Technical Memorandum Update

Appendix 7

Hazardous and Contaminated Materials

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Appendix 7

Hazardous and Contaminated Materials

INTRODUCTION

A Phase I Environmental Site Assessment (ESA) was completed for the 5-mile Crystal City Potomac Yard (CCPY) transitway corridor in October 2006; see Appendix 7 of the 2007 Documented Categorical Exclusion (DCE) on attached CD.

In the analysis, the study area for the assessment of hazardous and contaminated materials was defined as 100 feet on either side of the planned alignment. Although sites located outside the 100-foot study area can be impacted, this study area was chosen to include potential sites within or immediately adjacent to the planned alignment due to the relatively limited construction foreseen for the project.

CURRENT USE OF ADJOINING PROPERTIES

Land use conditions along the Section B corridor are urban with a mix of commercial and residential land uses. Most of the corridor has been disturbed over the years to make way for the various developments that exist including the large railyard that once operated in the study area. Only minor natural environment areas exist within the study area.

East of Section B is the CSX rail right-of-way, WMATA right-of-way, and the George Washington Memorial Parkway and the Potomac Yard Area. The Potomac Yard area is and will be occupied by mixed-use development, parts of which are still under construction. West of Section B is the Del Ray and Oakville neighborhoods of Alexandria, higher density residential neighborhoods, fronted by commercial and light industrial land uses along US Route 1.

DOCUMENT REVIEW

The update approach involved the review of technical analyses developed for the transitway study area in 2006 to verify previous findings, and subsequent investigations completed by the City of Alexandria for the adjacent Potomac Yard area in 2010:

- Northern Virginia Transportation Commission, Arlington County Government, and Washington Metropolitan Area Transit Authority, *Crystal City / Potomac Yard Corridor Transit Improvements Project Phase I Environmental Site Assessment Hazardous and Contaminated Materials Technical Memorandum*, October 2006
- ECS LLC Mid-Atlantic, *Phase II And Risk Assessment Potomac Yards Landbay I & J, Alexandria, Virginia, ECS Project No. 9676-S For Potomac Yard Development,* May 3, 2010. The document is provided as Attachment 1 to this appendix.

FINDINGS

There is no property within the proposed limits of transitway construction where known contaminated or hazardous materials exist. There are properties in the project vicinity with hazardous materials.

A Phase I Environmental Site Assessment (ESA) was conducted as part of the 2006-2007 Documented Categorical Exclusion (see Appendix 7 of the 2007 DCE, attached CD). The ESA identified no properties within or adjacent to Section B of the proposed transitway where further, Phase II analysis is warranted.

As part of a subsequent, independent study, a Phase II ESA was conducted in the area east of US Route 1 between Swann and Howell Avenues (Site Characterization Report and Risk Assessment for Potomac Yard Landbay I & J). This assessment identified the presence of contaminants and recommended that the land developer follow Best Management Practices for protection of workers and the community during development of those parcels.

The shallow level of excavation required for the transitway project, the location of proposed transitway construction in the existing northbound lanes of US Route 1, and the historic location of the rail yard to the east of the US Route 1 right-of-way combine to limit the potential for exposure to contaminated or hazardous materials. See Appendix 7 for Technical Memorandum Update for Hazardous Materials.

In addition, as with any linear project, environmental sampling investigations will be completed in conjunction with the advancement of the geotechnical borings during preliminary design to get a better understanding of the conditions within the limits and depths of work to determine the presence/absence of any contaminated or hazardous materials. Soil and/or groundwater samples will be collected spatially along the proposed alignment to anticipated depths of construction to better quantify the potential impacts within the proposed alignment. Pre-determining the soil type will provide for upfront knowledge for any potential handling or off-site disposal issues. Additional sampling frequency will be completed at areas if extensive grading and soil volumes occur during construction.

The contaminants identified are of low enough concentrations that leaving them as is, capping the soils, and/or “natural attenuation” processes are appropriate. Unless disturbed, no further action would be needed. However, should a surplus of soil be generated during construction that cannot be reused on-site, it may require additional testing before being handled and disposed of off-site in accordance with all Federal, State and local requirements.

Environmental contamination has been documented within the footprint of Potomac Yard, a former rail yard in the vicinity of Section B of the CCPY transitway. FTA has requested the City of Alexandria provide a plan to address health and safety matters that might be associated with the project, and its proximity to Potomac Yard. The City of Alexandria has agreed to provide this plan.

Attachments

Attachment 1: ECS LLC Mid-Atlantic, *Phase II And Risk Assessment Potomac Yards Landbay I & J, Alexandria, Virginia, ECS Project No. 9676-S For Potomac Yard Development,* May 3, 2010.

PHASE II AND RISK ASSESSMENT
POTOMAC YARDS
LANDBAY I & J
ALEXANDRIA, VIRGINIA

ECS PROJECT NO. 9676-S

FOR

POTOMAC YARD DEVELOPMENT

MAY 3, 2010

May 3, 2010

Mr. Stephen Collins
Potomac Yard Development, LLC
2403 Jefferson Davis Highway
Alexandria, Virginia 22301

ECS Project No. 9676-S

Reference: Site Characterization Report and Risk Assessment, Potomac Yard Landbay I and J, Jefferson Davis Highway, Alexandria, Virginia.

Dear Mr. Collins:

ECS Mid-Atlantic, LLC (ECS) is pleased to provide Potomac Yard Development, LLC with the results of the Phase II and Risk Assessment for the above-referenced property. Our services were provided in accordance with ECS Proposal No. 32804-EP dated October 28, 2009. If you have any questions or comments regarding this report, or any other aspect of the project, please contact us at (703) 471-8400.

Respectfully submitted,

ECS MID-ATLANTIC, LLC

David J. Bookbinder
Environmental Scientist

James D. Succop, C.P.G.
Regional Environmental Director

COMMONWEALTH OF VIRGINIA
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cc: Steve Liam – Bowman Consulting

(DJB/environ/rpt/9000/9676-S-SCR)

SITE CHARACTERIZATION REPORT AND RISK ASSESSMENT
POTOMACY YARD
LANDBAY I & J
ALEXANDRIA, VIRGINIA

ECS PROJECT NO. 9676-S

1.0 BACKGROUND

Potomac Yards was a former rail yard, operated by the Richmond Fredericksburg and Potomac (RF&P) railroad from approximately 1906 to 1990. The subject property, Landbay I/J, is located east of Jefferson Davis Highway, to the south of Swann Avenue and to the north of Howell Avenue in Alexandria, Virginia. The property is located south of the former Central Operations Area for the rail yard. Activities in the Central Operations Area included refueling of diesel locomotives, repair, maintenance, servicing, and cleaning. There were a minimum of eight underground storage tanks located in and around the Central Operations Area, and also four large 25,000-gallon aboveground diesel tanks. Surface spills, releases from underground tanks, and runoff from repair and maintenance activities contributed to subsurface petroleum contamination beneath large portions of the Potomac Yards site.

