW = molecular weight	(mol/gram)	chem-specific
K_H - Henry's Law Constant	(unitless)	chem-specific
Kv = volatilization rate	(cm/hr)	Solved by Eq 1
k_g = gas phase transfer coefficient	(cm/hr)	Solved by Eq 2
k_l = liquid phase transfer coefficient	(cm/hr)	Solved by Eq 3
V = wind speed	(m/s)	4.4
Ka' = aeration rate	(cm/hr)	0.0633
ER = emission rate	(mg/hr)	Solved by Eq 4
A = area of excavation (utility ditch)	(m^2)	2,700
Era = area emission rate	(g/sec-m^2)	Solved by Eq 5
Ca = air concentration	(mg/m^3)	Solved using SCREEN3 model

Note: aeration rate based on aeration rate for small pond (0.1/day) multiplied by depth of water in excavation (1/2 ft)

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	1,2-Dichloroethane	4.1E-01	ug/L	NA	NA	NA	NA	NA	1.1E-05	mg/kg/day	NA	mg/kg/day	NA
				Benzene	8.9E+01	ug/L	NA	NA	NA	NA	NA	2.4E-03	mg/kg/day	4.0E-03	mg/kg/day	6.1E-01
				Chloroform	2.1E+00	ug/L	NA	NA	NA	NA	NA	5.8E-05	mg/kg/day	1.0E-02	mg/kg/day	5.8E-03
				Tetrachloroethene	1.0E+00	ug/L	NA	NA	NA	NA	NA	2.7E-05	mg/kg/day	1.0E-02	mg/kg/day	2.7E-03
				Trichloroethene	3.1E+03	ug/L	NA	NA	NA	NA	NA	8.5E-02	mg/kg/day	6.0E-03	mg/kg/day	1.4E+01
				Vinyl chloride	1.7E+02	ug/L	NA	NA	NA	NA	NA	4.7E-03	mg/kg/day	3.0E-03	mg/kg/day	1.6E+00
				cis-1,2-Dichloroethene	1.5E+03	ug/L	NA	NA	NA	NA	NA	4.2E-02	mg/kg/day	1.0E-02	mg/kg/day	4.2E+00
				trans-1,2-Dichloroethene	1.5E+01	ug/L	NA	NA	NA	NA	NA	4.1E-04	mg/kg/day	2.0E-02	mg/kg/day	2.1E-02
				bis(2-Ethylhexyl)phthalate	1.7E+01	ug/L	NA	NA	NA	NA	NA	4.8E-04	mg/kg/day	2.0E-02	mg/kg/day	2.4E-02
				Heptachlor epoxide	3.3E-02	ug/L	NA	NA	NA	NA	NA	9.1E-07	mg/kg/day	1.3E-05	mg/kg/day	7.0E-02
				RDX	5.3E+00	ug/L	NA	NA	NA	NA	NA	1.5E-04	mg/kg/day	3.0E-03	mg/kg/day	4.8E-02
				Arsenic	4.0E+01	ug/L	NA	NA	NA	NA	NA	1.1E-03	mg/kg/day	3.0E-04	mg/kg/day	3.7E+00
				Iron	9.0E+03	ug/L	NA	NA	NA	NA	NA	2.5E-01	mg/kg/day	7.0E-01	mg/kg/day	3.5E-01
				Molybdenum	1.3E+01	ug/L	NA	NA	NA	NA	NA	3.5E-04	mg/kg/day	5.0E-03	mg/kg/day	7.0E-02
			Exp. Route Total								NA					2.5E+01
			Dermal Absorption	1,2-Dichloroethane	4.1E-01	ug/L	NA	NA	NA	NA	NA	5.5E-07	mg/kg/day	NA	mg/kg/day	NA
				Benzene	8.9E+01	ug/L	NA	NA	NA	NA	NA	3.7E-04	mg/kg/day	4.0E-03	mg/kg/day	9.3E-02
				Chloroform	2.1E+00	ug/L	NA	NA	NA	NA	NA	5.2E-06	mg/kg/day	1.0E-02	mg/kg/day	5.2E-04
				Tetrachloroethene	1.0E+00	ug/L	NA	NA	NA	NA	NA	1.6E-05	mg/kg/day	1.0E-02	mg/kg/day	1.6E-03
				Trichloroethene	3.1E+03	ug/L	NA	NA	NA	NA	NA	1.5E-02	mg/kg/day	6.0E-03	mg/kg/day	2.4E+00
				Vinyl chloride	1.7E+02	ug/L	NA	NA	NA	NA	NA	2.5E-04	mg/kg/day	3.0E-03	mg/kg/day	8.3E-02
				cis-1,2-Dichloroethene	1.5E+03	ug/L	NA	NA	NA	NA	NA	3.7E-03	mg/kg/day	1.0E-02	mg/kg/day	3.7E-01
				trans-1,2-Dichloroethene	1.5E+01	ug/L	NA	NA	NA	NA	NA	3.6E-05	mg/kg/day	2.0E-02	mg/kg/day	1.8E-03
				bis(2-Ethylhexyl)phthalate	1.7E+01	ug/L	NA	NA	NA	NA	NA	9.2E-04	mg/kg/day	2.0E-02	mg/kg/day	4.6E-02
				Heptachlor epoxide	3.3E-02	ug/L	NA	NA	NA	NA	NA	4.3E-07	mg/kg/day	1.3E-05	mg/kg/day	3.3E-02
				RDX	5.3E+00	ug/L	NA	NA	NA	NA	NA	3.8E-07	mg/kg/day	3.0E-03	mg/kg/day	1.3E-04
				Arsenic	4.0E+01	ug/L	NA	NA	NA	NA	NA	5.8E-06	mg/kg/day	3.0E-04	mg/kg/day	1.9E-02
				Iron	9.0E+03	ug/L	NA	NA	NA	NA	NA	1.3E-03	mg/kg/day	7.0E-01	mg/kg/day	1.8E-03
				Molybdenum	1.3E+01	ug/L	NA	NA	NA	NA	NA	1.8E-06	mg/kg/day	2.0E-04	mg/kg/day	9.1E-03
			Exp. Route Total								NA					3.1E+00
		Exposure Point Total									NA					2.8E+01
	Exposure Medium Total										NA					2.8E+01

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Shower	Inhalation	1,2-Dichloroethane	4.1E-01	ug/L	2.8E-06	mg/kg/day	9.1E-02	1/mg/kg/day	2.5E-07	8.2E-06	mg/kg/day	7.0E-01	mg/kg/day	1.2E-05
				Benzene	8.9E+01	ug/L	8.0E-04	mg/kg/day	2.7E-02	1/mg/kg/day	2.2E-05	2.3E-03	mg/kg/day	8.6E-03	mg/kg/day	2.7E-01
				Chloroform	2.1E+00	ug/L	1.5E-05	mg/kg/day	8.1E-02	1/mg/kg/day	1.2E-06	4.5E-05	mg/kg/day	1.4E-02	mg/kg/day	3.2E-03
				Tetrachloroethene	1.0E+00	ug/L	6.5E-06	mg/kg/day	2.0E-02	1/mg/kg/day	1.3E-07	1.9E-05	mg/kg/day	8.0E-02	mg/kg/day	2.4E-04
				Trichloroethene	3.1E+03	ug/L	2.2E-02	mg/kg/day	7.0E-03	1/mg/kg/day	1.6E-04	6.5E-02	mg/kg/day	1.7E-01	mg/kg/day	3.8E-01
				Vinyl chloride	1.7E+02	ug/L	1.7E-03	mg/kg/day	3.1E-02	1/mg/kg/day	5.4E-05	5.1E-03	mg/kg/day	2.8E-02	mg/kg/day	1.8E-01
				cis-1,2-Dichloroethene	1.5E+03	ug/L	1.2E-02	mg/kg/day	NA	1/mg/kg/day	NA	3.6E-02	mg/kg/day	NA	mg/kg/day	NA
				trans-1,2-Dichloroethene	1.5E+01	ug/L	1.2E-04	mg/kg/day	NA	1/mg/kg/day	NA	3.6E-04	mg/kg/day	1.7E-02	mg/kg/day	2.1E-02
			Exp. Route Total								2.3E-04					8.6E-01
		Exposure Point Total									2.3E-04					8.6E-01
	Exposure Medium Total										2.3E-04					8.6E-01
	Air	Indoor Air	Inhalation													
				Benzene	2.6E-02	mg/m^3	NA	NA	NA	NA	NA	7.2E-03	mg/kg/day	8.6E-03	mg/kg/day	8.4E-01
				Bromoform	1.2E-06	mg/m^3	NA	NA	NA	NA	NA	3.2E-07	mg/kg/day	NA	NA	NA
				cis-1,2-dichloroethylene	5.0E-01	mg/m^3	NA	NA	NA	NA	NA	1.4E-01	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.1E-01	mg/m^3	NA	NA	NA	NA	NA	8.5E-02	mg/kg/day	5.0E-02	mg/kg/day	1.7E+00
				Cumene	1.2E-03	mg/m^3	NA	NA	NA	NA	NA	3.2E-04	mg/kg/day	1.1E-01	mg/kg/day	2.8E-03
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	4.8E+00	mg/m^3	NA	NA	NA	NA	NA	1.3E+00	mg/kg/day	8.6E+00	mg/kg/day	1.5E-01
				Trichloroethene	8.1E+00	mg/m^3	NA	NA	NA	NA	NA	2.2E+00	mg/kg/day	1.7E-01	NA	1.3E+01
				Vinyl Chloride	6.6E-01	mg/m^3	NA	NA	NA	NA	NA	1.8E-01	mg/kg/day	2.8E-02	mg/kg/day	6.4E+00
			Exp. Route Total								NA					2.2E+01
		Exposure Point Total									NA					2.2E+01
	Exposure Medium Total										NA					2.2E+01
Medium Total											NA					5.1E+01
										Total of Receptor Risks Across All Media	2.3E-04				Total of Receptor Hazards Across All Media	5.1E+01

Notes-

NA = Not applicable

DAevent for exposure to groundwater while showering is calculated on Table 7.6.RME Supplement A.

Shower exposure calculated on Table 7.6.RME Supplement B.

Table 7.6.RME Supplement A
Calculation of DAevent
Resident Adult Shallow Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
1,2-Dichloroethane	4.1E-01	4.2E-03	1.6E-02	3.8E-01	9.2E-01	1.0E+00	0.58	2.2E-09	2
Benzene	8.9E+01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	0.58	1.5E-06	2
Chloroform	2.1E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.58	2.1E-08	2
Tetrachloroethene	1.0E+00	3.3E-02	1.7E-01	9.1E-01	2.2E+00	1.0E+00	0.58	6.6E-08	2
Trichloroethene	3.1E+03	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	0.58	5.9E-05	2
Vinyl chloride	1.7E+02	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.58	1.0E-06	3
cis-1,2-Dichloroethene	1.5E+03	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	0.58	1.5E-05	2
trans-1,2-Dichloroethene	1.5E+01	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	0.58	1.5E-07	2
bis(2-Ethylhexyl)phthalate	1.7E+01	2.5E-02	1.9E-01	1.7E+01	4.0E+01	1.0E+00	0.58	3.7E-06	2
Heptachlor epoxide	3.3E-02	8.6E-03	6.4E-02	1.3E+01	3.2E+01	8.0E-01	0.58	1.8E-09	2
RDX	5.3E+00	1.0E-04	5.8E-04	1.9E+00	4.5E+00	1.0E+00	0.58	1.6E-09	2
Arsenic	4.0E+01	1.0E-03	NA	NA	NA	NA	0.58	2.3E-08	1
Iron	9.0E+03	1.0E-03	NA	NA	NA	NA	0.58	5.2E-06	1
Molybdenum	1.3E+01	1.0E-03	NA	NA	NA	NA	0.58	7.4E-09	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If $t_{event} < t^*$ then

$$DA_{event} = 2 \times FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}} \qquad \text{(eq 2)}$$

If $t_{event} > t^*$ then

$$DA_{event} = FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad \text{(eq 3)}$$

Notes:
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
NA - not applicable.

Table 7.6.RME Supplement B
Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical	Exposure Point Concentration Cwo (μg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (μg/l)	S (μg/m^3 -min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
1,2-Dichloroethane	4.1E-01	9.9E+01	9.8E-04	1.3E+03	1.3E+01	1.1E+01	1.4E+01	4.6E-02	3.9E-02	8.5E-06
Benzene	8.9E+01	7.8E+01	5.6E-03	1.4E+03	1.5E+01	1.4E+01	1.9E+01	1.3E+01	1.1E+01	2.4E-03
Chloroform	2.1E+00	1.2E+02	3.7E-03	1.2E+03	1.2E+01	1.1E+01	1.5E+01	2.5E-01	2.1E-01	4.6E-05
Tetrachloroethene	1.0E+00	1.7E+02	1.8E-02	9.9E+02	1.0E+01	1.0E+01	1.4E+01	1.1E-01	9.0E-02	2.0E-05
Trichloroethene	3.1E+03	1.3E+02	1.0E-02	1.1E+03	1.2E+01	1.1E+01	1.5E+01	3.7E+02	3.1E+02	6.8E-02
Vinyl chloride	1.7E+02	6.3E+01	2.7E-02	1.6E+03	1.7E+01	1.7E+01	2.2E+01	2.9E+01	2.4E+01	5.3E-03
cis-1,2-Dichloroethene	1.5E+03	9.7E+01	4.1E-03	1.3E+03	1.3E+01	1.3E+01	1.7E+01	2.0E+02	1.7E+02	3.7E-02
trans-1,2-Dichloroethene	1.5E+01	9.7E+01	9.4E-03	1.3E+03	1.3E+01	1.3E+01	1.8E+01	2.1E+00	1.7E+00	3.8E-04

Variables*	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	μg/l	Solved by Eq 5
sdt = shower droplet drop time	sec	0.5
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	10
SV = shower room air volume	m^3	12
S = indoor VOC generation rate	μg/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables*	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	30
Dt = total duration in shower room	min	60
R = air exchange rate	min^{-1}	0.0083
Ca = indoor air concentration of VOCs	μg/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	3000 * (18 / HH)$^{0.5}$	
Equation 2:	Kl(VOC) =	20 * (44 / HH)$^{0.5}$	
Equation 3:	KL =	((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))$^{-1}$	
Equation 4:	Kal =	(KL * (((Tl * Us) / (Ts * Ul))$^{-0.5}$))	
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))	
Equation 6:	S =	(Cwd * FR / SV)	
Equation 7:	see time series example on Table I-GW-5		
Equation 8:	Einh =	If t>Ds	(((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

* Values for variables are default EPA Region III values that have been provided by EPA on past projects.

TABLE 7.7.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	1,2-Dichloroethane	4.1E-01	ug/L	NA	NA	NA	NA	NA	2.6E-05	mg/kg/day	NA	mg/kg/day	NA
				Benzene	8.9E+01	ug/L	NA	NA	NA	NA	NA	5.7E-03	mg/kg/day	4.0E-03	mg/kg/day	1.4E+00
				Chloroform	2.1E+00	ug/L	NA	NA	NA	NA	NA	1.3E-04	mg/kg/day	1.0E-02	mg/kg/day	1.3E-02
				Tetrachloroethene	1.0E+00	ug/L	NA	NA	NA	NA	NA	6.4E-05	mg/kg/day	1.0E-02	mg/kg/day	6.4E-03
				Trichloroethene	3.1E+03	ug/L	NA	NA	NA	NA	NA	2.0E-01	mg/kg/day	6.0E-03	mg/kg/day	3.3E+01
				Vinyl chloride	1.7E+02	ug/L	NA	NA	NA	NA	NA	1.1E-02	mg/kg/day	3.0E-03	mg/kg/day	3.6E+00
				cis-1,2-Dichloroethene	1.5E+03	ug/L	NA	NA	NA	NA	NA	9.7E-02	mg/kg/day	1.0E-02	mg/kg/day	9.7E+00
				trans-1,2-Dichloroethene	1.5E+01	ug/L	NA	NA	NA	NA	NA	9.6E-04	mg/kg/day	2.0E-02	mg/kg/day	4.8E-02
				bis(2-Ethylhexyl)phthalate	1.7E+01	ug/L	NA	NA	NA	NA	NA	1.1E-03	mg/kg/day	2.0E-02	mg/kg/day	5.6E-02
				Heptachlor epoxide	3.3E-02	ug/L	NA	NA	NA	NA	NA	2.1E-06	mg/kg/day	1.3E-05	mg/kg/day	1.6E-01
				RDX	5.3E+00	ug/L	NA	NA	NA	NA	NA	3.4E-04	mg/kg/day	3.0E-03	mg/kg/day	1.1E-01
				Arsenic	4.0E+01	ug/L	NA	NA	NA	NA	NA	2.6E-03	mg/kg/day	3.0E-04	mg/kg/day	8.6E+00
				Iron	9.0E+03	ug/L	NA	NA	NA	NA	NA	5.7E-01	mg/kg/day	7.0E-01	mg/kg/day	8.2E-01
				Molybdenum	1.3E+01	ug/L	NA	NA	NA	NA	NA	8.1E-04	mg/kg/day	5.0E-03	mg/kg/day	1.6E-01
			Exp. Route Total								NA					5.8E+01
			Dermal Absorption	1,2-Dichloroethane	4.1E-01	ug/L	NA	NA	NA	NA	NA	1.3E-06	mg/kg/day	NA	mg/kg/day	NA
				Benzene	8.9E+01	ug/L	NA	NA	NA	NA	NA	8.7E-04	mg/kg/day	4.0E-03	mg/kg/day	2.2E-01
				Chloroform	2.1E+00	ug/L	NA	NA	NA	NA	NA	1.2E-05	mg/kg/day	1.0E-02	mg/kg/day	1.2E-03
				Tetrachloroethene	1.0E+00	ug/L	NA	NA	NA	NA	NA	3.7E-05	mg/kg/day	1.0E-02	mg/kg/day	3.7E-03
				Trichloroethene	3.1E+03	ug/L	NA	NA	NA	NA	NA	3.3E-02	mg/kg/day	6.0E-03	mg/kg/day	5.5E+00
				Vinyl chloride	1.7E+02	ug/L	NA	NA	NA	NA	NA	5.9E-04	mg/kg/day	3.0E-03	mg/kg/day	2.0E-01
				cis-1,2-Dichloroethene	1.5E+03	ug/L	NA	NA	NA	NA	NA	8.6E-03	mg/kg/day	1.0E-02	mg/kg/day	8.6E-01
				trans-1,2-Dichloroethene	1.5E+01	ug/L	NA	NA	NA	NA	NA	8.4E-05	mg/kg/day	2.0E-02	mg/kg/day	4.2E-03
				bis(2-Ethylhexyl)phthalate	1.7E+01	ug/L	NA	NA	NA	NA	NA	2.1E-03	mg/kg/day	2.0E-02	mg/kg/day	1.0E-01
				Heptachlor epoxide	3.3E-02	ug/L	NA	NA	NA	NA	NA	9.7E-07	mg/kg/day	1.3E-05	mg/kg/day	7.5E-02
				RDX	5.3E+00	ug/L	NA	NA	NA	NA	NA	8.6E-07	mg/kg/day	3.0E-03	mg/kg/day	2.9E-04
				Arsenic	4.0E+01	ug/L	NA	NA	NA	NA	NA	1.7E-05	mg/kg/day	3.0E-04	mg/kg/day	5.7E-02
				Iron	9.0E+03	ug/L	NA	NA	NA	NA	NA	3.8E-03	mg/kg/day	7.0E-01	mg/kg/day	5.4E-03
				Molybdenum	1.3E+01	ug/L	NA	NA	NA	NA	NA	5.4E-06	mg/kg/day	2.0E-04	mg/kg/day	2.7E-02
			Exp. Route Total								NA					7.0E+00
		Exposure Point Total									NA					6.5E+01
	Exposure Medium Total										NA					6.5E+01

TABLE 7.7.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Indoor Air	Inhalation													
				Benzene	2.6E-02	mg/m^3	NA	NA	NA	NA	NA	2.0E-02	mg/kg/day	8.6E-03	mg/kg/day	2.4E+00
				Bromoform	1.2E-06	mg/m^3	NA	NA	NA	NA	NA	8.9E-07	mg/kg/day	NA	NA	NA
				cis-1,2-dichloroethylene	5.0E-01	mg/m^3	NA	NA	NA	NA	NA	3.8E-01	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.1E-01	mg/m^3	NA	NA	NA	NA	NA	2.4E-01	mg/kg/day	5.0E-02	mg/kg/day	4.8E+00
				Cumene	1.2E-03	mg/m^3	NA	NA	NA	NA	NA	9.1E-04	mg/kg/day	1.1E-01	mg/kg/day	7.9E-03
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	4.8E+00	mg/m^3	NA	NA	NA	NA	NA	3.6E+00	mg/kg/day	8.6E+00	mg/kg/day	4.2E-01
				Trichloroethene	8.1E+00	mg/m^3	NA	NA	NA	NA	NA	6.2E+00	mg/kg/day	1.7E-01	mg/kg/day	3.6E+01
				Vinyl Chloride	6.6E-01	mg/m^3	NA	NA	NA	NA	NA	5.1E-01	mg/kg/day	2.8E-02	mg/kg/day	1.8E+01
			Exp. Route Total								NA					6.2E+01
		Exposure Point Total									NA					6.2E+01
	Exposure Medium Total										NA					6.2E+01
Medium Total											NA					1.3E+02
										Total of Receptor Risks Across All Media	NA				Total of Receptor Hazards Across All Media	1.3E+02

Notes-

NA = Not applicable

DAevent for exposure to groundwater while bathing is calculated on Table 7.7.RME Supplement A.

Table 7.7.RME Supplement A
Calculation of DAevent
Resident Adult Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
1,2-Dichloroethane	4.1E-01	4.2E-03	1.6E-02	3.8E-01	9.2E-01	1.0E+00	1	3.0E-09	3
Benzene	8.9E+01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	1	2.1E-06	3
Chloroform	2.1E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	1	2.8E-08	2
Tetrachloroethene	1.0E+00	3.3E-02	1.7E-01	9.1E-01	2.2E+00	1.0E+00	1	8.7E-08	2
Trichloroethene	3.1E+03	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	1	7.8E-05	2
Vinyl chloride	1.7E+02	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	1	1.4E-06	3
cis-1,2-Dichloroethene	1.5E+03	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	1	2.0E-05	3
trans-1,2-Dichloroethene	1.5E+01	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	1	2.0E-07	3
bis(2-Ethylhexyl)phthalate	1.7E+01	2.5E-02	1.9E-01	1.7E+01	4.0E+01	1.0E+00	1	4.9E-06	2
Heptachlor epoxide	3.3E-02	8.6E-03	6.4E-02	1.3E+01	3.2E+01	8.0E-01	1	2.3E-09	2
RDX	5.3E+00	1.0E-04	5.8E-04	1.9E+00	4.5E+00	1.0E+00	1	2.0E-09	2
Arsenic	4.0E+01	1.0E-03	NA	NA	NA	NA	1	4.0E-08	1
Iron	9.0E+03	1.0E-03	NA	NA	NA	NA	1	9.0E-06	1
Molybdenum	1.3E+01	1.0E-03	NA	NA	NA	NA	1	1.3E-08	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If $t_{event} < t^*$ then

$$DA_{event} = 2 \times FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}} \qquad \text{(eq 2)}$$

If $t_{event} > t^*$ then

$$DA_{event} = FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad \text{(eq 3)}$$

Notes:
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
NA - not applicable.

TABLE 7.8.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	1,2-Dichloroethane	4.1E-01	ug/L	6.1E-06	mg/kg/day	9.1E-02	NA	5.6E-07	NA	NA	NA	NA	NA
				Benzene	8.9E+01	ug/L	1.3E-03	mg/kg/day	5.5E-02	NA	7.3E-05	NA	NA	NA	NA	NA
				Chloroform	2.1E+00	ug/L	3.1E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Tetrachloroethene	1.0E+00	ug/L	1.5E-05	mg/kg/day	5.4E-01	NA	8.1E-06	NA	NA	NA	NA	NA
				Trichloroethene	3.1E+03	ug/L	4.6E-02	mg/kg/day	1.3E-02	NA	6.0E-04	NA	NA	NA	NA	NA
				Vinyl chloride	1.7E+02	ug/L	2.5E-03	mg/kg/day	1.4E+00	NA	3.6E-03	NA	NA	NA	NA	NA
				cis-1,2-Dichloroethene	1.5E+03	ug/L	2.3E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				trans-1,2-Dichloroethene	1.5E+01	ug/L	2.2E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				bis(2-Ethylhexyl)phthalate	1.7E+01	ug/L	2.6E-04	mg/kg/day	1.4E-02	NA	3.6E-06	NA	NA	NA	NA	NA
				Heptachlor epoxide	3.3E-02	ug/L	5.0E-07	mg/kg/day	9.1E+00	NA	4.5E-06	NA	NA	NA	NA	NA
				RDX	5.3E+00	ug/L	7.9E-05	mg/kg/day	1.1E-01	NA	8.7E-06	NA	NA	NA	NA	NA
				Arsenic	4.0E+01	ug/L	6.0E-04	mg/kg/day	1.5E+00	NA	9.1E-04	NA	NA	NA	NA	NA
				Iron	9.0E+03	ug/L	1.3E-01	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Molybdenum	1.3E+01	ug/L	1.9E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								5.2E-03					0.0E+00
			Dermal Absorption	1,2-Dichloroethane	4.1E-01	ug/L	3.0E-07	mg/kg/day	9.1E-02	NA	2.7E-08	NA	NA	NA	NA	NA
				Benzene	8.9E+01	ug/L	2.0E-04	mg/kg/day	5.5E-02	NA	1.1E-05	NA	NA	NA	NA	NA
				Chloroform	2.1E+00	ug/L	2.8E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Tetrachloroethene	1.0E+00	ug/L	8.7E-06	mg/kg/day	5.4E-01	NA	4.7E-06	NA	NA	NA	NA	NA
				Trichloroethene	3.1E+03	ug/L	7.8E-03	mg/kg/day	1.3E-02	NA	1.0E-04	NA	NA	NA	NA	NA
				Vinyl chloride	1.7E+02	ug/L	1.4E-04	mg/kg/day	7.2E-01	NA	9.8E-05	NA	NA	NA	NA	NA
				cis-1,2-Dichloroethene	1.5E+03	ug/L	2.0E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				trans-1,2-Dichloroethene	1.5E+01	ug/L	2.0E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				bis(2-Ethylhexyl)phthalate	1.7E+01	ug/L	4.9E-04	mg/kg/day	1.4E-02	NA	6.9E-06	NA	NA	NA	NA	NA
				Heptachlor epoxide	3.3E-02	ug/L	2.3E-07	mg/kg/day	9.1E+00	NA	2.1E-06	NA	NA	NA	NA	NA
				RDX	5.3E+00	ug/L	2.0E-07	mg/kg/day	1.1E-01	NA	2.3E-08	NA	NA	NA	NA	NA
				Arsenic	4.0E+01	ug/L	3.4E-06	mg/kg/day	1.5E+00	NA	5.2E-06	NA	NA	NA	NA	NA
				Iron	9.0E+03	ug/L	7.6E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Molybdenum	1.3E+01	ug/L	1.1E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								2.3E-04					NA
		Exposure Point Total									5.4E-03					NA
	Exposure Medium Total										5.4E-03					NA

TABLE 7.8.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Indoor Air	Inhalation													
				Benzene	2.6E-02	mg/m^3	4.2E-03	mg/kg/day	2.7E-02	1/mg/kg-day	1.1E-04	NA	NA	NA	NA	NA
				Bromoform	1.2E-06	mg/m^3	1.9E-07	mg/kg/day	3.9E-03	1/mg/kg-day	7.2E-10	NA	NA	NA	NA	NA
				cis-1,2-dichloroethylene	5.0E-01	mg/m^3	8.0E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.1E-01	mg/m^3	5.0E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Cumene	1.2E-03	mg/m^3	1.9E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	4.8E+00	mg/m^3	7.6E-01	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Trichloroethene	8.1E+00	mg/m^3	1.3E+00	mg/kg/day	7.0E-03	1/mg/kg-day	9.0E-03	NA	NA	NA	NA	NA
				Vinyl Chloride	6.6E-01	mg/m^3	1.1E-01	mg/kg/day	3.1E-02	1/mg/kg-day	3.3E-03	NA	NA	NA	NA	NA
			Exp. Route Total								1.2E-02					NA
		Exposure Point Total									1.2E-02					NA
	Exposure Medium Total										1.2E-02					NA
Medium Total											1.8E-02					NA
										Total of Receptor Risks Across All Media	1.8E-02			Total of Receptor Hazards Across All Media		NA

Notes-

NA = Not applicable

DAevent for exposure to groundwater while showering and bathing is calculated on Tables 7.5.RME Supplement A and 7.6.RME Supplement B.