Based on previous environmental investigations conducted across the Potomac Yards site, much of the shallow fill used to level the rail yard appears to have been contaminated with petroleum products and/or heavy metals when it was placed. Cinder ballast, the bottom ash left over from coal burning, was used as fill material throughout large portions of the Potomac yards property. Cinder ballast commonly contains elevated levels of lead and arsenic. There is no definable pattern to the use of cinder ballast as fill; it was used to fill in holes and depressions along with other fill materials, resulting in pockets and layers of cinder ballast interspersed with other fill across the site.

Site development will consist of the construction of slab on-grade townhouses. The majority of the property will be occupied by these structures. However, areas not occupied by these structures will be covered with at least two feet of clean fill or hardscape.

In March 2004, ECS conducted a subsurface investigation on Landbays G through L. During that investigation, seven borings were advanced on the subject property to a depth of 20 feet below surface grade. Two soil samples from each boring were sent to an independent laboratory for analysis of total petroleum hydrocarbons diesel and gasoline range organics (TPH DRO and GRO), volatile organic compounds (VOCs), polychlorinated byphenols (PCBs) and RCRA 8 metals. The following tables summarize the results from the 2004 sampling.

Summary of Soil Analytical Results
(Samples collected March 2004)

Boring and depth of soil sample	DRO (mg/kg)	GRO (mg/kg)	VOCs (ug/kg)	PCBs (ug/kg)
ECS-11 – 5'	--	--	Carbon Disulfide = 34	--
ECS-11 – 15'	--	--	--	--
ECS-12 – 3'	**461**	--	--	--
ECS-12 – 10'	27	--	--	--
ECS-14 – 5'	**242**	--	--	--
ECS-14 – 15'	--	--	Acetone = 30	--
ECS-16 – 4'	**184**	--	Acetone = 73	--
ECS-16 – 12'	--	--	Acetone = 13	--
ECS-17 – 6'	**52**	--	Acetone = 17	--
ECS-17 – 18'	--	--	Acetone = 18	--
ECS-18 – 5'	--	--	Acetone = 17	--
ECS-18 – 15'	45	--	Acetone = 16	--
ECS-19 – 3'	**587**	--	Acetone = 74	--
ECS-19 – 10'	--	--	Acetone = 13	--

Notes: -- = not detected at or above the analytical detection limit.
mg/kg = milligrams per kilogram, equivalent to parts per million (ppm)
ug/kg = micrograms per kilogram, equivalent to parts per billion (ppb).
Concentrations in bold represent DRO concentrations above 50 ppm that cannot be reused as clean fill per restrictions noted on 9 VAC 20-80-700 "Soil contaminated with petroleum products."

Summary of Soil Analytical Results (continued)
(Samples collected March 2004)

Boring and depth of soil sample	Arsenic (mg/kg)	Barium (mg/kg)	Chromium (ug/kg)	Lead (ug/kg)	Mercury (mg/kg)
ECS-11 – 5'	**72.9**	95.8	43.4	66.7	--
ECS-11 – 15'	**7.8**	123	24	33.8	--
ECS-12 – 3'	**337**	79	42.4	112	0.057
ECS-12 – 10'	**5**	45.9	16.3	6.1	--
ECS-14 – 5'	**451**	117	15.2	248	--
ECS-14 – 15'	**5.1**	74.1	22.5	8	--
ECS-16 – 4'	**16.2**	36.2	11.5	23.2	--
ECS-16 – 12'	**4.9**	74.4	13.4	8.8	--
ECS-17 – 6'	**65.1**	89.1	18.5	41.1	0.051
ECS-17 – 18'	--	67	17	5	--
ECS-18 – 5'	--	17.5	4.2	--	--
ECS-18 – 15'	**2.4**	64.4	23.1	11.6	--
ECS-19 – 3'	**583**	186	76	196	0.27
ECS-19 – 10'	**5.5**	56.1	19.7	9.6	--

Notes: -- = not detected at or above the analytical detection limit.
mg/kg = milligrams per kilogram, equivalent to parts per million (ppm).
Concentrations in bold represent concentrations detected above respective VRP Tier II risk based screening level.

Analysis of the soil samples indicated that DRO was detected in seven of the fourteen soil samples at concentrations ranging from 27 to 587 parts per million (ppm). Of the seven samples with DRO detected, five of the samples were located in the fill material (upper five feet) and was also the location of the more elevated DRO concentrations. Acetone was detected in nine of the fourteen soil samples at concentrations ranging from 13 to 74 parts per billion (ppb), and carbon disulfide was detected in one soil sample (34 ppb). All of the detected VOC concentrations were significantly below their respective Virginia VRP Tier II Risk Based Screening level for a residential setting (4,570 ppb for acetone and 1,520 ppb for carbon disulfide). No other VOC was detected above the laboratory detection limit. PCBs were not detected in any of the soil samples. Barium and chromium were detected in all of the soil samples, arsenic was detected in all but two samples, lead was detected in all but one sample, and mercury was detected in the three samples located in the fill material. Only arsenic was detected above its respective Tier II risk based screening level, and all samples exceeded the screening level. The more elevated concentrations were located in the fill material with significantly lower concentrations located in the natural soils.

2.0 METHODOLOGY

A total of 14 additional borings were advanced on the Landbay I/J property. The boring locations were selected by ECS to create, along with the seven previous borings, three transects spaced along the property where future townhouses will be constructed, and to provide a broad overall look at subsurface environmental conditions beneath the property.

Over the past 3-4 years fill materials from northern portions of the Potomac yards site were brought in and stockpiled on northwestern portion of Landbay I. The stockpile and areas of engineered fill range in thickness from approximately 5 to 25 feet above original surface grades. The imported fill soils were tested for petroleum contaminants while they were being imported and placed on the site. In addition, only material which met the criteria for re-use on Potomac Yards as outlined in the original soil management plan were imported from other areas. The DRO sampling and analysis was performed as an additional level of screening. The soils have since been moisture treated with lime stabilization techniques and extensively reworked onsite. For purposes of this study and future development of the site, the overlying fill soils were considered to be clean fill materials. Therefore, sampling of the four borings advanced on the stockpile for this study began below the approximate depth of the existing fill materials, and included sampling below the original rail yard surface. For example, in areas where there was approximately fifteen feet of new fill, the top fifteen feet of the boring were ignored, and sampling began fifteen feet below the existing surface. A relatively consistent layer of cinder ballast was found in many of the borings at the 0'-6' interval below the original rail yard surface, which was useful for establishing the depth of the original surface before fill placement. The remainder of the site consisted of an at grade parking lot with one structure located on the west-central portion of Landbay I.

Borings were advanced using a track-mounted GeoProbe direct push soil sampler. The GeoProbe uses a hydraulic hammer to push steel macrocore sampling tubes into the ground in five-foot intervals. Continuous soil samples were collected at two-foot intervals from the estimated original surface grade to a depth of 20' below original grade. Boring logs describing the soil types and other observations (staining, odors, etc.) are included here as Appendix II. Samples were collected into clean plastic bags. Each sample was field-screened with a photoionization detector (PID) which measures VOCs. Based on the PID results and soil observations, two samples from each boring were transferred to clean, laboratory grade-glass jars with Teflon lids. The samples were packed on ice and submitted under chain-of-custody protocol to an independent laboratory for analysis of TPH DRO and GRO, VOCs and RCRA 8 metals.

Four of the borings were converted to temporary groundwater sampling points by inserting slotted PVC well screen into the open boreholes and allowing the temporary wells to recharge with groundwater. Adjusting for the presence of overlying fill materials, groundwater was encountered at depths ranging from 12 to 20 feet below the original rail yard surface grade. Saturated soil conditions indicative of groundwater were one to two feet thick in all well locations. One groundwater sample from each of the temporary wells was collected into clean, laboratory-grade glass bottles treated with appropriate preservative. The groundwater samples were packed on ice and transported under chain-of-custody protocol to an independent laboratory for analysis of TPH DRO GRO, VOCs and RCRA 8 metals.

3.0 RESULTS

3.1 Soil Results

Two soil samples from each boring were analyzed for DRO, GRO, VOCs and RCRA 8 metals. The laboratory results for petroleum constituents are summarized in following tables.

Soil Analytical Results
(Samples collected March 2010)

Boring and depth of soil sample	DRO (mg/kg)	GRO (mg/kg)	VOCs (ug/kg)
E-1 – 4'	**280**	--	--
E-1 – 20'	--	--	--
E-2 – 4'	**84**	0.15	Acetone = 26
E-2 – 12'	--	--	--
E-3 – 4'	**371**	--	Acetone = 21
E-3 – 12'	--	--	--
E-4 – 8'	--	--	Acetone = 17
E-4 – 12'	--	--	--
E-5 – 4'	--	--	--
E-5 – 10'	29	--	--
E-6 – 6'	23	--	--

Boring and depth of soil sample	DRO (mg/kg)	GRO (mg/kg)	VOCs (ug/kg)
E-6 – 16'	--	--	Acetone = 12
E-7 – 6'	**55**	--	Acetone = 40 p-Isopropyl toluene = 90
E-7 – 18'	--	--	--
E-8 – 6'	--	--	--
E-8 – 20'	--	--	--
E-9 – 2'	49	--	Acetone = 54
E-9 – 18'	--	--	--
E-10 – 2'	**89**	--	--
E-10 – 14'	--	--	--
E-11 – 2'	**365**	--	--
E-11 – 10'	--	--	Acetone = 20
E-12 – 6'	--	--	Acetone = 13
E-12 – 14'	--	--	Acetone = 13
E-13 – 4'	**165**	--	Acetone = 88
E-13 – 12'	--	--	Acetone = 14
E-14 – 8'	**264**	--	--
E-14 – 16'	--	--	Acetone = 20

Notes: -- = not detected at or above the analytical detection limit.
mg/kg = milligrams per kilogram, equivalent to parts per million (ppm)
ug/kg = micrograms per kilogram, equivalent to parts per billion (ppb).
Concentrations in bold represent DRO concentrations above 50 ppm that cannot be reused as clean fill per restrictions noted on 9 VAC 20-80-700 "Soil contaminated with petroleum products."

Petroleum

Petroleum compounds were detected in 11 of the 28 soil samples submitted for this investigation. The primary contaminant of concern with regard to the eventual development of the site is TPH DRO. The diesel range organics include diesel fuel, lubricating oil, hydraulic oils and other heavy petroleum products. A relatively low concentration of gasoline range organics was identified in one sample. The TPH DRO concentrations were primarily detected in the fill material located between original surface grade and six feet below original surface grade. TPH DRO was only detected in two samples analyzed beneath the fill material.

Volatile Organic Compounds

No VOCs were detected above the laboratory detection with the exception of acetone, which was detected in 12 of the 28 samples analyzed at concentrations ranging from 12 to 88 ppb and p-isopropyl toluene, which was detected in one sample at a concentration of 90 ppb. Concentrations for both analytes were significantly below their respective Virginia VRP Tier II (unrestricted/residential) Risk Based Screening Level (RBSL) which is 4,570 ppb for acetone and 17,500 ppb for p-isopropyl toluene. No other VOC was detected above the laboratory detection limit.

Metals

Soil Metal Results
(Samples collected March 2010)

Boring and depth of soil sample	Arsenic (mg/kg)	Barium (mg/kg)	Chromium (ug/kg)	Lead (ug/kg)	Mercury (mg/kg)	Selenium (mg/kg)
E-1 – 4'	**817**	126	22.4	157	0.135	2.37
E-1 – 20'	**1.96**	119	17.9	14.5	--	0.45
E-2 – 4'	**88.7**	69.1	9.22	124	0.132	0.74
E-2 – 12'	**2.79**	30.2	13.6	7.22	--	0.52
E-3 – 4'	**504**	119	18.2	129	**0.882**	0.75
E-3 – 12'	**3.73**	13.9	3.74	2.87	--	--
E-4 – 8'	**3.69**	25.0	13.5	7.38	--	--
E-4 – 12'	**4.53**	85.3	13.9	11.7	--	--
E-5 – 4'	**3.01**	48.6	10.3	7.42	--	--
E-5 – 10'	**3.41**	59.7	13.2	8.77	--	--
E-6 – 6'	**11.6**	67.1	12.1	11.8	--	0.53
E-6 – 16'	**4.76**	88.0	12.3	13.4	--	0.48
E-7 – 6'	**3.75**	59.0	13.5	16.1	--	--
E-7 – 18'	**1.78**	107	17.0	13.5	--	0.49
E-8 – 6'	**0.63**	28.9	7.27	4.20	--	--
E-8 – 20'	**2.96**	99.7	16.2	11.6	--	--
E-9 – 2'	**74.5**	55.5	9.80	14.3	--	--
E-9 – 18'	**0.96**	168	17.6	12.0	--	0.78
E-10 – 2'	**62.3**	58.7	12.2	66.8	--	0.62
E-10 – 14'	**3.58**	45.1	17.6	8.50	--	--
E-11 – 2'	**108**	51.5	12.0	58.3	--	0.88
E-11 – 10'	**1.99**	34.5	6.89	6.04	--	--
E-12 – 6'	**5.05**	116	12.7	10.5	--	--
E-12 – 14'	**4.70**	79.3	13.8	75.3	--	0.66
E-13 – 4'	**89.5**	74.6	24.6	76.8	--	0.44
E-13 – 12'	**3.32**	62.7	12.3	11.9	--	0.45
E-14 – 8'	**142**	128	11.6	203	0.101	3.15
E-14 – 16'	**4.93**	78.1	13.6	9.92	--	--

Notes: -- = not detected at or above the analytical detection limit.
mg/kg = milligrams per kilogram, equivalent to parts per million (ppm).
Concentrations in bold represent concentrations detected above respective VRP Tier II risk based screening level.

Arsenic concentrations ranged from 0.63 mg/kg to 817 mg/kg in samples analyzed from the fill material and 0.96 mg/kg to 4.93 mg/kg in samples analyzed below the fill material. For comparison purposes, the Virginia VRP Tier II RBSL for arsenic is 0.39 mg/kg; however, natural background concentrations of arsenic in soil in this geologic area can range up to 25-30 mg/kg or higher in some areas. Eight of the thirteen fill material samples tested had arsenic concentrations that were elevated above such local background levels.