TABLE 7.1.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Vapors from Shallow Groundwater	Building 13 Indoor Air	Inhalation	cis-1,2-Dichloroethylene	2.6E-02	mg/m3	6.2E-06	mg/kg/day	NA	NA	NA	4.8E-05	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	4.0E-04	mg/m3	9.8E-08	mg/kg/day	NA	NA	NA	7.6E-07	mg/kg/day	5.0E-02	mg/kg/day	1.5E-05
				Trichloroethene	1.6E+00	mg/m3	3.9E-04	mg/kg/day	7.0E-03	1/mg/kg-day	2.7E-06	3.0E-03	mg/kg/day	1.7E-01	mg/kg/day	1.8E-02
				Vinyl Chloride	6.0E-04	mg/m3	1.5E-07	mg/kg/day	1.5E-02	1/mg/kg-day	2.2E-09	1.1E-06	mg/kg/day	2.8E-02	mg/kg/day	4.0E-05
			Exp. Route Total								2.7E-06					1.8E-02
		Exposure Point Total									2.7E-06					1.8E-02
		Building 46 Indoor Air	Inhalation	Bromoform	3.8E-07	mg/m3	9.3E-11	mg/kg/day	3.9E-03	1/mg/kg-day	3.6E-13	7.2E-10	mg/kg/day	NA	NA	NA
				cis-1,2-Dichloroethylene	1.2E-04	mg/m3	2.8E-08	mg/kg/day	NA	NA	NA	2.2E-07	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	2.3E-02	mg/m3	5.5E-06	mg/kg/day	NA	NA	NA	4.3E-05	mg/kg/day	5.0E-02	mg/kg/day	8.5E-04
				Trichloroethene	4.0E-03	mg/m3	9.8E-07	mg/kg/day	7.0E-03	1/mg/kg-day	6.8E-09	7.6E-06	mg/kg/day	1.7E-01	mg/kg/day	4.5E-05
			Exp. Route Total								6.8E-09					9.0E-04
		Exposure Point Total									6.8E-09					9.0E-04
		Building 47 Indoor Air	Inhalation	Benzene	8.4E-06	mg/m3	7.4E-08	mg/kg/day	2.7E-02	1/mg/kg-day	2.0E-09	2.1E-07	mg/kg/day	8.6E-03	mg/kg/day	2.4E-05
				Bromoform	1.7E-07	mg/m3	1.5E-09	mg/kg/day	3.9E-03	1/mg/kg-day	5.9E-12	4.2E-09	mg/kg/day	NA	NA	NA
				cis-1,2-Dichloroethylene	2.9E-03	mg/m3	2.6E-05	mg/kg/day	NA	NA	NA	7.2E-05	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.5E-02	mg/m3	3.0E-04	mg/kg/day	NA	NA	NA	8.5E-04	mg/kg/day	5.0E-02	mg/kg/day	1.7E-02
				Cumene	1.3E-04	mg/m3	1.2E-06	mg/kg/day	NA	NA	NA	3.3E-06	mg/kg/day	1.1E-01	mg/kg/day	2.9E-05
				Trichloroethene	1.0E-02	mg/m3	8.9E-05	mg/kg/day	7.0E-03	1/mg/kg-day	6.2E-07	2.5E-04	mg/kg/day	1.7E-01	mg/kg/day	1.5E-03
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	3.8E-02	mg/m3	3.3E-04	mg/kg/day	NA	NA	NA	9.3E-04	mg/kg/day	8.6E+00	mg/kg/day	1.1E-04
				Vinyl Chloride	6.3E-02	mg/m3	5.6E-04	mg/kg/day	1.5E-02	1/mg/kg-day	8.5E-06	1.6E-03	mg/kg/day	2.8E-02	mg/kg/day	5.6E-02
			Exp. Route Total								9.2E-06					7.4E-02
		Exposure Point Total									9.2E-06					7.4E-02
		Building 54 Indoor Air	Inhalation	cis-1,2-Dichloroethylene	1.5E-02	mg/m3	1.3E-04	mg/kg/day	NA	NA	NA	1.0E-03	mg/kg/day	NA	NA	NA
				Trichloroethene	9.6E-01	mg/m3	8.4E-03	mg/kg/day	7.0E-03	1/mg/kg-day	5.9E-05	6.6E-02	mg/kg/day	1.7E-01	mg/kg/day	3.9E-01
				Vinyl Chloride	9.6E-04	mg/m3	8.5E-06	mg/kg/day	1.5E-02	1/mg/kg-day	1.3E-07	6.6E-05	mg/kg/day	2.8E-02	mg/kg/day	2.3E-03
			Exp. Route Total								5.9E-05					3.9E-01
		Exposure Point Total									5.9E-05					3.9E-01

TABLE 7.1.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
		Building 63 Indoor Air	Inhalation	Benzene	1.2E-05	mg/m3	2.8E-09	mg/kg/day	2.7E-02	1/mg/kg-day	7.6E-11	2.2E-08	mg/kg/day	8.6E-03	mg/kg/day	2.5E-06
				cis-1,2-Dichloroethylene	2.1E-03	mg/m3	5.1E-07	mg/kg/day	NA	NA	NA	4.0E-06	mg/kg/day	NA	NA	NA
				Trichloroethene	1.9E-02	mg/m3	4.6E-06	mg/kg/day	7.0E-03	1/mg/kg-day	3.2E-08	3.6E-05	mg/kg/day	1.7E-01	mg/kg/day	2.1E-04
				Vinyl Chloride	3.9E-03	mg/m3	9.4E-07	mg/kg/day	1.5E-02	1/mg/kg-day	1.4E-08	7.3E-06	mg/kg/day	2.8E-02	mg/kg/day	2.6E-04
			Exp. Route Total								4.7E-08					4.7E-04
		Exposure Point Total									4.7E-08					4.7E-04
		Building 90 Indoor Air	Inhalation	cis-1,2-Dichloroethylene	8.4E-03	mg/m3	2.0E-06	mg/kg/day	NA	NA	NA	1.6E-05	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	2.3E-02	mg/m3	5.7E-06	mg/kg/day	NA	NA	NA	4.4E-05	mg/kg/day	5.0E-02	mg/kg/day	8.8E-04
				Trichloroethene	1.8E-02	mg/m3	4.5E-06	mg/kg/day	7.0E-03	1/mg/kg-day	3.1E-08	3.5E-05	mg/kg/day	1.7E-01	mg/kg/day	2.0E-04
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	2.8E-02	mg/m3	6.7E-06	mg/kg/day	NA	NA	NA	5.2E-05	mg/kg/day	8.6E+00	mg/kg/day	6.1E-06
				Vinyl Chloride	5.6E-02	mg/m3	1.3E-05	mg/kg/day	1.5E-02	1/mg/kg-day	2.1E-07	1.0E-04	mg/kg/day	2.8E-02	mg/kg/day	3.7E-03
			Exp. Route Total								2.4E-07					4.8E-03
		Exposure Point Total									2.4E-07					4.8E-03
		Building 1556 Indoor Air	Inhalation	Benzene	1.0E-03	mg/m3	9.2E-06	mg/kg/day	2.7E-02	1/mg/kg-day	2.5E-07	7.1E-05	mg/kg/day	8.6E-03	mg/kg/day	8.3E-03
				Bromoform	8.6E-08	mg/m3	7.6E-10	mg/kg/day	3.9E-03	1/mg/kg-day	3.0E-12	5.9E-09	mg/kg/day	NA	NA	NA
				cis-1,2-Dichloroethylene	2.1E-02	mg/m3	1.8E-04	mg/kg/day	NA	NA	NA	1.4E-03	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.3E-04	mg/m3	2.9E-06	mg/kg/day	NA	NA	NA	2.3E-05	mg/kg/day	5.0E-02	mg/kg/day	4.5E-04
				Cumene	4.2E-05	mg/m3	3.7E-07	mg/kg/day	NA	NA	NA	2.9E-06	mg/kg/day	1.1E-01	mg/kg/day	2.5E-05
				Trichloroethene	3.2E-01	mg/m3	2.9E-03	mg/kg/day	7.0E-03	1/mg/kg-day	2.0E-05	2.2E-02	mg/kg/day	1.7E-01	mg/kg/day	1.3E-01
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	4.7E-04	mg/m3	4.2E-06	mg/kg/day	NA	NA	NA	3.2E-05	mg/kg/day	8.6E+00	mg/kg/day	3.8E-06
				Vinyl Chloride	5.5E-03	mg/m3	4.9E-05	mg/kg/day	1.5E-02	1/mg/kg-day	7.5E-07	3.8E-04	mg/kg/day	2.8E-02	mg/kg/day	1.3E-02
			Exp. Route Total								2.1E-05					1.5E-01
		Exposure Point Total									2.1E-05					1.5E-01
	Exposure Medium Total										9.2E-05					6.4E-01
Groundwater - Vapors from Shallow Groundwater Total											9.2E-05					6.4E-01
										Total of Receptor Risks Across All Media	9.2E-05				Total of Receptor Hazards Across All Media	6.4E-01

Notes-
NA = Not applicable

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Deep Groundwater	Tap Water	Ingestion	Chloroform	3.0E+00	ug/L	NA	NA	NA	NA	NA	5.8E-05	mg/kg/day	1.0E-02	mg/kg/day	5.8E-03
				1,3-Dinitrobenzene	1.1E+00	ug/L	NA	NA	NA	NA	NA	2.1E-05	mg/kg/day	1.0E-04	mg/kg/day	2.1E-01
				Arsenic	2.6E+01	ug/L	NA	NA	NA	NA	NA	5.0E-04	mg/kg/day	3.0E-04	mg/kg/day	1.7E+00
				Chromium	2.5E+01	ug/L	NA	NA	NA	NA	NA	4.7E-04	mg/kg/day	3.0E-03	mg/kg/day	1.6E-01
				Vanadium	1.8E+01	ug/L	NA	NA	NA	NA	NA	3.5E-04	mg/kg/day	1.0E-03	mg/kg/day	3.5E-01
			Exp. Route Total								NA					2.4E+00
			Dermal Absorption	Chloroform	3.0E+00	ug/L	NA	NA	NA	NA	NA	4.9E-06	mg/kg/day	1.0E-02	mg/kg/day	4.9E-04
				1,3-Dinitrobenzene	1.1E+00	ug/L	NA	NA	NA	NA	NA	6.3E-07	mg/kg/day	1.0E-04	mg/kg/day	6.3E-03
				Arsenic	2.6E+01	ug/L	NA	NA	NA	NA	NA	1.6E-06	mg/kg/day	3.0E-04	mg/kg/day	5.4E-03
				Chromium	2.5E+01	ug/L	NA	NA	NA	NA	NA	1.5E-06	mg/kg/day	7.5E-05	mg/kg/day	2.0E-02
				Vanadium	1.8E+01	ug/L	NA	NA	NA	NA	NA	1.1E-06	mg/kg/day	2.6E-05	mg/kg/day	4.4E-02
			Exp. Route Total								NA					7.6E-02
		Exposure Point Total									NA					2.5E+00
	Exposure Medium Total										NA					2.5E+00
	Air	Shower	Inhalation	Chloroform	3.0E+00	ug/L	8.2E-06	mg/kg/day	8.1E-02	1/mg/kg/day	6.6E-07	6.4E-05	mg/kg/day	1.4E-02	mg/kg/day	4.5E-03
			Exp. Route Total								6.6E-07					4.5E-03
		Exposure Point Total									6.6E-07					4.5E-03
	Exposure Medium Total										6.6E-07					4.5E-03
Medium Total											NA					2.5E+00
							Total of Receptor Risks Across All Media				NA	Total of Receptor Hazards Across All Media				2.5E+00

Notes-

NA = Not applicable

DAevent for exposure to groundwater while showering is calculated on Table 7.1.CTE Supplement A.

Shower exposure calculated on Table 7.1.RME Supplement C.

Table 7.2.CTE Supplement A
Calculation of DAevent
Resident Adult Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	3.0E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.25	2.0E-08	2
1,3-Dinitrobenzene	1.1E+00	1.7E-03	8.7E-03	9.2E-01	2.2E+00	1.0E+00	0.25	2.5E-09	2
Arsenic	2.6E+01	1.0E-03	NA	NA	NA	NA	0.25	6.5E-09	1
Chromium	2.5E+01	1.0E-03	NA	NA	NA	NA	0.25	6.1E-09	1
Vanadium	1.8E+01	1.0E-03	NA	NA	NA	NA	0.25	4.6E-09	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If t_{event} < t* then

$$DA_{event} = 2 \times FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}} \qquad \text{(eq 2)}$$

If t_{event} > t* then

$$DA_{event} = FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad \text{(eq 3)}$$

Notes:
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
NA - not applicable.

TABLE 7.3.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Deep Groundwater	Tap Water	Ingestion	Chloroform	3.0E+00	ug/L	NA	NA	NA	NA	NA	1.9E-04	mg/kg/day	1.0E-02	mg/kg/day	1.9E-02
				1,3-Dinitrobenzene	1.1E+00	ug/L	NA	NA	NA	NA	NA	7.0E-05	mg/kg/day	1.0E-04	mg/kg/day	7.0E-01
				Arsenic	2.6E+01	ug/L	NA	NA	NA	NA	NA	1.7E-03	mg/kg/day	3.0E-04	mg/kg/day	5.6E+00
				Chromium	2.5E+01	ug/L	NA	NA	NA	NA	NA	1.6E-03	mg/kg/day	3.0E-03	mg/kg/day	5.2E-01
				Vanadium	1.8E+01	ug/L	NA	NA	NA	NA	NA	1.2E-03	mg/kg/day	1.0E-03	mg/kg/day	1.2E+00
			Exp. Route Total								NA					8.0E+00
			Dermal Absorption	Chloroform	3.0E+00	ug/L	NA	NA	NA	NA	NA	9.7E-06	mg/kg/day	1.0E-02	mg/kg/day	9.7E-04
				1,3-Dinitrobenzene	1.1E+00	ug/L	NA	NA	NA	NA	NA	1.2E-06	mg/kg/day	1.0E-04	mg/kg/day	1.2E-02
				Arsenic	2.6E+01	ug/L	NA	NA	NA	NA	NA	3.6E-06	mg/kg/day	3.0E-04	mg/kg/day	1.2E-02
				Chromium	2.5E+01	ug/L	NA	NA	NA	NA	NA	3.4E-06	mg/kg/day	7.5E-05	mg/kg/day	4.5E-02
				Vanadium	1.8E+01	ug/L	NA	NA	NA	NA	NA	2.6E-06	mg/kg/day	2.6E-05	mg/kg/day	9.8E-02
			Exp. Route Total								NA					1.7E-01
		Exposure Point Total									NA					8.2E+00
	Exposure Medium Total										NA					8.2E+00
Medium Total											NA					8.2E+00
Total of Receptor Risks Across All Media											NA	Total of Receptor Hazards Across All Media				8.2E+00

Notes-

NA = Not applicable

DAevent for exposure to groundwater while showering is calculated on Table 7.2.CTE Supplement A.

Table 7.3.CTE Supplement A
Calculation of DAevent
Resident Adult Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Chloroform	3.0E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.33	2.3E-08	2
1,3-Dinitrobenzene	1.1E+00	1.7E-03	8.7E-03	9.2E-01	2.2E+00	1.0E+00	0.33	2.9E-09	2
Arsenic	2.6E+01	1.0E-03	NA	NA	NA	NA	0.33	8.6E-09	1
Chromium	2.5E+01	1.0E-03	NA	NA	NA	NA	0.33	8.1E-09	1
Vanadium	1.8E+01	1.0E-03	NA	NA	NA	NA	0.33	6.1E-09	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If $t_{event} < t^*$ then

$$DA_{event} = 2 \times FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}} \qquad \text{(eq 2)}$$

If $t_{event} > t^*$ then

$$DA_{event} = FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad \text{(eq 3)}$$

Notes:
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
NA - not applicable.

TABLE 7.4.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Deep Groundwater	Tap Water	Ingestion	Chloroform	3.0E+00	ug/L	2.4E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				1,3-Dinitrobenzene	1.1E+00	ug/L	8.7E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	2.6E+01	ug/L	2.1E-04	mg/kg/day	1.5E+00	1/mg/kg/day	3.1E-04	NA	NA	NA	NA	NA
				Chromium	2.5E+01	ug/L	1.9E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.8E+01	ug/L	1.5E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3.1E-04					0.0E+00
			Dermal Absorption	Chloroform	3.0E+00	ug/L	1.5E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				1,3-Dinitrobenzene	1.1E+00	ug/L	1.9E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	2.6E+01	ug/L	5.2E-07	mg/kg/day	1.5E+00	1/mg/kg/day	7.8E-07	NA	NA	NA	NA	NA
				Chromium	2.5E+01	ug/L	4.9E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.8E+01	ug/L	3.6E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								7.8E-07					NA
		Exposure Point Total									3.1E-04					NA
	Exposure Medium Total										3.1E-04					NA
Medium Total											3.1E-04					NA
							Total of Receptor Risks Across All Media				3.1E-04	Total of Receptor Hazards Across All Media				NA

Notes-

NA = Not applicable

DAevent for exposure to groundwater while showering and bathing is calculated on Tables 7.2.CTE Supplement A and 7.3.CTE Supplement B.

TABLE 7.5.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Construction Excavation	Dermal													
				1,2-Dichloroethane	4.1E-01	µg/L	5.5E-10	mg/kg/day	9.1E-02	1/mg/kg-day	5.0E-11	3.8E-08	mg/kg/day	NA	NA	NA
				Benzene	6.2E+01	µg/L	2.7E-07	mg/kg/day	5.5E-02	1/mg/kg-day	1.5E-08	1.9E-05	mg/kg/day	3.0E-03	mg/kg/day	6.3E-03
				Chloroform	2.1E+00	µg/L	4.9E-09	mg/kg/day	NA	NA	NA	3.5E-07	mg/kg/day	1.0E-02	mg/kg/day	3.5E-05
				Tetrachloroethene	1.0E+00	µg/L	1.4E-08	mg/kg/day	5.4E-01	1/mg/kg-day	7.7E-09	1.0E-06	mg/kg/day	1.0E-01	mg/kg/day	1.0E-05
				Trichloroethene	1.8E+03	µg/L	7.7E-06	mg/kg/day	1.3E-02	1/mg/kg-day	1.0E-07	5.4E-04	mg/kg/day	6.0E-03	mg/kg/day	9.0E-02
				Vinyl chloride	7.4E+01	µg/L	1.2E-07	mg/kg/day	7.2E-01	1/mg/kg-day	8.5E-08	8.3E-06	mg/kg/day	3.0E-03	mg/kg/day	2.8E-03
				cis-1,2-Dichloroethene	4.2E+02	µg/L	1.0E-06	mg/kg/day	NA	NA	NA	7.1E-05	mg/kg/day	1.0E-01	mg/kg/day	7.1E-04
				trans-1,2-Dichloroethene	1.5E+01	µg/L	3.6E-08	mg/kg/day	NA	NA	NA	2.5E-06	mg/kg/day	2.0E-01	mg/kg/day	1.3E-05
				bis(2-Ethylhexyl)phthalate	6.3E+00	µg/L	2.9E-07	mg/kg/day	1.4E-02	1/mg/kg-day	4.1E-09	2.1E-05	mg/kg/day	2.0E-02	mg/kg/day	1.0E-03
				Heptachlor epoxide	2.9E-02	µg/L	3.3E-10	mg/kg/day	9.1E+00	1/mg/kg-day	3.0E-09	2.3E-08	mg/kg/day	1.3E-05	mg/kg/day	1.8E-03
				RDX	1.5E+00	µg/L	9.4E-11	mg/kg/day	1.1E-01	1/mg/kg-day	1.0E-11	6.6E-09	mg/kg/day	3.0E-03	mg/kg/day	2.2E-06
				Arsenic	5.7E+00	µg/L	1.3E-09	mg/kg/day	1.5E+00	1/mg/kg-day	2.0E-09	9.3E-08	mg/kg/day	3.0E-04	mg/kg/day	3.1E-04
				Iron	5.4E+03	µg/L	8.8E-10	mg/kg/day	NA	NA	NA	8.8E-05	mg/kg/day	7.0E-01	mg/kg/day	1.3E-04
				Molybdenum	3.8E+00	µg/L	8.8E-10	mg/kg/day	NA	NA	NA	6.2E-08	mg/kg/day	2.0E-04	mg/kg/day	3.1E-04
			Exp. Route Total								2.2E-07					1.0E-01
		Exposure Point Total									2.2E-07					1.0E-01
	Exposure Medium Total										2.2E-07					1.0E-01
Groundwater	Air	Construction Excavation	Inhalation													
				1,2-Dichloroethane	4.1E-01	µg/L	3.2E-10	mg/kg/day	9.1E-02	1/mg/kg-day	2.9E-11	2.2E-08	mg/kg/day	7.0E-01	mg/kg/day	3.2E-08
				Benzene	6.2E+01	µg/L	6.7E-08	mg/kg/day	2.7E-02	1/mg/kg-day	1.8E-09	4.7E-06	mg/kg/day	1.7E-02	mg/kg/day	2.8E-04
				Chloroform	2.1E+00	µg/L	2.0E-09	mg/kg/day	8.1E-02	1/mg/kg-day	1.6E-10	1.4E-07	mg/kg/day	1.4E-02	mg/kg/day	1.0E-05
				Tetrachloroethene	1.0E+00	µg/L	9.0E-10	mg/kg/day	2.0E-02	1/mg/kg-day	1.8E-11	6.3E-08	mg/kg/day	8.0E-02	mg/kg/day	7.9E-07
				Trichloroethene	1.8E+03	µg/L	1.7E-06	mg/kg/day	7.0E-03	1/mg/kg-day	1.2E-08	1.2E-04	mg/kg/day	1.7E-01	mg/kg/day	6.9E-04
				Vinyl chloride	7.4E+01	µg/L	8.5E-08	mg/kg/day	3.1E-02	1/mg/kg-day	2.6E-09	5.9E-06	mg/kg/day	2.8E-02	mg/kg/day	2.1E-04
				cis-1,2-Dichloroethene	4.2E+02	µg/L	4.3E-07	mg/kg/day	NA	NA	NA	3.0E-05	mg/kg/day	NA	NA	NA
				trans-1,2-Dichloroethene	1.5E+01	µg/L	1.5E-08	mg/kg/day	NA	NA	NA	1.1E-06	mg/kg/day	1.7E-02	mg/kg/day	6.3E-05
			Exp. Route Total								1.6E-08					1.3E-03
		Exposure Point Total									1.6E-08					1.3E-03
	Exposure Medium Total										1.6E-08					1.3E-03
Groundwater - Shallow Groundwater in Excavation Total											2.3E-07					1.0E-01
										Total of Receptor Risks Across All Media	2.3E-07			Total of Receptor Hazards Across All Media		1.0E-01

Notes-
NA = Not applicable
Subcronic RfD values used when available

DAevent for exposure to shallow aquifer groundwater during excavation activities calculated on Table 7.5.CTE Supplement A.
EPC for inhalation of volatiles from shallow aquifer groundwater from excavation pit calculated on Table 7.5.CTE Supplement B.

Table 7.5.CTE Supplement A
Calculation of DAevent
Construction Worker
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
1,2-Dichloroethane	4.1E-01	4.2E-03	1.6E-02	3.8E-01	9.2E-01	1.0E+00	2.0E+00	4.7E-09	3
Benzene	6.2E+01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	2.0E+00	2.3E-06	3
Chloroform	2.1E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	2.0E+00	4.2E-08	3
Tetrachloroethene	1.0E+00	3.3E-02	1.7E-01	9.1E-01	2.2E+00	1.0E+00	2.0E+00	1.2E-07	2
Trichloroethene	1.8E+03	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	2.0E+00	6.6E-05	3
Vinyl chloride	7.4E+01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	2.0E+00	1.0E-06	3
cis-1,2-Dichloroethene	4.2E+02	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	2.0E+00	8.7E-06	3
trans-1,2-Dichloroethene	1.5E+01	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	2.0E+00	3.1E-07	3
bis(2-Ethylhexyl)phthalate	6.3E+00	2.5E-02	1.9E-01	1.7E+01	4.0E+01	1.0E+00	2.0E+00	2.5E-06	2
Heptachlor epoxide	2.9E-02	8.6E-03	6.4E-02	1.3E+01	3.2E+01	8.0E-01	2.0E+00	2.8E-09	2
RDX	1.5E+00	1.0E-04	5.8E-04	1.9E+00	4.5E+00	1.0E+00	2.0E+00	8.1E-10	2
Arsenic	5.7E+00	1.0E-03	NA	NA	NA	NA	2.0E+00	1.1E-08	1
Iron	5.4E+03	1.0E-03	NA	NA	NA	NA	2.0E+00	1.1E-05	1
Molybdenum	3.8E+00	1.0E-03	NA	NA	NA	NA	2.0E+00	7.6E-09	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If tevent<t*, then DAevent =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =
FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:
NA - Not applicable
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).
t* - Time to reach steady-state
trans-1,2-Dichloroethene values used as surrogate for cis-1,2-dichloroethene.
Heptachlor values used as surrogate for Heptachlor epoxide.

Table 7.5.CTE Supplement B
Inhalation of Volatiles from Groundwater During Construction Excavation
Inhalation Exposure Concentrations Calculated Using a Two-Film Volatilization Model
Future Construction Worker Senario
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical	Cw (μg/L)	MW (mol/gram)	KH (unitless)	kl (cm/hr)	kg (cm/hr)	Kv (cm/hr)	ER (mg/hr)	ERa (g/sec-m2)	Ca (mg/m3)
1,2-Dichloroethane	4.1E-01	1.9E+02	1.3E-02	2.8E+00	1.7E+03	2.5E+00	1.0E+00	1.1E-10	3.0E-06
Benzene	6.2E+01	7.8E+01	2.3E-01	3.5E+00	2.1E+03	3.5E+00	2.2E+02	2.2E-08	6.3E-04
Chloroform	2.1E+00	1.2E+02	1.5E-01	3.2E+00	1.9E+03	3.1E+00	6.6E+00	6.8E-10	1.9E-05
Tetrachloroethene	1.0E+00	1.7E+02	7.5E-01	2.9E+00	1.8E+03	2.9E+00	2.9E+00	3.0E-10	8.5E-06
Trichloroethene	1.8E+03	1.3E+02	4.2E-01	3.1E+00	1.9E+03	3.1E+00	5.4E+03	5.6E-07	1.6E-02
Vinyl chloride	7.4E+01	6.3E+01	1.1E+00	3.7E+00	2.3E+03	3.7E+00	2.7E+02	2.8E-08	8.0E-04
cis-1,2-Dichloroethene	4.2E+02	9.7E+01	1.7E-01	3.3E+00	2.0E+03	3.3E+00	1.4E+03	1.4E-07	4.0E-03
trans-1,2-Dichloroethene	1.5E+01	9.7E+01	3.9E-01	3.3E+00	2.0E+03	3.3E+00	5.0E+01	5.1E-09	1.5E-04

Equations

Equation 1	$Kv = 1/(1/k_l + 1/K_H{*}K_g)$
Equation 2	$k_g = 700(18/MW)^{1/4}V$
Equation 3	$k_l = (32/MW)^{1/4}Ka'$
Equation 4	$ER = Kv * Cw * L/1000\ cm^3 * mg/1000\ \mu g$
Equation 5	$ERa = ER * g/1000\ mg * hr/60\ min * min/60\ sec * 1/A$

Variables	Units	Exposure Assumptions
Cw = groundwater concentration	(μg/L)	chem-specific
MW = molecular weight	(mol/gram)	chem-specific
K_H - Henry's Law Constant	(unitless)	chem-specific
Kv = volatilization rate	(cm/hr)	Solved by Eq 1
k_g = gas phase transfer coefficient	(cm/hr)	Solved by Eq 2
k_l = liquid phase transfer coefficient	(cm/hr)	Solved by Eq 3
V = wind speed	(m/s)	4.4
Ka' = aeration rate	(cm/hr)	0.0633
ER = emission rate	(mg/hr)	Solved by Eq 4
A = area of excavation (utility ditch)	(m^2)	2,700
Era = area emission rate	(g/sec-m^2)	Solved by Eq 5
Ca = air concentration	(mg/m^3)	Solved using SCREEN3 model

Note: aeration rate based on aeration rate for small pond (0.1/day) multiplied by depth of water in excavation (1/2 ft)

TABLE 7.6.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	1,2-Dichloroethane	4.1E-01	ug/L	NA	NA	NA	NA	NA	7.9E-06	mg/kg/day	NA	mg/kg/day	NA
				Benzene	6.2E+01	ug/L	NA	NA	NA	NA	NA	1.2E-03	mg/kg/day	4.0E-03	mg/kg/day	3.0E-01
				Chloroform	2.1E+00	ug/L	NA	NA	NA	NA	NA	4.0E-05	mg/kg/day	1.0E-02	mg/kg/day	4.0E-03
				Tetrachloroethene	1.0E+00	ug/L	NA	NA	NA	NA	NA	1.9E-05	mg/kg/day	1.0E-02	mg/kg/day	1.9E-03
				Trichloroethene	1.8E+03	ug/L	NA	NA	NA	NA	NA	3.4E-02	mg/kg/day	6.0E-03	mg/kg/day	5.6E+00
				Vinyl chloride	7.4E+01	ug/L	NA	NA	NA	NA	NA	1.4E-03	mg/kg/day	3.0E-03	mg/kg/day	4.7E-01
				cis-1,2-Dichloroethene	4.2E+02	ug/L	NA	NA	NA	NA	NA	8.0E-03	mg/kg/day	1.0E-02	mg/kg/day	8.0E-01
				trans-1,2-Dichloroethene	1.5E+01	ug/L	NA	NA	NA	NA	NA	2.9E-04	mg/kg/day	2.0E-02	mg/kg/day	1.4E-02
				bis(2-Ethylhexyl)phthalate	6.3E+00	ug/L	NA	NA	NA	NA	NA	1.2E-04	mg/kg/day	2.0E-02	mg/kg/day	6.1E-03
				Heptachlor epoxide	2.9E-02	ug/L	NA	NA	NA	NA	NA	5.5E-07	mg/kg/day	1.3E-05	mg/kg/day	4.2E-02
				RDX	1.5E+00	ug/L	NA	NA	NA	NA	NA	2.8E-05	mg/kg/day	3.0E-03	mg/kg/day	9.5E-03
				Arsenic	5.7E+00	ug/L	NA	NA	NA	NA	NA	1.1E-04	mg/kg/day	3.0E-04	mg/kg/day	3.7E-01
				Iron	5.4E+03	ug/L	NA	NA	NA	NA	NA	1.0E-01	mg/kg/day	7.0E-01	mg/kg/day	1.5E-01
				Molybdenum	3.8E+00	ug/L	NA	NA	NA	NA	NA	7.3E-05	mg/kg/day	5.0E-03	mg/kg/day	1.5E-02
			Exp. Route Total								NA					7.8E+00
			Dermal Absorption	1,2-Dichloroethane	4.1E-01	ug/L	NA	NA	NA	NA	NA	3.6E-07	mg/kg/day	NA	mg/kg/day	NA
				Benzene	6.2E+01	ug/L	NA	NA	NA	NA	NA	1.7E-04	mg/kg/day	4.0E-03	mg/kg/day	4.3E-02
				Chloroform	2.1E+00	ug/L	NA	NA	NA	NA	NA	3.4E-06	mg/kg/day	1.0E-02	mg/kg/day	3.4E-04
				Tetrachloroethene	1.0E+00	ug/L	NA	NA	NA	NA	NA	1.1E-05	mg/kg/day	1.0E-02	mg/kg/day	1.1E-03
				Trichloroethene	1.8E+03	ug/L	NA	NA	NA	NA	NA	5.5E-03	mg/kg/day	6.0E-03	mg/kg/day	9.2E-01
				Vinyl chloride	7.4E+01	ug/L	NA	NA	NA	NA	NA	6.9E-05	mg/kg/day	3.0E-03	mg/kg/day	2.3E-02
				cis-1,2-Dichloroethene	4.2E+02	ug/L	NA	NA	NA	NA	NA	6.7E-04	mg/kg/day	1.0E-02	mg/kg/day	6.7E-02
				trans-1,2-Dichloroethene	1.5E+01	ug/L	NA	NA	NA	NA	NA	2.4E-05	mg/kg/day	2.0E-02	mg/kg/day	1.2E-03
				bis(2-Ethylhexyl)phthalate	6.3E+00	ug/L	NA	NA	NA	NA	NA	2.2E-04	mg/kg/day	2.0E-02	mg/kg/day	1.1E-02
				Heptachlor epoxide	2.9E-02	ug/L	NA	NA	NA	NA	NA	2.5E-07	mg/kg/day	1.3E-05	mg/kg/day	1.9E-02
				RDX	1.5E+00	ug/L	NA	NA	NA	NA	NA	7.0E-08	mg/kg/day	3.0E-03	mg/kg/day	2.3E-05
				Arsenic	5.7E+00	ug/L	NA	NA	NA	NA	NA	3.5E-07	mg/kg/day	3.0E-04	mg/kg/day	1.2E-03
				Iron	5.4E+03	ug/L	NA	NA	NA	NA	NA	3.3E-04	mg/kg/day	7.0E-01	mg/kg/day	4.7E-04
				Molybdenum	3.8E+00	ug/L	NA	NA	NA	NA	NA	2.3E-07	mg/kg/day	2.0E-04	mg/kg/day	1.2E-03
			Exp. Route Total								NA					1.1E+00
		Exposure Point Total									NA					8.9E+00
	Exposure Medium Total										NA					8.9E+00

TABLE 7.6.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Shower	Inhalation	1,2-Dichloroethane	4.1E-01	ug/L	2.8E-06	mg/kg/day	9.1E-02	1/mg/kg/day	2.5E-07	8.2E-06	mg/kg/day	7.0E-01	mg/kg/day	1.2E-05
				Benzene	8.9E+01	ug/L	8.0E-04	mg/kg/day	2.7E-02	1/mg/kg/day	2.2E-05	2.3E-03	mg/kg/day	8.6E-03	mg/kg/day	2.7E-01
				Chloroform	2.1E+00	ug/L	1.5E-05	mg/kg/day	8.1E-02	1/mg/kg/day	1.2E-06	4.5E-05	mg/kg/day	1.4E-02	mg/kg/day	3.2E-03
				Tetrachloroethene	1.0E+00	ug/L	6.5E-06	mg/kg/day	2.0E-02	1/mg/kg/day	1.3E-07	1.9E-05	mg/kg/day	8.0E-02	mg/kg/day	2.4E-04
				Trichloroethene	3.1E+03	ug/L	2.2E-02	mg/kg/day	7.0E-03	1/mg/kg/day	1.6E-04	6.5E-02	mg/kg/day	1.7E-01	mg/kg/day	3.8E-01
				Vinyl chloride	1.7E+02	ug/L	1.7E-03	mg/kg/day	3.1E-02	1/mg/kg/day	5.4E-05	5.1E-03	mg/kg/day	2.8E-02	mg/kg/day	1.8E-01
				cis-1,2-Dichloroethene	1.5E+03	ug/L	1.2E-02	mg/kg/day	NA	1/mg/kg/day	NA	3.6E-02	mg/kg/day	NA	NA	NA
				trans-1,2-Dichloroethene	1.5E+01	ug/L	1.2E-04	mg/kg/day	NA	1/mg/kg/day	NA	3.6E-04	mg/kg/day	1.7E-02	mg/kg/day	2.1E-02
			Exp. Route Total								2.3E-04					8.6E-01
		Exposure Point Total									2.3E-04					8.6E-01
	Exposure Medium Total										2.3E-04					8.6E-01
	Air	Indoor Air	Inhalation													
				Benzene	2.6E-02	mg/m3	NA	NA	NA	NA	NA	2.7E-03	mg/kg/day	8.6E-03	mg/kg/day	3.1E-01
				Bromoform	1.2E-06	mg/m3	NA	NA	NA	NA	NA	1.2E-07	mg/kg/day	NA	NA	NA
				cis-1,2-dichloroethylene	5.0E-01	mg/m3	NA	NA	NA	NA	NA	5.1E-02	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.1E-01	mg/m3	NA	NA	NA	NA	NA	3.2E-02	mg/kg/day	5.0E-02	mg/kg/day	6.4E-01
				Cumene	1.2E-03	mg/m3	NA	NA	NA	NA	NA	1.2E-04	mg/kg/day	1.1E-01	mg/kg/day	1.1E-03
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	4.8E+00	mg/m3	NA	NA	NA	NA	NA	4.9E-01	mg/kg/day	8.6E+00	mg/kg/day	5.7E-02
				Trichloroethene	8.1E+00	mg/m3	NA	NA	NA	NA	NA	8.3E-01	mg/kg/day	1.7E-01	mg/kg/day	4.9E+00
				Vinyl Chloride	6.6E-01	mg/m3	NA	NA	NA	NA	NA	6.8E-02	mg/kg/day	2.8E-02	mg/kg/day	2.4E+00
			Exp. Route Total								NA					8.3E+00
		Exposure Point Total									NA					8.3E+00
	Exposure Medium Total										NA					8.3E+00
Medium Total											2.3E-04					1.8E+01
										Total of Receptor Risks Across All Media	2.3E-04				Total of Receptor Hazards Across All Media	1.8E+01

Notes-
NA = Not applicable
DAevent for exposure to groundwater while showering is calculated on Table 7.5.CTE Supplement A.
Shower exposure calculated on Table 7.6.RME Supplement B.