Lead concentrations ranged from 4.2 mg/kg to 203 mg/kg. None of the 28 samples exceeded the Virginia VRP Tier II RBSL for lead of 270 mg/kg.

Mercury was detected in five of the fill material samples at concentrations ranging from 0.101 mg/kg to 0.882 mg/kg. The Virginia VRP Tier II RBSL for mercury is 0.43 mg/kg. Only one of the detected mercury concentrations was found to exceed the Virginia risk-based standard.

3.2 Groundwater Results

Groundwater was encountered at depths ranging from 12 to 20 below original surface grade. Four of the borings were converted into temporary monitoring wells (E-6, E-7, E-8 and E-10). A groundwater sample was collected from each of the wells and analyzed for DRO, GRO, VOCs and RCRA 8 metals. Only 80 milliliters of water was able to be collected from E-8, and therefore, only DRO was analyzed. The laboratory results are summarized in following table.

Groundwater Analytical Results
(Samples collected March 2010)

Boring	DRO (mg/L)	GRO (ug/L)	VOCs (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Cadmium (ug/L)	Chromium (ug/L)
E-6	--	--	--	--	54	--	--
E-7	0.70	--	p-Isopropyl toluene = 49	--	245	--	--
E-8	--	NA	NA	NA	NA	NA	NA
E-10	--	--	--	6	57	1	1

Notes: -- = not detected at or above the analytical detection limit.
mg/L = milligrams per Liter, equivalent to parts per million (ppm).
ug/L = micrograms per Liter, equivalent to parts per billion (ppb).
NA = not analyzed.

Petroleum and VOCs

TPH DRO was detected in one of the four groundwater samples collected for this investigation. E-7 had a DRO concentration of 0.70 mg/L and was located in the southeastern portion of the property. As depicted in the table above, none of the groundwater samples exceeded the 1.0 mg/L VDEQ action level for TPH-DRO in groundwater. The E-7 sample also contained a minor concentration of p-isopropyl toluene (49 ug/L) but did not contain chlorinated solvents or other VOCs of significant concern. The detected concentration of p-isopropyl toluene was below the VRP Tier II risk based screening level 68 ug/L.

Metals

With regard to metals, arsenic (6 ug/L), cadmium (1 ug/L) and chromium (1 ug/L) were detected in one (E-10) of the three groundwater samples analyzed (E-8 only produced 80 mL of water during sampling, and therefore, was only analyzed for TPH DRO). Barium was detected in all three groundwater samples at concentrations ranging from 54 to 245 ug/L. All concentrations for metals detected were below their respective VRP Tier II Risk Based Screening Concentrations for a residential setting.

Future development of the site will consist of the construction of at-grade townhouses. Based on the depth of saturated conditions encountered, groundwater is not expected to be encountered during construction activities. Additionally, the groundwater exposure to future residents or commercial workers will be closed because the City of Alexandria has a prohibition against groundwater extraction for drinking purposes.

4.0 SITE-SPECIFIC RISK ASSESSMENT

The risk assessment methodology follows the VDEQ Voluntary Remediation Program (VRP) guidance. Risk assessments under the VRP guidance generally follow the methodology described in the EPA's Risk Assessment Guidance for Superfund (RAGS). The steps involved in this risk assessment are as follows:

1) Determine the most likely routes of exposure based on site development and future use.
2) Determine an "average" arsenic in soil concentration.
3) Quantify the risk based on VRP standard equations for the exposure route and exposure population that has the potential to present the greatest risk during site development.

4.1 Exposure Routes

As noted above, Potomac Yards Landbay I/J will be developed with slab-on-grade residential townhomes. All of the utility work associated with site development will occur on the developed portion of the site. It is our opinion that the risk pathways that have the greatest potential to present an exposure risk are utility/construction worker exposure to arsenic in soil during site development. Utility/construction workers can be exposed to arsenic and mercury in soil through one of three pathways: dermal contact, ingestion, and inhalation of air-borne dust.

4.2 Determining Soil Concentration

The sampling locations are depicted on the attached figure. Sampling consisted of collecting 42 soil samples and 4 groundwater samples in March 2004 and March 2010.

All of the soil samples collected were analyzed for metals. The deepest utilities will be storm sewers which will have a maximum depth of 6'. Consequently, soil samples collected from depths greater than 6' are below the deepest utility construction depth and were not included. Therefore, arsenic concentrations from 19 of the 42 soil samples were included. Additionally, the one soil sample for mercury that exceeded the VRP Tier II screening level was included.

For VRP risk assessments either the maximum contaminant concentration or the 95% Upper Confidence Limit (UCL) on the arithmetic mean should be used as the exposure concentration. The UCL calculation is justified when the number of samples collected is greater than thirty. A total of 19 soil samples were collected from the on-site borings by ECS in March 2004 and March 2010 at depths between the surface and six feet. Because the total number of soil samples is insufficient to warrant the calculation of a statistical average, the maximum concentration for both arsenic and mercury was used in the risk assessment.

4.3 Risks Posed by Metals in Soil

As noted above, it is our opinion that exposure of utility/construction workers to arsenic and mercury in soil through the pathways of dermal contact, ingestion, or inhalation of air-borne dust has the greatest risk potential during site development. The risk is calculated based on the average concentration in the soil and exposure times that are determined by VRP. The VRP employs the same tables to calculate risk from these three exposure routes. The only difference between utility and construction workers is the duration of their exposure.

The default exposure time for a utility/construction worker is 125 days work days over a one-year period. Based on ECS experience with construction management on similar projects in Alexandria, we believe that one month is the maximum period that a utility trench would be left open and six months is the maximum period that site excavation/grading would occur. Consequently, the risk to an above-ground construction worker would exceed that to a utility worker because of the longer period of exposure. Therefore, we employed 120 working days over a six-month period as the exposure duration. Carcinogenic risk was calculated for only arsenic, while non-carcinogenic risk was calculated for both arsenic and mercury.

The calculated carcinogenic risk for arsenic is summarized below.

Carcinogenic Risk (Soil) – Construction Worker Pathway			
	Dermal	**Ingestion**	**Inhalation**
Arsenic	7.63E-06	2.05E-05	8.58E-10

Likewise, non-carcinogenic hazard quotients are also considered additive. Therefore, the total hazard quotient is calculated by adding the quotients for both arsenic and mercury for all of the open pathways. The quantitative results of the non-carcinogenic hazard quotient assessment for the open pathways are provided in the following table.

Non-Carcinogenic Hazard Quotient (Soil) – Construction Worker Pathway			
	Dermal	**Ingestion**	**Inhalation**
Arsenic	1.19E+00	3.20E+00	9.31E-04
Mercury	8.04E-04	6.47E-03	Note 1
Total Hazard Quotient	**1.19E+00**	**3.21e+00**	**9.31E-04**

Note 1 = No inhalation unit risk factor is listed for this contaminant.

5.0 SUMMARY AND RECOMMENDATIONS

Potomac Yards was a former rail yard, operated by the Richmond Fredericksburg and Potomac (RF&P) railroad from approximately 1906 to 1990. The subject property, Landbay I/J, is located east of Jefferson Davis Highway, to the south of Swann Avenue and to the north of Howell Avenue in Alexandria, Virginia. The property is located south of the former Central Operations Area for the rail yard. Activities in the Central Operations Area included refueling of diesel locomotives, repair, maintenance, servicing, and cleaning. There were a minimum of eight underground storage tanks located in and around the Central Operations Area, and also four large 25,000-gallon aboveground diesel tanks. Surface spills, releases from underground tanks, and runoff from repair and maintenance activities contributed to subsurface petroleum contamination beneath large portions of the Potomac Yards site.

Site development will consist of the construction of slab on-grade townhouses. The majority of the property will be occupied by these structures. However, areas not occupied by these structures will be covered with at least two feet of clean fill or hardscape.

Soil contamination has been identified predominantly within the fill areas of the site (i.e. upper 6 feet). The results of the Phase II study revealed that of the constituents detected, only arsenic (in all samples) and mercury (one sample) exceeded its respective VRP Tier II risk based screening level. The details of the ECS sampling events in 2004 and 2010 were presented above. None of the contaminants detected in the groundwater exceeded their respective VRP Tier II risk based screening concentration.

The primary exposure will be to construction and utility workers whose exposure pathways are dermal, ingestion and inhalation. Therefore, an exposure assessment was performed for the construction and utility workers using the highest concentration for both arsenic and mercury. The results are as follows:

Construction and Utility Workers
Total Carcinogenic Risk and Hazard Quotients from Soil

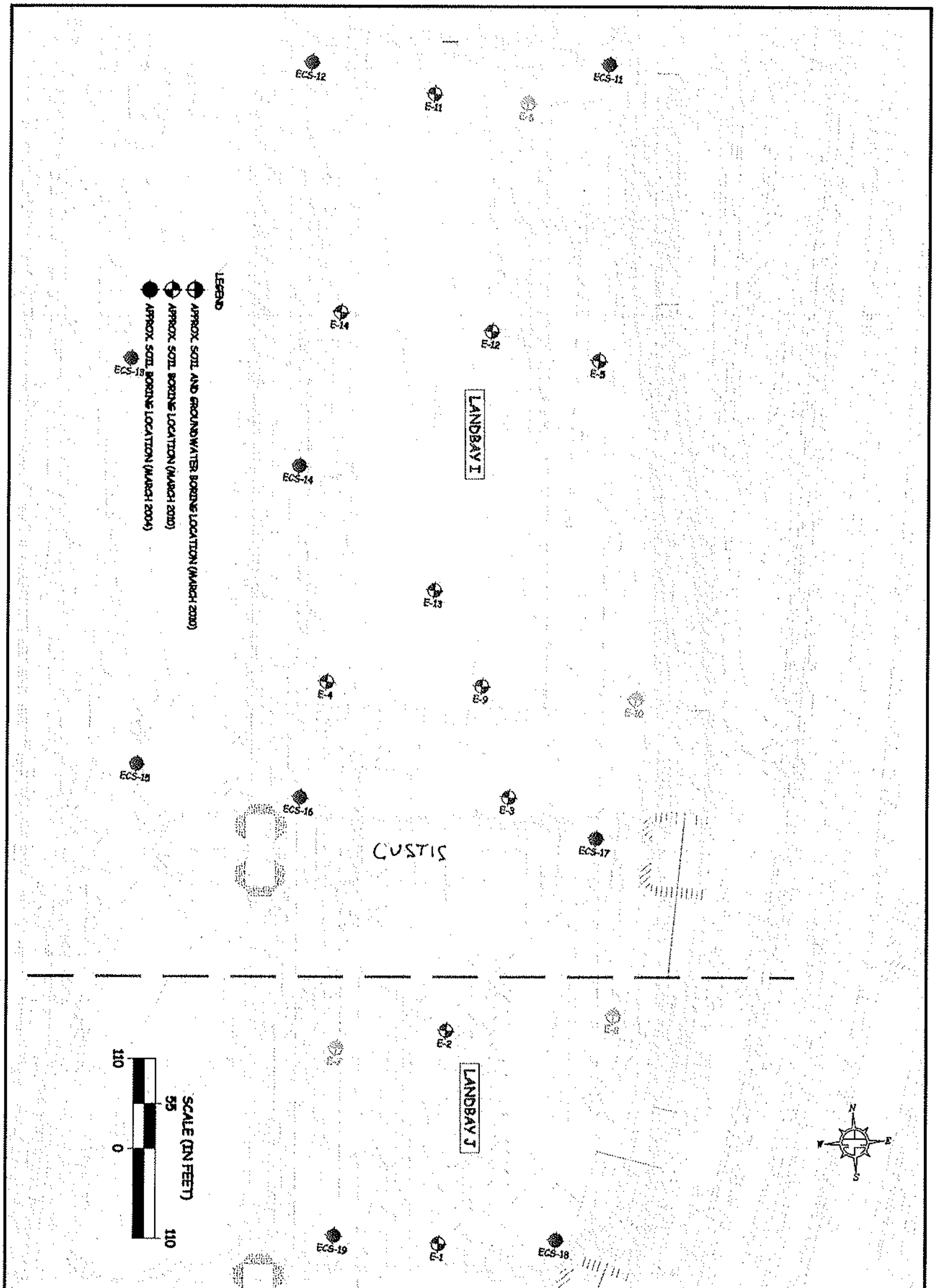
	Dermal	**Ingestion**	**Inhalation**
Total Carcinogenic Risk	7.63E-06	2.05E-05	8.58E-10
Total Hazard Quotient	1.19E+00	3.21E+00	9.31E-04

The total carcinogenic risk for the dermal and ingestion pathways for construction workers exceeds the acceptable risk of $1.0x10^{-6}$, while the inhalation pathway is less than the acceptable risk of $1.0x10^{-6}$. The total non-carcinogenic hazard quotient for the dermal and ingestion pathways exceeds the VRP target quotient of one.

Prior to construction activities, the general contractor will prepare a Health and Safety Plan (HASP). The HASP will include engineering controls to limit the construction workers exposure. These controls may include a prohibition against eating and smoking (i.e. the two primary pathways by which dermal and ingestion occur), and guidelines for on-site dust control, which would consist of site watering. The controls implemented with the HASP would effectively limit worker exposure whereby decrease the risk.