Table 7.6.CTE Supplement A
Calculation of DAevent
Resident Adult Shallow Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
1,2-Dichloroethane	4.1E-01	4.2E-03	1.6E-02	3.8E-01	9.2E-01	1.0E+00	0.25	1.5E-09	2
Benzene	6.2E+01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	0.25	6.9E-07	2
Chloroform	2.1E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.25	1.4E-08	2
Tetrachloroethene	1.0E+00	3.3E-02	1.7E-01	9.1E-01	2.2E+00	1.0E+00	0.25	4.4E-08	2
Trichloroethene	1.8E+03	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	0.25	2.2E-05	2
Vinyl chloride	7.4E+01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.25	2.8E-07	2
cis-1,2-Dichloroethene	4.2E+02	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	0.25	2.7E-06	2
trans-1,2-Dichloroethene	1.5E+01	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	0.25	9.7E-08	2
bis(2-Ethylhexyl)phthalate	6.3E+00	2.5E-02	1.9E-01	1.7E+01	4.0E+01	1.0E+00	0.25	8.9E-07	2
Heptachlor epoxide	2.9E-02	8.6E-03	6.4E-02	1.3E+01	3.2E+01	8.0E-01	0.25	1.0E-09	2
RDX	1.5E+00	1.0E-04	5.8E-04	1.9E+00	4.5E+00	1.0E+00	0.25	2.8E-10	2
Arsenic	5.7E+00	1.0E-03	NA	NA	NA	NA	0.25	1.4E-09	1
Iron	5.4E+03	1.0E-03	NA	NA	NA	NA	0.25	1.3E-06	1
Molybdenum	3.8E+00	1.0E-03	NA	NA	NA	NA	0.25	9.5E-10	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If $t_{event} < t^*$ then

$$DA_{event} = 2 \times FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}} \qquad \text{(eq 2)}$$

If $t_{event} > t^*$ then

$$DA_{event} = FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad \text{(eq 3)}$$

Notes:
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
NA - not applicable.

TABLE 7.7.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	1,2-Dichloroethane	4.1E-01	ug/L	NA	NA	NA	NA	NA	2.6E-05	mg/kg/day	NA	NA	NA
				Benzene	6.2E+01	ug/L	NA	NA	NA	NA	NA	4.0E-03	mg/kg/day	4.0E-03	mg/kg/day	9.9E-01
				Chloroform	2.1E+00	ug/L	NA	NA	NA	NA	NA	1.3E-04	mg/kg/day	1.0E-02	mg/kg/day	1.3E-02
				Tetrachloroethene	1.0E+00	ug/L	NA	NA	NA	NA	NA	6.4E-05	mg/kg/day	1.0E-02	mg/kg/day	6.4E-03
				Trichloroethene	1.8E+03	ug/L	NA	NA	NA	NA	NA	1.1E-01	mg/kg/day	6.0E-03	mg/kg/day	1.9E+01
				Vinyl chloride	7.4E+01	ug/L	NA	NA	NA	NA	NA	4.7E-03	mg/kg/day	3.0E-03	mg/kg/day	1.6E+00
				cis-1,2-Dichloroethene	4.2E+02	ug/L	NA	NA	NA	NA	NA	2.7E-02	mg/kg/day	1.0E-02	mg/kg/day	2.7E+00
				trans-1,2-Dichloroethene	1.5E+01	ug/L	NA	NA	NA	NA	NA	9.6E-04	mg/kg/day	2.0E-02	mg/kg/day	4.8E-02
				bis(2-Ethylhexyl)phthalate	6.3E+00	ug/L	NA	NA	NA	NA	NA	4.0E-04	mg/kg/day	2.0E-02	mg/kg/day	2.0E-02
				Heptachlor epoxide	2.9E-02	ug/L	NA	NA	NA	NA	NA	1.8E-06	mg/kg/day	1.3E-05	mg/kg/day	1.4E-01
				RDX	1.5E+00	ug/L	NA	NA	NA	NA	NA	9.5E-05	mg/kg/day	3.0E-03	mg/kg/day	3.2E-02
				Arsenic	5.7E+00	ug/L	NA	NA	NA	NA	NA	3.7E-04	mg/kg/day	3.0E-04	mg/kg/day	1.2E+00
				Iron	5.4E+03	ug/L	NA	NA	NA	NA	NA	3.4E-01	mg/kg/day	7.0E-01	mg/kg/day	4.9E-01
				Molybdenum	3.8E+00	ug/L	NA	NA	NA	NA	NA	2.4E-04	mg/kg/day	5.0E-03	mg/kg/day	4.9E-02
			Exp. Route Total								NA					2.6E+01
			Dermal Absorption	1,2-Dichloroethane	4.1E-01	ug/L	NA	NA	NA	NA	NA	8.0E-07	mg/kg/day	NA	mg/kg/day	NA
				Benzene	6.2E+01	ug/L	NA	NA	NA	NA	NA	3.6E-04	mg/kg/day	4.0E-03	mg/kg/day	9.0E-02
				Chloroform	2.1E+00	ug/L	NA	NA	NA	NA	NA	6.8E-06	mg/kg/day	1.0E-02	mg/kg/day	6.8E-04
				Tetrachloroethene	1.0E+00	ug/L	NA	NA	NA	NA	NA	2.1E-05	mg/kg/day	1.0E-02	mg/kg/day	2.1E-03
				Trichloroethene	1.8E+03	ug/L	NA	NA	NA	NA	NA	1.1E-02	mg/kg/day	6.0E-03	mg/kg/day	1.8E+00
				Vinyl chloride	7.4E+01	ug/L	NA	NA	NA	NA	NA	1.4E-04	mg/kg/day	3.0E-03	mg/kg/day	4.7E-02
				cis-1,2-Dichloroethene	4.2E+02	ug/L	NA	NA	NA	NA	NA	1.5E-03	mg/kg/day	1.0E-02	mg/kg/day	1.5E-01
				trans-1,2-Dichloroethene	1.5E+01	ug/L	NA	NA	NA	NA	NA	5.3E-05	mg/kg/day	2.0E-02	mg/kg/day	2.6E-03
				bis(2-Ethylhexyl)phthalate	6.3E+00	ug/L	NA	NA	NA	NA	NA	4.3E-04	mg/kg/day	2.0E-02	mg/kg/day	2.2E-02
				Heptachlor epoxide	2.9E-02	ug/L	NA	NA	NA	NA	NA	4.8E-07	mg/kg/day	1.3E-05	mg/kg/day	3.7E-02
				RDX	1.5E+00	ug/L	NA	NA	NA	NA	NA	1.4E-07	mg/kg/day	3.0E-03	mg/kg/day	4.6E-05
				Arsenic	5.7E+00	ug/L	NA	NA	NA	NA	NA	8.0E-07	mg/kg/day	3.0E-04	mg/kg/day	2.7E-03
				Iron	5.4E+03	ug/L	NA	NA	NA	NA	NA	7.5E-04	mg/kg/day	7.0E-01	mg/kg/day	1.1E-03
				Molybdenum	3.8E+00	ug/L	NA	NA	NA	NA	NA	5.3E-07	mg/kg/day	2.0E-04	mg/kg/day	2.6E-03
			Exp. Route Total								NA					2.2E+00
		Exposure Point Total									NA					2.8E+01
	Exposure Medium Total										NA					2.8E+01

TABLE 7.7.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Indoor Air	Inhalation													
				Benzene	2.6E-02	mg/m3	NA	NA	NA	NA	NA	2.0E-02	mg/kg/day	8.6E-03	mg/kg/day	2.4E+00
				Bromoform	1.2E-06	mg/m3	NA	NA	NA	NA	NA	8.9E-07	mg/kg/day	NA	NA	NA
				cis-1,2-dichloroethylene	5.0E-01	mg/m3	NA	NA	NA	NA	NA	3.8E-01	mg/kg/day	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.1E-01	mg/m3	NA	NA	NA	NA	NA	2.4E-01	mg/kg/day	5.0E-02	mg/kg/day	4.8E+00
				Cumene	1.2E-03	mg/m3	NA	NA	NA	NA	NA	9.1E-04	mg/kg/day	1.1E-01	mg/kg/day	7.9E-03
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	4.8E+00	mg/m3	NA	NA	NA	NA	NA	3.6E+00	mg/kg/day	8.6E+00	mg/kg/day	4.2E-01
				Trichloroethene	8.1E+00	mg/m3	NA	NA	NA	NA	NA	6.2E+00	mg/kg/day	1.7E-01	mg/kg/day	3.6E+01
				Vinyl Chloride	6.6E-01	mg/m3	NA	NA	NA	NA	NA	5.1E-01	mg/kg/day	2.8E-02	mg/kg/day	1.8E+01
			Exp. Route Total								NA					6.2E+01
		Exposure Point Total									NA					6.2E+01
	Exposure Medium Total										NA					6.2E+01
Medium Total											NA					9.0E+01
							Total of Receptor Risks Across All Media				NA	Total of Receptor Hazards Across All Media				9.0E+01

Notes-

NA = Not applicable

DAevent for exposure to groundwater while bathing is calculated on Table 7.7.CTE Supplement A.

Table 7.7.CTE Supplement A
Calculation of DAevent
Resident Adult Ground Water
Site 21 Remedial Investigation Report
St. Juliens Creek Annex
Chesapeake, Virginia

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
1,2-Dichloroethane	4.1E-01	4.2E-03	1.6E-02	3.8E-01	9.2E-01	1.0E+00	0.33	1.9E-09	2
Benzene	6.2E+01	1.5E-02	5.1E-02	2.9E-01	7.0E-01	1.0E+00	0.33	8.6E-07	2
Chloroform	2.1E+00	6.8E-03	2.9E-02	5.0E-01	1.2E+00	1.0E+00	0.33	1.6E-08	2
Tetrachloroethene	1.0E+00	3.3E-02	1.7E-01	9.1E-01	2.2E+00	1.0E+00	0.33	5.0E-08	2
Trichloroethene	1.8E+03	1.2E-02	5.1E-02	5.8E-01	1.4E+00	1.0E+00	0.33	2.6E-05	2
Vinyl chloride	7.4E+01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.33	3.4E-07	2
cis-1,2-Dichloroethene	4.2E+02	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	0.33	3.5E-06	2
trans-1,2-Dichloroethene	1.5E+01	7.7E-03	2.9E-02	3.7E-01	8.9E-01	1.0E+00	0.33	1.2E-07	2
bis(2-Ethylhexyl)phthalate	6.3E+00	2.5E-02	1.9E-01	1.7E+01	4.0E+01	1.0E+00	0.33	1.0E-06	2
Heptachlor epoxide	2.9E-02	8.6E-03	6.4E-02	1.3E+01	3.2E+01	8.0E-01	0.33	1.1E-09	2
RDX	1.5E+00	1.0E-04	5.8E-04	1.9E+00	4.5E+00	1.0E+00	0.33	3.3E-10	2
Arsenic	5.7E+00	1.0E-03	NA	NA	NA	NA	0.33	1.9E-09	1
Iron	5.4E+03	1.0E-03	NA	NA	NA	NA	0.33	1.8E-06	1
Molybdenum	3.8E+00	1.0E-03	NA	NA	NA	NA	0.33	1.3E-09	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If $t_{event} < t^*$ then

$$DA_{event} = 2 \times FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}} \qquad \text{(eq 2)}$$

If $t_{event} > t^*$ then

$$DA_{event} = FA \times K_p \times C_w \times 0.001 \quad mg/ug \times 0.001 \quad l/cm^3 \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad \text{(eq 3)}$$

Notes:
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
NA - not applicable

TABLE 7.8.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21, ST. JULIEN'S CREEK ANNEX, CHESAPEAKE, VIRGINIA

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	1,2-Dichloroethane	4.1E-01	ug/L	3.3E-06	mg/kg/day	9.1E-02	1/mg/kg-day	3.0E-07	NA	NA	NA	NA	NA
				Benzene	6.2E+01	ug/L	4.9E-04	mg/kg/day	5.5E-02	1/mg/kg-day	2.7E-05	NA	NA	NA	NA	NA
				Chloroform	2.1E+00	ug/L	1.7E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Tetrachloroethene	1.0E+00	ug/L	7.9E-06	mg/kg/day	5.4E-01	1/mg/kg-day	4.3E-06	NA	NA	NA	NA	NA
				Trichloroethene	1.8E+03	ug/L	1.4E-02	mg/kg/day	1.3E-02	1/mg/kg-day	1.8E-04	NA	NA	NA	NA	NA
				Vinyl chloride	7.4E+01	ug/L	5.9E-04	mg/kg/day	1.4E+00	1/mg/kg-day	8.2E-04	NA	NA	NA	NA	NA
				cis-1,2-Dichloroethene	4.2E+02	ug/L	3.3E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				trans-1,2-Dichloroethene	1.5E+01	ug/L	1.2E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				bis(2-Ethylhexyl)phthalate	6.3E+00	ug/L	5.0E-05	mg/kg/day	1.4E-02	1/mg/kg-day	7.0E-07	NA	NA	NA	NA	NA
				Heptachlor epoxide	2.9E-02	ug/L	2.3E-07	mg/kg/day	9.1E+00	1/mg/kg-day	2.1E-06	NA	NA	NA	NA	NA
				RDX	1.5E+00	ug/L	1.2E-05	mg/kg/day	1.1E-01	1/mg/kg-day	1.3E-06	NA	NA	NA	NA	NA
				Arsenic	5.7E+00	ug/L	4.6E-05	mg/kg/day	1.5E+00	1/mg/kg-day	6.8E-05	NA	NA	NA	NA	NA
				Iron	5.4E+03	ug/L	4.3E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Molybdenum	3.8E+00	ug/L	3.0E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								1.1E-03					0.0E+00
			Dermal Absorption	1,2-Dichloroethane	4.1E-01	ug/L	1.2E-07	mg/kg/day	9.1E-02	1/mg/kg-day	1.0E-08	NA	NA	NA	NA	NA
				Benzene	6.2E+01	ug/L	5.3E-05	mg/kg/day	5.5E-02	1/mg/kg-day	2.9E-06	NA	NA	NA	NA	NA
				Chloroform	2.1E+00	ug/L	1.0E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Tetrachloroethene	1.0E+00	ug/L	3.2E-06	mg/kg/day	5.4E-01	1/mg/kg-day	1.7E-06	NA	NA	NA	NA	NA
				Trichloroethene	1.8E+03	ug/L	1.6E-03	mg/kg/day	1.3E-02	1/mg/kg-day	2.1E-05	NA	NA	NA	NA	NA
				Vinyl chloride	7.4E+01	ug/L	2.1E-05	mg/kg/day	7.2E-01	1/mg/kg-day	1.5E-05	NA	NA	NA	NA	NA
				cis-1,2-Dichloroethene	4.2E+02	ug/L	2.1E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				trans-1,2-Dichloroethene	1.5E+01	ug/L	7.6E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				bis(2-Ethylhexyl)phthalate	6.3E+00	ug/L	6.5E-05	mg/kg/day	1.4E-02	1/mg/kg-day	9.2E-07	NA	NA	NA	NA	NA
				Heptachlor epoxide	2.9E-02	ug/L	7.3E-08	mg/kg/day	9.1E+00	1/mg/kg-day	6.6E-07	NA	NA	NA	NA	NA
				RDX	1.5E+00	ug/L	2.1E-08	mg/kg/day	1.1E-01	1/mg/kg-day	2.3E-09	NA	NA	NA	NA	NA
				Arsenic	5.7E+00	ug/L	1.1E-07	mg/kg/day	1.5E+00	1/mg/kg-day	1.7E-07	NA	NA	NA	NA	NA
				Iron	5.4E+03	ug/L	1.1E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Molybdenum	3.8E+00	ug/L	7.5E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								4.3E-05					NA
		Exposure Point Total									1.2E-03					NA
	Exposure Medium Total										1.2E-03					NA

TABLE 7.8.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 21, ST. JULIEN'S CREEK ANNEX, CHESAPEAKE, VIRGINIA

SITE 21 REMEDIAL INVESTIGATION REPORT

ST. JULIENS CREEK ANNEX

CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Indoor Air	Inhalation													
				Benzene	2.6E-05	mg/m3	2.7E-06	mg/kg/day	2.7E-02	1/mg/kg-day	7.2E-08	NA	NA	NA	NA	NA
				Bromoform	1.2E-09	mg/m3	1.2E-10	mg/kg/day	3.9E-03	1/mg/kg-day	4.6E-13	NA	NA	NA	NA	NA
				cis-1,2-dichloroethylene	5.0E-04	mg/m3	5.1E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Dichlorodifluoromethane (Freon 12)	3.1E-04	mg/m3	3.1E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Cumene	1.2E-06	mg/m3	1.2E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	4.8E-03	mg/m3	4.8E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Trichloroethene	8.1E-03	mg/m3	8.2E-04	mg/kg/day	7.0E-03	1/mg/kg-day	5.7E-06	NA	NA	NA	NA	NA
				Vinyl Chloride	6.6E-04	mg/m3	6.7E-05	mg/kg/day	3.1E-02	1/mg/kg-day	2.1E-06	NA	NA	NA	NA	NA
			Exp. Route Total								7.8E-06					NA
		Exposure Point Total									7.8E-06					NA
	Exposure Medium Total										7.8E-06					NA
Medium Total											1.2E-03					NA
										Total of Receptor Risks Across All Media	1.2E-03			Total of Receptor Hazards Across All Media		NA

Notes-

NA = Not applicable

DAevent for exposure to groundwater while showering and bathing is calculated on Tables 7.5.RME Supplement A and 7.6.RME Supplement B.

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Vapors from Shallow Groundwater	Building 13 Indoor Air	cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	4.9E-05	NA	4.9E-05
			Trichloroethene	NA	2.4E-05	NA	2.4E-05	Nervous System, Eyes	NA	5.7E-02	NA	5.7E-02
			Vinyl Chloride	NA	2.0E-08	NA	2.0E-08	Liver	NA	1.3E-04	NA	1.3E-04
			Chemical Total	0.0E+00	2.4E-05	0.0E+00	2.4E-05		0.0E+00	5.7E-02	0.0E+00	5.7E-02
		Exposure Point Total					2.4E-05					5.7E-02
		Building 46 Indoor Air	Bromoform	NA	3.2E-12	NA	3.2E-12	NA	NA	NA	NA	0.0E+00
			cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	2.7E-03	NA	2.7E-03
			Trichloroethene	NA	6.1E-08	NA	6.1E-08	Nervous System, Eyes	NA	1.4E-04	NA	1.4E-04
			Chemical Total	0.0E+00	6.1E-08	0.0E+00	6.1E-08		0.0E+00	2.9E-03	0.0E+00	2.9E-03
		Exposure Point Total					6.1E-08					2.9E-03
		Building 47 Indoor Air	Benzene	NA	1.0E-08	NA	1.0E-08	Blood, Immune	NA	1.2E-04	NA	1.2E-04
			Bromoform	NA	3.0E-11	NA	3.0E-11	NA	NA	NA	NA	0.0E+00
			cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	8.6E-02	NA	8.6E-02
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	1.4E-04	NA	1.4E-04
			Trichloroethene	NA	3.2E-06	NA	3.2E-06	Nervous System, Eyes	NA	7.4E-03	NA	7.4E-03
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	5.5E-04	NA	5.5E-04
			Vinyl Chloride	NA	4.3E-05	NA	4.3E-05	Liver	NA	2.8E-01	NA	2.8E-01
			Chemical Total	0.0E+00	4.7E-05	0.0E+00	4.7E-05		0.0E+00	3.8E-01	0.0E+00	3.8E-01
		Exposure Point Total					4.7E-05					3.8E-01
		Building 54 Indoor Air	cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Trichloroethene	NA	3.0E-04	NA	3.0E-04	Nervous System, Eyes	NA	7.0E-01	NA	7.0E-01
			Vinyl Chloride	NA	6.6E-07	NA	6.6E-07	Liver	NA	4.3E-03	NA	4.3E-03
			Chemical Total	0.0E+00	3.0E-04	0.0E+00	3.0E-04		0.0E+00	7.1E-01	0.0E+00	7.1E-01

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
		Exposure Point Total					3.0E-04					7.1E-01
		Building 63 Indoor Air	Benzene	NA	6.7E-10	NA	6.7E-10	Blood, Immune	NA	8.1E-06	NA	8.1E-06
			cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Trichloroethene	NA	2.9E-07	NA	2.9E-07	Nervous System, Eyes	NA	6.7E-04	NA	6.7E-04
			Vinyl Chloride	NA	1.3E-07	NA	1.3E-07	Liver	NA	8.3E-04	NA	8.3E-04
			Chemical Total	0.0E+00	4.2E-07	0.0E+00	4.2E-07		0.0E+00	1.5E-03	0.0E+00	1.5E-03
		Exposure Point Total					4.2E-07					1.5E-03
		Building 90 Indoor Air	cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	2.8E-03	NA	2.8E-03
			Trichloroethene	NA	2.8E-07	NA	2.8E-07	Nervous System, Eyes	NA	6.5E-04	NA	6.5E-04
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	1.9E-05	NA	1.9E-05
			Vinyl Chloride	NA	1.8E-06	NA	1.8E-06	Liver	NA	1.2E-02	NA	1.2E-02
			Chemical Total	0.0E+00	2.1E-06	0.0E+00	2.1E-06		0.0E+00	1.5E-02	0.0E+00	1.5E-02
		Exposure Point Total					2.1E-06					1.5E-02
		Building 1556 Indoor Air	Benzene	NA	1.3E-06	NA	1.3E-06	Blood, Immune	NA	1.5E-02	NA	1.5E-02
			Bromoform	NA	1.5E-11	NA	1.5E-11	NA	NA	NA	NA	0.0E+00
			cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	8.2E-04	NA	8.2E-04
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	4.6E-05	NA	4.6E-05
			Trichloroethene	NA	1.0E-04	NA	1.0E-04	Nervous System, Eyes	NA	2.4E-01	NA	2.4E-01
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	6.9E-06	NA	6.9E-06
			Vinyl Chloride	NA	3.8E-06	NA	3.8E-06	Liver	NA	2.5E-02	NA	2.5E-02
			Chemical Total	0.0E+00	1.1E-04	0.0E+00	1.1E-04		0.0E+00	2.8E-01	0.0E+00	2.8E-01
		Exposure Point Total					1.1E-04					2.8E-01

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

HI - Hazard Index

Building 13

Total Liver HI Across All Media =	1.8E-04
Total Nervous System HI Across All Media =	5.7E-02
Total Eyes HI Across All Media =	5.7E-02

Building 46

Total Liver HI Across All Media =	2.7E-03
Total Nervous System HI Across All Media =	1.4E-04
Total Eyes HI Across All Media =	1.4E-04

Building 47

Total Blood HI Across All Media =	1.2E-04
Total Immune HI Across All Media =	1.2E-04
Total Liver HI Across All Media =	3.7E-01
Total Kidney HI Across All Media =	1.4E-04
Total Whole Body HI Across All Media =	5.5E-04
Total Nervous System HI Across All Media =	7.4E-03
Total Eyes HI Across All Media =	7.4E-03

Building 54

Total Liver HI Across All Media =	4.3E-03

Building 63

Total Blood HI Across All Media =	8.1E-06
Total Immune HI Across All Media =	8.1E-06
Total Liver HI Across All Media =	8.3E-04
Total Nervous System HI Across All Media =	6.7E-04
Total Eyes HI Across All Media =	6.7E-04

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Building 90

Total Liver HI Across All Media =	1.5E-02
Total Whole Body HI Across All Media =	1.9E-05
Total Nervous System HI Across All Media =	6.5E-04
Total Eyes HI Across All Media =	6.5E-04

Building 1556

Total Blood HI Across All Media =	1.5E-02
Total Immune HI Across All Media =	1.5E-02
Total Liver HI Across All Media =	2.5E-02
Total Kidney HI Across All Media =	4.6E-05
Total Whole Body HI Across All Media =	6.9E-06

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			Chloroform	NA	NA	NA	0.0E+00	Liver	8.2E-03	NA	7.5E-04	9.0E-03
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	3.0E-01	NA	9.6E-03	3.1E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	6.6E+00	NA	3.5E-02	6.7E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	4.3E-01	NA	9.0E-02	5.2E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	9.8E-01	NA	2.0E-01	1.2E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		8.4E+00	0.0E+00	3.3E-01	8.7E+00
		Exposure Point Total					0.0E+00					8.7E+00
	Exposure Medium Total						0.0E+00					8.7E+00
	Air	Shower	Chloroform	NA	1.8E-06	NA	1.8E-06	Liver	NA	4.5E-03	NA	4.5E-03
			Chemical Total	0.0E+00	1.8E-06	0.0E+00	1.8E-06		0.0E+00	4.5E-03	0.0E+00	4.5E-03
		Exposure Point Total					1.8E-06					4.5E-03
	Exposure Medium Total						1.8E-06					4.5E-03
Medium Total							0.0E+00					4.5E-03
Receptor Total							0.0E+00				Receptor HI Total	8.7E+00

HI - Hazard Index

Total Liver HI Across All Media =	1.4E-02
Total Spleen HI Across All Media =	3.1E-01
Total Skin HI Across All Media =	6.7E+00
Total Vascular HI Across All Media =	6.7E+00
Total Kidney HI Across All Media =	1.2E+00

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			Chloroform	NA	NA	NA	0.0E+00	Liver	1.9E-02	NA	1.7E-03	2.1E-02
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	7.0E-01	NA	2.1E-02	7.2E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.6E+01	NA	1.0E-01	1.6E+01
			Chromium	NA	NA	NA	0.0E+00	Not identified	1.0E+00	NA	2.7E-01	1.3E+00
			Vanadium	NA	NA	NA	0.0E+00	Kidney	2.3E+00	NA	5.8E-01	2.9E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.0E+01	0.0E+00	9.7E-01	2.1E+01
		Exposure Point Total					0.0E+00					2.1E+01
	Exposure Medium Total						0.0E+00					2.1E+01
Medium Total							0.0E+00					2.1E+01
Receptor Total							0.0E+00				Receptor HI Total	2.1E+01

HI - Hazard Index

Total Liver HI Across All Media =	2.1E-02
Total Spleen HI Across All Media =	7.2E-01
Total Skin HI Across All Media =	1.6E+01
Total Vascular HI Across All Media =	1.6E+01
Total Kidney HI Across All Media =	2.9E+00

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			Chloroform	NA	NA	NA	0.0E+00	Liver	NA	NA	NA	0.0E+00
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	NA	NA	NA	0.0E+00
			Arsenic	1.6E-03	NA	9.3E-06	1.6E-03	Skin, Vascular	NA	NA	NA	0.0E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	NA	NA	NA	0.0E+00
			Vanadium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chemical Total	1.6E-03	0.0E+00	9.3E-06	1.6E-03		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					1.6E-03					0.0E+00
	Exposure Medium Total						1.6E-03					0.0E+00
Medium Total							1.6E-03					0.0E+00
Receptor Total							1.6E-03				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Construction Excavation										
			1,2-Dichloroethane	NA	NA	1.7E-10	1.7E-10	NA	NA	NA	NA	0.0E+00
			Benzene	NA	NA	7.4E-08	7.4E-08	Blood, Immune	NA	NA	3.1E-02	3.1E-02
			Chloroform	NA	NA	NA	0.0E+00	Liver	NA	NA	1.1E-04	1.1E-04
			Tetrachloroethene	NA	NA	2.3E-08	2.3E-08	Liver, Whole body	NA	NA	3.0E-05	3.0E-05
			Trichloroethene	NA	NA	5.6E-07	5.6E-07	Liver	NA	NA	5.0E-01	5.0E-01
			Vinyl chloride	NA	NA	7.0E-07	7.0E-07	Liver	NA	NA	2.3E-02	2.3E-02
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	NA	NA	8.8E-03	8.8E-03
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	NA	NA	4.3E-05	4.3E-05
			bis(2-Ethylhexyl)phthalate	NA	NA	3.2E-08	3.2E-08	Reproductive	NA	NA	7.9E-03	7.9E-03
			Heptachlor epoxide	NA	NA	9.7E-09	9.7E-09	Liver	NA	NA	5.7E-03	5.7E-03
			RDX	NA	NA	1.0E-10	1.0E-10	Prostate	NA	NA	2.2E-05	2.2E-05
			Arsenic	NA	NA	5.6E-08	5.6E-08	Skin, Vascular	NA	NA	8.7E-03	8.7E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	8.3E-04	8.3E-04
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	NA	NA	4.1E-03	4.1E-03
			Chemical Total	0.0E+00	0.0E+00	1.5E-06	1.5E-06		0.0E+00	0.0E+00	5.9E-01	5.9E-01
		Exposure Point Total					1.5E-06					5.9E-01
	Exposure Medium Total						1.5E-06					5.9E-01
	Air	Construction Excavation	1,2-Dichloroethane	NA	2.4E-10	NA	2.4E-10	Blood, Kidney, Liver	NA	2.7E-07	NA	2.7E-07
			Benzene	NA	1.7E-08	NA	1.7E-08	Blood	NA	2.6E-03	NA	2.6E-03
			Chloroform	NA	1.1E-09	NA	1.1E-09	Liver	NA	6.7E-05	NA	6.7E-05
			Tetrachloroethene	NA	1.2E-10	NA	1.2E-10	Liver, Kidney	NA	5.2E-06	NA	5.2E-06
			Trichloroethene	NA	1.4E-07	NA	1.4E-07	Nervous System, Eyes	NA	8.0E-03	NA	8.0E-03
			Vinyl chloride	NA	4.0E-08	NA	4.0E-08	Liver	NA	3.2E-03	NA	3.2E-03
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Liver, Lung	NA	4.2E-04	NA	4.2E-04
			Chemical Total	0.0E+00	1.9E-07	0.0E+00	1.9E-07		0.0E+00	1.4E-02	0.0E+00	1.4E-02
		Exposure Point Total					1.9E-07					1.4E-02
	Exposure Medium Total						1.9E-07					1.4E-02
Medium Total							1.6E-06					6.1E-01
Receptor Total							1.6E-06				Receptor HI Total	6.1E-01

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

HI - Hazard Index

Total Blood HI Across All Media =	4.3E-02
Total Liver HI Across All Media =	5.3E-01
Total Whole Body HI Across All Media =	3.0E-05
Total Reproductive HI Across All Media =	7.9E-03
Total Prostate HI Across All Media =	2.2E-05
Total Skin HI Across All Media =	8.7E-03
Total Vascular HI Across All Media =	8.7E-03
Total Kidney HI Across All Media =	4.1E-03
Total Lung HI Across All Media =	4.2E-04
Total Immune HI Across All Media =	3.1E-02
Total Gastrointestinal HI Across All Media =	8.3E-04

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			1,2-Dichloroethane	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	6.1E-01	NA	9.3E-02	7.0E-01
			Chloroform	NA	NA	NA	0.0E+00	Liver	5.8E-03	NA	5.2E-04	6.3E-03
			Tetrachloroethene	NA	NA	NA	0.0E+00	Liver, Whole body	2.7E-03	NA	1.6E-03	4.4E-03
			Trichloroethene	NA	NA	NA	0.0E+00	Liver	1.4E+01	NA	2.4E+00	1.7E+01
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	1.6E+00	NA	8.3E-02	1.6E+00
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	4.2E+00	NA	3.7E-01	4.5E+00
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	2.1E-02	NA	1.8E-03	2.2E-02
			bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.0E+00	Liver	2.4E-02	NA	4.6E-02	7.0E-02
			Heptachlor epoxide	NA	NA	NA	0.0E+00	Liver	7.0E-02	NA	3.3E-02	1.0E-01
			RDX	NA	NA	NA	0.0E+00	Prostate	4.8E-02	NA	1.3E-04	4.9E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	3.7E+00	NA	1.9E-02	3.7E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	3.5E-01	NA	1.8E-03	3.5E-01
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	7.0E-02	NA	9.1E-03	7.9E-02
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.5E+01	0.0E+00	3.1E+00	2.8E+01
		Exposure Point Total					0.0E+00					2.8E+01
	Exposure Medium Total						0.0E+00					2.8E+01
	Air	Shower	1,2-Dichloroethane	NA	2.5E-07	NA	2.5E-07	Blood, Kidney, Liver	NA	1.2E-05	NA	1.2E-05
			Benzene	NA	2.2E-05	NA	2.2E-05	Blood, Immune	NA	2.7E-01	NA	2.7E-01
			Chloroform	NA	1.2E-06	NA	1.2E-06	Liver	NA	3.2E-03	NA	3.2E-03
			Tetrachloroethene	NA	1.3E-07	NA	1.3E-07	Liver, Kidney	NA	2.4E-04	NA	2.4E-04
			Trichloroethene	NA	1.6E-04	NA	1.6E-04	Nervous System, Eyes	NA	3.8E-01	NA	3.8E-01
			Vinyl chloride	NA	5.4E-05	NA	5.4E-05	Liver	NA	1.8E-01	NA	1.8E-01
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Liver, Lung	NA	2.1E-02	NA	2.1E-02
			Chemical Total	0.0E+00	2.3E-04	0.0E+00	2.3E-04		0.0E+00	8.6E-01	0.0E+00	8.6E-01
		Exposure Point Total					2.3E-04					8.6E-01
	Exposure Medium Total						2.3E-04					8.6E-01