APPENDIX I

FIGURE



DATE 4/4/10 SHEET 1 PROJECT NO. 9676-5 SCALE 1" = 110' ENGINEER DJB DRAFTING RAC ECS REVISIONS DJB 4/7/10	**BORING LOCATION DIAGRAM** **POTOMAC YARD DEVELOPMENT**	ECS LLC MID-ATLANTIC	**POTOMAC YARD LANDBAY I AND J** **ALEXANDRIA, VA**

APPENDIX II

BORING LOGS

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E1

Contractor:	Green Services	Date:	3/29/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
			Asphalt and gravel base.
-1-		0.0	Sandy silt fill material with rock fragments, black and tan, moist and soft.
-2-			
-3-		0.0	
-4-			
-5-		0.0	Sand, orange and light brown, moist and soft.
-6-			
-7-		0.0	
-8-			
-9-		0.0	
-10-			
-11-		0.0	
-12-			
-13-		0.0	
-14-			Sandy clay, reddish brown, moist and tight.
-15-		0.0	
-16-			
			Sandy silt, gray, damp and soft.
-17-		0.0	Marine clay, gray, moist, tight.
-18-			
-19-		0.0	
-20-			
			End of boring at 20'.
-21-			
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☒		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400		SOIL BORING LOG Potomac Yard Landbay I/J		Boring No. E2
Contractor:	Green Services		Date:	3/29/2010
Drill Method:	Direct-Push		ECS Project No.:	9676-S
Sample Method:	Macro-core		ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
			Asphalt and gravel base.
-1-		0.0	Sand and gravel fill material, brown and black, moist and tight.
-2-			
-3-		0.0	
-4-			
-5-		0.0	Silty sand, gray and light brown, moist and tight. Petroleum odor encountered from 3' to 6'.
-6-			
-7-		0.0	
-8-			
-9-		0.0	
-10-			
-11-		0.0	
-12-			Sandy clay, gray and light brown, moist and tight. Saturated conditions encountered from 13 – 13.5' Saturated conditions encountered from 17.5 – 18.5'.
-13-		0.0	
-14-			
-15-		0.0	
-16-			
-17-		0.0	
-18-			
-19-		0.0	Marine clay, gray, moist and tight.
-20-			
			End of boring at 20'.
-21-			
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)	1	Sample Method	
Temporary Piezometer	☒	PVC	☒	Depth (ft)	20	Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)	10	Foot-Valve, Inertial Tube	☒
None	☐		☐	Slot Size (in.)	0.10	Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E3

Contractor:	Green Services	Date:	3/29/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
		0.8	Asphalt and gravel base.
-1-			
			Silty sand fill material, black and brown, moist and tight.
-2-			
		1.1	
-3-			
-4-			
		0.4	Silty sand with small cobbles, brown, moist and tight.
-5-			
-6-			
		0.2	
-7-			Sandy clay, brown, moist and tight.
-8-			
		1.2	Sandy clay, brown and gray, moist and tight.
-9-			
-10-			
		0.9	
-11-			
-12-			Sandy clay, brown and gray, saturated, soft.
		2.0	Sandy clay, brown and gray, moist and tight.
-13-			
-14-			
		3.2	
-15-			Sandy clay, brown and gray, saturated, soft.
-16-			
		0.0	
-17-			
-18-			
		0.0	Silty clay, gray, moist and tight.
-19-			
-20-			
			End of boring at 20'.
-21-			
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E4

Contractor:	Green Services	Date:	3/29/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
-1-		3.2	Asphalt and gravel base. Sandy fill material with cinder ballast, black, dry and loose.
-2-			
-3-		0.0	
-4-			
-5-		0.0	
-6-			
-7-		0.0	Sandy clay with gravel, brown, damp, tight.
-8-			
-9-		0.0	Silty clay, brown and gray, moist and tight.
-10-			
-11-		0.0	Silty sand, brown and gray, saturated, soft.
-12-			Silty sand, brown and gray, damp, soft.
-13-		0.0	Silty sand, brown, saturated, soft.
-14-			
-15-		0.0	
-16-			Sandy clay, gray, moist and tight.
-17-		0.0	Silty clay, gray, saturated, soft.
-18-			Silty clay, gray, moist and tight.
-19-		0.0	
-20-			
-21-			End of boring at 20'.
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E5

Contractor:	Green Services	Date:	3/29/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
-1-		0.0	Asphalt and gravel base. Silty sand fill material with gravel, black and brown, moist and tight.
-2-			
-3-		0.0	
-4-			
-5-		0.0	
-6-			
-7-		0.0	Sandy clay, light brown and gray, moist and tight.
-8-			
-9-		0.0	
-10-			
-11-		0.0	Sandy clay, light brown and gray, damp and soft.
-12-			
-13-		0.0	
-14-			
-15-		0.0	Sandy clay with organic matter, dark gray, moist and tight. Sandy clay with organic matter, dark gray, saturated, soft.
-16-			
-17-		0.0	Silty clay, reddish brown and gray, moist and tight.
-18-			
-19-		0.0	
-20-			
-21-			End of boring at 20'.
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E7

Contractor:	Green Services	Date:	3/30/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
-1-		0.7	Asphalt and gravel base. Sandy fill material with cinder ballast, black, dry and loose.
-2-			
-3-		0.4	
-4-			
-5-		40.0	Sandy clay, brown and gray, moist and tight. Wood.
-6-			Silty sand, brown, moist and soft.
-7-		2.7	
-8-			
-9-		2.6	
-10-			
-11-		1.2	Sand, brown and gray, moist and soft.
-12-			
-13-		2.8	Sand, brown and gray, saturated and soft. Sand, brown and gray, moist and soft.
-14-			
-15-		0.2	Silty clay, gray, moist and tight.
-16-			
-17-		0.0	
-18-			
-19-		0.8	
-20-			
-21-			End of boring at 20'.
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E8

Contractor:	Green Services	Date:	3/30/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
-1-		1.3	Asphalt and gravel base. Sandy fill material with gravel, brown and black, moist and tight.
-2-			
-3-		2.4	Silty sand, brown, moist and tight.
-4-			Sand, light brown, moist and tight.
-5-		0.0	Silty sand, brown, moist and tight.
-6-			
-7-		0.0	Silty sand, brown, saturated and soft.
-8-			
-9-		1.1	Silty sand, gray, moist and tight.
-10-			
-11-		0.0	
-12-			
-13-		0.3	
-14-			
-15-		0.0	Silty clay, gray, damp and soft.
-16-			Silty clay, brown, damp, soft.
-17-		1.7	
-18-			
-19-		0.0	
-20-			End of boring at 20'.
-21-			
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E9

Contractor:	Green Services	Date:	3/30/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
-1-		2.6	Asphalt and gravel base. Sandy silt fill material, black and brown, moist and tight.
-2-			Silty sand, reddish brown, moist and tight.
-3-		0.3	
-4-			Cinder ballast, black, moist, loose.
-5-		1.8	Sandy clay, dark gray and brown, moist and tight.
-6-			
-7-		0.2	
-8-			
-9-		0.7	Silty sand, brown, moist and tight.
-10-			
-11-		1.7	
-12-			
-13-		0.9	
-14-			
-15-		0.9	Silty clay, brown and gray, moist and tight.
-16-			
-17-		1.0	
-18-			
-19-		0.0	
-20-			Silty clay, gray, saturated, soft. End of boring at 20'.
-21-			
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E10

Contractor: Green Services
Drill Method: Direct-Push
Sample Method: Macro-core
Date: 3/30/2010
ECS Project No.: 9676-S
ECS Field Geologist: Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
-1-		5.2	Asphalt and gravel base. Silty sand fill material with gravel and cinder ballast, brown and black, moist and tight.
-2-			
-3-		0.4	
-4-			
-5-		0.0	Sandy clay, brown, moist and tight.
-6-			
-7-		5.3	Silty sand, brown, moist and tight. Sandy clay, light brown and gray, moist and tight.
-8-			
-9-		0.4	Silty sand, brown and gray, moist and tight.
-10-			
-11-		0.0	
-12-			
-13-		5.7	Sandy clay, brown and gray, moist and tight.
-14-			Sandy clay, brown and gray, saturated and soft.
-15-		2.8	Sandy clay, brown and gray, moist and tight.
-16-			
-17-		2.5	Sandy clay, brown and gray, saturated and soft. Marine clay, gray, moist and very tight.
-18-			
-19-		2.1	
-20-			
-21-			End of boring at 20'.
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E11 (on stockpile)