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Air	Indoor Air	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	8.4E-01	NA	8.4E-01
			Bromoform	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			cis-1,2-dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Fre	NA	NA	NA	0.0E+00	Liver	NA	1.7E+00	NA	1.7E+00
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	2.8E-03	NA	2.8E-03
			1,1,2-Trichloro-1,2,2-trifluoroe	NA	NA	NA	0.0E+00	Whole Body	NA	1.5E-01	NA	1.5E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Nervous System, Eyes	NA	1.3E+01	NA	1.3E+01
			Vinyl Chloride	NA	NA	NA	0.0E+00	Liver	NA	6.4E+00	NA	6.4E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	2.2E+01	0.0E+00	2.2E+01
		Exposure Point Total					0.0E+00					2.2E+01
	Exposure Medium Total						0.0E+00					2.2E+01
Medium Total							0.0E+00					5.1E+01
Receptor Total							0.0E+00				Receptor HI Total	5.1E+01

HI - Hazard Index

Total Blood HI Across All Media =	6.4E+00
Total Liver HI Across All Media =	2.7E+01
Total Whole Body HI Across All Media =	1.6E-01
Total Prostate HI Across All Media =	4.9E-02
Total Skin HI Across All Media =	3.7E+00
Total Vascular HI Across All Media =	3.7E+00
Total Kidney HI Across All Media =	8.2E-02
Total Lung HI Across All Media =	2.1E-02
Total Immune HI Across All Media =	1.8E+00
Total Gastrointestinal HI Across All Media =	3.5E-01

TABLE 9.7.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			1,2-Dichloroethane	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	1.4E+00	NA	2.2E-01	1.6E+00
			Chloroform	NA	NA	NA	0.0E+00	Liver	1.3E-02	NA	1.2E-03	1.5E-02
			Tetrachloroethene	NA	NA	NA	0.0E+00	Liver, Whole body	6.4E-03	NA	3.7E-03	1.0E-02
			Trichloroethene	NA	NA	NA	0.0E+00	Liver	3.3E+01	NA	5.5E+00	3.8E+01
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	3.6E+00	NA	2.0E-01	3.8E+00
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	9.7E+00	NA	8.6E-01	1.1E+01
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	4.8E-02	NA	4.2E-03	5.2E-02
			bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.0E+00	Liver	5.6E-02	NA	1.0E-01	1.6E-01
			Heptachlor epoxide	NA	NA	NA	0.0E+00	Liver	1.6E-01	NA	7.5E-02	2.4E-01
			RDX	NA	NA	NA	0.0E+00	Prostate	1.1E-01	NA	2.9E-04	1.1E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	8.6E+00	NA	5.7E-02	8.7E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	8.2E-01	NA	5.4E-03	8.2E-01
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	1.6E-01	NA	2.7E-02	1.9E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		5.8E+01	0.0E+00	7.0E+00	6.5E+01
		Exposure Point Total					0.0E+00					6.5E+01
	Exposure Medium Total						0.0E+00					6.5E+01
	Air	Indoor Air	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	2.4E+00	NA	2.4E+00
			Bromoform	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			cis-1,2-dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	4.8E+00	NA	4.8E+00
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	7.9E-03	NA	7.9E-03
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	4.2E-01	NA	4.2E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Nervous System, Eyes	NA	3.6E+01	NA	3.6E+01
			Vinyl Chloride	NA	NA	NA	0.0E+00	Liver	NA	1.8E+01	NA	1.8E+01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	6.2E+01	0.0E+00	6.2E+01
		Exposure Point Total					0.0E+00					6.2E+01
	Exposure Medium Total						0.0E+00					6.2E+01
Medium Total							0.0E+00					1.3E+02
Receptor Total							0.0E+00				Receptor HI Total	1.3E+02

TABLE 9.7.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

HI - Hazard Index

Total Blood HI Across All Media =	1.5E+01
Total Liver HI Across All Media =	6.5E+01
Total Whole Body HI Across All Media =	1.0E-02
Total Prostate HI Across All Media =	1.1E-01
Total Skin HI Across All Media =	8.7E+00
Total Vascular HI Across All Media =	8.7E+00
Total Kidney HI Across All Media =	2.0E-01
Total Immune HI Across All Media =	4.0E+00
Total Gastrointestinal HI Across All Media =	8.2E-01

TABLE 9.8.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			1,2-Dichloroethane	5.6E-07	NA	2.7E-08	5.8E-07	NA	NA	NA	NA	0.0E+00
			Benzene	7.3E-05	NA	1.1E-05	8.4E-05	Blood, Immune	NA	NA	NA	0.0E+00
			Chloroform	NA	NA	NA	0.0E+00	Liver	NA	NA	NA	0.0E+00
			Tetrachloroethene	8.1E-06	NA	4.7E-06	1.3E-05	Liver, Whole body	NA	NA	NA	0.0E+00
			Trichloroethene	6.0E-04	NA	1.0E-04	7.0E-04	Liver	NA	NA	NA	0.0E+00
			Vinyl chloride	3.6E-03	NA	9.8E-05	3.7E-03	Liver	NA	NA	NA	0.0E+00
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			bis(2-Ethylhexyl)phthalate	3.6E-06	NA	6.9E-06	1.1E-05	Liver	NA	NA	NA	0.0E+00
			Heptachlor epoxide	4.5E-06	NA	2.1E-06	6.6E-06	Liver	NA	NA	NA	0.0E+00
			RDX	8.7E-06	NA	2.3E-08	8.7E-06	Prostate	NA	NA	NA	0.0E+00
			Arsenic	9.1E-04	NA	5.2E-06	9.1E-04	Skin, Vascular	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chemical Total	5.2E-03	0.0E+00	2.3E-04	5.4E-03		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					5.4E-03					0.0E+00
	Exposure Medium Total						5.4E-03					0.0E+00
	Air	Indoor Air	Benzene	NA	1.1E-04	NA	1.1E-04	Blood, Immune	NA	NA	NA	0.0E+00
			Bromoform	NA	7.2E-10	NA	7.2E-10	NA	NA	NA	NA	0.0E+00
			cis-1,2-dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	NA	NA	0.0E+00
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	NA	NA	0.0E+00
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	NA	NA	0.0E+00
			Trichloroethene	NA	9.0E-03	NA	9.0E-03	Nervous System, Eyes	NA	NA	NA	0.0E+00
			Vinyl Chloride	NA	3.3E-03	NA	3.3E-03	Liver	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	1.2E-02	0.0E+00	1.2E-02		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					1.2E-02					0.0E+00
	Exposure Medium Total						1.2E-02					0.0E+00
Medium Total							1.8E-02					0.0E+00
Receptor Total							1.8E-02				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Vapors from Shallow Groundwater	Building 13 Indoor Air	cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	1.5E-05	NA	1.5E-05
			Trichloroethene	NA	2.7E-06	NA	2.7E-06	Nervous System, Eyes	NA	1.8E-02	NA	1.8E-02
			Vinyl Chloride	NA	2.2E-09	NA	2.2E-09	Liver	NA	4.0E-05	NA	4.0E-05
			Chemical Total	0.0E+00	2.7E-06	0.0E+00	2.7E-06		0.0E+00	1.8E-02	0.0E+00	1.8E-02
		Exposure Point Total					2.7E-06					1.8E-02
		Building 46 Indoor Air	Bromoform	NA	3.6E-13	NA	3.6E-13	NA	NA	NA	NA	0.0E+00
			cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	8.5E-04	NA	8.5E-04
			Trichloroethene	NA	6.8E-09	NA	6.8E-09	Nervous System, Eyes	NA	4.5E-05	NA	4.5E-05
			Chemical Total	0.0E+00	6.8E-09	0.0E+00	6.8E-09		0.0E+00	9.0E-04	0.0E+00	9.0E-04
		Exposure Point Total					6.8E-09					9.0E-04
		Building 47 Indoor Air	Benzene	NA	2.0E-09	NA	2.0E-09	Blood, Immune	NA	2.4E-05	NA	2.4E-05
			Bromoform	NA	5.9E-12	NA	5.9E-12	NA	NA	NA	NA	0.0E+00
			cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	1.7E-02	NA	1.7E-02
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	2.9E-05	NA	2.9E-05
			Trichloroethene	NA	6.2E-07	NA	6.2E-07	Nervous System, Eyes	NA	1.5E-03	NA	1.5E-03
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	1.1E-04	NA	1.1E-04
			Vinyl Chloride	NA	8.5E-06	NA	8.5E-06	Liver	NA	5.6E-02	NA	5.6E-02
			Chemical Total	0.0E+00	9.2E-06	0.0E+00	9.2E-06		0.0E+00	7.4E-02	0.0E+00	7.4E-02
		Exposure Point Total					9.2E-06					7.4E-02
		Building 54 Indoor Air	cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Trichloroethene	NA	5.9E-05	NA	5.9E-05	Nervous System, Eyes	NA	3.9E-01	NA	3.9E-01
			Vinyl Chloride	NA	1.3E-07	NA	1.3E-07	Liver	NA	2.3E-03	NA	2.3E-03
			Chemical Total	0.0E+00	5.9E-05	0.0E+00	5.9E-05		0.0E+00	3.9E-01	0.0E+00	3.9E-01
		Exposure Point Total					5.9E-05					3.9E-01

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
		Building 63 Indoor Air	Benzene	NA	7.6E-11	NA	7.6E-11	Blood, Immune	NA	2.5E-06	NA	2.5E-06
			cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Trichloroethene	NA	3.2E-08	NA	3.2E-08	Nervous System, Eyes	NA	2.1E-04	NA	2.1E-04
			Vinyl Chloride	NA	1.4E-08	NA	1.4E-08	Liver	NA	2.6E-04	NA	2.6E-04
			Chemical Total	0.0E+00	4.7E-08	0.0E+00	4.7E-08		0.0E+00	4.7E-04	0.0E+00	4.7E-04
		Exposure Point Total					4.7E-08					4.7E-04
		Building 90 Indoor Air	cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	8.8E-04	NA	8.8E-04
			Trichloroethene	NA	3.1E-08	NA	3.1E-08	Nervous System, Eyes	NA	2.0E-04	NA	2.0E-04
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	6.1E-06	NA	6.1E-06
			Vinyl Chloride	NA	2.1E-07	NA	2.1E-07	Liver	NA	3.7E-03	NA	3.7E-03
			Chemical Total	0.0E+00	2.4E-07	0.0E+00	2.4E-07		0.0E+00	4.8E-03	0.0E+00	4.8E-03
		Exposure Point Total					2.4E-07					4.8E-03
		Building 1556 Indoor Air	Benzene	NA	2.5E-07	NA	2.5E-07	Blood, Immune	NA	8.3E-03	NA	8.3E-03
			Bromoform	NA	3.0E-12	NA	3.0E-12	NA	NA	NA	NA	0.0E+00
			cis-1,2-Dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	4.5E-04	NA	4.5E-04
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	2.5E-05	NA	2.5E-05
			Trichloroethene	NA	2.0E-05	NA	2.0E-05	Nervous System, Eyes	NA	1.3E-01	NA	1.3E-01
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	3.8E-06	NA	3.8E-06
			Vinyl Chloride	NA	7.5E-07	NA	7.5E-07	Liver	NA	1.3E-02	NA	1.3E-02
			Chemical Total	0.0E+00	2.1E-05	0.0E+00	2.1E-05		0.0E+00	1.5E-01	0.0E+00	1.5E-01
		Exposure Point Total					2.1E-05					1.5E-01

HI - Hazard Index

Building 13

Total Liver HI Across All Media =	5.6E-05
Total Nervous System HI Across All Media =	1.8E-02
Total Eyes HI Across All Media =	1.8E-02

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Building 46

Total Liver HI Across All Media =	8.5E-04
Total Nervous System HI Across All Media =	4.5E-05
Total Eyes HI Across All Media =	4.5E-05

Building 47

Total Blood HI Across All Media =	2.4E-05
Total Immune HI Across All Media =	2.4E-05
Total Liver HI Across All Media =	7.3E-02
Total Kidney HI Across All Media =	2.9E-05
Total Whole Body HI Across All Media =	1.1E-04
Total Nervous System HI Across All Media =	1.5E-03
Total Eyes HI Across All Media =	1.5E-03

Building 54

Total Liver HI Across All Media =	2.3E-03

Building 63

Total Blood HI Across All Media =	2.5E-06
Total Immune HI Across All Media =	2.5E-06
Total Liver HI Across All Media =	2.6E-04
Total Nervous System HI Across All Media =	2.1E-04
Total Eyes HI Across All Media =	2.1E-04

Building 90

Total Liver HI Across All Media =	4.6E-03
Total Whole Body HI Across All Media =	6.1E-06
Total Nervous System HI Across All Media =	2.0E-04
Total Eyes HI Across All Media =	2.0E-04

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Building 1556

Total Blood HI Across All Media =	8.3E-03
Total Immune HI Across All Media =	8.3E-03
Total Liver HI Across All Media =	1.4E-02
Total Kidney HI Across All Media =	2.5E-05
Total Whole Body HI Across All Media =	3.8E-06
Total Nervous System HI Across All Media =	1.3E-01
Total Eyes HI Across All Media =	1.3E-01

TABLE 9.2.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			Chloroform	NA	NA	NA	0.0E+00	Liver	5.8E-03	NA	4.9E-04	6.2E-03
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	2.1E-01	NA	6.3E-03	2.2E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.7E+00	NA	5.4E-03	1.7E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	1.6E-01	NA	2.0E-02	1.8E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	3.5E-01	NA	4.4E-02	4.0E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.4E+00	0.0E+00	7.6E-02	2.5E+00
		Exposure Point Total					0.0E+00					2.5E+00
	Exposure Medium Total						0.0E+00					2.5E+00
	Air	Shower	Chloroform	NA	6.6E-07	NA	6.6E-07	Liver	NA	4.5E-03	NA	4.5E-03
			Chemical Total	0.0E+00	6.6E-07	0.0E+00	6.6E-07		0.0E+00	4.5E-03	0.0E+00	4.5E-03
		Exposure Point Total					6.6E-07					4.5E-03
	Exposure Medium Total						6.6E-07					4.5E-03
Medium Total							0.0E+00					4.5E-03
Receptor Total							0.0E+00				Receptor HI Total	2.5E+00

HI - Hazard Index

Total Liver HI Across All Media =	1.1E-02
Total Spleen HI Across All Media =	2.2E-01
Total Skin HI Across All Media =	1.7E+00
Total Vascular HI Across All Media =	1.7E+00
Total Kidney HI Across All Media =	4.0E-01

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			Chloroform	NA	NA	NA	0.0E+00	Liver	1.9E-02	NA	9.7E-04	2.0E-02
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	7.0E-01	NA	1.2E-02	7.2E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	5.6E+00	NA	1.2E-02	5.6E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	5.2E-01	NA	4.5E-02	5.7E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.2E+00	NA	9.8E-02	1.3E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		8.0E+00	0.0E+00	1.7E-01	8.2E+00
		Exposure Point Total					0.0E+00					8.2E+00
	Exposure Medium Total						0.0E+00					8.2E+00
Medium Total							0.0E+00					8.2E+00
Receptor Total							0.0E+00				Receptor HI Total	8.2E+00

HI - Hazard Index

Total Liver HI Across All Media =	2.0E-02
Total Spleen HI Across All Media =	7.2E-01
Total Skin HI Across All Media =	5.6E+00
Total Vascular HI Across All Media =	5.6E+00
Total Kidney HI Across All Media =	1.3E+00

TABLE 9.4.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			Chloroform	NA	NA	NA	0.0E+00	Liver	NA	NA	NA	0.0E+00
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	NA	NA	NA	0.0E+00
			Arsenic	3.1E-04	NA	7.8E-07	3.1E-04	Skin, Vascular	NA	NA	NA	0.0E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	NA	NA	NA	0.0E+00
			Vanadium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chemical Total	3.1E-04	0.0E+00	7.8E-07	3.1E-04		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					3.1E-04					0.0E+00
	Exposure Medium Total						3.1E-04					0.0E+00
Medium Total							3.1E-04					0.0E+00
Receptor Total							3.1E-04				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 9.5.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Construction Excavation	1,2-Dichloroethane	NA	NA	5.0E-11	5.0E-11	NA	NA	NA	NA	0.0E+00
			Benzene	NA	NA	1.5E-08	1.5E-08	Blood, Immune	NA	NA	6.3E-03	6.3E-03
			Chloroform	NA	NA	NA	0.0E+00	Liver	NA	NA	3.5E-05	3.5E-05
			Tetrachloroethene	NA	NA	7.7E-09	7.7E-09	Liver, Whole body	NA	NA	1.0E-05	1.0E-05
			Trichloroethene	NA	NA	1.0E-07	1.0E-07	Liver	NA	NA	9.0E-02	9.0E-02
			Vinyl chloride	NA	NA	8.5E-08	8.5E-08	Liver	NA	NA	2.8E-03	2.8E-03
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	NA	NA	7.1E-04	7.1E-04
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	NA	NA	1.3E-05	1.3E-05
			bis(2-Ethylhexyl)phthalate	NA	NA	4.1E-09	4.1E-09	Reproductive	NA	NA	1.0E-03	1.0E-03
			Heptachlor epoxide	NA	NA	3.0E-09	3.0E-09	Liver	NA	NA	1.8E-03	1.8E-03
			RDX	NA	NA	1.0E-11	1.0E-11	Prostate	NA	NA	2.2E-06	2.2E-06
			Arsenic	NA	NA	2.0E-09	2.0E-09	Skin, Vascular	NA	NA	3.1E-04	3.1E-04
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	1.3E-04	1.3E-04
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	NA	NA	3.1E-04	3.1E-04
			Chemical Total	0.0E+00	0.0E+00	2.2E-07	2.2E-07		0.0E+00	0.0E+00	1.0E-01	1.0E-01
		Exposure Point Total					2.2E-07					1.0E-01
	Exposure Medium Total						2.2E-07					1.0E-01
	Air	Construction Excavation	1,2-Dichloroethane	NA	2.9E-11	NA	2.9E-11	Blood, Kidney, Liver	NA	3.2E-08	NA	3.2E-08
			Benzene	NA	1.8E-09	NA	1.8E-09	Blood	NA	2.8E-04	NA	2.8E-04
			Chloroform	NA	1.6E-10	NA	1.6E-10	Liver	NA	1.0E-05	NA	1.0E-05
			Tetrachloroethene	NA	1.8E-11	NA	1.8E-11	Liver, Kidney	NA	7.9E-07	NA	7.9E-07
			Trichloroethene	NA	1.2E-08	NA	1.2E-08	Nervous System, Eyes	NA	6.9E-04	NA	6.9E-04
			Vinyl chloride	NA	2.6E-09	NA	2.6E-09	Liver	NA	2.1E-04	NA	2.1E-04

TABLE 9.5.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Liver, Lung	NA	6.3E-05	NA	6.3E-05
			Chemical Total	0.0E+00	1.6E-08	0.0E+00	1.6E-08		0.0E+00	1.3E-03	0.0E+00	1.3E-03
		Exposure Point Total					1.6E-08					1.3E-03
	Exposure Medium Total						1.6E-08					1.3E-03
Medium Total							2.3E-07					1.0E-01
Receptor Total							2.3E-07				Receptor HI Total	1.0E-01

HI - Hazard Index

Total Blood HI Across All Media =	7.3E-03
Total Liver HI Across All Media =	9.4E-02
Total Whole Body HI Across All Media =	1.0E-05
Total Reproductive HI Across All Media =	1.0E-03
Total Prostate HI Across All Media =	2.2E-06
Total Skin HI Across All Media =	3.1E-04
Total Vascular HI Across All Media =	3.1E-04
Total Kidney HI Across All Media =	5.2E-04
Total Lung HI Across All Media =	6.3E-05
Total Gastrointestinal HI Across All Media =	1.3E-04

TABLE 9.6.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			1,2-Dichloroethane	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	3.0E-01	NA	4.3E-02	3.4E-01
			Chloroform	NA	NA	NA	0.0E+00	Liver	4.0E-03	NA	3.4E-04	4.4E-03
			Tetrachloroethene	NA	NA	NA	0.0E+00	Liver, Whole body	1.9E-03	NA	1.1E-03	3.0E-03
			Trichloroethene	NA	NA	NA	0.0E+00	Liver	5.6E+00	NA	9.2E-01	6.6E+00
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	4.7E-01	NA	2.3E-02	4.9E-01
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	8.0E-01	NA	6.7E-02	8.7E-01
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	1.4E-02	NA	1.2E-03	1.6E-02
			bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.0E+00	Liver	6.1E-03	NA	1.1E-02	1.7E-02
			Heptachlor epoxide	NA	NA	NA	0.0E+00	Liver	4.2E-02	NA	1.9E-02	6.1E-02
			RDX	NA	NA	NA	0.0E+00	Prostate	9.5E-03	NA	2.3E-05	9.5E-03
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	3.7E-01	NA	1.2E-03	3.7E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.5E-01	NA	4.7E-04	1.5E-01
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	1.5E-02	NA	1.2E-03	1.6E-02
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		7.8E+00	0.0E+00	1.1E+00	8.9E+00
		Exposure Point Total					0.0E+00					8.9E+00
	Exposure Medium Total						0.0E+00					8.9E+00
	Air	Shower	1,2-Dichloroethane	NA	2.5E-07	NA	2.5E-07	Blood, Kidney, Liver	NA	1.2E-05	NA	1.2E-05
			Benzene	NA	2.2E-05	NA	2.2E-05	Blood, Immune	NA	2.7E-01	NA	2.7E-01
			Chloroform	NA	1.2E-06	NA	1.2E-06	Liver	NA	3.2E-03	NA	3.2E-03
			Tetrachloroethene	NA	1.3E-07	NA	1.3E-07	Liver, Kidney	NA	2.4E-04	NA	2.4E-04
			Trichloroethene	NA	1.6E-04	NA	1.6E-04	Nervous System, Eyes	NA	3.8E-01	NA	3.8E-01
			Vinyl chloride	NA	5.4E-05	NA	5.4E-05	Liver	NA	1.8E-01	NA	1.8E-01
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Liver, Lung	NA	2.1E-02	NA	2.1E-02
			Chemical Total	0.0E+00	2.3E-04	0.0E+00	2.3E-04		0.0E+00	8.6E-01	0.0E+00	8.6E-01
		Exposure Point Total					2.3E-04					8.6E-01
	Exposure Medium Total						2.3E-04					8.6E-01

TABLE 9.6.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Air	Indoor Air	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	3.1E-01	NA	3.1E-01
			Bromoform	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			cis-1,2-dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Fred	NA	NA	NA	0.0E+00	Liver	NA	6.4E-01	NA	6.4E-01
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	1.1E-03	NA	1.1E-03
			1,1,2-Trichloro-1,2,2-trifluoroet	NA	NA	NA	0.0E+00	Whole Body	NA	5.7E-02	NA	5.7E-02
			Trichloroethene	NA	NA	NA	0.0E+00	Nervous System, Eyes	NA	4.9E+00	NA	4.9E+00
			Vinyl Chloride	NA	NA	NA	0.0E+00	Liver	NA	2.4E+00	NA	2.4E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	8.3E+00	0.0E+00	8.3E+00
		Exposure Point Total					0.0E+00					8.3E+00
	Exposure Medium Total						0.0E+00					8.3E+00
Medium Total							2.3E-04					1.8E+01
Receptor Total							2.3E-04				Receptor HI Total	1.8E+01

HI - Hazard Index

Total Blood HI Across All Media =	1.8E+00
Total Liver HI Across All Media =	1.0E+01
Total Whole Body HI Across All Media =	6.0E-02
Total Prostate HI Across All Media =	9.5E-03
Total Skin HI Across All Media =	3.7E-01
Total Vascular HI Across All Media =	3.7E-01
Total Kidney HI Across All Media =	1.7E-02
Total Lung HI Across All Media =	2.1E-02
Total Immune HI Across All Media =	9.3E-01
Total Gastrointestinal HI Across All Media =	1.5E-01

TABLE 9.7.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			1,2-Dichloroethane	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	9.9E-01	NA	9.0E-02	1.1E+00
			Chloroform	NA	NA	NA	0.0E+00	Liver	1.3E-02	NA	6.8E-04	1.4E-02
			Tetrachloroethene	NA	NA	NA	0.0E+00	Liver, Whole body	6.4E-03	NA	2.1E-03	8.5E-03
			Trichloroethene	NA	NA	NA	0.0E+00	Liver	1.9E+01	NA	1.8E+00	2.1E+01
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	1.6E+00	NA	4.7E-02	1.6E+00
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	2.7E+00	NA	1.5E-01	2.8E+00
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	4.8E-02	NA	2.6E-03	5.1E-02
			bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.0E+00	Liver	2.0E-02	NA	2.2E-02	4.2E-02
			Heptachlor epoxide	NA	NA	NA	0.0E+00	Liver	1.4E-01	NA	3.7E-02	1.8E-01
			RDX	NA	NA	NA	0.0E+00	Prostate	3.2E-02	NA	4.6E-05	3.2E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.2E+00	NA	2.7E-03	1.2E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.9E-01	NA	1.1E-03	4.9E-01
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	4.9E-02	NA	2.6E-03	5.1E-02
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.6E+01	0.0E+00	2.2E+00	2.8E+01
		Exposure Point Total					0.0E+00					2.8E+01
	Exposure Medium Total						0.0E+00					2.8E+01
	Air	Indoor Air	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	2.4E+00	NA	2.4E+00
			Bromoform	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			cis-1,2-dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	4.8E+00	NA	4.8E+00
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	7.9E-03	NA	7.9E-03

TABLE 9.7.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	4.2E-01	NA	4.2E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Nervous System, Eyes	NA	3.6E+01	NA	3.6E+01
			Vinyl Chloride	NA	NA	NA	0.0E+00	Liver	NA	1.8E+01	NA	1.8E+01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	6.2E+01	0.0E+00	6.2E+01
		Exposure Point Total					0.0E+00					6.2E+01
	Exposure Medium Total						0.0E+00					6.2E+01
Medium Total							0.0E+00					9.0E+01
Receptor Total							0.0E+00				Receptor HI Total	9.0E+01

HI - Hazard Index

Total Blood HI Across All Media =	6.3E+00
Total Liver HI Across All Media =	4.5E+01
Total Whole Body HI Across All Media =	4.3E-01
Total Prostate HI Across All Media =	3.2E-02
Total Skin HI Across All Media =	1.2E+00
Total Vascular HI Across All Media =	1.2E+00
Total Kidney HI Across All Media =	5.9E-02
Total Immune HI Across All Media =	3.4E+00
Total Gastrointestinal HI Across All Media =	4.9E-01

TABLE 9.8.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			1,2-Dichloroethane	3.0E-07	NA	1.0E-08	3.1E-07	NA	NA	NA	NA	0.0E+00
			Benzene	2.7E-05	NA	2.9E-06	3.0E-05	Blood, Immune	NA	NA	NA	0.0E+00
			Chloroform	NA	NA	NA	0.0E+00	Liver	NA	NA	NA	0.0E+00
			Tetrachloroethene	4.3E-06	NA	1.7E-06	6.0E-06	Liver, Whole body	NA	NA	NA	0.0E+00
			Trichloroethene	1.8E-04	NA	2.1E-05	2.0E-04	Liver	NA	NA	NA	0.0E+00
			Vinyl chloride	8.2E-04	NA	1.5E-05	8.4E-04	Liver	NA	NA	NA	0.0E+00
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			trans-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			bis(2-Ethylhexyl)phthalate	7.0E-07	NA	9.2E-07	1.6E-06	Liver	NA	NA	NA	0.0E+00
			Heptachlor epoxide	2.1E-06	NA	6.6E-07	2.7E-06	Liver	NA	NA	NA	0.0E+00
			RDX	1.3E-06	NA	2.3E-09	1.3E-06	Prostate	NA	NA	NA	0.0E+00
			Arsenic	6.8E-05	NA	1.7E-07	6.8E-05	Skin, Vascular	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chemical Total	1.1E-03	0.0E+00	4.3E-05	1.2E-03		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					1.2E-03					0.0E+00
	Exposure Medium Total						1.2E-03					0.0E+00
	Air	Indoor Air	Benzene	NA	7.2E-08	NA	7.2E-08	Blood, Immune	NA	NA	NA	0.0E+00
			Bromoform	NA	4.6E-13	NA	4.6E-13	NA	NA	NA	NA	0.0E+00
			cis-1,2-dichloroethylene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	NA	NA	0.0E+00
			Cumene	NA	NA	NA	0.0E+00	kidney	NA	NA	NA	0.0E+00
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	NA	NA	0.0E+00
			Trichloroethene	NA	5.7E-06	NA	5.7E-06	Nervous System, Eyes	NA	NA	NA	0.0E+00
			Vinyl Chloride	NA	2.1E-06	NA	2.1E-06	Liver	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	7.8E-06	0.0E+00	7.8E-06		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					7.8E-06					0.0E+00
	Exposure Medium Total						7.8E-06					0.0E+00
Medium Total							1.2E-03					0.0E+00
Receptor Total							1.2E-03				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 10.1.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Vapors from Shallow Groundwater	Building 54 Indoor Air	Trichloroethene	NA	3.0E-04	NA	3.0E-04	NA	NA	7.0E-01	NA	7.0E-01
			Chemical Total	0.0E+00	3.0E-04	0.0E+00	3.0E-04		0.0E+00	7.0E-01	0.0E+00	7.0E-01
		Exposure Point Total					3.0E-04					7.0E-01
		Building 1556 Indoor Air	Benzene	NA	1.3E-06	NA	1.3E-06	Blood, Immune	NA	1.5E-02	NA	1.5E-02
			Trichloroethene	NA	1.0E-04	NA	1.0E-04	Nervous System, Eyes	NA	2.4E-01	NA	2.4E-01
			Vinyl chloride	NA	3.8E-06	NA	3.8E-06	Liver	NA	2.5E-02	NA	2.5E-02
			Chemical Total	0.0E+00	1.1E-04	0.0E+00	1.1E-04		0.0E+00	2.8E-01	0.0E+00	2.8E-01
		Exposure Point Total					1.1E-04					2.8E-01

HI - Hazard Index

TABLE 10.2.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	3.0E-01	NA	9.6E-03	3.1E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	6.6E+00	NA	3.5E-02	6.7E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	4.3E-01	NA	9.0E-02	5.2E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	9.8E-01	NA	2.0E-01	1.2E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		8.4E+00	0.0E+00	3.3E-01	8.7E+00
		Exposure Point Total					0.0E+00					8.7E+00
	Exposure Medium Total						0.0E+00					8.7E+00
Medium Total							0.0E+00					8.7E+00
Receptor Total							0.0E+00				Receptor HI Total	8.7E+00

HI - Hazard Index

Total Spleen HI Across All Media =	3.1E-01
Total Skin HI Across All Media =	6.7E+00
Total Vascular HI Across All Media =	6.7E+00
Total Kidney HI Across All Media =	1.2E+00

TABLE 10.3.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	7.0E-01	NA	2.1E-02	7.2E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.6E+01	NA	1.0E-01	1.6E+01
			Chromium	NA	NA	NA	0.0E+00	Not identified	1.0E+00	NA	2.7E-01	1.3E+00
			Vanadium	NA	NA	NA	0.0E+00	Kidney	2.3E+00	NA	5.8E-01	2.9E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.0E+01	0.0E+00	9.7E-01	2.0E+01
		Exposure Point Total					0.0E+00					2.0E+01
	Exposure Medium Total						0.0E+00					2.0E+01
Medium Total							0.0E+00					2.0E+01
Receptor Total							0.0E+00				Receptor HI Total	2.0E+01

HI - Hazard Index

Total Spleen HI Across All Media =	7.2E-01
Total Skin HI Across All Media =	1.6E+01
Total Vascular HI Across All Media =	1.6E+01
Total Kidney HI Across All Media =	2.9E+00

TABLE 10.4.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water	Arsenic	1.6E-03	NA	9.3E-06	1.6E-03	Skin, Vascular	NA	NA	NA	0.0E+00
			Chemical Total	1.6E-03	0.0E+00	9.3E-06	1.6E-03		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					1.6E-03					0.0E+00
	Exposure Medium Total						1.6E-03					0.0E+00
Medium Total							1.6E-03					0.0E+00
Receptor Total							1.6E-03				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 10.5.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	6.1E-01	NA	9.3E-02	7.0E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Liver	1.4E+01	NA	2.4E+00	1.7E+01
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	1.6E+00	NA	8.3E-02	1.6E+00
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	4.2E+00	NA	3.7E-01	4.5E+00
			Heptachlor epoxide	NA	NA	NA	0.0E+00	Liver	7.0E-02	NA	3.3E-02	1.0E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	3.7E+00	NA	1.9E-02	3.7E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	3.5E-01	NA	1.8E-03	3.5E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.5E+01	0.0E+00	3.0E+00	2.8E+01
		Exposure Point Total					0.0E+00					2.8E+01
	Exposure Medium Total						0.0E+00					2.8E+01
	Air	Shower	Benzene	NA	2.2E-05	NA	2.2E-05	Blood, Immune	NA	2.7E-01	NA	2.7E-01
			Chloroform	NA	1.2E-06	NA	1.2E-06	Liver	NA	3.2E-03	NA	3.2E-03
			Trichloroethene	NA	1.6E-04	NA	1.6E-04	Nervous System, Eyes	NA	3.8E-01	NA	3.8E-01
			Vinyl chloride	NA	5.4E-05	NA	5.4E-05	Liver	NA	1.8E-01	NA	1.8E-01
			Chemical Total	0.0E+00	2.3E-04	0.0E+00	2.3E-04		0.0E+00	8.4E-01	0.0E+00	8.4E-01
		Exposure Point Total					2.3E-04					8.4E-01
	Exposure Medium Total						2.3E-04					8.4E-01
	Air	Indoor Air	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	8.4E-01	NA	8.4E-01
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	1.7E+00	NA	1.7E+00
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	1.5E-01	NA	1.5E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Nervous System, Eyes	NA	1.3E+01	NA	1.3E+01
			Vinyl Chloride	NA	NA	NA	0.0E+00	Liver	NA	6.4E+00	NA	6.4E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	2.2E+01	0.0E+00	2.2E+01
		Exposure Point Total					0.0E+00					2.2E+01
	Exposure Medium Total						0.0E+00					2.2E+01
Medium Total							2.3E-04					5.1E+01
Receptor Total							2.3E-04				Receptor HI Total	5.1E+01

TABLE 10.5.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

HI - Hazard Index

Total Blood HI Across All Media =	6.4E+00
Total Liver HI Across All Media =	2.7E+01
Total Skin HI Across All Media =	3.7E+00
Total Vascular HI Across All Media =	3.7E+00
Total Immune HI Across All Media =	1.8E+00
Total Whole Body HI Across All Media =	1.5E-01
Total Gastrointestinal HI Across All Media =	3.5E-01
Total Nervous System HI Across All Media =	1.3E+01
Total Eyes HI Across All Media =	1.3E+01

TABLE 10.6.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	1.4E+00	NA	2.2E-01	1.6E+00
			Trichloroethene	NA	NA	NA	0.0E+00	Liver	3.3E+01	NA	5.5E+00	3.8E+01
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	3.6E+00	NA	2.0E-01	3.8E+00
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	9.7E+00	NA	8.6E-01	1.1E+01
			bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.0E+00	Liver	5.6E-02	NA	1.0E-01	1.6E-01
			Heptachlor epoxide	NA	NA	NA	0.0E+00	Liver	1.6E-01	NA	7.5E-02	2.4E-01
			RDX	NA	NA	NA	0.0E+00	Prostate	1.1E-01	NA	2.9E-04	1.1E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	8.6E+00	NA	5.7E-02	8.7E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	8.2E-01	NA	5.4E-03	8.2E-01
			Molybdenum	NA	NA	NA	0.0E+00	Kidney	1.6E-01	NA	2.7E-02	1.9E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		5.8E+01	0.0E+00	7.0E+00	6.5E+01
		Exposure Point Total					0.0E+00					6.5E+01
	Exposure Medium Total						0.0E+00					6.5E+01
	Air	Indoor Air	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	2.4E+00	NA	2.4E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	4.8E+00	NA	4.8E+00
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	4.2E-01	NA	4.2E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Nervous System, Eyes	NA	3.6E+01	NA	3.6E+01
			Vinyl Chloride	NA	NA	NA	0.0E+00	Liver	NA	1.8E+01	NA	1.8E+01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	6.2E+01	0.0E+00	6.2E+01
		Exposure Point Total					0.0E+00					6.2E+01
	Exposure Medium Total						0.0E+00					6.2E+01
Medium Total							0.0E+00					1.3E+02
Receptor Total							0.0E+00				Receptor HI Total	1.3E+02

HI - Hazard Index

Total Blood HI Across All Media =	1.5E+01
Total Liver HI Across All Media =	6.5E+01
Total Prostate HI Across All Media =	1.1E-01
Total Skin HI Across All Media =	8.7E+00
Total Vascular HI Across All Media =	8.7E+00
Total Kidney HI Across All Media =	1.9E-01
Total Immune HI Across All Media =	4.0E+00
Total Whole Body HI Across All Media =	4.2E-01
Total Gastrointestinal HI Across All Media =	8.2E-01
Total Nervous System HI Across All Media =	3.6E+01

TABLE 10.7.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			Benzene	7.3E-05	NA	1.1E-05	8.4E-05	Blood, Immune	NA	NA	NA	0.0E+00
			Tetrachloroethene	8.1E-06	NA	4.7E-06	1.3E-05	Liver, Whole body	NA	NA	NA	0.0E+00
			Trichloroethene	6.0E-04	NA	1.0E-04	7.0E-04	Liver	NA	NA	NA	0.0E+00
			Vinyl chloride	3.6E-03	NA	9.8E-05	3.7E-03	Liver	NA	NA	NA	0.0E+00
			bis(2-Ethylhexyl)phthalate	3.6E-06	NA	6.9E-06	1.1E-05	Liver	NA	NA	NA	0.0E+00
			Heptachlor epoxide	4.5E-06	NA	2.1E-06	6.6E-06	Liver	NA	NA	NA	0.0E+00
			RDX	8.7E-06	NA	2.3E-08	8.7E-06	Prostate	NA	NA	NA	0.0E+00
			Arsenic	9.1E-04	NA	5.2E-06	9.1E-04	Skin, Vascular	NA	NA	NA	0.0E+00
			Chemical Total	5.2E-03	0.0E+00	2.3E-04	5.4E-03		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					5.4E-03					0.0E+00
	Exposure Medium Total						5.4E-03					0.0E+00
	Air	Indoor Air	Benzene	NA	1.1E-04	NA	1.1E-04	Blood, Immune	NA	NA	NA	0.0E+00
			Trichloroethylene	NA	9.0E-03	NA	9.0E-03	NA	NA	NA	NA	0.0E+00
			Vinyl Chloride	NA	3.3E-03	NA	3.3E-03	Liver	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	1.2E-02	0.0E+00	1.2E-02		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					1.2E-02					0.0E+00
	Exposure Medium Total						1.2E-02					0.0E+00
Medium Total							1.8E-02					0.0E+00
Receptor Total							1.8E-02				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 10.1.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	2.1E-01	NA	6.3E-03	2.2E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.7E+00	NA	5.4E-03	1.7E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	1.6E-01	NA	2.0E-02	1.8E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	3.5E-01	NA	4.4E-02	4.0E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.4E+00	0.0E+00	7.5E-02	2.5E+00
		Exposure Point Total					0.0E+00					2.5E+00
	Exposure Medium Total						0.0E+00					2.5E+00
Medium Total							0.0E+00					2.5E+00
Receptor Total							0.0E+00				Receptor HI Total	2.5E+00

HI - Hazard Index

Total Spleen HI Across All Media =	2.2E-01
Total Skin HI Across All Media =	1.7E+00
Total Vascular HI Across All Media =	1.7E+00
Total Kidney HI Across All Media =	4.0E-01

TABLE 10.2.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water										
			1,3-Dinitrobenzene	NA	NA	NA	0.0E+00	Spleen	7.0E-01	NA	1.2E-02	7.2E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	5.6E+00	NA	1.2E-02	5.6E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	5.2E-01	NA	4.5E-02	5.7E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.2E+00	NA	9.8E-02	1.3E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		8.0E+00	0.0E+00	1.7E-01	8.1E+00
		Exposure Point Total					0.0E+00					8.1E+00
	Exposure Medium Total						0.0E+00					8.1E+00
Medium Total							0.0E+00					8.1E+00
Receptor Total							0.0E+00				Receptor HI Total	8.1E+00

HI - Hazard Index

Total Spleen HI Across All Media =	7.2E-01
Total Skin HI Across All Media =	5.6E+00
Total Vascular HI Across All Media =	5.6E+00
Total Kidney HI Across All Media =	1.3E+00

TABLE 10.3.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Deep Groundwater	Tap Water	Arsenic	3.1E-04	NA	7.8E-07	3.1E-04	Skin, Vascular	NA	NA	NA	0.0E+00
			Chemical Total	3.1E-04	0.0E+00	7.8E-07	3.1E-04		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					3.1E-04					0.0E+00
	Exposure Medium Total						3.1E-04					0.0E+00
Medium Total							3.1E-04					0.0E+00
Receptor Total							3.1E-04				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 10.4.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	3.0E-01	NA	4.3E-02	3.4E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Liver	5.6E+00	NA	9.2E-01	6.6E+00
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	4.7E-01	NA	2.3E-02	4.9E-01
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	8.0E-01	NA	6.7E-02	8.7E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	3.7E-01	NA	1.2E-03	3.7E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.5E-01	NA	4.7E-04	1.5E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		7.7E+00	0.0E+00	1.0E+00	8.8E+00
		Exposure Point Total					0.0E+00					8.8E+00
	Exposure Medium Total						0.0E+00					8.8E+00
	Air	Shower	Benzene	NA	2.2E-05	NA	2.2E-05	Blood, Immune	NA	2.7E-01	NA	2.7E-01
			Chloroform	NA	1.2E-06	NA	1.2E-06	Liver	NA	3.2E-03	NA	3.2E-03
			Trichloroethene	NA	1.6E-04	NA	1.6E-04	Nervous System, Eyes	NA	3.8E-01	NA	3.8E-01
			Vinyl chloride	NA	5.4E-05	NA	5.4E-05	Liver	NA	1.8E-01	NA	1.8E-01
			Chemical Total	0.0E+00	2.3E-04	0.0E+00	2.3E-04		0.0E+00	8.4E-01	0.0E+00	8.4E-01
		Exposure Point Total					2.3E-04					8.4E-01
	Exposure Medium Total						2.3E-04					8.4E-01
	Air	Indoor Air	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	3.1E-01	NA	3.1E-01
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	6.4E-01	NA	6.4E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Nervous System, Eyes	NA	4.9E+00	NA	4.9E+00
			Vinyl Chloride	NA	NA	NA	0.0E+00	Liver	NA	2.4E+00	NA	2.4E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	8.2E+00	0.0E+00	8.2E+00
		Exposure Point Total					0.0E+00					8.2E+00
	Exposure Medium Total						0.0E+00					8.2E+00

TABLE 10.4.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Medium Total							2.3E-04					1.8E+01
Receptor Total							2.3E-04				Receptor HI Total	1.8E+01

HI - Hazard Index

Total Blood HI Across All Media =	1.8E+00
Total Liver HI Across All Media =	1.0E+01
Total Skin HI Across All Media =	3.7E-01
Total Vascular HI Across All Media =	3.7E-01
Total Immune HI Across All Media =	9.3E-01
Total Gastrointestinal HI Across All Media =	1.5E-01
Total Nervous System HI Across All Media =	5.3E+00
Total Eyes HI Across All Media =	5.3E+00

TABLE 10.5.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	9.9E-01	NA	9.0E-02	1.1E+00
			Trichloroethene	NA	NA	NA	0.0E+00	Liver	1.9E+01	NA	1.8E+00	2.1E+01
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	1.6E+00	NA	4.7E-02	1.6E+00
			cis-1,2-Dichloroethene	NA	NA	NA	0.0E+00	Blood	2.7E+00	NA	1.5E-01	2.8E+00
			Heptachlor epoxide	NA	NA	NA	0.0E+00	Liver	1.4E-01	NA	3.7E-02	1.8E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.2E+00	NA	2.7E-03	1.2E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	4.9E-01	NA	1.1E-03	4.9E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.5E+01	0.0E+00	2.1E+00	2.8E+01
		Exposure Point Total					0.0E+00					2.8E+01
	Exposure Medium Total						0.0E+00					2.8E+01
	Air	Indoor Air	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	2.4E+00	NA	2.4E+00
			Dichlorodifluoromethane (Freon 12)	NA	NA	NA	0.0E+00	Liver	NA	4.8E+00	NA	4.8E+00
			1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NA	NA	NA	0.0E+00	Whole Body	NA	4.2E-01	NA	4.2E-01
			Trichloroethene	NA	NA	NA	0.0E+00	Nervous System, Eyes	NA	3.6E+01	NA	3.6E+01
			Vinyl Chloride	NA	NA	NA	0.0E+00	Liver	NA	1.8E+01	NA	1.8E+01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	6.2E+01	0.0E+00	6.2E+01
		Exposure Point Total					0.0E+00					6.2E+01
	Exposure Medium Total						0.0E+00					6.2E+01
Medium Total							0.0E+00					9.0E+01
Receptor Total							0.0E+00				Receptor HI Total	9.0E+01

TABLE 10.5.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

HI - Hazard Index

Total Blood HI Across All Media =	6.3E+00
Total Liver HI Across All Media =	4.5E+01
Total Skin HI Across All Media =	1.2E+00
Total Vascular HI Across All Media =	1.2E+00
Total Immune HI Across All Media =	3.4E+00
Total Whole Body Across All Media =	4.2E-01
Total Gastrointestinal Across All Media =	4.9E-01
Total Nervous System Across All Media =	3.6E+01
Total Eyes Across All Media =	3.6E+01

TABLE 10.6.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 21 REMEDIAL INVESTIGATION REPORT
ST. JULIENS CREEK ANNEX
CHESAPEAKE, VIRGINIA

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Shallow Groundwater	Tap Water										
			Benzene	2.7E-05	NA	2.9E-06	3.0E-05	Blood, Immune	NA	NA	NA	0.0E+00
			Tetrachloroethene	4.3E-06	NA	1.7E-06	6.0E-06	Liver, Whole body	NA	NA	NA	0.0E+00
			Trichloroethene	1.8E-04	NA	2.1E-05	2.0E-04	Liver	NA	NA	NA	0.0E+00
			Vinyl chloride	8.2E-04	NA	1.5E-05	8.4E-04	Liver	NA	NA	NA	0.0E+00
			bis(2-Ethylhexyl)phthalate	7.0E-07	NA	9.2E-07	1.6E-06	Liver	NA	NA	NA	0.0E+00
			Heptachlor epoxide	2.1E-06	NA	6.6E-07	2.7E-06	Liver	NA	NA	NA	0.0E+00
			RDX	1.3E-06	NA	2.3E-09	1.3E-06	Prostate	NA	NA	NA	0.0E+00
			Arsenic	6.8E-05	NA	1.7E-07	6.8E-05	Skin, Vascular	NA	NA	NA	0.0E+00
			Chemical Total	1.1E-03	0.0E+00	4.3E-05	1.1E-03		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					1.1E-03					0.0E+00
	Exposure Medium Total						1.1E-03					0.0E+00
	Air	Indoor Air										
			Trichloroethylene	NA	5.7E-06	NA	5.7E-06	NA	NA	NA	NA	0.0E+00
			Vinyl Chloride	NA	2.1E-06	NA	2.1E-06	Liver	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	7.8E-06	0.0E+00	7.8E-06		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					7.8E-06					0.0E+00
	Exposure Medium Total						7.8E-06					0.0E+00
Medium Total							1.2E-03					0.0E+00
Receptor Total							1.2E-03				Receptor HI Total	0.0E+00

HI - Hazard Index

Table 1
Building Specifications
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Building	Length (ft)	Width (ft)	Height (ft)	# Stories	Year Built	Foundation	HVAC	Vapor Barrier	Use/Access
13	202	31	27	1	1903	slab on grade	no heat, no AC, no ventilation	Assume not present	Unoccupied; cold storage; sporadic access
46	255	47	19	1 - 2 (2nd story in middle)	1916	reinforced, raised slab on pier (~2 ft. off nominal ground surface)	no heat, no AC, no ventilation, no power		Unoccupied; storage
47	178	123	19	1	1916	slab on grade	heat (steam with forced air fans), no AC	Assume not present	Occupied, 15 - 20 shop employees, 1 - 2 hours per day (morning and end of day; most time in field); 97% open bay storage, rest few small offices
54	56	38	24	1	1916 (improvements 1998)	slab on grade	heat (steam with forced air fans), no AC	Assume not present	Occupied, 2 people in 8-hr shifts; auto repair shop
63	153	56	25	1	1918	slab on grade	no heat, no AC, no power	Assume not present	Cold storage (heavy equipment, buoys, anchors); sporadic access approx once per month
90	36	10	17	1	1910	slab on grade	heat (steam with forced air fans), no AC, no ventilation	Assume not present	Abandoned; no access (former air compressor building)
1556	404	202	19.3 - 24.3	2	1992	slab on grade	Heating Ventilation Air Conditioning (HVAC) system is in use	4" porous fill vapor barrie present	Occupied; maintenance shops, storage, offices; daily acces in 8-hr shifts

Table 2
Groundwater to Indoor Air Parameters Used in the Johnson and Ettinger Model - Buildings 13
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Symbol	Parameter	Description	Selected Value	Units	Sources
T_S	Average Soil/Groundwater Temperature		23	°C	Site-specific average temperature (permanent monitoring wells, Table 5-3)
L_F	Depth Below Grade to Bottom of Enclosed Space Floor	This is the depth from soil surface to the bottom of the floor in contact with soil	15	cm	Default value in User's Guide for slab-on-grade construction (USEPA 2004).
L_{WT}	Depth Below Grade to Water Table		48	cm	Depth to groundwater in building vicinity based on MW16S (depth to water - 1.59 ft)
h_A	Thickness of Soil Stratum A		48	cm	Thickness of soil stratum A based on boring log for MW16S.
h_B	Thickness of Soil Stratum B		NA	cm	Not Used
h_C	Thickness of Soil Stratum C		NA	cm	Not Used
	Soil Stratum Directly Above Water Table		A	unitless	Consistent with the deepest stratum with a specified thickness (h_A).
	SCS Soil Type Above Water Table		S	unitless	Soils are modeled as loamy sand based on information from boring log MW16S
	Soil Stratum A SCS Soil Type	Used to estimate soil vapor permeability	S	unitless	Soils are modeled as loamy sand based on information from boring log MW16S
k_v	User-defined Soil Vapor Permeability	A parameter associated with convective transport of vapors within the zone of influence of a building. It is related to the size and shape of connected soil pores	Not Used	cm^2	Not Used
ρ_b^A	Stratum A Soil Dry Bulk Density		1.66	g/cm^3	Default value in User's Guide (USEPA 2004).
n^A	Stratum A Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.375	unitless	Default value in User's Guide (USEPA 2004).
θ_w^A	Stratum A Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.054	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^B	Stratum B Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^B	Stratum B Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^B	Stratum B Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
ρ_b^C	Stratum C Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^C	Stratum C Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^C	Stratum C Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
L_{crack}	Enclosed Space Floor Thickness		30	cm	Building slab thickness of 12".
Δ_P	Soil-Building Pressure Differential		NA	$g/cm\text{-}s^2$	Not Used - Qsoil calculated directly from building parameters.
L_B	Enclosed Space Floor Length		6,157	cm	Length of first floor
W_B	Enclosed Space Floor Width		945	cm	Width of first floor
H_B	Enclosed Space Height		823	cm	First floor height (conservatively assume uniform height of 27 ft)
w	Floor-Wall Seam Crack Width	Represents a gap assumed to exist at the junction between the floor and the foundation perimeter.	NA	cm	Not Used - Qsoil calculated directly from building parameters.
ER	Indoor air exchange rate	Building ventilation rate, expressed in units of air changes per hour (ACH)	0.25	(1/h)	Assumed to be representive of the air exchange rate provided by steam heating and natural ventilation through windows and doors.
Qsoil	Average vapror flow rate into building		17.755	(L/m)	Calculated (NJDEP, 2005)
AT_C	Averaging Time for Carcinogens		70	yrs	Default
AT_{NC}	Averaging Time for Noncarcinogens		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
ED	Exposure Duration		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
EF	Exposure Frequency		250	days/yr	Worker scenario (USEPA Exposure Factors 1991)
TR	Target Risk for Carcinogens	Used to calculate risk-based groundwater concentration	1×10^{-6}	unitless	Not Used
THQ	Target Hazard Quotient for Noncarcinogens	Used to calculate risk-based groundwater concentration	1	days/yr	Not Used

Table 3
Groundwater to Indoor Air Parameters Used in the Johnson and Ettinger Model - Buildings 46
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Symbol	Parameter	Description	Selected Value	Units	Sources
T_S	Average Soil/Groundwater Temperature		23	°C	Site-specific average (permanent monitoring wells, Table 5-3)
L_F	Depth Below Grade to Bottom of Enclosed Space Floor	This is the depth from soil surface to the bottom of the floor in contact with soil	15	cm	Default value in User's Guide for slab-on-grade construction (USEPA 2004).
L_{WT}	Depth Below Grade to Water Table		48	cm	Depth to groundwater in building vicinity based on MW16S (depth to water - 1.59 ft)
h_A	Thickness of Soil Stratum A		48	cm	Thickness of soil stratum A based on boring log for MW16S.
h_B	Thickness of Soil Stratum B		NA	cm	Not Used
h_C	Thickness of Soil Stratum C		NA	cm	Not Used
	Soil Stratum Directly Above Water Table		A	unitless	Consistent with the deepest stratum with a specified thickness (h_A).
	SCS Soil Type Above Water Table		S	unitless	Soils are modeled as loamy sand based on information from boring log MW16S
	Soil Stratum A SCS Soil Type	Used to estimate soil vapor permeability	S	unitless	Soils are modeled as loamy sand based on information from boring log MW16S
k_v	User-defined Soil Vapor Permeability	A parameter associated with convective transport of vapors within the zone of influence of a building. It is related to the size and shape of connected soil pores	Not Used	cm^2	Not Used
ρ_b^A	Stratum A Soil Dry Bulk Density		1.66	g/cm^3	Default value in User's Guide (USEPA 2004).
n^A	Stratum A Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.375	unitless	Default value in User's Guide (USEPA 2004).
θ_w^A	Stratum A Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.054	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^B	Stratum B Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^B	Stratum B Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^B	Stratum B Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
ρ_b^C	Stratum C Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^C	Stratum C Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^C	Stratum C Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
L_{crack}	Enclosed Space Floor Thickness		30	cm	Building slab thickness of 12".
Δ_P	Soil-Building Pressure Differential		NA	$g/cm\text{-}s^2$	Not Used - Qsoil calculated directly from building parameters.
L_B	Enclosed Space Floor Length		7,772	cm	Length of first floor
W_B	Enclosed Space Floor Width		1,433	cm	Width of first floor
H_B	Enclosed Space Height		579	cm	First floor height (conservatively assume uniform height of 19 ft)
w	Floor-Wall Seam Crack Width	Represents a gap assumed to exist at the junction between the floor and the foundation perimeter.	NA	cm	Not Used - Qsoil calculated directly from building parameters.
ER	Indoor air exchange rate	Building ventilation rate, expressed in units of air changes per hour (ACH)	0.25	(1/h)	Assumed to be representive of the air exchange rate provided by steam heating and natural ventilation through windows and doors.
Qsoil	Average vapror flow rate into building		23.01	(L/m)	Calculated (NJDEP, 2005)
AT_C	Averaging Time for Carcinogens		70	yrs	Default
AT_{NC}	Averaging Time for Noncarcinogens		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
ED	Exposure Duration		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
EF	Exposure Frequency		250	days/yr	Worker scenario (USEPA Exposure Factors 1991)
TR	Target Risk for Carcinogens	Used to calculate risk-based groundwater concentration	1×10^{-6}	unitless	Not Used
THQ	Target Hazard Quotient for Noncarcinogens	Used to calculate risk-based groundwater concentration	1	days/yr	Not Used

Table 4
Groundwater to Indoor Air Parameters Used in the Johnson and Ettinger Model - Building 47
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Symbol	Parameter	Description	Selected Value	Units	Sources
T_S	Average Soil/Groundwater Temperature		23	°C	Site-specific average temperature (permanent monitoring wells, Table 5-3)
L_F	Depth Below Grade to Bottom of Enclosed Space Floor	This is the depth from soil surface to the bottom of the floor in contact with soil	15	cm	Default value in User's Guide for slab-on-grade construction (USEPA 2004).
L_{WT}	Depth Below Grade to Water Table		75	cm	Depth to groundwater in building vicinity based on MW01S (minus asphalt layer)
h_A	Thickness of Soil Stratum A		75	cm	Thickness of soil stratum A is assumed to be consistent with average depth to groundwater in building vicinity.
h_B	Thickness of Soil Stratum B		NA	cm	Not Used
h_C	Thickness of Soil Stratum C		NA	cm	Not Used
	Soil Stratum Directly Above Water Table		A	unitless	Consistent with the deepest stratum with a specified thickness (h_A).
	SCS Soil Type Above Water Table		S	unitless	Soils are modeled as sand based on information from boring log MW01S
	Soil Stratum A SCS Soil Type	Used to estimate soil vapor permeability	S	unitless	Soils are modeled as sand based on information from boring log MW01S
k_v	User-defined Soil Vapor Permeability	A parameter associated with convective transport of vapors within the zone of influence of a building. It is related to the size and shape of connected soil pores	Not Used	cm^2	Not Used
ρ_b^A	Stratum A Soil Dry Bulk Density		1.66	g/cm^3	Default value in User's Guide (USEPA 2004).
n^A	Stratum A Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.375	unitless	Default value in User's Guide (USEPA 2004).
θ_w^A	Stratum A Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.054	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^B	Stratum B Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^B	Stratum B Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^B	Stratum B Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
ρ_b^C	Stratum C Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^C	Stratum C Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^C	Stratum C Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
L_{crack}	Enclosed Space Floor Thickness		30	cm	Building slab thickness of 12".
Δ_P	Soil-Building Pressure Differential		NA	$g/cm\text{-}s^2$	Not Used - Qsoil calculated directly from building parameters.
L_B	Enclosed Space Floor Length		5,425	cm	Length of first floor
W_B	Enclosed Space Floor Width		3,749	cm	Width of first floor
H_B	Enclosed Space Height		579	cm	First floor height (conservatively assume uniform height of 19 ft)
w	Floor-Wall Seam Crack Width	Represents a gap assumed to exist at the junction between the floor and the foundation perimeter.	NA	cm	Not Used - Qsoil calculated directly from building parameters.
ER	Indoor air exchange rate	Building ventilation rate, expressed in units of air changes per hour (ACH)	0.25	(1/h)	Assumed to be representive of the air exchange rate provided by steam heating and natural ventilation through windows and doors.
Qsoil	Average vapror flow rate into building		22.94	(L/m)	Calculated (NJDEP, 2005)
AT_C	Averaging Time for Carcinogens		70	yrs	Default
AT_{NC}	Averaging Time for Noncarcinogens		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
ED	Exposure Duration		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
EF	Exposure Frequency		250	days/yr	Worker scenario (USEPA Exposure Factors 1991)
TR	Target Risk for Carcinogens	Used to calculate risk-based groundwater concentration	1×10^{-6}	unitless	Not Used
THQ	Target Hazard Quotient for Noncarcinogens	Used to calculate risk-based groundwater concentration	1	days/yr	Not Used

Table 5
Groundwater to Indoor Air Parameters Used in the Johnson and Ettinger Model - Buildings 54
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Symbol	Parameter	Description	Selected Value	Units	Sources
T_S	Average Soil/Groundwater Temperature		23	°C	Site-specfic average (permanent monitoring wells, Table 5-3)
L_F	Depth Below Grade to Bottom of Enclosed Space Floor	This is the depth from soil surface to the bottom of the floor in contact with soil	15	cm	Default value in User's Guide for slab-on-grade construction (USEPA 2004).
L_{WT}	Depth Below Grade to Water Table		48	cm	Depth to groundwater in building vicinity based on MW16S (depth to water - 1.59 ft)
h_A	Thickness of Soil Stratum A		48	cm	Thickness of soil stratum A based on boring log for MW16S.
h_B	Thickness of Soil Stratum B		NA	cm	Not Used
h_C	Thickness of Soil Stratum C		NA	cm	Not Used
	Soil Stratum Directly Above Water Table		A	unitless	Consistent with the deepest stratum with a specified thickness (h_A).
	SCS Soil Type Above Water Table		S	unitless	Soils are modeled as loamy sand based on information from boring log MW16S
	Soil Stratum A SCS Soil Type	Used to estimate soil vapor permeability	S	unitless	Soils are modeled as loamy sand based on information from boring log MW16S
k_v	User-defined Soil Vapor Permeability	A parameter associated with convective transport of vapors within the zone of influence of a building. It is related to the size and shape of connected soil pores	Not Used	cm^2	Not Used
ρ_b^A	Stratum A Soil Dry Bulk Density		1.66	g/cm^3	Default value in User's Guide (USEPA 2004).
n^A	Stratum A Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.375	unitless	Default value in User's Guide (USEPA 2004).
θ_w^A	Stratum A Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.054	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^B	Stratum B Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^B	Stratum B Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^B	Stratum B Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
ρ_b^C	Stratum C Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^C	Stratum C Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^C	Stratum C Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
L_{crack}	Enclosed Space Floor Thickness		30	cm	Building slab thickness of 12".
Δ_P	Soil-Building Pressure Differential		NA	$g/cm\text{-}s^2$	Not Used - Qsoil calculated directly from building parameters.
L_B	Enclosed Space Floor Length		1,707	cm	Length of first floor
W_B	Enclosed Space Floor Width		1,158	cm	Width of first floor
H_B	Enclosed Space Height		732	cm	First floor height (conservatively assume uniform height of 24 ft)
w	Floor-Wall Seam Crack Width	Represents a gap assumed to exist at the junction between the floor and the foundation perimeter.	NA	cm	Not Used - Qsoil calculated directly from building parameters.
ER	Indoor air exchange rate	Building ventilation rate, expressed in units of air changes per hour (ACH)	0.25	(1/h)	Assumed to be representive of the air exchange rate provided by steam heating and natural ventilation through windows and doors.
Qsoil	Average vapror flow rate into building		7.16	(L/m)	Calculated (NJDEP, 2005)
AT_C	Averaging Time for Carcinogens		70	yrs	Default
AT_{NC}	Averaging Time for Noncarcinogens		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
ED	Exposure Duration		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
EF	Exposure Frequency		250	days/yr	Worker scenario (USEPA Exposure Factors 1991)
TR	Target Risk for Carcinogens	Used to calculate risk-based groundwater concentration	1×10^{-6}	unitless	Not Used
THQ	Target Hazard Quotient for Noncarcinogens	Used to calculate risk-based groundwater concentration	1	days/yr	Not Used

Table 6
Groundwater to Indoor Air Parameters Used in the Johnson and Ettinger Model - Buildings 63
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Symbol	Parameter	Description	Selected Value	Units	Sources
T_S	Average Soil/Groundwater Temperature		23	°C	Site-specific average temperature (permanent monitoring wells, Table 5-3)
L_F	Depth Below Grade to Bottom of Enclosed Space Floor	This is the depth from soil surface to the bottom of the floor in contact with soil	15	cm	Default value in User's Guide for slab-on-grade construction (USEPA 2004).
L_{WT}	Depth Below Grade to Water Table		95	cm	Averaged depth to groundwater at in building vicinity. Based on MW17S (depth to water - 4.11 ft)
h_A	Thickness of Soil Stratum A		61	cm	Thickness of soil stratum A based on boring log for MW17S.
h_B	Thickness of Soil Stratum B		34	cm	Thickness of soil stratum B based on boring log for MW17S.
h_C	Thickness of Soil Stratum C		NA	cm	Not Used
	Soil Stratum Directly Above Water Table		B	unitless	Consistent with the deepest stratum with a specified thickness (h_A).
	SCS Soil Type Above Water Table		LS	unitless	Soils are modeled as silt loam based on information from boring log MW17S
	Soil Stratum A SCS Soil Type	Used to estimate soil vapor permeability	SIL	unitless	Soils are modeled as loamy sand based on information from boring log MW17S
k_v	User-defined Soil Vapor Permeability	A parameter associated with convective transport of vapors within the zone of influence of a building. It is related to the size and shape of connected soil pores	Not Used	cm^2	Not Used
ρ_b^A	Stratum A Soil Dry Bulk Density		1.49	g/cm^3	Default value in User's Guide (USEPA 2004).
n^A	Stratum A Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.439	unitless	Default value in User's Guide (USEPA 2004).
θ_w^A	Stratum A Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.18	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^B	Stratum B Soil Dry Bulk Density		1.62	g/cm^3	Default value in User's Guide (USEPA 2004).
n^B	Stratum B Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.39	unitless	Default value in User's Guide (USEPA 2004).
θ_w^B	Stratum B Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.076	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^C	Stratum C Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^C	Stratum C Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^C	Stratum C Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
L_{crack}	Enclosed Space Floor Thickness		30	cm	Building slab thickness of 12".
Δ_P	Soil-Building Pressure Differential		NA	$g/cm\text{-}s^2$	Not Used - Qsoil calculated directly from building parameters.
L_B	Enclosed Space Floor Length		4,663	cm	Length of first floor
W_B	Enclosed Space Floor Width		1707	cm	Width of first floor
H_B	Enclosed Space Height		762	cm	First floor height (conservatively assume uniform height of 25 ft)
w	Floor-Wall Seam Crack Width	Represents a gap assumed to exist at the junction between the floor and the foundation perimeter.	NA	cm	Not Used - Qsoil calculated directly from building parameters.
ER	Indoor air exchange rate	Building ventilation rate, expressed in units of air changes per hour (ACH)	0.25	(1/h)	Assumed to be representive of the air exchange rate provided by steam heating and natural ventilation through windows and doors.
Qsoil	Average vapror flow rate into building		15.93	(L/m)	Calculated (NJDEP, 2005)
AT_C	Averaging Time for Carcinogens		70	yrs	Default
AT_{NC}	Averaging Time for Noncarcinogens		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
ED	Exposure Duration		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
EF	Exposure Frequency		250	days/yr	Worker scenario (USEPA Exposure Factors 1991)
TR	Target Risk for Carcinogens	Used to calculate risk-based groundwater concentration	1×10^{-6}	unitless	Not Used
THQ	Target Hazard Quotient for Noncarcinogens	Used to calculate risk-based groundwater concentration	1	days/yr	Not Used