Contractor:	Green Services	Date:	3/30/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
			Clean fill material.
-2-			
-4-			
-6-			
-8-			
-10-			
-12-			
-14-			
-16-			
		3.8	Sandy fill material with cinder ballast, black, damp, loose.
-18-			
		0.3	
-20-			
		0.5	Sandy clay, brown, moist and soft.
-22-			
		0.2	
-24-			
		2.9	Sandy silt, gray and brown, moist and tight.
-26-			
		0.5	
-28-			
		1.8	Silty clay, gray, moist and tight.
-30-			
		1.4	
-32-			
		0.0	Sandy clay, brown, moist and soft. Saturated conditions encountered from 32 – 33'.
-34-			
		0.2	
-36-			
			End of boring at 36'.
-38-			
-40-			
-42-			
-44-			
-46-			
-48-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E12 (on stockpile)

Contractor:	Green Services	Date:	3/30/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
			Clean fill material.
-2-			
-4-			
-6-			
-8-			
-10-			
-12-			
-14-			
-16-		0.0	Silty sand fill material, black and brown, moist and tight.
-18-		2.7	
-20-		0.6	Sandy clay, reddish brown, damp, soft.
-22-		1.1	
-24-		0.9	
			Silty clay, brown and gray, moist and tight.
-26-		0.7	
-28-		3.0	
			Sandy clay, brown and gray, damp and tight. Saturated conditions encountered from 31.5 – 32.5'.
-30-		0.7	
-32-		1.4	
-34-		0.0	Clayey sand, gray, damp and soft.
-36-			End of boring at 35'.
-38-			
-40-			
-42-			
-44-			
-46-			
-48-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E13 (on stockpile)

Contractor:	Green Services	Date:	3/30/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
			Clean fill material.
-2-			
-4-			
-6-			
-8-			
-10-			
-12-			
-14-			
-16-		0.8	Silty sand fill material with rock and brick fragment, brown and black, moist and tight.
-18-		0.8	
-20-		2.6	Clayey sand, reddish brown, moist and tight.
-22-		0.8	
-24-		5.0	Cinder ballast, black, dry and loose.
			Sand clay, brown, moist and tight.
-26-		1.9	
-28-		5.9	Silty clay, gray, damp and soft.
-30-		0.7	
			Silty sand, gray, moist and soft.
-32-		1.2	Silty clay, gray, damp and soft. Saturated conditions encountered from 32 – 33'.
-34-		2.2	
-36-			End of boring at 35'.
-38-			
-40-			
-42-			
-44-			
-46-			
-48-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400		**SOIL BORING LOG** Potomac Yard Landbay I/J	**Boring No.** E14 (on stockpile)
Contractor:	Green Services	Date:	3/30/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
			Clean fill material.
-2-			
-4-			
-6-			
-8-			
-10-			
-12-			
-14-			
-16-		1.5	Sandy fill material with rock fragment and cinder ballast, black and brown, moist and tight.
-18-		2.3	
-20-		3.4	
			Cinder ballast, black, damp and soft.
-22-		2.0	
-24-		0.6	Silty sand, brown, moist and tight.
-26-		1.7	
-28-		0.2	
-30-		0.3	
-32-		0.4	
-34-		2.1	
-36-			End of boring at 35'.
-38-			
-40-			
-42-			
-44-			
-46-			
-48-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)		Sample Method	
Temporary Piezometer	☐	PVC	☐	Depth (ft)		Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)		Foot-Valve, Inertial Tube	☐
None	☐		☐	Slot Size (in.)		Bailer	☐

ECS MID-ATLANTIC, LLC 14026 Thunderbolt Place, Suite 100 Chantilly, Virginia 20151 703-471-8400	SOIL BORING LOG Potomac Yard Landbay I/J	Boring No. E6

Contractor:	Green Services	Date:	3/29/2010
Drill Method:	Direct-Push	ECS Project No.:	9676-S
Sample Method:	Macro-core	ECS Field Geologist:	Mike Johnson

Depth (ft)	Recovery (ft)	PID (ppm)	Soil Description and Notes
			Asphalt and gravel base.
-1-		0.0	Silty sand fill material with gravel, black and brown, moist and tight.
-2-			
-3-		0.0	
-4-			
-5-		0.0	Silty sand, brown, moist and tight. Saturated conditions encountered from 12 – 14'.
-6-			
-7-		0.0	
-8-			
-9-		0.0	
-10-			
-11-		0.0	
-12-			
-13-		0.0	
-14-			
-15-		0.0	Silty clay, light brown and gray, moist and tight.
-16-			
-17-		0.0	
-18-			
-19-		0.0	Marine clay, gray, moist and tight.
-20-			
-21-			End of boring at 20'.
-22-			
-23-			
-24-			

Groundwater Sampling

Well Installed		Casing Type		Casing Dia. (in.)	1	Sample Method	
Temporary Piezometer	☒	PVC	☒	Depth (ft)	20	Peristaltic Pump	☐
Permanent Well	☐	Stainless-Steel	☐	Length (ft)	10	Foot-Valve, Inertial Tube	☒
None	☐		☐	Slot Size (in.)	0.10	Bailer	☐

APPENDIX III

VRP TABLES

A	B	C	D	E	F	G	H	I	J	K	L

Table 3.13
Construction/Utility Worker Dermal Pathway in Soil
Potomac Yards Landbay I/J

Medium:	Soil
Exposure Medium:	Soil
Receptor Population:	Construction Worker
Exposure Route:	Dermal
Receptor Age:	Adult

Intake Equation:
DAD=CS x ABS x IF
Intake Factor Equation:
IF=SA x CF x AF x EF x ED x 1/BW x 1/AT

Parameter Code	Parameter Definition	Units	VRP Default Value	Rationale/ Reference	User Defined Value	Rationale/ Reference
DAD	Dermally Absorbed Dose	mg/kg-day				
CS	Chemical Concentration in Soil	mg/kg				
CF	Conversion Factor	kg/mg	1E-06			
AF	Soil to Skin Adherence Factor	mg/cm^2	0.9 (3)	EPA, 2001		
ABS	Absorption Factor	unitless	Chemical Specific (1)	EPA, 1995 and EPA, 2001		
SA	Skin Surface Area Available for Contact	cm2/day	3,300 (2)	EPA, 2001		
EF	Exposure Frequency	days/years	125	DEQ		
ED	Exposure Duration	years	1	DEQ		
BW	Body Weight	kg	70	DEQ		
AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1991		
AT-N	Averaging Time (Non-Cancer)	days	365	EPA, 1989		
IF-C	Intake Factor (Cancer)	days^-1	2.08E-07	EPA, 1989		
IF-N	Intake Factor (Non-cancer)	days^-1	1.45E-05	calculated		
				calculated		