Table 7
Groundwater to Indoor Air Parameters Used in the Johnson and Ettinger Model - Buildings 90
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Symbol	Parameter	Description	Selected Value	Units	Sources
T_S	Average Soil/Groundwater Temperature		23	°C	Site-specific average temperature (permanent monitoring wells, Table 5-3)
L_F	Depth Below Grade to Bottom of Enclosed Space Floor	This is the depth from soil surface to the bottom of the floor in contact with soil	15	cm	Default value in User's Guide for slab-on-grade construction (USEPA 2004).
L_{WT}	Depth Below Grade to Water Table		98	cm	Depth to groundwater in building vicinity based on MW15S (minus asphalt layer)
h_A	Thickness of Soil Stratum A		25	cm	Thickness of soil stratum A based on boring log for MW15S.
h_B	Thickness of Soil Stratum B		21	cm	Thickness of soil stratum B based on boring log for MW15S.
h_C	Thickness of Soil Stratum C		52	cm	Thickness of soil stratum B based on boring log for MW15S.
	Soil Stratum Directly Above Water Table		C	unitless	Consistent with the deepest stratum with a specified thickness (h_A).
	SCS Soil Type Above Water Table		LS	unitless	Soils are modeled as loamy sand based on information from boring log MW15S.
	Soil Stratum A SCS Soil Type	Used to estimate soil vapor permeability	S	unitless	For Statum A sand was choosen as a conservative representation of fill material (MW15S).
k_v	User-defined Soil Vapor Permeability	A parameter associated with convective transport of vapors within the zone of influence of a building. It is related to the size and shape of connected soil pores	Not Used	cm^2	Not Used
ρ_b^A	Stratum A Soil Dry Bulk Density		1.66	g/cm^3	Default value in User's Guide (USEPA 2004).
n^A	Stratum A Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.375	unitless	Default value in User's Guide (USEPA 2004).
θ_w^A	Stratum A Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.054	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^B	Stratum B Soil Dry Bulk Density		1.38	g/cm^3	Not Used
n^B	Stratum B Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.481	unitless	Not Used
θ_w^B	Stratum B Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.216	cm^3/cm^3	Not Used
ρ_b^C	Stratum C Soil Dry Bulk Density		1.62	g/cm^3	Not Used
n^C	Stratum C Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.39	unitless	Not Used
θ_w^C	Stratum C Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.076	cm^3/cm^3	Not Used
L_{crack}	Enclosed Space Floor Thickness		30	cm	Building slab thickness of 12".
Δ_P	Soil-Building Pressure Differential		NA	$g/cm\text{-}s^2$	Not Used - Qsoil calculated directly from building parameters.
L_B	Enclosed Space Floor Length		1,097	cm	Length of first floor
W_B	Enclosed Space Floor Width		305	cm	Width of first floor
H_B	Enclosed Space Height		518	cm	First floor height (conservatively assume uniform height of 17 ft)
w	Floor-Wall Seam Crack Width	Represents a gap assumed to exist at the junction between the floor and the foundation perimeter.	NA	cm	Not Used - Qsoil calculated directly from building parameters.
ER	Indoor air exchange rate	Building ventilation rate, expressed in units of air changes per hour (ACH)	0.25	(1/h)	Assumed to be representive of the air exchange rate provided by steam heating and natural ventilation through windows and doors.
Qsoil	Average vapror flow rate into building		3.5	(L/m)	Calculated (NJDEP, 2005)
AT_C	Averaging Time for Carcinogens		70	yrs	Default
AT_{NC}	Averaging Time for Noncarcinogens		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
ED	Exposure Duration		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
EF	Exposure Frequency		250	days/yr	Worker scenario (USEPA Exposure Factors 1991)
TR	Target Risk for Carcinogens	Used to calculate risk-based groundwater concentration	1×10^{-6}	unitless	Not Used
THQ	Target Hazard Quotient for Noncarcinogens	Used to calculate risk-based groundwater concentration	1	days/yr	Not Used

Table 8
Groundwater to Indoor Air Parameters Used in the Johnson and Ettinger Model - Buildings 1556
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Symbol	Parameter	Description	Selected Value	Units	Sources
T_S	Average Soil/Groundwater Temperature		23	°C	Site-specific average temperature (permanent monitoring wells, Table 5-3)
L_F	Depth Below Grade to Bottom of Enclosed Space Floor	This is the depth from soil surface to the bottom of the floor in contact with soil	15	cm	Default value in User's Guide for slab-on-grade construction (USEPA 2004).
L_{WT}	Depth Below Grade to Water Table		98	cm	Averaged depth to groundwater at in building vicinity. Based on MW15S (depth to water - 3.71 ft)
h_A	Thickness of Soil Stratum A		25	cm	Thickness of soil stratum A based on boring log for MW15S.
h_B	Thickness of Soil Stratum B		21	cm	Thickness of soil stratum B based on boring log for MW15S.
h_C	Thickness of Soil Stratum C		52	cm	Thickness of soil stratum B based on boring log for MW15S.
	Soil Stratum Directly Above Water Table		C	unitless	Consistent with the deepest stratum with a specified thickness (h_A).
	SCS Soil Type Above Water Table		LS	unitless	Soils are modeled as loamy sand based on information from boring log MW15S.
	Soil Stratum A SCS Soil Type	Used to estimate soil vapor permeability	S	unitless	For Statum A sand was choosen as a conservative representation of fill material (MW15S).
k_v	User-defined Soil Vapor Permeability	A parameter associated with convective transport of vapors within the zone of influence of a building. It is related to the size and shape of connected soil pores	Not Used	cm^2	Not Used
ρ_b^A	Stratum A Soil Dry Bulk Density		1.66	g/cm^3	Default value in User's Guide (USEPA 2004).
n^A	Stratum A Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.375	unitless	Default value in User's Guide (USEPA 2004).
θ_w^A	Stratum A Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.054	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^B	Stratum B Soil Dry Bulk Density		1.38	g/cm^3	Not Used
n^B	Stratum B Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.481	unitless	Not Used
θ_w^B	Stratum B Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.216	cm^3/cm^3	Not Used
ρ_b^C	Stratum C Soil Dry Bulk Density		1.62	g/cm^3	Not Used
n^C	Stratum C Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.39	unitless	Not Used
θ_w^C	Stratum C Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.076	cm^3/cm^3	Not Used
L_{crack}	Enclosed Space Floor Thickness		30	cm	Building slab thickness of 12".
Δ_P	Soil-Building Pressure Differential		NA	$g/cm\text{-}s^2$	Not Used - Qsoil calculated directly from building parameters.
L_B	Enclosed Space Floor Length		12,339	cm	Length of first floor (estimate)
W_B	Enclosed Space Floor Width		6706	cm	Width of first floor (estimate)
H_B	Enclosed Space Height		589	cm	First floor height (assumed - conservatively assume uniform height of 19 ft)
w	Floor-Wall Seam Crack Width	Represents a gap assumed to exist at the junction between the floor and the foundation perimeter.	NA	cm	Not Used - Qsoil calculated directly from building parameters.
ER	Indoor air exchange rate	Building ventilation rate, expressed in units of air changes per hour (ACH)	0.25	(1/h)	Assumed to be representive of the air exchange rate provided by steam heating and natural ventilation through windows and doors.
Qsoil	Average vapror flow rate into building		47.61	(L/m)	Calculated (NJDEP, 2005)
AT_C	Averaging Time for Carcinogens		70	yrs	Default
AT_{NC}	Averaging Time for Noncarcinogens		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
ED	Exposure Duration		25	yrs	Worker scenario (USEPA Exposure Factors 1991)
EF	Exposure Frequency		250	days/yr	Worker scenario (USEPA Exposure Factors 1991)
TR	Target Risk for Carcinogens	Used to calculate risk-based groundwater concentration	1×10^{-6}	unitless	Not Used
THQ	Target Hazard Quotient for Noncarcinogens	Used to calculate risk-based groundwater concentration	1	days/yr	Not Used

Table 9
Groundwater to Indoor Air Parameters Used in the Johnson and Ettinger Model - Hypothetical Residence
Site 21 Vapor Intrusion Evaluation
St. Juliens Creek Annex
Chesapeake, Virginia

Symbol	Parameter	Description	Selected Value	Units	Sources
T_S	Average Soil/Groundwater Temperature		23	°C	Site-specific average temperature (permanent monitoring wells, Table 5-3)
L_F	Depth Below Grade to Bottom of Enclosed Space Floor	This is the depth from soil surface to the bottom of the floor in contact with soil	15	cm	Default value in User's Guide for slab-on-grade construction (USEPA 2004).
L_{WT}	Depth Below Grade to Water Table		48	cm	Depth to groundwater in building vicinity based on MW16S (depth to water - 1.59 ft)
h_A	Thickness of Soil Stratum A		48	cm	Thickness of soil stratum A based on boring log for MW16S.
h_B	Thickness of Soil Stratum B		NA	cm	Not Used
h_C	Thickness of Soil Stratum C		NA	cm	Not Used
	Soil Stratum Directly Above Water Table		A	unitless	Consistent with the deepest stratum with a specified thickness (h_A).
	SCS Soil Type Above Water Table		S	unitless	Soils are modeled as loamy sand based on information from boring log MW16S
	Soil Stratum A SCS Soil Type	Used to estimate soil vapor permeability	S	unitless	Soils are modeled as loamy sand based on information from boring log MW16S
k_v	User-defined Soil Vapor Permeability	A parameter associated with convective transport of vapors within the zone of influence of a building. It is related to the size and shape of connected soil pores	Not Used	cm^2	Not Used
ρ_b^A	Stratum A Soil Dry Bulk Density		1.66	g/cm^3	Default value in User's Guide (USEPA 2004).
n^A	Stratum A Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	0.375	unitless	Default value in User's Guide (USEPA 2004).
θ_w^A	Stratum A Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	0.054	cm^3/cm^3	Default value in User's Guide (USEPA 2004).
ρ_b^B	Stratum B Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^B	Stratum B Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^B	Stratum B Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
ρ_b^C	Stratum C Soil Dry Bulk Density		NA	g/cm^3	Not Used
n^C	Stratum C Total Soil Porosity	Used with water-filled porosity to calculate air-filled porosity (see below)	NA	unitless	Not Used
θ_w^C	Stratum C Soil Water-filled porosity	Used with total porosity to calculate air-filled porosity (see below)	NA	cm^3/cm^3	Not Used
L_{crack}	Enclosed Space Floor Thickness		10	cm	Default value in User's Guide (USEPA 2004) - building slab thickness of 4".
Δ_P	Soil-Building Pressure Differential		NA	$g/cm\text{-}s^2$	Not Used - Qsoil calculated directly from building parameters.
L_B	Enclosed Space Floor Length		1,000	cm	Default value in User's Guide (USEPA 2004) - representative of a residential structure.
W_B	Enclosed Space Floor Width		1,000	cm	Default value in User's Guide (USEPA 2004) - representative of a residential structure.
H_B	Enclosed Space Height		244	cm	Default value in User's Guide (USEPA 2004) - assumes slab on grade.
w	Floor-Wall Seam Crack Width	Represents a gap assumed to exist at the junction between the floor and the foundation perimeter.	0.1	cm	Default value in User's Guide (USEPA 2004) - assumes slab on grade.
ER	Indoor air exchange rate	Building ventilation rate, expressed in units of air changes per hour (ACH)	0.25	(1/h)	Default value in User's Guide (USEPA 2004).
Qsoil	Average vapror flow rate into building		5	(L/m)	Default value in User's Guide (USEPA 2004) for residenital scenario.
AT_C	Averaging Time for Carcinogens		70	yrs	Default
AT_{NC}	Averaging Time for Noncarcinogens		30	yrs	Residential scenario (USEPA Exposure Factors 1991)
ED	Exposure Duration		30	yrs	Residential scenario (USEPA Exposure Factors 1991)
EF	Exposure Frequency		350	days/yr	Residential scenario (USEPA Exposure Factors 1991)
TR	Target Risk for Carcinogens	Used to calculate risk-based groundwater concentration	1×10^{-6}	unitless	Not Used
THQ	Target Hazard Quotient for Noncarcinogens	Used to calculate risk-based groundwater concentration	1	days/yr	Not Used

Site 21, Shallow Aquifer ProUCL Output
From File-normal

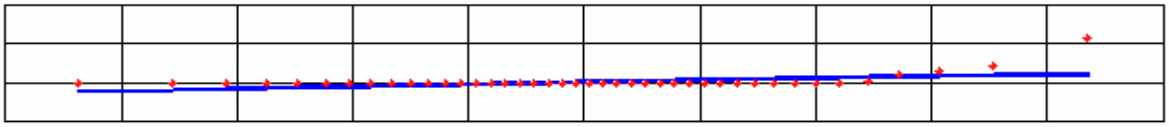
Variable name	NumObs	Minimum	Maximum	Mean	Median	Sd	CV	Skewness	Variance
1,2-Dichloroethane	42	0.25	1250	60.03952	5	211.9089	3.52949	4.819877	44905.38
Benzene	42	0.1	1250	62.14595	5	211.7426	3.407182	4.80054	44834.92
Chloroform	42	0.24	1250	60.14857	5	211.8793	3.522598	4.820395	44892.82
Tetrachloroethene	42	0.25	1250	59.94048	5	211.9362	3.535778	4.819375	44916.97
Trichloroethene	42	0.195	16000	1764.506	135	3579.275	2.028485	2.770249	12811209
Vinyl chloride	42	0.25	1250	73.81333	5	211.3417	2.863191	4.661929	44665.31
cis-1,2-Dichloroethene	42	0.19	3500	418.485	105.5	719.4841	1.719259	2.864363	517657.3
trans-1,2-Dichloroethe	42	0.25	1250	60.47929	5	211.7733	3.501584	4.823177	44847.92
bis(2-Ethylhexyl)phtha	13	0.4	73	8.507692	5	19.4807	2.289775	3.538082	379.4979
Heptachlor epoxide	13	0.025	0.059	0.028731	0.025	0.009315	0.324229	3.324691	8.68E-05
RDX	14	0.26	5.3	1.482857	1.25	1.463307	0.986816	1.41013	2.141268
Arsenic	13	1.1	47.3	5.730769	2.65	12.5688	2.193214	3.527507	157.9748
Molybdenum	5	0.8	18.9	4.8	1.7	7.896518	1.645108	2.21576	62.355

From File-lognormal

Variable name	NumObs	Minimum	Maximum	Mean	Median	Sd	CV	Skewness	Variance
1,2-Dichloroethane	42	-1.386294	7.130899	0.96423	1.609438	2.309446	2.395119	0.906253	5.33354
Benzene	42	-2.302585	7.130899	1.073213	1.609438	2.377644	2.215445	0.743313	5.653191
Chloroform	42	-1.427116	7.130899	0.991526	1.609438	2.315403	2.335192	0.861272	5.361093
Tetrachloroethene	42	-1.386294	7.130899	0.914132	1.609438	2.322551	2.540719	0.943093	5.394245
Trichloroethene	42	-1.634756	9.680344	3.921589	4.899064	3.850835	0.981958	-0.076642	14.82893
Vinyl chloride	42	-1.386294	7.130899	1.755691	1.609438	2.446927	1.393711	0.291726	5.98745
cis-1,2-Dichloroethene	42	-1.660731	8.160518	3.539766	4.602161	3.200819	0.904246	-0.335856	10.24524
trans-1,2-Dichloroethe	42	-1.386294	7.130899	1.22415	1.609438	2.213289	1.808022	0.760866	4.898649
bis(2-Ethylhexyl)phtha	13	-0.916291	4.290459	1.090511	1.609438	1.312809	1.203847	0.875918	1.723467
Heptachlor epoxide	13	-3.688879	-2.830218	-3.581839	-3.688879	0.237566	-0.066325	3.048817	0.056438
RDX	14	-1.347074	1.667707	-0.139934	0.223144	1.141819	-8.159707	0.015276	1.30375
Arsenic	13	0.09531	3.85651	0.888114	0.97456	1.066658	1.201037	1.941051	1.137759
Molybdenum	5	-0.223144	2.939162	0.722258	0.530628	1.299715	1.799516	1.745173	1.689259

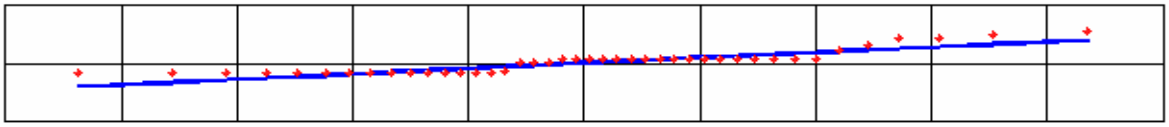
1,2-Dichloroethane - Shallow Groundwater

Normal Q-Q Plot for 1,2-Dichloroethane



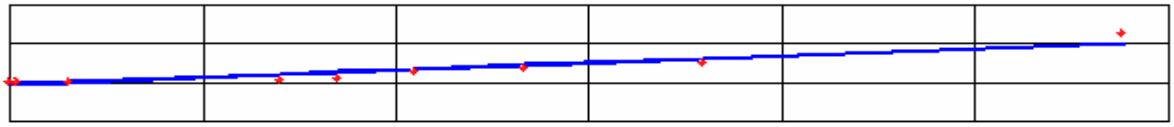
N = 42, Mean = 60.0395, Sd = 211.9089
Slope = 0.5524, Intercept = 0.0000, Correlation, R = 0.54068481
Shapiro-Wilk Statistic = 0.327, Critical Value(0.05) = 0.942, Data not Normal

Lognormal Q-Q Plot for 1,2-Dichloroethane



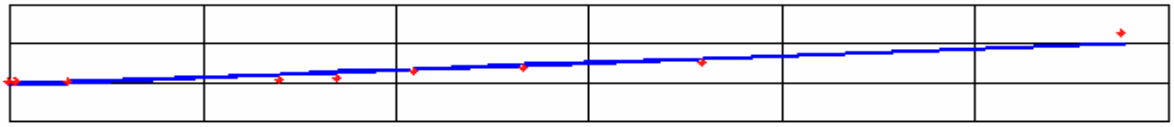
N = 42, Mean = 0.9642, Sd = 2.3094
Slope = 0.9272, Intercept = 0.0000, Correlation, R = 0.90757585
Shapiro-Wilk Statistic = 0.776, Critical Value(0.05) = 0.942, Data not Lognormal

Gamma Q-Q Plot for 1,2-Dichloroethane



N = 42, Mean = 60.040, k hat = 0.2299
Slope = 1.825, Intercept = -37.852, Correlation, R = 0.944
A-D Test Statistic= 6.195, Critical Value(0.05) = 0.891, Data not Gamma Distributed

Gamma Q-Q Plot for 1,2-Dichloroethane



N = 42, Mean = 60.040, k hat = 0.230
Slope = 1.825, Intercept = -37.852, Correlation, R = 0.944
K-S Test Statistic = 0.417, Critical Value(0.05) = 0.150, Data not Gamma Distributed

Data File Variable: 1,2-Dichloroethane

1,2-Dichloroethane - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	42
Number of Unique Samples	10
Minimum	0.25
Maximum	1250
Mean	60.03952
Median	5
Standard Deviation	211.9089
Variance	44905.38
Coefficient of Variation	3.52949
Skewness	4.819877

Gamma Statistics	
k hat	0.22994
k star (bias corrected)	0.229388
Theta hat	261.11
Theta star	261.7375
nu hat	19.31493
nu star	19.26862
Approx.Chi Square Value (.05)	10.31234
Adjusted Level of Significance	0.044286
Adjusted Chi Square Value	10.07832

Log-transformed Statistics	
Minimum of log data	-1.386294
Maximum of log data	7.130899
Mean of log data	0.96423
Standard Deviation of log data	2.309446
Variance of log data	5.33354

RECOMMENDATION

Data are Non-parametric (0.05)

Use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.326894
Shapiro-Wilk 5% Critical Value	0.942
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	115.0667

Gamma Distribution Test	
A-D Test Statistic	6.195447
A-D 5% Critical Value	0.890539
K-S Test Statistic	0.416547
K-S 5% Critical Value	0.150207
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	112.1839
Adjusted Gamma UCL	114.7889

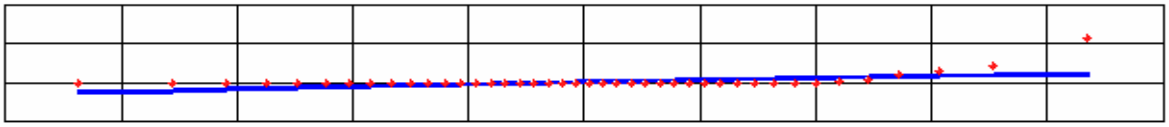
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.776183
Shapiro-Wilk 5% Critical Value	0.942
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	166.0439
95% Chebyshev (MVUE) UCL	101.5218
97.5% Chebyshev (MVUE) UCL	132.0886
99% Chebyshev (MVUE) UCL	192.1313

95% Non-parametric UCLs	
CLT UCL	113.8234
Adj-CLT UCL (Adjusted for skewness)	139.808
Mod-t UCL (Adjusted for skewness)	119.1198
Jackknife UCL	115.0667
Standard Bootstrap UCL	114.2304
Bootstrap-t UCL	232.169
Hall's Bootstrap UCL	277.229
Percentile Bootstrap UCL	118.0655
BCA Bootstrap UCL	156.1786
95% Chebyshev (Mean, Sd) UCL	202.5679
97.5% Chebyshev (Mean, Sd) UCL	264.24
99% Chebyshev (Mean, Sd) UCL	385.383

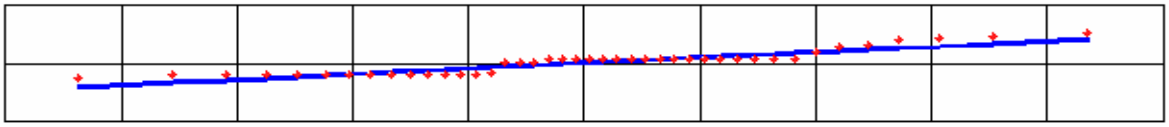
Benzene - Shallow Groundwater

Normal Q-Q Plot for Benzene



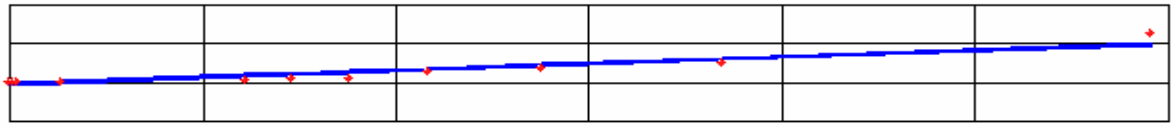
N = 42, Mean = 62.1460, Sd = 211.7426
Slope = 0.5640, Intercept = 0.0000, Correlation, R = 0.55209732
Shapiro-Wilk Statistic = 0.340, Critical Value(0.05) = 0.942, Data not Normal

Lognormal Q-Q Plot for Benzene



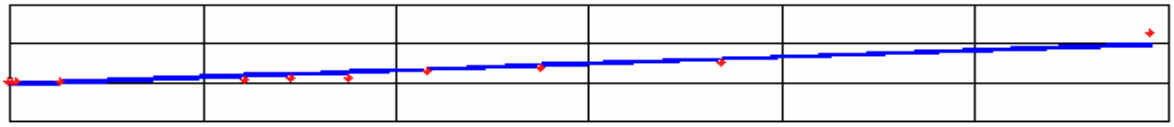
N = 42, Mean = 1.0732, Sd = 2.3776
Slope = 0.9468, Intercept = 0.0000, Correlation, R = 0.92676351
Shapiro-Wilk Statistic = 0.818, Critical Value(0.05) = 0.942, Data not Lognormal

Gamma Q-Q Plot for Benzene



N = 42, Mean = 62.146, k hat = 0.2348
Slope = 1.762, Intercept = -37.115, Correlation, R = 0.944
A-D Test Statistic= 5.475, Critical Value(0.05) = 0.888, Data not Gamma Distributed

Gamma Q-Q Plot for Benzene



N = 42, Mean = 62.146, k hat = 0.235
Slope = 1.762, Intercept = -37.115, Correlation, R = 0.944
K-S Test Statistic = 0.402, Critical Value(0.05) = 0.150, Data not Gamma Distributed

Data File Variable: Benzene

Benzene - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	42
Number of Unique Samples	12
Minimum	0.1
Maximum	1250
Mean	62.14595
Median	5
Standard Deviation	211.7426
Variance	44834.92
Coefficient of Variation	3.407182
Skewness	4.80054

Gamma Statistics	
k hat	0.234764
k star (bias corrected)	0.233868
Theta hat	264.7166
Theta star	265.7306
nu hat	19.72018
nu star	19.64493
Approx.Chi Square Value (.05)	10.58834
Adjusted Level of Significance	0.044286
Adjusted Chi Square Value	10.35085

Log-transformed Statistics	
Minimum of log data	-2.302585
Maximum of log data	7.130899
Mean of log data	1.073213
Standard Deviation of log data	2.377644
Variance of log data	5.653191

RECOMMENDATION

Data are Non-parametric (0.05)

Use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.339573
Shapiro-Wilk 5% Critical Value	0.942
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	117.1299

Gamma Distribution Test	
A-D Test Statistic	5.474555
A-D 5% Critical Value	0.888393
K-S Test Statistic	0.401943
K-S 5% Critical Value	0.150066
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	115.3017
Adjusted Gamma UCL	117.9472

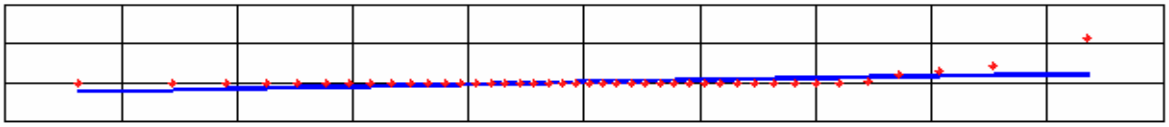
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.81752
Shapiro-Wilk 5% Critical Value	0.942
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	235.6146
95% Chebyshev (MVUE) UCL	133.4431
97.5% Chebyshev (MVUE) UCL	174.0417
99% Chebyshev (MVUE) UCL	253.7897

95% Non-parametric UCLs	
CLT UCL	115.8876
Adj-CLT UCL (Adjusted for skewness)	141.7476
Mod-t UCL (Adjusted for skewness)	121.1636
Jackknife UCL	117.1299
Standard Bootstrap UCL	115.774
Bootstrap-t UCL	206.9628
Hall's Bootstrap UCL	284.1604
Percentile Bootstrap UCL	120.3162
BCA Bootstrap UCL	153.0119
95% Chebyshev (Mean, Sd) UCL	204.5625
97.5% Chebyshev (Mean, Sd) UCL	266.1862
99% Chebyshev (Mean, Sd) UCL	387.2341

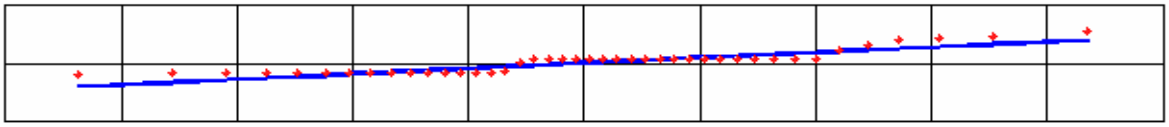
Chloroform - Shallow Groundwater

Normal Q-Q Plot for Chloroform



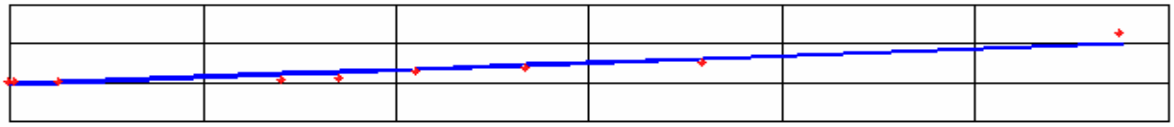
N = 42, Mean = 60.1486, Sd = 211.8793
Slope = 0.5523, Intercept = 0.0000, Correlation, R = 0.54067081
Shapiro-Wilk Statistic = 0.327, Critical Value(0.05) = 0.942, Data not Normal

Lognormal Q-Q Plot for Chloroform



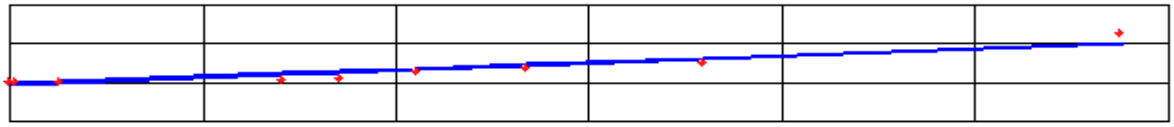
N = 42, Mean = 0.9915, Sd = 2.3154
Slope = 0.9236, Intercept = 0.0000, Correlation, R = 0.90412111
Shapiro-Wilk Statistic = 0.772, Critical Value(0.05) = 0.942, Data not Lognormal

Gamma Q-Q Plot for Chloroform



N = 42, Mean = 60.149, k hat = 0.2316
Slope = 1.834, Intercept = -36.665, Correlation, R = 0.945
A-D Test Statistic= 6.229, Critical Value(0.05) = 0.890, Data not Gamma Distributed

Gamma Q-Q Plot for Chloroform



N = 42, Mean = 60.149, k hat = 0.232
Slope = 1.834, Intercept = -36.665, Correlation, R = 0.945
K-S Test Statistic = 0.419, Critical Value(0.05) = 0.150, Data not Gamma Distributed

Data File Variable: Chloroform

Chloroform - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	42
Number of Unique Samples	11
Minimum	0.24
Maximum	1250
Mean	60.14857
Median	5
Standard Deviation	211.8793
Variance	44892.82
Coefficient of Variation	3.522598
Skewness	4.820395

Gamma Statistics	
k hat	0.231566
k star (bias corrected)	0.230898
Theta hat	259.7474
Theta star	260.4981
nu hat	19.45152
nu star	19.39546
Approx.Chi Square Value (.05)	10.40526
Adjusted Level of Significance	0.044286
Adjusted Chi Square Value	10.17006

Log-transformed Statistics	
Minimum of log data	-1.427116
Maximum of log data	7.130899
Mean of log data	0.991526
Standard Deviation of log data	2.315403
Variance of log data	5.361093

RECOMMENDATION

Data are Non-parametric (0.05)

Use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.326924
Shapiro-Wilk 5% Critical Value	0.942
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	115.168

Gamma Distribution Test	
A-D Test Statistic	6.22922
A-D 5% Critical Value	0.889816
K-S Test Statistic	0.41868
K-S 5% Critical Value	0.15016
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	112.1173
Adjusted Gamma UCL	114.7102

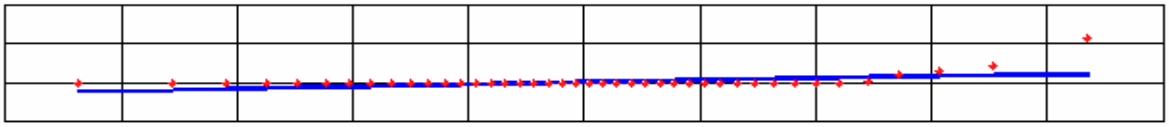
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.771885
Shapiro-Wilk 5% Critical Value	0.942
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	174.2196
95% Chebyshev (MVUE) UCL	105.8298
97.5% Chebyshev (MVUE) UCL	137.7237
99% Chebyshev (MVUE) UCL	200.373

95% Non-parametric UCLs	
CLT UCL	113.9249
Adj-CLT UCL (Adjusted for skewness)	139.9087
Mod-t UCL (Adjusted for skewness)	119.221
Jackknife UCL	115.168
Standard Bootstrap UCL	114.5263
Bootstrap-t UCL	204.6145
Hall's Bootstrap UCL	276.646
Percentile Bootstrap UCL	121.2976
BCA Bootstrap UCL	157.3512
95% Chebyshev (Mean, Sd) UCL	202.657
97.5% Chebyshev (Mean, Sd) UCL	264.3205
99% Chebyshev (Mean, Sd) UCL	385.4466

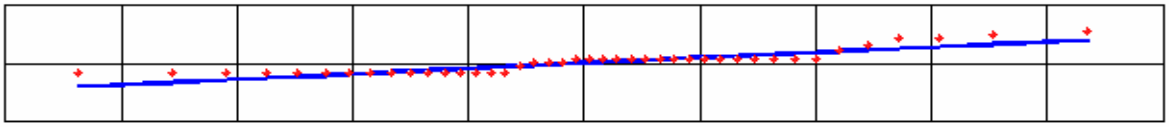
Tetrachloroethene - Shallow Groundwater

Normal Q-Q Plot for Tetrachloroethene



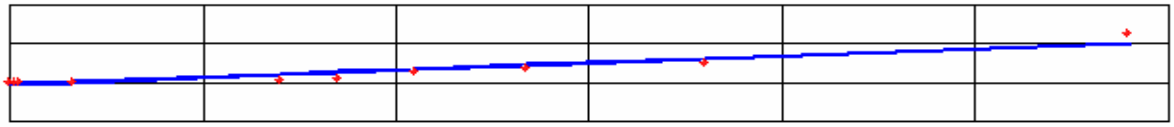
N = 42, Mean = 59.9405, Sd = 211.9362
Slope = 0.5524, Intercept = 0.0000, Correlation, R = 0.54069517
Shapiro-Wilk Statistic = 0.327, Critical Value(0.05) = 0.942, Data not Normal

Lognormal Q-Q Plot for Tetrachloroethene



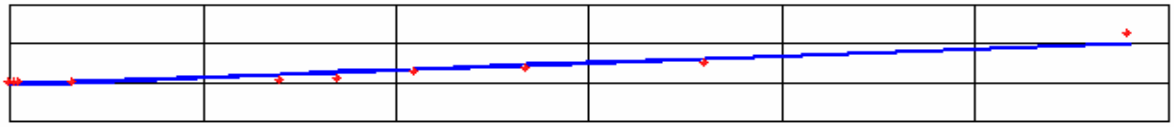
N = 42, Mean = 0.9141, Sd = 2.3226
Slope = 0.9271, Intercept = 0.0000, Correlation, R = 0.90753745
Shapiro-Wilk Statistic = 0.774, Critical Value(0.05) = 0.942, Data not Lognormal

Gamma Q-Q Plot for Tetrachloroethene



N = 42, Mean = 59.940, k hat = 0.2269
Slope = 1.815, Intercept = -37.965, Correlation, R = 0.944
A-D Test Statistic= 6.193, Critical Value(0.05) = 0.892, Data not Gamma Distributed

Gamma Q-Q Plot for Tetrachloroethene



N = 42, Mean = 59.940, k hat = 0.227
Slope = 1.815, Intercept = -37.965, Correlation, R = 0.944
K-S Test Statistic = 0.413, Critical Value(0.05) = 0.150, Data not Gamma Distributed

Data File Variable: Tetrachloroethene

Tetrachloroethene - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	42
Number of Unique Samples	10
Minimum	0.25
Maximum	1250
Mean	59.94048
Median	5
Standard Deviation	211.9362
Variance	44916.97
Coefficient of Variation	3.535778
Skewness	4.819375

Gamma Statistics	
k hat	0.226914
k star (bias corrected)	0.226579
Theta hat	264.1546
Theta star	264.5453
nu hat	19.06081
nu star	19.03265
Approx.Chi Square Value (.05)	10.13979
Adjusted Level of Significance	0.044286
Adjusted Chi Square Value	9.907953

Log-transformed Statistics	
Minimum of log data	-1.386294
Maximum of log data	7.130899
Mean of log data	0.914132
Standard Deviation of log data	2.322551
Variance of log data	5.394245

RECOMMENDATION

Data are Non-parametric (0.05)

Use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.326865
Shapiro-Wilk 5% Critical Value	0.942

Data not normal at 5% significance level

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	114.9747

Gamma Distribution Test	
A-D Test Statistic	6.193015
A-D 5% Critical Value	0.891885
K-S Test Statistic	0.412721
K-S 5% Critical Value	0.150296

Data do not follow gamma distribution at 5% significance level

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	112.5099
Adjusted Gamma UCL	115.1425

Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.773657
Shapiro-Wilk 5% Critical Value	0.942

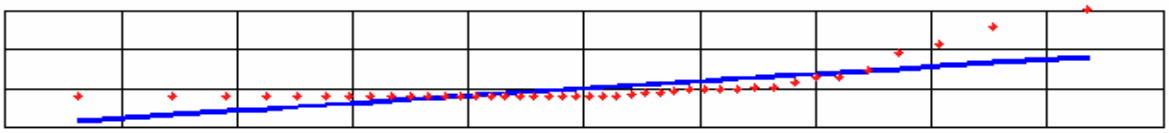
Data not lognormal at 5% significance level

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	165.3249
95% Chebyshev (MVUE) UCL	99.64135
97.5% Chebyshev (MVUE) UCL	129.7038
99% Chebyshev (MVUE) UCL	188.7557

95% Non-parametric UCLs	
CLT UCL	113.7313
Adj-CLT UCL (Adjusted for skewness)	139.7165
Mod-t UCL (Adjusted for skewness)	119.0279
Jackknife UCL	114.9747
Standard Bootstrap UCL	113.7561
Bootstrap-t UCL	230.5977
Hall's Bootstrap UCL	279.4797
Percentile Bootstrap UCL	119.3155
BCA Bootstrap UCL	158.3214
95% Chebyshev (Mean, Sd) UCL	202.4872
97.5% Chebyshev (Mean, Sd) UCL	264.1673
99% Chebyshev (Mean, Sd) UCL	385.3259

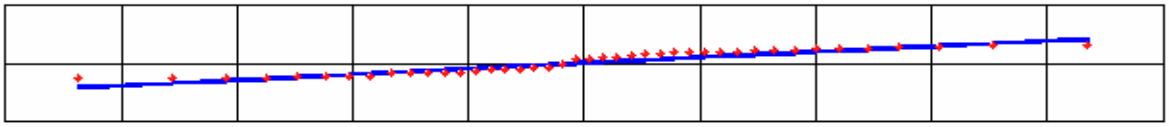
Trichloroethene - Shallow Groundwater

Normal Q-Q Plot for Trichloroethene



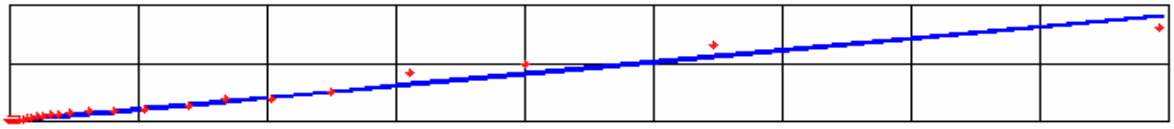
N = 42, Mean = 1764.5064, Sd = 3579.2749
Slope = 0.7575, Intercept = 0.0000, Correlation, R = 0.74151412
Shapiro-Wilk Statistic = 0.553, Critical Value(0.05) = 0.942, Data not Normal

Lognormal Q-Q Plot for Trichloroethene



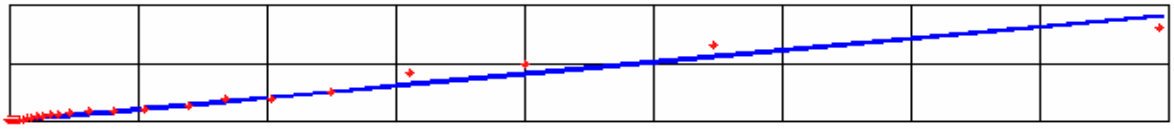
N = 42, Mean = 3.9216, Sd = 3.8508
Slope = 0.9742, Intercept = 0.0000, Correlation, R = 0.95360710
Shapiro-Wilk Statistic = 0.820, Critical Value(0.05) = 0.942, Data not Lognormal

Gamma Q-Q Plot for Trichloroethene



N = 42, Mean = 1764.506, k hat = 0.2061
Slope = 1.019, Intercept = 26.916, Correlation, R = 0.986
A-D Test Statistic= 1.377, Critical Value(0.05) = 0.901, Data not Gamma Distributed

Gamma Q-Q Plot for Trichloroethene



N = 42, Mean = 1764.506, k hat = 0.206
Slope = 1.019, Intercept = 26.916, Correlation, R = 0.986
K-S Test Statistic = 0.193, Critical Value(0.05) = 0.151, Data not Gamma Distributed

Data File Variable: Trichloroethene

Trichloroethene - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	42
Number of Unique Samples	35
Minimum	0.195
Maximum	16000
Mean	1764.506
Median	135
Standard Deviation	3579.275
Variance	12811209
Coefficient of Variation	2.028485
Skewness	2.770249

Gamma Statistics	
k hat	0.206096
k star (bias corrected)	0.207248
Theta hat	8561.579
Theta star	8513.994
nu hat	17.31206
nu star	17.40882
Approx.Chi Square Value (.05)	8.963678
Adjusted Level of Significance	0.044286
Adjusted Chi Square Value	8.747276

Log-transformed Statistics	
Minimum of log data	-1.634756
Maximum of log data	9.680344
Mean of log data	3.921589
Standard Deviation of log data	3.850835
Variance of log data	14.82893

RECOMMENDATION

Data are Non-parametric (0.05)

Use Hall's Bootstrap UCL

In case Hall's Bootstrap method yields
an erratic, unreasonably large UCL value,
use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.552731
Shapiro-Wilk 5% Critical Value	0.942
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	2693.95

Gamma Distribution Test	
A-D Test Statistic	1.376859
A-D 5% Critical Value	0.901146
K-S Test Statistic	0.192656
K-S 5% Critical Value	0.150906
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	3426.938
Adjusted Gamma UCL	3511.718

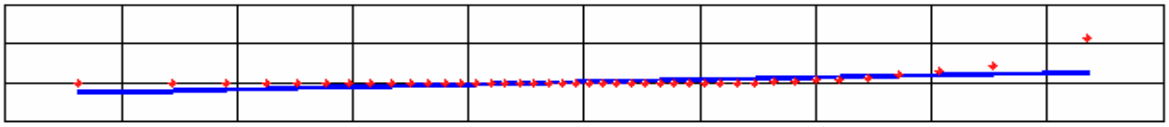
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.820476
Shapiro-Wilk 5% Critical Value	0.942
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	4079397
95% Chebyshev (MVUE) UCL	137730.5
97.5% Chebyshev (MVUE) UCL	184726.3
99% Chebyshev (MVUE) UCL	277040.2

95% Non-parametric UCLs	
CLT UCL	2672.949
Adj-CLT UCL (Adjusted for skewness)	2925.207
Mod-t UCL (Adjusted for skewness)	2733.297
Jackknife UCL	2693.95
Standard Bootstrap UCL	2671.704
Bootstrap-t UCL	3239.018
Hall's Bootstrap UCL	3087.68
Percentile Bootstrap UCL	2731.499
BCA Bootstrap UCL	3212.478
95% Chebyshev (Mean, Sd) UCL	4171.901
97.5% Chebyshev (Mean, Sd) UCL	5213.582
99% Chebyshev (Mean, Sd) UCL	7259.763

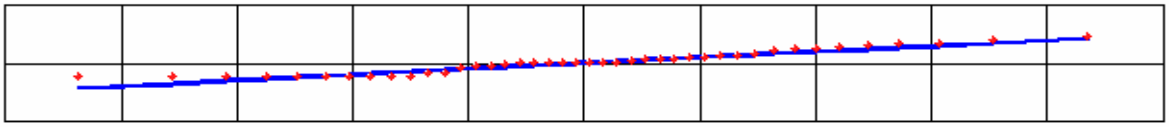
Vinyl chloride - Shallow Groundwater

Normal Q-Q Plot for Vinyl chloride



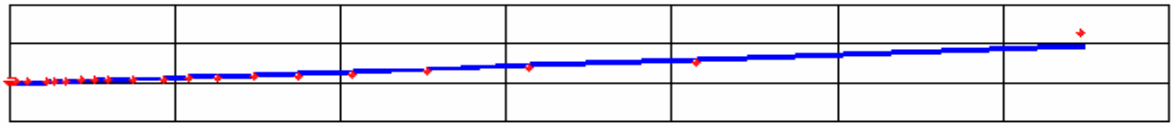
N = 42, Mean = 73.8133, Sd = 211.3417
Slope = 0.6178, Intercept = 0.0000, Correlation, R = 0.60475618
Shapiro-Wilk Statistic = 0.398, Critical Value(0.05) = 0.942, Data not Normal

Lognormal Q-Q Plot for Vinyl chloride



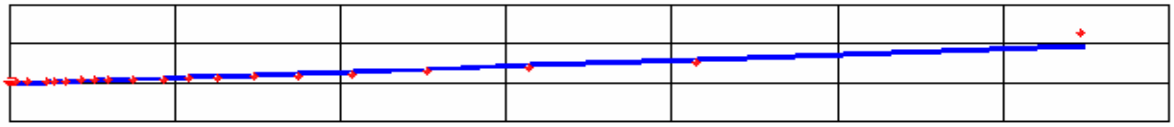
N = 42, Mean = 1.7557, Sd = 2.4469
Slope = 0.9901, Intercept = 0.0000, Correlation, R = 0.96918695
Shapiro-Wilk Statistic = 0.876, Critical Value(0.05) = 0.942, Data not Lognormal

Gamma Q-Q Plot for Vinyl chloride



N = 42, Mean = 73.813, k hat = 0.2748
Slope = 1.547, Intercept = -37.131, Correlation, R = 0.945
A-D Test Statistic= 2.573, Critical Value(0.05) = 0.871, Data not Gamma Distributed

Gamma Q-Q Plot for Vinyl chloride



N = 42, Mean = 73.813, k hat = 0.275
Slope = 1.547, Intercept = -37.131, Correlation, R = 0.945
K-S Test Statistic = 0.213, Critical Value(0.05) = 0.149, Data not Gamma Distributed

Data File Variable: Vinyl chloride

Vinyl chloride - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	42
Number of Unique Samples	25
Minimum	0.25
Maximum	1250
Mean	73.81333
Median	5
Standard Deviation	211.3417
Variance	44665.31
Coefficient of Variation	2.863191
Skewness	4.661929

Gamma Statistics	
k hat	0.274764
k star (bias corrected)	0.271011
Theta hat	268.6427
Theta star	272.3629
nu hat	23.08017
nu star	22.76492
Approx.Chi Square Value (.05)	12.91172
Adjusted Level of Significance	0.044286
Adjusted Chi Square Value	12.64666

Log-transformed Statistics	
Minimum of log data	-1.386294
Maximum of log data	7.130899
Mean of log data	1.755691
Standard Deviation of log data	2.446927
Variance of log data	5.98745

RECOMMENDATION

Data are Non-parametric (0.05)

Use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.398199
Shapiro-Wilk 5% Critical Value	0.942
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	128.6932

Gamma Distribution Test	
A-D Test Statistic	2.572898
A-D 5% Critical Value	0.870599
K-S Test Statistic	0.212841
K-S 5% Critical Value	0.148895
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	130.1418
Adjusted Gamma UCL	132.8695

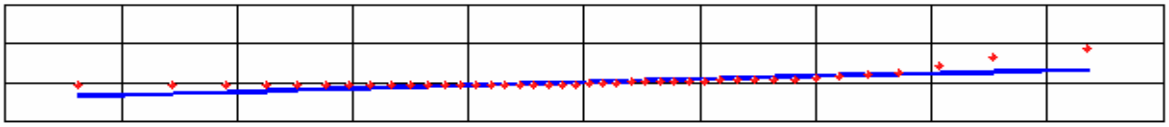
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.875655
Shapiro-Wilk 5% Critical Value	0.942
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	599.8608
95% Chebyshev (MVUE) UCL	312.8472
97.5% Chebyshev (MVUE) UCL	408.9715
99% Chebyshev (MVUE) UCL	597.7892

95% Non-parametric UCLs	
CLT UCL	127.4532
Adj-CLT UCL (Adjusted for skewness)	152.519
Mod-t UCL (Adjusted for skewness)	132.603
Jackknife UCL	128.6932
Standard Bootstrap UCL	127.3863
Bootstrap-t UCL	220.7779
Hall's Bootstrap UCL	314.8639
Percentile Bootstrap UCL	133.756
BCA Bootstrap UCL	126.6329
95% Chebyshev (Mean, Sd) UCL	215.9602
97.5% Chebyshev (Mean, Sd) UCL	277.4673
99% Chebyshev (Mean, Sd) UCL	398.286

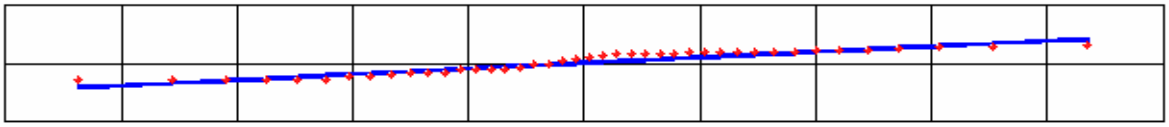
cis-1,2-Dichloroethene - Shallow Groundwater

Normal Q-Q Plot for cis-1,2-Dichloroethene



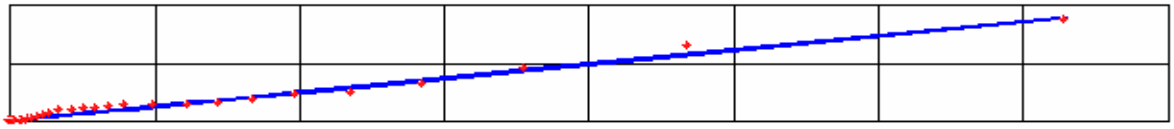
N = 42, Mean = 418.4850, Sd = 719.4841
Slope = 0.7978, Intercept = 0.0000, Correlation, R = 0.78096138
Shapiro-Wilk Statistic = 0.607, Critical Value(0.05) = 0.942, Data not Normal

Lognormal Q-Q Plot for cis-1,2-Dichloroethene



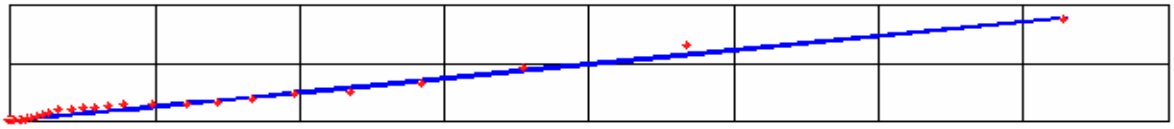
N = 42, Mean = 3.5398, Sd = 3.2008
Slope = 0.9713, Intercept = 0.0000, Correlation, R = 0.95076224
Shapiro-Wilk Statistic = 0.822, Critical Value(0.05) = 0.942, Data not Lognormal

Gamma Q-Q Plot for cis-1,2-Dichloroethene



N = 42, Mean = 418.485, k hat = 0.2794
Slope = 0.980, Intercept = 18.933, Correlation, R = 0.991
A-D Test Statistic= 1.146, Critical Value(0.05) = 0.869, Data not Gamma Distributed

Gamma Q-Q Plot for cis-1,2-Dichloroethene



N = 42, Mean = 418.485, k hat = 0.279
Slope = 0.980, Intercept = 18.933, Correlation, R = 0.991
K-S Test Statistic = 0.155, Critical Value(0.05) = 0.149, Data not Gamma Distributed

Data File Variable: cis-1,2-Dichloroethene

cis-1,2-Dichloroethene - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	42
Number of Unique Samples	33
Minimum	0.19
Maximum	3500
Mean	418.485
Median	105.5
Standard Deviation	719.4841
Variance	517657.3
Coefficient of Variation	1.719259
Skewness	2.864363

Gamma Statistics	
k hat	0.279393
k star (bias corrected)	0.275309
Theta hat	1497.837
Theta star	1520.054
nu hat	23.46901
nu star	23.12598
Approx.Chi Square Value (.05)	13.18429
Adjusted Level of Significance	0.044286
Adjusted Chi Square Value	12.91615

Log-transformed Statistics	
Minimum of log data	-1.660731
Maximum of log data	8.160518
Mean of log data	3.539766
Standard Deviation of log data	3.200819
Variance of log data	10.24524

RECOMMENDATION

Data are Non-parametric (0.05)

Use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.607337
Shapiro-Wilk 5% Critical Value	0.942
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	605.3161

Gamma Distribution Test	
A-D Test Statistic	1.145733
A-D 5% Critical Value	0.868539
K-S Test Statistic	0.155462
K-S 5% Critical Value	0.148759
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	734.0463
Adjusted Gamma UCL	749.2849

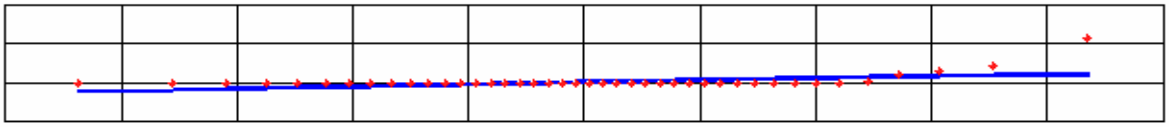
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.821544
Shapiro-Wilk 5% Critical Value	0.942
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	88271.4
95% Chebyshev (MVUE) UCL	13731.05
97.5% Chebyshev (MVUE) UCL	18270.35
99% Chebyshev (MVUE) UCL	27186.92

95% Non-parametric UCLs	
CLT UCL	601.0947
Adj-CLT UCL (Adjusted for skewness)	653.5247
Mod-t UCL (Adjusted for skewness)	613.4941
Jackknife UCL	605.3161
Standard Bootstrap UCL	599.7406
Bootstrap-t UCL	711.6002
Hall's Bootstrap UCL	816.8363
Percentile Bootstrap UCL	622.3736
BCA Bootstrap UCL	741.1814
95% Chebyshev (Mean, Sd) UCL	902.4047
97.5% Chebyshev (Mean, Sd) UCL	1111.797
99% Chebyshev (Mean, Sd) UCL	1523.108

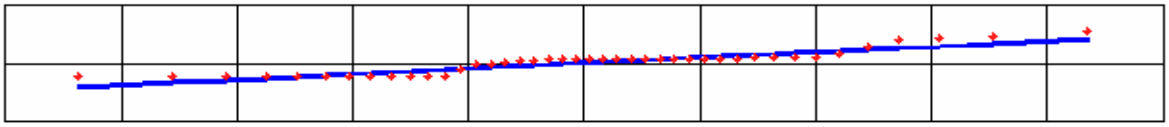
trans-1,2-Dichloroethene - Shallow Groundwater

Normal Q-Q Plot for trans-1,2-Dichloroethene



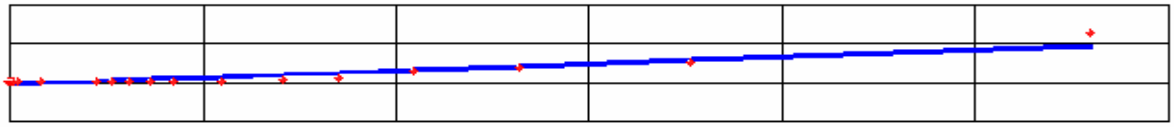
N = 42, Mean = 60.4793, Sd = 211.7733
Slope = 0.5526, Intercept = 0.0000, Correlation, R = 0.54091207
Shapiro-Wilk Statistic = 0.327, Critical Value(0.05) = 0.942, Data not Normal

Lognormal Q-Q Plot for trans-1,2-Dichloroethene



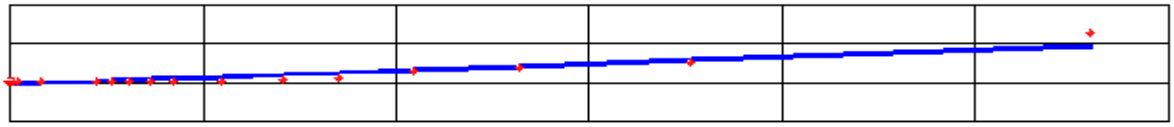
N = 42, Mean = 1.2241, Sd = 2.2133
Slope = 0.9472, Intercept = 0.0000, Correlation, R = 0.92713569
Shapiro-Wilk Statistic = 0.818, Critical Value(0.05) = 0.942, Data not Lognormal

Gamma Q-Q Plot for trans-1,2-Dichloroethene



N = 42, Mean = 60.479, k hat = 0.2472
Slope = 1.765, Intercept = -42.020, Correlation, R = 0.919
A-D Test Statistic= 5.814, Critical Value(0.05) = 0.883, Data not Gamma Distributed

Gamma Q-Q Plot for trans-1,2-Dichloroethene



N = 42, Mean = 60.479, k hat = 0.247
Slope = 1.765, Intercept = -42.020, Correlation, R = 0.919
K-S Test Statistic = 0.373, Critical Value(0.05) = 0.150, Data not Gamma Distributed

Data File Variable: trans-1,2-Dichloroethene

trans-1,2-Dichloroethene - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	42
Number of Unique Samples	18
Minimum	0.25
Maximum	1250
Mean	60.47929
Median	5
Standard Deviation	211.7733
Variance	44847.92
Coefficient of Variation	3.501584
Skewness	4.823177

Gamma Statistics	
k hat	0.24723
k star (bias corrected)	0.245444
Theta hat	244.6273
Theta star	246.4076
nu hat	20.76735
nu star	20.6173
Approx.Chi Square Value (.05)	11.30594
Adjusted Level of Significance	0.044286
Adjusted Chi Square Value	11.05964

Log-transformed Statistics	
Minimum of log data	-1.386294
Maximum of log data	7.130899
Mean of log data	1.22415
Standard Deviation of log data	2.213289
Variance of log data	4.898649

RECOMMENDATION

Data are Non-parametric (0.05)

Use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.327152
Shapiro-Wilk 5% Critical Value	0.942
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	115.4712

Gamma Distribution Test	
A-D Test Statistic	5.813611
A-D 5% Critical Value	0.882847
K-S Test Statistic	0.373345
K-S 5% Critical Value	0.149701
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	110.2889
Adjusted Gamma UCL	112.745

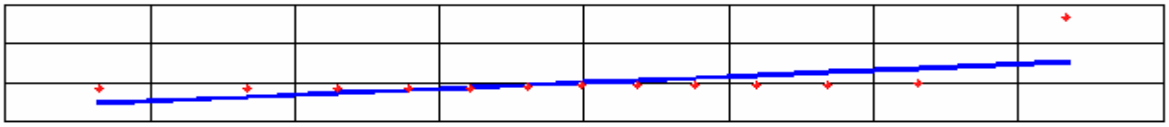
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.818456
Shapiro-Wilk 5% Critical Value	0.942
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	155.1472
95% Chebyshev (MVUE) UCL	104.8631
97.5% Chebyshev (MVUE) UCL	135.9359
99% Chebyshev (MVUE) UCL	196.9726

95% Non-parametric UCLs	
CLT UCL	114.2287
Adj-CLT UCL (Adjusted for skewness)	140.2145
Mod-t UCL (Adjusted for skewness)	119.5245
Jackknife UCL	115.4712
Standard Bootstrap UCL	113.1973
Bootstrap-t UCL	228.2469
Hall's Bootstrap UCL	280.4859
Percentile Bootstrap UCL	125.519
BCA Bootstrap UCL	157.325
95% Chebyshev (Mean, Sd) UCL	202.9164
97.5% Chebyshev (Mean, Sd) UCL	264.5491
99% Chebyshev (Mean, Sd) UCL	385.6146

bis(2-Ethylhexyl)phthalate - Shallow Groundwater

Normal Q-Q Plot for bis(2-Ethylhexyl)phthalate



N = 13, Mean = 8.5077, Sd = 19.4807
Slope = 0.6377, Intercept = 0.0000, Correlation, R = 0.60591916
Shapiro-Wilk Statistic = 0.399, Critical Value(0.05) = 0.866, Data not Normal

Lognormal Q-Q Plot for bis(2-Ethylhexyl)phthalate

N = 13, Mean = 1.0905, Sd = 1.3128
Slope = 0.9810, Intercept = 0.0000, Correlation, R = 0.93219891
Shapiro-Wilk Statistic = 0.888, Critical Value(0.05) = 0.866, Data are Lognormal

Gamma Q-Q Plot for bis(2-Ethylhexyl)phthalate

N = 13, Mean = 8.508, k hat = 0.5897
Slope = 1.756, Intercept = -5.198, Correlation, R = 0.875
A-D Test Statistic= 1.498, Critical Value(0.05) = 0.783, Data not Gamma Distributed

Gamma Q-Q Plot for bis(2-Ethylhexyl)phthalate

N = 13, Mean = 8.508, k hat = 0.590
Slope = 1.756, Intercept = -5.198, Correlation, R = 0.875
K-S Test Statistic = 0.369, Critical Value(0.05) = 0.248, Data not Gamma Distributed

Data File Variable: bis(2-Ethylhexyl)phthalate

bis(2-Ethylhexyl)phthalate - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	13
Number of Unique Samples	9
Minimum	0.4
Maximum	73
Mean	8.507692
Median	5
Standard Deviation	19.4807
Variance	379.4979
Coefficient of Variation	2.289775
Skewness	3.538082

Gamma Statistics	
k hat	0.589704
k star (bias corrected)	0.504901
Theta hat	14.42705
Theta star	16.85023
nu hat	15.33231
nu star	13.12742
Approx.Chi Square Value (.05)	5.977403
Adjusted Level of Significance	0.03009
Adjusted Chi Square Value	5.30483

Log-transformed Statistics	
Minimum of log data	-0.916291
Maximum of log data	4.290459
Mean of log data	1.090511
Standard Deviation of log data	1.312809
Variance of log data	1.723467

RECOMMENDATION

Data are lognormal (0.05)

Use 95% Chebyshev (MVUE) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.399408
Shapiro-Wilk 5% Critical Value	0.866
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	18.13735

Gamma Distribution Test	
A-D Test Statistic	1.498384
A-D 5% Critical Value	0.782903
K-S Test Statistic	0.36866
K-S 5% Critical Value	0.248396
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	18.68437
Adjusted Gamma UCL	21.05327

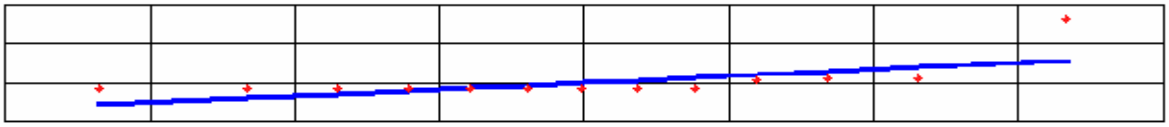
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.887512
Shapiro-Wilk 5% Critical Value	0.866
Data are lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	25.87646
95% Chebyshev (MVUE) UCL	17.42524
97.5% Chebyshev (MVUE) UCL	22.22453
99% Chebyshev (MVUE) UCL	31.65181

95% Non-parametric UCLs	
CLT UCL	17.3948
Adj-CLT UCL (Adjusted for skewness)	23.05992
Mod-t UCL (Adjusted for skewness)	19.02099
Jackknife UCL	18.13735
Standard Bootstrap UCL	17.07576
Bootstrap-t UCL	67.55121
Hall's Bootstrap UCL	65.56886
Percentile Bootstrap UCL	19.04615
BCA Bootstrap UCL	14.73846
95% Chebyshev (Mean, Sd) UCL	32.05872
97.5% Chebyshev (Mean, Sd) UCL	42.24926
99% Chebyshev (Mean, Sd) UCL	62.26662

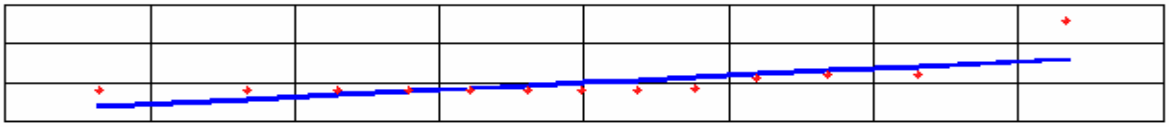
Heptachlor epoxide - Shallow Groundwater

Normal Q-Q Plot for Heptachlor epoxide



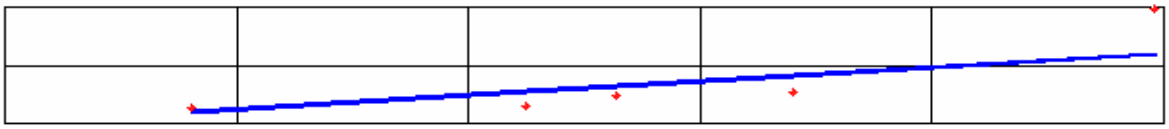
N = 13, Mean = 0.0287, Sd = 0.0093
Slope = 0.6889, Intercept = 0.0000, Correlation, R = 0.65461691
Shapiro-Wilk Statistic = 0.458, Critical Value(0.05) = 0.866, Data not Normal

Lognormal Q-Q Plot for Heptachlor epoxide



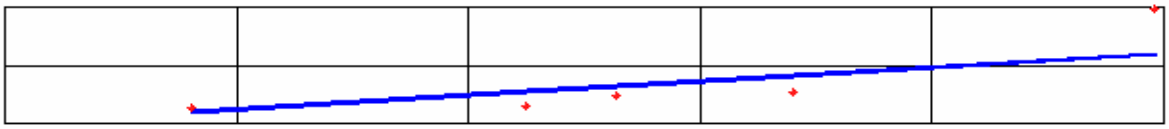
N = 13, Mean = -3.5818, Sd = 0.2376
Slope = 0.7382, Intercept = 0.0000, Correlation, R = 0.70140746
Shapiro-Wilk Statistic = 0.518, Critical Value(0.05) = 0.866, Data not Lognormal

Gamma Q-Q Plot for Heptachlor epoxide



N = 13, Mean = 0.029, k hat = 15.7644
Slope = 0.955, Intercept = 0.001, Correlation, R = 0.812
A-D Test Statistic= 2.740, Critical Value(0.05) = 0.734, Data not Gamma Distributed