DEQ= VRP Staff Professional Judgement
EPA, 1989= Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part A)
Office of Emergency and Remedial Response. EPA/540/1-89/002.
EPA, 1991= Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors.
Office of Solid Waste and Emergency Response. OSWER Directive 9285.6-03
EPA, 1995= Assessing Dermal Exposure from Soil. Region III, Office of Superfund Programs
EPA/903-K-95-003.
EPA, 2001= RAGS E, Chapter 3

(1) Absorption Factors are listed on VRP Table 3.23
(2) Represents face, hands, and forearms
(3) Based on soil-to-skin adherence data presented in EPA, 2001for a utility worker
Note the following AF s from RAGS E for site specific scenarios:
groundskeeper AF=0.1
construction worker AF=0.3

Revised 9/23/09 Chemical of Potential Concern	Cancer Classification	Exposure Point Concentration (CS) mg/kg	Dermally Absorbed Dose (Cancer) (DADc) mg/kg-day	Adjusted Dermal Cancer Slope Factor CSFd 1/(mg/kg-day)	Cancer Risk (DADc*CSFd) Dermal unitless	Dermally Absorbed Dose (Non-Cancer) (DADn) mg/kg-day	Adjusted Dermal Reference Dose (chronic) RfDd mg/kg-day	Adjusted Dermal Reference Dose (subchronic) RfDd mg/kg-day	Hazard Quotient (DADn/RfDd) Dermal unitless	Absorption Factor (ABS)
TAL Inorganics										
Arsenic	A	8.17E+02	5.09E-06	1.50E+00	7.63E-06	3.56E-04	3.00E-04	3.00E-04	1.19E+00	3.00E-02
Mercury	D	6.62E-01				1.28E-07	1.60E-04	1.60E-04	8.01E-04	1.00E-02
Total					7.63E-06				1.19E+00	

	B	M	N	O	P	Q	R	S	T	U

Table 3.14
Construction/Utility Worker Ingestion Pathway in Soil
Potomac Yards Landbay I/J

Medium:	Soil
Exposure Medium:	Soil
Receptor Population:	Construction Worker
Exposure Route:	Ingestion
Receptor Age:	Adult

Intake Equation:
CDI = CS x IF
Intake Factor Equation:
IF= IR-S x FI x EF x ED x CF x 1/BW x 1/AT

Parameter Code	Parameter Definition	Units	VRP Default Value	Rationale/ Reference	User Defined Value	Rationale/ Reference
CDI	Chronic Daily Intake	mg/kg-day				
CS	Chemical Concentration in Soil	mg/kg				
CF	Conversion Factor	kg/mg	1E-06			
IR-S	Ingestion Rate - Soil	mg/day	480	EPA,1991		
FI	Fraction Ingested from source	unitless	0.5	DEQ		
EF	Exposure Frequency	days/years	125	DEQ		
ED	Exposure Duration	years	1	DEQ		
BW	Body Weight	kg	70	EPA, 1991		
AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989		
AT-N	Averaging Time (Non-Cancer)	days	365	EPA, 1989		
IF-C	Intake Factor (Cancer)	days^-1	1.68E-08	calculated		
IF-N	Intake Factor (Non-cancer)	days^-1	1.17E-06	calculated		

DEQ= VRP Staff Professional Judgement
EPA, 1989= Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002.
EPA, 1991= Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Office of Solid Waste and Emergency Response. OSWER Directive 9285.6-03
EPA, 2001= Draft SSL Guidance, March 2001

Revised [illegible]

Chemical of Potential Concern	Cancer Classification	Exposure Point Concentration (Oral) (CS) mg/kg	Chronic Daily Intake (Cancer) (CDIc) mg/kg-day	Oral Cancer Slope Factor CSFo (mg/kg-day)^-1	Cancer Risk (CDIc*CSFo) Oral unitless	Chronic Daily Intake (Non-Cancer) (CDIn) mg/kg-day	Oral Reference Dose (chronic) RfDc mg/kg-day	Oral Reference Dose (subchronic) RfDs mg/kg-day	Hazard Quotient (CDIn/RfDs) Oral unitless
(A) Inorganics									
Arsenic	A	8.17E+02	1.37E-05	1.50E+00	2.06E-05	9.58E-04	3.00E-04	3.00E-04	3.20E+00
Mercury	D	8.82E-01				1.04E-06	1.60E-04	1.60E-04	6.47E-03
Total					2.06E-05				

Table 3.15
Construction/Utility Worker Inhalation Pathway in Soil
Potomac Yards Landbay I/J

Medium:	Soil
Exposure Medium:	Air
Receptor Population:	Construction Worker
Exposure Route:	Inhalation
Receptor Age:	Adult

Intake Equation:
EC=(CA x (ET/24hrs/day) x EF x ED)/AT

Parameter Code	Parameter Definition	Units	VRP Default Value	Rationale/ Reference	User Defined Value	Rationale/ Reference
CA	Chemical Concentration in Air	mg/m^3	(1)			
EF	Exposure Frequency	days/year	125	DEQ		
ED	Exposure Duration	years	1	DEQ		
ET	Exposure Time	hours/day	4	DEQ		
AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989		
AT-N	Averaging Time (Non-Cancer)	days	365	EPA, 1989		

DEQ= VRP Staff Professional Judgement
EPA, 1989= Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002.
(1) Ambient air concentrations may be estimated by applying the particulate emission factor (PEF) or volatilization factor (VF) to soil concentrations as described in Soil Screening Guidance: Technical Background Document. U. S. EPA, Office of Solid Waste and Emergency Response. May 1996. (EPA/540/R-95/128) and Soil Screening Guidance: User's Guide. U.S.EPA, Office of Solid Waste and Emergency Response. April 1996. (EPA/540/R-96/018)
as described in Soil Screening Guidance: Technical Background Document. U. S. EPA, Office of Solid Waste

Revised 9/23/09

Chemical of Potential Concern	Cancer Classification	Soil Concentration mg/kg	Exposure Point Concentration (Inhalation) (CA) mg/m3	Exposure Concentration EC cancer mg/m3	Inhalation Unit Risk IUR (mg/m³)⁻¹	Cancer Risk (EC*IUR) unitless	Exposure Concentration EC noncancer mg/m3	Inhalation Reference Concentration (chronic) RfCi mg/m³	Inhalation Reference Concentration (subchronic) RfCi mg/m³	Hazard Quotient (EC/RfCi) unitless
TAL Inorganics										
Arsenic	A	8.17E+02	2.45E-07	1.95E-10	4.30E+00	8.56E-10	1.40E-08	1.50E-05	1.50E-05	9.31E-04
Mercury	D	8.82E-01						3.00E-04	3.00E-04	
Total						8.56E-10				9.31E-04

	B	AF	AG
50–55	Revised 3/23/09 Chemical of Potential Concern	Particulate Emission Factor (PEF) m3/kg	Volatilization Factor (VF) m3/kg
56	TAL Inorganics		
57	Arsenic	3.34E+09	
58	Mercury	3.34E+09	1.68E+04
59	Total		