Gamma Q-Q Plot for Heptachlor epoxide



N = 13, Mean = 0.029, k hat = 15.764
Slope = 0.955, Intercept = 0.001, Correlation, R = 0.812
K-S Test Statistic = 0.340, Critical Value(0.05) = 0.236, Data not Gamma Distributed

Data File Variable: Heptachlor epoxide

Heptachlor epoxide - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	13
Number of Unique Samples	5
Minimum	0.025
Maximum	0.059
Mean	0.028731
Median	0.025
Standard Deviation	0.009315
Variance	8.68E-05
Coefficient of Variation	0.324229
Skewness	3.324691

Gamma Statistics	
k hat	15.76438
k star (bias corrected)	12.17773
Theta hat	0.001823
Theta star	0.002359
nu hat	409.874
nu star	316.621
Approx.Chi Square Value (.05)	276.389
Adjusted Level of Significance	0.03009
Adjusted Chi Square Value	271.0322

Log-transformed Statistics	
Minimum of log data	-3.688879
Maximum of log data	-2.830218
Mean of log data	-3.581839
Standard Deviation of log data	0.237566
Variance of log data	0.056438

RECOMMENDATION

Data are Non-parametric (0.05)

Use Student's-t UCL
or Modified-t UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.457513
Shapiro-Wilk 5% Critical Value	0.866
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	0.033336

Gamma Distribution Test	
A-D Test Statistic	2.740343
A-D 5% Critical Value	0.733504
K-S Test Statistic	0.340155
K-S 5% Critical Value	0.23636
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	0.032913
Adjusted Gamma UCL	0.033563

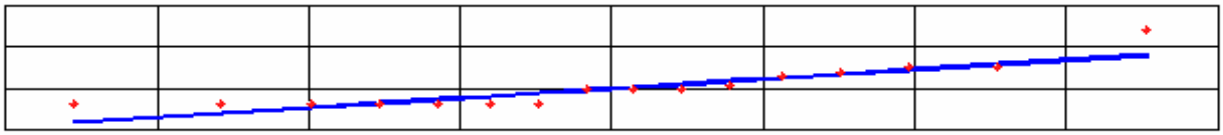
Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.517944
Shapiro-Wilk 5% Critical Value	0.866
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	0.032515
95% Chebyshev (MVUE) UCL	0.036811
97.5% Chebyshev (MVUE) UCL	0.040383
99% Chebyshev (MVUE) UCL	0.047398

95% Non-parametric UCLs	
CLT UCL	0.03298
Adj-CLT UCL (Adjusted for skewness)	0.035526
Mod-t UCL (Adjusted for skewness)	0.033733
Jackknife UCL	0.033336
Standard Bootstrap UCL	0.032834
Bootstrap-t UCL	0.047787
Hall's Bootstrap UCL	0.04736
Percentile Bootstrap UCL	0.033577
BCA Bootstrap UCL	0.036577
95% Chebyshev (Mean, Sd) UCL	0.039992
97.5% Chebyshev (Mean, Sd) UCL	0.044865
99% Chebyshev (Mean, Sd) UCL	0.054437

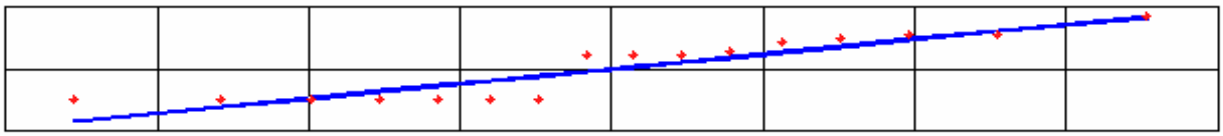
RDX - Shallow Groundwater

Normal Q-Q Plot for RDX



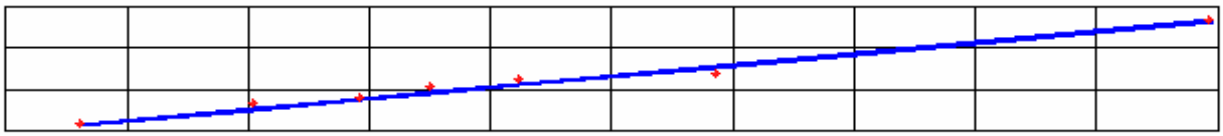
N = 16, Mean = 1.3919, Sd = 1.3965
Slope = 0.9305, Intercept = 0.0000, Correlation, R = 0.89052413
Shapiro-Wilk Statistic = 0.798, Critical Value(0.05) = 0.887, Data not Normal

Lognormal Q-Q Plot for RDX



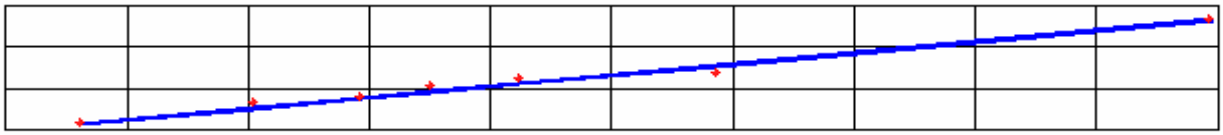
N = 16, Mean = -0.1927, Sd = 1.1104
Slope = 0.9563, Intercept = 0.0000, Correlation, R = 0.91515281
Shapiro-Wilk Statistic = 0.817, Critical Value(0.05) = 0.887, Data not Lognormal

Gamma Q-Q Plot for RDX



N = 16, Mean = 1.392, k hat = 1.0919
Slope = 1.079, Intercept = -0.057, Correlation, R = 0.991
A-D Test Statistic= 1.108, Critical Value(0.05) = 0.762, Data not Gamma Distributed

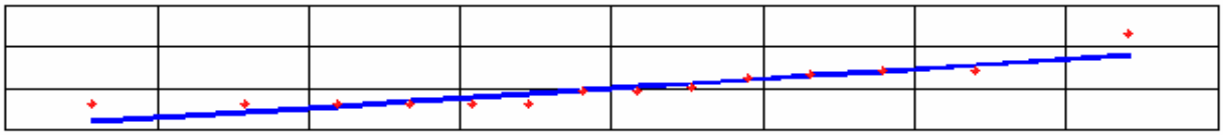
Gamma Q-Q Plot for RDX



N = 16, Mean = 1.392, k hat = 1.092
Slope = 1.079, Intercept = -0.057, Correlation, R = 0.991
K-S Test Statistic = 0.285, Critical Value(0.05) = 0.221, Data not Gamma Distributed

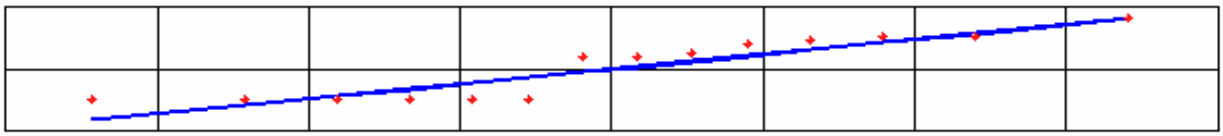
RDX - Shallow Groundwater

Normal Q-Q Plot for RDX



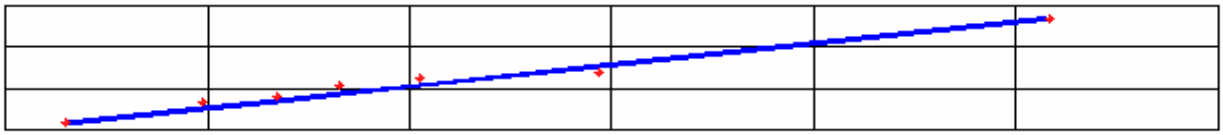
N = 14, Mean = 1.4829, Sd = 1.4633
Slope = 0.9453, Intercept = 0.0000, Correlation, R = 0.90067830
Shapiro-Wilk Statistic = 0.814, Critical Value(0.05) = 0.874, Data not Normal

Lognormal Q-Q Plot for RDX



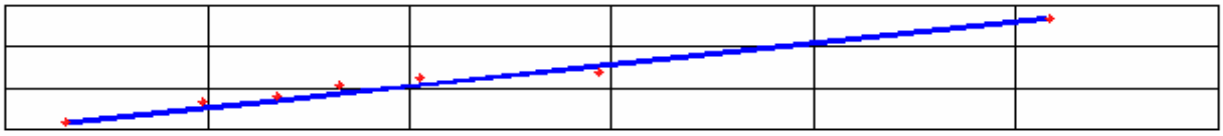
N = 14, Mean = -0.1399, Sd = 1.1418
Slope = 0.9619, Intercept = 0.0000, Correlation, R = 0.91645324
Shapiro-Wilk Statistic = 0.817, Critical Value(0.05) = 0.874, Data not Lognormal

Gamma Q-Q Plot for RDX



N = 14, Mean = 1.483, k hat = 1.0725
Slope = 1.051, Intercept = -0.014, Correlation, R = 0.989
A-D Test Statistic= 0.966, Critical Value(0.05) = 0.759, Data not Gamma Distributed

Gamma Q-Q Plot for RDX



N = 14, Mean = 1.483, k hat = 1.072
Slope = 1.051, Intercept = -0.014, Correlation, R = 0.989
K-S Test Statistic = 0.282, Critical Value(0.05) = 0.235, Data not Gamma Distributed

RDX - Shallow Groundwater

Data File

Variable: RDX

Raw Statistics	
Number of Valid Samples	14
Number of Unique Samples	7
Minimum	0.26
Maximum	5.3
Mean	1.482857
Median	1.25
Standard Deviation	1.463307
Variance	2.141268
Coefficient of Variation	0.986816
Skewness	1.41013

Gamma Statistics	
k hat	1.072461
k star (bias corrected)	0.890267
Theta hat	1.382668
Theta star	1.665632
nu hat	30.02891
nu star	24.92748
Approx.Chi Square Value (.05)	14.55436
Adjusted Level of Significance	0.03122
Adjusted Chi Square Value	13.51114

Log-transformed Statistics	
Minimum of log data	-1.347074
Maximum of log data	1.667707
Mean of log data	-0.139934
Standard Deviation of log data	1.141819
Variance of log data	1.30375

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.814046
Shapiro-Wilk 5% Critical Value	0.874
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	2.175443

Gamma Distribution Test	
A-D Test Statistic	0.965682
A-D 5% Critical Value	0.758611
K-S Test Statistic	0.282016
K-S 5% Critical Value	0.234782
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	2.539712
Adjusted Gamma UCL	2.735808

Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.817473
Shapiro-Wilk 5% Critical Value	0.874
Data not lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	4.374483
95% Chebyshev (MVUE) UCL	3.837633
97.5% Chebyshev (MVUE) UCL	4.824289
99% Chebyshev (MVUE) UCL	6.762384

95% Non-parametric UCLs	
CLT UCL	2.126135
Adj-CLT UCL (Adjusted for skewness)	2.283623
Mod-t UCL (Adjusted for skewness)	2.200008
Jackknife UCL	2.175443
Standard Bootstrap UCL	2.103321
Bootstrap-t UCL	2.40359
Hall's Bootstrap UCL	2.529171
Percentile Bootstrap UCL	2.118571
BCA Bootstrap UCL	2.484286
95% Chebyshev (Mean, Sd) UCL	3.187559
97.5% Chebyshev (Mean, Sd) UCL	3.925184
99% Chebyshev (Mean, Sd) UCL	5.374107

RECOMMENDATION

Data are Non-parametric (0.05)

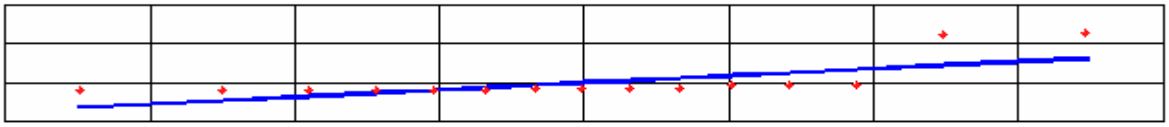
Use 99% Chebyshev (Mean, Sd) UCL

Recommended UCL exceeds the maximum observation

Consider using 95% or 97.5% Chebyshev (Mean, Sd) UCL

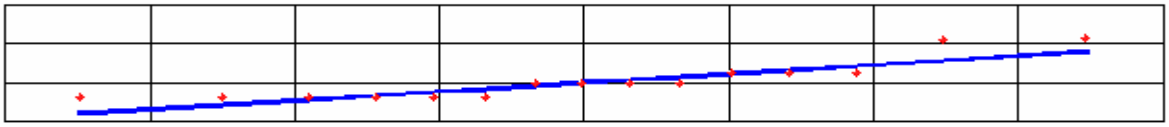
Arsenic - Shallow Groundwater

Normal Q-Q Plot for Arsenic



N = 15, Mean = 8.3000, Sd = 15.4441
Slope = 0.7303, Intercept = 0.0000, Correlation, R = 0.69746213
Shapiro-Wilk Statistic = 0.495, Critical Value(0.05) = 0.881, Data not Normal

Lognormal Q-Q Plot for Arsenic

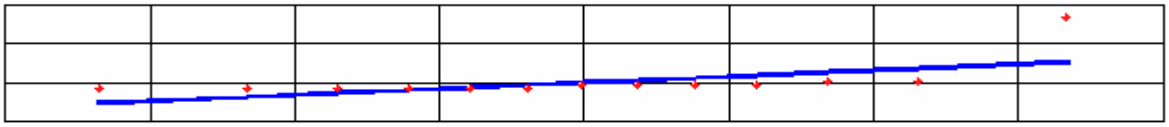


N = 15, Mean = 1.1308, Sd = 1.2481
Slope = 0.9256, Intercept = 0.0000, Correlation, R = 0.88392267
Shapiro-Wilk Statistic = 0.774, Critical Value(0.05) = 0.881, Data not Lognormal

Gamma Q-Q Plot for Arsenic

N = 15, Mean = 8.300, k hat = 0.6235
Slope = 1.461, Intercept = -3.065, Correlation, R = 0.909
A-D Test Statistic= 2.148, Critical Value(0.05) = 0.784, Data not Gamma Distributed

Normal Q-Q Plot for Arsenic



N = 13, Mean = 5.7308, Sd = 12.5688
Slope = 0.6385, Intercept = 0.0000, Correlation, R = 0.60675738
Shapiro-Wilk Statistic = 0.399, Critical Value(0.05) = 0.866, Data not Normal

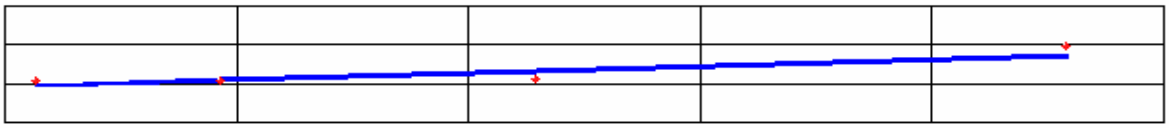
Lognormal Q-Q Plot for Arsenic

Arsenic - Shallow Groundwater

Lognormal Q-Q Plot for Arsenic

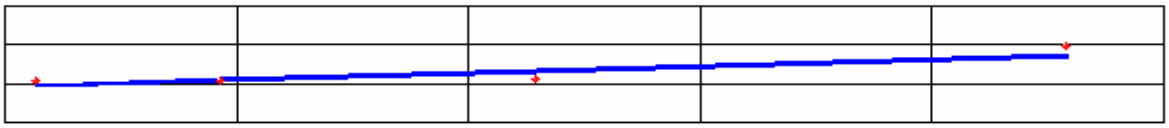
N = 13, Mean = 0.8881, Sd = 1.0667
Slope = 0.8976, Intercept = 0.0000, Correlation, R = 0.85291197
Shapiro-Wilk Statistic = 0.740, Critical Value(0.05) = 0.866, Data not Lognormal

Gamma Q-Q Plot for Arsenic



N = 13, Mean = 5.731, k hat = 0.7040
Slope = 1.767, Intercept = -3.637, Correlation, R = 0.869
A-D Test Statistic= 2.080, Critical Value(0.05) = 0.774, Data not Gamma Distributed

Gamma Q-Q Plot for Arsenic



N = 13, Mean = 5.731, k hat = 0.704
Slope = 1.767, Intercept = -3.637, Correlation, R = 0.869
K-S Test Statistic = 0.331, Critical Value(0.05) = 0.247, Data not Gamma Distributed

Data File

Variable: Arsenic

Raw Statistics	
Number of Valid Samples	13
Number of Unique Samples	4
Minimum	1.1
Maximum	47.3
Mean	5.730769
Median	2.65
Standard Deviation	12.5688
Variance	157.9748
Coefficient of Variation	2.193214
Skewness	3.527507
Gamma Statistics	
k hat	0.704019

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.39935
Shapiro-Wilk 5% Critical Value	0.866
Data not normal at 5% significance level	
95% UCL (Assuming Normal Distribution)	
Student's-t UCL	11.94375
Gamma Distribution Test	
A-D Test Statistic	2.079682
A-D 5% Critical Value	0.773922
K-S Test Statistic	0.33096
K-S 5% Critical Value	0.246595
Data do not follow gamma distribution	

Arsenic - Shallow Groundwater

k star (bias corrected)	0.592835
Theta hat	8.140079
Theta star	9.666719
nu hat	18.30449
nu star	15.41371
Approx.Chi Square Value (.05)	7.548984
Adjusted Level of Significance	0.03009
Adjusted Chi Square Value	6.77837

Log-transformed Statistics

Minimum of log data	0.09531
Maximum of log data	3.85651
Mean of log data	0.888114
Standard Deviation of log data	1.066658
Variance of log data	1.137759

RECOMMENDATION

Data are Non-parametric (0.05)

Use 99% Chebyshev (Mean, Sd) UCL

at 5% significance level

95% UCLs (Assuming Gamma Distribution)

Approximate Gamma UCL	11.70123
Adjusted Gamma UCL	13.03151

Lognormal Distribution Test

Shapiro-Wilk Test Statisitic	0.739917
Shapiro-Wilk 5% Critical Value	0.866

Data not lognormal at 5% significance level

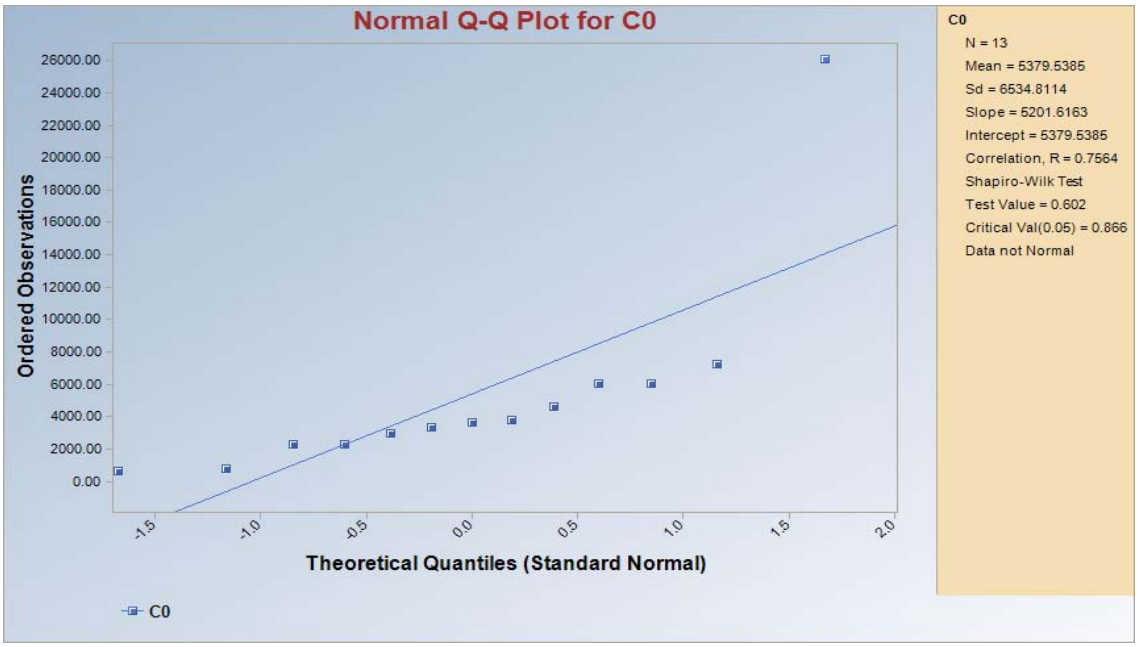
95% UCLs (Assuming Lognormal Distribution)

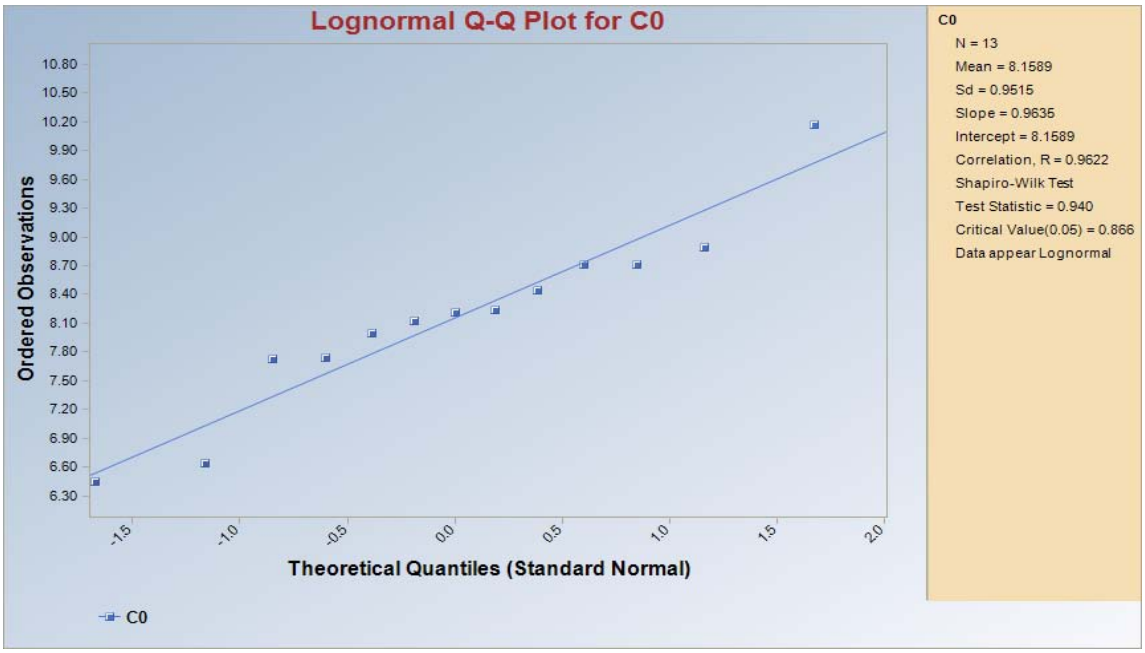
95% H-UCL	10.73037
95% Chebyshev (MVUE) UCL	9.677879
97.5% Chebyshev (MVUE) UCL	12.11941
99% Chebyshev (MVUE) UCL	16.91533

95% Non-parametric UCLs

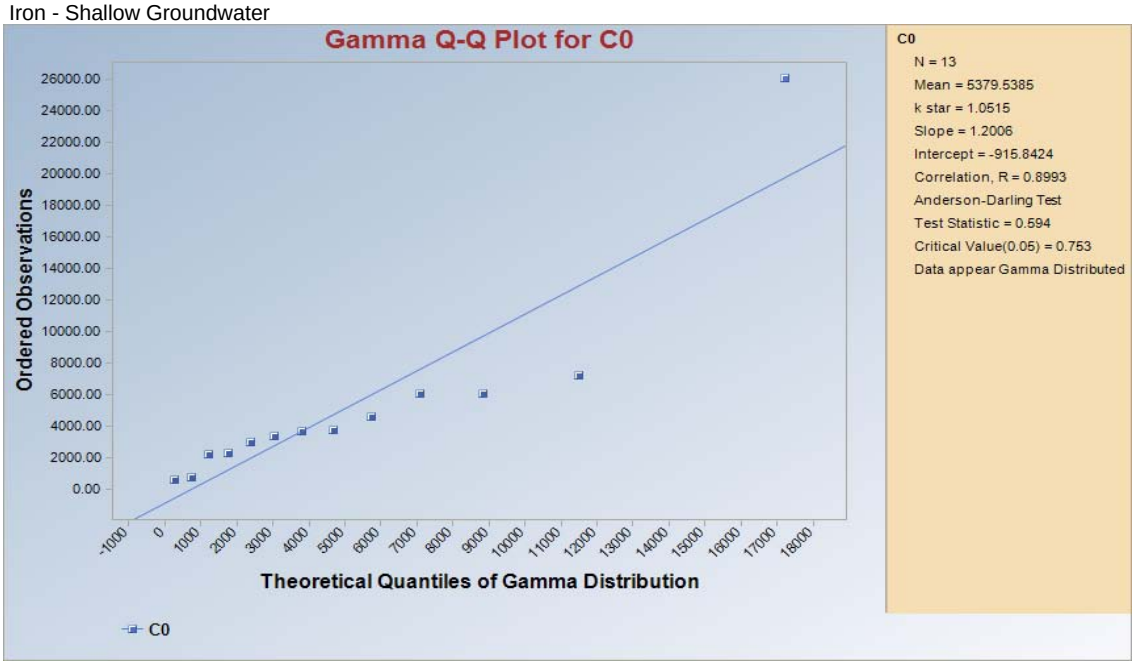
CLT UCL	11.46466
Adj-CLT UCL (Adjusted for skewness)	15.10883
Mod-t UCL (Adjusted for skewness)	12.51217
Jackknife UCL	11.94375
Standard Bootstrap UCL	N/R
Bootstrap-t UCL	N/R
Hall's Bootstrap UCL	N/R
Percentile Bootstrap UCL	N/R
BCA Bootstrap UCL	N/R
95% Chebyshev (Mean, Sd) UCL	20.92571
97.5% Chebyshev (Mean, Sd) UCL	27.50057
99% Chebyshev (Mean, Sd) UCL	40.41562

Iron - Shallow Groundwater





Iron - Shallow Groundwater



General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

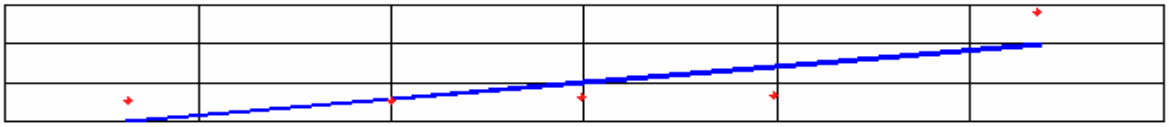
Iron

General Statistics			
Number of Valid Samples	13	Number of Unique Samples	13
Raw Statistics		Log-transformed Statistics	
Minimum	634	Minimum of Log Data	6.452
Maximum	26100	Maximum of Log Data	10.17
Mean	5380	Mean of log Data	8.159
Median	3680	SD of log Data	0.952
SD	6535		
Coefficient of Variation	1.215		
Skewness	3.038		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.602	Shapiro Wilk Test Statistic	0.94
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	8610	95% H-UCL	11774
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	11720
95% Adjusted-CLT UCL	9992	97.5% Chebyshev (MVUE) UCL	14522
95% Modified-t UCL	8864	99% Chebyshev (MVUE) UCL	20026
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.051	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	5116		
nu star	27.34		
Approximate Chi Square Value (.05)	16.41	Nonparametric Statistics	

Adjusted Level of Significance	0.0301	95% CLT UCL	8361
Adjusted Chi Square Value	15.22	95% Jackknife UCL	8610
		95% Standard Bootstrap UCL	8252
Anderson-Darling Test Statistic	0.594	95% Bootstrap-t UCL	13847
Anderson-Darling 5% Critical Value	0.753	95% Hall's Bootstrap UCL	20513
Kolmogorov-Smirnov Test Statistic	0.181	95% Percentile Bootstrap UCL	8643
Kolmogorov-Smirnov 5% Critical Value	0.242	95% BCA Bootstrap UCL	10403
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	13280
		97.5% Chebyshev(Mean, Sd) UCL	16698
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	23413
95% Approximate Gamma UCL	8960		
95% Adjusted Gamma UCL	9664		
Potential UCL to Use		Use 95% Approximate Gamma UCL	8960

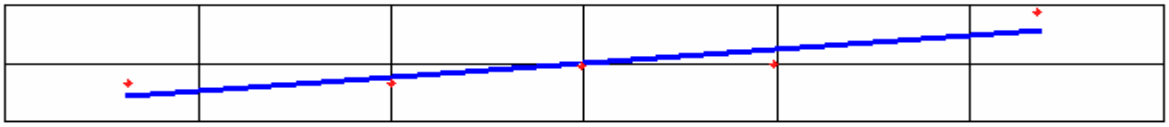
Molybdenum - Shallow Groundwater

Normal Q-Q Plot for Molybdenum



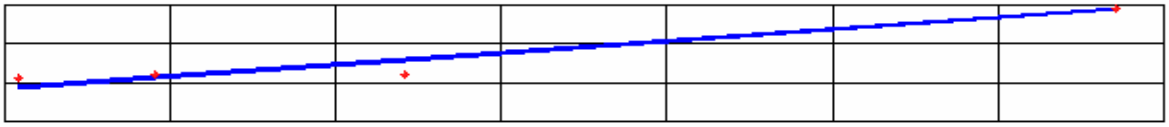
N = 5, Mean = 4.8000, Sd = 7.8965
Slope = 0.8441, Intercept = 0.0000, Correlation, R = 0.76417501
Shapiro-Wilk Statistic = 0.604, Critical Value(0.05) = 0.762, Data not Normal

Lognormal Q-Q Plot for Molybdenum



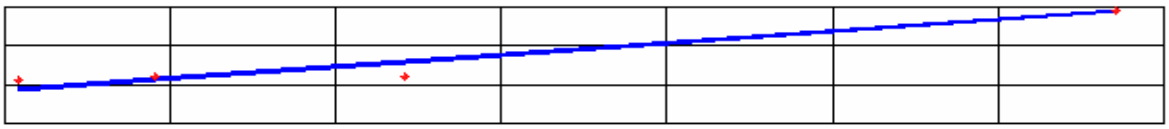
N = 5, Mean = 0.7223, Sd = 1.2997
Slope = 0.9703, Intercept = 0.0000, Correlation, R = 0.87837055
Shapiro-Wilk Statistic = 0.781, Critical Value(0.05) = 0.762, Data are Lognormal

Gamma Q-Q Plot for Molybdenum



N = 5, Mean = 4.800, k hat = 0.7123
Slope = 1.534, Intercept = -1.492, Correlation, R = 0.956
A-D Test Statistic= 0.839, Critical Value(0.05) = 0.700, Data not Gamma Distributed

Gamma Q-Q Plot for Molybdenum



N = 5, Mean = 4.800, k hat = 0.712
Slope = 1.534, Intercept = -1.492, Correlation, R = 0.956
K-S Test Statistic = 0.415, Critical Value(0.05) = 0.367, Data not Gamma Distributed

Data File Variable: Molybdenum

Molybdenum - Shallow Groundwater

Raw Statistics	
Number of Valid Samples	5
Number of Unique Samples	4
Minimum	0.8
Maximum	18.9
Mean	4.8
Median	1.7
Standard Deviation	7.896518
Variance	62.355
Coefficient of Variation	1.645108
Skewness	2.21576

Gamma Statistics	
k hat	0.712322
k star (bias corrected)	0.418262
Theta hat	6.738527
Theta star	11.47606
nu hat	7.123218
nu star	4.182621
Approx.Chi Square Value (.05)	0.794836
Adjusted Level of Significance	0.0086
Adjusted Chi Square Value	0.335093

Log-transformed Statistics	
Minimum of log data	-0.223144
Maximum of log data	2.939162
Mean of log data	0.722258
Standard Deviation of log data	1.299715
Variance of log data	1.689259

RECOMMENDATION

Data are lognormal (0.05)

Use 95% Chebyshev (MVUE) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.603667
Shapiro-Wilk 5% Critical Value	0.762
Data not normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	12.32847

Gamma Distribution Test	
A-D Test Statistic	0.839192
A-D 5% Critical Value	0.700166
K-S Test Statistic	0.415218
K-S 5% Critical Value	0.367416
Data do not follow gamma distribution	
at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	25.25877
Adjusted Gamma UCL	59.91353

Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.781082
Shapiro-Wilk 5% Critical Value	0.762
Data are lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	273.1717
95% Chebyshev (MVUE) UCL	12.72519
97.5% Chebyshev (MVUE) UCL	16.58645
99% Chebyshev (MVUE) UCL	24.17114

95% Non-parametric UCLs	
CLT UCL	10.60869
Adj-CLT UCL (Adjusted for skewness)	14.3478
Mod-t UCL (Adjusted for skewness)	12.91169
Jackknife UCL	12.32847
Standard Bootstrap UCL	N/R
Bootstrap-t UCL	N/R
Hall's Bootstrap UCL	N/R
Percentile Bootstrap UCL	N/R
BCA Bootstrap UCL	N/R
95% Chebyshev (Mean, Sd) UCL	20.19315
97.5% Chebyshev (Mean, Sd) UCL	26.85378
99% Chebyshev (Mean, Sd) UCL	39.93729